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Pennsylvania's Energy Crossroads: Charting a Pragmatic Path to Decarbonization

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BALANCING INDUSTRIAL HERITAGE WITH CLIMATE AMBITION

Pennsylvania stands as a pivotal state in the American energy landscape, defined by a deep heritage as a major producer and consumer of fossil fuels. This legacy has powered its industries and communities for generations, but it also presents a formidable challenge in an era of accelerating climate change. Pennsylvania is therefore confronted with a defining question: how to reconcile its climate ambitions with the economic realities of its industrial base and the affordability needs of its citizens, a tension that can only be resolved through pragmatism.

ENERGY CONSUMPTION AND EMISSIONS

Pennsylvania's energy consumption and emissions per person are close to the national average, according to data from the U.S. Energy Information Administration (*see Fig. 1)*. Coal-fired generation has been cut by 90% since 2005, with nearly all electricity now coming from gas and nuclear, reducing emissions from the power sector (*see Fig. 2)*. Residential electricity prices are slightly above average, but consumption is well below, keeping bills in check. Total energy spending per person on electricity, gas, and gasoline is about 5% below the national average (*see Fig. 3)*. But like other states in the PJM Interconnection, growing demand from data centers and capacity shortages are putting upward pressure on power prices.

Pennsylvania's total emissions rank in line (4th) with its population (5th) and the size of its economy (6th). But the state has been more successful than most in lowering them: Emissions were cut to 201 million metric tons in 2023 from 276 million in 2005. The decline was significantly faster (1.9% per year) than the country as a whole (1.2% per year), mostly because gas has replaced coal-fired electricity generation while population growth has been slow.

Emissions are relatively high given the size of the economy. Pennsylvania's principal economic activities are finance, insurance, real estate, and professional and business services, which are not energy intensive. But chemicals, oil and gas extraction, mining, food manufacturing, metals, and machinery are also significant and use far more energy. The state emitted 251 tons for every $1 million of output in 2023, down from 450 tons in 2005, after adjusting for inflation. Emissions per $1 million of output were the 23rd highest in the country and well above the national average (211 tons). Pennsylvania emits almost three times as much CO_2 as New York and twice as much as Connecticut to produce the same amount of economic output.

The state has made slightly faster progress than most others in reducing the carbon intensity of its energy system (*see Fig. 4)*. Fossil fuels accounted for 78% of primary energy consumption in 2023, down only marginally from 81% in 2025, but there has been a shift to lower-emission gas from oil and especially coal. As a result, Pennsylvania emitted 46 metric tons of CO_2 for every 1 billion British thermal units of energy supplied in 2023, down from 61 tons in 2005. Carbon intensity was well above low-carbon leaders Vermont (38 tons), New Hampshire (39 tons), and South Carolina (40 tons), but 9% below the national average (51 tons).

Pennsylvania is the country's third-largest electricity generator (after Texas and Florida), and it exports more surplus power to neighboring states than any other. Fossil fuels accounted for 65% of generation in 2023, a slight increase from 63% in 2005. But coal-fired generation has been slashed by 90%, replaced by lower-emission gas. Fossil fuels retained their market share for two reasons: First, while the state remains the second-highest nuclear generator in the country after Illinois, production from that source has remained flat over time. Meanwhile, renewable growth has been slow: The state uses little hydro, wind, or solar power, with them accounting for just 4% of its electricity generated in 2023.

Pennsylvania's energy consumption is in line with the national average, making the state something of a bellwether. Consumption per person (277 million BTUs) was indistinguishable from the national average (278 million BTUs) in 2023. But energy efficiency is low. Energy consumption per $1 million of output was 9% above the national average. Since 2005, the state has been falling further behind, with consumption per unit of output declining more slowly (1.9% per year) than across the country as a whole (2.2% per year).

How Natural Gas Reshaped Pennsylvania's Emissions Landscape

The single most significant event in Pennsylvania's recent emissions history has been the massive, market-driven fuel switch from coal to natural gas, particularly in the power sector. Rather than being the result of prescriptive mandates, it demonstrates the power of market forces to deliver deep decarbonization.

The scale of this shift is striking. In electricity generation, coal's dominance collapsed from providing 110 billion kilowatt-hours (kWh) in 2010 to just 13 billion kWh in 2024. Over the same period, natural gas generation surged from 34 billion kWh to 144 billion kWh, fundamentally remaking the state's power grid. This transition was the primary driver of a 32% reduction in per capita emissions from their peak of 22.7 metric tons in 2005. Having already captured these immense, market-driven gains, Pennsylvania must now confront the much harder task of decarbonizing the rest of its energy system.

2020 MANDATES MEET 2026 REALITY

In 2019, then-Governor Tom Wolf signed an executive order that mandated a reduction in greenhouse gas emissions of 26% by 2025 and 80% by 2050 compared to 2005 levels.

Like many other states, Pennsylvania made dramatic reductions through switching from coal generation to natural gas. By 2017, emissions were already 19.2% below 2005 levels, and by 2022, reductions had reached 21.2%. Achieving the 80% reduction by 2050 will likely be much more difficult and costly.

Governor Josh Shapiro has proposed ambitious legislation to continue reducing emissions, but on a path that is more suitable to Pennsylvania’s unique energy profile. In November of 2025, Pennsylvania left the Regional Greenhouse Gas Initiative (RGGI), a cap-and-invest program that covers the Northeast and Mid-Atlantic states that sets mandatory limits on emissions from large fossil fuel generation plants. Both of these actions reflect a pragmatic approach to emissions reduction and economic growth. Leaving RGGI for a proposed PA-centered cap-and-invest program has riled many environmentalists, but the Governor’s continued commitment to reducing the state’s emissions shows reasonable climate ambitions.

NAVIGATING THE NEXT PHASE

While the coal-to-gas transition yielded significant and relatively low-cost emissions reductions, Pennsylvania now faces a far more complex and costly set of challenges on its path to a low-carbon future. The era of low-hanging fruit is largely over. This section evaluates the primary obstacles to further decarbonization, focusing on the composition of the state's remaining emissions and the critical importance of maintaining energy affordability for consumers and industry.

Beyond the Low-Hanging Fruit

Unlike its previous phase, which involved replacing a high-carbon fossil fuel (coal) with a lower-carbon one (natural gas), the next stage of deep decarbonization in Pennsylvania would require displacing the state's dominant and reliable energy sources with intermittent renewables. This presents a challenge of a completely different magnitude, cost structure, and technical complexity.

Identifying the Core Emitters

To effectively target emissions, policymakers must focus on the largest sources. A breakdown of Pennsylvania's energy-related CO_2 emissions by economic sector in 2023 reveals a clear set of priorities:

1. **Industrial Sector:** 67 million tonnes
2. **Transportation Sector:** 56 million tonnes
3. **Electric Power Sector:** 49 million tonnes

This hierarchy of emissions sources reveals a pivotal strategic reality: while much of the policy discourse focuses on the power grid, it is now the third-largest source of emissions in Pennsylvania. A credible decarbonization strategy must therefore prioritize the far more complex challenge of the industrial and transportation sectors.

The Consumer Affordability Equation

A crucial factor for the political sustainability of any climate policy is its impact on consumers. Historically, Pennsylvanians often paid energy prices above the national average (*see Fig. 5*). But no longer: In 2023, Pennsylvania's per capita energy spending stood at $4,445, below the national average of $4,657. The trend toward improving affordability directly coincided with the shale gas revolution, which transformed Pennsylvania into a leading energy producer and lowered in-state fuel costs for power generation and heating.

This newfound affordability is a significant economic benefit for households and businesses, but it is also fragile. Aggressive, mandated decarbonization policies that force the replacement of low-cost energy sources with more expensive alternatives have slowed this positive trend. A sharper rise in energy costs could quickly undermine public and political support for the energy transition, making consumer impact a central consideration for any future policy design.

A PRAGMATIC PATH FORWARD FOR THE KEYSTONE STATE

Pennsylvania's unique profile as an industrial energy producer requires a tailored decarbonization strategy, distinct from approaches that may work in consumption-driven, high-efficiency states. The commonwealth must forge a path that aligns climate ambition with economic pragmatism. The following three principles provide a framework for a durable, effective, and sustainable climate strategy.

Leverage, Don't Eliminate, Foundational Energy Assets

Pennsylvania's electricity grid is anchored by two dominant sources of reliable, dispatchable power: natural gas, which generated 144 TWh in 2024, and nuclear, which produced 75 TWh. With the industrial and transportation sectors now representing the state's largest emissions sources, prematurely destabilizing the power grid would be a strategic error. State policy must treat these assets as the foundational pillars of a stable transition, ensuring grid reliability and affordability, which are the essential preconditions for durable public support for any long-term climate strategy. This foundation will serve to increase renewable deployments without threatening reliability and affordability.

Prioritize Technology-Neutral, Outcome-Based Policy

Effective climate policy should shift away from prescriptive technological mandates such as specific percentage targets for wind or solar and toward a framework that incentivizes the most cost-effective CO_2 reductions, regardless of their source. A technology-neutral, outcome-based approach fosters innovation and competition among all low-carbon solutions. This could include advancements in carbon capture for natural gas facilities, next-generation nuclear technologies, and other emerging systems that can deliver clean, reliable power at the lowest possible cost to society.

Ground Climate Ambition in Economic and Grid Reality

For a state with a significant industrial base and a population sensitive to energy costs, climate policy cannot succeed in a vacuum. The political durability of any climate strategy in Pennsylvania is directly tied to its ability to achieve emissions goals without compromising economic competitiveness, straining household budgets, or degrading the reliability of the energy services upon which modern life depends.

A PENNSYLVANIAN CLIMATE STRATEGY

Pennsylvania's high-energy, industrial profile makes its decarbonization journey fundamentally different from that of other states. Its path forward cannot be a simple matter of adopting policies designed for vastly different economies. The state's most significant emissions reductions to date were not the result of prescriptive mandates but rather a market-driven technological shift, the transition from coal to natural gas in power generation.

A successful future strategy must learn from this history. It must be pragmatic, not prescriptive, building upon the state's existing energy strengths in natural gas and nuclear power to ensure reliability and affordability. The focus should be on achieving measurable, cost-effective emissions reductions rather than mandating specific technologies. For the Keystone State, a durable climate plan must also be a durable economic plan, one that brings voters together to reduce emissions and build a successful economy.

APPENDIX: PENNSYLVANIA STATE ENERGY CONSUMPTION AND EMISSIONS

Pennsylvania's energy consumption and emissions per person are close to the national average, making the state something of a bellwether, according to data from the U.S. Energy Information Administration [1]. Coal-fired generation has been cut by 90% since 2005, with nearly all electricity now coming from gas and nuclear, reducing emissions from the power sector. Residential electricity prices are slightly above average, but consumption is well below, keeping bills in check. Total energy spending per person on electricity, gas, and gasoline is about 5% below the national average. But like other states in the PJM Interconnection, growing demand from data centers and capacity shortages are putting upward pressure on power prices.

Pennsylvania's total emissions rank in line (4th) with its population (5th) and the size of its economy (6th). The state has been more successful than most in lowering them further. Emissions were cut to 201 million metric tons in 2023 from 276 million in 2005. The decline was significantly faster (1.9% per year) than the country as a whole (1.2% per year), mostly because gas has replaced coal-fired electricity generation while population growth has been slow.

Emissions per person are aligned with the national average and have fallen at a similar rate to the country as a whole. Per capita emissions were cut to 15 tons in 2023 from 23 tons in 2005. Emissions per person were the 22nd highest in the country and almost exactly in line with the national average (14 tons). Emissions were about the same as Australia (14 tons) and Canada (15 tons), but much higher than Germany (7 tons) or Japan (8 tons).[2]

Emissions are relatively high given the size of the economy. Pennsylvania's principal economic activities are finance, insurance, real estate, and professional and business services, which are not energy-intensive. But chemicals, oil and gas extraction, mining, food manufacturing, and metals and machinery are also significant and use far more energy. The state emitted 251 tons for every $1 million of output in 2023, down from 450 tons in 2005, after adjusting for inflation. Emissions per $1 million of output were the 23rd highest in the country and well above the national average (211 tons). Pennsylvania emits almost three times as much CO_2 as New York and twice as much as Connecticut to produce the same amount of output.

The state has made slightly faster progress than most others in reducing the carbon intensity of its energy system. Fossil fuels accounted for 78% of primary energy consumption in 2023, down only marginally from 81% in 2025, but there has been a shift to lower-emission gas from oil and especially coal. As a result, Pennsylvania emitted 46 metric tons of CO_2 for every 1 billion British thermal units of energy supplied in 2023, down from 61 tons in 2005. Carbon intensity was well above low-carbon leaders Vermont (38 tons), New Hampshire (39 tons), and South Carolina (40 tons), but 9% below the national average (51 tons).

Pennsylvania is the country's third-largest electricity generator (after Texas and Florida), and it exports more surplus power to neighboring states than any other. Fossil fuels accounted for

65% of generation in 2023, and the proportion had actually increased slightly from 63% in 2005. Coal-fired generation has been slashed by 90%, replaced by gas, which increased twelvefold. Pennsylvania's non-fossil generation comes almost entirely from nuclear. The state is the second-highest nuclear generator in the country after Illinois. But nuclear generation has remained flat, and its share of the total has been diminishing. The state has little other low-emission generation from hydro, wind, or solar. Renewables accounted for just 4% of electricity generated in the state in 2023. As a result, there has been a small increase in both the share and the absolute amount of fossil generation, albeit from lower-emission gas rather than coal.

Pennsylvania's energy consumption is in line with the national average, making the state something of a bellwether. Consumption per person (277 million British thermal units) was indistinguishable from the national average (278 million BTUs) in 2023. But energy efficiency is low. Energy consumption per $1 million of output (4.51 billion BTU) was 9% above the national average (4.13 billion BTU). Since 2005, the state has been falling further behind, with consumption per unit of output declining more slowly (1.9% per year) than across the country as a whole (2.2% per year).

Pennsylvania is fairly urbanised. Population density is among the highest in the country (9th), with three times as many inhabitants per square mile (291) as the national average (94). Most dwellings are single-family homes (60%) rather than multi-family units (40%). The share of single-family homes is much higher than in neighboring New York (40%), New Jersey (53%), and Maryland (53%), but slightly lower than the national average (62%). Smaller dwellings use less energy for heating, cooling, lighting, and power.

Residential electricity consumption per person has declined at an average annual rate of 0.4% since 2005 as a result of efficiency improvements. Residential use ranked fairly low (31st) (4,020 kilowatt-hours per person) and 7% below the average (4,305 kWh per person) in 2023, which has helped keep bills down.

By contrast, gas use per person has surged faster than in any other state except North Dakota, as a result of abundant production from the Marcellus Shale and the massive expansion of gas-fired electricity generation. Consumption by all sectors, including generators, tripled to 149 million BTU per person in 2023 from 58 million in 2005. Per capita gas use is among the highest in the country (11th) and 49% above the average (100 million BTU).

Pennsylvania lies on the heavily travelled East Coast transportation corridor, but it also has the fifth-highest transit use in the country because of its relatively high urban density. State highways recorded 100 billion vehicle-miles travelled in 2023 (ranking 15th). But the volume of driving (7,691 vehicle-miles per person) was 20% below the national average (9,640). As a result, state residents consumed less oil (18 barrels per person per year) than the U.S. average (22 barrels).

Pennsylvania's energy and climate policies have not so far contributed to higher prices for gas, electricity, and gasoline. State gasoline prices (including taxes) were 3% above the national average in 2023. But this was more than offset by low consumption, ensuring residents spent $200 per person less on gasoline than in the country as a whole during 2023.

In 2023, electricity prices were slightly above average while gas prices were slightly below as a result of the abundance of local shale gas production. Overall, however, residents spent less on gas, electricity, and petroleum than in most states. Pennsylvania residents spent just over $4,445 per person on energy (35th highest in the country), well below the national average of over $4,600. But because the state's economic value-added is relatively low, energy expenditure accounted for 5.9% of state output (32nd highest in the country), slightly higher than the national average (5.7%).

RECENT DEVELOPMENTS IN ELECTRICITY PRICES (2019-2024)

Since 2019, Pennsylvania's electricity prices have increased slightly faster than the country as a whole. Retail prices for residential customers increased by almost 29% between 2019 and 2024. Most of the increase was attributable to inflation, with the consumer price index excluding volatile food and energy items up by 21%. In real terms, residential prices increased by 6% compared with an increase of under 5% nationwide. Real power prices have risen more slowly (1.2% per year) than in neighboring New York (2.4% per year), Maryland (2.4% per year), and Delaware (1.7%).

But upward pressure on power prices is starting to accelerate. Pennsylvania is the core of the PJM wholesale electricity market, where prices surged last year as a result of increased demand from data centers. Wholesale electricity costs across the region soared by more than 40% in the first nine months of 2025 compared with the same period in 2024, the fastest increase since Russia's invasion of Ukraine caused gas prices to spike in 2022. [3]

Rising wholesale costs are filtering through to higher residential rates. Residential prices increased by almost 8% in the first ten months of 2025 compared with the same period in 2024. Price increases were among the fastest in the country and well above the nationwide increase of 5%. Further increases are likely in 2026, with regulators blaming data centers and rising capacity charges for pushing up power bills.

1 Unless stated otherwise, all the data and rankings in this profile are taken from the most recent online edition of the State Energy Data System (SEDS) published by the U.S. Energy Information Administration and cover energy consumption and emissions through 2023. Emissions are restricted to carbon dioxide (CO_2) from combustion of fossil fuels, excluding fugitive methane, other greenhouse gases, and emissions from land use, land-use change, and forestry.

2 International comparisons are taken from the Emissions Database for Global Atmospheric Research (EDGAR) published by the Joint Research Centre of the European Union.

3 PJM State of the Market Report (Monitoring Analytics LLC, 13 November 2025).

Figure 1: State-level energy consumption in 2023
million British thermal units per capita

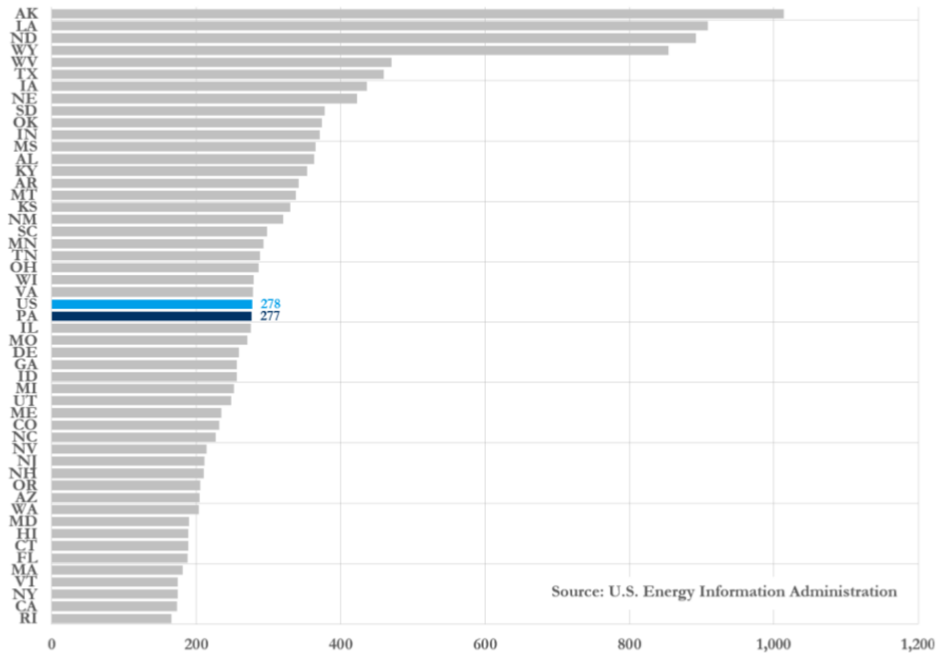
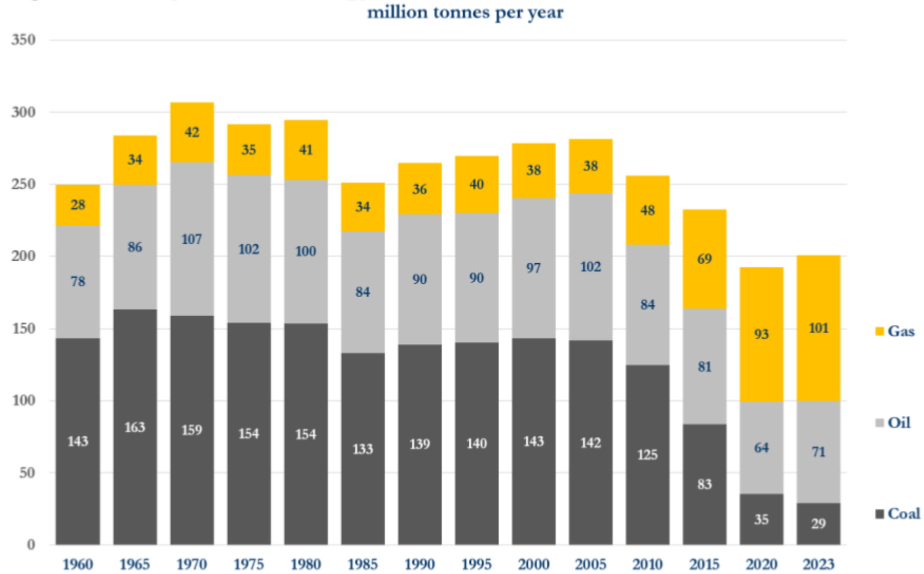
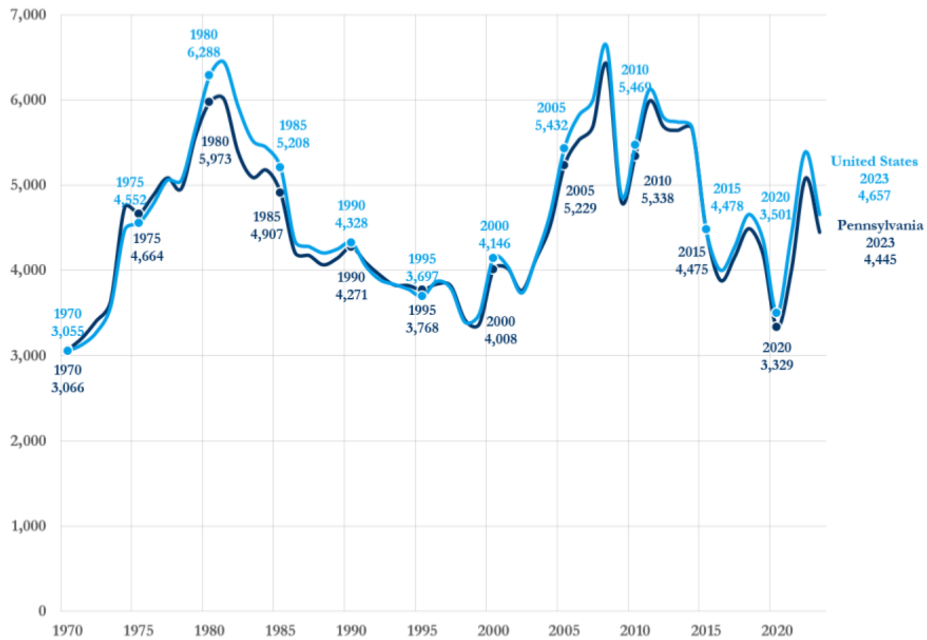


Figure 2: Pennsylvania state energy-related carbon dioxide emissions, 1965-2023
million tonnes per year



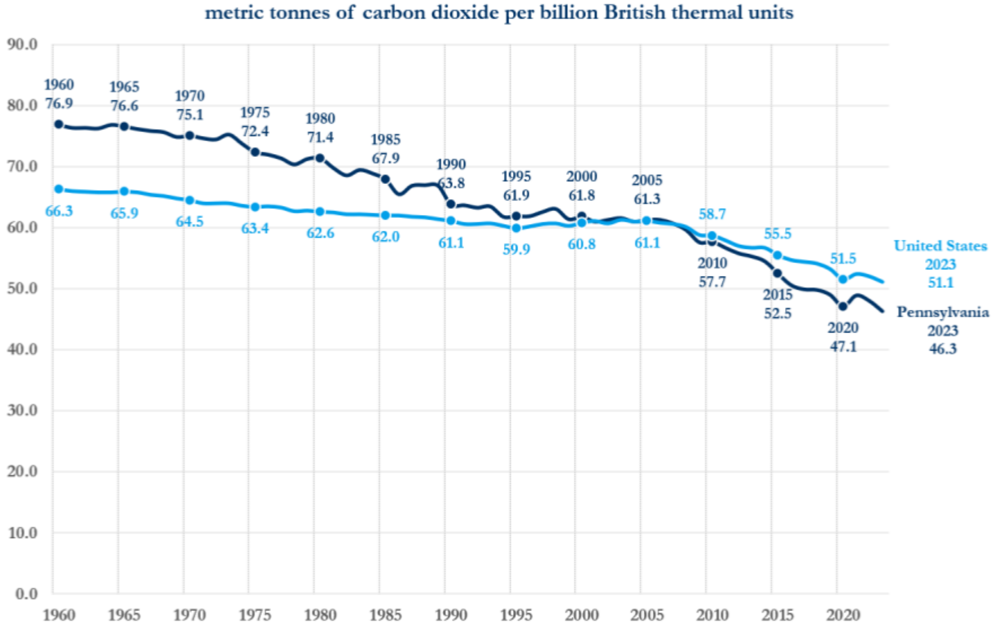
Source: State Energy Data System (U.S. Energy Information Administration, 2024)

Figure 3: Pennsylvania energy spending per capita, 1970-2023
U.S.$ (2023) per person (electricity, gas and petroleum fuels)



Source: State Energy Data System (U.S. Energy Information Administration, 2024)

Figure 4: Pennsylvania state emissions-intensity of energy, 1960-2023
metric tonnes of carbon dioxide per billion British thermal units



Source: State Energy Data System (U.S. Energy Information Administration, 2024)

Figure 4: Pennsylvania state emissions-intensity of energy, 1960-2023
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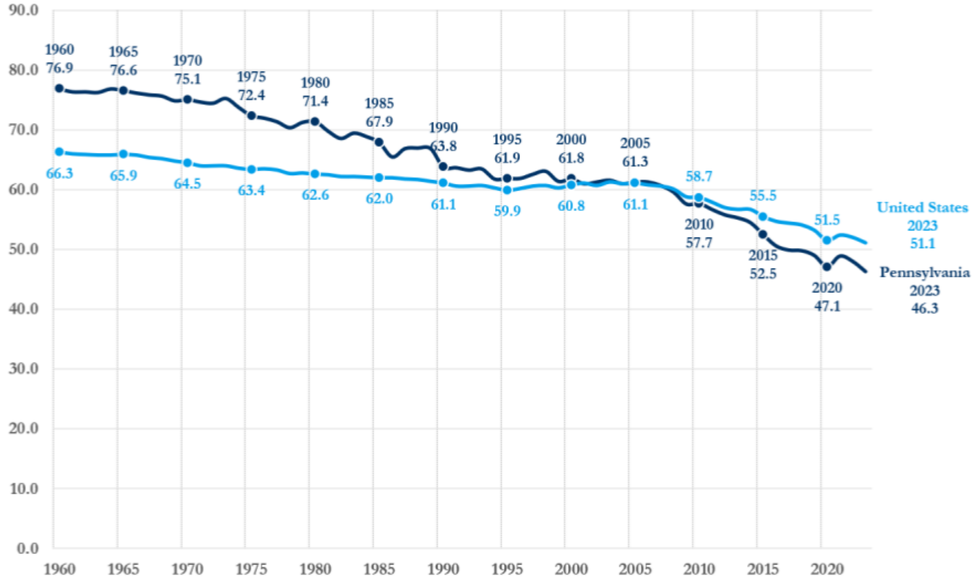
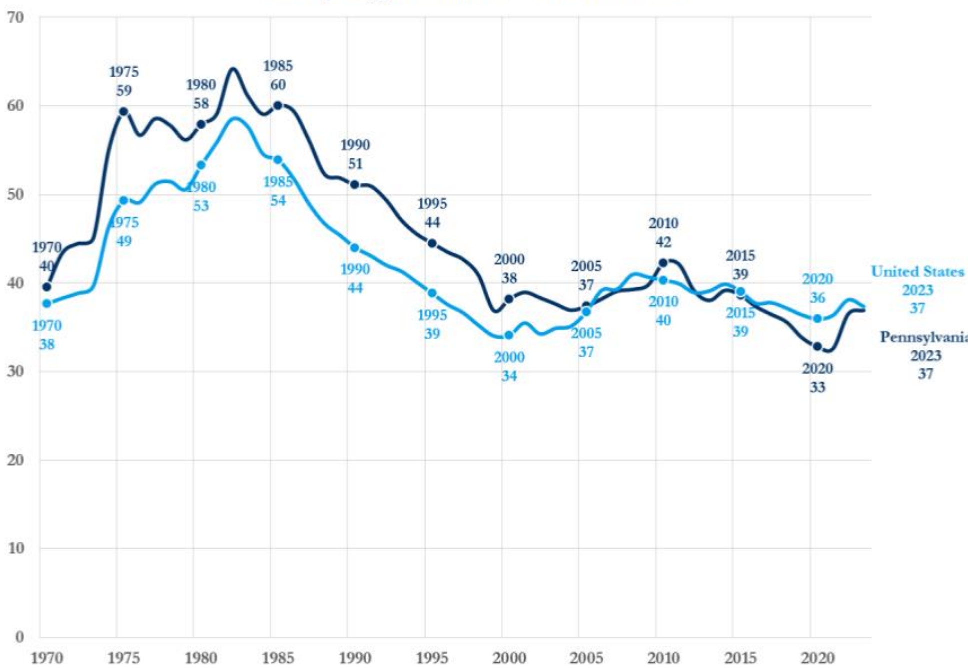


Source: State Energy Data System (U.S. Energy Information Administration, 2024)

Figure 5: Pennsylvania state electricity prices, 1970-2023
U.S.$ (2023) per million British thermal units



Source: State Energy Data System (U.S. Energy Information Administration, 2024)

ABOUT THE AUTHORS

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Neel is Managing Director at PPI where he helped build the Energy and Climate Solutions Initiative, which is widely respected and relied on by Members of Congress, Senators, and their staff for pragmatic proposals and solutions.

Neel is deeply engaged in PPI's international efforts, frequently engaging with policymakers and think tanks in Europe on energy issues and other policy and political topics.

Before joining PPI, Neel was the President of Legis Media, an advocacy communications firm that he founded in 2004. He has extensive experience in advocacy advertising, grassroots organization, and coalition building. He spent over seven years working on Capitol Hill and political campaigns.

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He also publishes a newsletter three times a week analysing major developments across most sources (oil, gas, coal, renewables and electricity) and regions (North America, Europe, China, India, Southeast Asia and Latin America).