Modernizing Pennsylvania's Clean Energy Policies

An analysis of the proposed
PRESS and PACER policies

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EXECUTIVE SUMMARY

Pennsylvania's electricity prices have been on the rise in recent years due to a variety of intersecting issues. Some of these issues, including the PJM interconnection queue backlog for new generators, increasing demand for electricity, plant retirements, and severe weather including extreme cold and heat could continue to increase costs in the future. The July 2024 PJM capacity auction for the 2025/2026 delivery year, in which prices reached a historical high of $263 per MW-day (compared to just $29 per MW-day for the previous year), is just one symptom of the challenges facing the electricity grid and market construct in which Pennsylvania participates.

As Pennsylvania looks to reduce costs for its electricity customers, invest in the state's future role in being an energy supplier, and curb greenhouse gas emissions, we evaluated the Pennsylvania Climate Emissions Reduction Program (PACER) and the Pennsylvania Reliable Energy Sustainability Standard (PRESS). Specifically, we assessed the potential for these policies to reduce bills, drive resource development, and lower emissions.

PACER and PRESS

PACER would create a Pennsylvania-specific cap-and invest-program. Pennsylvania would set its own cap on carbon dioxide (CO_2) and fossil generators with nameplate capacities over 25 MW would purchase allowances for CO_2 emitted annually. The revenue from the sale of allowances would be used to reduce customers' electricity bills, invest in jobs in communities that have hosted fossil fuel infrastructure, and implement air pollution reduction projects. Specifically, PACER directs the majority of collected revenue back to Pennsylvania customers as direct discounts on their utility bills.

PRESS modernizes Pennsylvania's existing portfolio standard, the Alternative Energy Portfolio Standards (AEPS), to ensure that the state remains an energy leader in this rapidly changing sector. PRESS aims to attract investment and jobs to Pennsylvania and maintain a reliable grid through a diverse resource portfolio. To ensure Pennsylvania's competitiveness in the market, PRESS increases the percentage of retail electricity sales that are required to come from in-state generators, as well as the total quantity of generation that is required to come from low-and-no-carbon resources. The policy also updates resource eligibility criteria to reflect increasing interest in modern technologies like energy storage, geothermal, use of hydrogen as well as future technologies like fusion and small nuclear reactors.

Compared to a base case without PACER and PRESS, these policies would:

- Reduce residential bills by $1 per month, on average. We project a $3 monthly bill reduction for low-income ratepayers.
- Reduce in-state CO_2 emissions by 38 percent.
- Create $8 billion in in-state energy investments, plus an additional $3.4 billion in federal tax credits.

We modeled and compared two cases: (1) a Base case that presents a future in which Pennsylvania does not modify its existing energy policies; and (2) a Policy case that presents a future where Pennsylvania implements both PACER and PRESS. The implementation of these policies is the only difference between the Policy case and the Base case. In both scenarios, we assume that surrounding states' energy policies do not change. Both cases assume that load increases substantially by 2040 due to data centers, electric vehicles, and conventional load growth. We project that Pennsylvania load will increase by 32 percent between 2024 and 2040 and that PJM-wide load as a whole will increase by 64 percent between 2024 and 2040.

Our analysis illustrates the policies' expected impacts in the context of the broader current energy landscape. Most importantly, the region needs to solve its interconnection queue bottleneck, which is holding up progress for Pennsylvania. We modeled a sensitivity to demonstrate the increased benefits that PACER and PRESS could offer if supply-side infrastructure build constraints were removed (see Section 3.1).

Even with the current regional interconnection queue issues, we project PACER and PRESS will create benefits. This success is due to the complementary nature of these policies: PRESS incentivizes the development of emissions-reducing resources, and the revenue from PACER reduces customer bills.

PRESS incentivizes the development of emissions-reducing resources, and the revenue from PACER reduces customer bills.

Our modeling results show that:

- **PACER and PRESS can lower residential customer bills**. We project that the implementation of PACER and PRESS could reduce residential customers bills by $1 per month relative to the Base case (see Table 1). We also project that low-income customers (which represent nearly half of Pennsylvania's residential customers) could see bill reductions of $3 per month relative to the Base case. These policies may slightly increase the average commercial and industrial customer's bill by less than 0.5 percent from 2025–2040, relative to the Base case. In aggregate, these policies are expected to reduce electric system costs for all Pennsylvania customers by $664 million for 2025-2040.

- **A policy that offers reduced bills for residential customers and diversifies Pennsylvania's generation portfolio can mitigate the impacts of broader energy forces that are outside of Pennsylvania's control**. Natural gas price swings and other factors have caused residential bills to fluctuate significantly in recent years. The average residential bill ranged from $126 to $140 per month between 2019 and 2023, with some year-on-year changes approaching $10 per month.

- **The bill reductions are especially significant compared to the existing Alternative Energy Portfolio Standard (AEPS) policy's impact**. The current AEPS program cost each residential customer $1-3 per month from 2019–2023. These policies would provide savings instead of costs, relative to the Base case.

Table 1. Projected monthly bills compared to Pennsylvania's recent historical bills

	Recent historical 2019–2023	Projected 2025–2040		Policy relative to Base case	
		Base case	Policy case	$	%
Residential low-income	$113	$118	$115	-$3	-2%
Residential other	$146	$152	$152	$0	0%
All residential	$133	$138	$137	-$1	-1%
All commercial and industrial	-	-	-	-	<0.5%

Note: All values described in this document are in real 2022 dollars, unless otherwise noted. Low-income customers are defined as Pennsylvania residents earning less than 80 percent of Area Median Income (AMI) using the U.S. Department of Energy's Low-Income Energy Affordability Data (LEAD) tool. On average, low-income households use less electricity than higher-income households, and therefore tend to have lower bills. Historical and projected bills in dollar quantities are not shown for commercial and industrial customers due to this customer class's wide variety in consumption and rate structures.

- **PACER and PRESS reduce Pennsylvania's in-state CO_2 emissions by 38 percent which has the effect of avoiding 138 million short tons of CO_2 regionwide, a cumulative 4 percent reduction in projected CO_2 emissions PJM-wide (see Figure 1).** By 2040, Pennsylvania's electric sector emissions are just 15 million short tons in the Policy case, a reduction of 82 percent compared to 2022 levels.

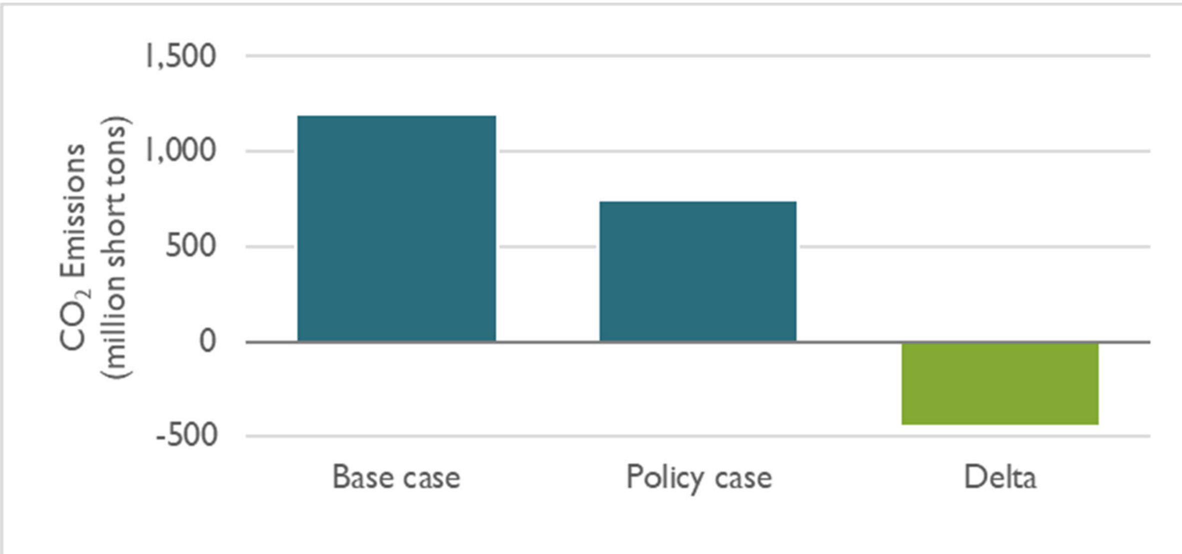
- **PACER and PRESS attract an additional $8 billion of capital investment in PRESS-eligible resources to Pennsylvania, along with $3.4 billion in federal clean energy tax credits to Pennsylvania.** This investment will help communities by contributing revenue to the local tax base and creating jobs.

- **These policies drive the construction of an additional 4.1 GW of clean energy resources in Pennsylvania over 2025–2040 compared to the Base case.** Overall, we project the state's PRESS-eligible capacity in 2040 will be 5 times greater than the 2024 PRESS-eligible capacity.

- **Addressing interconnection queue and permitting issues would unlock even more benefits.** Allowing Pennsylvania and neighboring states to more quickly build generating resources would lead to even greater bill savings for Pennsylvania's residential customers (see Section 3.1). Not only would the Policy case reduce residential bills by an additional $1 per month relative to the Base case, future bills would be even lower than observed in the recent past by about $7 per month. For commercial and industrial customers, addressing interconnection queue and permitting issues would enable the policies to save customers money compared to the Base case: in a future without build constraints, the Policy case would be 2 percent less expensive than the Base case for commercial and industrial customers. Pennsylvania would also benefit from an additional 180 MW of additional capacity built in-state in 2030, meaning investment in local communities and jobs would occur earlier. Finally, cumulative in-state emissions would be an additional 9 percent lower.

- **The policies do not have a bearing on reliability.** Because of high regional load growth and assumed energy infrastructure build constraints, we project that PJM may face reliability challenges in 2030, under certain weather conditions. Because PRESS and PACER do not produce substantial differences in resource builds by 2030, we do not observe differences in reliability impacts specifically associated with these policies.

Figure 1. CO_2 emissions in Pennsylvania, cumulative 2025–2040



1. INTRODUCTION

Pennsylvania state legislators introduced the Pennsylvania Climate Emissions Reduction Program (PACER) and Pennsylvania Reliable Energy Sustainability Standard (PRESS) in May 2024 as part of Governor Josh Shapiro's proposed energy plan to modernize existing policy and further Pennsylvania's reputation as an energy leader.[1] The plan and these policies are designed to create in-state energy investment, reduce carbon pollution, and lower bills for Pennsylvania customers. PACER would set up a Pennsylvania-controlled cap-and-invest program to limit carbon pollution and improve quality of life in Pennsylvania while also reducing customers' electricity bills (particularly for low-income residential customers), investing in air pollution reduction projects, and creating economic investment in Pennsylvania. PRESS would modernize the state's existing Alternative Energy Portfolio Standards (AEPS) to reflect cost declines in the energy industry. This update will enable Pennsylvania to remain competitive with the nine other states in PJM that have passed more aggressive energy portfolio standards since AEPS was passed in 2004, and also to create clean, reliable, and affordable energy.[2] PRESS expands upon AEPS by increasing the percentages of retail sales required to come from in-state and low-carbon generators.[3]

Since the state legislature introduced PACER and PRESS, the need for new energy capacity has only become more urgent. In July 2024, capacity prices in the PJM Base Residual Auction (BRA) for the 2025–2026 delivery year hit an extreme high of $269.92 per MW-day, compared to just $28.92 per MW-day in the auction for the 2024–2025 delivery year.[4] Increasing load forecasts and planned plant retirements are driving up capacity prices. These high capacity prices are expected to cause electricity bills to increase. The events of Summer 2024 provide further reason to study potential energy policies that would incentivize new diverse generation and protect customer bills from unchecked increases.

Any analysis of potential energy policies for Pennsylvania must consider PJM's current supply-side constraints related to the interconnection queue and regional and local permitting process, which are a barrier to rapid development of new resources. Low-cost and ready-to-deploy energy resources will be crucial for serving increasing projections of future load without greatly increasing costs to ratepayers.

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[1] Pennsylvania General Assembly. May 8, 2024. "House Bill No. 2275." Available at: https://legiscan.com/PA/text/HB2275/id/2995099. Pennsylvania General Assembly. May 8, 2024. "House Bill No. 2277." Available at: https://legiscan.com/PA/bill/HB2277/2023.

[2] PJM Environmental Information Services. January 3, 2022. "Comparison of Renewable Portfolio Standards (RPS) Programs in PJM States." Available at: https://www.pjm-eis.com/~/media/pjm-eis/documents/rps-comparison.ashxm.

[3] Commonwealth of Pennsylvania. "Governor Josh Shapiro's Energy Plan Builds on Pennsylvania's Legacy of Energy Leadership by Protecting and Creating Energy Jobs and Lowering Electricity Costs for Consumers." March 13, 2024. Available at: https://www.pa.gov/en/governor/newsroom/2024-press-releases/governor-josh-shapiro-s-energy-plan-builds-on-pennsylvania-s-leg.html.

[4] PJM. "2025/2026 Base Residual Auction Report." July 30, 2024. Available at: https://pjm.com/-/media/markets-ops/rpm/rpm-auction-info/2025-2026/2025-2026-base-residual-auction-report.ashx.

PJM has a long list of projects applying for interconnection and is currently reforming its interconnection process. However, as part of its interconnection reform process, PJM has closed its queue and will not reopen it until the fourth quarter of 2025.[5]

In addition, periods of severe weather—such as winter storms in December 2022 and January 2025—have stressed the energy system, making advance planning with a focus on grid resilience all the more important as extreme weather is projected to become more frequent.

This set of challenges requires innovative approaches at the state and federal levels. It is in this context that Pennsylvania lawmakers introduced two pieces of energy legislation intended to ensure that the state remains an energy leader in the rapidly changing energy industry while protecting residential and especially low-income ratepayers.

The U.S. Department of Energy Grid Deployment Office (DOE-GDO) and Lawrence Berkeley National Laboratory (LBNL) hired Synapse Energy Economics, Inc. (Synapse) to analyze these two proposed policies and inform leaders on their impacts in the context of the broader energy landscape. Synapse analyzed and estimated the effects of these policies on customer bills, capital investments, system costs, reliability, carbon dioxide (CO_2) emissions, and resource builds and dispatch. This report discusses our findings.

1.1. Pennsylvania Climate Emissions Reduction Program (PACER)

In April 2023, Governor Shapiro established a working group made up of labor, energy industry, environmental, and consumer protection representatives. He charged this group with evaluating the merits of Pennsylvania's membership in the Regional Greenhouse Gas Initiative (RGGI). In addition, the group was asked to consider alternatives to RGGI membership and policy recommendations to create in-state energy jobs, ensure reliable and affordable power in Pennsylvania, and address climate change.[6] The working group determined that the best approach for Pennsylvania to meet these goals would be to create a state-specific cap-and-invest program. PACER, also known as House Bill 2275 and Senate Bill 1191, would implement this Pennsylvania-run cap-and-invest program. The legislation would allow Pennsylvania to set its own cap on CO_2 emissions and invest the proceeds directly in Pennsylvania-specific projects and people. The goal of PACER is to give Pennsylvania control over its energy future and allow the state to continue being an energy leader.

PACER would generate revenue for Pennsylvania by requiring fossil generators with capacity of 25 MW or greater to purchase allowances equal to the tons of CO_2 that they emit annually. These allowance purchase requirements would generate revenue for Pennsylvania's residents while modernizing the electricity market. The program administrator would determine the initial number of allowances

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[5] Bruggers, James. "Largest US grid operator puts 1,200 mostly solar projects on hold for 2 years." *Courier Journal*, April 30, 2022. Available at: https://www.courier-journal.com/story/news/local/science/environment/2022/04/30/solarprojects-put-pause-largest-us-power-grid-operator/9587074002/.

[6] Pennsylvania General Assembly. May 8, 2024. "House Bill No. 2275." Available at: https://legiscan.com/PA/text/HB2275/id/2995099.

available for auction and then review the number on a recurring basis and revise it as needed to maximize in-state benefits such as job creation, bill reduction, and more.

The revenue created from the sale of allowances would be used to reduce customers' electricity bills, invest in jobs in communities that have hosted coal, oil, or gas infrastructure, and implement air pollution reduction projects. The current PACER legislation calls for the program to provide the majority of revenue as direct rebates to all Pennsylvania ratepayers on their utility bills. The legislation also directs the uses of the remaining revenue: to reduce electricity bills for low-income households via Low Income Home Energy Assistance Program (LIHEAP) grants or grants for cooling assistance; to create jobs related to geothermal, clean hydrogen, and carbon capture and storage resource development; and to fund projects that reduce air pollution for the state's residents.

For this study, we assumed that 75 percent of the PACER revenue would be available for customer dividends. We split this dividend pool in two parts, with 63 percent going to residential customers and 37 percent going to commercial and industrial (C&I) customers. This pool was then distributed within those customer classes proportional to electricity sales.[7] We further assumed that 10 percent of PACER revenue would be directed to low-income customers through the Low-Income Support Account.[8] We assumed that another 10 percent sent to the Workforce Enhancement Fund would be used to reduce bills indirectly through energy industry economic development and job creation, which would make clean energy less expensive. Finally, we assumed that 5 percent of the revenues would be spent on administrative costs related to running the program.[9]

At the time of writing, PACER had been referred to the Pennsylvania House Consumer Protection, Technology and Utilities Committee and the Senate Environmental Resources and Energy Committee.

1.2. Pennsylvania Reliable Energy Sustainability Standard (PRESS)

Pennsylvania has had a renewable portfolio standard (RPS) policy since the implementation of the 2004 Alternative Energy Portfolio Standards (AEPS) Act. AEPS was originally developed as a tool to encourage investment in emerging energy technologies and associated jobs within the state. AEPS requires utilities to include a specified percentage of alternative energy in the generation they sell to customers in the

[7] Section 3.2 provides more information on the rationale behind and impact of this allocation assumption.

[8] For this analysis, "low-income" is defined as Pennsylvania residents earning less than 80 percent of Area Median Income (AMI) using the U.S. Department of Energy's Low-Income Energy Affordability Data (LEAD) tool. By this metric, 41 percent of Pennsylvania residents are considered low-income and would see extra bill reductions from these policies.

[9] The legislation as written allocates 70 percent to the Customer Protection Account for customer dividends, 10 percent to the Pennsylvania Energy Transformation Account for administering PACER and cost-effectiveness-tested grant programs, 10 percent to the Workforce Enhancement Fund for industry and workforce projects, and a final 10 percent to the Low-Income Support Account for low-income programs. For modeling simplicity, we assumed 75 percent rather than 70 percent of PACER revenues are rebated to customers (we included a portion of revenues in the Pennsylvania Energy Transformation Account because they would indirectly reduce customer bills through programs tested for cost-effectiveness). We treat the 10 percent in the Low-Income Support Account that would be allocated to low-income customers through LIHEAP grants and cooling assistance grants as a direct rebate to low-income customers.

state. These percentages increased gradually each year.[10] At present, 8 percent of Pennsylvania's annual retail electricity sales must come from Tier 1 resources, which include wind, solar, biomass, low-impact hydro, landfill gas, fuel cells, and more.[11] Within Tier I, there is a carve-out requiring that half a percent come from solar energy. Another 10 percent of retail electricity sales must come from Tier 2 resources, which include waste coal, hydro and pumped hydro storage, municipal solid waste, and more. Since the passage of Act 114 of 2020, eligibility for Tier II is limited to facilities located in Pennsylvania.

Twenty years after the passage of AEPS, the energy landscape has changed. Technologies that were once new are now mature, federal subsidies have evolved, and an expanded set of new technologies are becoming commercially available. Additionally, nine other PJM states plus Washington, D.C., have established RPS policies since the passage of AEPS.[12] PRESS, also known as House Bill 2277 and Senate Bill 1190, serves to update AEPS for the modern era. The goal of PRESS is to improve upon AEPS to attract investment and jobs to Pennsylvania and ensure grid reliability through a diverse generation portfolio.

In general, PRESS, as compared to AEPS, requires that a higher percentage of retail sales come from low-and-no-carbon resources as well as from in-state generators. Both policies prioritize resource diversity and require that a percentage of annual retail electricity sales come from a diverse set of generation resources, including wind, solar, landfill gas, hydro, biomass, fuel cells, waste coal, and others.

PRESS makes the following changes to Pennsylvania's portfolio standard:

- **Increases percentage of sales required from Tier I resources:** The required percentage of annual retail electricity sales would increase gradually by 2.7 percent annually from 2024–2034. It starts at 8 percent in 2024, reaches 35 percent by 2034, and then remains at 35 percent through 2040. This update to the allocation to Tier I resources reflects improved project economics due to declining resource costs.

- **Increases share of Tier I allowances that are required to come from in-state resources:** Starting in 2030, 10 percent of Pennsylvania's total annual wholesale electricity demand must be met by renewable energy credits (RECs) that originate in Pennsylvania. This quantity increases by 1 percent per year through 2050.

- **Updates Tier I resource eligibility:** PRESS adds small modular reactors and fusion energy to the list of Tier I resources, which already includes low-impact hydropower, geothermal energy, wind, solar, and coal mine methane. Fuel cells and biomass energy are now in Tier II.

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[10] Pennsylvania Public Utility Commission and Department of Environmental Protection. "Alternative Energy Portfolio Standards Act of 2004: Compliance for Reporting Year 2022-23." https://www.puc.pa.gov/media/2997/aeps-2023-report-final.pdf.

[11] Act 129 of 2008 changed the percentage requirement slightly by adding additional alternative energy resources to Tier I such that for the 2023 reporting year, the requirement was 7.8344 percent.

[12] PJM Environmental Information Services. January 3, 2022. "Comparison of Renewable Portfolio Standards (RPS) Programs in PJM States." Available at: https://www.pjm-eis.com/~/media/pjm-eis/documents/rps-comparison.ashxm.

- **Decreases required near-term percentage for Tier II resources:** The AEPS requirement for Tier II resources was 10 percent. The PRESS requirement starts at 6 percent in 2025 and increases by 0.5 percent every year until it reaches 10 percent in 2033 and continues at 10 percent.

- **Updates Tier II resource eligibility:** Fuel cells and biomass energy are added to Tier II from Tier I. Additionally, several new resources were included. These additional resources include co-located energy storage resources, power plants that burn hydrogen for at least 80 percent of their fuel input by volume, and combined heat and power plants. Hydropower, distributed generation systems, and demand-side management remain on the list of AEPS Tier II resources. Finally, a few resources are moved from Tier II to Tier III (these are described below in the Tier III resource eligibility section).

- **Creates a new Tier III requirement:** The requirement for Tier III resources is 3.8 percent of Pennsylvania's annual retail electricity sales for 2024–2027, increasing to 4.4 percent for 2028–2030, 5 percent in 2030, and remaining at 5 percent for all subsequent years.

- **Establishes Tier III resource eligibility criteria:** Tier III is a new category populated with a subset of resources from the current AEPS Tier II category, as well as one new technology. The resources that came from the current AEPS Tier II are waste coal, municipal solid waste, integrated combined coal gasification, and power plants that utilize by-products of the pulping processes and wood manufacturing processes. The new resource is power plants that burn hydrogen for at least 20 percent of their fuel input by volume.[13]

Like AEPS, PRESS allows for Alternative Compliance Payments (ACP). In the Base case, we assumed a maximum price for RECs based on the average ACP price of each PJM state, weighted by the contribution of RECs to each of the resource tiers, including the current Pennsylvania ACP price of $45 per MWh. This produced a PJM-wide ACP of $42 per MWh in nominal dollars. In the Policy case, we assumed a Pennsylvania ACP of $20 per MWh for all three PRESS tiers, which produces a PJM-wide ACP of $35 per MWh.[14]

Our modeling of PRESS assumes the following simplifications to resource eligibility. (More information on other modeling simplifications is available in Appendix B.) If these resources were included in our analysis, it is likely that we would see even greater contributions to resource diversity and possibly further reductions in compliance costs.

- We do not explicitly model the aspect of PRESS that results in co-located storage resources as producing RECs as Tier II PRESS sources. However, even without this inclusion, by 2040, the modeled policies drive the buildout of an additional 1,750 MW of energy storage in PJM, 870 MW of which is built in Pennsylvania. Increased solar deployment resulting from PRESS and PACER improves the economics for storage projects by creating greater opportunities for energy arbitrage within the course of a

[13] Pennsylvania General Assembly. May 8, 2024. "House Bill No. 2277." Available at: https://legiscan.com/PA/bill/HB2277/2023.

[14] As written, proposed language for PRESS describes an ACP of $45 per MWh for Tier I, $35 per MWh for Tier II, and $15 per MWh for Tier III.

day. It is possible that the inclusion of co-located energy storage resources in the PRESS Tier II category would drive an even greater deployment of energy storage resources, contributing to a diverse resource mix and improving resource adequacy.

- We do not model geothermal resources, since these resources are not yet widely commercially available. If geothermal resources become more available, their inclusion as Tier I PRESS energy sources would support their development, encouraging a diverse and reliable resource mix.
- We assume that the ZEC component of PRESS has the effect of retaining nuclear plants over the study period. We do not explicitly model ZEC compliance or payments.

At the time of writing, PRESS had been referred to the Environmental Resources and Energy Committee in both the Pennsylvania House and Senate.

1.3. Overview of analytical methods

This analysis uses a detailed PJM-wide capacity-expansion and production-cost analysis from 2025–2040, coupled with a rigorous reliability analysis, and post-processing analyses to describe the impacts of these policies on ratepayer bills, capital investments, CO_2 emissions, resource builds, and more.

With stakeholder collaboration, Synapse created two primary scenarios, including a business-as-usual Base case and a Policy case featuring both PACER and PRESS. The Base case presents a future in which Pennsylvania does not modify its existing policies related to clean energy and CO_2 emissions. In this scenario, surrounding states continue their existing policies without any changes. We project load growth using the latest estimates from PJM.

The Policy case presents a future in which Pennsylvania implements both PACER and PRESS. The presence of these policies is the only difference between the Policy case and the Base case.

2. RESULTS

This section describes the key findings of our analysis, including results related to bill impacts, capacity, generation, exports, CO_2 emissions, reliability impacts, and other findings. Appendix A has further detail on approaches used in this analysis.

2.1. PACER and PRESS reduce average residential bills by $1 per month compared to Base case

Ratepayer bills are influenced by factors such as energy costs, capacity costs, costs of RECs and RPS compliance, transmission costs, legacy plant costs, distribution costs, and utility return on equity. Our modeling focuses on the components that are likely to be different across scenarios, including costs related to energy, capacity, RPS compliance, and new transmission builds.[15]

Several factors other than PRESS and PACER influence electricity bill trends in both the Base case and Policy case. Constrained resource deployment is projected to increase capacity market prices and REC prices. However, these increased costs are partially offset by projected near-term decreases in gas prices, relative to the historical highs in 2021 and 2022.[16] If resource deployment constraints were resolved, that would lead to lower capacity prices, lower REC prices, and lower energy prices.[17]

In aggregate, these policies are expected to reduce electric system costs for all Pennsylvania customers by $664 million for 2025-2040. This includes $807 million in savings for all customers in the first five years, and savings of $1.3 billion for all residential customers from 2025-2040.[18]

More detail on the methodology used to estimate bills and bill impacts can be found in the Appendices.

We project that the average residential bill and the average low-income residential bill will decrease under the Policy case compared to the Base case

In the Policy case, we project that the average residential customer bill will decrease by $1 per month compared to the Base case without PACER and PRESS (see Table 2). We project that the average low-income residential customer bill will decrease by $3 per month compared to the Base case.

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[15] Specifically, we assume that cost allocation across sectors is based on historical actuals and does not change over time except to reflect new load from data center customers. We assume that all costs other than energy, capacity, RECs, and transmission are fixed over time.

[16] Gas prices are assumed to be lower in the mid-2020s than they were in 2021-2022, based on short-term projections obtained from NYMEX, but we project that gas prices gradually rise over time following the projection from the U.S. Energy Information Agency's (EIA) 2023 *Annual Energy Outlook*.

[17] We ranked these drivers according to their estimated scale of impact. We did not quantify the actual impacts of each driver.

[18] Note that the initial announcement of the proposed PRESS and PACER legislation released by Governor Shapiro's office in March 2024 contained a high-level estimate of savings of $252 million over five years. See https://www.pa.gov/governor/newsroom/2024-press-releases/governor-josh-shapiro-s-energy-plan-builds-on-pennsylvania-s-leg.html.

Unlike the current AEPS program, which imposes a cost on residential ratepayers, the combined impact of PACER and PRESS will provide bill savings to residential ratepayers. Based on recent AEPS reports from 2019–2023, we observe recent costs of $97 to $510 million per year, or $1–3 per month when allocated to residential ratepayers based on MWh sales.[19,20]

In other words, while the current policy adds $1–3 per month to the average residential ratepayer's bill, the updated policies would instead subtract $1 per month.

We estimate that C&I customer bills will increase very slightly under the Policy case compared to the Base case

The C&I customer class consists of a wide range of customer profiles. Different customers within this class can have drastically different energy consumption. C&I customers also have different rate structures than residential customers, often with lower volumetric (per kWh) charges than residential customers but with additional rate components including demand charges. As a result of the variety within the C&I customer class and its differences compared to residential customers, C&I bill impacts are difficult to compare with residential bill impacts and are best quantified through percent changes rather than absolute dollar changes. In the Policy case, we project that the average C&I bill will increase by less than 0.5 percent compared to the Base case.

These observed C&I bill increases are much smaller than recent historical variations in C&I electricity bills. While there is significant variety in C&I customer user profiles, it can still be useful to estimate an average bill to illustrate recent historical bill swings. Using the average monthly C&I bill from 2019–2023 as a benchmark, we find that monthly bills during that period fluctuated by up to plus or minus 9 percent from the historical average over this time period.[21] Larger year-on-year variations in electricity bills are influenced by factors outside of Pennsylvania's direct control, such as the price of natural gas or changing dynamics within PJM's capacity market. Drivers of potential bill increases in the Policy case include higher energy costs associated with PACER and higher REC costs associated with PRESS. However, the impacts of these drivers can be mitigated by refunding revenue collected from emitting power plants under PACER to ratepayers.[22]

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[19] *Alternative Energy Portfolio Standards (AEPS) Reports*. Pennsylvania Public Utility Commission. Available at https://www.puc.pa.gov/filing-resources/reports/alternative-energy-portfolio-standards-aeps-reports/.

[20] Since Act 40 of 2017 and Act 114 of 2020, Tier I Solar and Tier II resources, respectively, have been limited to in-state facilities, which resulted in increased costs for both tiers of resources.

[21] All monthly bills are calculated using historical data published by the EIA in EIA Form 860. For more about this dataset, see https://www.eia.gov/electricity/data/eia860/.

[22] We observe that there are multiple ways of allocating revenue from PACER, with our Policy case representing just one possible option. For more on this, see Section 3.2.

Table 2. Projection of monthly bills and bill impacts

	Recent historical 2019–2023	Near term 2025–2030	Long term 2031–2040	Entire period 2025–2040
All Residential				
Base Case	$133	$145	$134	$138
Policy Case	$133	$143	$133	$137
Bill impacts of Policy case ($)	-	-$2	-$1	-$1
Bill impacts of Policy Case (%)	-	-1%	0%	-1%
Residential low-income				
Base Case	$113	$124	$114	$118
Policy Case	$113	$120	$112	$115
Bill impacts of Policy case ($)	-	-$4	-$2	-$3
Bill impacts of Policy case (%)	-	-3%	-2%	-2%
Residential other				
Base Case	$146	$160	$147	$152
Policy Case	$146	$159	$148	$152
Bill impacts of Policy case ($)	-	-$1	$0.5	<-$0.1
Bill impacts of Policy case (%)	-	-1%	0%	0%
All Commercial & Industrial				
Bill impacts of Policy case (%)	-	<0.1%	0.7%	<0.5%

Note: Negative bill impacts indicate cost savings, and positive numbers indicate a cost increase. All values described in this document are in real 2022 dollars, unless otherwise noted. All values refer to the monthly bills (or bill impacts) paid by the average customer in Pennsylvania. Historical and projected bills in dollar quantities are not shown for commercial and industrial customers due to this customer class's wide variety in consumption and rate structures.

2.2. PACER and PRESS drive down CO_2 emissions in Pennsylvania

PACER and PRESS are projected to cause a substantial decrease in CO_2 emissions inside Pennsylvania. These polices are expected to have an immediate effect: with the implementation of these polices (and PACER in particular), in-state CO_2 emissions in 2025 are 27 million short tons lower than the Base case, a reduction of 29 percent (see Figure 2). Policy case emissions are lower than Base emissions in every modeled year. By 2040, Pennsylvania's electric sector emissions are just 15 million short tons in the Policy case, a reduction of 82 percent compared to 2022 levels. We estimate that PACER drives the majority of these emissions reductions (see Figure 3).[23]

Over the study period, the policies avoid 138 million short tons of CO_2 regionwide. To put this in perspective, this is more CO_2 than was produced by all of Pennsylvania's coal-fired power plants in 2020 through 2022. This translates into a cumulative 4 percent reduction in projected CO_2 emissions PJM-

[23] For the purposes of Figure 3, we estimate emission reductions attributable to PACER by estimating the total increase in Pennsylvania's clean energy generation from 2025-2040, and then multiply this by the emissions rate of a typical natural gas-fired combined cycle plant. Emissions attributable to PRESS are estimated to be the remainder of the modeled emissions reduction. In reality, both policies assist one another: by making in-state fossil generation more expensive, PACER incentivizes more clean energy builds. Meanwhile, by incentivizing in-state clean energy, PRESS reduces the need to rely on fossil plants, thus decreasing in-state emissions.

wide, highlighting Pennsylvania's leadership in catalyzing regionwide benefits despite increasing load across the region.

Figure 2. Modeled annual CO_2 emissions in Pennsylvania and PJM-wide

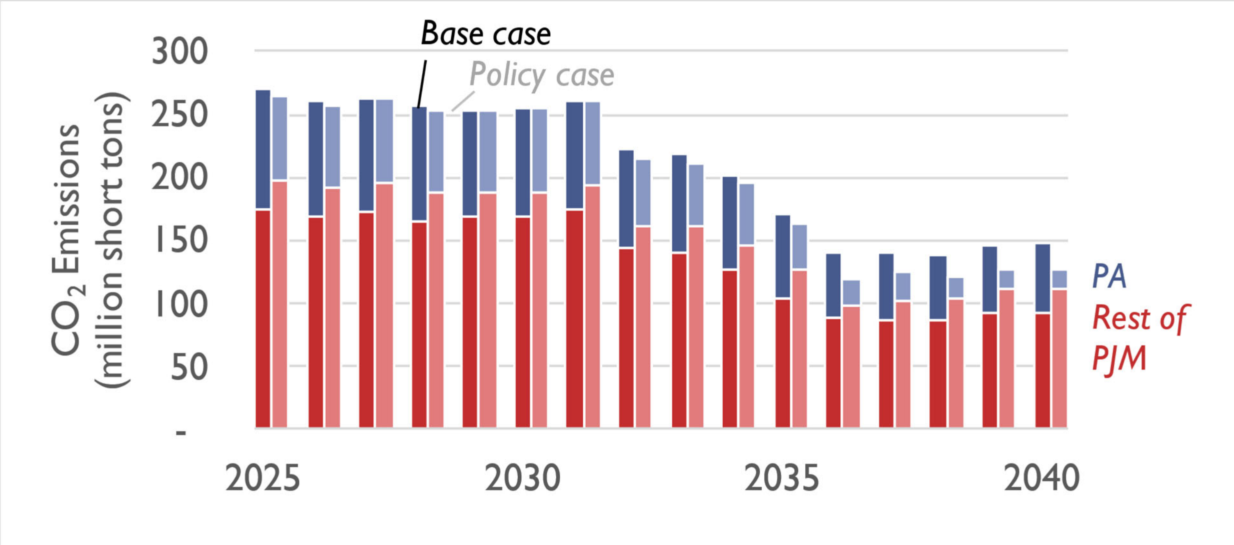
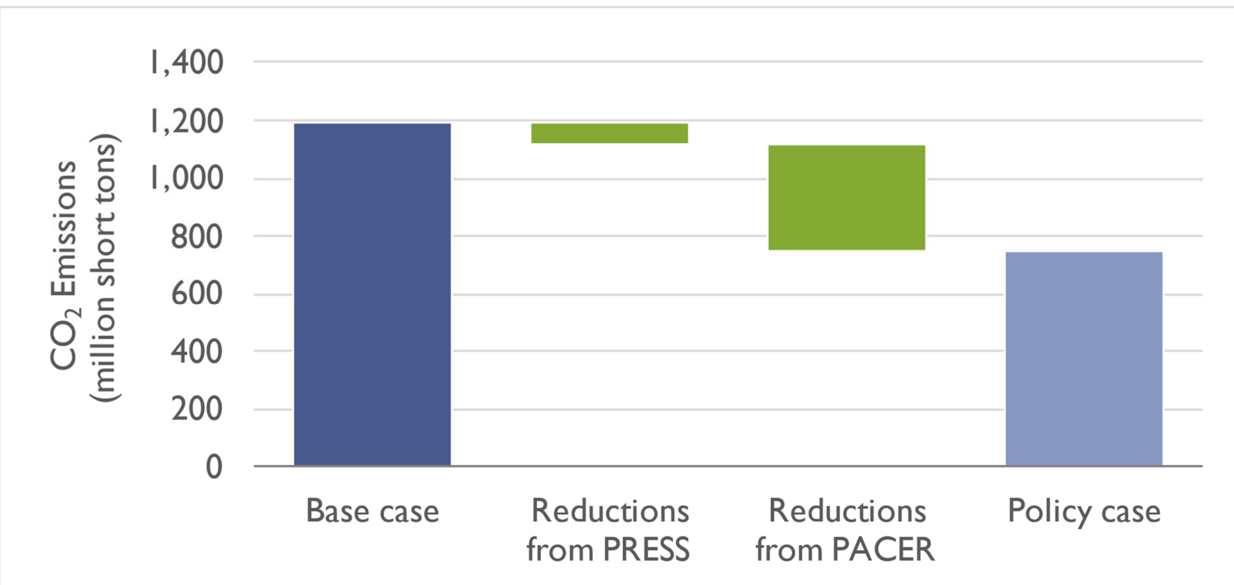


Figure 3. Estimated cumulative attribution for CO_2 emissions decreases, Pennsylvania 2025–2040



2.3. PRESS drives financial investment in Pennsylvania's energy future

PRESS facilitates the development of an additional 4.1 GW of new, clean energy resources in Pennsylvania. Based on projected capital expenditures for these resources, we find that the Policy case drives an additional $8 billion in investments to the state. Project investments are valuable to a local community because energy projects pay taxes based on valuations of real property, and they also create jobs.[24,25]

The Policy case also brings an additional $3.4 billion in federal tax credits to Pennsylvania cumulatively over 2025–2040.[26] Over the same period, the wider PJM region is expected to receive $6.2 billion in additional tax credits as a result of PACER and PRESS, highlighting Pennsylvania's majority share of the regional projection given its leading policies.[27] Clean energy resources are financed in part through the federal government's tax credit program, enabled by the *Inflation Reduction Act of 2022* (IRA). Under the IRA, entities including state and local governments, nonprofits, and economic development agencies can receive investment tax credits (calculated as a percentage of the resource's upfront capital cost) or production tax credits (calculated according to the annual generation output of a resource). Local entities can earn bonus tax credits if they are sited in an energy community, built with domestic parts, and if the developer meets prevailing wage and apprenticeship requirements.[28,29] According to one analysis, over 75 percent of Pennsylvania's land area is eligible for the energy community bonus tax credit, particularly rural areas which supported legacy energy infrastructure.[30] These tax credits help to buy down the cost of building new clean energy generation and infrastructure, making it more economical to build these resources, specifically in energy communities.

2.4. PRESS drives the buildout of diverse energy resources as Pennsylvania adapts to a high load forecast

To a large degree, our modeled bill impacts are driven by our assumptions regarding allowable resource builds. In general, we assume that the PJM region is heavily constrained in terms of its ability to build new resources, based on available information from the PJM interconnection queue and state-level resource permitting. Specifically, we assume that the only new resources allowed to be built between 2025 and 2030 are those that are currently in the interconnection queue with a status of "Under

[24] DSIRE. July 11, 2020. "Property Tax Assessment for Commercial Wind Farms." Available at: https://programs.dsireusa.org/system/program/detail/2369.

[25] Penn State. 2022. "Municipal Officials Guide to Grid-Scale Solar Development In Pennsylvania." Available at: https://bpb-us-e1.wpmucdn.com/sites.psu.edu/dist/0/147548/files/2022/12/municipal-officials-guide-to-grid-scale-solar-development-in-pa-section-07.pdf.

[26] These numbers are above and beyond the investment and tax credit figures of the Base case.

[27] The $6.2 billion in tax credits going to PJM includes the $3.4 billion going to Pennsylvania.

[28] Energy community projects earn an additional 10 percent tax credit. The IRA defines energy communities as (1) a brownfield site, (2) an area that has relied on natural gas, coal, or oil as a major source of employment or tax revenue and has an above-average unemployment rate, or (3) a census tract belonging to a closed coal mine or retired power plant.

[29] Interagency Working Group on Coal & Power Plant Communities & Economic Revitalization. N.D. "Energy Community Tax Credit Bonus." Available at: https://energycommunities.gov/energy-community-tax-credit-bonus/.

[30] Raimi, Daniel and Sophie Pesek. November 2022. "What Is An 'Energy Community'? Alternative Approaches for Geographically Targeted Energy Policy." Resources for the Future. Available at: https://media.rff.org/documents/Report_22-12_AxXwJqy.pdf.

Construction” and “Engineering and Procurement.”[31] After 2030, resource build constraints are gradually loosened to the point that they no longer exist in 2036.

As a result of these assumptions, projected resource builds in both the Base and Policy cases are similar through 2035. We observe only small differences between the two scenarios: for example, we observe slightly different locations for a small number of future solar and storage projects. One major difference is that the Policy case features more transmission builds to help facilitate changing flows of electricity, with an additional 800 MW of transmission built in 2034 between the PJM-AD and PJM-APS regions (i.e., between AEP Ohio and West Virginia / West Penn Power).

By 2040, the Policy case results indicate that PRESS is working as designed to reduce emissions for Pennsylvania even given interconnection and permitting challenges. The Policy case shows an incremental 4.1 GW PRESS-eligible resources built in Pennsylvania. Figure 4 illustrates resource additions in the Policy case from 2025–2040, starting with Pennsylvania’s existing capacity resources that are PRESS-eligible and highlighting that the Policy case projects a ten-fold increase in PRESS-eligible capacity by 2040. Meanwhile, PJM-wide, in both cases we observe about 75 GW of gas added by 2040, alongside about 118 GW of solar, 79 GW of wind, 32 GW of battery storage, and 1 GW of nuclear.[32] Both cases see 24 GW of coal retirements by 2040, leaving 15 GW of coal remaining, PJM-wide.[33] PRESS and PACER drive incremental regional additions of 14 GW of energy resources.[34]

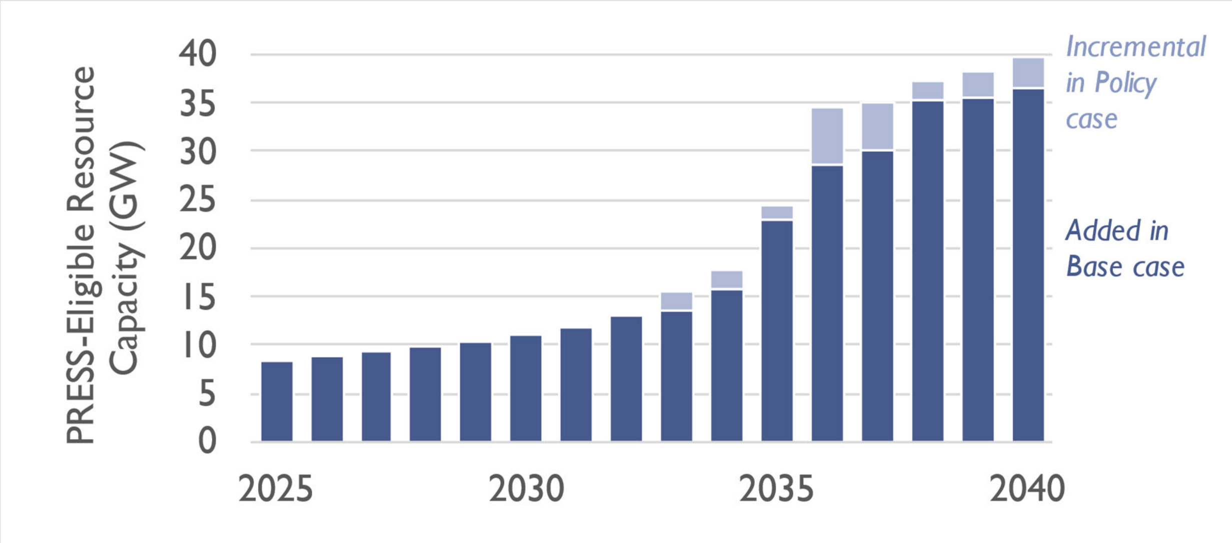
[31] This excludes a large percentage of queued resources, which are in the “Active” stage. It is challenging to determine the likelihood or progress of the resources in this Active stage, and it is likely that it includes some duplicate resources (which may be listed under several different project names). As a result, we have excluded these resources from our main analysis but have examined the impact of their inclusion in a sensitivity. See Section 3.1 for more information.

[32] This increase in nuclear capacity is associated with the repowering of Three Mile Island 1, which we assume occurs in January 2028.

[33] All of these coal retirements are based on currently published information about coal retirement dates. The model is prohibited from endogenously retiring any existing capacity.

[34] In our model, resources are built where they are most economical. This means that resources may be built in states neighboring Pennsylvania if those resources have higher capacity factors or lower capital costs.

Figure 4. Projected PRESS-eligible capacity in Pennsylvania



Note: Values refer to all PRESS-eligible capacity resources, as well as capacity for battery storage resources.

Both cases assume that load increases substantially by 2040. Virtually all load projections in our modeling are based on the latest data from PJM's 2024 Load Forecast Report.[35] This projection includes load increases due to conventional load growth, electric vehicle load growth, and load growth due to data centers and other large loads. In addition to the data center load from the PJM forecast, we also model an additional 960 MW of data center load in Pennsylvania.[36] As a result, we project PJM-wide load grows by 503 TWh by 2040, relative to 2024 (an increase of 64 percent). In Pennsylvania, load is 48 TWh higher in 2040 (an increase of 32 percent relative to 2024).

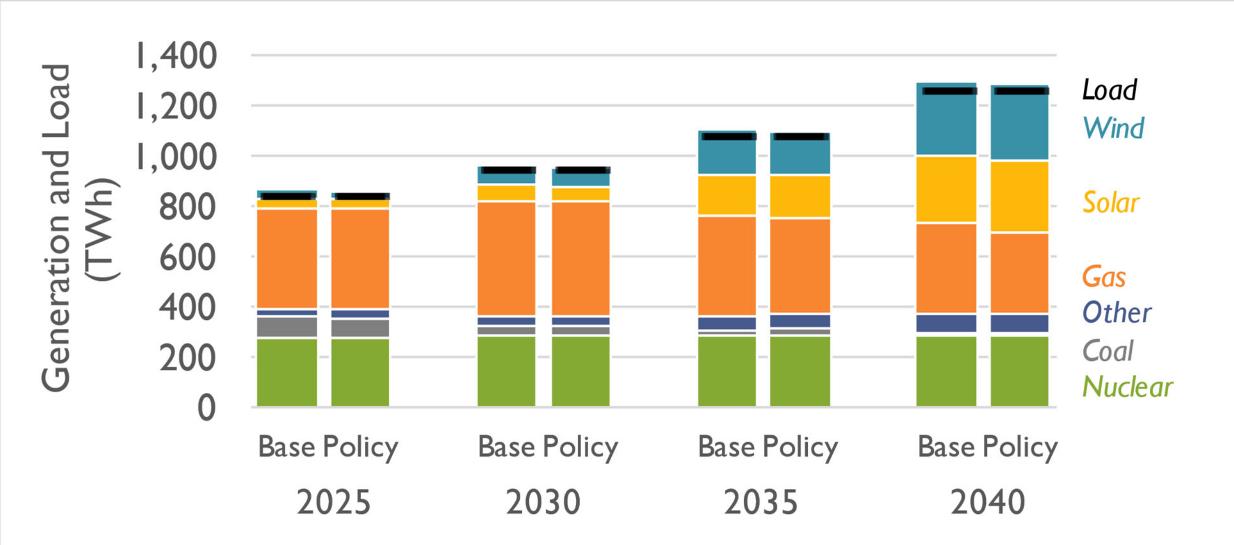
The proposed policies are not assumed to substantially change total PJM-wide generation in any year (see Figure 5). Within Pennsylvania, electricity generation remains relatively constant in the Policy case over time, averaging about 241 TWh per year. As a result of increasing in-state loads, we project that the percentage of electricity that Pennsylvania exports will gradually decrease.[37]

[35] See 2024 Load Forecast Report. PJM. Revised February 1, 2024. Available at https://www.pjm.com/-/media/library/reports-notices/load-forecast/2024-load-report.ashx.

[36] This additional load is intended to represent the planned load associated with data centers co-located at the Susquehanna Nuclear Power Plant. For more information on the planned Susquehanna data center, see https://www.datacenterfrontier.com/hyperscale/article/33038288/aws-eyes-960-mw-for-newly-acquired-nuclear-power-data-center-in-pennsylvania and https://ir.talenenergy.com/static-files/f02c44a9-d2dc-45c1-9331-eee1495f7d2d.

[37] We calculate that in recent years, Pennsylvania has exported about 100 TWh per year, or about 40 percent of its generation. In the Policy case, we project that in 2040, Pennsylvania will export about 30 TWh, or about 13 percent of its generation.

Figure 5. Modeled PJM-wide generation and loads



2.5. PACER and PRESS are not projected to impact PJM's ability to reliably provide electricity

The loads and resources estimated for the Base and Policy cases were modeled in SERVM to evaluate the reliability of each case in 2030. Our primary observation is that there is hardly any difference in reliability between the Policy and the Base cases. In other words, because both cases have virtually the same set of resources built by 2030, the SERVM model does not identify material differences in reliability metrics between the two runs. However, both cases show reliability issues in Virginia in 2030 due to load growth and limitations on resource builds. The typical approach when evaluating the Loss of Load Expectation (LOLE) for a system is to add proxy units to a system if the system is not at or below a 0.1 LOLE, when considering multiple decades' of weather years with varying weather extremes.[38]

We modeled the reliability of the entire PJM system in 2030, under both the Policy and Base cases. This involved estimating the LOLE that would occur under 40 years' worth of weather conditions.[39] The purpose of this analysis is to evaluate the two cases under several sets of risk, which include weather, load, unit outages, and renewable profiles. The resulting LOLE from each case will help identify capacity and energy resource additions that may be needed. While we do not observe material differences in reliability between the two cases, we do observe that both cases contain the same set of reliability issues. In particular, when modeling storage, transmission, and gas CTs as proxy resources, we found

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[38] One method is to use gas CTs as the proxy resource. For example, the *Planning Year 2024–2025 Loss of Load Expectation Study Report* published by MISO states, "If the LOLE is greater than the minimum seasonal LOLE criteria, proxy units based on a typical combustion turbine unit of 160 MW with class average seasonal forced outage rates will be added to the model until the LOLE reaches the minimum seasonal LOLE criteria." See https://cdn.misoenergy.org/LOLE%20Study%20Report%20PY%202024-2025631112.pdf, page 33.

[39] Loss of Load Expectation ("LOLE") is one of the primary metrics used to describe reliability issues. LOLE is the number of days of loss of load events due to capacity shortages, measured in events per year. Additional detail on this metric and the SERVM modeling used in this part of the analysis can be found in Appendix A.

that large quantities (e.g., greater than 8 GW) of resources were required in order to achieve this reliability threshold.

The presence of projected reliability issues in 2030 is not surprising given the very high load forecast and the fact that many new resources needed to meet that forecast will be completed after 2030.[40] These reliability issues can be traced to (a) load growth throughout PJM and (b) limited resource builds related to the PJM queue. In general, we find that the PJM zones located in Pennsylvania do not have reliability issues; instead, the issues with regional reliability in other zones are primarily tied to load growth from data centers in Virginia. While both cases experience reliability events in some regions outside of Virginia, we find that resolving the reliability events with resources built inside Virginia also improves reliability elsewhere. We found that we were able to avoid regional reliability issues in 2030 by adding storage, transmission, and gas resources in Virginia.[41]

Reliability considerations

There are a number of considerations related to modeling data centers and reliability. First, datacenters like the kind currently being built in PJM are generally built with backup generators. While backup generation is not a resource included in SERVM, it is possible that datacenter backups could provide some of the reliability support necessary, thereby decreasing the necessary additional builds. However, it is unknown whether these backups would be permitted to run for the duration of time needed to cover all of the modeled events. Based on data available, data centers are often built with backup generators equal in capacity to site load.[42, 43] As a point of reference, we modeled about 17 GW of incremental data centers through 2030.[44]

A second consideration is that data center load shapes are currently challenging to model. Data center load is projected to be rapidly added in large quantities over the next decade. The types of data centers being built in PJM are assumed to be inflexible and operate at a relatively constant level, independent of weather. Because the SERVM model creates weather-dependent load shapes using recent historical data, these estimates may not adequately capture the impact of large changes to load shapes. In other

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[40] The load forecasts used in this analysis largely rely on data published by PJM in its 2024 PJM Load Forecast. PJM's 2025 Preliminary Load Forecast (published in December 2024 and not used in this analysis) indicate even higher levels of load growth in 2030 and later years. PJM. December 9, 2024. "2025 Preliminary PJM Load Forecast." Available at: https://www.pjm.com/-/media/DotCom/committees-groups/subcommittees/las/2024/20241209/20241209-item-03---2025-preliminary-pjm-load-forecast.ashx.

[41] In the current modeling, neither scenario adds any gas CTs by 2030, anywhere in PJM. As a point of reference, in the current modeling, both scenarios have about 29 GW of existing gas CT resources active in 2030. However, in the current modeling, both scenarios add about 2.5 GW of new gas *combined cycle (CC)* resources.

[42] Companies developing data centers in Virginia are coming under scrutiny from the state Department of Environmental Quality for the pollution and noise caused by backup diesel generators, but backup generators seem poised to continue being the norm.

[43] Paullin, Charlie. 2024 "Virginia environmental regulators make info on data center operations more publicly accessible." *Virginia Mercury*. November 13. Available at: https://virginiamercury.com/2024/11/13/virginia-environmental-regulators-make-info-on-data-center-operations-more-publicly-accessible/

[44] This includes 960 MW in Pennsylvania in addition to the data center load forecast described by PJM in its 2023 load forecast. This includes 12 GW of new datacenter load by 2030 in Virginia.

words, SERVM may be overestimating the amount of 2030 load that is weather-dependent, which could exaggerate peaks and produce more loss-of-load events. As a result, it is possible that this analysis overestimates the reliability issues likely to be present in 2030. Further analysis is needed to better understand the reliability challenges that may become present elsewhere in PJM, independent of Pennsylvania's energy policy choices.

2.6. Impacts on secondary market metrics

The proposed PRESS and PACER policies have combined impacts on other electricity market metrics, such as CO_2 prices, CO_2 allowance revenues, REC prices, and REC availability.

PACER drives increases in near-term CO_2 prices but causes long-term CO_2 prices to fall

The projected price paid for PACER allowances starts at $16 per short ton in 2025, and rises to $20 per short ton in 2030, tracking at or near the assumed price cap for the combined PACER+RGGI program (see Figure 6). These prices continue to increase through 2033, before falling. Beginning in 2035, the Policy case's PACER prices are lower than the Base case's RGGI prices as a result of a looser regional GHG cap. In other words, even though adding PACER to RGGI expands the number of power plants under the total regional emissions cap, the quantity of allowances added by PACER produces a less stringent cap for all PACER+RGGI plants than RGGI alone.

The application of PACER to Pennsylvania power plants is projected to create about $940 million in revenue each year from 2025–2035 (see Figure 7). From 2036–2040, PACER revenue falls to about $410 million per year. This decrease in revenue is the result of gradually loosening constraints around resource builds, which enables the construction of more zero-emitting resources and requires less reliance on existing power plants. Over the entire study period, annual revenues average around $780 million per year. As described earlier, we assume that all but 5 percent of this revenue is available to reduce electricity bills for Pennsylvania ratepayers, either directly through bill rebates or indirectly through incentives for energy investments.[45]

[45] The remaining 5 percent is assumed to be used to cover the costs of administering the program, in line with the administrative costs experienced by states under the RGGI program.

Figure 6. Modeled CO_2 emission prices under the Base case and Policy case

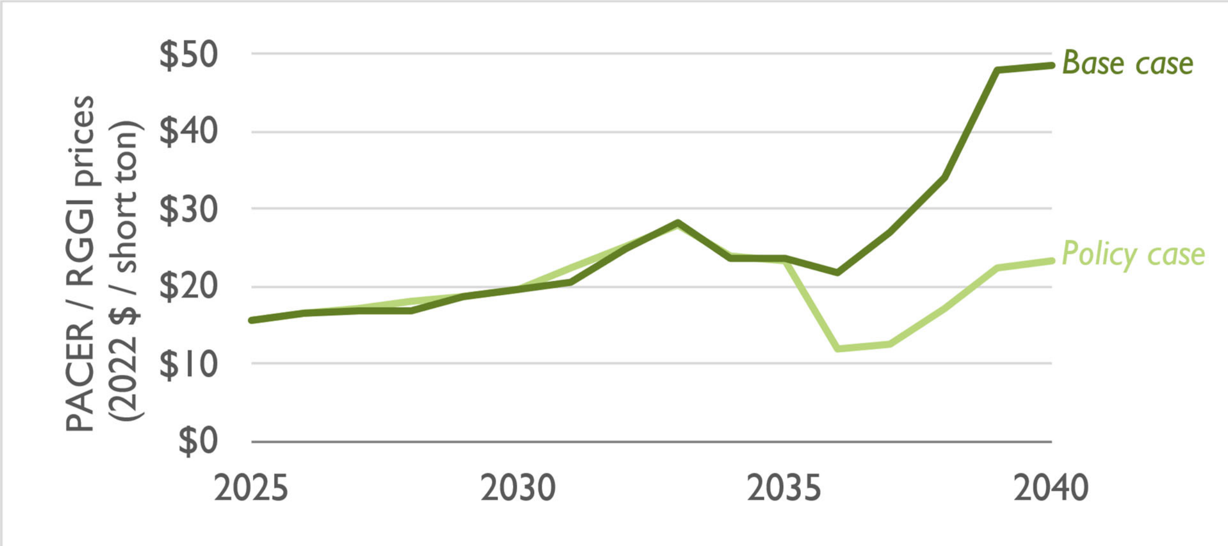
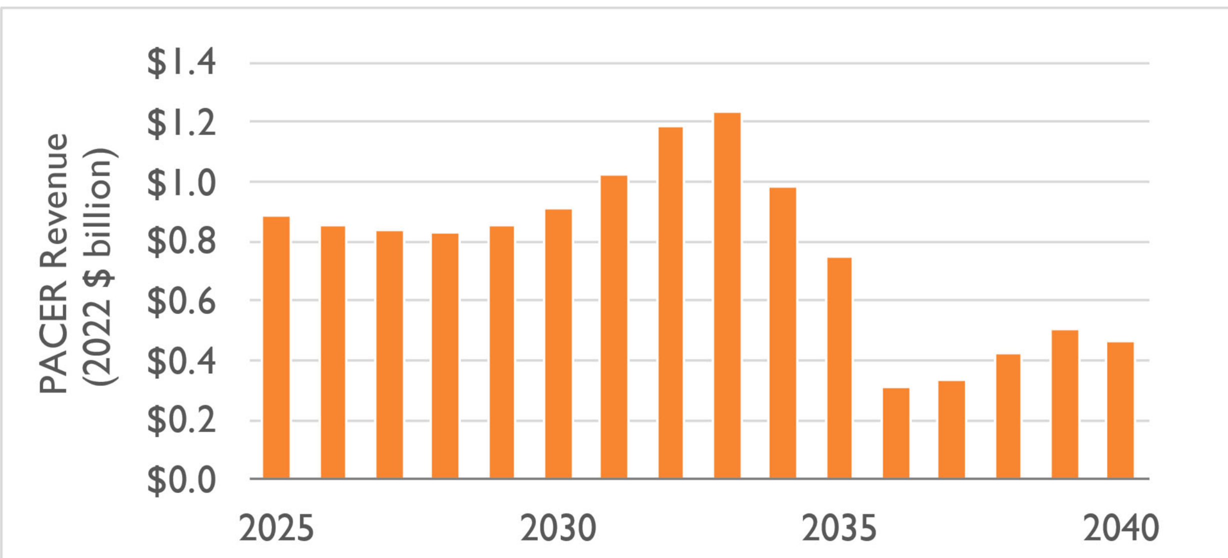


Figure 7. PACER revenue in Policy case



PRESS causes an increase in demand for RECs, leading to an increase in REC prices

Changes in REC prices are a result of changing demand and supply for RECs. This includes RECs produced and consumed inside Pennsylvania as well as neighboring PJM states (including Delaware, District of Columbia, Illinois Maryland, New Jersey, Ohio, and Virginia). In the Base case, the demand for PJM-wide RECs is expected to increase gradually over time, as demand for electricity grows and (to a lesser extent) as the percentage of load covered by state RPS policies increases over time (see Figure 8). One major exception to this trend is in 2027, when Ohio's RPS is assumed to expire, decreasing the regional demand for RECs by about 8 GWh. On the supply side, assumed build constraints prohibit large increases in REC availability from onshore wind and solar resources, while large offshore wind projects slated to come online in 2026–2027 are projected to be large, new sources of RECs. As a result of these trends, REC prices in the Base case are projected to fall from the historical highs observed in recent years to about $13 per MWh in 2026–2027, before rebounding to higher prices in the late 2020s (see Figure 9). REC prices are then projected to remain high until sufficient clean energy generating capacity can be built in the early 2030s. After this point, the pace of clean energy generators coming online exceeds the demand for RECs in the Base case, leading to REC prices falling to near-zero levels.

The Policy case changes this dynamic. In the Policy case, increases in regional REC demand due to PRESS outpace REC supply in virtually every year of our analysis through 2034. This leads to a situation where REC prices are at or near the assumed price cap through the early 2030s. Prices fall in the mid-2030s, when resource build constraints are assumed to loosen sufficiently to the degree that REC supply exceeds REC demand. This causes REC prices to fall to near-zero levels beginning in 2035. The maximum REC prices observed in the Policy case are lower than those observed in the Base case as a result of lower assumed ACP levels for Pennsylvania.

Figure 8. Modeled PJM-wide REC demand and supply

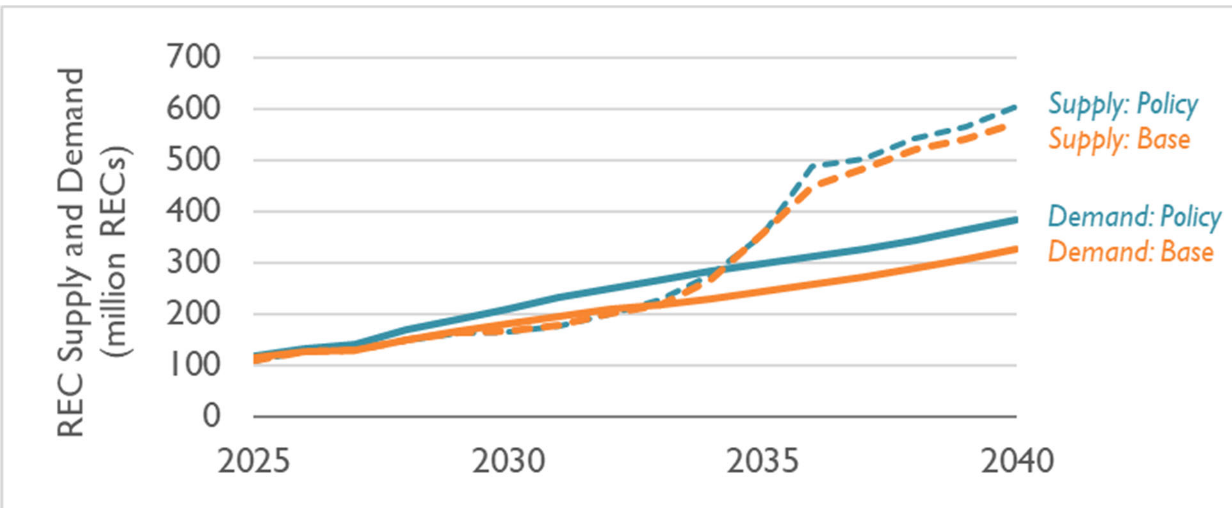
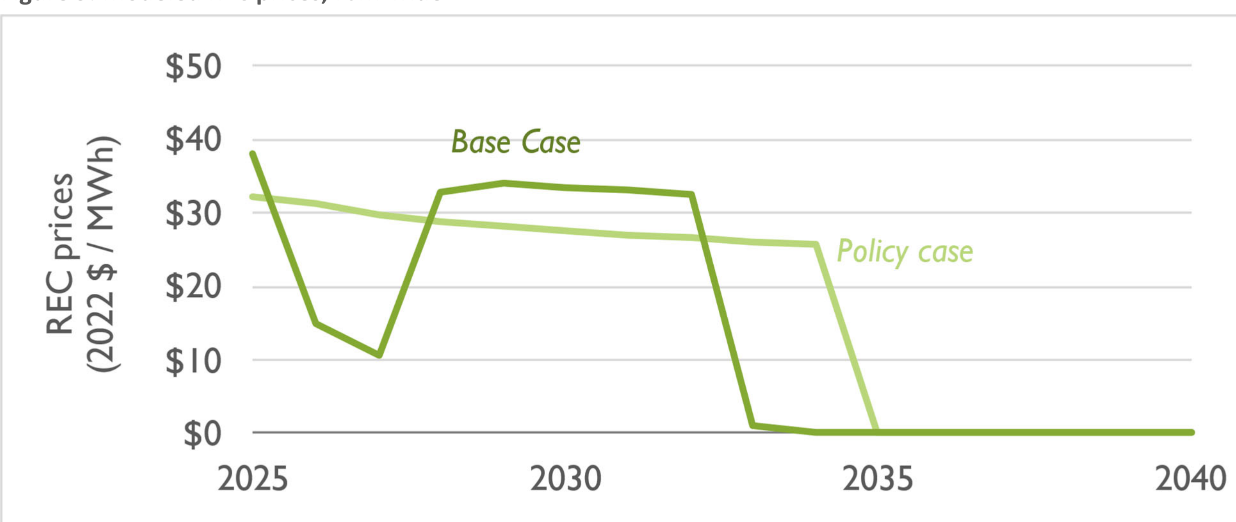


Figure 9. Modeled REC prices, PJM-wide



3. Discussion

Multiple variables influence the policies' projected outcomes. PJM leaders and Pennsylvania policymakers have several tools at their disposal for achieving policy goals. These include bill reductions, emissions reductions, and investment.

3.1. Addressing build constraints would have profound impacts on the ability of PRESS to incentivize new clean energy generation at low costs

Supply-side constraints related to PJM's interconnection queue and regional permitting processes will be a critical bottleneck to address in the coming years. Data centers and electrification are increasing load forecasts across PJM, while generator retirements are accelerating due to economics and environmental policies. PJM's declining reserve margin is driving up capacity market prices, increasing costs to ratepayers. Accelerating new resource deployment will be necessary to reliably serve new and existing load without greatly increasing costs to ratepayers. These dynamics also reduce the ability of state RPS policies to effectively incentivize changes to their resource portfolios in the near term.

PJM has been struggling with a large backlog of new project interconnections, while simultaneously working toward compliance with new and anticipated Federal Energy Regulatory Commission (FERC) reforms. In 2020, PJM launched a stakeholder process to explore interconnection reforms resulting in a closure of the queue in 2022 to enable PJM to process backlogs and implement reforms. But in spring 2022, PJM announced that it would not reopen the queue until the fourth quarter of 2025.[46] These reforms include a transition from a serial first-come, first-serve process to a first-ready, first-served cluster study process. The move to a cluster study model is intended to enable PJM to study more projects within a shorter amount of time. The move to a first-ready prioritization, as opposed to first-come, is intended to reduce the risk of speculative projects withdrawing. While FERC approved PJM's proposed reforms in November 2022,in late 2023, FERC announced Order 2023, which required RTOs to overhaul their interconnection process and raised questions about whether the timeline for PJM's initial reforms will be impacted.[47] The Commission has rejected any presumption of compliance for recently approved interconnection process reforms, including PJM's.[48] As PJM is continuing to litigate compliance questions at FERC, it is starting to make progress implementing its reforms by initiating the first transition cycle of its reformed interconnection process on January 22, 2024.[49]

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[46] Bruggers, James. 2022. "Largest US grid operator puts 1,200 mostly solar projects on hold for 2 years." *Courier Journal*, April 30. Available at: https://www.courier-journal.com/story/news/local/science/environment/2022/04/30/solarprojects-put-pause-largest-us-power-grid-operator/9587074002/.

[47] PJM Inside Lines, November 30, 2022. "FERC Approves Interconnection Process Reform Plan." Available at: https://insidelines.pjm.com/ferc-approves-interconnection-process-reform-plan/.

[48] PJM Request for Clarification and Rehearing of PJM Interconnection, 179 FERC ¶ 61,194 p. 8-10 (2023).

[49] PJM Inside Lines, January 22, 2024. "Transition Cycle 1 of New Interconnection Process Begins Jan. 22." Available at: https://insidelines.pjm.com/transition-cycle-1-of-new-interconnection-process-begins-jan-22/.

These factors, along with local permitting challenges, limit the development of new generating resources within PJM. PJM currently has the longest average duration between interconnection requests and interconnection agreements of any RTO in the United States, ranging from around 30 to 50 months.[50] The lengthy reform timeline is also increasing investment uncertainty for energy infrastructure developers who are already facing increasing interconnection costs.[51]

In our analysis, we rendered these supply-side constraints by including resource build constraints, based on feedback from PJM's modeling team. In the near- to mid-term, we limit the model's ability to build new capacity based on data from PJM's interconnection queue. Starting in 2031, we begin to loosen the build caps to reflect gradual improvements to the interconnection process. By 2036, all interconnection queue constraints are removed. Appendix A describes our resource build constraints in further detail.

If the constraints on building new resources in PJM were resolved, PRESS would be able to more effectively drive the buildout of new renewable energy resources in the region.[52] In this situation, the incremental REC demand created by PRESS would be competitively supplied by new energy resources. REC prices would likely be reduced in the near- and mid-term periods where the model is currently constrained. This would likely cause total bills in both the Base case and Policy case to be lower, with relative bill reductions in the Policy case even greater than currently modeled.

To test this, we modeled a sensitivity where we assumed that some number of resources in PJM's queue with the status of "Active" could get built before 2030.[53] Under these assumptions, residential monthly bills in the Base case and Policy case drop by $10 and $11 per month, respectively, compared to the scenario in which the build constraints are not resolved. In the Policy case, the average residential customer's bill would decrease by over $7 per month compared to recent historical bills. C&I monthly bills would drop by 7 percent in the Base and 9 percent in the Policy case compared to a future situation in which the build constraints are not more quickly resolved. These improvements demonstrate that solving the PJM queue bottleneck could reduce future electricity bills. These cost reductions are partially attributable to cheaper REC costs but are also caused by decreases in capacity prices (due to greater resource availability), and decreases in energy prices (due to zero-marginal-cost clean energy resources reducing the dollar-per-MWh price paid by all consumers). In a future with build constraints, the Policy case saves residential customers $1 compared to the Base case. In a future *without* build constraints,

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[50] Lawrence Berkeley National Laboratory. 2024. "Queued Up: 2024 Edition." Available at: https://emp.lbl.gov/sites/default/files/2024-04/Queued%20Up%202024%20Edition_R2.pdf.

[51] Seel, Joachim et al. 2023. "Interconnection Cost Analysis in the PJM Territory," Lawrence Berkeley National Laboratory, Available at: https://emp. lbl.gov/publications/interconnection-cost-analysis-pjm.

[52] The *Inflation Reduction Act* tax credits, along with declining capital costs for renewable energy resources, have generated significant interest among developers in building renewable energy resources. At the end of 2023, the PJM interconnection queue contained 287 GW of active resources. 7 GW of this was gas and the remaining resources were a combination of solar, wind, batteries and hybrid projects.

[53] We used queue data from late summer 2024 to create this sensitivity analysis. For wind, solar, storage, and gas resources, we assumed that the share of "Active" resources that could be built was equal to the total quantity of capacity in the queue for each resource since 2020, adjusted the amount of resources that moved from "Active" to "Under construction", "Engineering and procurement", or "Operational" in years prior to 2020. For example, this results in about one-quarter of the solar capacity in the "Active" queue being buildable by 2030. These values were added to the build constraints assumed in the main scenarios.

the Policy case saves residential customers $3 compared to the Base case. These additional savings indicate that alleviating permitting and queue constraints would enable PRESS and PACER to save residential customers an additional $2 per month.

On the C&I side, in a future with larger build constraints, the Policy case creates bill impacts for C&I customers of less than 0.5 percent compared to the Base case. In contrast, in a future without build constraints, the Policy case produces monthly bill *savings* for C&I customers of 2 percent. These additional savings show that alleviating permitting and queue constraints would enable the policies to save C&I customers an additional 2.5 percentage points per month.

With build constraints removed, the policies would drive the additional buildout of 180 MW of energy projects in Pennsylvania by 2030, meaning investment in local communities and jobs would occur earlier. And, if these build issues were resolved, the policies would reduce cumulative Pennsylvania emissions by an additional 9 percent.[54] Resolving build constraints would allow Pennsylvania to more efficiently meet its goals of reducing emissions and bills, and it would bring additional energy investment to the state.

3.2. Modifying PRESS and PACER program parameters could decrease bills even more

Pennsylvania leaders can consider a few options for adjusting program parameters to prioritize reducing bills. In terms of PRESS, language could be included to dynamically adjust ACP levels or REC requirements in order to mitigate bill impacts. In terms of PACER, there are multiple methods for allocating the revenue PACER generates, with each method having different bill impacts on different customer classes.

PRESS program parameters

One way to mitigate bill impacts is to adjust ACP levels. In our modeling, we assumed a level of $20 per MWh (in nominal dollars) for all tiers of the proposed PRESS program.[55] This level of ACP pricing, along with a REC supply that was constrained in many years of the analysis, resulted in RECs trading at or near the ACP price in all years from 2025 through 2034. This put upward pressure on projected bills. In general, if resource builds are constrained and utilities are regularly making Alternative Compliance Payments, higher ACP prices will lead to greater bill impacts. Conversely, if resources can be built more easily, higher ACPs can lead to more investment from developers and potentially more clean energy. In addition to adjusting the ACP level, bill impacts could also be mitigated by adjusting the demand for

[54] In referencing energy infrastructure builds and emissions reduction, we compare a Policy case future without build constraints to a Policy case future with build constraints to see what additional benefits the policies could drive with fewer barriers.

[55] As written, proposed language for PRESS describes an ACP of $45 per MWh for Tier I, $35 per MWh for Tier II, and $15 per MWh for Tier III. We note that neighboring PJM states with RPS policies (i.e., NJ, MD, DE, DC, VA) have Tier I ACPs between $25-50 per MWh, and Tier 2 ACPs of $10-50 per MWh (see https://www.pjm-eis.com/~/media/pjm-eis/documents/rps-comparison.ashx for more information).

RECs. If REC demand is high, but the system cannot build additional renewable energy (for example, due to interconnection or permitting issues), REC prices will be high, which will increase bills.

Other neighboring states include statutory language intended to minimize the cost impacts posed by RPS programs analogous to PRESS. For example, in Delaware, Illinois, and Michigan, the RPS statues allow commissions to modify RPS requirements and/or the ACP level to reduce customer bill impacts. In Illinois, this adjustment is limited to a $-per-kWh level specified in the legislation.

PACER revenue allocation parameters

Another way to mitigate bill impacts is to use different allocation methods for the revenues created by PACER. Potential options include having carve-outs for specific programs or customer classes, updating the size of any carve-outs, and considering the mechanics by which revenue is distributed to ratepayers receiving a dividend. The size and number of carve-outs will impact the amount of revenue remaining for customer dividends. Dividend reallocation can occur proportional to MWh sales of electricity, proportional to costs, or on a flat basis with each customer receiving an equal dividend amount. Different customer dividend allocation methods will have different impacts for different customer classes. Our modeled Policy case, which assumes that 75 percent of PACER revenue is directly rebated to customers through two pools (a residential pool and a commercial-and-industrial pool) produces bill savings for residential customers and very small bill impacts for C&I customers. Other allocation methods may produce larger bill impacts for certain customer classes.

APPENDIX A. MODELING METHODOLOGY

This section describes our analytical methods in greater detail.

EnCompass modeling

Developed by Yes Energy, EnCompass is a single, fully integrated power system platform that allows for utility-scale generation planning and operations analysis.[56] EnCompass is an optimization model that covers all facets of power system planning, including the following:

- Short-term scheduling, including detailed unit commitment and economic dispatch
- Mid-term energy budgeting analysis, including maintenance scheduling and risk analysis
- Long-term integrated resource planning, including capital project optimization and environmental compliance
- Market price forecasting for energy, ancillary services, capacity, and environmental programs

EnCompass provides unit-specific, detailed forecasts of the composition, operations, and costs of the regional generation fleet given the assumptions described in this document. Synapse has populated the model using the *EnCompass National Database*, created by Horizons Energy. Horizons Energy benchmarked its comprehensive dataset across the 21 North American Electric Reliability Corporation (NERC) Assessment Areas and it incorporates market rules and transmission constructs across 76 distinct zonal pricing points. Synapse uses EnCompass to first benchmark historical years, and then optimize the generation mix in PJM, NYISO, and ISO New England and to estimate the costs of a changing energy system over time.

Background on key inputs and assumptions in EnCompass modeling

Our analysis relies on several key assumptions related to load forecasts, resource costs and availability, and other parameters. These include:

- **Load projections** primarily based on PJM's 2024 Long-Term Load Forecast, supplemented with assumptions related to an additional 960-MW of data center load in Pennsylvania.
- **Natural gas fuel price projections** based on near-term and recent historical data retrieved from Natural Gas Intelligence, with longer-term gas price forecasts based on

[56] More information on EnCompass and the Horizons dataset can be found at https://www.yesenergy.com/encompass-power-system-planning-software.

the most recently available Annual Energy Outlook (2023) published by the U.S. Energy Information Administration (EIA).[57]

- **Resource cost projections** based on NREL's 2024 Annual Technology Baseline (ATB).[58] These costs are supplemented by assumed capital cost adders of 25 percent for onshore wind and utility-scale solar, which are intended to reflect increased costs related to supply chain constraints, permitting, and queue delays that are not otherwise captured in the ATB.

- **Resource cost potentials and capacity factors** based on data associated with the U.S. Environmental Protection Agency's (EPA) Power Sector Modeling Platform 2023.[59]

- **A system of resource build constraints based on feedback from PJM's modeling team.** This set of assumptions apply to onshore wind, utility-scale solar, battery storage, and gas-fired power plants, and include the following phases:

    - **Phase 1 (2025-2026):** Endogenous capacity builds not allowed.

    - **Phase 2 (2027-2030):** Endogenous capacity builds only allowed up to the maximum capacity in PJM's interconnection queue for solar, onshore wind, batteries, and gas. This "maximum capacity" is derived based on (a) projects in PJM's expediated queue that were submitted after 2021 with online dates of 2023 or later, and have a status of "engineering & procurement" or "under construction" less (b) the quantity of exogenous resource additions (which are subtracted from the cap in order to avoid double-counting).

    - **Phase 3 (2031-2035):** Endogenous capacity builds are allowed up to gradually loosening build caps. This phase is meant to represent gradual improvements to the PJM queue and siting, such that by the mid-2030s, resource builds are constrained only by economics and available resources.

    - **Phase 4 (2036-2040):** Endogenous capacity builds allowed, up to specified resource potentials. Offshore wind and long-duration storage are allowed to be built endogenously. Offshore wind and long-duration storage are only allowed to be built endogenously during Phase 4. Prior to Phase 4, the only offshore wind projects assumed include those projects that are named and have a known online date. During Phase 4, long-duration storage cost and operational parameters are based on data published by Form Energy.[60]

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[57] Historical Henry Hub prices were retrieved from Natural Gas Intelligence's (NGI's) "Daily" subscription service. NYMEX Futures prices for Henry Hub were retrieved from NGI's "Forward Look" subscription service. More details on each service can be found at: https://www.naturalgasintel.com/. Information on the Annual Energy Outlook can be found at https://www.eia.gov/outlooks/aeo/.

[58] More information on the Annual Technology Baseline (ATB) is available at https://atb.nrel.gov/.

[59] See https://www.epa.gov/power-sector-modeling/documentation-2023-reference-case for more on this data source.

[60] Form Energy. 2023 "Clean, Reliable, Affordable: The Value of Multi-Day Storage in New England." Available at https://formenergy.com/wp-content/uploads/2023/09/Form-ISO-New-England-whitepaper-09.27.23.pdf.

- **Modeled environmental costs for power** plants are consistent with the latest finalized EPA regulations, including regulations for greenhouse gas emissions under Section 111 of the *Clean Air Act* relevant from existing coal-fired power plants and new natural-gas-fired power plants.

Bill impact modeling

Our bill impact modeling uses data from our EnCompass modeling, as well as publicly available data published by EIA. It includes the following assumptions:

- We developed forward-going costs for energy, capacity, new transmission, and RECs using the EnCompass model.
- For a set of recent historical years, we subcontracted these costs from statewide revenues for Pennsylvania collected by EIA in Form 860.[61] The remaining quantity is assumed to be related to cost components not modeled in EnCompass, such as costs of distribution, utility return on equity, and legacy plant costs. We then assumed these costs to be constant in real dollar terms in all future years. In future years, this constant component is added to the changing energy, capacity, new transmission, and REC costs to estimate total systemwide costs.
- We then allocated systemwide costs across three sectors: residential, commercial, and industrial. Costs are allocated based on recent historical cost allocation, per data published by EIA 860. We assumed this cost allocation would change slightly over time, in order to reflect a shift towards large load customers (e.g., data centers).
- We then divided allocated costs by projected customer counts for each customer sector. Customer counts are based on recent historical data published by EIA 860 and are assumed to change in the future in line with load additions.
- We performed this set of steps for each modeled scenario, for each customer category, and for each year.

SERVM modeling

The Strategic Energy and Risk Valuation Model ("SERVM") model was developed by Astrapé and is a widely used reliability planning and production cost model.[62] SERVM evaluates an electric system through the lens of uncertainty and risk by taking information about past risks—such as historical weather, economic forecast error, load uncertainty, unit performance, and other information—and conducting hundreds of thousands of independent chronological simulations to evaluate the likelihood, magnitude, and economic cost of future reliability events on a system. SERVM can be used in several different ways. For instance, SERVM modeling can inform resource adequacy studies and determine the reserve margin necessary for a system to satisfy reliability metrics. Modelers can also use it to calculate

[61] For more on this dataset, see https://www.eia.gov/electricity/data/eia860/.

[62] For more information on SERVM, see https://www.astrape.com/servm/.

Effective Load Carrying Capacity ("ELCC") of solar and battery storage resources. SERVM can also be used to evaluate specific candidate resource portfolios to determine whether they satisfy reliability criteria. This is the manner in which SERVM was used for this study.

SERVM evaluates several areas of risk—weather, economic forecast error, load uncertainty, and unit performance—to evaluate reliability events for an electric system. For weather- and load-related risk, SERVM uses historical weather patterns to develop load profiles for each weather year. The load profiles are intended to predict how loads would respond if future weather were identical to historical weather in the period evaluated. SERVM then applies load forecast error multipliers with their associated probabilities to capture the potential for uncertainty in economic forecasts. Since economic variables are typically one of the key variable inputs into the development of a load forecast, the load forecast error multipliers simulate the expected probability that the peak demand would be higher or lower because of an error in the economic indicator forecast. The weather years included in the model also reflect the uncertainty around renewable resources, as the profiles for each resource will reflect the expected availability for that resource based on the historical weather profiles. SERVM models the uncertainty around generator unit availability through the simulation of random unit outage draws.

The simulations performed in SERVM result in the production of several reliability metrics, such as the Loss of Load Expectation ("LOLE"), Loss of Load Hours ("LOLH"), and Expected Unserved Energy ("EUE"), which can be used to evaluate the reliability of a resource portfolio. Most typically, a 1-day-in-10-year LOLE reliability standard (0.1 days/year) is used to evaluate the reliability of a resource portfolio.

The starting point for this study is Astrapé's Eastern Interconnect database, which includes the hourly load shapes and renewable resource profiles for the weather years spanning 1980 to 2022. The topology of PJM and interactions with neighboring regions were set up in SERVM to reflect what was modeled in EnCompass.

APPENDIX B. DETAILS OF PACER AND PRESS MODELING

This appendix provides additional detail on the specific ways PACER and PRESS were rendered in our analysis.

PACER

The Pennsylvania Climate Emissions Reduction Program (PACER) is a Pennsylvania cap-and-invest program. In this analysis, simplifications to modeling PACER include:

- We assume full trading and interoperability with RGGI allowances, including assumptions for cost containment and emissions containment rules, historical and future banking assumptions, price floors, and program extensions past 2030.[63] We assume that the RGGI program continues past 2030, with annual reductions in total allowances occurring at the same rate as have occurred in the recent past.
- Our capacity expansion modeling does not assume any dynamic recirculation of funds raised by PACER. Instead, after an EnCompass capacity expansion modeling run is complete, we estimate the amount of funds created through allowance sales and use post-processing analyses to determine the effect that these funds will have on ratepayers in Pennsylvania.
- The initial CO_2 allowance allocations are based on from the Pennsylvania CO_2 Budget Trading Program base budget, as described in Table 3.
- We assume that the PACER program will apply to all emitting plants in Pennsylvania that have unit capacities greater than or equal to 25 MW. This includes the plants described in Table 4.
- PACER contains a set-aside program for waste coal, wherein 10.4 million allowances are removed from the auction each year and "set aside" to be available for use by waste coal plants.[64] We assume that waste coal plants are able to access these allowances for free. Of the remaining allowances, 90 percent are recirculated into the auction, with 10 percent retained for use in a strategic set-aside account.

[63] Specifically, we are assuming that historical "TABA" banking adjustments (which lower the RGGI cap) continue through 2030 at the same quantity as is currently in effect through 2025. We do not model year-to-year banking (as this is computationally difficult to implement without also allowing for year-to-year borrowing). We assume that after 2030, the RGGI CO_2 cap continues to decline at the same rate it has been declining at and a price floor of $2 per short ton in 2014 dollars. Our modeling assumes that Virginia is not part of RGGI in 2024 or any later years.

[64] The proposed statutory language for PACER also includes a set-aside related to combined heat-and-power (CHP) resources. This set-aside has not been modeled as it appears to be both idiosyncratic year-to-year and not as impactful to bill impacts, emissions, or other metrics as other components of PACER.

Table 3. Assumed annual allowances in PACER (million short tons CO_2)

Year	Annual CO_2 allowances	Notes
2022	78	-
2023	75.5	-
2024	73	-
2025	70.5	-
2026	68	-
2027	65.5	-
2028	63	-
2029	60.5	-
2030	58	-
2031	55.5	We assume that the emissions cap in 2031 and all later years declines at the same rate as in 2022–2030 (i.e., a decline of 2.5 million short tons per year).
2032	53	
2033	50.5	
2034	48	
2035	45.5	
2036	43	
2037	40.5	
2038	38	
2039	35.5	
2040	33	

Table 4. List of Pennsylvania power plants assumed to be affected by PACER

Plant Name	Plant ID	Plant Type	Nameplate Capacity (MW)
Allegheny Energy Units 3, 4, & 5	55710	NGCC	556
Archbald Power Station	50279	NGGT	92.9
Armstrong	55347	NGGT	688
Bethlehem Power Plant	55690	NGCC	1,153
Birdsboro Power	61035	NGCC	525
Brunner Island	3140	Oil/Gas Steam	1,616.1
Brunot Island	3096	Oil GT	25.3
Brunot Island	3096	NGCC	340.1
Chambersburg	55654	NGGT	87.6
Colver Green Energy	10143	Waste Coal	118
Conemaugh	3118	Coal Steam	1,963
Covanta Delaware Valley	10746	Trash-to-energy	90
Covanta Plymouth Renewable Energy	54625	Trash-to-energy	32.1
CPV Fairview Energy Center	60589	NGCC	1,197
Croydon CT Generating Station	8012	Oil GT	546.4
Ebensburg Power	10603	Waste Coal	57.6
Eddystone Generating Station	3161	Oil/Gas Steam	861.6
Fairless Energy Center	55298	NGCC	1,338
Fayette Energy Facility	55516	NGCC	714.9
Foster Wheeler Mt Carmel Cogen	10343	Waste Coal	47.3
Gans	55377	NGGT	87.6
Grays Ferry Cogeneration	54785	Oil/Gas Steam	57.6
Grays Ferry Cogeneration	54785	NGGT	135
Hamilton Liberty	58420	NGCC	870

Plant Name	Plant ID	Plant Type	Nameplate Capacity (MW)
Hamilton Patriot Generation Plant	58426	NGCC	870
Handsome Lake Energy LLC	55233	NGGT	294.5
Hickory Run Energy Station	61028	NGCC	1,033.7
Hill Top Energy Center, LLC	62565	NGCC	664.7
Homer City Generating Station	3122	Coal Steam	2,012
Hummel Station LLC	60368	NGCC	1,194.4
Hunlock Power Station	3176	NGCC	145.9
Hunlock Unit 4	56397	NGGT	44
Hunterstown Power Plant	55976	NGCC	898
Ironwood LLC	55337	NGCC	777.6
John B Rich Memorial Power Station	10113	Waste Coal	88.4
Keystone	3136	Coal Steam	1,883.2
Lackawanna Energy Center	60357	NGCC	1,498.5
Lancaster County Resource Recovery	50859	Trash-to-energy	35.7
Liberty Electric Power Plant	55231	NGCC	614
Lower Mount Bethel Energy	55667	NGCC	651.6
Marcus Hook Energy LP	55801	NGCC	836.1
Mon Valley Works	50732	Oil/Gas Steam	52.5
Mountain	3111	Oil GT	54
Moxie Freedom Generation Plant	59906	NGCC	1,058
New Castle Plant	3138	Oil/Gas Steam	354.4
Northampton Generating Company LP	50888	Waste Coal	134.1
Ontelaunee Energy Center	55193	NGCC	728
Orrtanna	3112	Oil GT	27
Panther Creek Energy Facility	50776	Waste Coal	94
Pixelle Specialty Solutions LLC - Spring Grove Facility	50397	Coal Steam	45.9
Pixelle Specialty Solutions LLC - Spring Grove Facility	50397	Biomass Byproducts	57.7
Portland (PA)	3113	Oil GT	194
Procter & Gamble Mehoopany Mill	50463	NGGT	120.2
Richmond Generating Station	3168	Oil GT	131.6
Scrubgrass Reclamation CO. LP.	50974	Waste Coal	94.7
Seward (PA)	3130	Waste Coal	585
Shawville	3131	Oil/Gas Steam	632
Shell Chemical Appalachia LLC	58933	NGCC	309.8
Springdale 1 & 2	55196	NGGT	87.6
St Nicholas Cogen Project	54634	Waste Coal	99.2
TalenEnergy Martins Creek	3148	Oil/Gas Steam	1,794.1
TalenEnergy Montour	3149	Coal Steam	1,757.9
Tenaska Westmoreland Generating Station	60464	NGCC	1,134
Tolna	3116	Oil GT	54
Warren	3132	NGGT	53.1
West Point (PA)	52149	NGGT	85.8
Westwood Generation LLC	50611	Waste Coal	36
Wheelabrator Falls	54746	Trash-to-energy	53.3
York County Resource Recovery	50215	Trash-to-energy	36.5
York Energy Center	55524	NGCC	1,449.4

PRESS

The Pennsylvania Reliable Energy Sustainability Standard (PRESS) is a policy aimed at updating and replacing Pennsylvania's current Alternative Energy Portfolio Standards (AEPS) policy. The main elements of PRESS include creating or revising the parameters of Tier I, II, and III resources that can generate renewable energy credits (REC), increasing the share of electric energy that must come from each resource tier by certain key dates, and establishing a zero-emissions credit (ZEC) program. Table 5 describes both the existing AEPS policy from 2021–2040 and the proposed PRESS policy.

Table 5. REC percentage requirements under the existing AEPS policy and the proposed PRESS policy, 2021–2040

	Existing AEPS			Proposed PRESS				
	Tier I	*Tier I solar carve-out*	*Tier II*	*Tier I*	*Tier I solar carve-out*	*Tier I in-state carve-out*	*Tier II*	*Tier III*
2021	8.0%	0.5%	10.0%	8.0%	0.5%	-	-	-
2022	8.0%	0.5%	10.0%	8.0%	0.5%	-	-	-
2023	8.0%	0.5%	10.0%	8.0%	0.5%	-	-	-
2024	8.0%	0.5%	10.0%	8.0%	0.5%	-	-	-
2025	8.0%	0.5%	10.0%	10.7%	0.5%	-	6.0%	3.80%
2026	8.0%	0.5%	10.0%	13.4%	0.5%	-	6.5%	3.80%
2027	8.0%	0.5%	10.0%	16.1%	0.5%	-	7.0%	3.80%
2028	8.0%	0.5%	10.0%	18.8%	0.5%	-	7.5%	4.40%
2029	8.0%	0.5%	10.0%	21.5%	0.5%	-	8.0%	4.40%
2030	8.0%	0.5%	10.0%	24.2%	0.5%	10.0%	8.5%	4.40%
2031	8.0%	0.5%	10.0%	26.9%	0.5%	11.0%	9.0%	5.0%
2032	8.0%	0.5%	10.0%	29.6%	0.5%	12.0%	9.5%	5.0%
2033	8.0%	0.5%	10.0%	32.3%	0.5%	13.0%	10.0%	5.0%
2034	8.0%	0.5%	10.0%	35.0%	0.5%	14.0%	10.0%	5.0%
2035	8.0%	0.5%	10.0%	35.0%	0.5%	15.0%	10.0%	5.0%
2036	8.0%	0.5%	10.0%	35.0%	0.5%	16.0%	10.0%	5.0%
2037	8.0%	0.5%	10.0%	35.0%	0.5%	17.0%	10.0%	5.0%
2038	8.0%	0.5%	10.0%	35.0%	0.5%	18.0%	10.0%	5.0%
2039	8.0%	0.5%	10.0%	35.0%	0.5%	19.0%	10.0%	5.0%
2040	8.0%	0.5%	10.0%	35.0%	0.5%	20.0%	10.0%	5.0%

Notes: All percentages refer to the share of energy relative to Pennsylvania's total retail electricity demand. Compliance years are from June 1 to May 31. For purposes of modeling simplification and alignment with other RPS programs with mutual resource eligibility, we assume that compliance years are equal to January 1 to December 31.

Our modeling of the PRESS program includes the following assumptions and simplifications:

- We assume that both AEPS and PRESS exist within the context of the broader market for RECs in PJM. Numerous other PJM states (including Delaware, District of Columbia, Illinois, Maryland, New Jersey, Ohio, and Virginia) have RPS-like policies. Like Pennsylvania, many of these states have multiple tiers for compliance, each of which has different but overlapping resource eligibility. In other words, a resource that is eligible to sell a Tier I REC in one state may only be eligible to sell that same MWh as a Tier II REC in a different state. As a result of this overlapping eligibility, we estimate the total REC demand for each PJM state across all tiers, and we group this demand together as a single pool in which eligible resources from all RPS tiers are able to generate RECs.

- Separately, we also model the demand for in-state RECs for Pennsylvania under PRESS. Eligible resources in Pennsylvania are able to create RECs both for the in-state requirement and the PJM REC demand at large.

- We model alternative compliance payment (ACP) prices as an average of all PJM state's ACP prices, weighted by each state and each tier's contribution to REC demand. This leads to an average nominal price of $42 per MWh in the Base case and $35 per MWh in the Policy case.