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Economic and Environmental Impact of Governor Shapiro's "30 x 30" Alternative Energy Pledge

Gabel Associates, Inc.
2001 Market Street
Philadelphia, Pennsylvania
417 Denison Street
Highland Park, New Jersey
(732) 296-0770
gabelassociates.com

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EXECUTIVE SUMMARY

Gabel Associates, Inc. (Gabel) was engaged by MAREC Action (informally, "Mid-Atlantic Renewable Energy Coalition"), American Clean Power Association (ACP), and Advanced Energy United to provide an independent analysis that explains and quantifies the economic benefits associated with an increase to the Pennsylvania Alternative Energy Portfolio Standard (AEPS) consistent with Governor Shapiro's 30% AEPS by 2030 (30 x 30). The analysis is based on the framework provided for in House Bill 1467 (HB1467). Although this report specifically refers to "HB1467" throughout, similar AEPS plans would likely produce similar costs and benefits.

The analysis presented in this Report can provide clarity and guidance as Pennsylvania evaluates the costs and benefits of HB1467 and the development of increased renewable energy that can be promoted and stimulated by the Governor's 30 x 30 pledge.

Gabel is a well-respected energy consulting firm with offices in Pennsylvania and New Jersey that has provided specialized analytical services, economic analysis, and regulatory support across the country for more than 30 years. The firm frequently analyzes the impacts of current and proposed state and federal policies in relation to renewable energy, energy efficiency, electric vehicles, and more. The firm lives in both the world of policy analysis and commercial project development, giving it specialized insight into the feasibility and impact of proposed energy policy. The firm has been extensively involved in the development of energy policy and energy projects and markets in the Commonwealth of Pennsylvania.

The AEPS is a requirement in Pennsylvania law that created a market mechanism to increase demand for renewable energy and other preferred energy production technologies. It requires all electricity suppliers to include specified percentages of renewable energy in their supply mix. It, along with similar policies elsewhere, has enabled the Commonwealth and many other states to increase the development of renewable energy and other preferred energy generation technologies and to foster economic activity and job creation.

Currently, the Pennsylvania AEPS has a requirement that electric suppliers include 8% of Tier 1 resources (solar photovoltaic, solar thermal energy, wind power, low-impact hydropower, geothermal energy, biologically derived methane gas, generation of electricity utilizing wood processing by-products, biomass energy, and coal mine methane) in their supply mix, which includes 0.5% of in-state solar. HB1467 proposes to increase this Tier 1 requirement to 30% by 2030, including the following requirements:

1) 14% carve-out for in-state solar, comprised of the following:
    a. 8% for utility solar
    b. 4% for distributed solar

c. 2% for community solar

2) 16% for Tier 1 resources which can be sourced from in or out-of-state.

This report (Report) provides a comprehensive analysis of the estimated benefits and costs to the Commonwealth which will be realized by the enactment of HB1467.

To provide a comprehensive view of the impacts of HB1467, the following four (4) categories of benefits and costs were analyzed:

1. Ratepayer Costs
2. Ratepayer Benefits
3. Economic Benefits and Job Creation
4. Environmental Benefits

Methodology

This Report uses widely accepted methods and models to estimate the full range of direct, indirect, and induced impacts that will be realized across Pennsylvania. An overview of the approach utilized for each cost and benefit is described below:

- **Ratepayer costs** result from the increased renewable purchase requirements of HB1467. Ratepayers will bear the full cost of meeting the increased renewable purchases associated with the HB1467 requirements. These costs were estimated in a conservative manner to determine the maximum ratepayer exposure. Actual compliance costs will most likely be less than the levels in this analysis.

- **Ratepayer benefits** include reduced wholesale energy prices which occur through the merit order effect, customer-generator energy savings, and direct wholesale energy savings from renewable energy power purchase agreements (PPAs).

  The merit order effect reduces wholesale market prices and creates ratepayer benefits because renewable energy (which has no fuel cost) enters the supply stack in the grid at the "bottom" of the stack and prevents higher cost generation from being dispatched. Since the highest cost resource sets the wholesale market price, energy prices are reduced as a result of the additional renewable energy development caused by HB1467.

- **Economic benefits** result from the increased level of investment and related expenditures to construct and operate the new renewable projects that will be developed to meet the increased AEPS. These investments lead to increases in

Pennsylvania's gross state product (GSP) and in jobs created in the state. These direct, indirect, and induced economic impacts were estimated using IMPLAN, a well-regarded economic model that is widely utilized by state and federal agencies and businesses across the country.

- **Environmental benefits** include the health and economic benefits resulting from reductions in fossil fuel emissions: CO_2, SO_2, NO_X, and PM2.5. Reductions in emissions will improve health outcomes throughout the Commonwealth, with notable benefits to urban communities, and will support efforts to fight climate change.

  These benefits can be stated on a dollar-value basis using widely accepted studies conducted by the U.S. Environmental Protection Agency (USEPA) and the U.S. Interagency Working Group (USIWG) on the Social Cost of Greenhouse Gases. As with job creation, these benefits do not impact retail electric customer bills, rather they benefit all who work and live in Pennsylvania.

Consistent with the term of HB1467, the analysis assumes that the 30% pledge is satisfied with projects completed by the end of calendar year 2030 (part or energy year 2031). As such, the IMPLAN economic analysis covers energy years 2024 through 2031. Although load growth in Pennsylvania will require additional renewable energy capacity in the future, the economic benefits of these incremental projects are not included in this analysis.

After this initial construction period, the AEPS maintains its 30% Tier 1 requirements, continuing to provide Pennsylvania with economic and environmental benefits. To identify these ongoing ratepayer and environmental benefits, the HB1467 costs and benefits analysis extends to cover EY 2024 through 2035.

Summary of Results

Unless otherwise stated, costs and benefits are reported in 2023 dollars. The results in this report assume 2.0% for future inflation and use a 6.0% discount rate for net present value (NPV) calculations.

The low program price caps (via Alternative Compliance Payment prices) mean that, at most, the average ratepayer impact will be $3.43 per month ($41.18 per year, a 2.2% increase) for a typical residential customer using 885 kWh/Month[1] during the 2024-2035 forecast period. In other words, the Alternative Compliance Payment (ACP) policy itself prevents average

[1] https://www.eia.gov/electricity/data/eia861m/

costs from rising any higher. These modest program costs will support a significant amount of economic benefit for the Commonwealth.

HB1467 provides Pennsylvania with the opportunity to spur renewable energy development and lead to widespread benefits across the Commonwealth. Based on our analysis, HB1467 will result in the following quantifiable estimated economic benefits through its enactment:

- Spur an estimated investment in Pennsylvania of $13.1 billion ($9.9 billion NPV) to develop energy projects;
- Increase the state GSP by $15.0 billion ($11.4 billion NPV);
- Create 129,134 direct, indirect, and induced job-years between 2024 through 2031;
- Create an average of 3,154 annual direct, indirect, and induced job years supported by the ongoing operations and maintenance of the installed systems;
- Lower the cost to ratepayers through reductions in the price cap (known as the Alternative Compliance Payment) on alternative energy credits starting in 2032, further increasing the value of the enhanced AEPS in HB1467; and,
- Yield estimated environmental benefits through reduced emissions of $6.5 billion ($4.2 billion NPV).

In summary, the Study finds the following net benefits for Pennsylvania from 2024-2035:

- **Net economic benefits** can be calculated by subtracting ratepayer costs from the economic benefits to Pennsylvania. Based on the analysis in the Report, **Pennsylvania will realize net economic benefits of $8.3 billion NPV**.
- **Net economic and societal benefits** can be calculated by subtracting ratepayer costs from the economic and environmental benefits to Pennsylvania. Based on the analysis in the Report, **Pennsylvania will realize net total benefits of $11.2 billion NPV**.

HB1467 is an important step in advancing the Commonwealth's economic development, job creation, environmental, and renewable energy commitments. The net benefits of HB1467 can provide real and significant value to the state's residents and businesses.

1 INTRODUCTION

The Pennsylvania AEPS requires electric distribution companies (EDCs) and electric generation suppliers (EGSs) to include a specific percentage of electricity from alternative energy resources in the generation that they sell to Pennsylvania customers. EDCs and EGSs meet this requirement by utilizing Alternative Energy Credits (AECs) generated by qualified alternative energy sources to demonstrate compliance with the AEPS. Each AEC represents 1 MWh of renewable energy generation. The AEPS was designed to foster economic development and encourage reliance on more diverse and environmentally friendly sources of energy.

Currently, the Pennsylvania AEPS has a requirement that electric suppliers include 8% of Tier 1 resources (solar photovoltaic, solar thermal energy, wind power, low-impact hydropower, geothermal energy, biologically derived methane gas, generation of electricity utilizing wood processing by-products, biomass energy, and coal mine methane) in their supply mix, which includes 0.5% of in-state solar. HB1467 proposes to increase this Tier 1 requirement to 30% by 2030, including the following requirements:

1) 14% carve-out for in-state solar, comprised of the following:
   a. 8% for utility solar
   b. 4% for distributed solar
   c. 2% for community solar

2) 16% for Tier 1 resources which can be sourced from in or out-of-state

Gabel was engaged by MAREC Action to conduct an independent analysis that focuses on the costs and benefits of the increased renewable energy requirements associated with HB1467.

This Report is intended to help guide Pennsylvania in its consideration of HB1467 and the increased renewable energy activity that it will promote.

1.1 About Gabel Associates

Gabel is an energy, environmental, and public utility consulting firm that has provided highly focused and specialized energy consulting services and strategic insight to its clients for over 30 years. Gabel has applied its expertise to drive success for hundreds of clients involved in virtually every sector of the energy industry. The firm has built its reputation on its extensive knowledge and rigorous analysis of wholesale and retail energy markets. We have successfully assisted public and private sector clients implement energy projects and programs that reduce costs and enhance environmental quality. The firm possesses strong

economic, financial, project development, technical, and regulatory knowledge and has significant experience in Pennsylvania and nationally.

The firm has a strong regulatory background and extensive involvement in regulatory proceedings. Specifically, Gabel's two principals each have over 40 years of energy experience and have been responsible for reviewing or testifying at state utility commissions and the Federal Energy Regulatory Commission (FERC) on every aspect of public utility rate cases, including tariff design, cost of service, and revenue requirements. Firm personnel also serve as expert witnesses on a wide range of other issues, including those related to energy and capacity markets, renewable energy, energy efficiency, electric vehicles, ancillary services, interconnection, power plant acquisitions, reactive rates, and mergers/acquisitions.

Gabel also supports policy development, and related analysis, on both the national and state levels. The firm has been an important contributor to policy discussions related to renewable energy, industry restructuring, energy efficiency, and environmental issues.

We have performed extensive analysis around Renewable Portfolio Standards (RPS), including proposed RPS increases, the inclusion of offshore wind, the evaluation of cost caps, and incentive changes. Specifically, the firm has modeled a wide range of RPS impacts including direct and ongoing costs; ratepayer cost impacts; the wholesale electric price merit order impact of renewable energy generation; environmental benefits associated with the displacement of fossil fuels, and employment/job/multiplier impacts. We are also active in regulatory, policy, and legislative activities surrounding renewable energy.

Gabel has extensive experience working on various energy issues in Pennsylvania. Our services have included in-depth analysis of wholesale power and RTO issues, SREC/REC sales, renewable energy economic modeling, RPS supply/demand analysis, and expert policy and ratemaking testimony.

2 METHODOLOGY AND DATA SOURCES

Our analysis applies well-recognized methodologies to accurately quantify the cost and benefits associated with the increased renewable requirements of HB1467. Modeling assumptions were drawn from the U.S. Energy Information Administration (EIA), the National Renewable Energy Laboratory (NREL), U.S. Environmental Protection Agency (USEPA), and the United States Interagency Working Group (USIWG) on the Social Cost of Greenhouse Gases.

Modeling of energy markets included the use of EnCompass, an investment grade, industry-accepted model that simulates electric power grids; IMPLAN, a widely used input/output econometric model; as well as Gabel's proprietary modeling.

3 IN-STATE JOBS AND ECONOMIC ANALYSIS

The economic benefits of building and operating the HB1467-incentivized renewable energy capacity were modeled using IMPLAN, a widely used industry standard input/output econometric model. IMPLAN estimates changes in the local economy based on spending and revenue changes to specific industries. IMPLAN is based on the interdependency between economic sectors, which allows estimations of impacts on the economy, including multiplier effects from changes in spending to specific sectors.

IMPLAN identifies the full economic multiplier effect, with GSP and jobs details of direct spending (e.g., solar installation labor), indirect impacts (e.g., supply chain), and induced impacts (e.g., solar installer buys lunch). Jobs are reported as one-year, Full Time Equivalent (FTE). For example, a solar installation requiring twelve employees for a one-month duration would be reported as one FTE.

The modeling takes into consideration the level of expenditures related to each type of resource and the origin of the costs. For example, installation labor for a solar array is economically sourced in Pennsylvania while the panels themselves are sourced from outside of Pennsylvania and do not contribute to in-state benefits. The installation cost details and ongoing operations and maintenance costs (OpEx, including the levelized cost of inverter replacement) for solar projects are regularly updated by NREL[2] and are shown in the table below.

Solar Installation Cost Detail $/Watt ($2021)

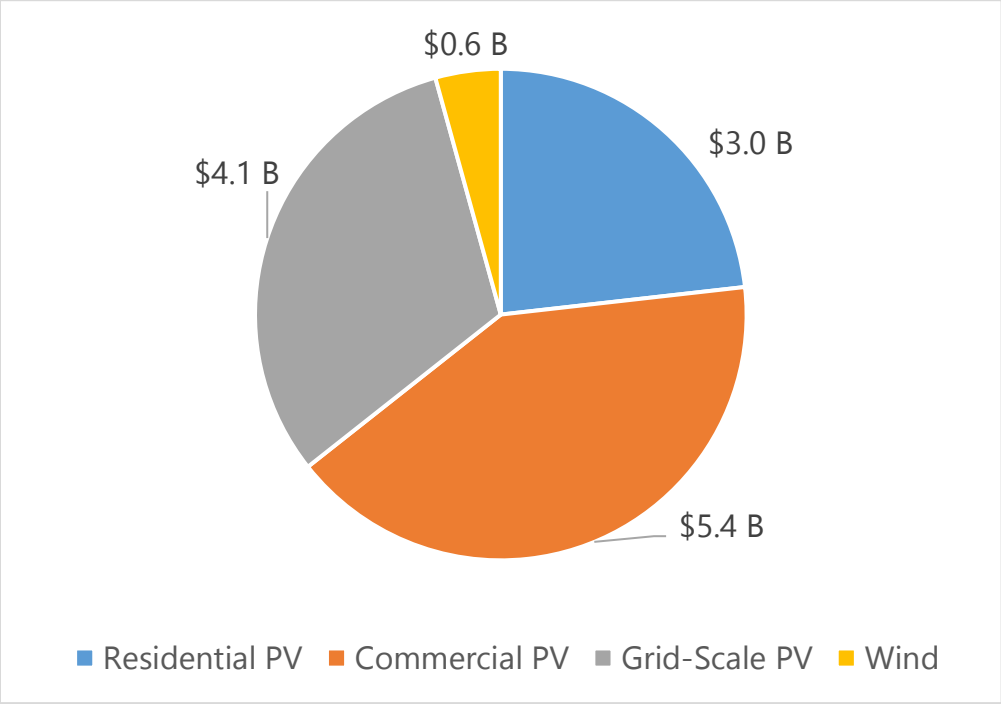
Category	Residential	Commercial	Grid
EPC/Developer Profit	$0.34	$0.14	$0.05
Contingency		$0.05	$0.03
Developer Overhead	$0.26	$0.40	$0.02
Transmission Line (if any)			$0.01
Sales Tax	$0.08	$0.06	$0.04
Permitting	$0.21	$0.04	$0.02
EPC Overhead	$0.40	$0.12	$0.06
Install Labor & Equipment	$0.16	$0.16	$0.12
Electrical BOS	$0.37	$0.28	$0.08
Structural BOS	$0.16	$0.17	$0.18

[2] https://www.nrel.gov/docs/fy22osti/83586.pdf

Inverter	$0.44	$0.06	$0.03
Module	$0.53	$0.46	$0.35
Total	**$2.95**	**$1.94**	**$0.99**
Total OpEx - $/kW/year	**$31.12**	**$19.06**	**$16.42**

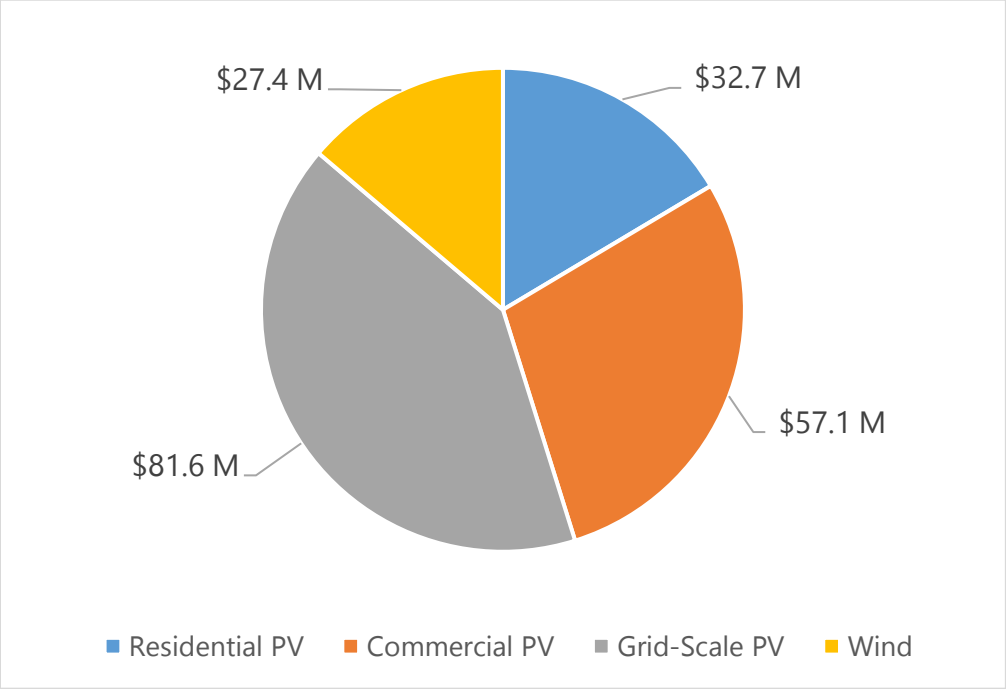
HB1467 will drive a significant level of capital expenditures in Pennsylvania to support the development of solar and wind resources. The chart below provides the estimated level of capital expenditures between 2024 and 2031 which total $13.1 billion on a net present value (NPV) basis:

Renewable Energy Capital Expenditures in Pennsylvania ($Billion, NPV)



The 13 GW of solar and 1 GW of wind resources will require ongoing expenditures to support their operation and maintenance (O&M). The chart below provides the estimated level of annual O&M expenditures:

Annual Renewable Energy O&M Expenditures in Pennsylvania ($Million/Year, $2023)



The wind and solar capacity built and operated in-state to comply with HB1467 will produce the following economic benefits through 2031.

Economic Benefits and Jobs Creation

	Pennsylvania GSP Value Added ($ Billion, NPV)	Pennsylvania Job-Years (FTE) Added
Direct Impacts	$6.6	73,283
Indirect Impacts	$1.6	15,682
Induced Impacts	$3.2	40,169
Total Impacts	**$11.4**	**129,134**

4 ENERGY MARKET PRICE MODELING TO ESTIMATE MERIT ORDER EFFECTS AND ENVIRONMENTAL IMPACTS

The development of new renewable projects in Pennsylvania through HB1467 will have an impact on energy prices and air emissions by injecting new electricity supplies into the grid. These new projects will change the dispatch of generation on the grid by pushing out higher costs and higher emitting generation resources. Generation resources are dispatched based on the variable operating and fuel cost of each resource, with lower-cost units at the "bottom" of the stack which are selected for dispatch most frequently. As electricity demand grows over the course of the day (or years), higher-cost units are designated for dispatch.

To conduct the dynamic analysis of these grid impacts, Gabel utilized EnCompass, an industry-leading, fundamental market-driven North American electric market forecast model that simulates the hourly commitment, dispatch, and operation of generators to serve utility load. EnCompass simulates the entire North American power grid to forecast wholesale energy prices, generation output, and other key variables.

To evaluate the impact on wholesale electric rates in Pennsylvania, Gabel conducted two electric market simulations:

1) Business-as-Usual Case (BAU), in which Pennsylvania maintains its existing AEPS

2) HB1467 Case (HB1467), in which Pennsylvania complies with the increased AEPS proposed by HB1467. A similar AEPS structure would produce similar results.

The differentials between these two scenarios provide the impacts of HB1467, including changes in energy prices and changes in generation and emissions.

4.1 Key Assumptions

The following table details key assumptions that were used in the market simulations that were conducted. Although still the subject of legal challenges, this analysis assumes Pennsylvania's participation in the Regional Greenhouse Gas Initiative (RGGI).

Electric Energy Market Modeling Assumptions ($2023)

Year	Natural Gas Prices[3] ($/MMBtu)	RGGI Costs ($/Ton)	Retail Load (MWh/Year)	Average Retail Electric Rate ($/kWh)
2024	$3.50	$15.89	137,828,233	$0.135
2025	$3.93	$17.04	137,859,406	$0.139
2026	$3.89	$18.27	138,544,609	$0.138
2027	$3.76	$19.58	139,308,039	$0.138
2028	$3.60	$20.99	140,196,798	$0.138
2029	$3.57	$22.51	140,973,318	$0.139
2030	$3.52	$24.13	141,730,079	$0.139
2031	$3.47	$24.18	142,511,985	$0.141
2032	$3.50	$24.23	143,317,756	$0.145
2033	$3.65	$24.27	144,087,377	$0.145
2034	$3.81	$24.32	144,893,410	$0.147
2035	$3.96	$24.37	145,864,651	$0.147

To determine the total solar capacity required, Gabel used NREL PVWatts to estimate the energy production of smaller, customer-owned systems (distributed generation or DG), as well as the larger grid-scale systems (Grid). DG capacity is assumed to have a capacity factor of 14.9% compared to 16.9% for Grid. This produces an estimate that approximately 13 GW of in-state solar will be required to satisfy the new AEPS under HB1467.

For the balance of Tier 1 compliance, it is assumed that wind turbines will be the compliance technology. Of the planned renewable energy capacity additions in PJM[4], wind has the second highest capacity behind solar. Wind energy is well developed throughout PJM (the regional grid operator), primarily in Illinois, Indiana, Ohio, Pennsylvania, and West Virginia. Analysis of the renewable generators registered in PJM shows that 14.3% of wind capacity is installed in Pennsylvania. Therefore, we conservatively assume that 14.3% of the wind capacity required for the balance of Pennsylvania's Tier 1 requirements will be built in-state. This produces an estimate that approximately 7.2 GW of total wind capacity will be required to satisfy the new AEPS, just over 1.0 GW of which will be built in-state. Note that no out-of-state economic benefits are included in this analysis.

[3] October 2023 NYMEX Henry Hub Futures blended into EIA AEO 2023 Reference Case https://www.eia.gov/outlooks/aeo/

[4] https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/outlook-2023-pjm-seeing-a-surge-in-solar-less-new-natural-gas-75004386

Comparing the BAU Case to the HB1467 Case identifies the market and environmental impacts resulting from HB1467's renewable energy requirements.

4.2 Merit Order Benefits

Renewable energy resources impact the wholesale energy markets administered by PJM, either indirectly, as BTM projects reducing electric load, or as grid-scale projects that bid directly into the wholesale energy market. As previously discussed, solar and wind power have no variable costs and therefore are low-cost resources in PJM's dispatch logic that is used to match supply and demand. As new low-cost resources are inserted into the generation supply curve (or reducing on-site load), they displace more expensive resources at the top of the resource stack. Because prices are set based on the cost of the marginal unit of energy, displacing a more expensive resource reduces wholesale energy market prices thereby reducing costs for all customers. Similarly, PJM's capacity market is also a single clearing price auction – meaning that displacing more expensive capacity units will have a similar impact by reducing costs to all customers. As with energy markets, BTM resources reduce the need for capacity and grid-scale projects directly provide low-cost capacity to the PJM market. In short, resources with low energy and capacity costs result in reduced market prices, which benefits all customers.

Similar to the merit order price reductions that occur when lower cost resources are added to the "bottom" of the supply stack; reductions in demand (as with a behind-the-meter solar project) have a similar effect. This impact is known as a demand reduction-induced price effect ("DRIPE"). The benefits of these reduced wholesale prices were also quantified through Encompass market simulation modeling.

As shown in the table below, the increase in renewable generation puts downward pressure on wholesale energy prices. These benefits act as an offset to the cost associated with ratepayers paying for the additional AEC purchases that would be required by HB1467, as further described in Section 5 below.

Renewable Energy Wholesale Merit Order Benefits ($2023)

Year	Energy Merit Order Benefit ($/MWh)	Capacity Merit Order Benefit ($/MWh)	Total Merit Order Benefit ($/MWh)
2024	$0.51	$0.16	$0.66
2025	$0.79	$0.28	$1.07
2026	$0.99	$0.52	$1.51
2027	$1.47	$0.57	$2.04
2028	$1.88	$0.61	$2.49
2029	$2.14	$0.63	$2.77
2030	$3.06	$0.57	$3.64
2031	$3.08	$0.51	$3.59
2032	$3.11	$0.51	$3.63
2033	$3.05	$0.51	$3.56
2034	$2.78	$0.51	$3.29
2035	$2.68	$0.51	$3.19

4.3 Environmental Benefits

This same EnCompass modeling also quantifies the reduction in emissions that will occur as a result of increased renewable development. Traditional fossil fuel generation produces emissions, including carbon dioxide ("CO_2"), sulfur dioxide ("SO_2"), nitrogen dioxide ("NO_X"), and particulate matter (PM2.5). These pollutants are avoided when wind or solar energy production displaces fossil fuel generation. Combining these results with nationally and internationally accepted monetary benefits associated with avoiding the negative health and economic impact of these emissions (as provided in the widely recognized analysis of USEPA[5] and USIAWG[6]), we estimated the displaced air emissions for the life of the projects and quantified the economic value associated with the avoided damages from harmful air emissions. These reductions are summarized in the tables below.

[5] https://www.epa.gov/benmap/estimating-benefit-ton-reducing-directly-emitted-pm25-pm25-precursors-and-ozone-precursors

[6] https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf

Annual Electric Emissions Reductions (Tons)

Year	CO_2 Reductions (Tons)	SO_2 Reductions (Tons)	NOx Reductions (Tons)	PM2.5 Reductions (Tons)
2024	2,099,087	284	724	90
2025	3,270,412	323	753	122
2026	4,043,712	365	869	141
2027	5,435,835	263	893	176
2028	6,505,922	183	868	230
2029	6,703,688	65	581	239
2030	9,298,485	75	757	280
2031	9,232,488	23	749	277
2032	9,203,958	22	761	281
2033	9,336,373	20	786	291
2034	9,485,492	48	794	294
2035	9,522,342	66	804	297

Annual Emissions Reductions Benefits ($2023, Million)

Year	CO_2 Reductions	SO_2 Reductions	NOx Reductions	PM2.5 Reductions	Total Benefits
2024	$123.3	$28.4	$9.7	$17.7	$179.2
2025	$195.8	$33.2	$10.4	$24.9	$264.3
2026	$246.7	$38.2	$12.2	$29.4	$326.5
2027	$337.8	$28.1	$12.8	$37.5	$416.3
2028	$411.7	$20.0	$12.6	$50.0	$494.4
2029	$431.8	$7.2	$8.6	$53.1	$500.8
2030	$609.5	$8.5	$11.4	$63.5	$692.9
2031	$616.4	$2.7	$11.5	$64.3	$694.9
2032	$625.7	$2.6	$11.9	$66.8	$707.1
2033	$646.0	$2.4	$12.6	$70.7	$731.6
2034	$667.8	$5.8	$13.0	$73.0	$759.6
2035	$682.0	$8.3	$13.4	$75.5	$779.1

4.4 Other Benefits and Considerations

Renewable energy can provide additional ratepayer benefits not quantified in this analysis. For example, by displacing fossil-fuel-fired electric generation, the increased use of renewable energy reduces ratepayer's exposure to market volatility, especially natural gas price volatility. As a result, renewable energy provides a significant price hedge value that benefits all ratepayers. The long-term price stability supported by increased renewables provides increased budget certainty, which can be critically important to all customers.

Finally, this Study has the objective of estimating the total costs and benefits to the Commonwealth. It does not focus on "cost shifting" between customers or customer rate classes. These cost shifts might occur over time due to ratemaking and regulatory policies. These shifts do not increase total costs or benefits to the Commonwealth.

5 DIRECT COSTS AND RATEPAYER IMPACTS

HB1467 will cause a series of direct impacts on energy costs to be borne by ratepayers. Most critically, the cost incurred by suppliers to meet the new AEC purchase requirements of HB1467 will be passed through to customers. There are also several key benefits that reduce the direct impact on customers.

Net ratepayer impacts include:

a) the costs of the additional AECs required by HB1467, which will be borne by ratepayers;

b) the "merit order" benefits (discussed in detail above) which occur because renewable energy with zero fuel costs will reduce wholesale energy costs to all customers;

c) energy cost savings from behind-the-meter and community solar installations (collectively labeled as "BTM Savings"). These BTM savings are realized by customers who participate in community solar or on-site behind-the-meter solar projects. Federal tax credits and the SAEC revenue allow PPA providers to offer customers significant electric savings and self-owned systems realize similar savings. These direct customer savings offset the cost of AECs on a statewide basis; and,

d) wholesale energy cost savings from utility-scale solar PPA which, like BTM solar, can provide lower-cost energy, supported by SAEC revenue and Federal tax credits.

Our scenario for AEPS 30x30 would be 2.9% more expensive (on average) than BAU (the flatlined existing AEPS) over the years 2024 through 2035. Critically Pennsylvania will realize

net total benefits of $11.2 billion NPV through that same time period compared with BAU. The monthly annual net ratepayer costs are detailed in the tables below.

Ratepayer Average Net Costs ($2023)

Year	Retail Load	Average Retail Rate $/kWh	Net Residential Ratepayer Cost $/Mo	Net Cost as a Percent of Retail Rates
2024	137,828,233	$0.135	$1.07	0.9%
2025	137,859,406	$0.139	$2.06	1.7%
2026	138,544,609	$0.138	$2.77	2.3%
2027	139,308,039	$0.138	$3.32	2.8%
2028	140,196,798	$0.138	$3.75	3.2%
2029	140,973,318	$0.139	$4.22	3.6%
2030	141,730,079	$0.139	$4.14	3.5%
2031	142,511,985	$0.141	$4.78	4.0%
2032	143,317,756	$0.145	$3.95	3.3%
2033	144,087,377	$0.145	$3.77	3.1%
2034	144,893,410	$0.147	$3.75	3.1%
2035	145,864,651	$0.147	$3.61	2.9%

The energy cost savings for BTM Savings above assume that customer-generator and community solar customers will save an average of 30% relative to retail rates. Our market experience shows that this level of savings is required to incentivize the decision to make the required long-term commitment to on-site solar electric supply. Solar developers can provide discounted pricing due to the SAECs generated and the generous Federal tax credits.

It is important to note that this cost analysis represents the maximum ratepayer exposure in that it assumes AEPS costs are set at the level of the Alternative Compliance Payment (ACP). If there is a sufficient supply of AECs to purchase and an electricity supplier fails to meet Pennsylvania's renewable requirements by securing the necessary number of AECs, it must pay the ACP (not at the expense of ratepayers) for the remaining AECs -- which essentially acts as a price cap on the market. However, if there is a short supply of AECs to meet the electricity suppliers' requirement, they do not necessarily pay the ACP for the shortfall, but this will trigger the force majeure clause for the PA PUC to reevaluate the AEC requirement for that period. Normally, the market price for AECs (solar or otherwise), trades below the ACP. But like other commodities, AEC markets are subject to supply/demand dynamics,

which would push AEC costs down during periods of surplus supply. As such, ratepayer costs will likely be significantly lower than the maximum costs assumed in this Study.
It is also worth noting that energy supplier AEC purchases involve transaction costs, such as legal and broker fees. Because there are no such fees associated with ACP payments, the economic break-even pushes AEC prices somewhat below the ACP. To reflect this market dynamic and based on a review of historic pricing data[7] during periods of short supply, all AEC costs are assumed to be 96.5% of the ACP price.

Finally, with predetermined reductions in ACP values, the annual net cost of the AEPS to ratepayers will decline beyond 2031. Starting with Energy Year 2032, HB1467 provides that the customer-generator solar ACP will decline by $5/year from $100/AEC to $45/AEC and community solar will decline $5/year from $70/AEC to $25/AEC. These ACP reductions will reduce AEPS costs, further increasing the net benefits of HB1467.

[7] S&P Capital - Global IQ-Pro

6 CONCLUSION

HB1467 is an important step in advancing the Commonwealth's job creation, environmental, and renewable energy commitments.

The low program price caps (via Alternative Compliance Payment prices) mean that, at most, the average ratepayer impact will be $3.43 per month ($41.18 per year, a 2.2% increase) for a typical residential customer using 885 kWh/Month[8] during the 2024-2035 forecast period. In other words, the Alternative Compliance Payment (ACP) policy itself prevents average costs from rising any higher.[9] These modest program costs will support a significant amount of economic benefit for the Commonwealth.

HB1467 provides Pennsylvania with the opportunity to spur renewable energy development and lead to widespread benefits across the Commonwealth. Based on our analysis, HB1467 will result in the following quantifiable estimated costs and benefits through its enactment, covering the period 2024-2031:

- Spur an estimated investment in Pennsylvania of $13.1 billion ($9.9 billion NPV) to develop energy projects;
- Increase the state GSP by $15.0 billion ($11.4 billion NPV);
- Create 129,134 direct, indirect, and induced job-years between 2024 through 2031;
- Create an average of 3,154 annual direct, indirect, and induced job-years supported by the ongoing operations and maintenance of the installed systems;
- Lower the cost to ratepayers through reductions in the price cap (known as the Alternative Compliance Payment) on alternative energy credits starting in 2032, further increasing the value of the enhanced AEPS in HB1467; and,
- Yield estimated environmental benefits through reduced emissions of $6.5 billion ($4.2 billion NPV).

In summary, the Study finds the following net benefits for Pennsylvania from 2024-2035:

- **Net economic benefits** can be calculated by subtracting ratepayer impacts from the economic benefits to Pennsylvania. Based on the analysis in the Report, **Pennsylvania will realize net economic benefits of $8.3 billion NPV**.

[8] https://www.eia.gov/electricity/data/eia861m/

- **Net economic and societal benefits** can be calculated by subtracting ratepayer impacts from the economic and environmental benefits to Pennsylvania. Based on the analysis in the Report, **Pennsylvania will realize net total benefits of $11.2 billion NPV**.

HB1467 is an important step in advancing the Commonwealth's economic development, job creation, environmental, and renewable energy commitments. The net benefits of HB1467 can provide real and significant value to Pennsylvania's residents and businesses.