Alternative Energy Portfolio Standards Act of 2004
Compliance for Reporting Year 2021

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 2021

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Gladys M. Brown Dutrieuille, *Chairman*
John F. Coleman Jr., *Vice Chairman*
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

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Front cover, title page and back cover: Solar Farm Owned & Operated by The University Area Joint Authority (UAJA)
Front cover photo credit: Solar Renewable Energy LLC and RETTEW

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Tier I Solar Compliance

- **All EDCs** and **all but two EGSs** met their requirements. Three EGSs paid the required ACPs to achieve compliance. Two EGSs filed for bankruptcy and failed to meet their compliance obligations.

Tier II Compliance

- **All EDCs** and **all but two EGSs** met their requirements. Two EGSs paid the required ACPs to achieve compliance. Two EGSs filed bankruptcy and failed to meet their compliance obligations.

Tier I Non-Solar Compliance

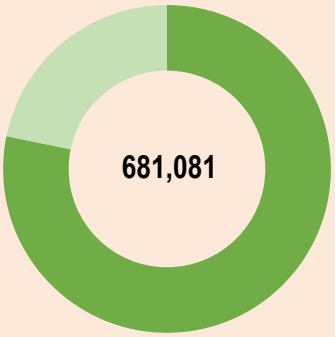
- **All EDCs** and **all but two EGSs** met their requirements. Two EGSs paid the required ACPs to achieve compliance. Two EGSs filed bankruptcy and failed to meet their compliance obligations.

Total Number of Credits Retired

- **24,898,015** credits retired by **11** EDCs and **115** EGSs. Two EGSs filed for bankruptcy and did not retire 120,192 credits of their combined obligation.

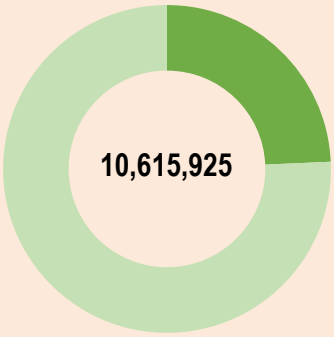
Source of Tier I Solar RECs Retired

- **Pennsylvania – 78.2%**
- **Other States – 21.8%**



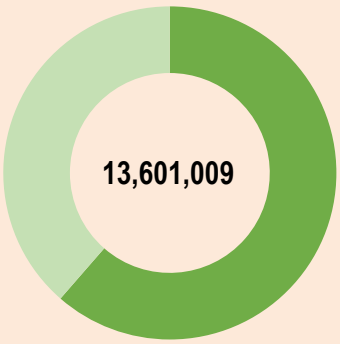
Source of Tier I Non-Solar RECs Retired

- **Pennsylvania – 20.4%**
- **Other States – 79.6%**



Source of Tier II RECs Retired

- **Pennsylvania – 61.4%**
- **Other States – 38.6%**



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 increased 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 2021 reporting year (June 1, 2020, through May 31, 2021) the Tier I requirement was 8% of all retail sales, of which at least 0.5% of all retail sales was to come from solar photovoltaic (PV) sources. The requirement for Tier II resources was 10% 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 year that adjustment is 0.303947% for a total Tier I requirement of 7.803947%.

At the close of the 2021 reporting year, all the EDCs and all but five EGSs met their requirements by acquiring and retiring sufficient AECs. Three 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, 44.4% 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 indicates that sufficient Solar, Tier I Non-solar, and Tier II AECs are available to meet the AEPS Act requirements through the 2022 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] Similarly, the AEPS Act was amended by Act 114 of 2020 that was

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

signed into law on Nov. 23, 2020. One Section of Act 114 modified Section 4 of the AEPS Act to effectively limit eligibility of Tier II alternative energy sources to facilities located in Pennsylvania. However, Act 114 allows exceptions for existing contracts for AECs from out-of-state Tier II facilities.[2]

[2] *Implementation of Act 114 of 2020,* Final Implementation Order at Docket No. M-2020-3023323

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 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 were permitted to obtain AECs from resources located within the entire PJM Interconnection, LLC[3] (regional transmission organization) area, until limited by Act 40 of 2017 and Act 114 of 2020, 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

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

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

The law provides for a three-month true-up period that runs from the conclusion of each reporting year, May 31, until September 1 of the same calendar year. During the true-up period, EDCs and EGSs may acquire any additional alternative energy credits needed for compliance. After the conclusion of the true-up period, the PUC verifies compliance and imposes alternative compliance payments (ACPs), as appropriate, by providing notice of the payment due as well as 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 and monitoring the alternative energy market and its associated costs of energy generation, as well as conducting an ongoing alternative energy planning assessment. The PUC and DEP are to report their findings and any recommendations for changes to the Act to the General Assembly via an annual report.

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

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

[4] *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

#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 established 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. May 31, 2021, was the end of the 15-year schedule to reach the goal of 18%.

2. Compliance Summary

As of May 31, 2021, a little more than 18% of electricity sold to retail customers was generated by qualifying alternative energy resources.

Of all the AECs retired for compliance, 44.4% were generated in Pennsylvania and the remaining 55.6% were generated from other states in the PJM service territory.

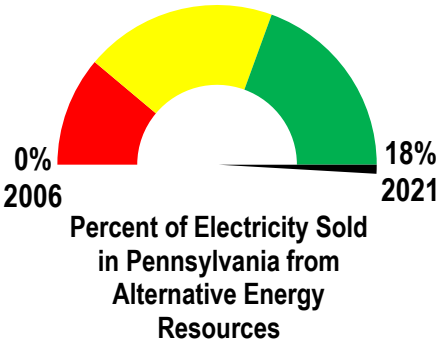
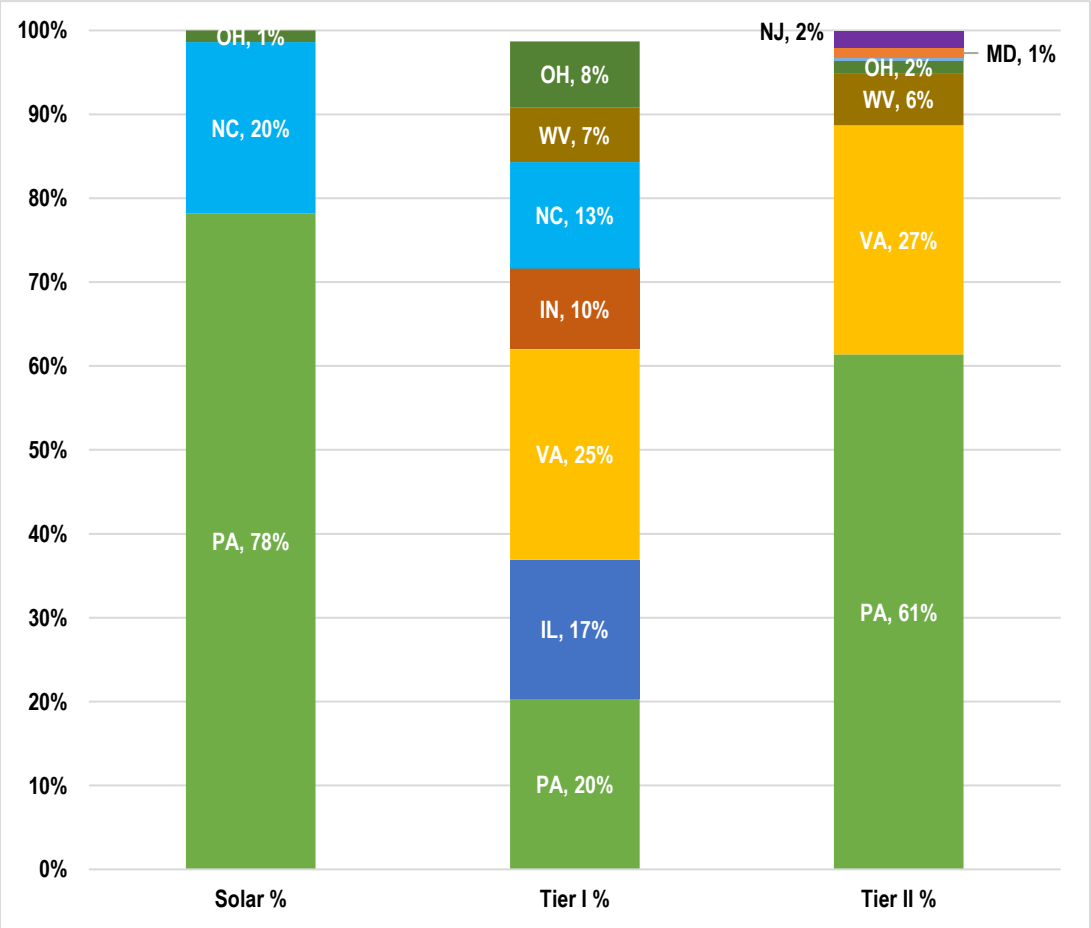


Chart 1 shows the percentage of AECs that were retired in Pennsylvania in the 2021 reporting year and their states of origin. As can be seen, Pennsylvania-sourced AECs accounted for 78% of the Solar PV, 20% of the Tier I Non-solar, and 61% of the Tier II requirements, respectively.

Chart 1: Percentage of AECs Retired in 2021



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.

Chart 2: Percentage of Retired AECs that Originated in Pennsylvania

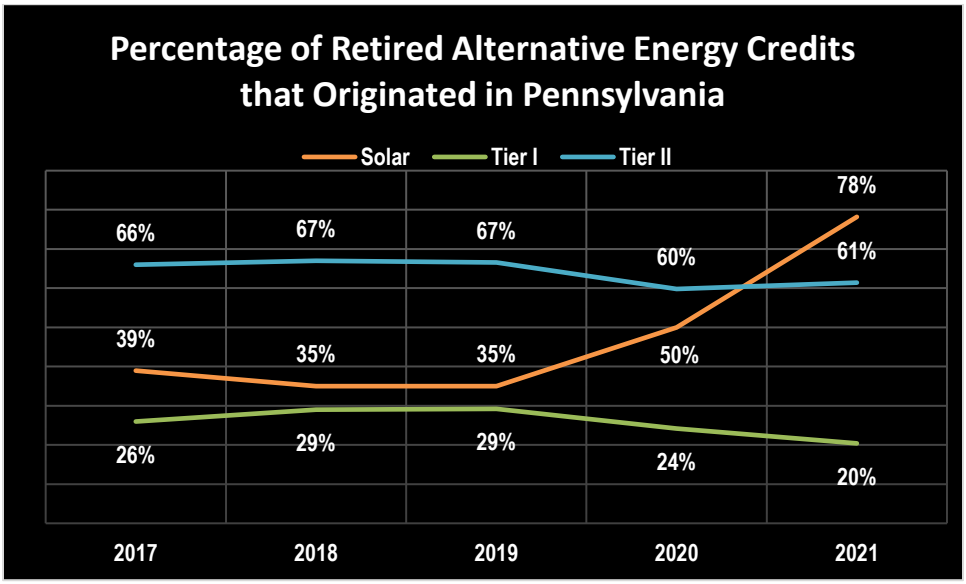


Chart 2 reflects the most recent five-year trend in the percentage of retired AECs that originated in Pennsylvania. Since the passage of Act 40 of 2017, the downward trend of retiring fewer Solar AECs generated in Pennsylvania has reversed sharply and soon will reach 100%. The same outcome will soon become evident for Tier II, as a result of the passage of Act 114 of 2020.

For additional details turn to Appendix A of this report. Table 2 provides a compliance summary for each tier for the current reporting year. Table 3 provides detailed compliance information for each tier and EDC service territory for the current reporting year and Table 4 shows the actual quantity of AECs, by state of origin, that were used for compliance in each of the three tiers.

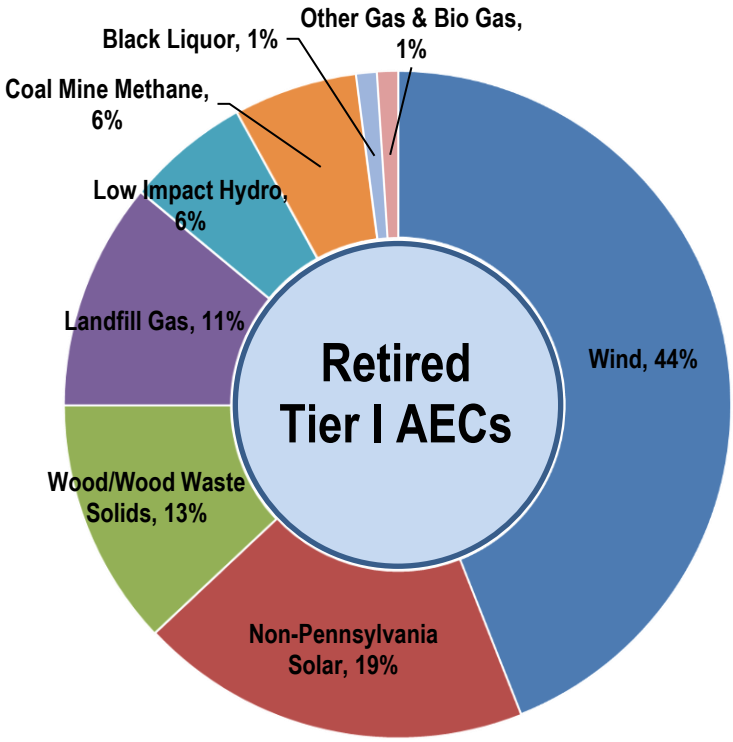
During the 2021 reporting year, 11 EDCs and 117 EGSs had compliance obligations. All EDCs achieved compliance in the reporting year by retiring the requisite number of AECs. Five EGSs did not retire sufficient AECs, three of the five EGSs achieved compliance by paying the required ACPs. Two EGSs, Entrust Energy East, Inc. and Liberty Power Holdings, LLC did not pay the required ACPs as they are no longer in business and have filed for bankruptcy. The Commission is taking steps to recover what it can against the obligations of Entrust Energy East and Liberty Power Holdings. Specifically, the Commission is seeking to recover ACP money from the financial assurances posted by both companies. The ACP amounts owed by Entrust Energy East and Liberty Power Holdings are $2,780,741.52 and $2,706,535.52, respectively

As previously mentioned, Table 3 of Appendix A presents details of the compliance obligations in each EDC territory and the compliance status for the reporting year 2021. The extent of geographic breadth of service provided by Entrust Energy East and Liberty Power Holdings can be seen in the two far-right columns of Table 3; these two EGSs represent the sole reason for compliance being unmet in most EDC service territories. 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. Commission staff also note that several EGSs retired excess credits beyond the required AEPS obligations. EGS sales information is considered proprietary, therefore, their AEPS credit retirement data are combined and shown in the appropriate EDC service 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 I AECs retired in the 2021 reporting year. Wind energy produced 42% of the retired Tier I 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 2021 Reporting Year



a. Solar Compliance

For the 2021 reporting year, the Solar PV obligation was 0.5%. All EDCs and all but five EGSs retired the requisite number of Solar AECs. Three of the five EGSs paid the ACP for their Solar PV obligation. Two EGSs, Entrust Energy East, Inc. and Liberty Power Holdings, LLC did not pay the required ACPs as they are no longer in business and have filed for bankruptcy. The Commission is taking steps to recover what it can against the obligations of Entrust Energy East and Liberty Power Holdings. The number of Solar AECs not retired by Entrust Energy East and Liberty Power Holdings represented 0.366% of the total Solar AEC obligation.

b. Tier I Non-Solar Compliance

For the 2021 reporting year, the base obligation for non-solar Tier I was 7.5%. The Tier I quarterly adjustment, impacting only non-solar Tier I, added a quarterly increase of 0.2874%, 0.3489%, 0.3943%, and 0.4592%, for quarters one through four, respectively. This resulted in 415,402 AECs added to the base obligation of 10,250,193. All EDCs and all but four EGSs achieved compliance by retiring the requisite number of Tier I AECs. Two of the four EGSs paid ACPs for their non-

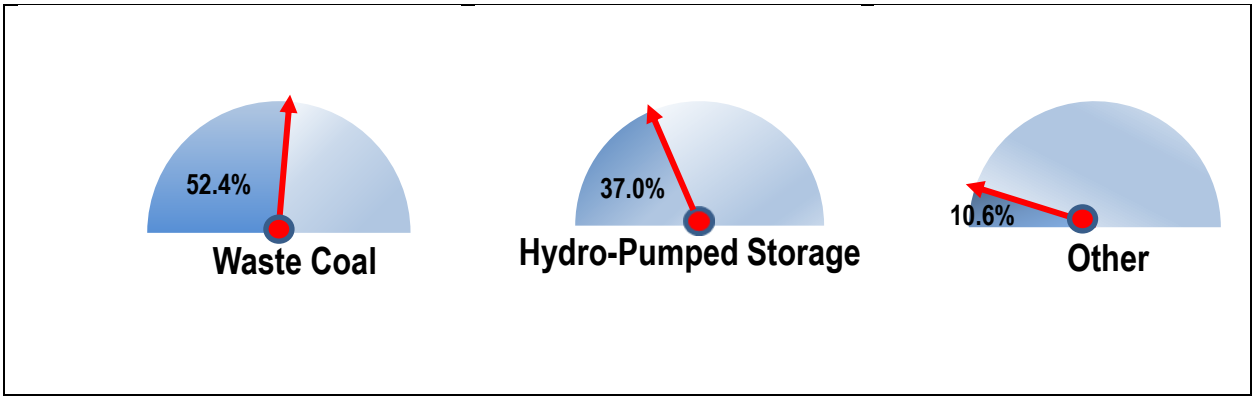
solar Tier I obligations. Entrust Energy East, Inc. and Liberty Power Holdings, LLC did not pay the required ACPs as they are no longer in business and have filed for bankruptcy. The Commission is taking steps to recover what it can against the obligations of Entrust Energy East and Liberty Power Holdings. The number of Tier I AECs that were not retired by Entrust Energy East and Liberty Power Holdings represented 0.484% of the total Tier I AEC obligation.

B. Tier II Compliance

For the 2021 reporting year, the base obligation for Tier II was 10.0%. All EDCs and all but four EGSs achieved compliance in the reporting year by retiring the requisite number of AECs. Two of the four EGSs paid ACPs for their Tier II obligations. Entrust Energy East, Inc. and Liberty Power Holdings, LLC did not pay the required ACPs as they are no longer in business and have filed for bankruptcy. The Commission is taking steps to recover what it can against the obligations of Entrust Energy East and Liberty Power Holdings. The number of Tier II AECs not retired by Entrust Energy East and Liberty Power Holdings represented 0.484% of the total Tier II AEC obligation.

Chart 3 shows sources and percentages of Tier II AECs retired in the 2021 reporting year.

Chart 3: Sources and Percentages of Tier II AECs Retired for the 2021 Reporting Year



3. Costs and Benefits of Alternative Energy Generation

A. Current Estimated Costs of Future Alternative Energy Generation

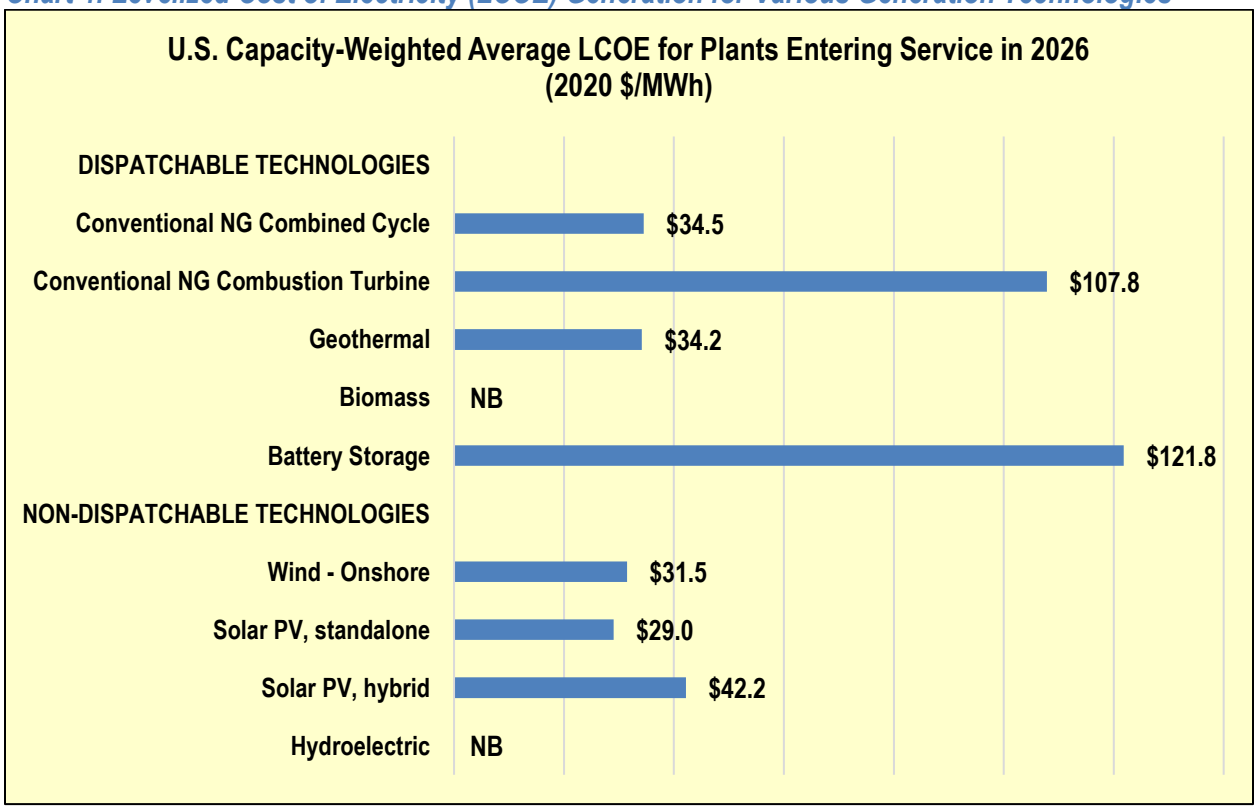
The United States Energy Information Administration (EIA) provided estimated cost data for the construction and operation of utility-scale generation plants that may be brought online in 2026.[5] The EIA data is used as the most consistently reliable information available. In using this data, 2026 was 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 2020 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 2021*, February 2021. 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.
Solar PV Costs are expressed in terms of net AC power available to the grid for the installed capacity.
Solar PV Hybrid is a single axis PV system coupled with four-hour battery storge system.

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 2022. Since the percentage requirements for each tier of the AEPS will remain at 2021 levels going forward, compliance costs will be determined by load (MWh) served for each EDC and the credit prices of retired Solar, Tier I non-solar, and Tier II credits. Load growth had been trending down in recent years but increased in 2021 and projections offered by the EDCs indicate a very slight increase (0.6%) for each of the next few years. Given that load growth is expected to remain fairly flat the driver in estimating costs for AEPS compliance is understanding credit prices and most significantly, Tier II credits. This is because Tier II obligations are the largest among the three tiers and Tier II credits have realized an unprecedented ten-fold increase in spot market prices since January

2020, despite there being an adequate supply of Tier II credits available for near-term AEPS 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 "2021 Pennsylvania Clean Energy Employment Report," recently released by the DEP, over 90,000 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 clean energy jobs in Pennsylvania declined by 7.4% compared to the 2020 Pennsylvania Clean Energy Employment report. Impacts from the Coronavirus (COVID-19) pandemic resulted in job losses across the state, including the clean energy sector. Despite economywide job losses, employment in solar and alternative transportation remained fairly steady throughout 2020, while clean energy generation manufacturing and wholesale trade grew slightly. In fact, Pennsylvania's solar jobs market remained steady despite a nationwide decline of 8%, or almost 28,000 jobs lost. Clean energy generation manufacturing grew by 2.1%, or about 70 jobs, while wholesale trade also saw a slight increase of almost 80 jobs—a growth of 5.7%.[7]

According to the report, roughly 73% of Pennsylvania's clean energy jobs pertain to energy efficiency, which is an AEPS Tier II resource, including manufacturing, construction and installation of high efficiency appliances and products, high efficiency lighting, and energy efficient buildings and associated building materials. The report also notes that solar industry jobs made up the largest share of the clean energy generation subsector, at 36.6% (5,158 jobs), followed by jobs in the wind industry with 2,772 Pennsylvanians employed.

[7] *2021 Pennsylvania Clean Energy Employment Report*

In reporting year 2021, approximately 134.6 megawatts AC (MWac) of solar-electric generating capacity was installed in PA, which brought the in-state total capacity to 534.4 MWac. It should be noted that the above values include only AEPS-certified systems and does not account for other installed systems in Pennsylvania that are not certified in a timely fashion, and systems owned by owners who do not seek certification under AEPS. These installations at private residences, businesses, institutions, and utility-scale solar sites across Pennsylvania, help sustain a workforce of slightly more than 4,310[8] 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, compensation within the solar industry is comparable with similar occupations in other energy industries.[9] 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 end of 2020, Pennsylvania ranked 20th in the country for installed wind capacity 1,419.5 MW (1,459 MW).[10] Additionally, Pennsylvania supports a number of wind energy jobs. Through Q4 2019, the total number of direct and indirect jobs supporting the wind industry in Pennsylvania was approximately 2,937.[11] 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.

Supporting the growth of hydropower in Pennsylvania and globally are two of the world's largest turbine manufacturers, Voith Hydro and 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 400 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

[8] *SEIA Pennsylvania State Solar Spotlight 2nd Quarter 2021*

[9] *National Solar Jobs Census 2020*,. available at: https://www.thesolarfoundation.org/national/

[10] The wind capacity installed in Pennsylvania reported by US DOE (1,459 MW) differs from the capacity of certified wind reported by Pennsylvania's AEPS Administrator (1,419.5 MW). Pg. 8 at Land-Based Wind Market Report: 2021 Edition (energy.gov)

[11] *Clean Jobs Pennsylvania* 2019 - https://e2.org/reports/clean-jobs-pennsylvania-2020/

full-time jobs is created.[12] 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 alternative energy and high-performance buildings projects. In the 2021 reporting year, the Commonwealth Financing Authority approved $10.9 million in loans and grants to eleven alternative energy & one high-performance building projects. All the alternative energy projects funded were combined heat and power systems. In response to impacts on the clean energy sector as a result of the COVID-19 pandemic, The Pennsylvania Energy Development Authority (PEDA) developed a grant program offering $1.71 million to Pennsylvania clean energy projects that were disrupted. The grant solicitation required applicants to demonstrate how an award would mitigate the impact of a project disruption caused by the COVID-19 pandemic. This included re-hiring of workers or hiring of additional workers to complete the project quickly, the ability to make immediate equipment payments to restart the supply chain, and the opportunity to overcome lost revenue due to market stagnation. Projects eligible for funding included the development and deployment of innovative, clean, advanced, and efficient technologies; the generation of alternative energy or the production of alternative fuels; or the implementation of energy-efficiency/demand-side energy projects.

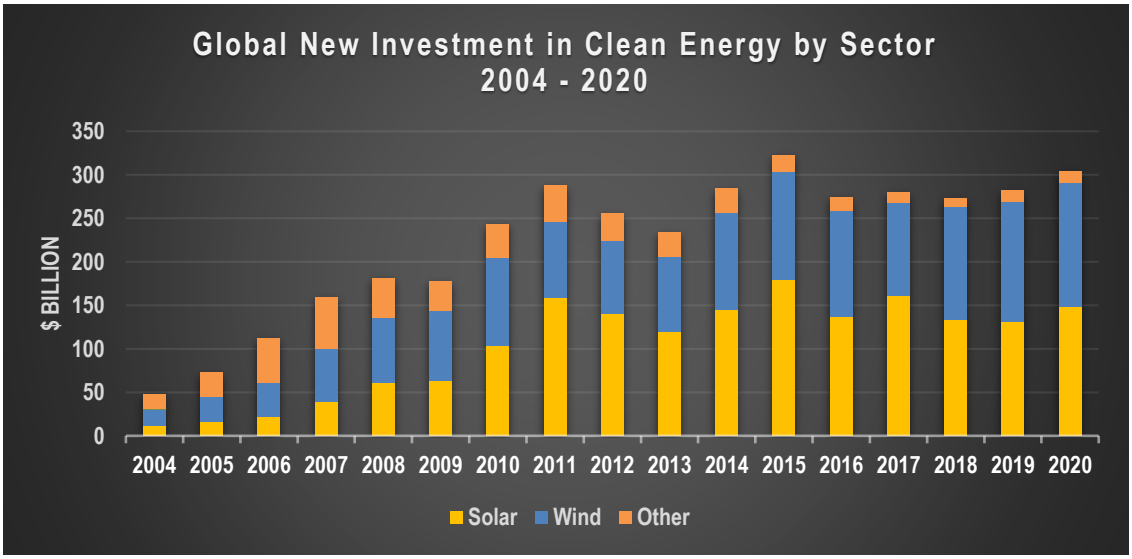
The PEDA Board voted to approve 11 projects at the November 2020 Board meeting, and DEP staff distributed all funds by May 2021. The projects included energy efficiency, solar energy, high-performance buildings, and electric vehicle charging projects halted by the pandemic. Five businesses, two municipalities, two school districts, and two nonprofit organizations received grants for a variety of building and transportation projects that had broken ground or were in advanced planning stages before being disrupted by the pandemic. The projects are located in urban and rural areas in eight counties, and seven are in or will serve Environmental Justice communities.

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

4. Market Trends

The renewable energy industry is becoming one of the most transformative sectors of the global economy. Through technology improvements, cost declines, new financing structures, and regulatory policy, the sector has driven economic growth around the world including in the United States. Chart 5 shows the new global investments in clean energy from 2004 through 2020. Investments in clean energy projects totaled $304 billion in 2020, which was 2% higher than 2019.

Chart 5: Global New Investment in Clean Energy by Sector (2004-2020)



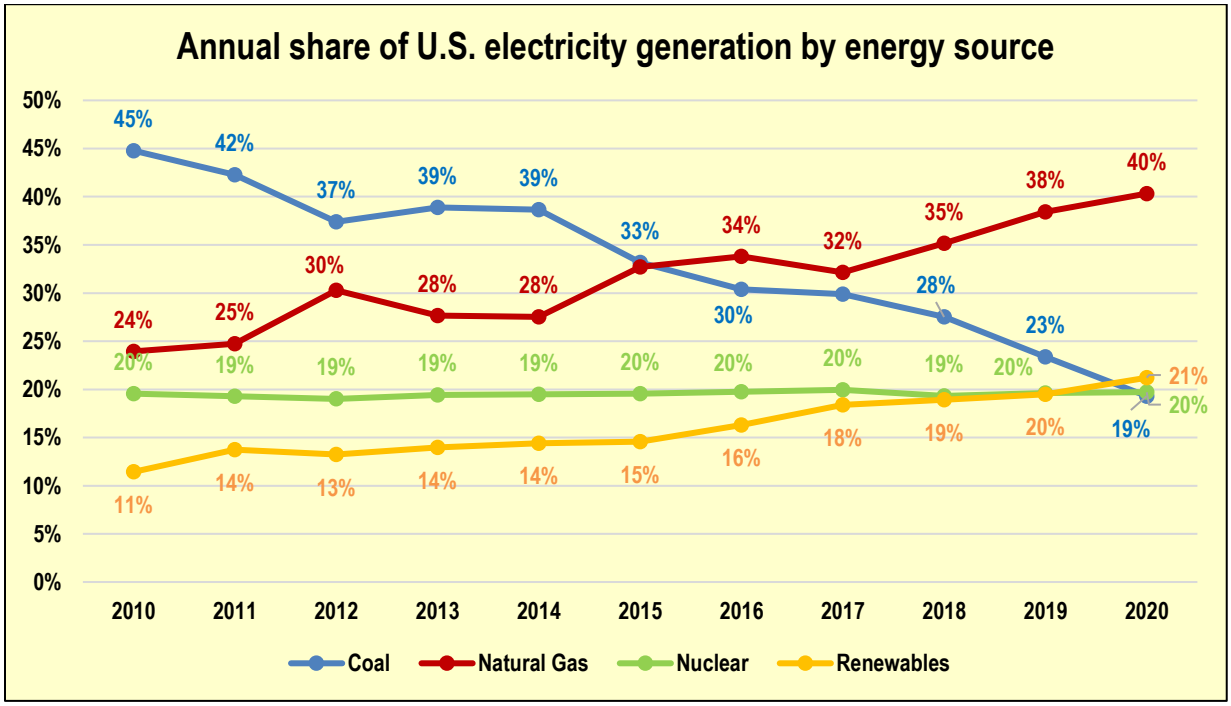
Source: Energy Transition Investment Trends 2021[13]

Globally, in 2020, approximately 260 gigawatts[14] (GW) of renewable energy production capacity (excluding large hydro) came online. Solar alone accounted for almost 125 GW of new capacity in 2020. The United States ranks second in the world for renewable energy capacity (292 GW), behind China (895 GW)[15].

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.

[13] Bloomberg NEF. Energy Transition Investment Trends, 2021, Summary, page 7
https://assets.bbhub.io/professional/sites/24/Energy-Transition-Investment-Trends_Free-Summary_Jan2021.pdf
[14] 1 gigawatt (GW) = 1,000 megawatts (MW) or 1,000,000 kilowatts (kW)
[15] IRENA - *Renewable Energy Capacity Statistics 2021*, pages 2 - 6 Renewable Energy Statistics 2021 (irena.org)

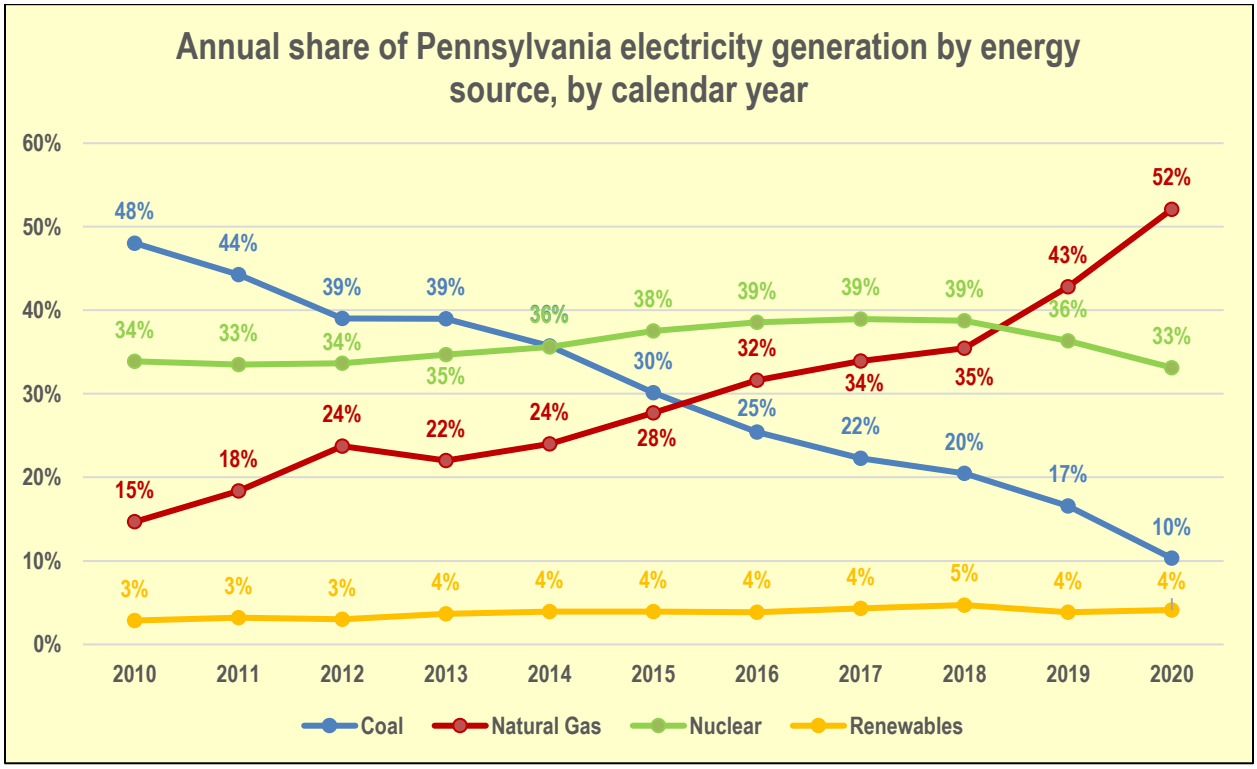
Chart 6: U.S. Electricity Generation by Energy Source, 2020 Calendar Year



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 the growth of Pennsylvania's renewable energy generating capacity and has provided 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***

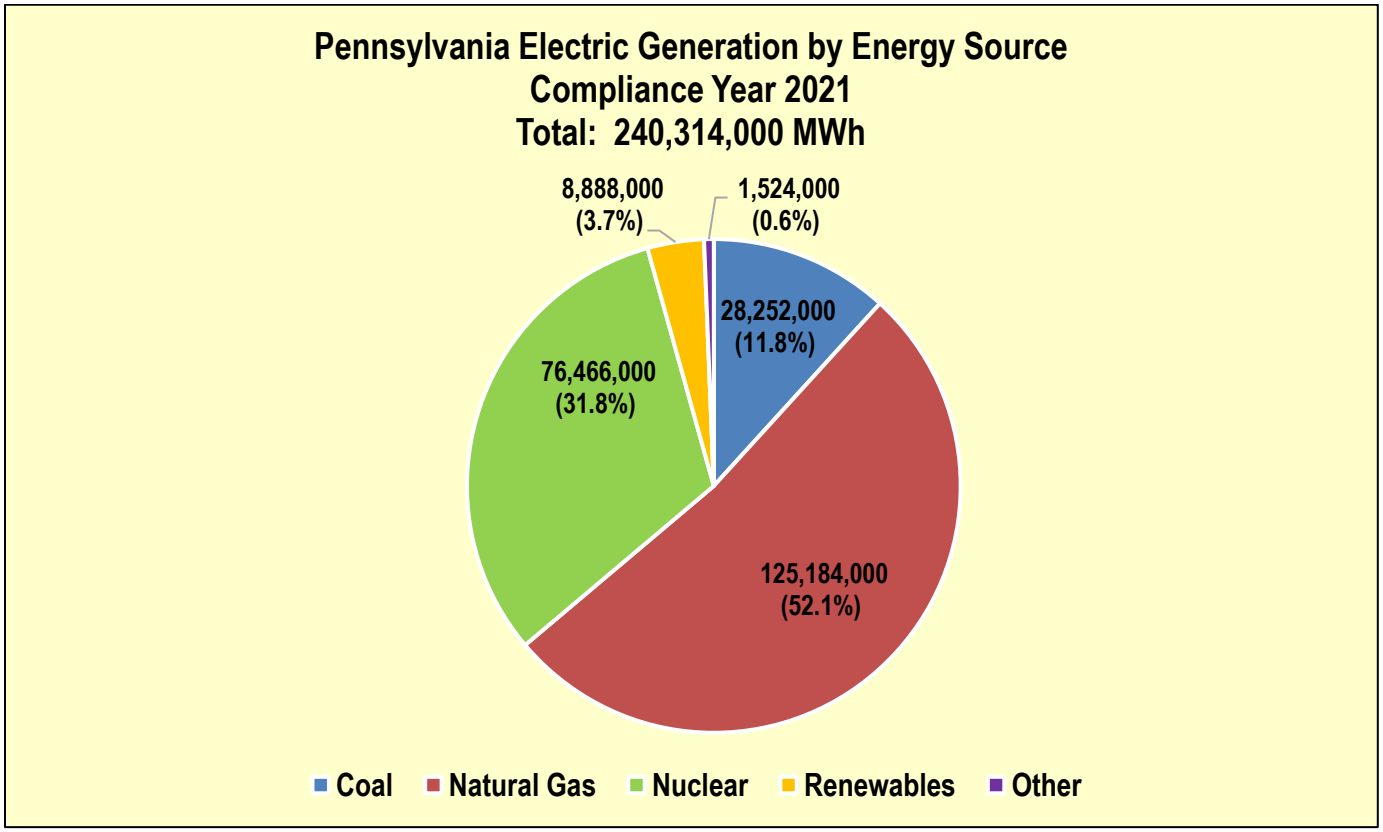
Chart 7 shows annual Pennsylvania electric generation by energy source. In 2020, approximately 4% of the state's electricity generation was from renewable energy sources.[16] The chart mimics the general trend in U.S. electricity generation (Chart 6), where electricity generation from coal is steadily 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 AEPS Act

[16] Energy Information Administration Electricity Data Browser

allows compliance to come from credits generated from out-of-state resources, with the recent exception, as previously noted, for Tier I Solar and Tier II obligations.

Chart 8 shows the breakdown of total electricity generation in Pennsylvania by source for compliance year 2021. This information is obtained from EIA using their Electricity Data Browser tool.

Chart 8: Pennsylvania Compliance Year Electric Generation by Energy Source



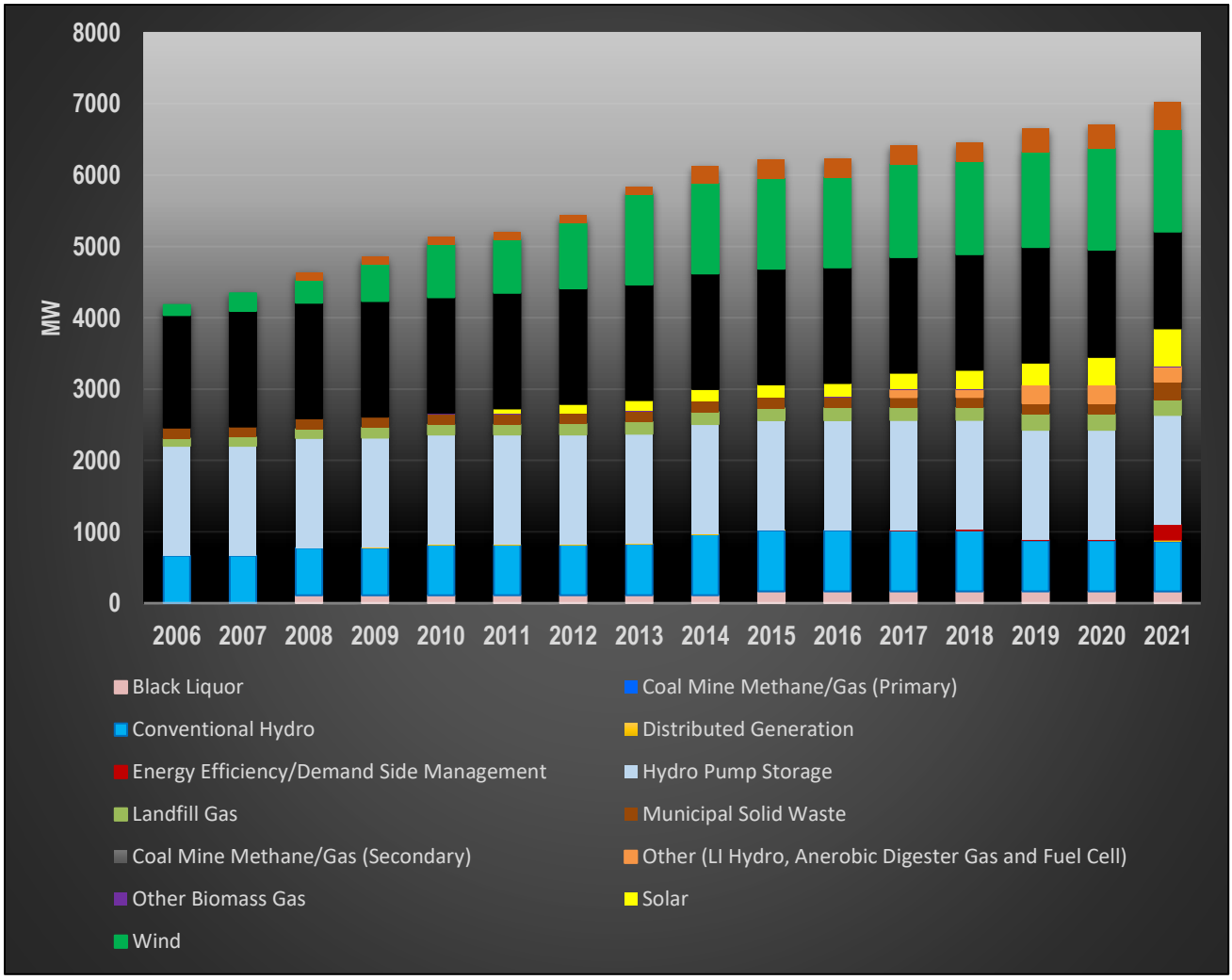
Source: *Energy Information Administration Electricity Data Browser*

Action at the federal level, 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 2020 when congress passed a stimulus bill with a goal of minimizing the economic impacts caused by COVID-19. The PTC and ITC expire or decline in value for both technologies with the PTC for wind expiring in 2021 and the ITC for large-scale solar declining from the current 26% to 22% in 2023, becoming fixed at 10% from 2024 onwards but expiring for residential projects in 2024. Any policy changes affecting the incentive

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

Chart 9 shows an historical view of the Pennsylvania certified alternative electricity generation capacity available in Pennsylvania. As of the end of the 2021 compliance year, Pennsylvania had approximately 7,019.6 MWac of installed alternative electricity generation capacity.

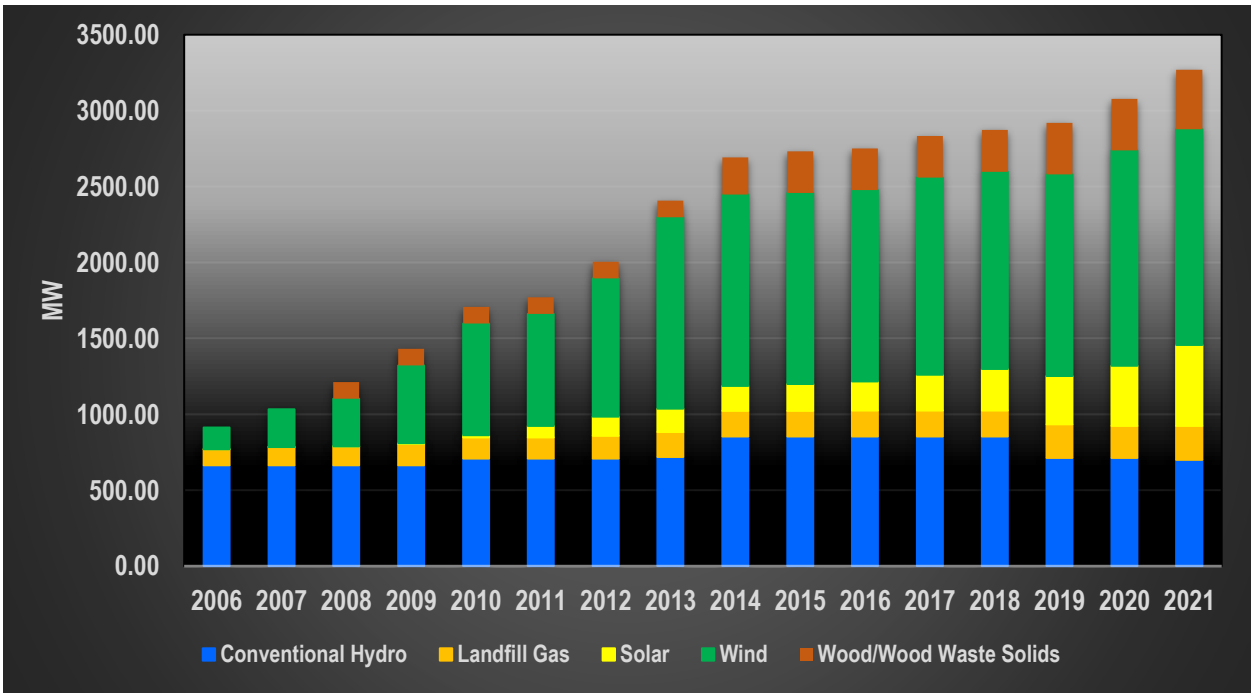
Chart 9: PA In-State AEPS-Certified Alternative Energy Capacity – 2006-2021 (MWac)



Refer to Table 5 in the Appendix for compliance year 2021 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 – 2006-2021 (MWac)



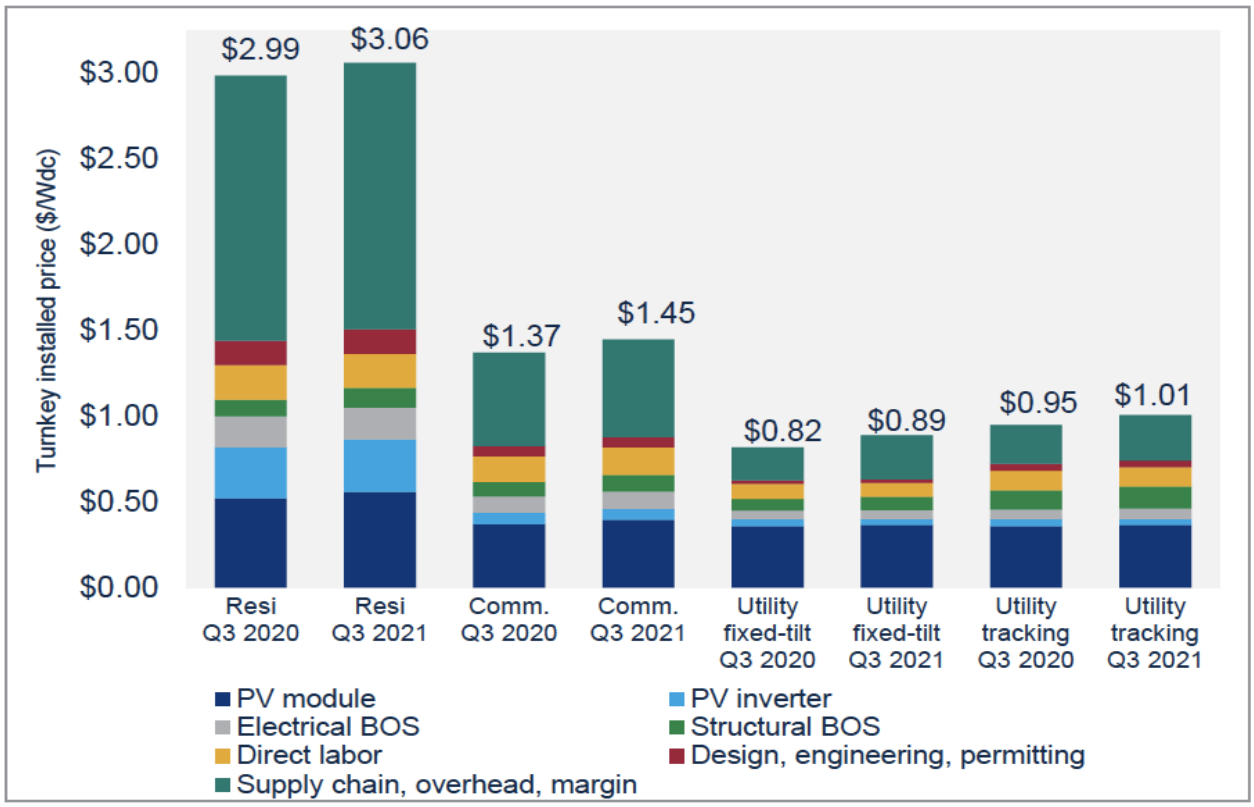
A. Solar

In 2020, approximately 19.2 GWdc (direct current gigawatts) of Solar PV was installed in the U.S. Several news outlets have reported that the sales and installations of solar across the country were significantly impacted by the COVID-19 pandemic. Despite the impact of the pandemic, in the first quarter of 2021, approximately 4.9 GWdc of Solar PV was installed in the U.S, the largest first quarter total ever.[17]

Chart 11 shows the trend in the cost of Solar PV systems.[18] Solar panels produce direct current (DC) and are rated in terms of the power output expressed in watts (W). In many cases, system cost is expressed as $/Wdc (direct current watts).

[17] https://www.seia.org/research-resources/solar-market-insight-report-2021-q4
[18] https://www.seia.org/solar-industry-research-data

Chart 11: US National Average Solar System Prices by Market Segment Q3 2020 and Q3 2021



Source: Wood Mackenzie Power & Renewables and SEIA (Solar Energy Industries Association)
https://www.seia.org/research-resources/solar-market-insight-report-2021-q4

As of the end of 2020, the United States had a total of 100 GWdc of cumulative operating Solar PV capacity.[19] 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[20] for these resources are typically lower than those of the other resources.[21] Per EIA data, in 2020 the nationwide capacity factor for utility scale solar was 24.9%.[22] 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 534.4 MWac (647 MWdc) of solar electric capacity had been installed through the end of the 2021 compliance year, enough to power

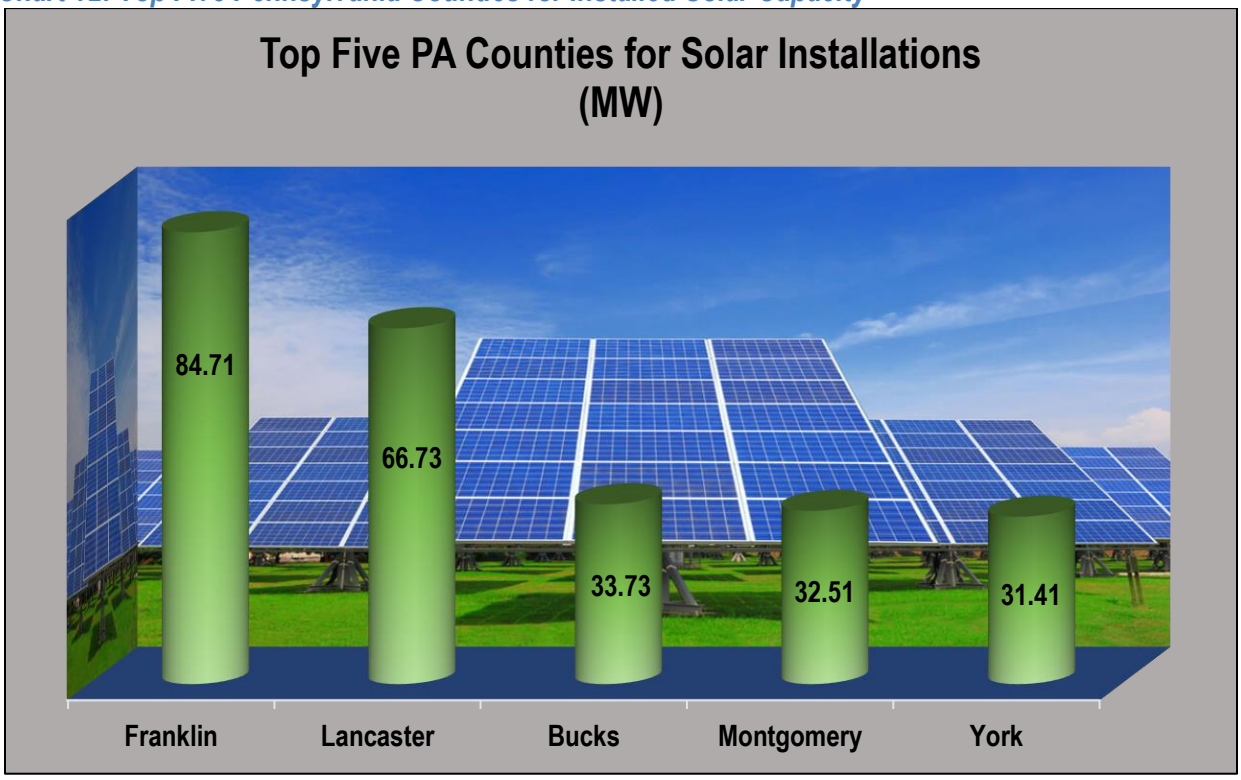
[19] https://www.nrel.gov/docs/fy21osti/80427.pdf
[20] A ratio of the actual power output for a time period to the maximum possible power output if the plant was operating at full name plate capacity for the same time period.
[21] U.S. Energy Information Administration, Electric Generators Report - 2016
[22] https://www.eia.gov/electricity/monthly/archive/june2021.pdf

nearly 70,200 homes.[23] It should be noted that the above number includes only AEPS-certified systems. According to the Solar Energy Industries Association (SEIA), the solar industry has invested $2.4 billion in Pennsylvania, including $368.49 million in 2020.[24]

There was a 38% reduction in solar system installs in Pennsylvania from March through October of 2020, as compared to the average historical installs for the same period from 2017 through 2019. This is presumed to be directly related to complications and challenges associated with COVID-19

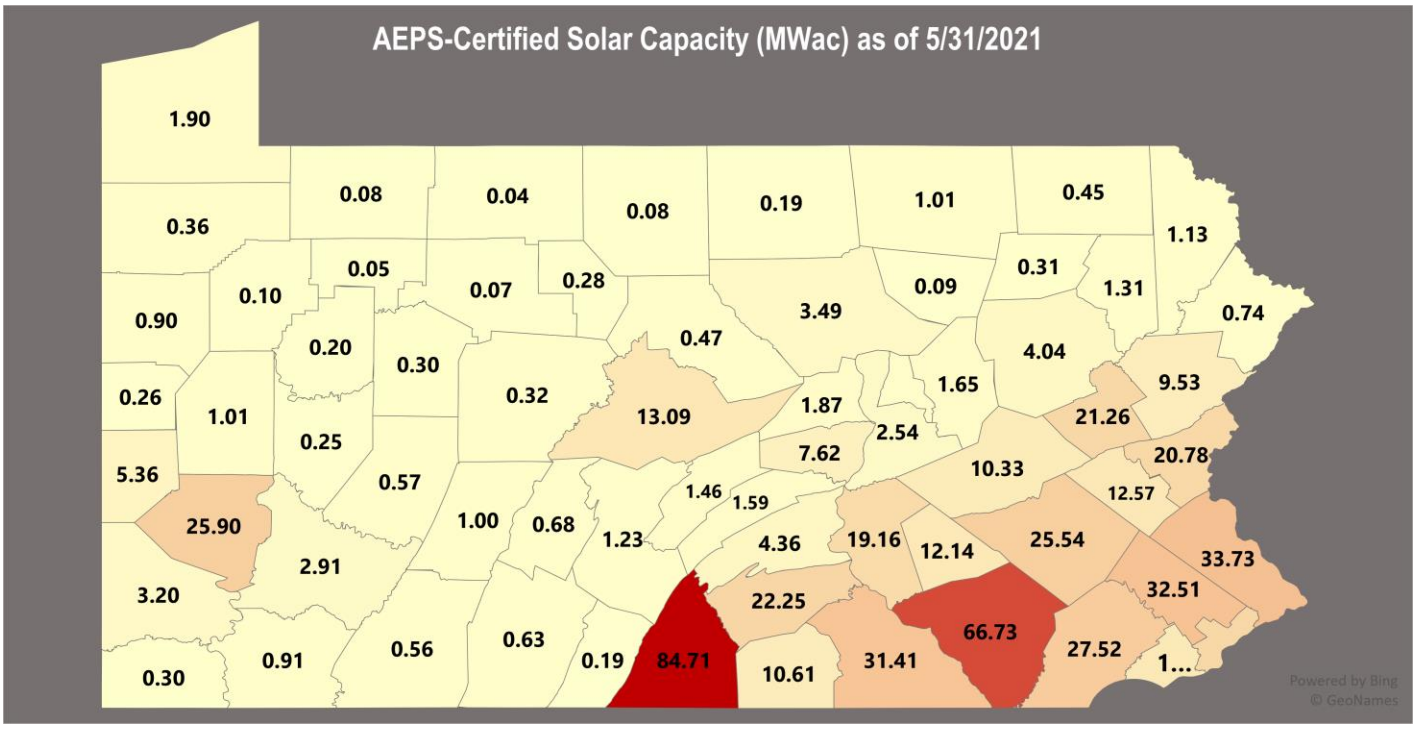
Chart 12 shows the top five Pennsylvania counties for installed solar capacity, as of the end of the compliance year.

Chart 12: Top Five Pennsylvania Counties for Installed Solar Capacity

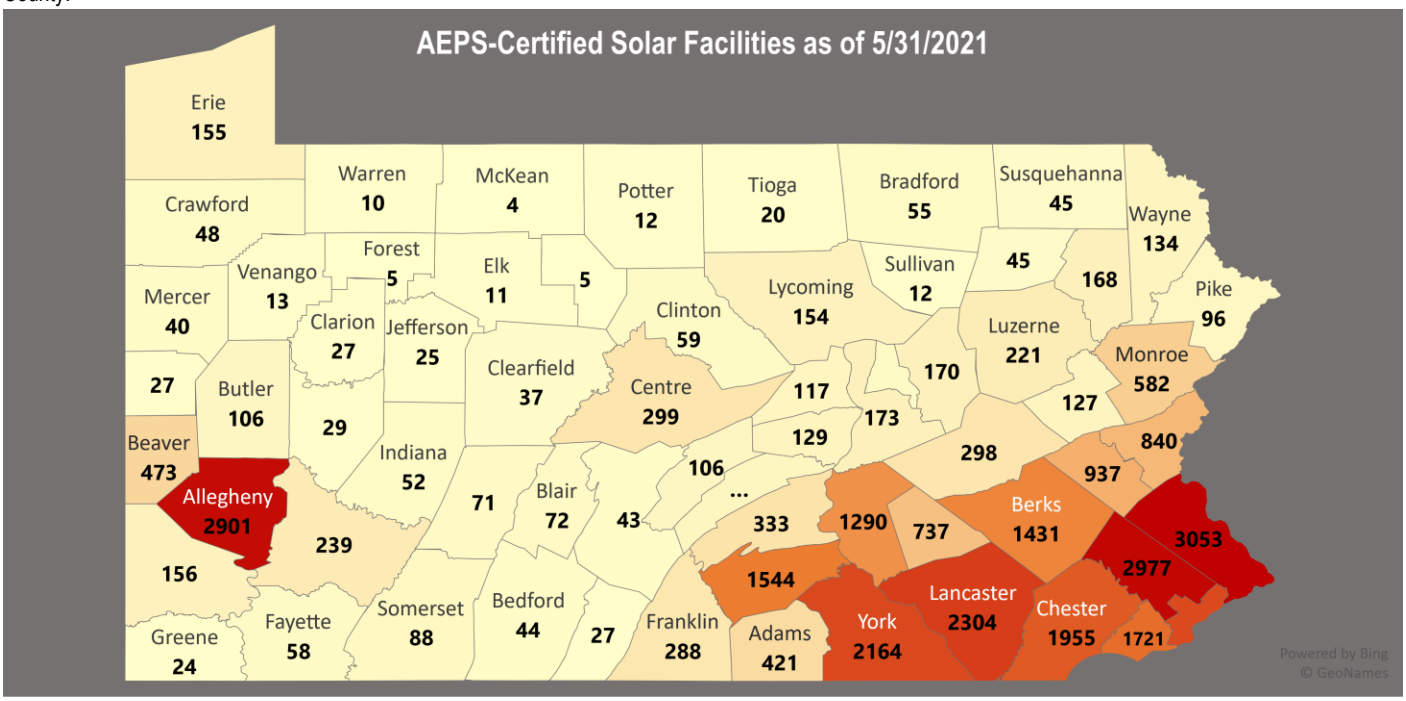


[23] Based on average annual electricity consumption of approximately 10,000 kWh and an average solar capacity factor of 15%.
[24] https://www.seia.org/sites/default/files/2021-12/Pennsylvania%20Solar-Factsheet-2021-Q4.pdf

The following two maps show the AEPS certified solar PV electric generating capacity and the number of facilities, by county, in Pennsylvania, as of the end of the compliance year.



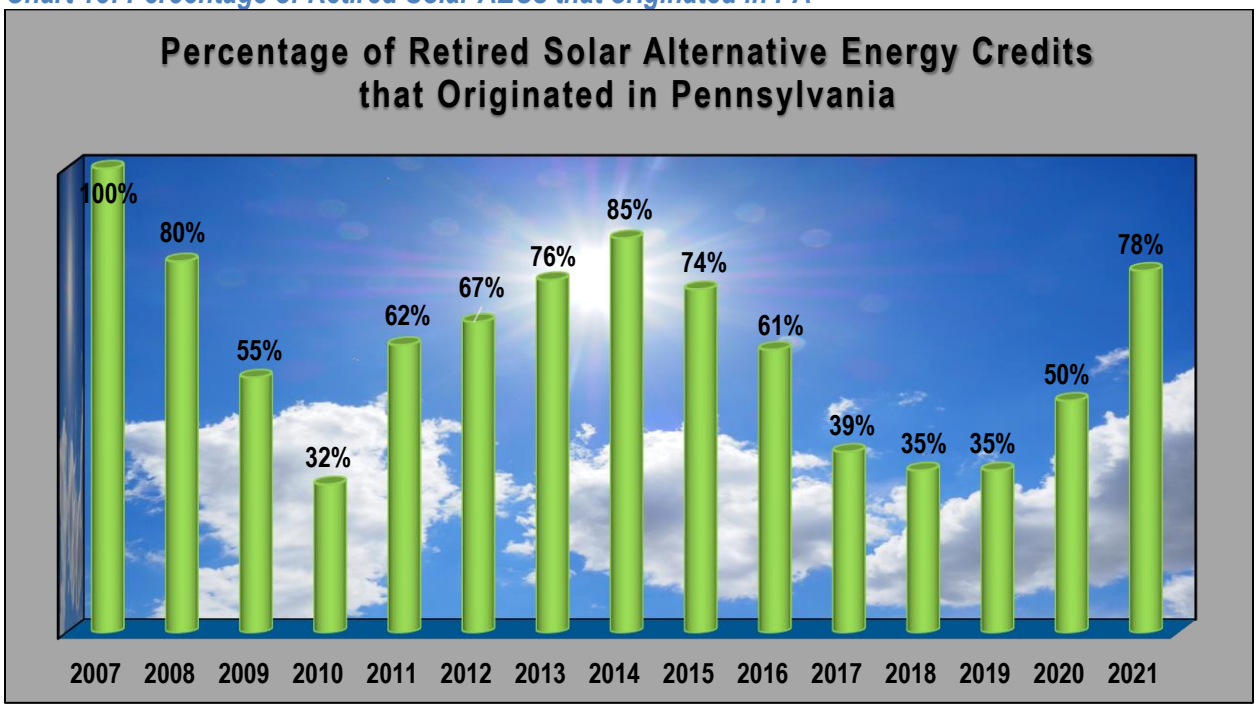
Note: As of 5/31/2021, the AEPS certified solar generation capacity was 11.90 MWac in Delaware County and 21.27 MWac in Philadelphia County.



Note: As of 5/31/2021, Philadelphia County has 2,146 AEPS certified solar generation facilities.

Chart 13 shows the percentage of retired in-state Solar AECs used for AEPS Act compliance. 2021 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 DEP began a 30-month stakeholder engagement and modeling initiative, "Finding Pennsylvania's Solar Future". The resultant plan identifies that, to meet a goal of 10% in-state solar by 2030, approximately 11 GW of solar generation capacity needs to be installed. The final plan: Pennsylvania's Solar Future Plan was released Nov. 2018.[25] The plan includes several recommendations and was provided to the public, the legislature, and the Governor to be used as a guide for policy making. One strategy in the plan recommends increasing the AEPS Solar PV carve-out to between 4% and 8% by 2030. Additionally, the Pennsylvania

[25] https://www.dep.pa.gov/Business/Energy/OfficeofPollutionPrevention/SolarFuture/Pages/Pennsylvania's-Solar-Future-Plan.aspx

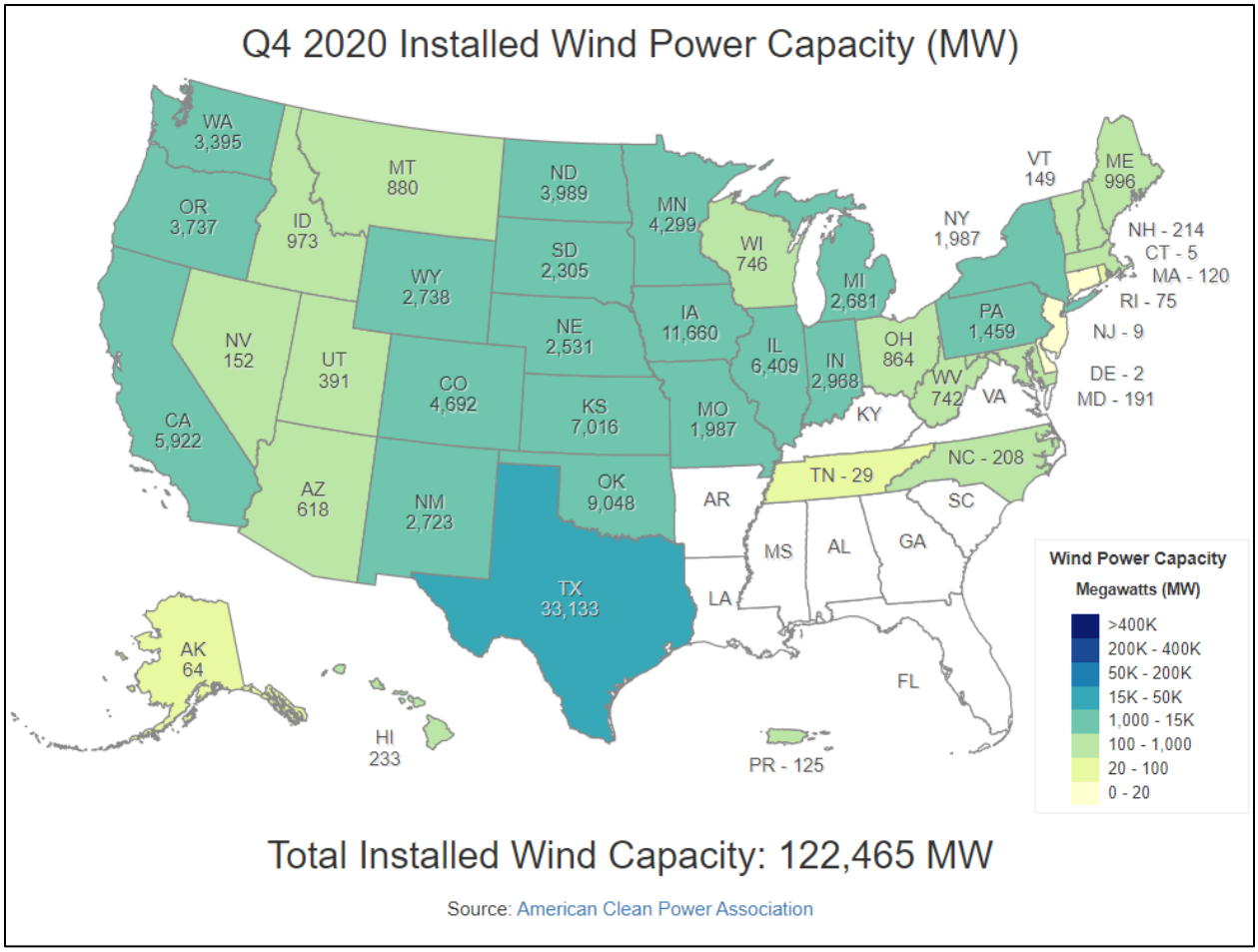
Climate Action Plan, authored by DEP and released in September 2021, recommends increasing AEPS targets to 100 percent by 2050 to meet the Commonwealth's greenhouse gas reduction goal of 80 percent below 2005 emissions levels by 2050[26]. In response to a multi-GW increase in the PJM Queue for solar, the DEP developed a website for solar resources. The website includes information for residential, commercial, and grid-scale solar installations.[27] Grid-scale solar installations are being developed within Pennsylvania, yet many local governments have not established zoning ordinances that specifically address this relatively new form of land use. The DEP is working with the Penn State Cooperative Extension to develop outreach, and resource materials for local governments to better assist them in understanding the various aspects associated with these larger solar projects. Targeted outreach is ongoing and will continue throughout 2022.

B. Wind

In the first nine months of 2021, the United States saw a total of 7.3 GW of wind electricity generation capacity installed. This brings the cumulative installed capacity in the U.S. to 125 GW.[28]

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%.[29] Technological improvements, particularly, increased blade length, contributed to the increased capacity factor. [30]

[26] Pennsylvania Climate Action Plan 2021, https://www.dep.pa.gov/citizens/climate/Pages/PA-Climate-Action-Plan.aspx
[27] https://www.dep.pa.gov/Citizens/solar/Pages/default.aspx
[28] American Clean Power, Wind Power Facts and Statistics | ACP (cleanpower.org) and Clean Power quarterly Report Q3 2021
[29] US Department of Energy, WINDExchange Database https://windexchange.energy.gov/maps-data/332
[30] US Department of Energy, 2016 Wind Technologies Market Report



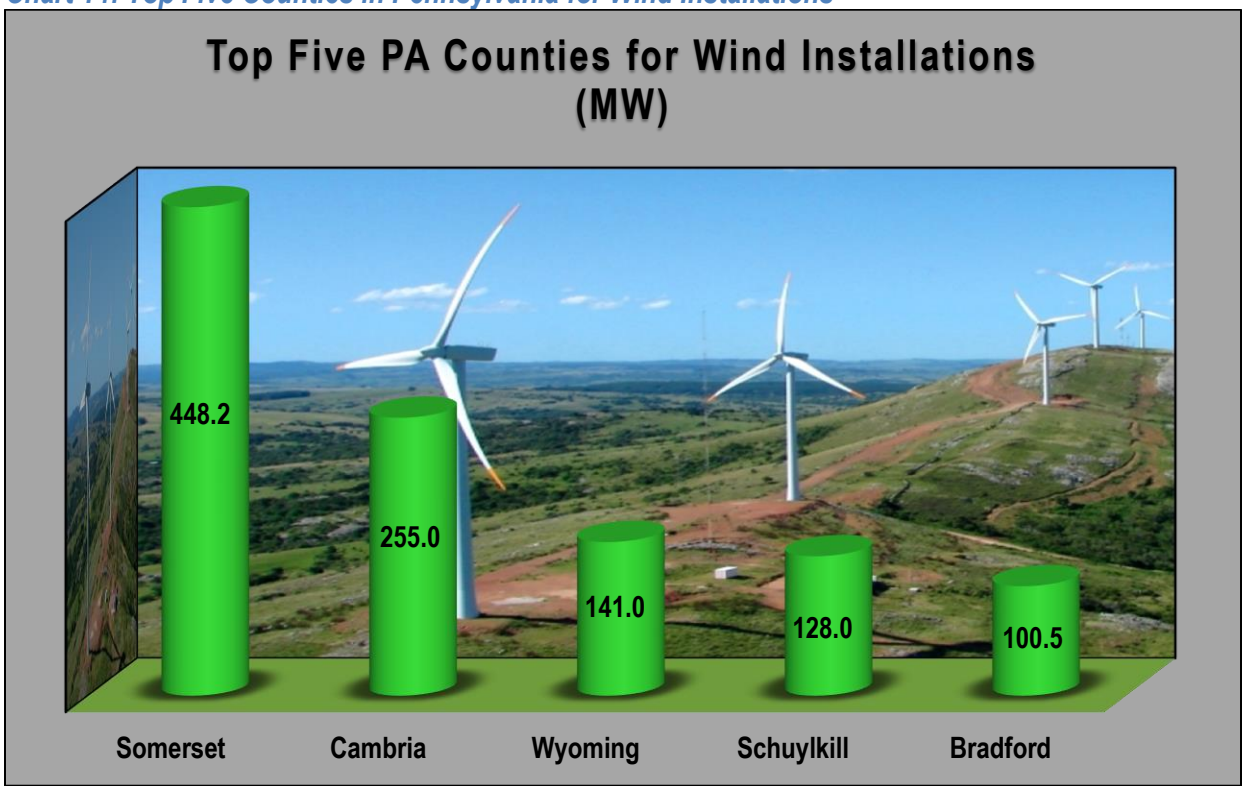
Energy.Gov Office of Energy Efficiency & Renewable Energy[31]

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, 2021, the AEPS-certified installed wind capacity in Pennsylvania is 1,419.5 MW.

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

[31] WINDExchange: U.S. Installed and Potential Wind Power Capacity and Generation (energy.gov)

Chart 14: Top Five Counties in Pennsylvania for Wind Installations



C. Hydropower

The United States has almost 102 GW of installed hydropower capacity; the third largest installed capacity in the world, behind China and Brazil.[32] 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. Most future domestic capacity growth is expected to occur in the form of incremental 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.[33] 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.[34]

[32] International Hydropower Association 2021 Status Report, https://www.hydropower.org/status-report
[33] *2016 International Trade Administration (ITA) Energy Top Markets Report*
[34] *2014 New Stream-reach Development: A comprehensive Assessment of Hydropower Energy Potential in the United States.*

Projects such as these are beginning to take shape in Pennsylvania. The University of Pittsburgh has committed to purchasing 100% of the power output from a 17.8 MW hydropower project being developed at Allegheny Lock and Dam No 2.[35] Similarly, Allegheny County officials have signed a power purchase agreement for a portion of another 17.8 MW hydropower project under development at the Emsworth Lock Main Channel Dam.[36]

As of the end of the 2021 AEPS Act compliance year, Pennsylvania has approximately 2,433 MW of certified hydropower generating capacity of which, 1,540 MW is from pumped storage hydropower projects.

[35] University of Pittsburgh, http://www.news.pitt.edu/news/university-pittsburgh-purchase-local-hydropower
[36] Allegheny County Hydropower, https://alleghenycounty.us/county-executive/allegheny-county-hydropower.aspx

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

This section discusses renewable and alternative energy data trends and generation capacity within Pennsylvania and throughout the PJM region. Specifically, this section compares the amount of renewable and alternative energy generation available 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, and the AEC price trend. 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% (30,064 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 reflect 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

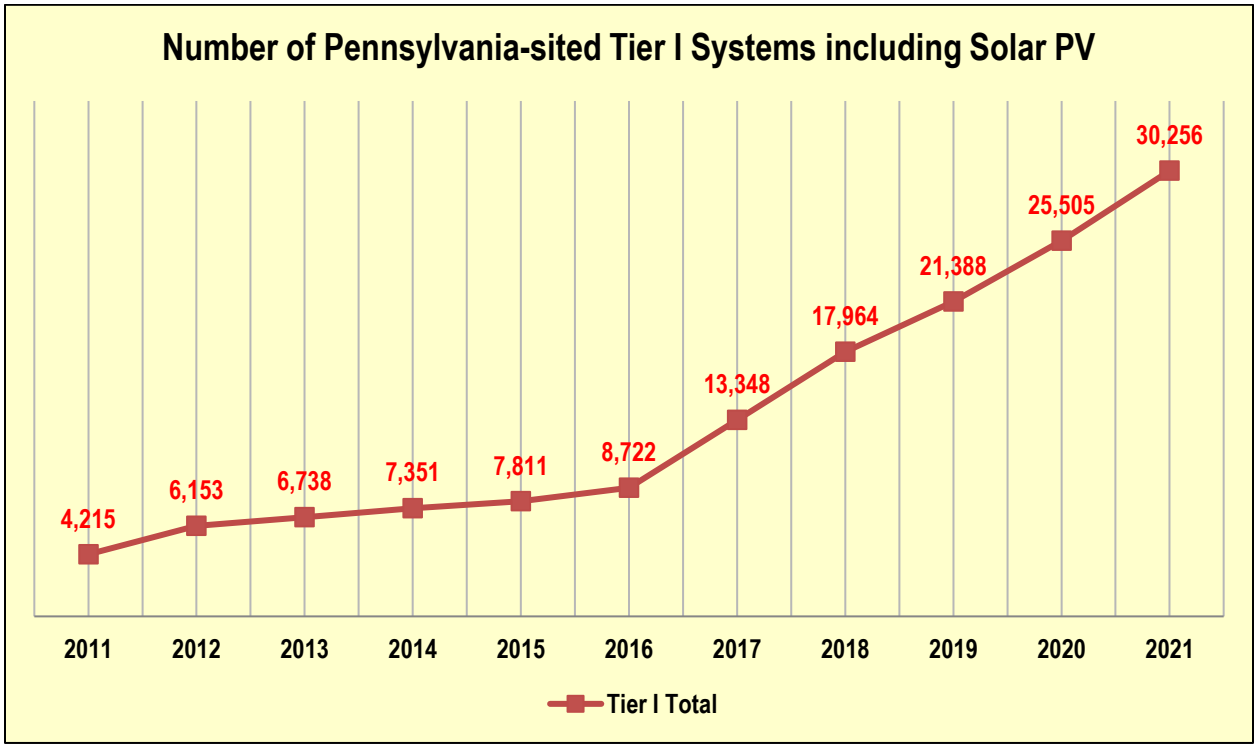
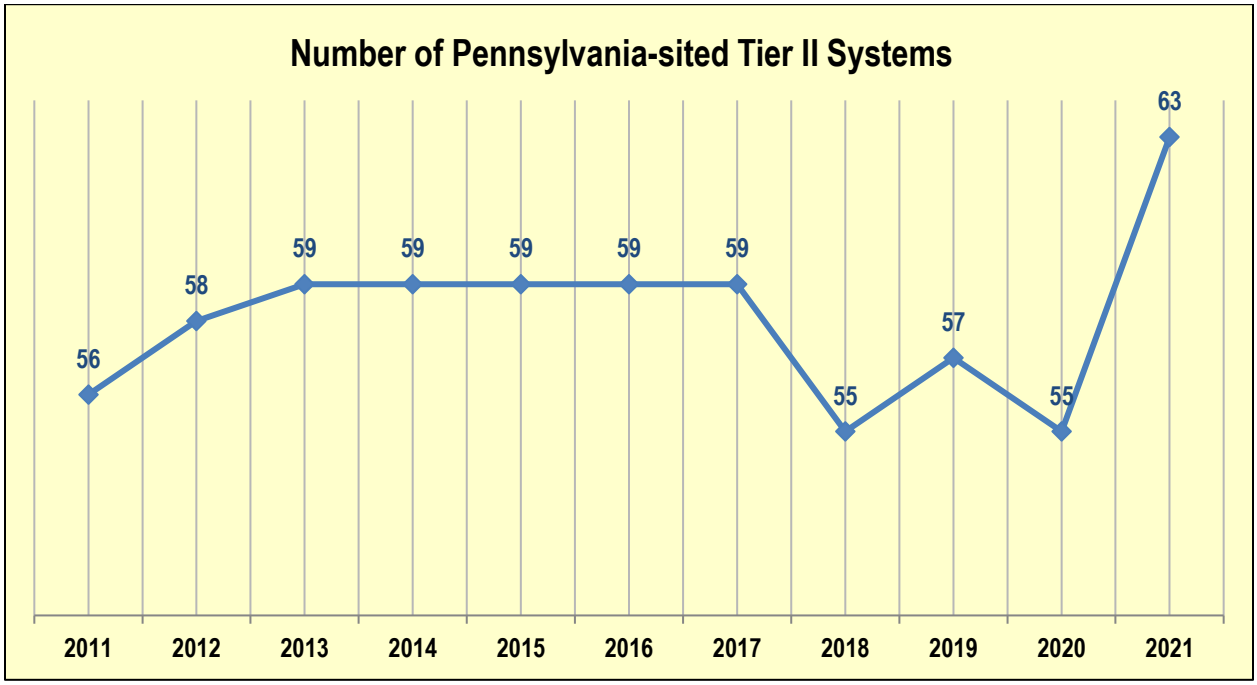


Chart 16: Cumulative Number of In-State Tier II Systems, by Year



Note: *This chart only shows Tier II certified electric generation facilities. It does not include Energy Efficiency and Demand Response certified resources.*

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

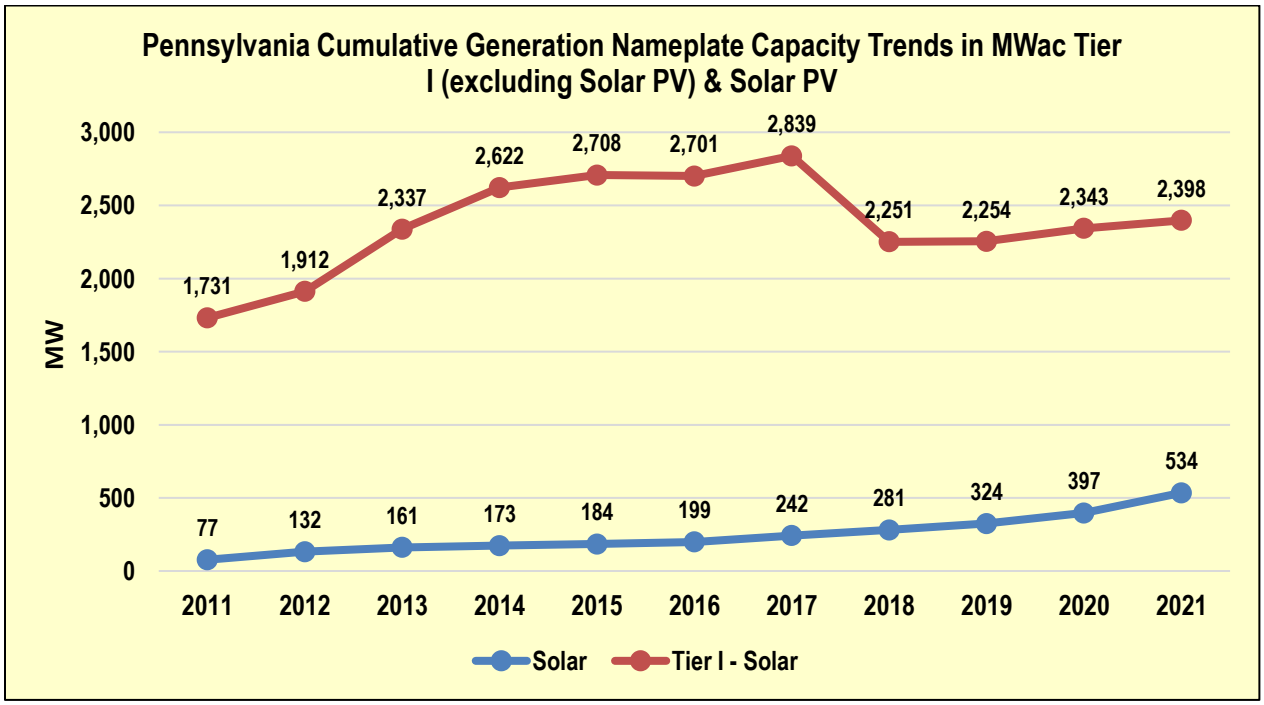
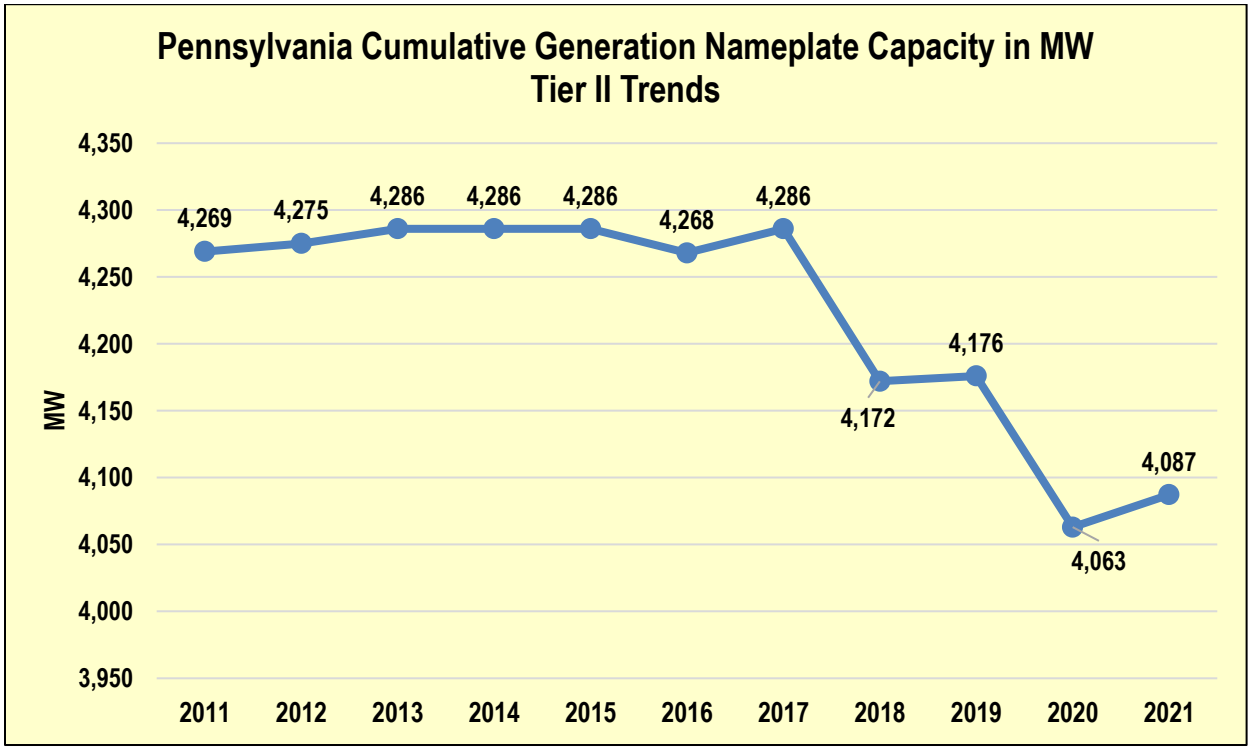


Chart 18: Cumulative Tier II Nameplate Capacity Installed by Year



Charts 19, 20 and 21, on the following pages, provide a comparison of the average annual (compliance year) spot market prices[37] 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.

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

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

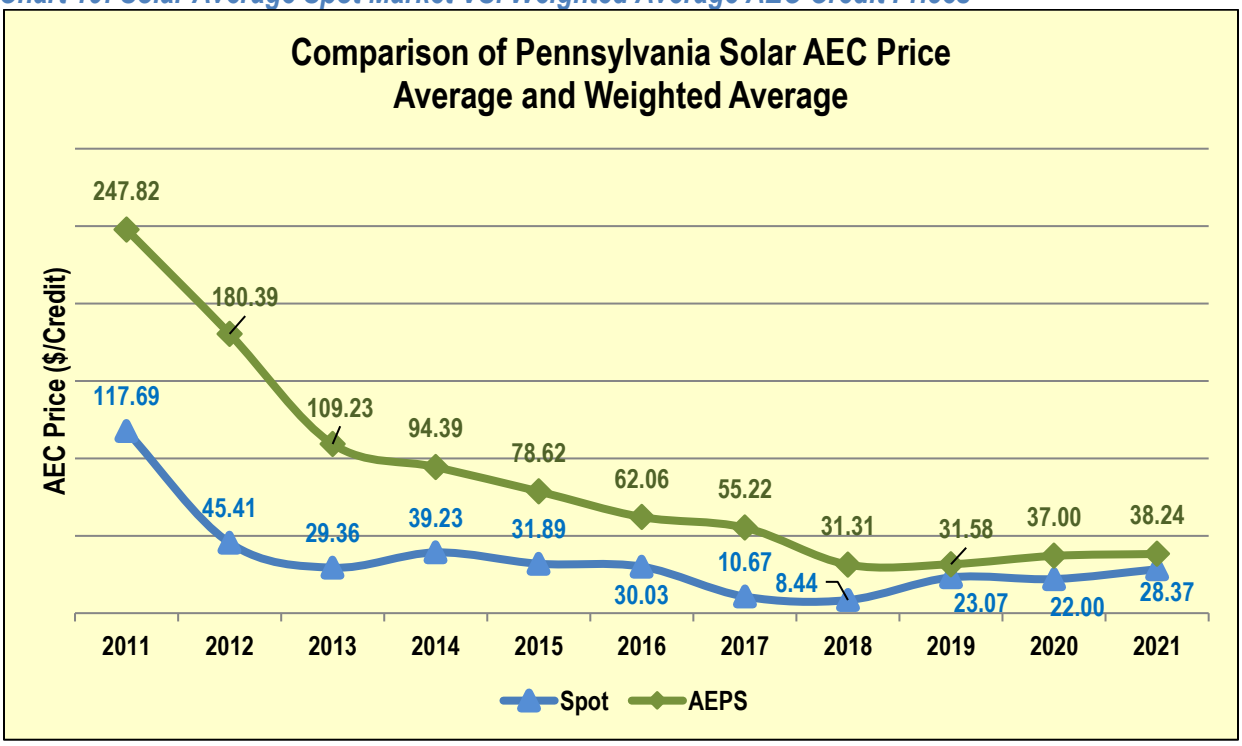


Chart 20: Tier I Average Spot Market vs. Weighted Average AEC Credit Prices

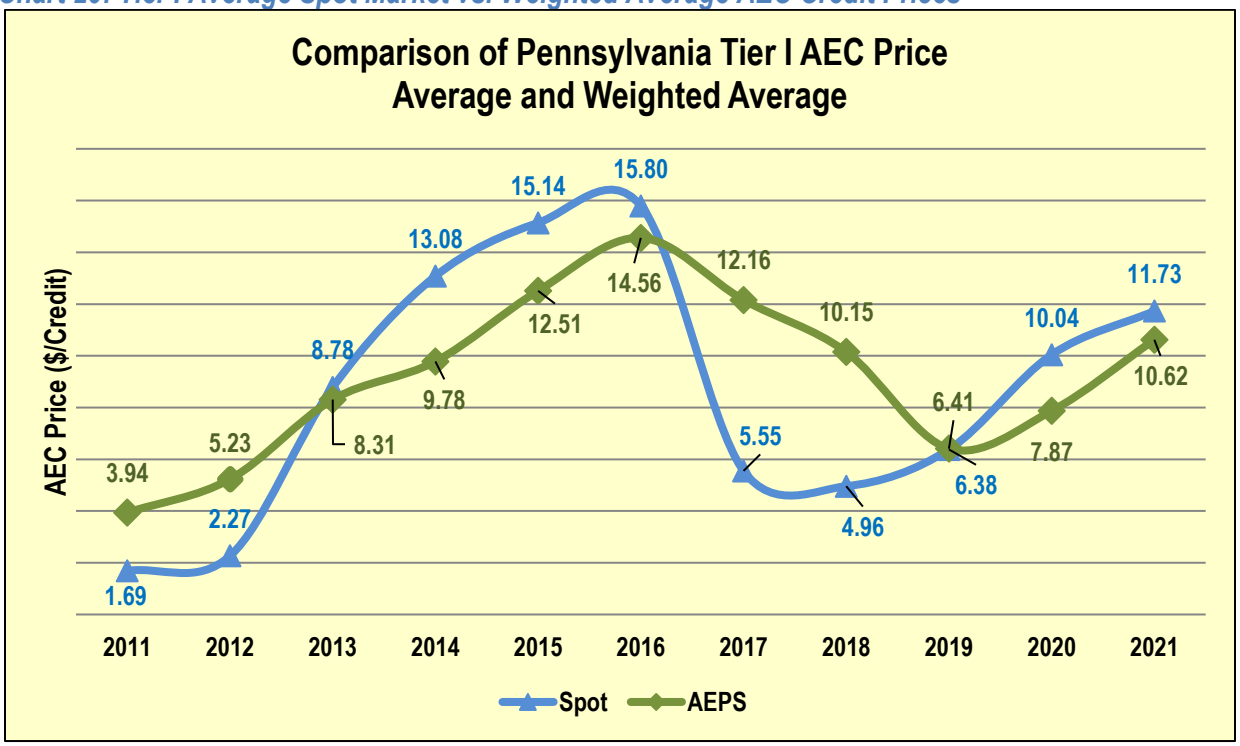
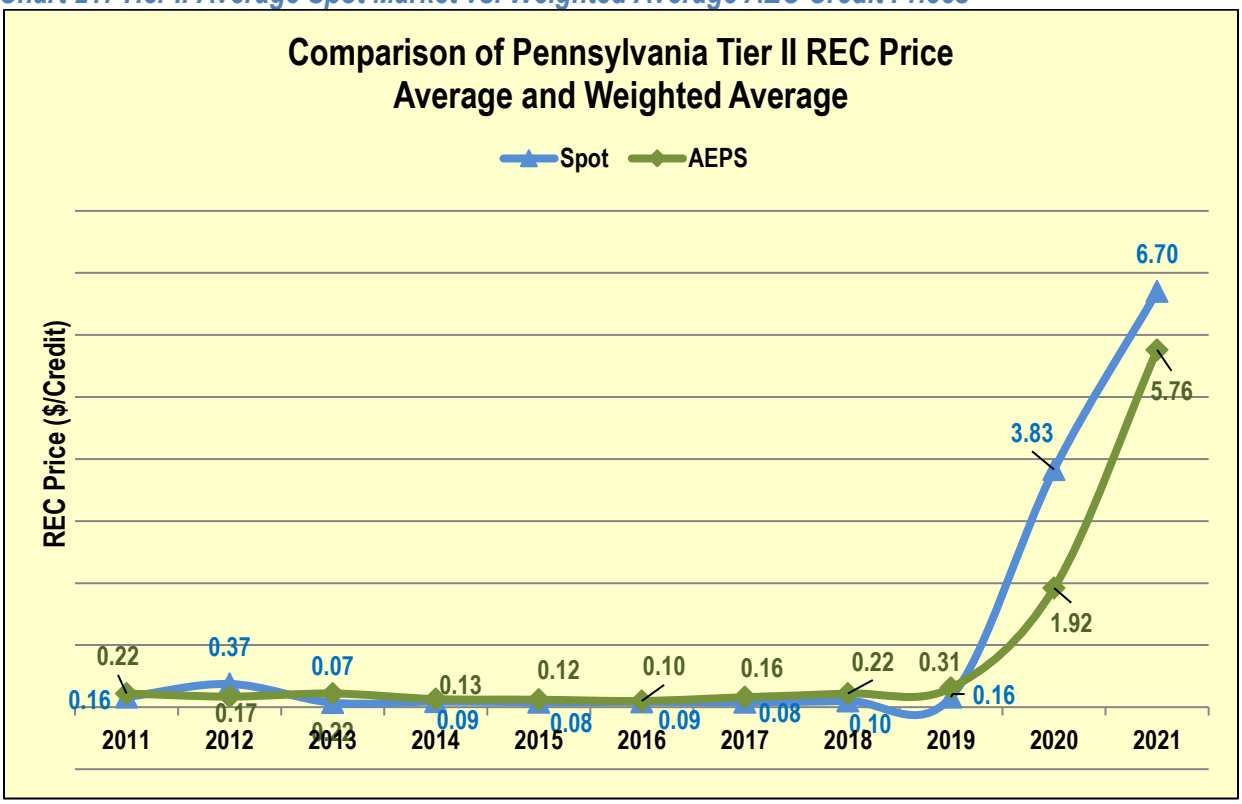


Chart 21: Tier II Average Spot Market vs. Weighted Average AEC Credit Prices



Impact of Act 40 Implementation

Pursuant to the passage of Act 40 and consistent with its Implementation Order[38], the Commission reviewed many petitions and associated contracts that sought 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.

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

Chart 23 shows an estimate of the approved NSTI credits available for use in each compliance year.

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

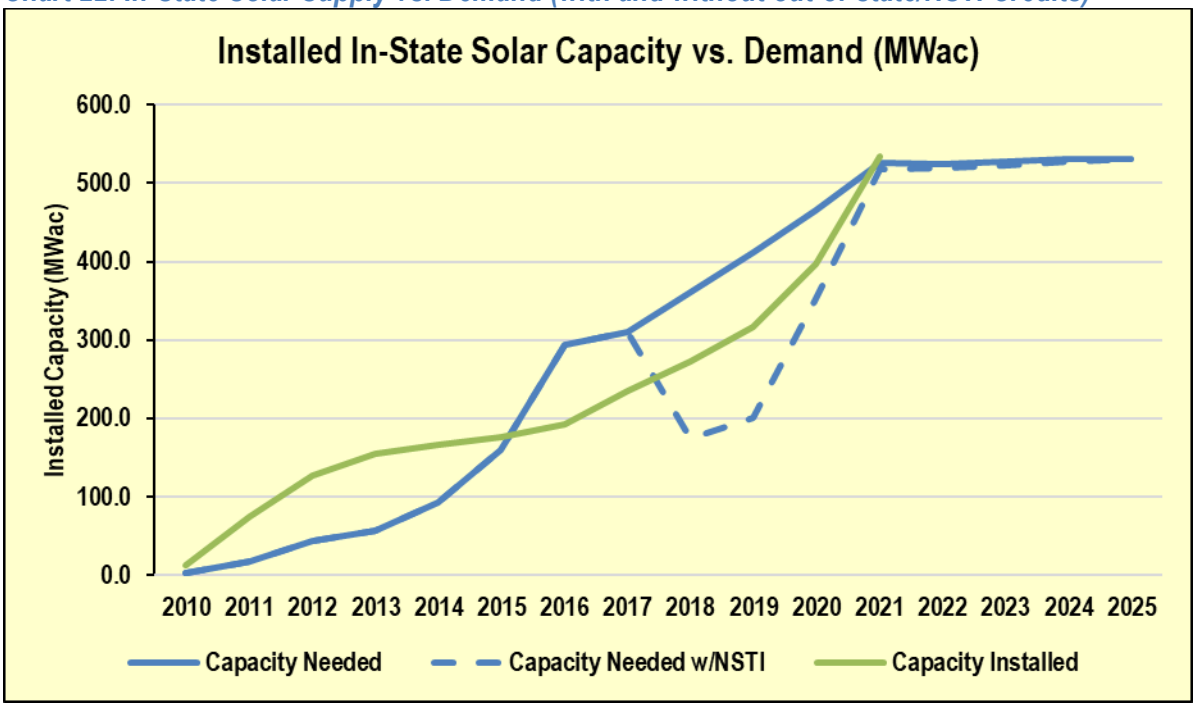
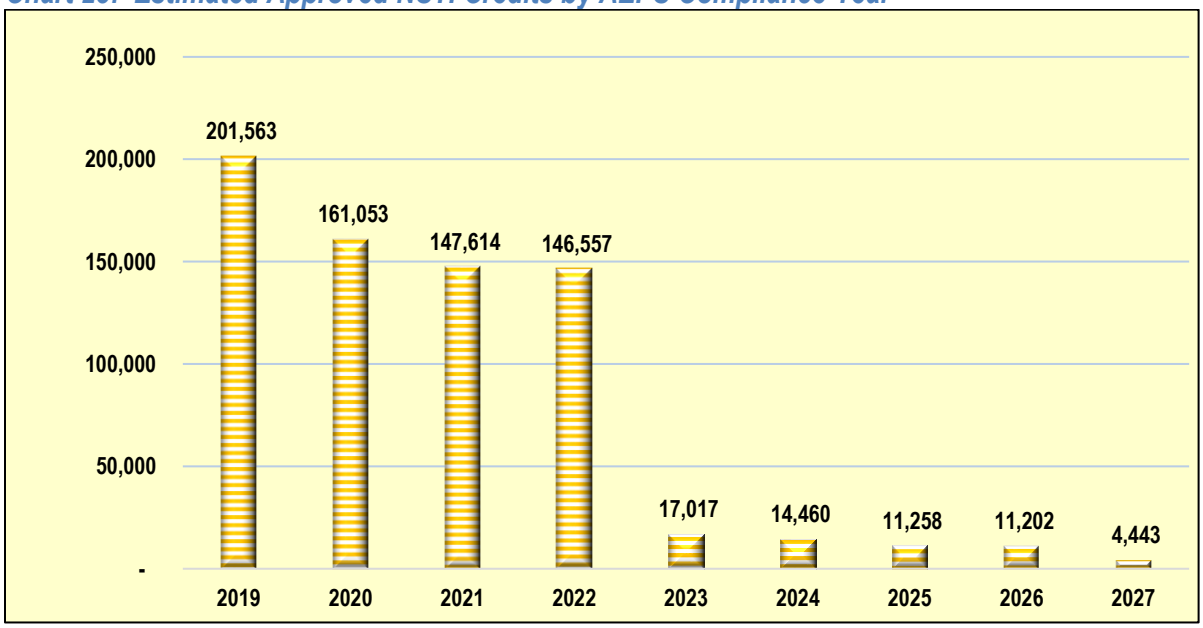


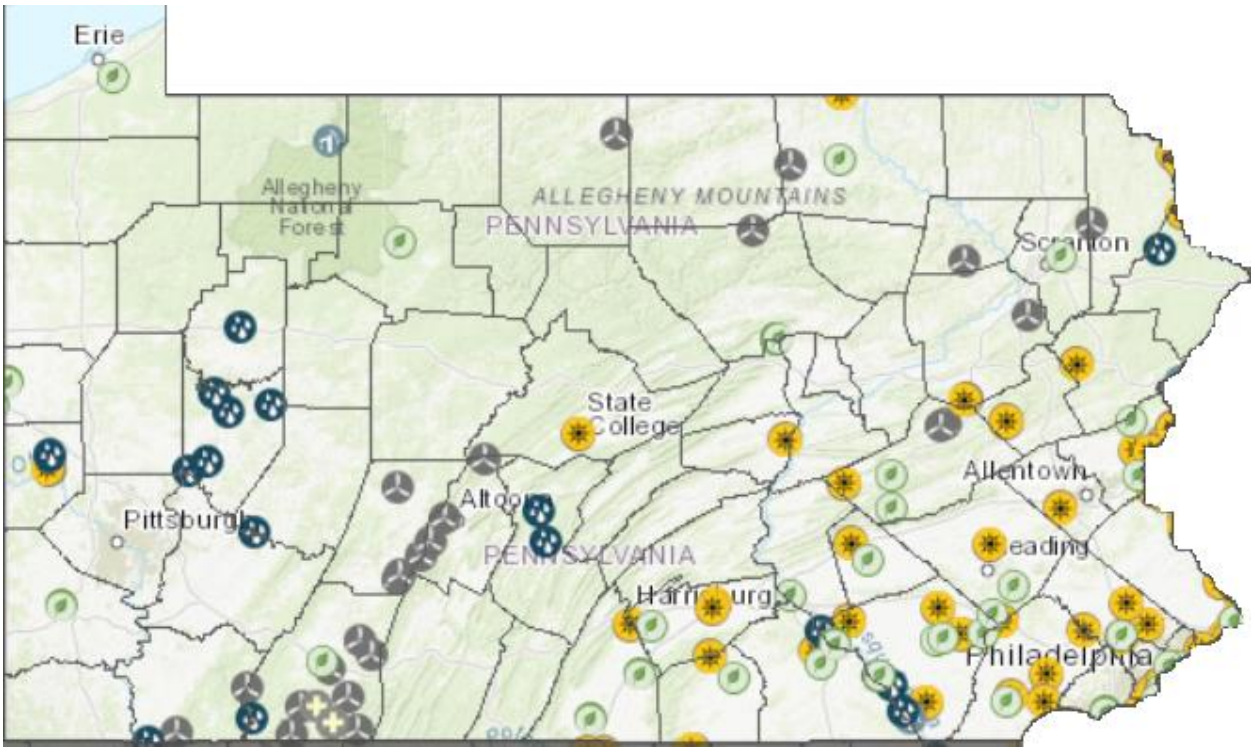
Chart 23: Estimated Approved NSTI Credits by AEPS Compliance Year



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.[39]



The Pennsylvania AEPS website[40] maintains a summary of all AEPS-certified generation facilities and certified energy efficiency and demand-side management (EE/DSM) resources. There were 37,142 certified generation facilities as of May 31, 2021.

Statistics for AEPS-certified generators, as of May 31, 2021, include:

- 30,256 generators (81.5%) are located in Pennsylvania with a total nameplate generating capacity of 7,019.6 MWac.
- 6,886 generators are located outside of Pennsylvania with a total nameplate generating capacity of 19,184.5 MWac.
- 30,064 solar facilities are located in Pennsylvania with a total nameplate generating capacity of 534.4 MWac. This represents 99% of all certified

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

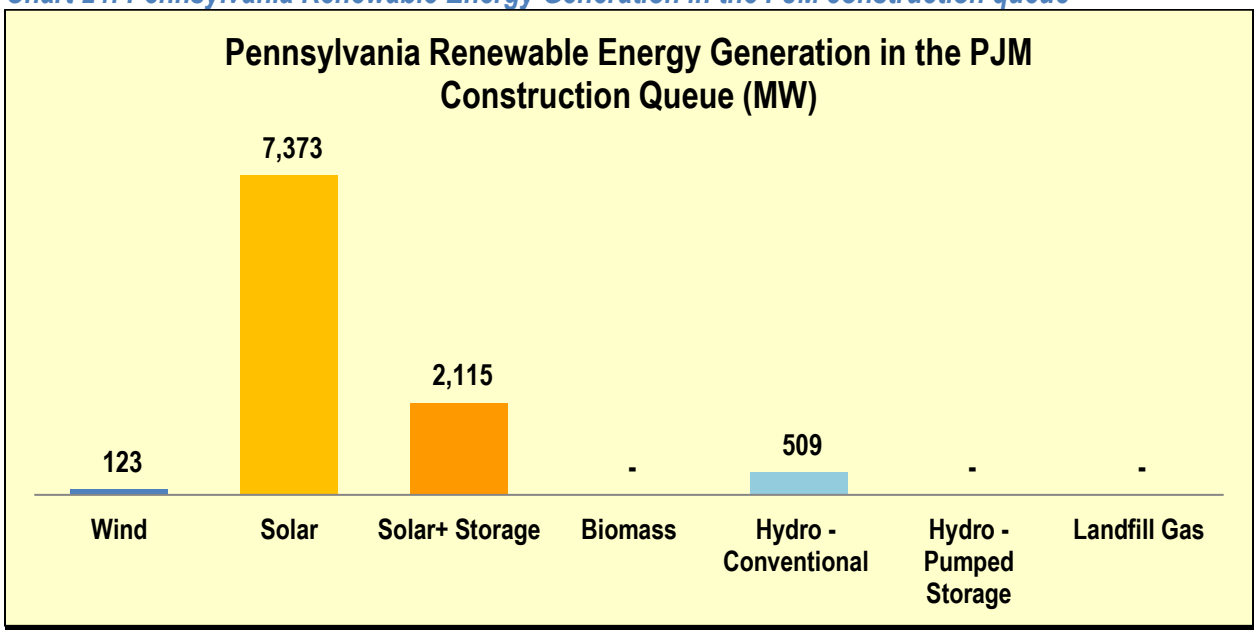
systems located in Pennsylvania but only 7.6% of nameplate generating capacity located in Pennsylvania.

Table 5 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 January 26, 2022, with expected completion dates through third quarter of 2025.[41] Only active projects, projects in engineering and procurement phase and projects under construction are included in this analysis, totaling 10,120 MW of generating capacity. It's also worth noting that among the many projects in the PJM queue, there are several solar signed Power Purchase Agreements (PPAs) totaling more than 820 MWac from several Pennsylvania institutions and businesses. Some of the more significant PPAs were initiated by The Pennsylvania State University, The University of Pittsburgh, The University of Pennsylvania, The City of Philadelphia, SEPTA, and the Commonwealth of Pennsylvania as part of their ongoing commitments 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.

[41] https://www.pjm.com/planning/services-requests/interconnection-queues.aspx

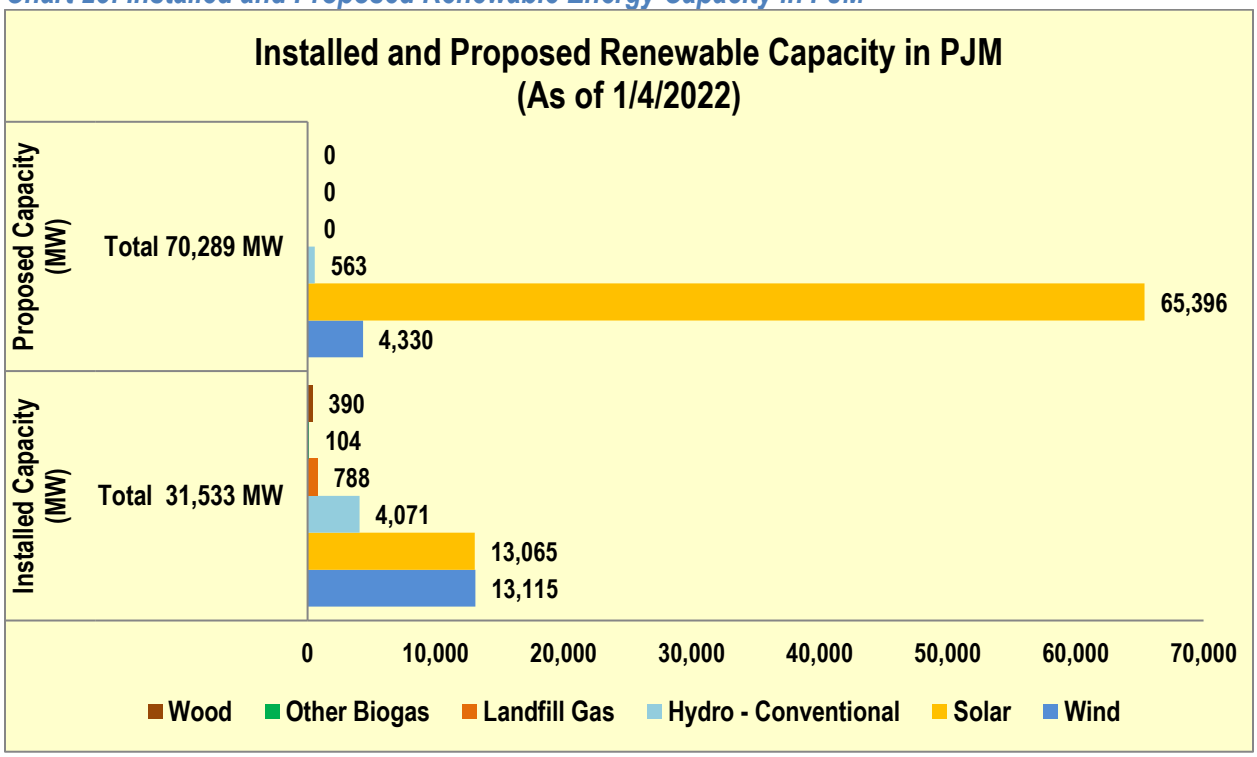
Chart 24: Pennsylvania Renewable Energy Generation in the PJM construction queue



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 and Tier II AECs only from in-state facilities, unless the contracts for NSTI credits and Tier II AECs from out-of-state facilities have been approved by the Commission. Tier I non-solar 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.[42]

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

Chart 25: Installed and Proposed Renewable Energy Capacity in PJM



Note: Solar PV supply includes existing supply and 25% 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.[43]

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

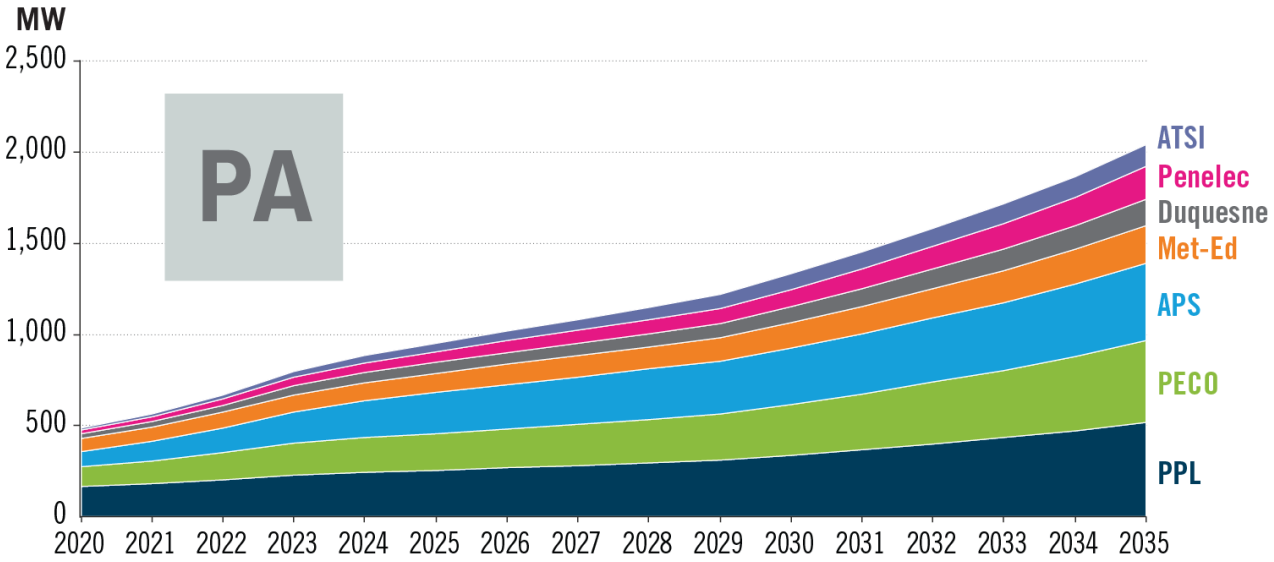
[43] https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx

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, issued May 6, 2021. 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, and in consideration of other state requirements, staff estimates that adequate Solar, Tier I non-solar and Tier II supply exists to meet compliance obligations through 2025. Shortly after the passage of Act 40 there had been some speculation about the availability of in-state solar available to meet AEPS compliance requirements. As Table 6 in Appendix A will show, there should not be any concerns for solar credit availability for AEPS compliance purposes through 2025.

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 26 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 26: PJM's Non-Wholesale Solar Growth Projection for Pennsylvania EDCs



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 into law 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. On May 6, 2021, the Commission issued a Final Implementation Order to effectuate the changes to the AEPS required by Act 114.

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. PJM has been working with stakeholders over the last year to discuss implementation options and is expected to release its tariff filing to implement Order 2222 in early 2022.

Recommendation for the Legislature

On February 17, 2021, the PA Supreme Court summarily affirmed the Commonwealth Court decision in Hommrich v. PUC, invalidating the Commission's regulations at 52 Pa. Code §§ 75.12 (definition of virtual meter aggregation where the Commission added references to independent load) and 75.13(a)(1) to be invalid and unenforceable. Further, the Court found the definitions of "customer-generator" and "utility" in 52 Pa. Code § 75.1 to be invalid and unenforceable pertaining virtual meter aggregation.

Consequentially, the Court's decision is encouraging the development and net metering of 3 MW solar projects that have no electric load but for the project's parasitic load. This presents an enticing business model whereby the developer can reap retail compensation for what is otherwise wholesale merchant generation, but this is done at the expense of increasing costs to the rate-base, which must be recovered via increases to the non-residential customer rate classes. By way of example, the Commission has recently reviewed a 3 MW non-residential solar project that is estimated to have an annual electric load of approximately 2,000 kWh, which is far less than even a small residential customer would use annually and yet the proposed system is expected to sell more than 5.5 million kWh at a retail rate, net metering 275,000% of the load. The result will likely net the owner of the project more than $500,000 per year. The continued proliferation of masked wholesale generation, such as in this example, will negatively impact non-residential customer rates. The Commission therefore recommends that the General Assembly consider modifying the structure of net metering by placing reasonable bounds to curb excessive wholesale generation from being compensated at retail rates.

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%
16	Each reporting year after May 31, 2021	8.00%	0.5000%	7.5000%	10.00%

Table 2: 2021 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				
136,669,240	Solar	0.5	681,081	$38.24	$26,043,046.42	2,572
	I	7.5	10,615,925	$10.62	$112,699,605.90	51,854
	II	10.0	13,601,009	$5.76	$78,374,259.11	66,444
	Total	18.0	24,898,015	N/A	$217,116,911.43	120,870

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.

Table 3: 2021 AEPS Compliance Report by EDC Service Territory[44,45]

Distribution Service Territory	Total Energy Sold (MWhs)	Alternative Energy Requirement	Credits Required	Credits Retired[46]	Compliance Status[47]	
					ACPs Required	Met 🟢 / Unmet 🚫
Citizens' Electric and EGS	163,731					
Solar		0.500%	819	819		🟢
Tier I (non-solar)		7.804%	12,777	12,777		🟢
Tier II		10.000%	16,373	16,373		🟢
Duquesne Light and EGSs	12,198,886					
Solar		0.500%	60,994	60,791	✓	🚫
Tier I (non-solar)		7.804%	951,995	948,884	✓	🚫
Tier II		10.000%	1,219,889	1,215,282	✓	🚫
Met Ed and EGSs	14,192,119					
Solar		0.500%	70,961	70,963		🟢
Tier I (non-solar)		7.804%	1,107,545	1,101,182	✓	🚫
Tier II		10.000%	1,419,212	1,410,945	✓	🚫
PECO and EGSs	35,886,555					
Solar		0.500%	179,433	178,711	✓	🚫
Tier I (non-solar)		7.804%	2,800,568	2,789,170	✓	🚫
Tier II		10.000%	3,588,655	3,573,961	✓	🚫
Penelec and EGSs	13,154,265					
Solar		0.500%	65,771	65,773		🟢
Tier I (non-solar)		7.804%	1,026,552	1,023,193	✓	🚫
Tier II		10.000%	1,315,427	1,310,455	✓	🚫
Penn Power and EGSs	4,220,085					
Solar		0.500%	21,100	21,099		🟢
Tier I (non-solar)		7.804%	329,333	327,114	✓	🚫
Tier II		10.000%	422,008	419,170	✓	🚫

[44] The data reported for each Distribution Service Territory is aggregated for the EDC and all EGSs that served customers in that territory.
[45] The Tier I (non-solar) percentage requirement includes the quarterly adjustment.
[46] 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.
[47] Two EGSs, Entrust Energy East, Inc. and Liberty Power holdings, LLC failed to meet their 2021 AEPS obligations.

Distribution Service Territory	Total Energy Sold (MWhs)	Alternative Energy Requirement	Credits Required	Credits Retired[46]	Compliance Status[47]	
					ACPs Required	Met 🟢 / Unmet 🚫
Pike County and EGSs	73,449					
Solar		0.500%	367	367		🟢
Tier I (non-solar)		7.804%	5,732	5,733		🟢
Tier II		10.000%	7,345	7,345		🟢
PPL and EGSs	36,756,478					
Solar		0.500%	183,782	182,566	✓	🚫
Tier I (non-solar)		7.804%	2,868,456	2,849,900	✓	🚫
Tier II		10.000%	3,675,648	3,651,624	✓	🚫
UGI Electric and EGSs	1,011,043					
Solar		0.500%	5,055	4,950	✓	🚫
Tier I (non-solar)		7.804%	78,901	77,261	✓	🚫
Tier II		10.000%	101,104	99,001	✓	🚫
Wellsboro Electric and EGSs	103,180					
Solar		0.500%	516	516		🟢
Tier I (non-solar)		7.804%	8,052	8,052		🟢
Tier II		10.000%	10,318	10,318		🟢
West Penn Power and EGSs	18,909,449					
Solar		0.500%	94,547	94,526	✓	🚫
Tier I (non-solar)		7.804%	1,475,683	1,472,659	✓	🚫
Tier II		10.000%	1,890,945	1,886,535	✓	🚫

[44] The data reported for each Distribution Service Territory is aggregated for the EDC and all EGSs that served customers in that territory.
[45] The Tier I (non-solar) percentage requirement includes the quarterly adjustment.
[46] 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.
[47] Two EGSs, Entrust Energy East, Inc. and Liberty Power holdings, LLC failed to meet their 2021 AEPS obligations.

Table 4: AEC State of Origin – Retired for Compliance in 2021

State	Solar		Tier I		Tier II		Total Credits Retired	% of Total Credits Retired
	Retired	%	Retired	%	Retired	%		
PA	532,736	78.2%	2,163,338	20.4%	8,353,092	61.4%	11,049,167	44.4%
VA			2,662,742	25.1%	3,713,874	27.3%	6,376,616	25.6%
IL			1,751,596	16.5%			1,751,596	7.0%
WV			695,259	6.5%	839,976	6.2%	1,535,235	6.2%
NC	138,679	20.4%	1,342,924	12.7%	381	0.0%	1,481,984	6.0%
OH	9,666	1.4%	834,138	7.9%	210,732	1.5%	1,054,536	4.2%
IN			1,020,934	9.6%			1,020,934	4.1%
NJ			16,393	0.2%	273,154	2.0%	289,547	1.2%
MD			27,901	0.3%	169,360	1.2%	197,261	0.8%
KY			58,290	0.5%	40,440	0.3%	98,730	0.4%
DE			27,311	0.3%			27,311	0.1%
DC			15,051	0.1%			15,051	0.1%
TN			30	0.0%			30	0.0%
MI			18	0.0%			18	0.0%
Total	**681,081**		**10,615,925**		**13,601,009**		**24,898,017**	**100%**

Table 5: 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	392.8	1,122.4	1,515.2
	Black Liquor	163.7	0.0	163.7
I	Coal Mine Methane* (primary fuel source)	0.0	0.0	0.0
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	192.7	2.2	194.9
I	Biologically Derived Methane Gas			
	Other Biomass Gas	3.3	0.0	3.3
	Anaerobic Digester Gas (primary fuel source)	15.0	19.7	34.7
	Anaerobic Digester Gas (secondary fuel source)	0.0	0.0	0.0
	Landfill Gas (primary fuel source)	210.2	381.6	591.8
	Landfill Gas (secondary fuel source)	0.0**	0.0	0.0
I	Solar PV	534.4	2,551.4	3,085.8
I	Wind	1,419.5	8,340.9	9,760.4
I	**TOTAL of Tier I**	**2,932.4**	**12,506.2**	**15,438.6**
II	Biomass Energy			
	Cellulosic (woody) Biomass	0.0	126.5	126.5
	Black Liquor	0.0	367.9**	367.9
II	Distributed Generation	26.1	0.0	26.1
II	Hydropower			
	Conventional, Non-Low Impact	700.5	1,191.8	1,892.3
	Pumped Storage	1,540.0	4,042.0	5,582.0
II	Municipal Solid Waste	256.8	202.2	459.0
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	62.5	0.0	62.6
	Industrial By-product	0.0	0.0	0.0
II	Waste Coal	1356.4	681.0	2,037.4
II	**TOTAL of Tier II**	**4,087.2**	**6,678.4**	**10,765.5**
I & II	**TOTAL of Tiers I & II**	**7,019.6**	**19,184.6**	**26,204.1**

* 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 6A: Estimated Need and Availability of AECs for AEPS Solar Compliance: 2022 – 2025[48]

Year	Estimated Credits Required	Estimated In-state Credits Created	Estimated Banked Solar Credits Available	Estimated NSTI Credits Available	Estimated Total Supply of Available Credits
2022	690,044	562,369	746,249	146,557	1,455,175
2023	693,993	621,550	626,805	17,017	1,265,372
2024	697,993	681,036	571,379	14,460	1,266,875
2025	702,043	740,523	568,882	11,258	1,320,663

Table 6B: Estimated Nameplate Solar Capacity Buildout: 2022 – 2025[49]

Year	Estimated Capacity Required w/o Banked & NSTI Credits (MWac)	Estimated Installed Capacity (MWac)
2022	510	595
2023	512	655
2024	515	715
2025	518	775

[48] Assumes an annual average build rate of 60 MW/yr installed. Calculations also acknowledge that GATS currently reflects 14.54 MW of AEPS-registered solar capacity is inactive (not reporting generation for credit creation).
[49] Assumes an average annual buildout rate of 60 MW per year.

Table 7: 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, 2019
Act 114 of 2020	Nov. 23, 2020
Final Implementation Order – Implementation of Act 114 of 2020	May 6, 2021

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.[50]

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.[51]

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;

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

vi. Was completed after Feb. 28, 2005.

Solar Photovoltaic (PV)

A Solar PV System[52] 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[53] 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.

[52] Solar Photovoltaic Technology Basics at www.energy.gov
[53] 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