Alternative Energy Portfolio Standards Act

Compliance for Reporting Year 2020

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

PAPUC

pennsylvania
DEPARTMENT OF ENVIRONMENTAL
PROTECTION

Alternative Energy Portfolio Standards Act of 2004
Compliance for Reporting Year 2020

Published by the
Pennsylvania Public Utility Commission
Commonwealth Keystone Building
400 North Street
Harrisburg, PA 17120
www.puc.pa.gov

Gladys M. Brown Dutrieuille, *Chairman*
David W. Sweet, *Vice Chairman*
John F. Coleman Jr., *Commissioner*
Ralph V. Yanora, *Commissioner*

Prepared by the
PUC Bureau of Technical Utility Services
Paul Diskin, *Director*

In cooperation with the
Pennsylvania Department of Environmental Protection
Patrick McDonnell, *Secretary*
www.dep.pa.gov

February 2021

Front cover, title page and back cover: Big Level Wind Farm, Hector Township, Potter County
Photo: Transalta Corporation

Contents

Executive Summary

Alternative Energy Portfolio Standards Act

Compliance for Reporting Year 2020

Tier I Solar Compliance

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

Tier II Compliance

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

Tier I Non-Solar Compliance

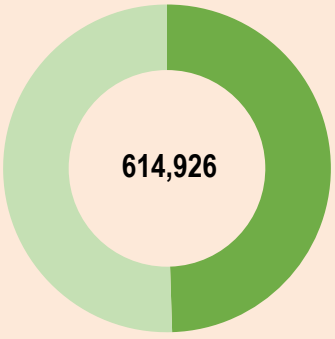
- **All EDCs** and **all but two EGSs** met their requirements. Four EGSs paid the required ACPs to achieve compliance. Two EGSs filed bankruptcy and reached settlements with the Commission regarding their compliance obligations.

Total Number of Credits Retired

- **21,904,531** credits retired by **11** EDCs and **117** EGSs.

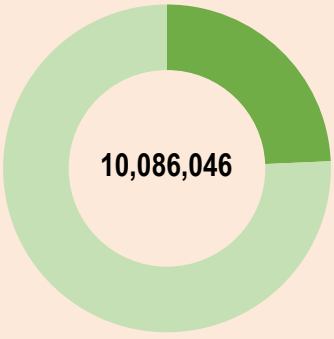
Source of Tier I Solar RECs Retired

- **Pennsylvania – 49.5%**
- **Other States – 50.5%**



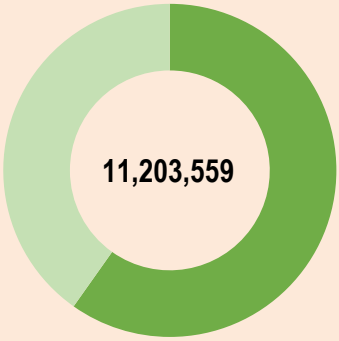
Source of Tier I Non-Solar RECs Retired

- **Pennsylvania – 24.3%**
- **Other States – 75.7%**



Source of Tier II RECs Retired

- **Pennsylvania – 59.8%**
- **Other States – 40.2%**



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 Electric Distribution Companies (EDCs) and Electric Generation Suppliers (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 2020 reporting year (June 1, 2019 through May 31, 2020) the Tier I requirement was 7.5% of all retail sales, of which at least 0.4433% 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. As required by Act 129 of 2008, 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 in 2009. 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 0.3567% for a total Tier I requirement of 7.4134%.

For the 2020 reporting year, all the EDCs and all but seven EGSs met their requirements by acquiring and retiring sufficient AECs. Five EGSs came into compliance through the submission of alternative compliance payments. Two EGSs, discussed later in this report, filed for bankruptcy. Of the total number of AECs retired, 43.1% 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. Similarly, qualified and registered energy efficiency projects can create AECs for each MWh of electricity saved.*** 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, LLC[2] (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

[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.

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 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**
• Solar Photovoltaic (PV) (Solar PV is a Tier I resource but also has a stand-alone requirement)	• 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#	• 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.

**Includes energy efficiency, demand response and use of industrial by-products and technologies such as waste heat.*

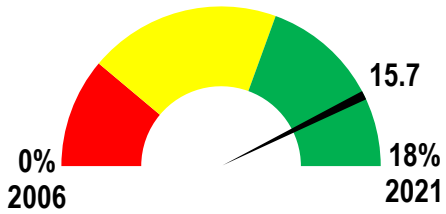
Although Solar PV is a Tier I resource, it also has a standalone requirement for each reporting year.

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 2020, a little more than 15.7% 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, 43.1% were generated in Pennsylvania and the remaining 56.9% were generated from other states in the PJM service territory.

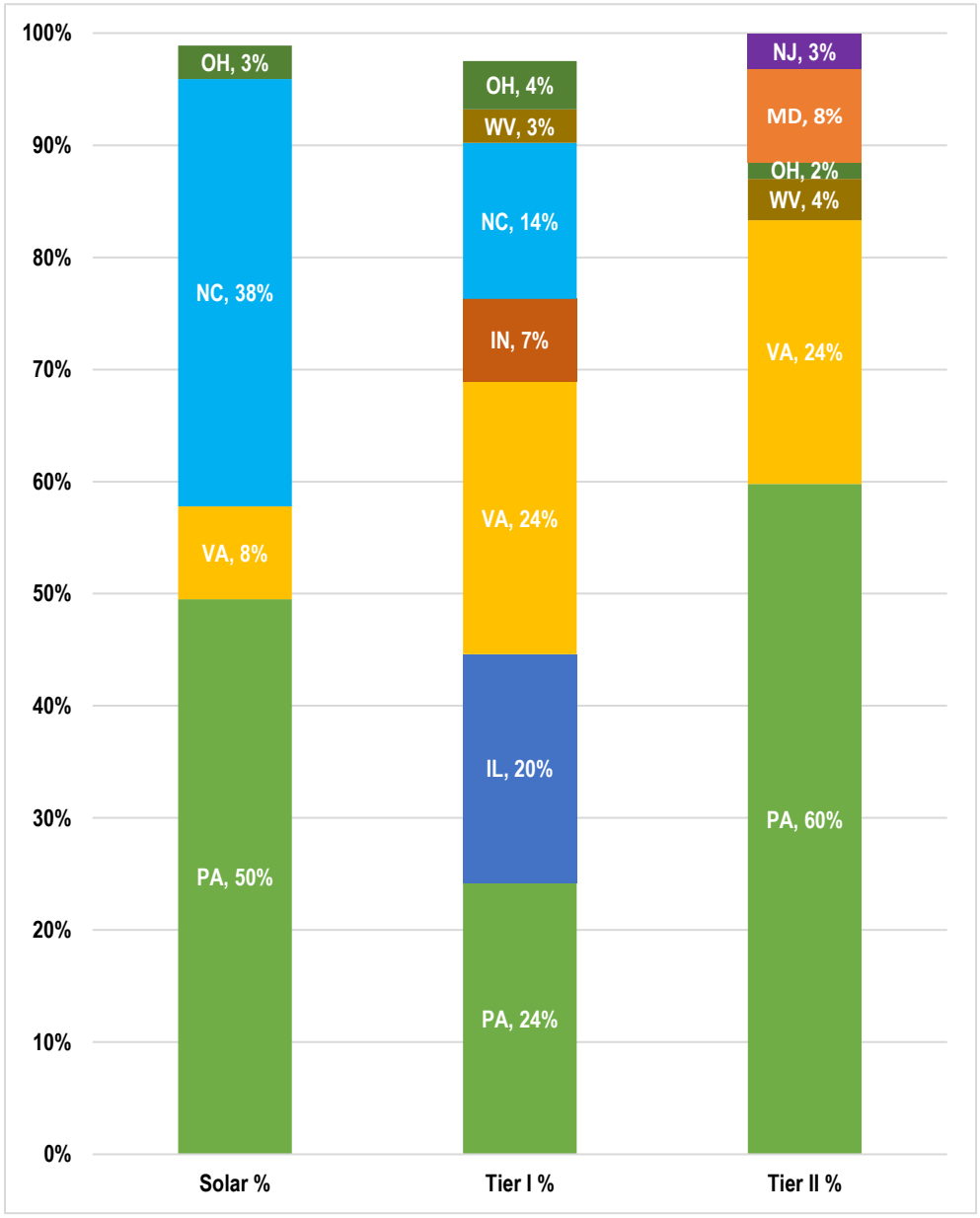


Percent of Electricity Sold in Pennsylvania from Alternative Energy Resources

Chart 1 shows the percentage of AECs that were retired in Pennsylvania in the 2020 reporting year and their states of origin.

For the Solar PV requirement, 49.5% of retired AECs originated in Pennsylvania, 38.1% came from North Carolina, 8.3% came from Virginia, 3% came from Ohio and the other 1.1% came from seven other states. Though Act 40 of 2017 created restrictions for Solar AECs generated outside of Pennsylvania, solar AECs generated prior to Nov. 1, 2017, from facilities outside of Pennsylvania were still eligible for use as are credits from facilities with existing contracts.

Chart 1: Percentage of AECs Retired in 2020



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, 24.2% of retired AECs came from Pennsylvania. Another 24.3% came from Virginia, 20.4% came from Illinois, 13.9% came from North Carolina, 7.4% came from Indiana, 4.3% came from Ohio, 3% came from West Virginia and the remaining 2.5% came from seven other states.

For the Tier II requirement, 59.8% of retired AECs came from Pennsylvania. Another 23.5% came from Virginia, 8.3% came from Maryland, 3.7% came from West Virginia, 3.1% came from New Jersey and the remaining 1.5% came from Ohio and Kentucky.

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

During the 2020 reporting year, 11 EDCs and 117 EGSs had compliance obligations. All EDCs achieved compliance in the reporting year by retiring the requisite number of AECs. Seven EGSs did not retire sufficient AECs, five of the seven EGSs achieved compliance by paying the required ACPs. 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 took 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 filed a successful 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 approximately 56% of the $6,695,277 combined, in ACP obligations owed by these two companies, but is not permitted to seek any further remuneration regarding this or any other claims.[4] As of Aug. 19, 2020, the Commission has been able to recover, in total, approximately $1.45 million by securing the Letter of Credit and payment of the priority unsecured claims from the bankruptcy court proceedings. The Commission's claims against both companies' bonds are still pending, as are the non-priority general unsecured claims in bankruptcy court. 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 of $3.27 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.

Table 3 in Appendix A presents details of the compliance obligations in each EDC territory and the compliance status for the reporting year 2020. The table presents reporting year data on the number of AECs retired by tier in the EDC territories.

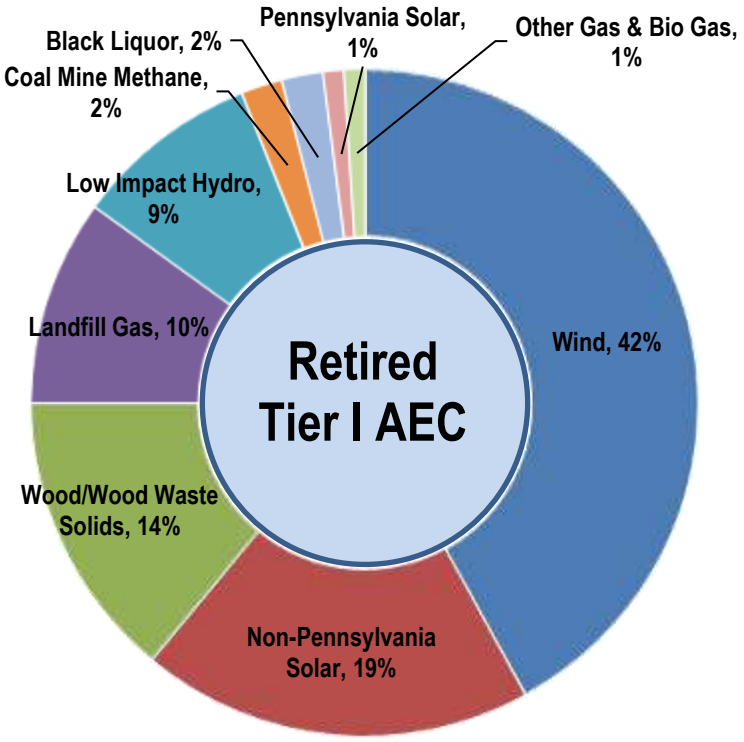
[4] United States Bankruptcy Court Southern District of New York, Case No. 19-23802 (RDD), June 25,2020

Several EGSs retired excess credits beyond the required AEPS obligations. EGS compliance via ACP, securitization of bond assets or bankruptcy proceedings bares 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 2020 reporting year. Wind energy produced 42% of the retired Tier 1 AECs, followed by Non-Pennsylvania Solar energy and electricity generation from Wood/Wood Waste to round out the top three resource types.

Chart 2: Percentage of sources of Tier I AECs Retired for the 2020 Reporting Year



a. Solar Compliance

For the 2020 reporting year, the Solar PV obligation was 0.4433%. All EDCs and all but six EGSs retired the requisite number of Solar AECs. Four of the six 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 not retired by Agera Energy and energy.me Midwest represented 0.40% of the total Solar AEC obligation. However, several EGSs retired Solar AECs in excess such that the total Solar AECs retired was 1.65% more than the total obligation.

b. Non-Solar Compliance

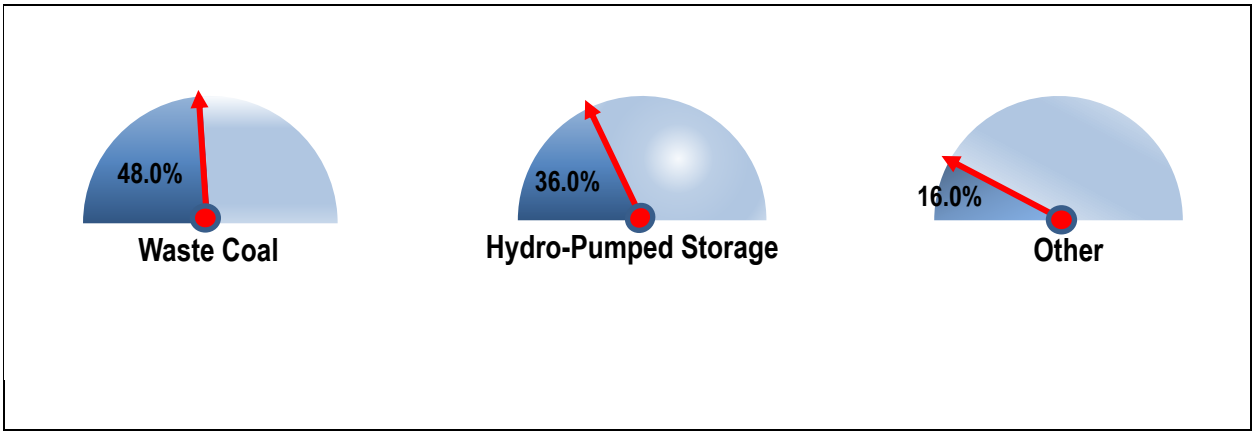
For the 2020 reporting year, the base obligation for non-solar Tier I was 7.0567%. The Tier I quarterly adjustment, impacting only non-solar Tier I, added a quarterly increase of 0.2404%, 0.2374%, 0.4390%, and 0.5335%, for quarters one through four, respectively. This resulted in 486,701 AECs added to the base obligation of 9,629,485. 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 0.30% 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 five EGSs achieved compliance in the reporting year by retiring the requisite number of AECs. Three of the five 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 not retired by Agera Energy and energy.me Midwest represented 0.67% of the total Tier II AEC obligation. However, several EGSs retired Tier II AECs in excess such that the total Tier II AECs retired was 0.12% more than the total obligation.

Chart 3 shows sources and percentages of Tier II AECs retired in the 2020 reporting year.

Chart 3: Sources and Percentages of Tier II AECs Retired for the 2020 Reporting Year



3. Costs and Benefits of Alternative Energy Generation

A. Current Estimated Costs of Future Alternative Energy Generation

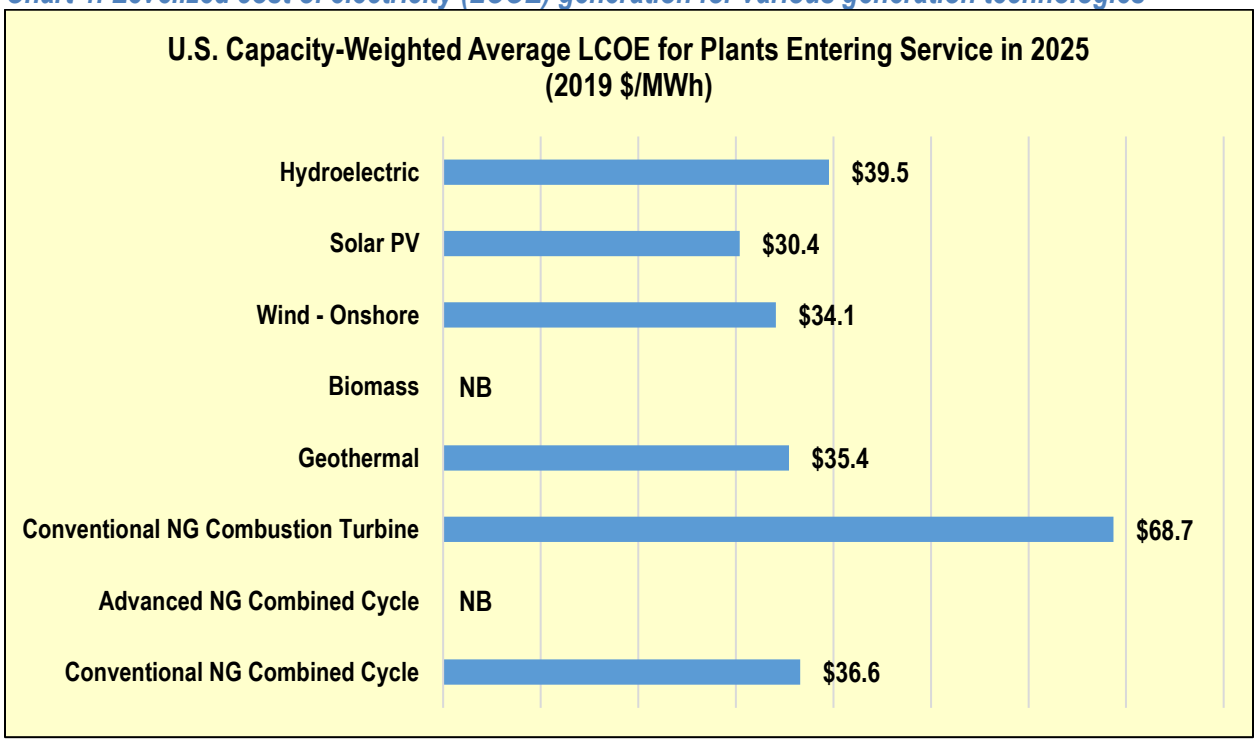
The United States Energy Information Administration (EIA) provided estimated cost data for the construction and operation of utility-scale generation plants that may be brought online in 2025.[5] The EIA data is used as the most consistently reliable information available. In using this data, 2025 was 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 2019 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 2020*, February 2020. 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



NB=Technologies for which capacity additions are not expected, or not built.

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, and notwithstanding the potential impacts associated with COVID-19, Commission staff have estimated a cost of AEPS compliance of approximately $176 million in 2021. This is based on revised electric consumption projections and the most recent estimate of AEPS credit prices anticipated to be retired. To put these figures in perspective, annual statewide customer expenditures on electric service, across all sectors, were approximately $14.3 billion in 2019.[7] Therefore, approximately $0.012 (1.2 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 Governor's Office, 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

[7] *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

employees earned higher wages than the statewide median. The report goes on to note that two-thirds of these jobs are full-time positions.[8]

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 an 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 2020, approximately 79.6 megawatts AC (MWac) of solar-electric generating capacity was installed in PA, which brought the in-state total capacity to 396.8 MWac. These installations at private residences, businesses, and institutions, across Pennsylvania, help sustain a workforce of slightly more than 4,846[9] 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.[10] Beyond rooftop solar, Pennsylvania has abundant opportunities for solar development beyond productive or high value green spaces, including locations such as marginal use properties, abandoned mine lands, closed landfills, industrial and commercial warehouses and parking lot/garage canopies.

As of the third quarter of 2020, Pennsylvania ranked 19th in the country for installed wind capacity 1,419.5 MW (1,459 MW)[11] and for the number of wind turbines (751 installed). In 2019, wind provided enough electricity generation to power about 325,600 homes.[12] Additionally, Pennsylvania supports a number of wind energy jobs. For 2020, the total number of direct and indirect jobs supporting

---

[8] *2020 Pennsylvania Clean Energy Employment Report*

[9] *Clean Jobs Pennsylvania 2019* - https://www.e2.org/reports/clean-jobs-pennsylvania-2019/

[10] *National Solar Jobs Census 2019*, page 13. The Solar Foundation, available at: https://www.thesolarfoundation.org/national/

[11] The wind capacity installed in Pennsylvania reported by AWEA (1,459 MW) differs from the capacity of certified wind reported by Pennsylvania's AEPS Administrator (1,419.5 MW).

[12] American Wind Energy Association, *Wind Energy in Pennsylvania* 2020 State Fact Sheet

the wind industry in Pennsylvania was approximately 2,937.[13] More information about the Pennsylvania wind generation facilities can be found on AWEA's new wind industry map.[14] 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 $3.1 billion.[15]

As of the end of the 2020 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.[16] 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 2020 reporting year, the Commonwealth Financing Authority approved $10.94 million in loans and grants to eleven alternative and energy efficiency projects. The project types funded include high performance buildings, anaerobic digesters, 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. Over the

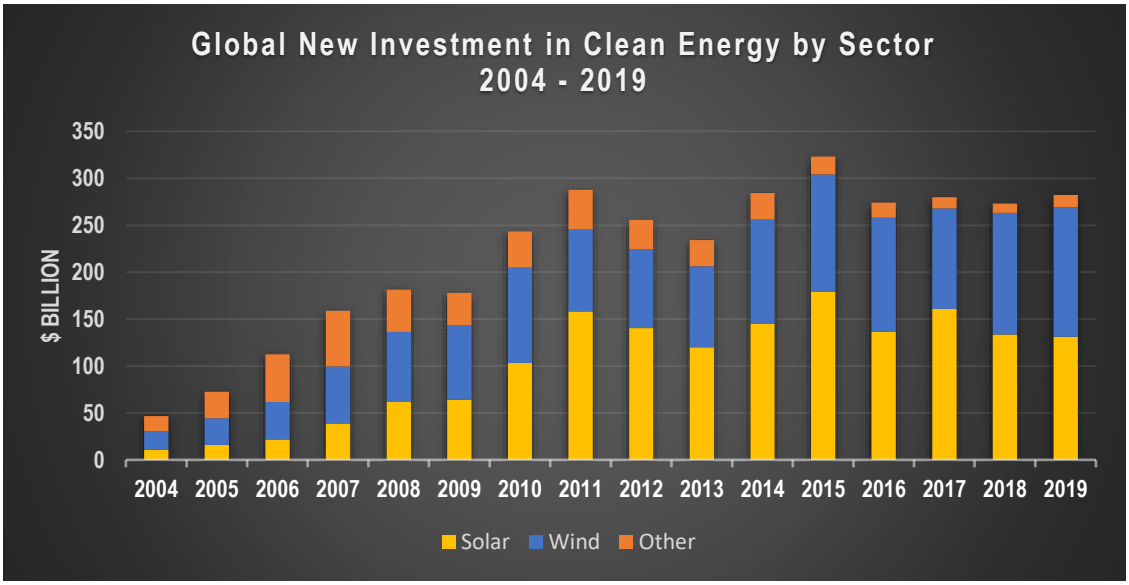
[13] *Clean Jobs Pennsylvania* 2019 - https://e2.org/reports/clean-jobs-pennsylvania-2020/
[14] American Wind Energy Association, https://www.awea.org/resources/fact-sheets/state-facts-sheets
[15] American Wind Energy Association, *Wind Energy in Pennsylvania* 2020 Fact Sheet
[16] *Job Creation Opportunities in Hydropower, 2009,* found at: http://www.hydro.org/waterpower/why-hydro/job-creation/navigant-study/

past year, the 21 projects from 2014 generated over 23,000 MWh of alternative energy and saved 12,221 MWh in electricity. The carbon dioxide emissions reductions from the projects over the past year were approximately 10,000 tons.

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 2019. Investments in clean energy projects totaled $282.2 billion in 2019, which was 1% higher than 2018 and significantly lower than the record investment in 2015.

Chart 5: Global New Investment in Clean Energy by Sector (2004-2019)



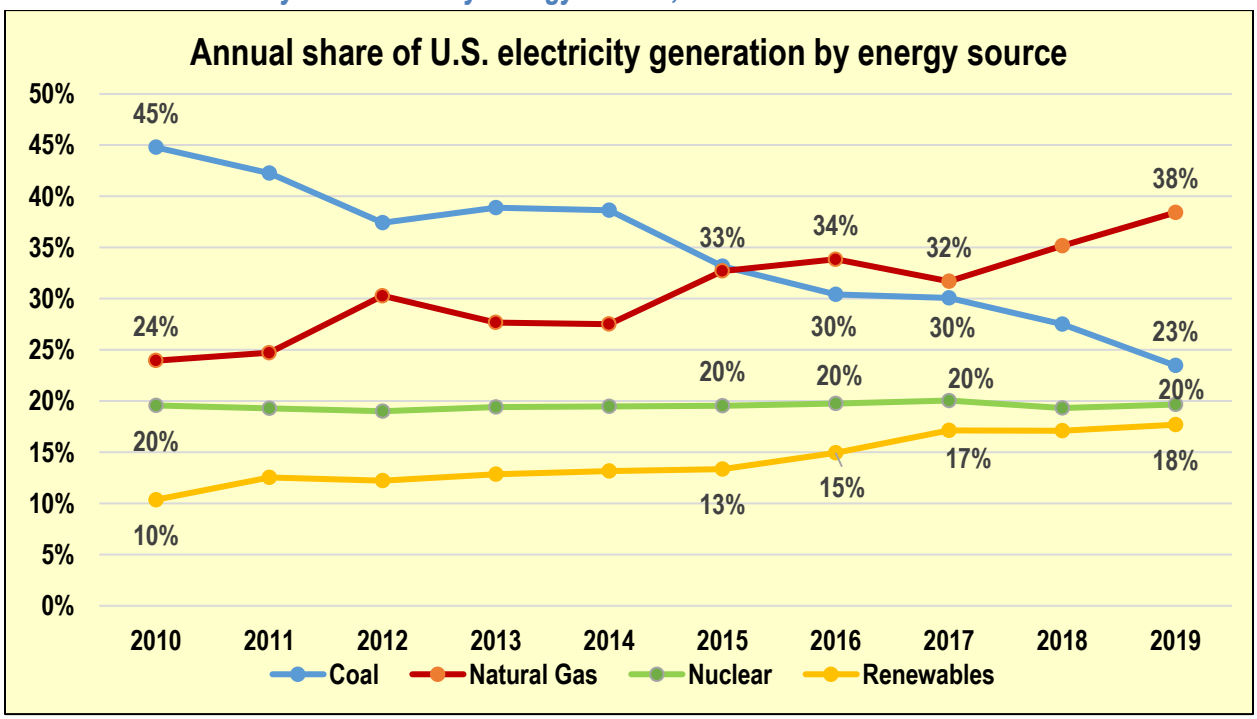
Source: Global Trends in Renewable Energy Investment 2020

Globally, in 2019, 184 gigawatts (GW) of renewable energy production capacity (excluding large hydro) came online, the highest ever. Solar alone accounted for 118 GW of new capacity in 2019.[17]

The United States ranks second in the world for renewable energy capacity (264.5 GW), behind China (758.6 GW)[18]. 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.

[17] Frankfurt School-UNEP Centre/BNEF. 2020. *Global Trends in Renewable Energy Investment 2020*, page 11
https://www.fs-unep-centre.org/wp-content/uploads/2020/06/GTR_2020.pdf
[18] IRENA - *Renewable Energy Capacity Statistics 2020*, pages 2 - 6
https://irena.org/-/media/Files/IRENA/Agency/Publication/2020/Jul/IRENA_Renewable_Energy_Statistics_2020.pdf

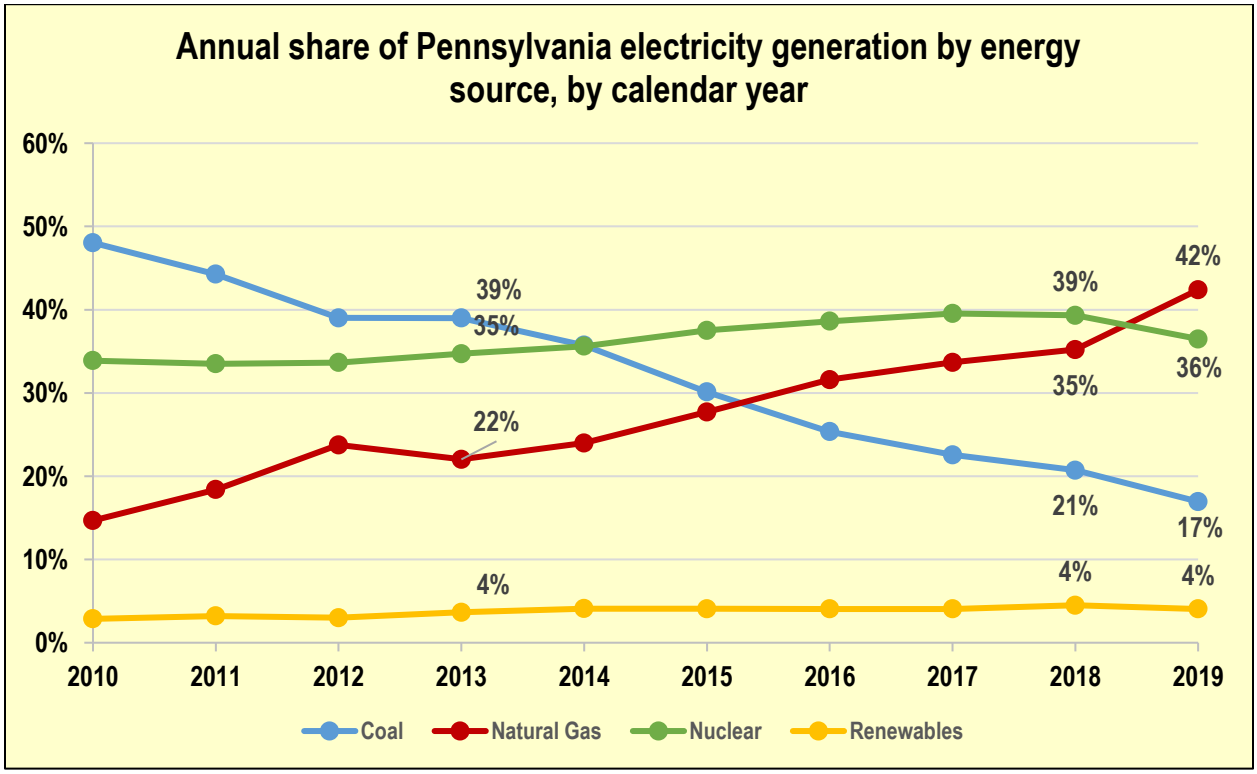
Chart 6: U.S. Electricity Generation by Energy Source, 2019 Calendar Year



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.

Chart 7: Pennsylvania Annual Electric Generation by Energy Source



Source: ***Energy Information Administration Electricity Data Browser***

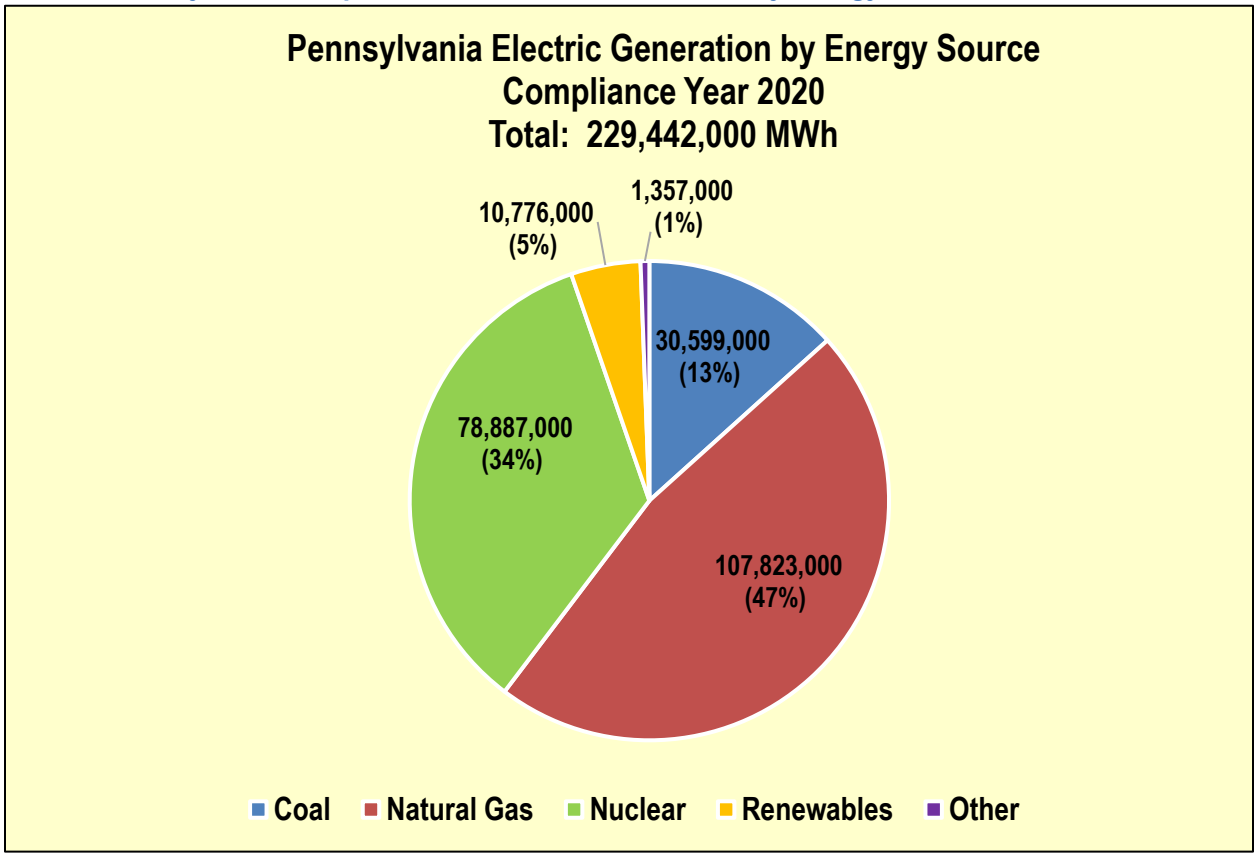
Chart 7 shows annual Pennsylvania electric generation by energy source. In 2019, approximately 4% of the state's electricity generation was from renewable energy sources.[19] The chart mimics the general trend in U.S. electricity generation (Chart 6), where electricity generation from coal is steadily 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. While there are many differences among the various state renewable and alternative energy portfolio standards, almost all of these standards are based on in-state consumption or sales of electric energy. This is an important consideration to understand because many states are net importers of electricity whereas, Pennsylvania is among the largest net exporters of electricity in the country. Similar to the comparisons shown in Charts 6 and 7, Pennsylvania's AEPS requirements, which are broader than renewables-only requirements, have not kept pace as compared to the requirements of other states with portfolio standards. Additionally, the broad geographic scope of the

[19] Energy Information Administration Electricity Data Browser

AEPS Act allows compliance to come from credits generated from out-of-state resources, with the recent exception of the Tier 1 Solar obligation.[20]

Chart 8 shows the breakdown of total electricity generation in Pennsylvania by source for the compliance year 2020. This information is obtained from EIA using their Electricity Data Browser tool.

Chart 8: Pennsylvania Compliance Year Electric Generation by Energy Source



Source: ***Energy Information Administration Electricity Data Browser***

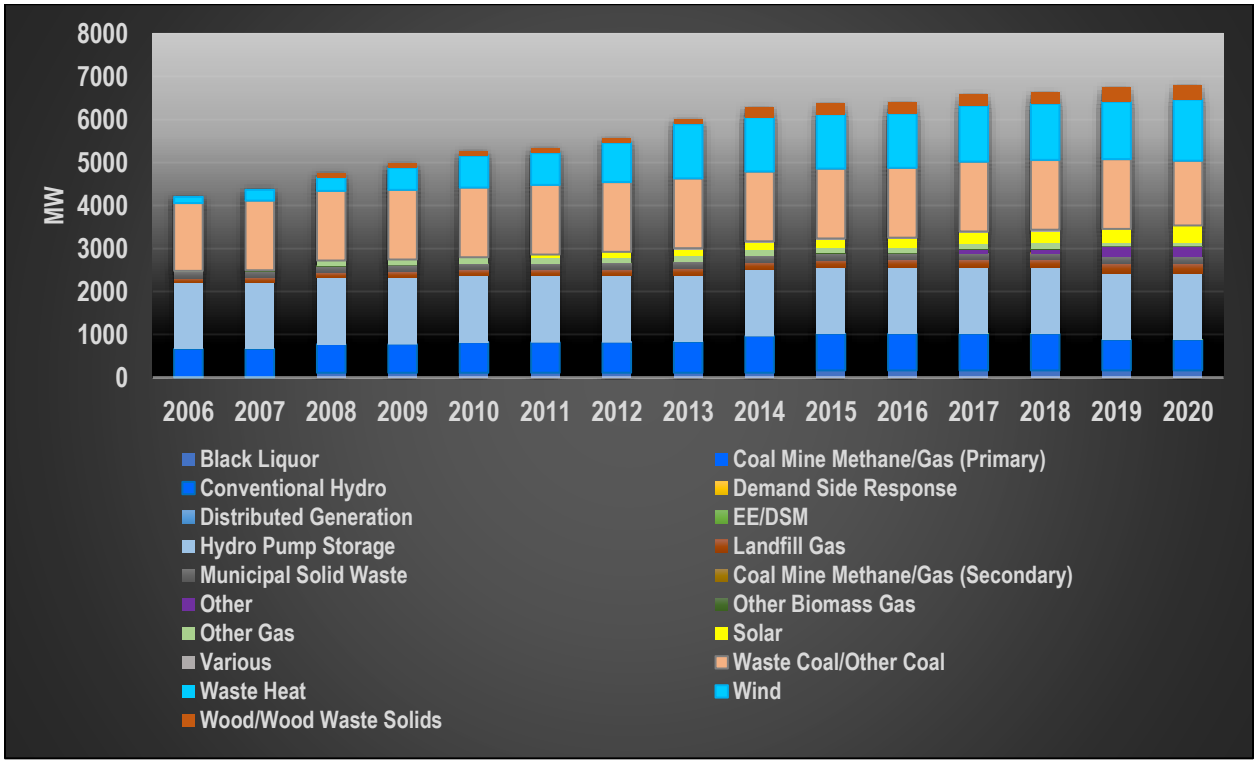
Alternative energy policy and federal policies such as the Business Energy Investment Tax Credit (ITC) and the Renewable Electricity Production Tax Credit (PTC) helped accelerate renewable energy investments and developments in the United States. The PTC for wind and the ITC for solar were extended at 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. Any policy

[20] As noted in section 7 of this report, the passage of Act 114 of 2020 will limit the geographic scope of Tier II credits to resources located in Pennsylvania.

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 2020 compliance year, Pennsylvania had approximately 6,802.7 MWac of installed renewable electricity generation capacity.

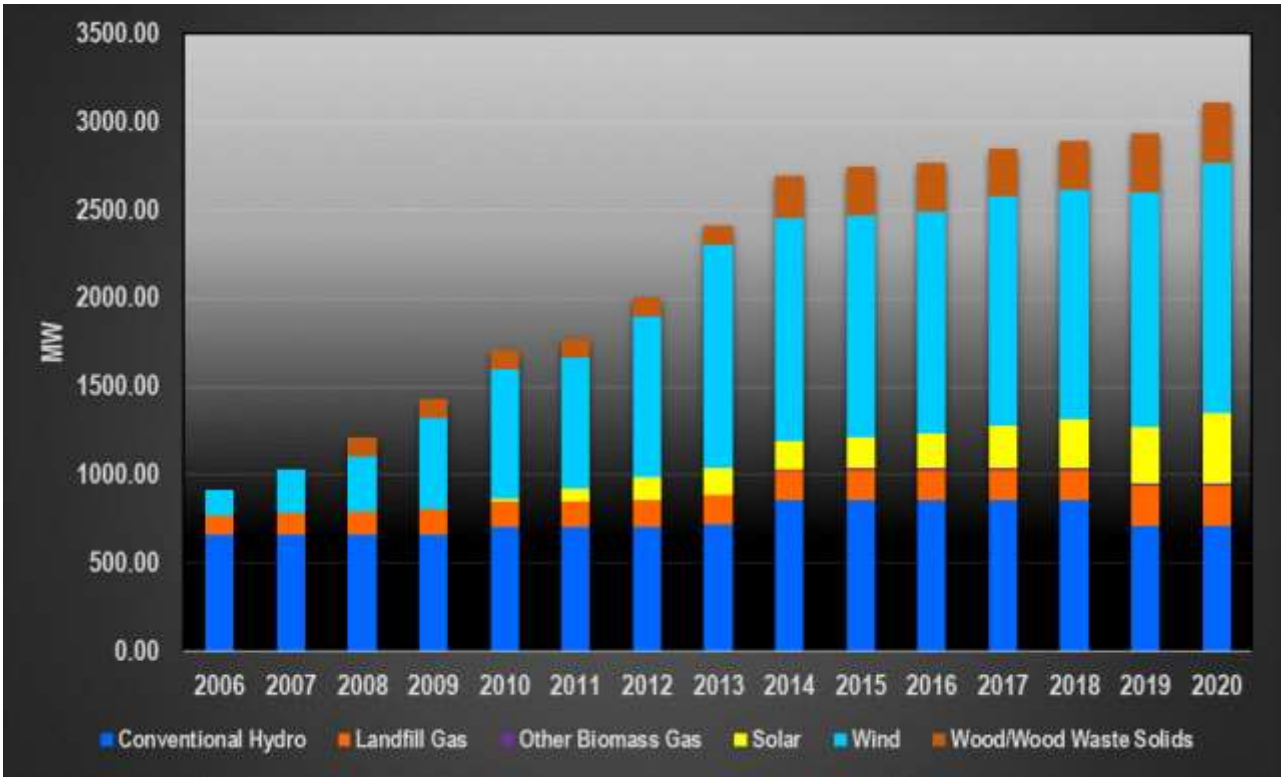
Chart 9: PA In-State AEPS-Certified Alternative Energy Capacity – 2006-2020 (MWac)



Refer to Table 6 in the Appendix for compliance year 2020 specifics.

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

Chart 10: PA In-State Renewable Capacity – 2006-2020 (MWac)



A. Solar

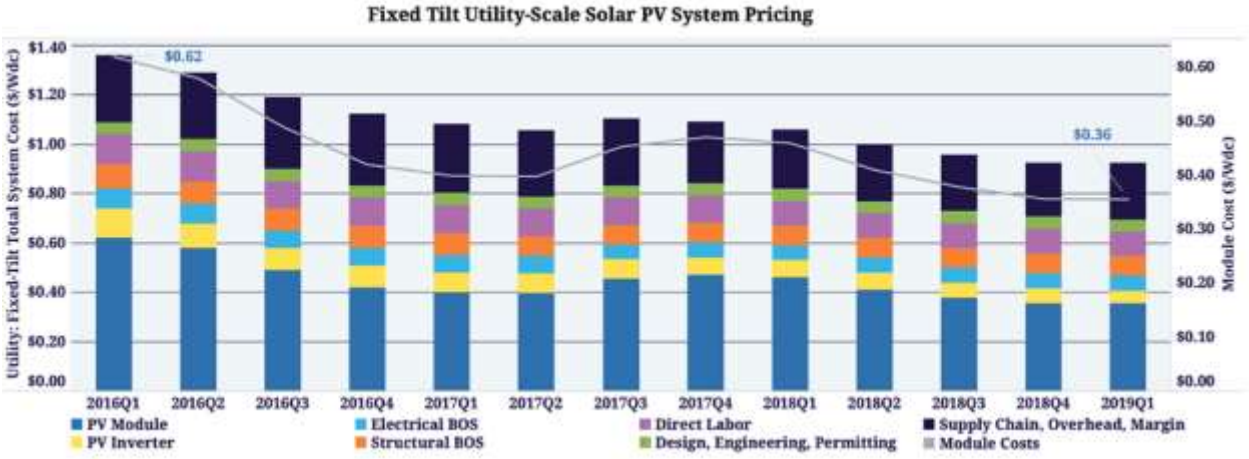
In 2019, approximately 13,300 MWdc (direct current megawatts) of solar PV was installed in the U.S. This represents an increase of slightly more than 23% from 2018. Several news outlets have reported that the sales and installation of solar across the country were significantly impacted by the COVID-19 pandemic. Despite the impact of the pandemic, in the first half of 2020, approximately 7,100 MWdc of solar PV was installed in the U.S. The installed capacity is expected to grow by 100,000 MWdc from 2021 to 2025.[21]

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.[22] Solar panels produce direct

[21] https://www.seia.org/research-resources/solar-market-insight-report-2020-q3
[22] 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 2019, the United States had a total of 76 GWdc of cumulative operating solar PV capacity.[23] 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 factors[24] for these resources are typically lower than those of the other resources.[25] Per EIA data, in 2019 the nationwide capacity factor for utility scale solar was 24.5%.[26] 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 396.8 MWac (485 MWdc) of solar electric capacity had been installed through the end of the 2020 Compliance Year, enough to power nearly 64,000[27] homes. According to the Pennsylvania Solar Energy Industry Association (PA SEIA), the solar industry has invested $1,933.29 million in Pennsylvania, including $178.67 million in 2019.

---

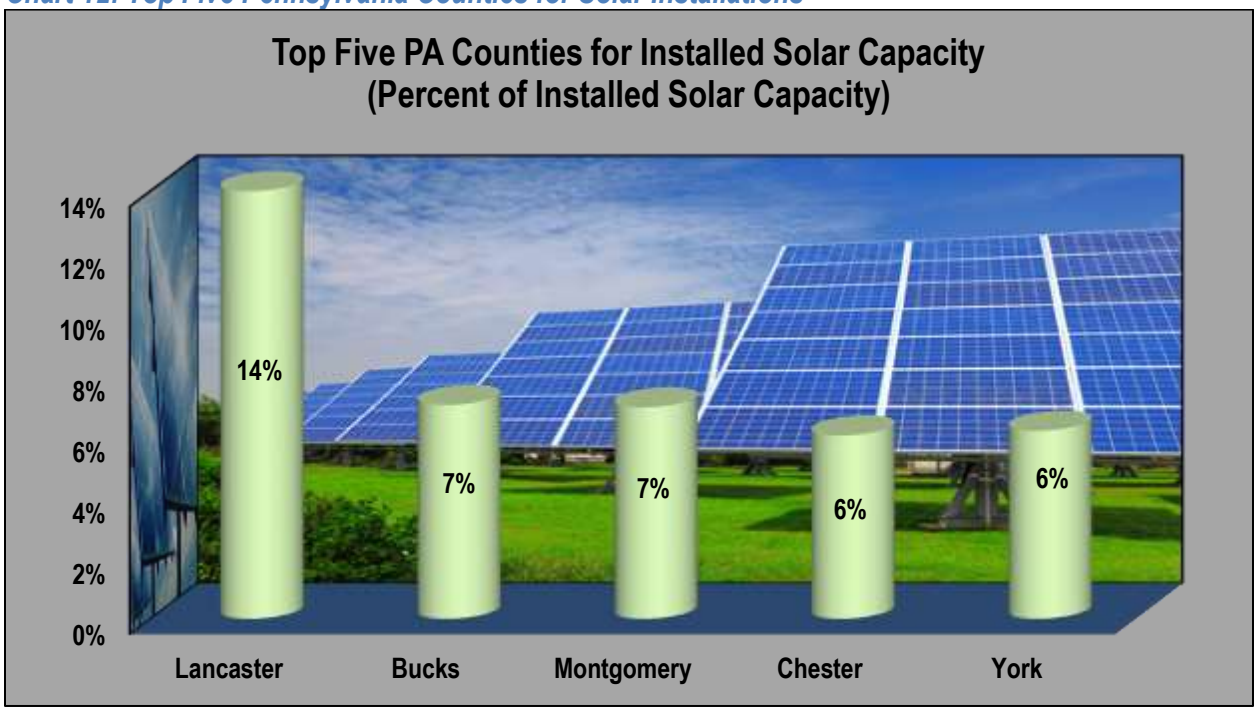
[23] https://www.nrel.gov/docs/fy20osti/77010.pdf
[24] A ratio of the actual power output for a time period to the maximum possible power output if the plant was operating at full name plate capacity for the same time period.
[25] U.S. Energy Information Administration, Electric Generators Report - 2016
[26] https://www.eia.gov/electricity/monthly/archive/june2020.pdf
[27] Based on annual electricity consumption of 10,000 kWh and an average solar capacity factor of 15%.

Due to complications and challenges associated with COVID-19, there was a 38% reduction in systems installed in Pennsylvania from March through October 2020, as compared to the average historical installs for the same period from 2017 through 2019.

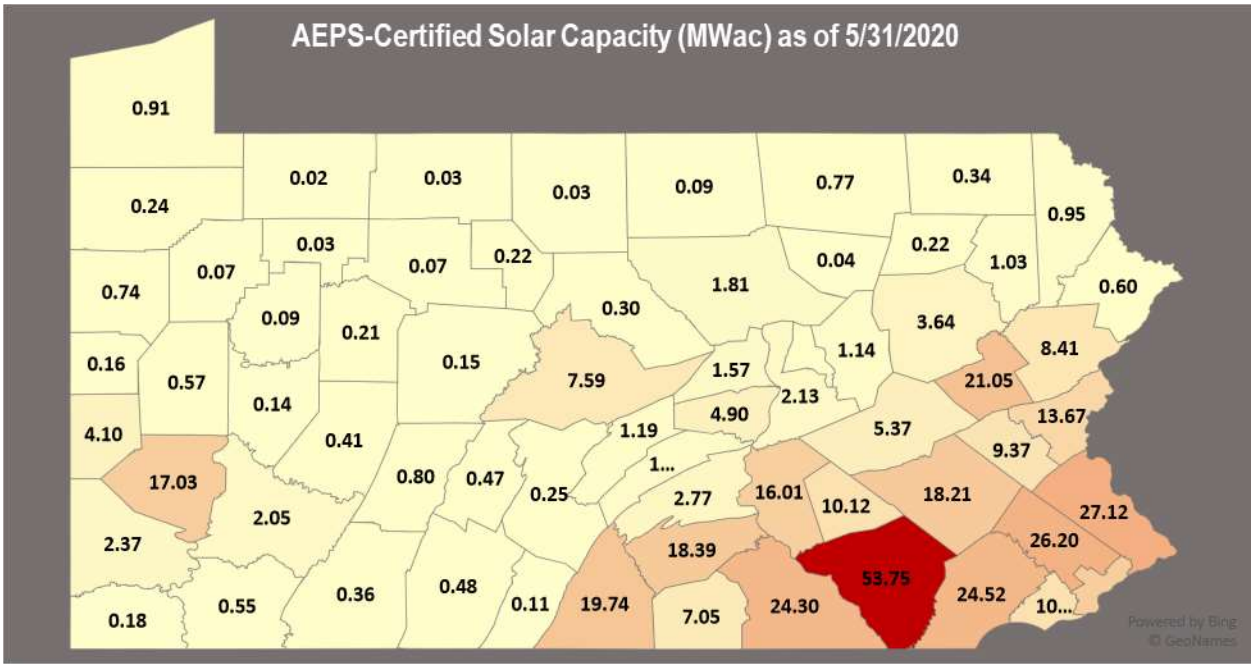
In recognition of this impact, Pennsylvania DEP announced on December 8, 2020 that the Pennsylvania Energy Development Authority awarded $1.7 million in COVID-19 Restart Grants to 11 energy efficiency, solar energy, high-performance building, and electric vehicle charging projects halted by the pandemic. These awards support current and new jobs to assist in Pennsylvania's economic recovery from the COVID-19 pandemic.

Chart 12 shows the top five Pennsylvania counties for installed solar capacity, 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.



Note: As of 5/31,2020, Philadelphia county has 1,626 AEPS certified solar generation facilities with a total capacity of 16.92 MWac.

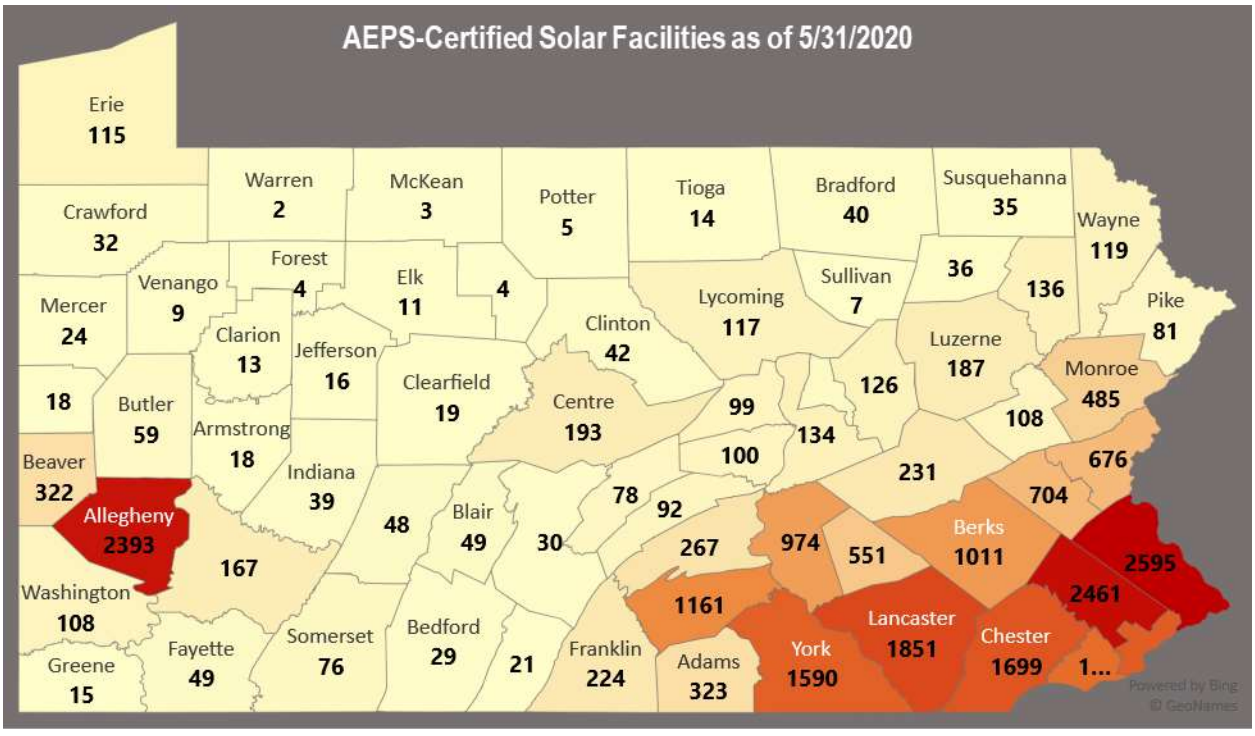
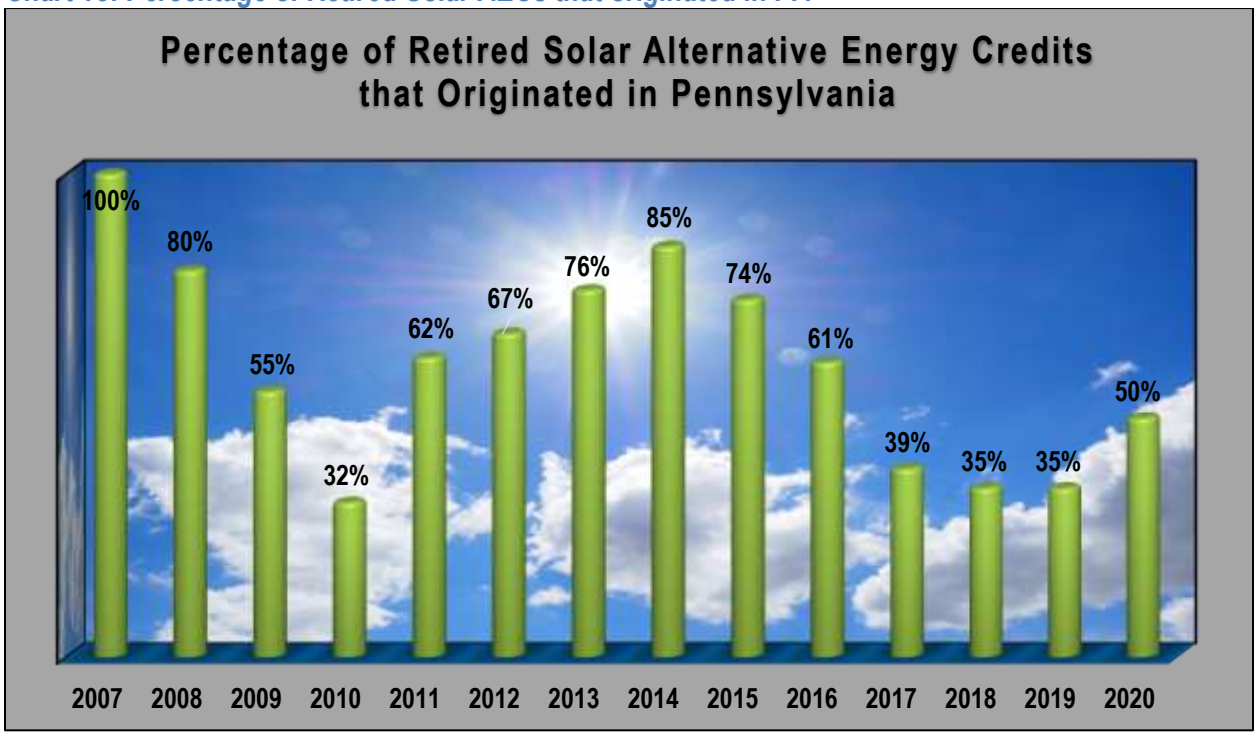


Chart 13 shows the percentage of retired in-state solar AECs used for AEPS Act compliance.[28] 2020 data shows a significant increase in the number of retired in-state solar AECs since 2019. This trend is expected to continue due to the implementation of Act 40 of 2017, that requires compliance with the Tier I Solar PV requirements of the AEPS Act to be met by using 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 Jan. 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 Nov.

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

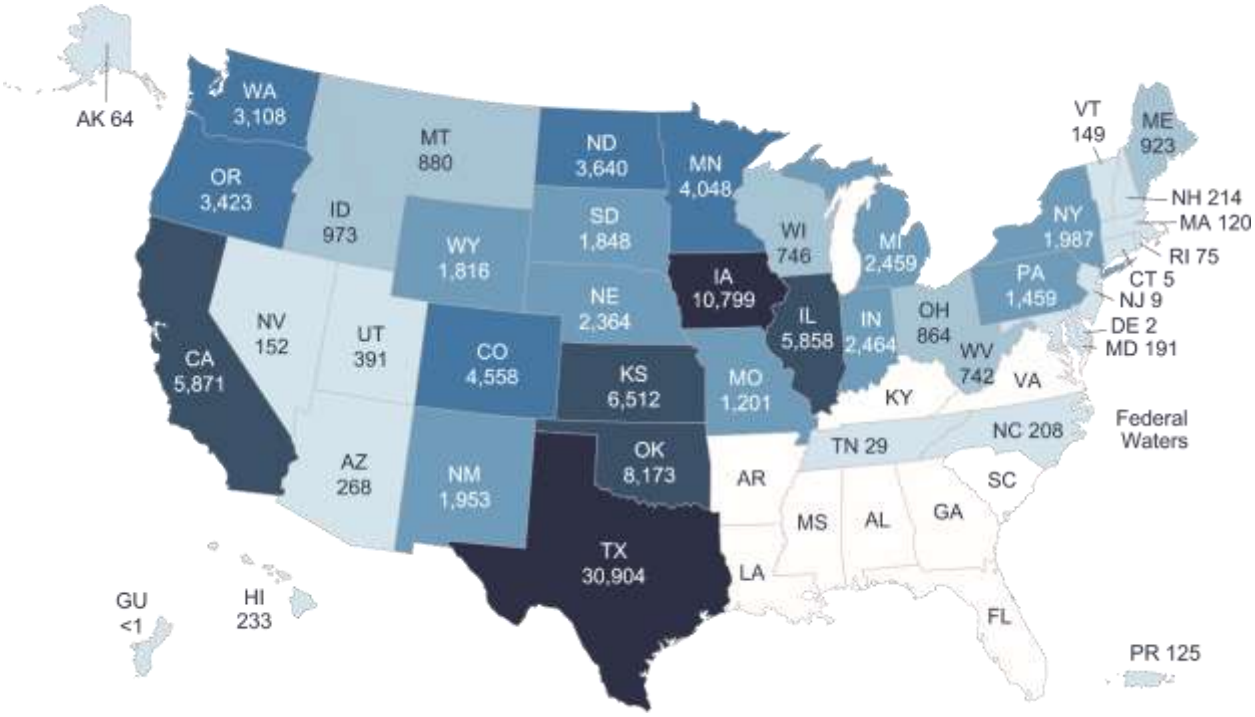
2018.[29] The plan was provided to the public, the legislature, and the Governor to be used as a guide for policy making. One strategy in the plan aimed at achieving this goal was to increase the AEPS solar PV carve-out to between 4% and 8% by 2030 and ensure creditable solar AECs are limited to those 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 the first nine months of 2020, the United States saw a total of 6,309 MW of wind electricity generation capacity installed. This brings the cumulative installed capacity in the U.S. to 111,808 MW. In 2019, wind energy generated 7.2% of the nation's electricity, enough to power 27.5 million homes.[30]

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. For comparison, the average capacity factor for wind energy production in the Pennsylvania is 30%.[31] Technological improvements, particularly, increased blade length, contributed to the increased capacity factor. [32]

[29] https://www.dep.pa.gov/Business/Energy/OfficeofPollutionPrevention/SolarFuture/Pages/Pennsylvania's-Solar-Future-Plan.aspx
[30] American Wind Energy Association, https://www.awea.org/wind-101/basics-of-wind-energy/wind-facts-at-a-glance
[31] US Department of Energy, WINDExchange Database https://windexchange.energy.gov/maps-data/332
[32] US Department of Energy, 2016 Wind Technologies Market Report



During 2019, wind energy provided 1.50% of all in-state electricity production, enough electricity to power over 325,600 average American homes.[33]

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 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.

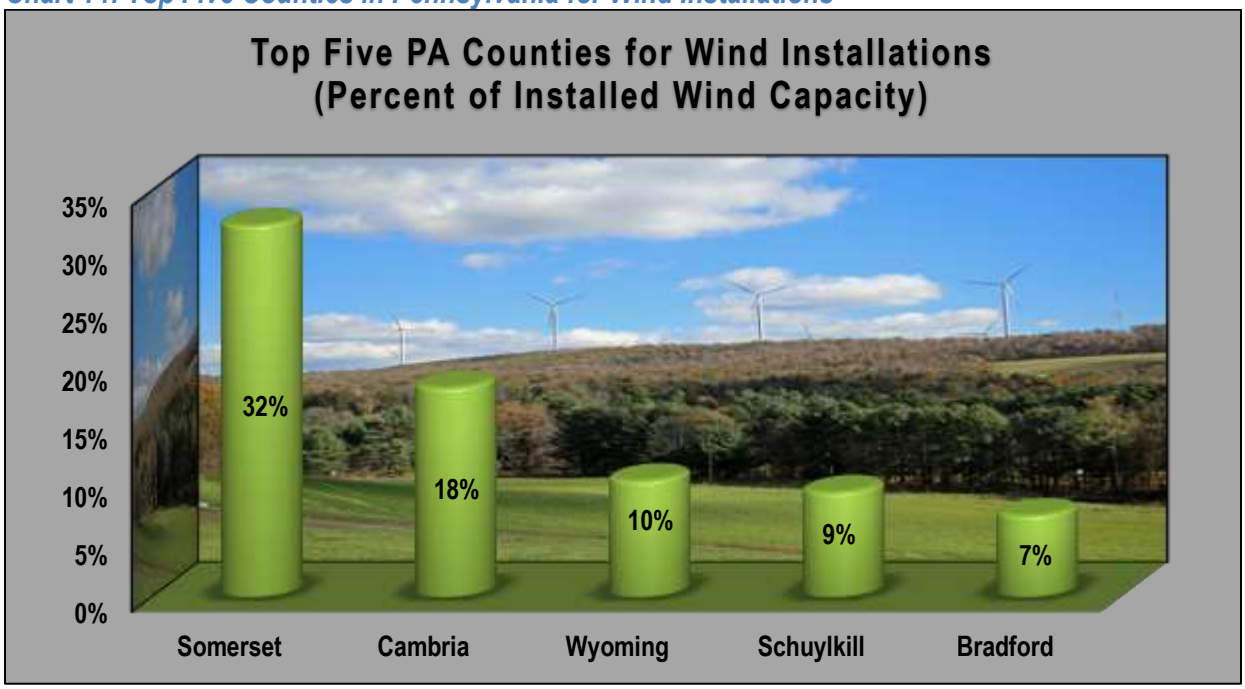
As of May 31, 2020, Pennsylvania's certified installed wind capacity of 1,419.5 MW accounts for roughly 3.25% of the state's potential wind electric generating capacity and supports between 2,000 and 3,000 direct and indirect jobs, respectively.[34]

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

[33] American Wind Energy Association, Statewide Facts, Pennsylvania - https://www.awea.org/Awea/media/Resources/StateFactSheets/Pennsylvania.pdf

[34] 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.[35] 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.[36] 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.[37] Projects such as these are beginning to take shape, such as the hydropower project at the Allegheny Lock and

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

[36] *2016 International Trade Administration (ITA) Energy Top Markets Report*

[37] *2014 New Stream-reach Development: A comprehensive Assessment of Hydropower Energy Potential in the United States.*

Dam No 2. The University of Pittsburgh has committed to purchasing 100% of the power output from this project.[38] DEP awarded a PEDA grant to Hydrogreen in 2014 to build a 5.25 MW low-impact facility in the weir of the Braddock Locks and Dam. This project is expected to be complete in 2022. The Carnegie Institute and the University of Pittsburgh will be purchasing some of the output for this project.

[38] 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 2020, 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% (31,203 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

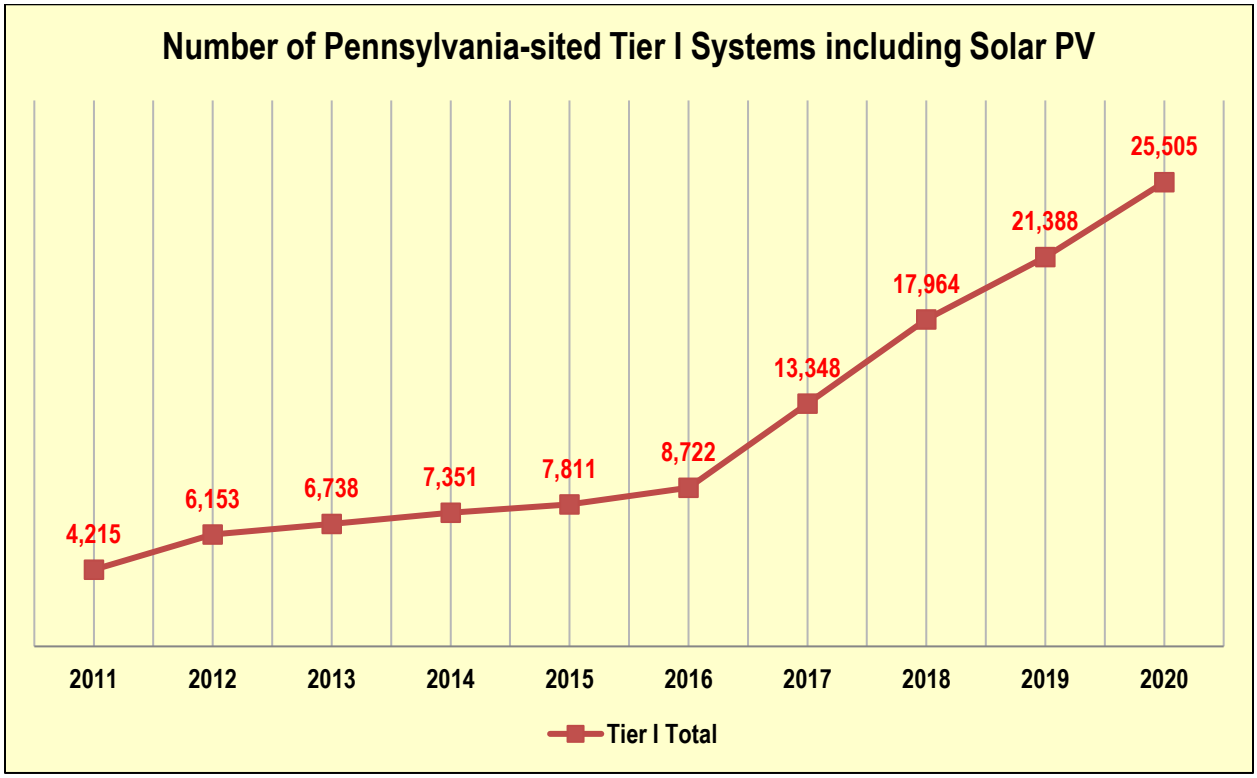
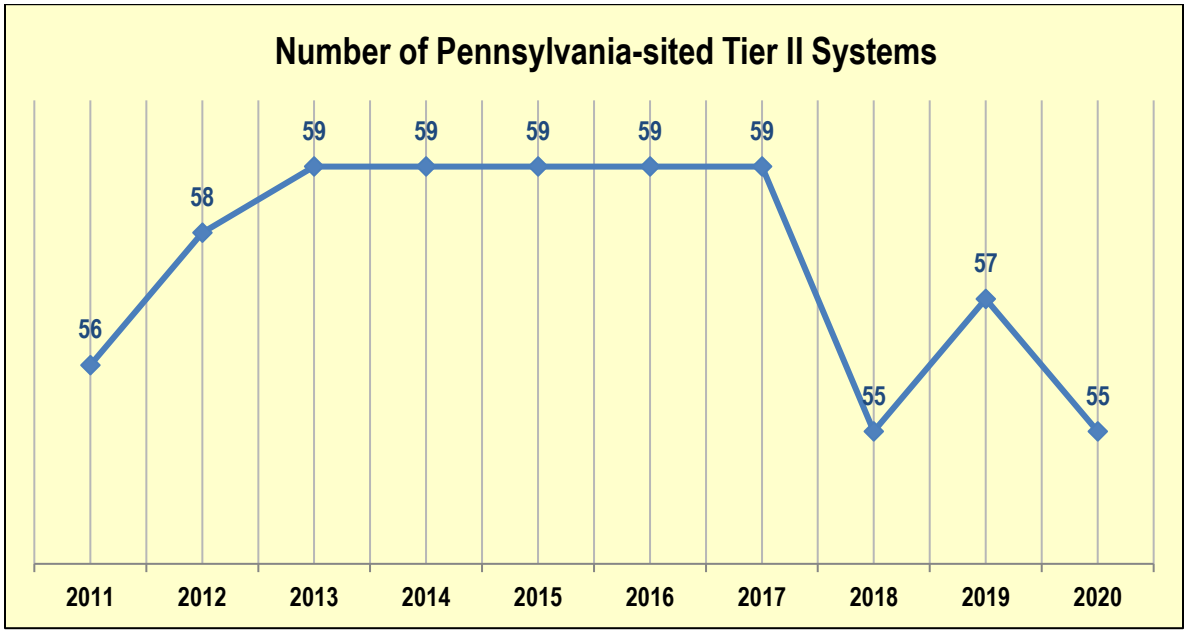


Chart 16: Cumulative Number of In-State Tier II Systems, by Year



Note: *This chart only shows Tier II certified electric generation facilities.*

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

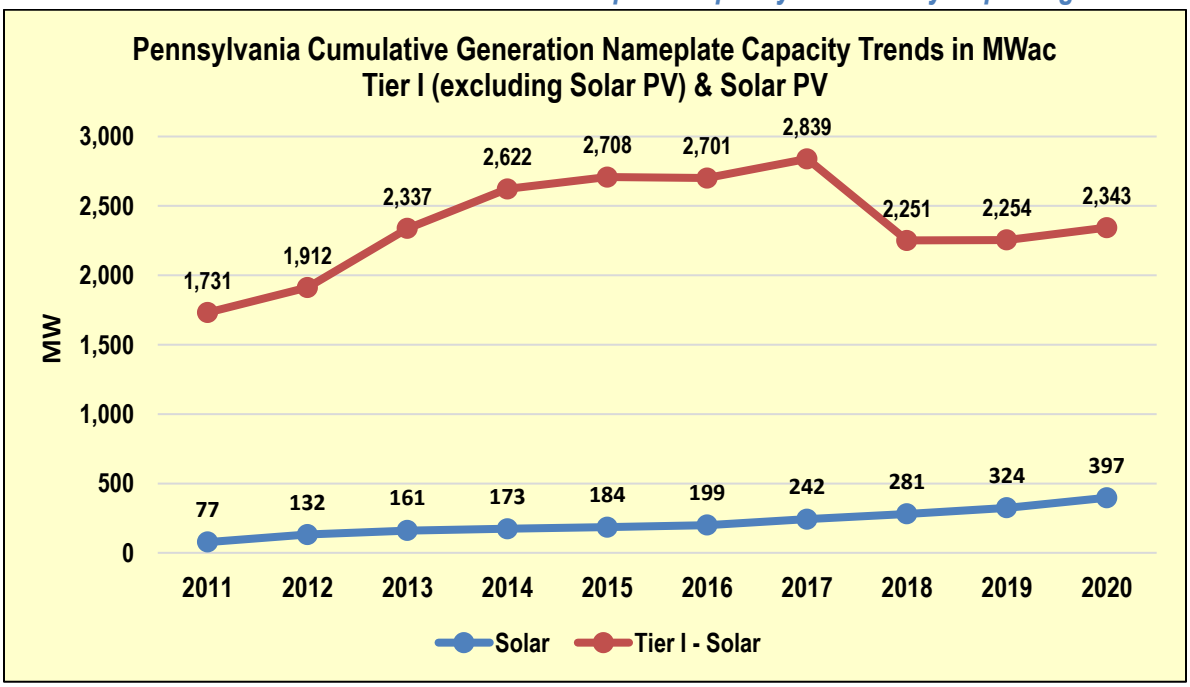
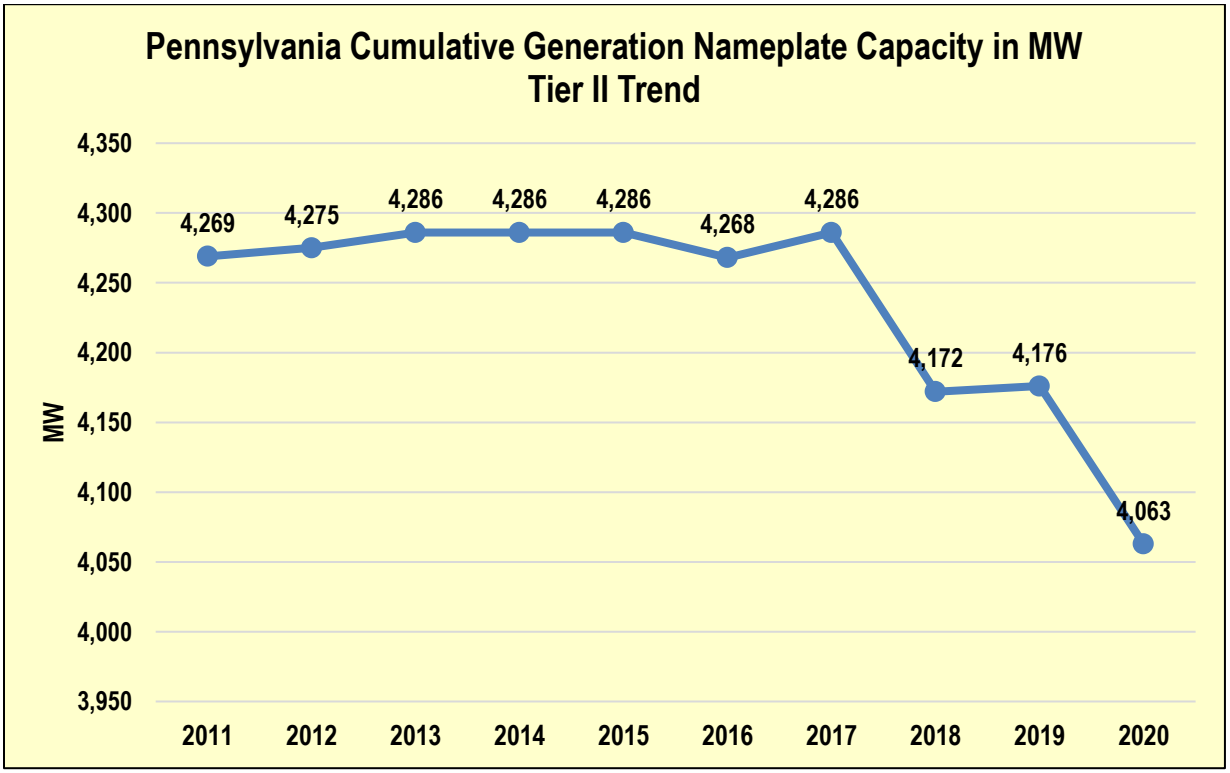


Chart 18: Cumulative Tier II Nameplate Capacity Installed by Year



Charts 19, 20 and 21, on the following pages, provide a comparison of the average annual (compliance year) spot market prices[39] 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.

[39] Spot prices from S&P Global Market Intelligence

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

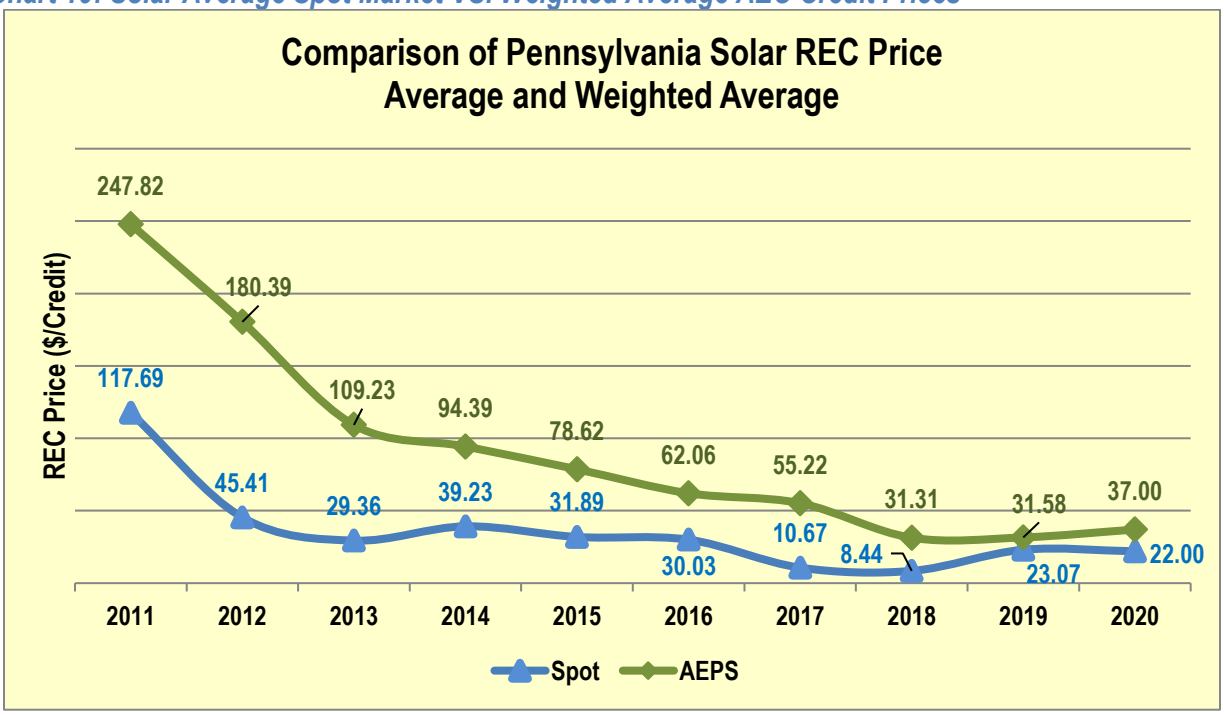


Chart 20: Tier I Average Spot Market vs. Weighted Average AEC Credit Prices

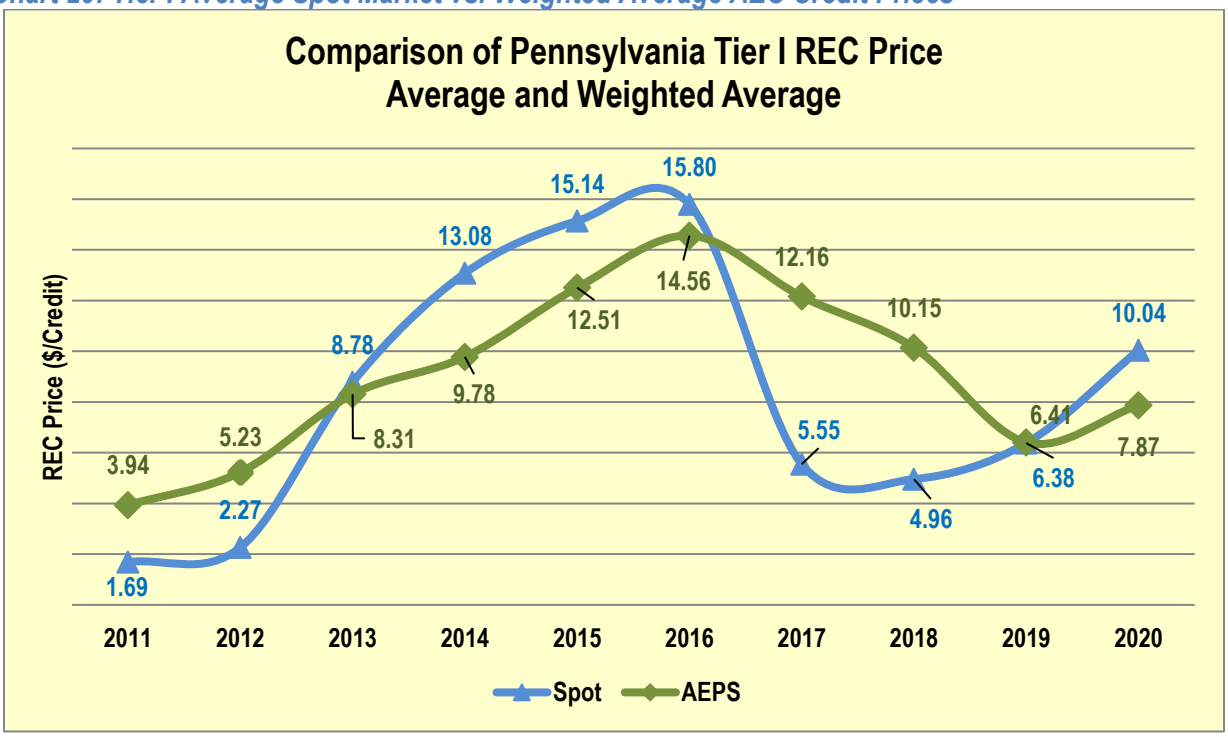
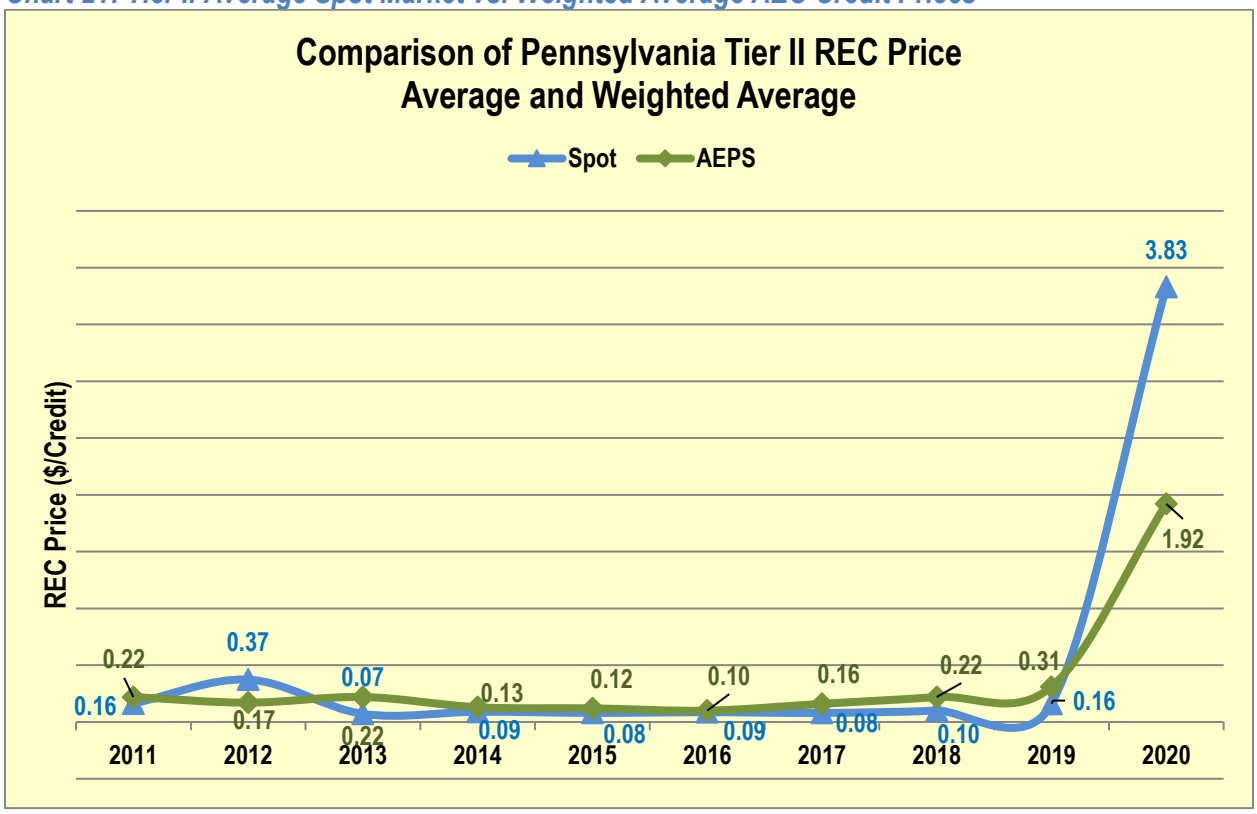


Chart 21: Tier II Average Spot Market vs. Weighted Average AEC Credit Prices



Impact of Act 40 Implementation

Pursuant to the passage of Act 40 and consistent with its Implementation Order[40], 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.

[40]http://www.puc.pa.gov/pcdocs/1565100.docx

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

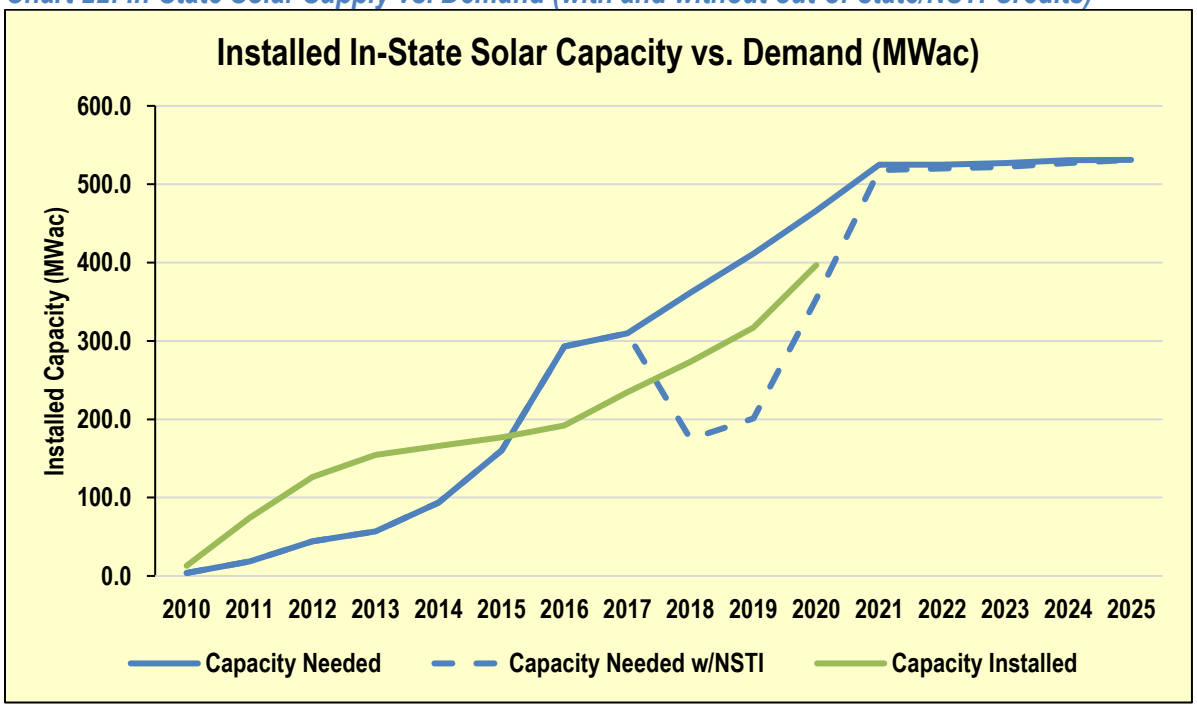
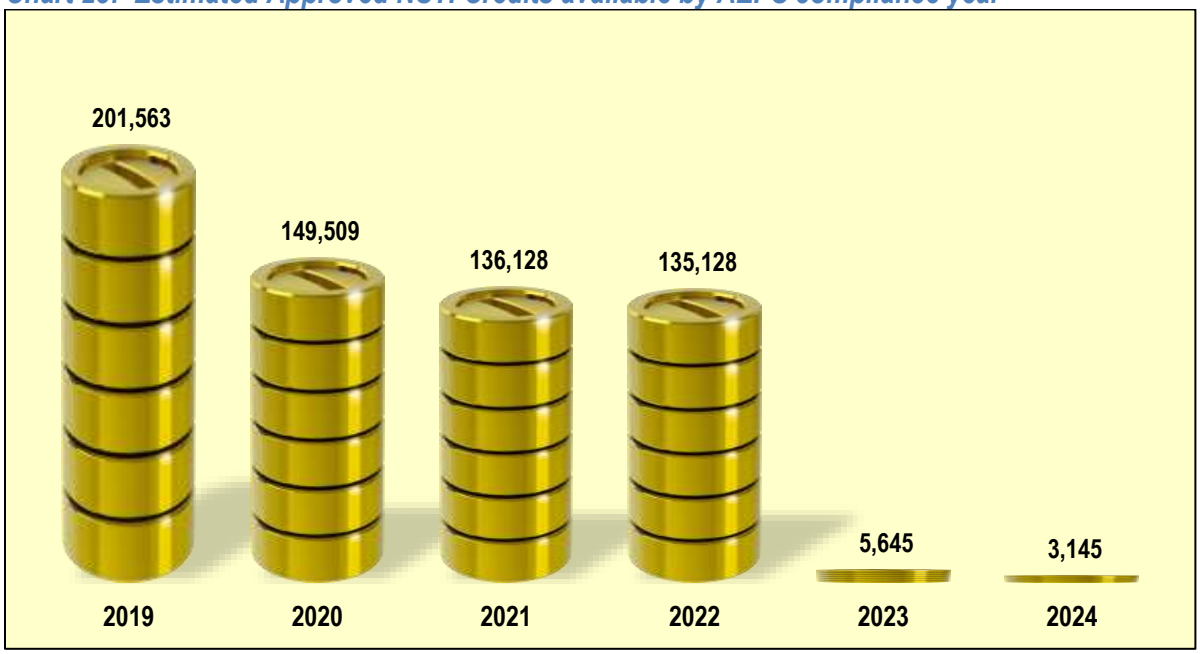


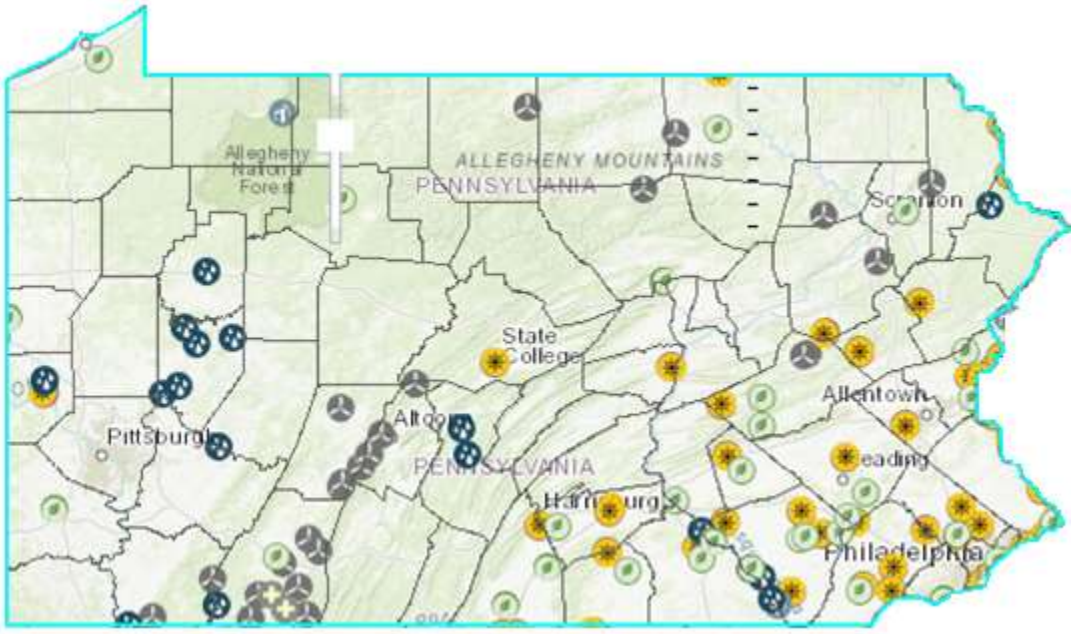
Chart 23: Estimated Approved NSTI Credits available by AEPS compliance year



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.[41]



The Pennsylvania AEPS website[42] maintains a summary of all AEPS-certified generation facilities and certified energy efficiency and demand-side management (EE/DSM) resources. There were 32,194 certified generation facilities as of May 31, 2020.

Statistics for AEPS-certified generators, as of May 31, 2020, include:

- 25,579 generators (79%) are located in Pennsylvania with a total nameplate generating capacity of 6,802.7 MWac
- 6,615 generators are located outside of Pennsylvania with a total nameplate generating capacity of 17,619.9 MWac
- 25,395 solar facilities are located in Pennsylvania with a total nameplate generating capacity of 396.8 MWac. This represents 99% of all systems located in Pennsylvania but only 5.8% of nameplate generating capacity located in Pennsylvania.

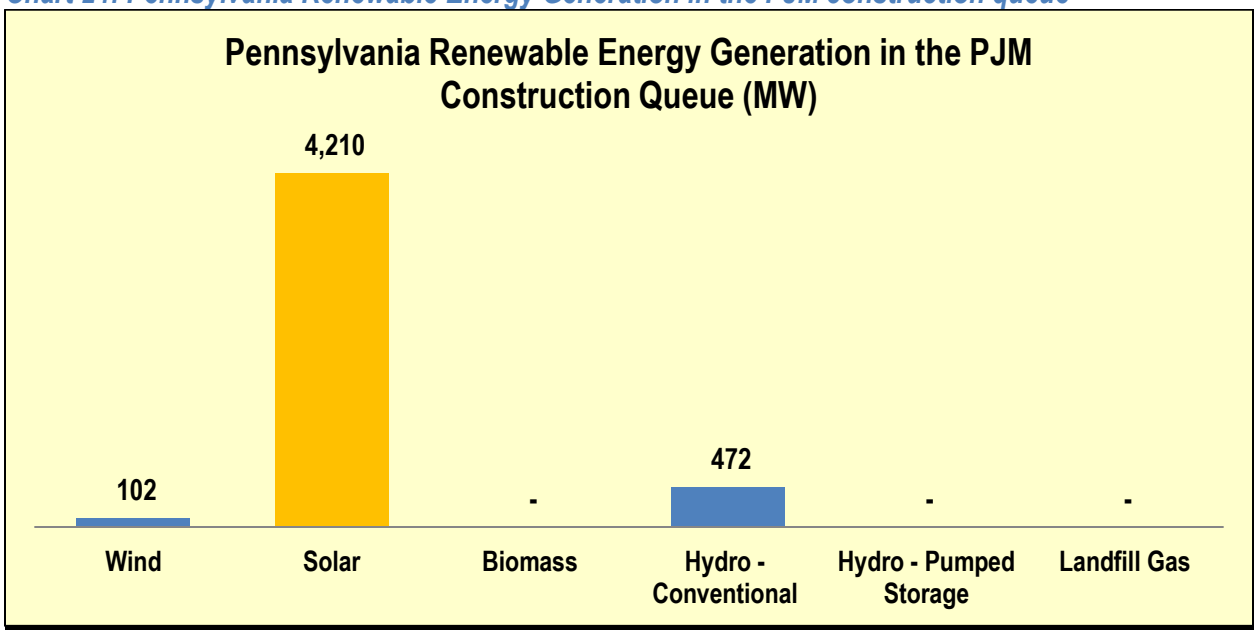
[41] https://www.eia.gov/state/?sid=PA#tabs-4
[42] http://www.pennaeps.com/reports/

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 September 28, 2020, with expected completion dates through third quarter of 2023.[43] Only active projects and projects under construction are included in this analysis, totaling 4,784 MW of generating capacity. It's also worth noting that among the many projects in the PJM queue, several large solar projects totaling approximately 400 MW are associated with signed Power Purchase Agreements (PPAs). The Pennsylvania State University, The University of Pittsburgh, The University of Pennsylvania, The City of Philadelphia, and SEPTA have each signed PPAs as part of their commitment to reducing greenhouse gas emissions, thereby lessening their contribution to climate change. In doing so, however, the solar credits associated with these projects must be kept and retired by each of these entities and therefore are not expected to be available for use by the EDCs and EGSs for AEPS compliance.

[43] http://www.pjm.com/planning/generation-interconnection/generation-queue-active.aspx

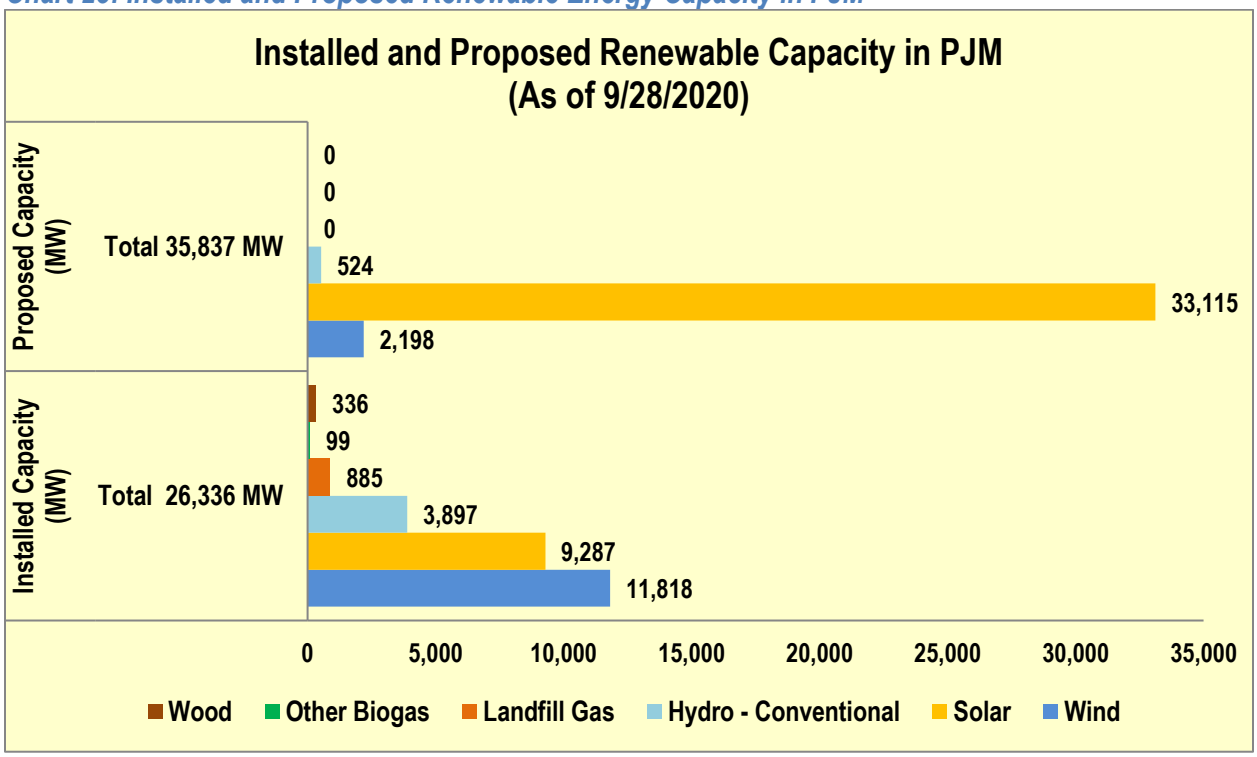
Chart 24: Pennsylvania Renewable Energy Generation in the PJM construction queue



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 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.[44]

[44] PJM-EIS Public Reports, Renewable Generators Registered in GATS and PJM queue. Includes "Active" and projects "Under Construction"

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 with RPS requirements, the final requirements range from 10% of electricity sales by 2025 in Indiana to 100% of sales by 2050 in Virginia.[45]

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

[45] https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx

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.

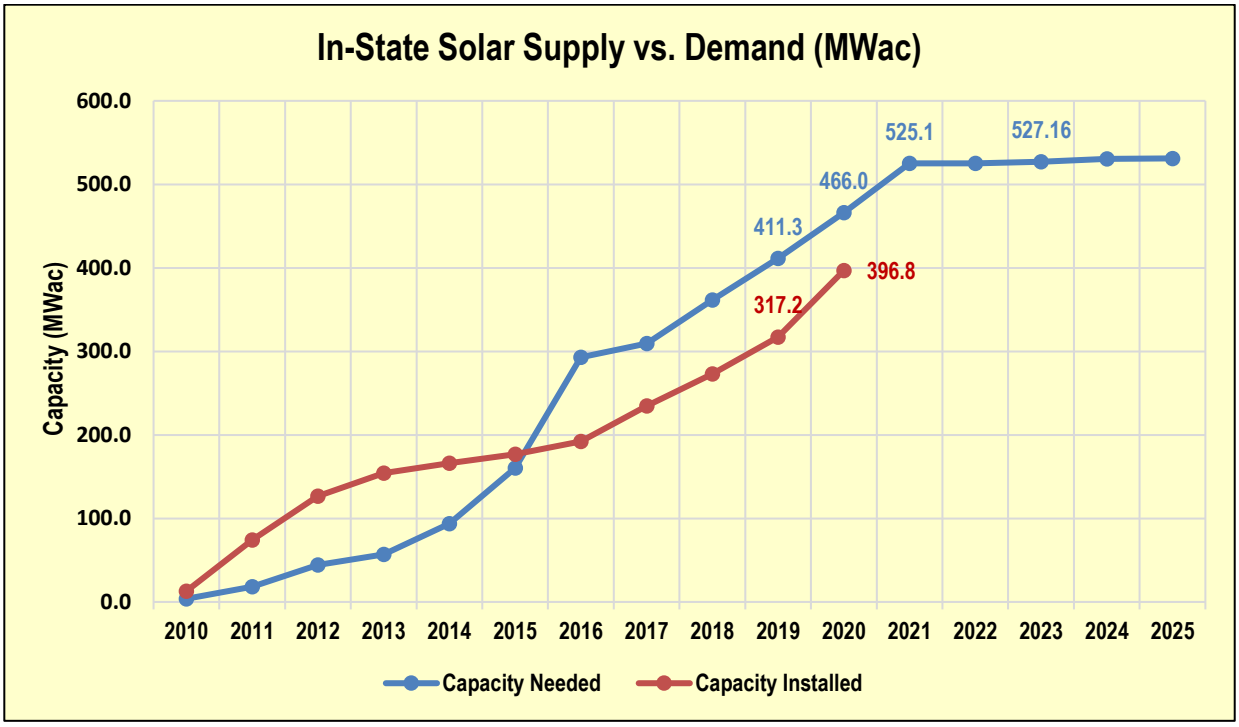
The AEPS marketplace for Pennsylvania is quite complex due to numerous factors which must be considered, such as those previously referenced. To meet the Tier I Solar AEPS obligations, EDCs and EGSs must purchase in-state solar AECs, with the exception of NSTI credits from pre-existing contracts that the PUC has subsequently reviewed and approved. Up to and through Compliance Year 2020, EDCs and EGSs were permitted to obtain Tier II AECs from anywhere within the PJM region to use for their respective AEPS obligations. With the passage of Act 114 of 2020, EDCs and EGSs are required to meet their Tier II obligations by using AECs from Tier II resources located within Pennsylvania. Tier II AECs generated prior to December 2020 from out-of-state resources maintain eligibility for the AEC's life. Eligibility of AECs from out-of-state Tier II resources with pre-existing contracts will be determined based on the Commission's Act 114 Final Implementation Order when issued. EDCs and EGSs may continue to obtain Tier I AECs from anywhere within the PJM region to use for their respective AEPS obligations.

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.

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 4,210 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

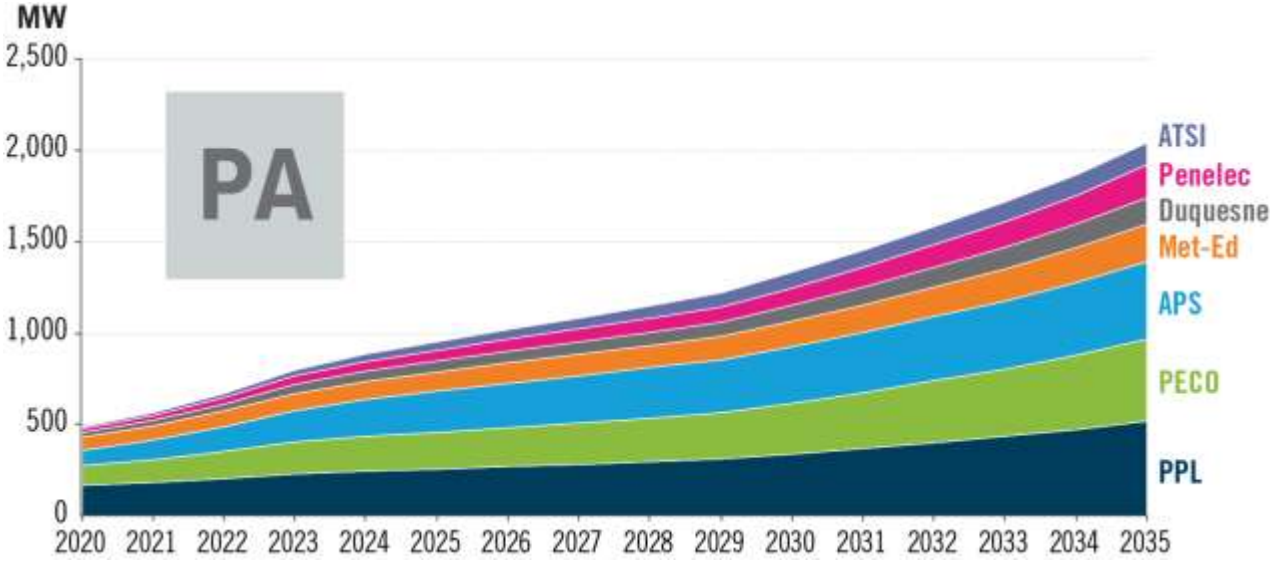


Similar to Pennsylvania, many of the PJM states have "closed their borders", not allowing the use of NSTI credits for use in complying with their state RPS solar requirements. For this reason, it is likely that most of Pennsylvania's in-state solar AECs that are currently available in GATS will remain 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.[46]

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



[46] The relative percentage of time a generator actually produces electricity

7. Recent Activity Since End of Compliance Year

The Pennsylvania legislature proposed several bills to address and update the Alternative Energy Portfolio Standards program, including several aimed at establishing community solar. By the end of the legislative session, only one bill had advanced to the Governor's desk and was signed into law, as noted below. Additionally, the U.S. Federal Energy Regulatory Commission (FERC) took action to facilitate the participation of distributed energy resources that are administered by regional transmission organizations.

Passage of Act 114 of 2020

On Nov. 23, 2020 Governor Wolf signed Act 114 which limits eligibility of Tier II resources to in-state only, in a manner very similar to the way in which Act 40 of 2017 limited solar resources to within Pennsylvania only. At the time of writing this report the Commission was in the process preparing the Tentative Implementation Order to establish the procedures and seek comment on how Act 114 will be implemented. Following review and consideration of comments submitted, the Commission will issue a Final Implementation Order.

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. This legislation removes existing policy barriers that would otherwise prevent ratepayers who are renters or who lack the physical ability to have solar installed on their property 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. These community partnerships are often broadened by establishing minimum shares of the solar output that are provided to lower and moderate-income ratepayers, thus ensuring that all economic classes of society are provided access to solar energy. Community solar has been allowed in 18 other states and the District of Columbia since 2010.

Economic Benefit

The Penn State Center for Economic Development conducted a study on the economic impact of community solar based on the currently planned 235 community solar projects in Pennsylvania. Their conservative estimate based on limited data indicates that the construction of 235 currently planned community solar projects could provide an infusion of $1.8 billion in economic output and support 11,631 jobs in the Commonwealth. This includes 5,991 direct jobs engaged in construction, interconnection, and advertising work, 1,907 indirect jobs associated with increased sales from construction, and 3,733 jobs induced from increased employee spending and landowner lease payment spending. Once operating, these community solar facilities are expected to generate around $83.3 million in annual economic output supporting 520 jobs across the Commonwealth. This includes 114 jobs directly engaged in the operation and maintenance of these facilities, 53 indirect jobs associated with providing goods and services to these facilities, and 354 induced jobs resulting from employee spending, landowner lease payment spending, and increased consumer spending resulting from savings from buying electricity from these facilities. In addition, these facilities will increase annual real property tax collections by about $574,260 across the Commonwealth.[47]

[47] https://aese.psu.edu/research/centers/cecd/publications/economic-impact/economic-impact-of-community-solar_sept-2020_psu-cecd.pdf

Distributed Energy Resources at the Wholesale Level: FERC Order 2222

On Sept. 17, 2020, the FERC issued Order 2222 concerning the participation of distributed energy resource aggregations in wholesale markets operated by Regional Transmission Organizations (RTOs) such as PJM. Order 2222 requires each RTO to revise its tariffs to allow for the participation of distributed energy resources (DER) in wholesale markets. Potentially, these new wholesale market participants may include customer-generators and alternative energy systems under 5 MWs which currently produce AEPS credits through companies which aggregate AEPS credits. AEPS credit aggregators may shift their business models to also become wholesale DER aggregators. In addition, this Order provides separate opportunities for smaller facilities to generate revenue outside of the creation of AEPS credits and net metering.

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: 2020 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				
136,458,735	Solar	0.4433	614,926	$37.00	$22,593,048.12	1,435
	I	7.0567	10,086,046	$7.87	$78,658,825.46	34,737
	II	8.2	11,203,559	$1.92	$21,280631.03	37,073
	Total	15.7	21,904,531	N/A	$122,532,504.61	73,245

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 failed to meet their 2020 AEPS obligations but reached a settlement with the Commission, via Chapter 11 bankruptcy proceedings.

Table 3: 2020 AEPS Compliance Report by EDC Service Territory[48,49]

Distribution Service Territory	Total Energy Sold (MWhs)	Alternative Energy Requirement	Credits Required	Credits Retired[50]	Compliance Status[51]
Citizens' Electric and EGS	162,210				
Solar		0.44%	719	719	In Compliance
Tier I (non-solar)		7.41%	12,025	12,025	In Compliance
Tier II		8.20%	13,301	13,301	In Compliance
Duquesne Light and EGSs	12,389,542				
Solar		0.44%	54,923	54,638	Not in Compliance
Tier I (non-solar)		7.41%	918,482	913,939	Not in Compliance
Tier II		8.20%	1,015,942	1,010,819	Not in Compliance
Met Ed and EGSs	14,114,456				
Solar		0.44%	62,569	62,576	In Compliance
Tier I (non-solar)		7.41%	1,045,356	1,045,479	Not in Compliance
Tier II		8.20%	1,157,385	1,156,057	Not in Compliance
PECO and EGSs	35,923,532				
Solar		0.44%	159,249	159,037	Not in Compliance
Tier I (non-solar)		7.41%	2,663,143	2,654,817	Not in Compliance
Tier II		8.20%	2,945,730	2,936,487	Not in Compliance
Penelec and EGSs	13,295,528				
Solar		0.44%	58,939	58,985	In Compliance
Tier I (non-solar)		7.41%	985,646	985,916	Not in Compliance
Tier II		8.20%	1,090,233	1,089,996	Not in Compliance
Penn Power and EGSs	4,395,542				
Solar		0.44%	19,485	19,489	In Compliance
Tier I (non-solar)		7.41%	325,858	316,152	Not in Compliance
Tier II		8.20%	360,434	349,704	Not in Compliance

[48] The data reported for each Distribution Service Territory is aggregated for the EDC and all EGSs that served customers in that territory.
[49] The Tier I (non-solar) percentage requirement includes the quarterly adjustment.
[50] 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.
[51] Two EGSs, Agera Energy, LLC, and energy.me Midwest LLC failed to meet their 2020 AEPS obligations but reached a settlement with the Commission, via Chapter 11 bankruptcy proceedings.

Distribution Service Territory	Total Energy Sold (MWhs)	Alternative Energy Requirement	Credits Required	Credits Retired[50]	Compliance Status[51]
Pike County and EGSs	68,886				
Solar		0.44%	305	306	In Compliance
Tier I (non-solar)		7.41%	5,107	5,107	In Compliance
Tier II		8.20%	5,649	5,649	In Compliance
PPL and EGSs	36,011,574				
Solar		0.44%	159,639	170,107	Not in Compliance
Tier I (non-solar)		7.41%	2,669,669	2,663,815	Not in Compliance
Tier II		8.20%	2,952,949	2,994,890	Not in Compliance
UGI Electric and EGSs	979,925				
Solar		0.44%	4,344	4,341	Not in Compliance
Tier I (non-solar)		7.41%	72,645	72,457	Not in Compliance
Tier II		8.20%	80,354	80,272	Not in Compliance
Wellsboro Electric and EGSs	102,467				
Solar		0.44%	454	454	In Compliance
Tier I (non-solar)		7.41%	7,596	7,596	In Compliance
Tier II		8.20%	8,402	8,402	In Compliance
West Penn Power and EGSs	19,015,072				
Solar		0.44%	84,294	84,274	Not in Compliance
Tier I (non-solar)		7.41%	1,409,657	1,408,743	Not in Compliance
Tier II		8.20%	1,559,236	1,557,982	Not in Compliance

Table 4: AEC State of Origin – Used for compliance in 2020

Tier	PA	NJ	MD	VA	WV	IL	OH	DE	NC	IN	MI	KY	TN	DC
Solar	304,271	0	132	50,968	445	3,975	18,552	2,359	234,210	6	3	0	5	0
Tier I	2,441,215	66,848	63,352	2,451,400	304,891	2,057,180	431,790	41,247	1,397,497	748,709	18	71,739	26	10,134
Tier II	6,700,940	349,981	927,432	2,636,576	418,726	0	167,433	0	0	0	0	2,471	0	0
Total	**9,446,426**	**416,829**	**990,916**	**5,138,944**	**724,062**	**2,061,155**	**617,775**	**43,606**	**1,631,707**	**748,715**	**21**	**74,210**	**31**	**10,134**

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 @ $40.00	Credits Needed	Tier I Credits @ $10.00	Credits Needed	Tier II Credits @ $3.00	
Duquesne	63,477	$ 2,539,093	952,160	$ 9,521,600	1,269,547	$ 3,808,640	$ 15,869,333
Met Ed	71,919	$ 2,876,753	1,078,782	$ 10,787,822	1,438,376	$ 4,315,129	$ 17,979,704
Penelec	68,201	$ 2,728,042	1,023,016	$ 10,230,158	1,364,021	$ 4,092,063	$ 17,050,263
Penn Power	23,574	$ 942,944	353,604	$ 3,536,039	471,472	$ 1,414,416	$ 5,893,398
PECO	182,116	$ 7,284,657	2,731,746	$ 27,317,464	3,642,329	$ 10,926,986	$ 45,529,107
PPL	188,296	$ 7,531,840	2,824,440	$ 28,244,399	3,765,920	$ 11,297,759	$ 47,073,998
UGI	99806	$ 3,992,237	1,497,089	$ 14,970,891	1,996,119	$ 5,988,356	$ 24,951,484
West Penn	5,035	$ 201,412	75,529	$ 755,294	100,706	$ 302,118	$ 1,258,823
Citizens'	868	$ 34,711	13,017	$ 130,166	17,355	$ 52,066	$ 216,944
Pike County	354	$ 14,141	5,303	$ 53,030	7,071	$ 21,212	$ 88,383
Wellsboro	527	$ 21,070	7,901	$ 79,014	10,535	$ 31,606	$ 131,690
Totals	704,173	$ 28,166,900	10,562,588	$ 105,625,876	14,083,450	$ 42,250,350	$ 176,043,127

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	1,122.4	1,461.6
	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	0.0	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)	14.6	19.7	34.4
	Anaerobic Digester Gas (secondary fuel source)	0.0	0.0	0.0
	Landfill Gas (primary fuel source)	222.0	389.8	611.8
	Landfill Gas (secondary fuel source)	0.0**	0.0	0.0
I	Solar PV	396.8	1885.1	2281.9
I	Wind	1,419.5	7,365.3	8,784.9
I	**TOTAL of Tier I**	**2,739.5**	**10,872.5**	**13,612.0**
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	1,191.8	1,904.1
	Pumped Storage	1,540.0	4,042.0	5,582.0
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	1,503.4	750.0	2,253.4
II	**TOTAL of Tier II**	**4,063.2**	**6,747.4**	**10,810.6**
I & II	**TOTAL of Tiers I & II**	**6,802.7**	**17,619.9**	**24,422.6**

* 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: 2019 – 2021

Year	Generation Requirement (MWh)	Capacity Required (MW)	Installed Capacity (MWac)
2019	557,611	424	317.2
2020	628,113	478	396.8
2021	704,173	536	

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 *Pennsylvania Bulletin*	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 InClime 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
Act 114 of 2020	Nov. 23, 2020

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;
    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;

[52] Geothermal Energy Association – Geothermal Basics Q&A, 2012
[53] Renewable Energy Policy Network (REN21) – Renewables 2016 Global Status Report

vi. Was completed after Feb. 28, 2005.

Solar Photovoltaic (PV)

A solar PV System[54] 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 plant[55] 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 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.

PA Public Utility Commission
400 North Street
Harrisburg, PA 17120
www.puc.pa.gov

PA Department of Environmental Protection
P.O. Box 2063
Harrisburg, PA 17105-2063
www.dep.pa.gov

PA Public Utility Commission
400 North Street
Harrisburg, PA 17120
www.puc.pa.gov

PA Department of Environmental Protection
P.O. Box 2063
Harrisburg, PA 17105-2063
www.dep.pa.gov