PennState Center for Energy Law and Policy

# Prospects for Pennsylvania in the Regional Greenhouse Gas Initiative

## Working Paper, December 2020

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**About the Center for Energy Law and Policy**

Penn State's Center for Energy Law and Policy (CELP) was founded in 2018 with a mission to harness interdisciplinary research strengths at Penn State and beyond to bring emerging science and scholarship to complex problems in energy law and policy. A major part of CELP's mission is to engage with stakeholders around energy policy issues in ways that drive and define interdisciplinary academic research problems and encourage ongoing interactions between researchers and practitioners. The Center for Energy Law and Policy is collaborative effort across Penn State's many disciplines, research centers and campuses, which makes it the only energy research center in the country that can fully harness the strengths of a leading land grant research university to assemble collaborative and interdisciplinary teams, providing Penn State with a unique opportunity to have a major impact. The University and its faculty also have a deep commitment to the kind of engaged and practitioner-informed scholarship that makes the Center for Energy Law and Policy a unique organization to serve the Commonwealth, the nation and the world.

**Acknowledgements**

This work was supported by the Center for Energy Law and Policy at Penn State. The Center is an interdisciplinary research initiative funded by multiple Colleges, Campuses and Institutes at Penn State. More information on the Center's funding structure can be found at https://celp.psu.edu. The researchers involved with this study would like to thank the participants in our research webinars held during Fall 2020. These webinars are available for public viewing at https://celp.psu.edu/rggi.

**Executive Summary**

The Penn State Center for Energy Law and Policy, as part of its mission to harness the breadth of Penn State's research talent and interdisciplinary capability to provide independent perspectives on complex issues in energy law, regulation and policy, has assembled a team of scholars from across the University to assess Pennsylvania's participation in the Regional Greenhouse Gas Initiative (RGGI). Our work began soon after much of normal life in Pennsylvania, the country, and the planet was disrupted by the Covid-19 pandemic. This public health situation has heightened awareness of the connections between energy, the global climate system, and how local air quality affects health outcomes and risk factors for disease such as Covid-19. It has also reinforced the critical role that energy has played and will continue to play in the Commonwealth and the region as we emerge from this global challenge.

RGGI is a voluntary mechanism to establish a market-based cap and trade system for managing greenhouse gas emissions from electric power generation, and Pennsylvania has taken steps to join RGGI beginning in 2022. Our assessment of RGGI draws on interdisciplinary strengths in energy and administrative law, public policy, power systems and economics, and air quality modeling to evaluate the legal and policy environment for joining RGGI; what it might mean for Pennsylvania's large power generation sector and for local air quality in the Commonwealth; and ways in which RGGI participation might be leveraged to promote energy innovation at a critical economic time for Pennsylvania. This joint work has generated several important insights:

*RGGI would benefit Pennsylvania's energy economy overall, but the benefits and costs are not evenly distributed*. Joining RGGI would likely accelerate the transition already underway away from using coal for power generation in favor of natural gas in Pennsylvania and other states in the wholesale electricity market managed by PJM. Acceleration of this transition is the primary driver of $CO_2$ emissions reductions from power generation in Pennsylvania. Because the carbon prices established through RGGI would likely be reflected in somewhat higher wholesale power prices in PJM, power generators in Pennsylvania as a whole are likely to see benefits in the form of higher profits. The implications for consumers' energy bills in Pennsylvania are less clear and will depend upon how allowance revenue from Pennsylvania's entry into RGGI are used.

*Joining RGGI will likely reduce emissions of multiple pollutants from Pennsylvania power plants, but the potential for emissions leakage is high.* Reduction of $CO_2$ and other air pollutants from Pennsylvania power plants is likely to be accompanied by substantial emissions leakage as power plants from other states are utilized more heavily within the PJM market. The extent of emissions leakage that we estimate varies by pollutant, with $CO_2$ and $SO_2$ leakage rates being higher and $NO_x$ leakage rates being lower. Specifically, we estimate that 86% of the $CO_2$ reductions from Pennsylvania's joining RGGI would be offset by emissions increases in PJM and/or other RGGI states. This leakage rate is consistent with estimates from other states joining RGGI. Even though the emissions leakage rate is high, we find that $CO_2$ emissions in the multi-state PJM region decline following Pennsylvania joining RGGI and that the climate benefits exceed the monetary costs of participating in RGGI.

*Governor Wolf has the legal authority to direct the Pennsylvania DEP to draft and finalize rules for joining RGGI.* Our analysis of multiple potential legal areas concludes that the DEP and the Environmental Quality Board (EQB) have ample authority to create and move forward with rules for joining RGGI. New York provides an instructive comparative case to Pennsylvania, as it is the only other state to join RGGI via executive action.

*Steps to mitigate emissions leakage by Pennsylvania will need to be taken with care, preferably in coordination with PJM.* The high leakage rates for $CO_2$ and some other pollutants estimated by our power market model raise potential constitutional issues under the dormant commerce clause if Pennsylvania were to take unilateral action to mitigate leakage. This is somewhat untested legal ground, since no RGGI state (nor the RGGI organization itself) has ever proposed or tried to implement leakage reduction measures.

*The health-related co-benefits of Pennsylvania joining RGGI are potentially large, and most of these co-benefits to Pennsylvanians may be concentrated in areas that see the largest reductions in power generation from conventional resources.* Reductions of air emissions of pollutants other than $CO_2$ (including oxides of sulfur and nitrogen, fine particulate matter and volatile organic compounds) could reduce health damages associated with air pollution by between 10 percent and 20 percent per year for some pollutants. The bulk of these health-related co-benefits would arise from reductions in emissions of $SO_2$, $NO_x$ and PM 2.5. We estimate that the monetary value of these reductions in health damages would amount to approximately $1 billion to $4 billion per year over the initial decade of Pennsylvania's RGGI participation.

*RGGI does not impose any inherent conflict with major electricity policy measures in Pennsylvania such as Act 129 and the Alternative Energy Portfolio Standard (AEPS).* Both the energy efficiency and demand reduction requirements under Act 129 and the incentives for renewable power generation under the AEPS also incentivize fewer greenhouse gas emissions from Pennsylvania's electricity sector. We find that these programs are complementary to RGGI; RGGI by itself, for example, is unlikely to incentivize large amounts of new low-carbon power generation as the AEPS with RGGI does. Some care may be needed to account for cost recovery under Act 129 if utility efficiency programs are commingled with RGGI energy efficiency investments.

*With cooperative approaches across state agencies, revenues from the RGGI auction could be re-invested in ways that promote energy innovation and further decarbonization in Pennsylvania*. Other RGGI states have taken a variety of approaches to re-invest auction revenues. An interpretation of Pennsylvania's Air Pollution Control Act (APCA) suggests that re-investment in Pennsylvania may be constrained to those areas featuring a strong nexus with air pollution reductions. In light of the large share of Pennsylvania's energy sector to the Commonwealth's economy, an expansive view of re-investment options merits consideration. In the absence of legislative authorization to direct RGGI revenues outside of the Clean Air Fund, we highlight some ways in which a cooperative and cross-agency approach could allow for reinvestment in targeted communities and to spur innovation that can also enhance economic development and environmental quality.

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## 1. Introduction

The Center for Energy Law and Policy at Penn State University, as part of its mission to bring a broad base of expertise to major energy law and policy dialogues, has assembled an interdisciplinary team to assess Pennsylvania's recent move towards joining the Regional Greenhouse Gas Initiative (RGGI). RGGI is a voluntary mechanism, adopted by several states in the northeastern U.S., focused on managing greenhouse gas emissions from electric power plants. Experts in power grid operations and economics, air quality modeling, energy and administrative law, and public policy have been working together to perform original integrated and cutting edge research that explores multiple inter-related dimensions of this policy initiative. The team started their work soon after the Covid-19 pandemic began to affect many facets of normal life in Pennsylvania and beyond. While the pandemic limited the extent to which we could hold multi-stakeholder discussions about Pennsylvania joining RGGI, we were able to discuss our ideas and results with leaders in business, government and the environmental community through individual conversations and a series of fall webinars.

This working paper represents the outcomes of our interdisciplinary efforts through the end of the summer of 2020. This work draws from relevant research across multiple domains, including power systems economics, air quality modeling, and legal and policy research, as well as the experiences of other states in joining RGGI. We have also included the results of original research in this working paper as an example of how Penn State's interdisciplinary expertise can be brought to emerging energy policy issues. The Center for Energy Law and Policy is continuing to support ongoing research related to RGGI and its potential implications for Pennsylvania's energy sector, greenhouse gas emissions, and local air quality and health outcomes.

The research in this working paper, and the continued interdisciplinary research efforts around Pennsylvania joining RGGI reflected in this working paper, were supported by the Center for Energy Law and Policy, which receives funding from multiple Colleges, Institutes and Commonwealth Campuses in the Penn State system. No other funding source supported this work.

Penn State's Center for Energy Law and Policy has a mission to harness interdisciplinary research expertise and stakeholder knowledge to bring independent and non-partisan insights to

complex and multifaceted energy choices. It is able to draw on the breadth of expertise in energy and environmental research at Penn State, leverages Penn State's ability to successfully support and execute collaborative research across traditionally separate disciplines, and helps to fulfill Penn State's land grant mission by actively engaging with diverse stakeholder groups that touch energy issues.

### 1.1. Overview of the Regional Greenhouse Gas Initiative

The Regional Greenhouse Gas Initiative, which became operational in 2009, is a cooperative mechanism to manage greenhouse gas emissions from power plants. As of this writing, ten states in the U.S. Northeast and Mid-Atlantic regions were part of RGGI, with Virginia slated to begin participation in RGGI in January 2021. A map of the RGGI participating states, including Pennsylvania, is shown in Figure 1.

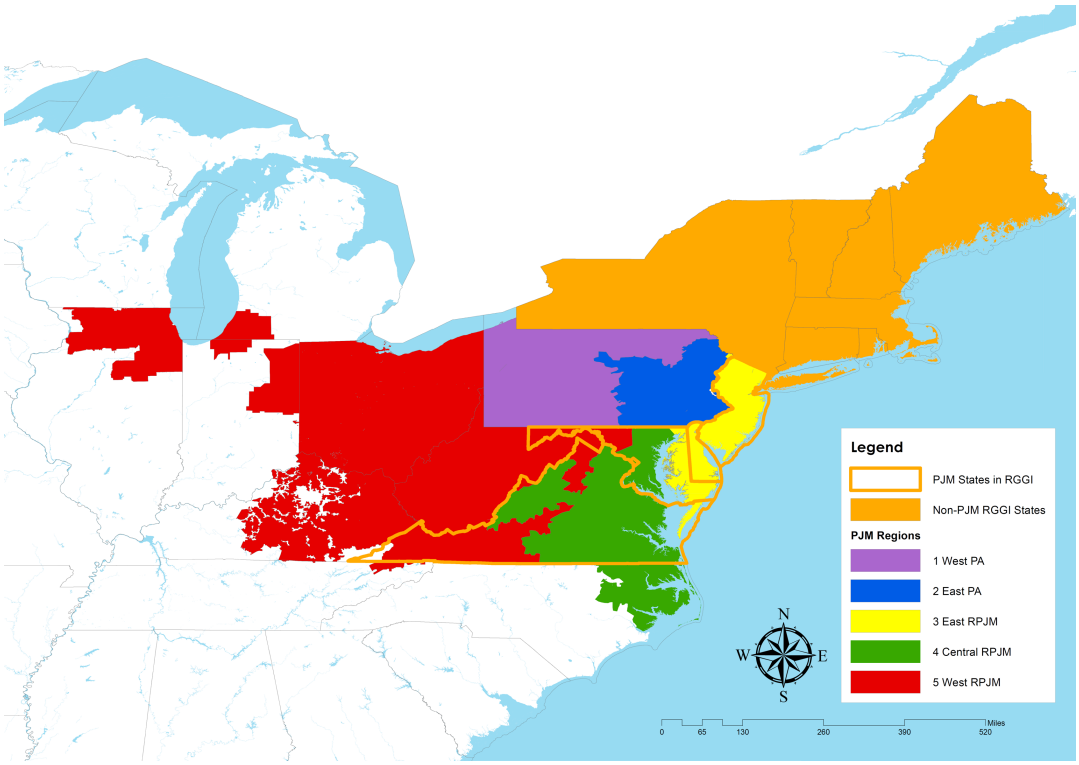


**Figure 1: Participating RGGI states.**

Participating states in RGGI see their power plants operate under a carbon dioxide ($CO_2$) emissions cap determined by RGGI and implemented by a relevant state authority (we note that

RGGI itself has no legal authority and relies on legislative or regulatory actions taken by each of its participating states to establish and enforce the $CO_2$ cap. For each short ton of $CO_2$ emitted by a qualifying power plant, an emitter must hold one permit, or "allowance." These allowances are auctioned quarterly by RGGI and holders of allowances can hold or "bank" them. Emitters that are short of allowances must either purchase allowances from other emitters or take steps to reduce $CO_2$ emissions, such as producing less electricity, investing in carbon capture equipment (which none have done to date) or investing in qualifying carbon offsets as defined in each state's RGGI rules. RGGI thus operates as a market-based system for limiting power-sector $CO_2$ emissions (through each state's carbon budget) and enabling allowances to be traded both within and across state borders.

Prices emerging from the RGGI auctions have varied through the program's decade-long existence, as shown in Figure 2, mostly ranging between $4 per short ton of $CO_2$ and $6 per short ton over the past several years (though more recent auction results have cleared above $7 per short ton). Alongside the quarterly auctions, there is an active secondary market in allowances, which gives power plants subject to emissions caps under RGGI some flexibility in buying or selling allowances between auction periods. While granular data is not available for the secondary market, reports of the RGGI market monitor have indicated that prices in the secondary market have been in line with prevailing auction prices.[1] Prevailing prices in the RGGI market are driven by a number of factors, including low-carbon energy investments in participating states, the number of allowances that are held or "banked" by emitters in one year to use in future years.

[1] Potomac Economics serves as the market monitor for RGGI, and puts out quarterly and annual reports on allowance market activity in the RGGI region. These reports are available at https://www.rggi.org/auctions/market-monitor-reports.

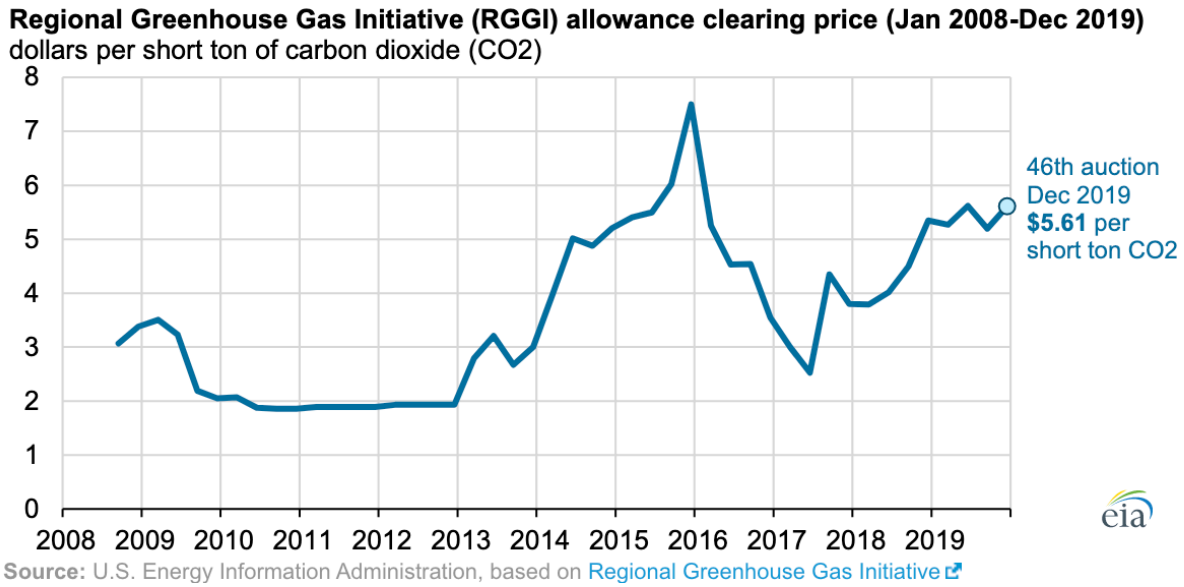


**Figure 2: Price history in RGGI auctions. Source: U.S. Energy Information Administration, https://www.eia.gov/todayinenergy/detail.php?id=42255**

Proceeds from the RGGI auction revenues are allocated among the RGGI states based on each state's share of the overall RGGI region emissions cap. The disposition of these auction revenues are determined by each state's relevant authority and there have been a variety of approaches to re-investing RGGI revenues in state activities. The scope of these activities are discussed in more detail in Section 5 of our report, but common revenue re-investment vehicles have included programs to promote energy efficiency or other low-carbon energy investments, or mechanisms to offset the economic impact that the RGGI carbon price might have on energy bills for low-income residents (Sections 3 and 5 address potential energy cost impacts in Pennsylvania in more detail).

## 1.2. Pennsylvania in the Regional Greenhouse Gas Initiative

Pennsylvania started the process of RGGI participation through an executive order issued by Governor Tom Wolf in October 2019. This executive order directed the Pennsylvania Department of Environmental Protection (DEP) to draft rules for Pennsylvania joining RGGI, and these draft rules were approved by the Environmental Quality Board in September 2020. The current time line for finalizing the draft RGGI rule would conclude in early 2021, with Pennsylvania beginning participation in the RGGI carbon market beginning in 2022.

Pennsylvania is a major energy-producing state, and its energy sector is very highly connected to surrounding states and regional markets for power and fuels. For many years, Pennsylvania has been the largest exporter of electricity to other states and has been one of the largest electricity producers in the United States. The Commonwealth is also the third largest exporter of total energy to other states. Within the past several years Pennsylvania has assumed a position as the second-largest natural gas producer in the United States, and the Commonwealth exports several times more natural gas to other states than it consumes in-state.

Like other RGGI states in the Mid-Atlantic region, Pennsylvania's power grid lies within the footprint of the PJM Interconnection, a Regional Transmission Organization that manages the flow of electricity in all or parts of thirteen states plus the District of Columbia. Unlike New York or the New England states that are already part of RGGI, PJM's footprint would not wholly overlap with the RGGI footprint, even after Pennsylvania commences participation. Figure 3 illustrates the PJM states that are or would be part of RGGI as of 2022 (and thus includes Pennsylvania). New York and the New England RGGI states lie entirely within the footprints of the New York ISO, and ISO New England, so the situation in the Mid-Atlantic is different from other areas of the RGGI market.

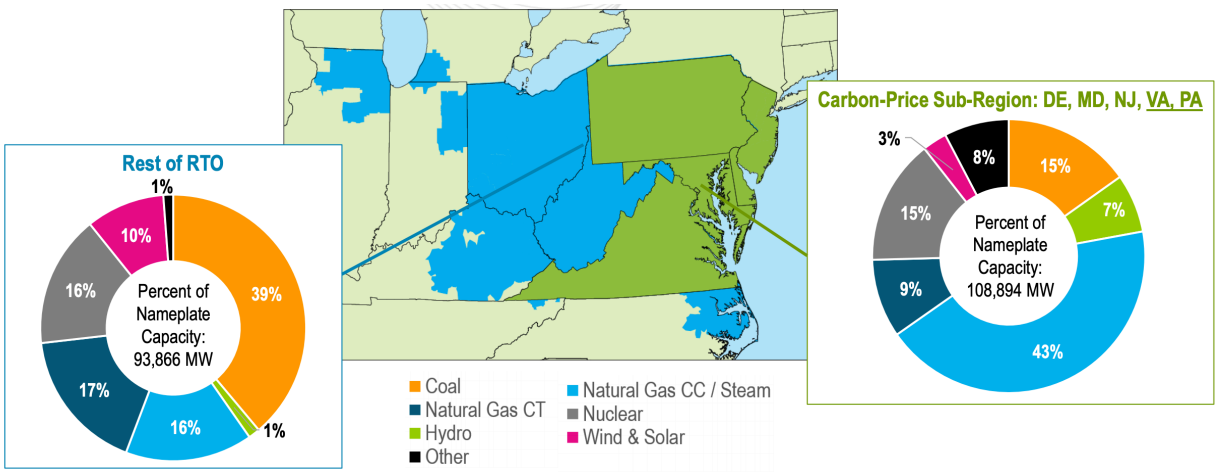


**Figure 3: The PJM and RGGI footprints in the Mid-Atlantic U.S. PJM states that are or intend to be part of RGGI, including Pennsylvania, are shown in green. Non-RGGI PJM states are shown in blue. Source: PJM (https://www.pjm.com/-/media/committees-groups/task-forces/cpstf/2020/20200225/20200225-item-03-pjm-study-results-additional-scenarios.ashx)**

Figure 3 illustrates that RGGI states in the PJM footprint represent a little over half of all generation capacity in PJM, but that the composition of technologies used for power generation in the RGGI PJM states is different than in the non-RGGI PJM states. In both areas, coal and natural gas (excluding combustion turbines, which are used primarily to supply peak power needs) account for over 55% of all power generation capacity, but natural gas is a much larger component of the generation fleet in the RGGI PJM states as compared to the non-RGGI states.

As a major electricity-producing state, including Pennsylvania power generation would increase the size of the RGGI market substantially. Total power generation in Pennsylvania was approximately 215,000 Gigawatt-hours (GWh) in 2018, which is approximately the size of the rest of the electricity generation market in the rest of the RGGI states except New York.[2] Based on generation output data from 2018 and without considering any shifts in generation output among states that might occur because of RGGI, adding Pennsylvania to the RGGI region would increase the amount of power generation output in the RGGI footprint by approximately 60%. We discuss this particular dimension more in Section 3 – the impact of Pennsylvania on the total size of the RGGI market (as measured in electricity output) will likely be tempered somewhat by shifts in spatial generation patterns in PJM that reduce power generation in Pennsylvania and increase power generation in neighboring PJM states.

### 1.3. Report structure and major findings

This assessment of Pennsylvania's participation in RGGI focuses on four inter-related areas. First, we evaluate the legal environment under which Pennsylvania has taken the initiative to join RGGI (Section 2). Unlike many other states participating in RGGI, Pennsylvania has moved to join RGGI via administrative actions rather than through an act of the state legislature. Second, we examine how RGGI is likely to affect the power generation sector in Pennsylvania and the broader PJM region (Section 3). The carbon pricing mechanism established through RGGI will affect the relative competitiveness of Pennsylvania power generation in the PJM market, thereby reducing air emissions of $CO_2$ and other pollutants from power plants in Pennsylvania. These emissions reductions, however, may be accompanied by increases in emissions from surrounding

[2] The source for the data in this paragraph is the U.S. Energy Information Administration, State Electricity Profiles for 2018, eia.gov/electricity/state.

states, a phenomenon known as "emissions leakage." Third, our report connects the emissions reductions discussed in Section 3 with expected changes in health outcomes (Section 4). Our analysis shows that health outcomes in Pennsylvania would likely improve as a result of Pennsylvania joining RGGI, and the social benefits of these improvements in health outcomes are substantial – potentially several times larger in monetary terms than the climate benefits of RGGI. Finally, we examine RGGI in light of other major aspects of energy policy in Pennsylvania, such as Act 129 and the Commonwealth's Alternative Energy Portfolio Standard (Section 5). We also review potential options for re-investment of RGGI revenues.

Our joint work has several important insights for the ongoing process of Pennsylvania becoming part of the RGGI market.

*RGGI would benefit Pennsylvania's energy economy overall, but the benefits and costs are not evenly distributed*. Joining RGGI would likely accelerate the transition already underway away from using coal for power generation in favor of natural gas in Pennsylvania and other states in the PJM region. Acceleration of this transition is the primary driver of $CO_2$ emissions reductions in Pennsylvania. Because the carbon prices established through RGGI would likely be reflected in somewhat higher wholesale power prices in PJM, power generators in Pennsylvania as a whole are likely to see benefits in the form of higher profits. The implications for consumer energy bills in Pennsylvania are less clear.

*Joining RGGI will likely reduce emissions of multiple pollutants from Pennsylvania power plants, but the potential for emissions leakage is high.* While RGGI directly caps $CO_2$ emissions from qualifying power plants in Pennsylvania, the act of reducing $CO_2$ emissions also leads to reductions of other pollutants that affect local air quality, including oxides of sulfur and nitrogen, fine particulate matter and volatile organic compounds. Reduction of these pollutants from Pennsylvania power plants, however, is likely to be accompanied by substantial emissions leakage as power plants from other states are utilized more heavily within the PJM market. The extent of emissions leakage that we estimate varies by pollutant, with $CO_2$ and $SO_2$ leakage rates being higher and $NO_x$ leakage rates being lower. Emissions leakage does not simply dampen the environmental benefits from Pennsylvania joining RGGI; our analysis suggests that it leads to increased energy market costs in surrounding non-RGGI states in PJM.

*Governor Wolf has the legal authority to direct the Pennsylvania DEP to draft and finalize rules for joining RGGI.* Our analysis of multiple potential legal areas concludes that the DEP and

the Environmental Quality Board (EQB) have ample authority to create and move forward with rules for joining RGGI. New York provides an instructive comparative case to Pennsylvania, as it is the only other state in the RGGI footprint that joined via executive action.

*Steps to mitigate emissions leakage by Pennsylvania will need to be taken with care, preferably in coordination with PJM.* The high leakage rates for $CO_2$ and some other pollutants estimated by our power market model raise potential constitutional issues under the dormant commerce clause if Pennsylvania were to take unilateral action to mitigate leakage. This is somewhat untested legal ground, since no RGGI state (nor the RGGI organization itself) has ever proposed or tried to implement a leakage reduction measure.

*The health-related co-benefits of Pennsylvania joining RGGI are potentially large, and most of these co-benefits to Pennsylvanians may be concentrated in areas that see the largest reductions in power generation from conventional resources.* Reductions of air emissions of pollutants other than $CO_2$ could reduce health damages associated with air pollution by between 10 percent and 20 percent per year for some pollutants. The bulk of these health-related co-benefits would arise from reductions in emissions of $SO_2$, $NO_x$ and PM 2.5. We estimate that the monetary value of these reductions in health damages would amount to approximately $1 billion to $4 billion per year over the initial decade of Pennsylvania's RGGI participation.

*RGGI does not impose any inherent conflict with major electricity policy measures in Pennsylvania such as Act 129 or the AEPS.* Both the energy efficiency and demand reduction requirements under Act 129 and the incentives for renewable power generation under the AEPS are mechanisms other than RGGI to reduce greenhouse gas emissions from Pennsylvania's electricity sector. We find that these programs are complementary to RGGI, in that they do not make one another redundant. RGGI by itself, for example, is unlikely to provide incentives for large amounts of new low-carbon power generation as AEPS would (our model suggests that RGGI does have the effect of keeping some generation resources from retiring). Some care may need to be taken in accounting for cost recovery under Act 129 if utility efficiency programs are commingled with RGGI re-investment programs that target energy efficiency.

*With cooperative approaches across state agencies, revenues from the RGGI auction could be re-invested in ways that promote energy innovation and further steps towards decarbonization in Pennsylvania*. Other RGGI states have taken a variety of approaches to re-investment of auction revenues. An interpretation of Pennsylvania's Air Pollution Control Act

(APCA) suggests that re-investment in Pennsylvania may be constrained to those areas featuring a strong nexus with air pollution reduction. Particularly in light of the role that Pennsylvania's energy sector can take in economic rebuilding in the Commonwealth, and the potential to leverage a lower-carbon power grid to achieve greater emissions reductions in other economic sectors, a more expansive view of re-investment options is worth consideration. Even in the absence of specific legislative authorization to direct RGGI revenues outside of the Clean Air Fund, we highlight how a cooperative and cross-agency approach could allow for reinvestment in targeted communities and areas of innovation that can help with economic re-building in Pennsylvania and contribute to improved environmental quality.

## 2. The Legal and Administrative Environment for Pennsylvania Joining RGGI

In 2019, Pennsylvania Governor Tom Wolf ordered the Pennsylvania Department of Environmental Protection (DEP) to "develop and present to the Pennsylvania Environmental Quality Board [EQB] a proposed rulemaking package to abate, control, or limit carbon dioxide emissions from fossil-fuel-fired electric power generators" under the Pennsylvania Air Pollution Control Act (APCA).[3] The rulemaking contemplated by the order would accomplish this end by, among other things, establishing a cap-and-trade system for carbon dioxide that can be integrated with other states' cap-and-trade programs under the Regional Greenhouse Gas Initiative (RGGI) model rules.[4] The order also asked DEP to work with the Pennsylvania Public Utility Commission and the regional transmission organization encompassing all of Pennsylvania (PJM Interconnection) to "promote the integration" of the PA cap-and-trade rules in a "manner that preserves orderly and competitive economic dispatch within PJM and minimizes emissions leakage."[5] Almost immediately after the order, speculation began about potential legal barriers to achieving the goals set out by Governor Wolf.[6]

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[3] Exec. Order 2019-07, *Commonwealth Leadership in Addressing Climate Change through Electric Sector Emissions Reductions* (Oct. 3, 2019), *available at* https://www.governor.pa.gov/newsroom/executive-order-2019-07-commonwealth-leadership-in-addressing-climate-change-through-electric-sector-emissions-reductions/ (citing Act of January 8, 1960 (1959 P.L. 2119, No. 787)).

[4] *Id.* RGGI is an informal arrangement among northeastern states to coordinate auctions and trading of carbon dioxide allowances across state lines. Each state promulgates its own rules against the backdrop of a Model RGGI Rule. Because each state's program is administered separately and coordination is voluntary, RGGI has not had to go through the interstate compact approval process set out in the U.S. Constitution for binding compacts. *See* Michael S. Smith, *Murky Precedent Meets Hazy Air: The Compact Clause and the Regional Greenhouse Gas Initiative*, 34 B.C. Envtl. Aff. L. Rev. 387 (2007). For general background on RGGI up to a major update to its Model Rule in 2013, see Jennifer Drust, *RGGI Gets Revamped: A Look at the Updated Model Rule and Implications for the Future*, 45 Trends 16 (2013); Bruce R. Huber, *How Did RGGI Do It: Political Economy and Emissions Auctions*, 40 Ecology L.Q. 59 (2013).

[5] *Id.*

[6] *See* Rob Altenburg, *Legislators say Gov. Wolf Lacks the Authority to Have Pennsylvania Join RGGI. This is Why They're Wrong*, PennFuture Blog (Nov. 22, 2019), *available* at https://www.pennfuture.org/Blog-Item-Legislators-say-Gov-Wolf-lacks-the-authority-to-have-Pennsylvania-join-RGGI-This-is-why-theyre-wrong.

This white paper closely examines a set of legal questions that are likely to arise in litigation about DEP's and EQB's authority and discretion to promulgate rules in accordance with the order under existing laws. While it is difficult to anticipate exactly what kinds of challenges might emerge, especially since DEP has not yet finalized its approach, in general the challenges will likely emerge in four categories of issues[7]:

- First, it is likely that arguments will be made that PA's cap-and-trade system would be an unconstitutional tax on electric power generators, either because it imposes a carbon budget with financial consequences for affected firms that choose to comply by

[7] These issues do not exhaust all of the possibilities. For instance, some have raised an argument that Governor Wolf's order signing onto RGGI would formally bind Pennsylvania to RGGI and other states without legislative authorization, purportedly violating the Air Pollution Control Act and the Uniform Interstate Air Pollution Agreements." *See* Craig Wilson, Anthony Holtzman, & Tad MacFarlan, *Constitutional Implications of Pa. Executive Branch Efforts to Join RGGI*, Law.com (Jul. 22, 2020), *available at* https://www.law.com/thelegalintelligencer/2020/07/22/constitutional-implications-of-pa-executive-branch-efforts-to-join-rggi/. Proponents of this argument cite the Air Pollution Control Act's requirement that DEP "[c]ooperate with the appropriate agencies of the United States or of other states or any interstate agencies with respect to the control, prevention, abatement and reduction of air pollution, and where appropriate formulate interstate air pollution control compacts or agreements for the submission thereof to the General Assembly." 35 P.S. § 4004(24). While this issue is beyond the scope of the white paper, the argument arguably misunderstands the nature of RGGI, which is not a formal interstate compact or agreement that binds any state that joins. To the contrary, it is a voluntary arrangement of state-level regulatory programs that are informally coordinated. Moreover, the precatory language "where appropriate" suggests that submission to the General Assembly is not an absolute prerequisite, even assuming that it is classifiable as a binding compact.

Another issue that may well arise, but which is beyond the scope of this analysis, is how Pennsylvania's participation in RGGI would interact with the PJM Interconnection's Minimum Offer Price Rule (MOPR). Whether certain aspects of the RGGI rule might be construed as subsidizing certain clean resources, and thereby prevent participation in PJM wholesale electricity markets below a certain bid price, is an important question, but there are major questions about whether the MOPR rule will survive pending litigation, which would render the question moot. *See* Catherine Morehouse, *Glick Vows to Prioritize Transmission, Reassess Capacity Markets If Named FERC Chair*, Utility Dive (Nov. 18, 2020), https://www.utilitydive.com/news/glick-vows-to-prioritize-transmission-reassess-capacity-markets-if-named-f/589252/ (noting that MOPR is caught up in litigation in the federal appellate courts and is legally suspect). Relatedly, some might wonder if the effect of RGGI on wholesale electricity prices in the PJM reason might run into preemption problems under the Federal Power Act (FPA). A trilogy of recent Supreme Court cases has dealt with preemption questions like these in recent years, apparently limiting the preemptive power of the FPA to situations in which a state government requires generators to bid into regional wholesale markets, and so it is unlikely that a court would find Pennsylvania's RGGI rule (which contains no such "tether") is preempted by federal law. *See generally* Matthew Christiansen & Joshua Macey, *Long Live the Federal Power Act's Bright Line*, 134 Harv. L. Rev. (forthcoming 2021), *available at* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3591412.

implementing carbon dioxide mitigation measures or because allowance auctions would result in financial payments by affected firms to come into compliance through the purchase of allowances. Such a "tax," promulgated by the EQB, might be argued to violate the Pennsylvania separation of powers principle because it amounts to executive taxation.

- Second, even assuming that PA's cap-and-trade is not an unauthorized tax, arguments may be made that a cap-and-trade program for carbon dioxide is not within the scope of delegated rulemaking authority under the APCA, and that EQB could only promulgate such a program with new authorizing legislation. Again, this would be framed as a violation of the Pennsylvania separation of powers principle.
- Third, separate and apart from the issue of whether carbon dioxide allowance auctions may be considered an unauthorized tax or beyond the scope of legislative authorization, arguments may be made about the precise scope of DEP's authority to collect the revenues from auctions and use it for particular programmatic purposes.
- Finally, to the extent that DEP and EQB eventually integrate measures designed to minimize emissions leakage across state lines, challengers may argue that the regulations violate the Dormant Commerce Clause of the U.S. Constitution by impermissibly discriminating against inter-state commerce and trade.

This white paper provides essential background understanding for each of these potential disputes, analyzes the potential arguments that might be leveraged for or against the agencies' authority and discretion to create a robust cap-and-trade system without any additional legislative action, and concludes that the agencies have ample authority under existing law to create the program and join RGGI. The analysis focuses on Pennsylvania law and U.S. constitutional law, but also draws heavily from a survey of relevant New York laws, as New York is the only other state to have entered RGGI administratively, making it a particularly useful comparison for Pennsylvania's attempt to do the same. It also draws more generally on state authorities from California, Delaware, New Jersey, and other states, but these treatments of cap-and-trade systems are not directly controlling in Pennsylvania and have only persuasive value.

### 2.1 Issue #1: Would a Cap-and-Trade Program for Carbon Dioxide Amount to an Unconstitutional Tax on the Electric Power Generation Sector?

In Pennsylvania, the taxing power is considered a branch of the legislative power.[8] Unlike the general police power, which may be delegated in broad strokes to administrative agencies or to municipalities,[9] the taxing power is subject to more restrictions on the delegation of the power it entails.[10] These limitations come from the Pennsylvania Constitution's general separation of powers principle. As the Pennsylvania Supreme Court explained in the *Robinson Township Case*, "[t]he core tenet of the separation of powers principle is that a branch of government is prohibited from exercising the functions committed exclusively to a co-equal branch."[11] The principle rests on "two distinct concepts, as embraced by the framers of both the federal and Pennsylvania constitutions: (1) no branch may usurp a function belonging to another and each must operate within its own separate sphere of power; and (2) a system of checks and balances exists, which prevents one branch from acting unchecked."[12] Cases identifying the line at which a delegation of taxing power exceeds constitutional separation of powers limits have not

[8] Pa. Const. Art. II., § 1; *P.R.R. Co. v. Pittsburgh*, 104 Pa. 522.

[9] As the Pennsylvania Supreme Court has said, "the legislative power to confer authority and discretion upon another body in connection with the execution of a law is subject to two principal limitations: 1) the basic policy choices must be made by the Legislature; and 2) the legislation must contain adequate standards which will guide and restrain the exercise of the delegated administrative functions. We observed, that this does not mean, however, that all details of administration must be precisely or separately enumerated in the statute." Pennsylvanians Against Gambling Expansion Fund, Inc. v. Commmonwealth, 877 A.2d 383, 418 (2005).

[10] *See* Mastrangelo v. Buckley, 433 Pa. 352, 363, 250 A.2d 447, 453 (1969) (giving a strict construction to a statute alleged to have delegated the taxing power to a municipality); Danson v. Casey, 33 Pa. Cmwlth. 614, 620, 382 A.2d 1238, 1241 n. 7 (1978) (noting that "the principal of nondelegation of taxing power is the general rule," but that the "delegation of this power to municipalities and school districts without any definite restrictions has been upheld" so long as such a delegation is not made to a "nonelective body"), *decree aff'd*, 484 Pa. 415, 399 A.2d 360 (1979); Thompson v. City of Altoona Code Appeals Bd., 934 A.2d 130, 133 (Pa. Commw. Ct. 2007) ("It is well-settled that '[t]he power of taxation ... lies solely in the General Assembly of the Commonwealth acting under the aegis of the Constitution. Absent a grant or a delegation of the power to tax from the General Assembly, no municipality ... has any power or authority to levy, assess or collect taxes.'").

[11] Robinson Twp., Washington Cty. v. Com., 623 Pa. 564, 711, 83 A.3d 901, 991 (2013).

[12] Jefferson Cty. Court Appointed Employees Ass'n v. Pennsylvania Labor Relations Bd., 603 Pa. 482, 497–98, 985 A.2d 697, 706 (2009).

provided any clear guidance.[13] More generally, the Pennsylvania Supreme Court has cautioned that "[p]erfect separation of duties between the branches is not required; indeed, the constitutional construct permits 'a degree of interdependence and reciprocity between the various branches,'" and that "dividing lines among the three branches are sometimes indistinct and are probably incapable of any precise definition."[14]

Assuming for the sake of argument that the power to tax has not been explicitly delegated to DEP and EQB by any existing statute, the separation of powers principle might be understood to bar the imposition of a tax by DEP and EQB.[15] But, critically, it would only do so if some aspect of the cap-and-trade system was considered to be a tax rather than something else within the normal scope of the general police power. While there is considerable uncertainty at the margins, the best understanding of existing law would be that no aspect of a cap-and-trade program could be properly labeled a tax. A carbon budget and associated compliance options such as purchasing allowances or reducing emissions function as a typical regulation. While it is common for opponents of regulation to label them as "taxes," this is a serious category mistake that courts (if not the general public) will identify as such. Accordinglyfor such a program's sanctions these classifications give

### 2.1.1. The Creation of a Carbon Dioxide Budget is a Market-Based Regulation Rather than a Tax

The first argument that might be made is that the carbon dioxide budget portion of the cap-and-trade regulation might amount to a tax, but this argument is highly unlikely to persuade a court to invalidate the regulations. If it were to be made, the argument would be that the imposition of a budget applicable to electric power generators would cause those generators to incur the costs of reducing carbon dioxide emissions or pay the government for the license to

[13] *See, e.g.*, Wm. Penn Parking Garage, Inc. v. City of Pittsburgh, 11 Pa. Cmwlth. 507, 514, 314 A.2d 322, 326 (1974) (holding that a delegation of authority to courts to review the reasonableness of a tax did not violate the separation of powers principle), *aff'd*, 464 Pa. 168, 346 A.2d 269 (1975).

[14] *Robinson Township*, 623 Pa. at 711.

[15] For such an argument, see Wilson, Holtzman, & Macfarlan, *supra* note 7.

pollute by purchasing carbon allowances.[16] Ultimately, as I will explain, this argument proves too much by equating any imposition of compliance costs with a tax—an untenable position that would render every regulation affecting the economy suspect.

To start, whether or not the requirement to reduce pollution (or pay someone else to do it at a market rate) can be considered to be a tax requires a definition of a tax, and the law provides one. A tax is "an enforced contribution to provide for the support of government."[17] The Pennsylvania Supreme Court has emphasized that the hallmark of a tax is that it operates as a "general revenue raising measure."[18] Most jurisdictions, Pennsylvania included, sharply distinguish fees and penalties based on their alternative functions. Fees are "charged in exchange for a particular governmental service which benefits the party paying the fee in a manner not shared by other members of society,"[19] and a penalty "regulates conduct by establishing criteria of wrongdoing and imposing its principal consequence on those who transgress its standard."[20] Fees are often further divided into "two categories: user fees or regulatory fees. User fees consist of charges levied by the government in exchange for citizen use of government services or property. Regulatory fees, which include licensing and inspection fees, are based more broadly on the government's police powers and are imposed on a regulated individual, entity, property, or business in order to offset the cost of the regulation."[21]

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[16] This argument was presaged in New York, when in 2011, residents and ratepayers in New York sued to stop the implementation of RGGI within New York on the grounds that the implementing regulations (New York, like Pennsylvania plans to do, entered RGGI administratively) "imposed an unlawful tax upon ratepayers not authorized by the Legislature," but the case was dismissed on jurisdictional grounds. *See* Thrun v. Cuomo, 112 A.D.3d 1038, 1039, 976 N.Y.S.2d 320, 322 (2013).

[17] 71 Am. Jur. 2d State and Local Taxation § 8 (quoting *United States v. La Franca,* 282 U.S. 568, 572, 51 S. Ct. 278 (1930)); *Child Labor Tax Case,* 259 U.S. 20, 38, 42 S. Ct. 449 (1922) ("The central objective of a tax is to 'obtain[ ] revenue.'").

[18] *Philadelphia v. Southeastern Pennsylvania Transp. Authority*, 8 Pa. Commw. 280, 303 A.2d 247, 288 (1973).

[19] 71 Am. Jur. 2d State and Local Taxation § 12.

[20] *Id.* at § 8.

[21] Laurie Reynolds, Taxes, Fees, Assessments, Dues, and the "Get What You Pay for" Model of Local Government, 56 Fla. L. Rev. 373, 407–11 (2004).

In practice, it can often be difficult to determine whether a policy is a tax where a government policy serves multiple purposes but does generate incidental revenue,[22] but in this case it is not. The primary purpose of the carbon dioxide budget cap, itself, would be to induce a change in behavior by establishing a regulatory standard and penalizing those who fail to comply. Broadly construed, any regulation that imposes a payment obligation on certain behavior that creates negative externalities could be construed rhetorically as a tax in the Pigouvian sense.[23] A carbon tax is the paradigmatic case of such a Pigouvian tax,[24] and a cap on carbon is "functionally identical to a carbon tax" insofar as it requires payment for noncompliance with a regulatory cap that is necessary to eliminate or mitigate an externality, with the price of permits fluctuating in response to market signals about the value of the pollution reduction.[25] But a Pigouvian tax, despite the label, is not a tax in the typical sense used to describe the state taxing power because its primary purpose is not to raise revenue for the

[22] Thomas More Law Ctr. v. Obama, 651 F.3d 529, 550–53 (6th Cir. 2011) ("That the penalty in its 'practical operation,' shares traits of a tax and that the opposite is sometimes true—taxes occasionally resemble regulatory penalties—do not change things either. From an economic standpoint, the line between regulatory penalties and taxes may sometimes blur: Taxes and penalties both extract money from individuals; both shape behavior as a result; and every tax penalizes people by imposing an "economic impediment" on one person "as compared with others not taxed.'"), *abrogated by* Nat'l Fed'n of Indep. Bus. v. Sebelius, 567 U.S. 519 (2012).

[23] Jonathan S. Masur & Eric A. Posner, *Toward a Pigouvian State*, 164 U. Pa. L. Rev. 93, 95 (2015) ("A Pigouvian tax is a tax equal to the harm that the firm imposes on third parties. For example, if a manufacturer pollutes, and the pollution causes a harm of $100 per unit of pollution to people who live in the area, then the firm should pay a tax of $100 per unit of pollution. This ensures that the manufacturer pollutes only if the value of the pollution-generating activities exceeds the harm, such that the social value of those activities is positive.").

[24] *See Some More Thoughts on a Carbon Tax*, The Economist (Jun. 18, 2010), *available at* https://www.economist.com/free-exchange/2010/06/18/some-more-thoughts-on-a-carbon-tax ("Carbon taxes are a subspecies of Pigovian tax; taxes that are designed primarily to change behaviour rather than to raise revenue.").

[25] Richard J. Pierce, Jr., *Energy Independence and Global Warming*, 37 Envtl. L. 595, 601 (2007); *but see* Reuven S. Avi-Yonah & David M. Uhlmann, *Combating Global Climate Change: Why a Carbon Tax is a Better Response to Global Warming than Cap and Trade*, 28 Stan. Envtl. L.J. 3 (2009) (arguing that, though similar, a carbon tax evades certain problems associated with cap-and-trade).

government, but rather to regulate for the public good by forcing the polluter to mitigate or pay for harms imposed on society generally—it is, in other words, an exercise of the police power.[26]

While federal law is not necessarily controlling as to the classification of government action as a tax under Pennsylvania law, it can be instructive to look to the U.S. Supreme Court's jurisprudence about the line between taxes and general policies. Doing so reveals more reasons why a cap-and-trade program is no tax. In *National Federation of Independent Business v. Sebelius*, the Supreme Court upheld the Affordable Care Act's individual mandate against constitutional challenge on the ground that the penalty for noncompliance was a valid exercise of the U.S. Constitution's taxing and spending power.[27] There the Supreme Court applied a "functional" test to determine whether the mandate and penalty for non-compliance could fit within the Congress's taxing and spending power.[28]

The *Sebelius* Court's own application of the functional test would seem to suggest that a penalty for noncompliance with a carbon dioxide cap could not reasonably be understood to be a tax. In holding that the "shared responsibility payment" in the Affordable Care Act was a tax, and therefore within Congress's power, the Court pointed to the fact that the payment was collected by tax authorities, that it was paid into the general treasury, that it did not apply to people who did not file income tax returns, and that the amount was figured using taxable income, number of dependents, and joint filing status.[29] But the Court also pointed to its prior

[26] In fact, a cap-and-trade system theoretically reduces the costs of compliance with the cap compared to a command-and-control regulation, *see infra* Part 2.1.2, which makes it more like a reduction of taxes if anything.

[27] Nat'l Fed'n of Indep. Bus. v. Sebelius, 567 U.S. 519 (2012).

[28] *Id.* at 564-66. While the Court held that the mandate and penalty were capable of classification as a tax under the taxing and spending power, the Court only fell back on that second-best description when it had to in order to uphold the law. The Court stated that the "most straightforward reading of the mandate is that it commands individuals to purchase insurance," which would make it a regulatory penalty, *Id.* at 562, but because it held that Congress's commerce power did not extend to nonparticipation in economic activity, the Court needed to find another basis for Congress's action (unlike in the states, Congress has no plenary police power authority to regulate). *Id.* at 562 ("[F]or the reasons explained above, the Commerce Clause does not give Congress that power. Under our precedent, it is therefore necessary to ask whether the Government's alternative reading of the statute—that it only imposes a tax on those without insurance—is a reasonable one.") *Id.* at 564-66.

[29] *Id.* at 563-64.

holding in *Drexel Furniture* (the *Child Labor Tax* case) as an instance where the application of the functional test would point in the direction of a policy *not* being a tax for the purposes of Congress's taxing power. In *Drexel Furniture*, the Court "focused on three practical characteristics of the so-called tax on employing child laborers that convinced [them] the 'tax' was actually a penalty. First, the tax imposed an exceedingly heavy burden—10 percent of a company's net income—on those who employed children, no matter how small their infraction. Second, it imposed that exaction only on those who knowingly employed underage laborers. Such scienter requirements are typical of punitive statutes, because Congress often wishes to punish only those who intentionally break the law. Third, this 'tax' was enforced in part by the Department of Labor, an agency responsible for punishing violations of labor laws, not collecting revenue."[30] Assuming that the carbon dioxide cap and noncompliance fees were to be administered by DEP, rather than state taxing authorities, the application of the functional test in *Drexel Furniture* is far more persuasive an analogy than the *Sebelius* case's application of the functional test to the individual mandate and shared responsibility payment.

Again, this is only suggestive, given that the federal taxing and spending power is separate from the commonwealth's taxing power, but it is consistent with the general notion, well established in the case law, that taxes are a far narrower legal category than opponents of RGGI suggest.

### 2.1.2. The Auctioning of Allowances Is Not a Tax Either

A distinctive feature of a cap-and-trade system is the addition of the possibility of purchasing and trading allowances, or permits, to pollute. This is what makes a cap-and-trade system comparable to, but more efficient than, the kind of command-and-control style regulation discussed in the previous subsection. The option to comply via allowance improves the efficiency of the regulatory command because it allows those most able to reduce emissions to do so and to "sell their overcompliance" to other firms who are not well situated to actually reduce emissions but still need to report compliance with the cap to avoid penalties. This feature,

[30] *Id.* at 565–66 (citing *Bailey v. Drexel Furniture Co.*, 259 U.S. 20 (1922)).

though, raises anew the questions about whether the allowances, and in particular the auction of some portion of them by the government,[31] is an unconstitutional tax.[32]

Proponents of this argument might start by arguing that permitting generators to comply by purchasing carbon allowances, whose price floats based on market signals, makes this approach different from traditional, command-and-control regulatory programs that impose a set penalty for failure to comply. The fact that prices of allowances float with the market, however, does not set this regulatory design apart for purposes of analysis of whether it constitutes a tax under the law. A cap on carbon dioxide backed by an option to pay for non-compliance with the cap is simply a substitute regulatory instrument. The economic and legal literature uniformly follow this conclusion, terming cap-and-trade as a variant of "market-based regulation" designed to achieve the familiar purposes of command-and-control regulation at a lower cost to regulated firms by creating transactional efficiencies as the firms able to comply are financially incentivized to do so.[33] This market-based mechanism substitutes for an agency's decision to impose a set penalty using some combination of informal and practical considerations about what kind of penalty would be appropriate to induce compliance, and it arguably does so in a way that is less arbitrary. Any doubt about whether this system is a tax is resolved by considering that the possibility of complete compliance with the cap would result in no revenue but would

[31] An auction of allowances is not strictly required for a cap-and-trade system, but it has clear advantages over the "free" distribution of allowances. By allowing the government to "capture" the value of the allowances, the overall program stringency is ramped up and the perennial problem of overallocation of allowances is resolved. *See* Robert W. Hahn & Robert N. Stavins, *The Effect of Allowance Allocations on Cap-and-Trade System Performance*, 54 J.L. & Econ. S267 (2011); Lesley McAllister, *The Overallocation Problem in Cap-and-Trade: Moving toward Stringency*, 34 Colum. J. Envtl. L. 395 (2009); Robert N. Stavins, *A Meaningful Cap-and-Trade System to Address Climate Change*, 32 Harv. Envtl. L. Rev. 293 (2008).

[32] Again, this argument was presaged in the *Thrun v. Cuomo* litigation in New York after New York administratively joined RGGI, *supra* note **Error! Bookmark not defined.**, but the court never rendered a decision on the merits.

[33] *See, e.g.*, Meredith Fowlie, Mar Reguant, & Stephen P. Ryan, *Market-Based Emissions Regulation and Industry Dynamics*, 124 J. Pol. Econ. 249 (2016); Richard Hahn & Robert Stavins, *The Effect of Allowance Allocations on Cap-and-Trade System Performance*, 54 J. L. & Econ. 267 (2011).

result in reduced carbon dioxide emissions.[34] This simple fact reveals cap-and-trade as a simple regulation.[35]

[34] In fact, a cap-and-trade system theoretically reduces the costs of compliance with the cap compared to a command-and-control regulation, *see infra* Part 2.1.2, which makes it more like a reduction of taxes if anything.

[35] Another question that some might have is whether the *legal sanction* behind violating the carbon dioxide cap (through a failure to mitigate or purchase allowances that match the budget) would be better understood as a regulatory fee or a penalty, but the better answer is that it is simply a penalty. Indeed, that is how the APCA itself describes them. *See* 35 P.S. § 4009.1 (West) (spelling out how DEP may impose "civil penalties" for violations of the APCA and any order, plan approval, or permit issued under it). This is important, because while neither fees nor penalties would be categorically unavailable for DEP and EQB (indeed, DEP other Pennsylvania agencies currently implement both penalties and fees in their regulatory programs without issue), *see, e.g.*, HIKO Energy, LLC v. Pennsylvania Pub. Util. Comm'n, 163 A.3d 1079, 1082 (Pa. Commw. Ct. 2017) (upholding $1.8 million civil penalty against an electric generator), *aff'd*, 209 A.3d 246 (Pa. 2019), fees do come with some constitutional limitations. As a general matter, "courts have traditionally identified three requirements for valid fees. First, the party being charged must benefit from the governmental service being funded or the regulatory program being implemented. Second, fees are voluntary. And third, the charges must correspond to the cost of the governmental activity being funded rather than reflect a general government desire to raise revenue." Reynolds, *supra* note 21, at 409. Pennsylvania law follows this general framework, and many court decisions (many concerning municipal services) examine whether the money collected "has for its purpose the defraying of the expense of the regulation of such acts for the benefit of the general public." Pennsylvania Liquor Control Bd. v. Publicker Commercial Alcohol Co., 347 Pa. 555, 559–60, 32 A.2d 914, 917 (1943); *see also* Nat'l Biscuit Co. v. City of Philadelphia, 374 Pa. 604, 615–16, 98 A.2d 182, 187–88 (1953) ("The distinguishing features of a license fee are (1) that it is applicable only to a type of business or occupation which is subject to supervision and regulation by the licensing authority under its police power; (2) that such supervision and regulation are in fact conducted by the licensing authority; (3) that the payment of the fee is a condition upon which the licensee is permitted to transact his business or pursue his occupation; and (4) that the legislative purpose in exacting the charge is to reimburse the licensing authority for the expense of the supervision and regulation conducted by it."). Going beyond this purpose of defraying the cost of the implementation of the regulation would disqualify the collection of money from consideration as a fee. By contrast, a penalty is not subject to any special restrictions beyond the general bounds of the police power, and it can therefore be untethered from the requirement that it be proportionate to the program expenses and may impose whatever charges might best advance the goal of curbing the regulated behavior. Univ. Park Cinemas, Inc. v. Windber Borough, 59 Pa. D. & C.2d 726, 732 (Pa. Com. Pl. 1972) ("A fine or penalty is not a tax, or assessment or charge for services sold, and differs substantially from a license fee. The purpose of the fine is to punish violators and to deter future violations, and the amount thereof may be fixed at whatever sum will effectively accomplish those objects irrespective of the cost to the municipality of enforcement and collection . . . ."). To be sure, it is not clear that EQB would lack authority to implement a carbon dioxide cap if it were to be construed as a regulatory fee rather than a penalty, but EQB can most easily justify the imposition of a system capping carbon dioxide and imposing an obligation to pay for noncompliance by styling it as a regulation with a corresponding civil penalty for noncompliance. DEP would be on strong grounds in arguing that any noncompliance payments could exceed mere administrative costs: the requirement that fees be limited to "defraying of the expense of the regulation of such acts for the benefit of the general public" might be read broadly enough to encompass fees that are sufficient to reimburse the public for the

To be sure, the argument that the auctions amount to a tax might appear to be more plausible than the cap on carbon dioxide since it involves the generation of auction revenue.[36] However, the one court to have engaged this question in any depth came to the opposite conclusion. In *California Chamber of Commerce v. State Air Resources Board*, the Court of Appeals in California examined the argument that the revenue generated through auctions of allowances under its landmark California Global Warming Solutions Act of 2006 (known popularly as AB 32) was a tax.[37] Even though the California legislature itself created the auctions, in California Proposition 13 requires a supermajority vote for anything that amounts to a tax,[38] and that was not the case with the legislation creating the auctions. The constitutionality of the auctions thus hinged on its legal classification. The court held that the "hallmarks of a tax are: 1) that it is compulsory; and 2) that the payor receives nothing of particular value for payment of the tax, that is, the payor receives nothing of specific value for the tax *itself*,"[39] but that the purchase of allowances at auction is "a voluntary decision driven by business judgments as to whether it is more beneficial to the company to make the purchase than to reduce emissions," and further that the purchaser does obtain something of value for the purchase because the "allowances are valuable, tradable commodities, conferring on the holder the privilege to pollute."[40]

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negatively externalized costs of the regulated activity, which could be substantial and on par with what would be allowed under the classification as a civil penalty. As will be discussed in the next subsection, this may become important for justifying the tradable permit aspect of the system.

[36] It bears repeating that the simple generation of revenue is not a talisman for whether a policy is a tax or penalty. *See supra* note 22.

[37] California Chamber of Commerce v. State Air Res. Bd., 10 Cal. App. 5th 604, 613, 216 Cal. Rptr. 3d 694, 700 (2017). For general background on the California cap-and-trade program, see Jonathan Kintzele, *Easy Come, Easy Go: A Guide to California Cap-and-Trade Spending*, 90 S. Cal. L. Rev. 719 (2017)

[38] Cal. Const., art. XIII A, § 3.

[39] *California Chamber of Commerce*, 10 Cal. App. 5th at 614.

[40] *Id.*

This analysis has significant persuasive force in the context of a possible auction of carbon dioxide allowances in Pennsylvania. Since the carbon dioxide cap stands alone and is perfectly justifiable as a police power regulation,[41] the choice of whether to purchase allowances at auction or on the secondary market for permits rather than reduce emissions to comply with the cap (or to simply pay noncompliance penalties) is entirely voluntary.[42] Who ever heard of a voluntary tax? [43] Moreover, the purchase of an allowance at auction or on a secondary market would give the purchaser a tradable commodity that has value on the market for allowances. Again, who ever heard of a tax that provides the payer with something specific of value rather than the more general benefit of government programs?[44]

The *California Chamber of Commerce* litigation is also helpful in dealing with an aspect of the allowance auctions that might seem in some tension with the traditional definition of a regulatory fee—that is, the fact that the revenue from auctions might be used by the government for a wide variety of purposes that bear more or less direct relationships to the purpose of the regulatory program. As does Pennsylvania, California maintains a distinction between taxes and regulatory fees, and the latter is similarly constrained by a proportionality analysis.[45] The

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[41] *See supra* Part 2.1.1.

[42] The court's rejection of the argument by the plaintiffs in that case that the choice is not truly voluntary because not acquiring allowances would lead to financial ruin or a need to leave the state is likewise persuasive for Pennsylvania courts contemplating the question. As the court noted, "[t]he fact that some businesses may choose not to participate in the program and may instead choose to leave the state is a potential side effect which the Act itself contemplates. But the possibility of leakage lends no weight to the argument that the cap-and-trade scheme amounts to a *tax*. A number of requirements for businesses, whether taxes, safety regulations, minimum wage statutes, or command-and-control pollution control regulations, might cause a particular business to become unprofitable. This unfortunate reality does not translate into a *compelled* purchase of auction credits." *California Chamber of Commerce*, 10 Cal. App. 5th at 644.

[43] Of course, in a technical sense taxes are voluntary if there is interjurisdictional competition on tax policy. One can always "decline" to make a tax payment by relocating to a jurisdiction with lower taxes. *See* Charles M. Tiebout, *A Pure Theory of Local Expenditures*, 64 J. Pol. Econ. 416 (1956). However, unless one is willing to relocate, a tax is in every relevant sense mandatory.

[44] "Taxation 'promises nothing to the person taxed beyond what may be anticipated from an administration of the laws for individual protection and the general public good.'" *Id.* at 641 (citing 71 Am. Jur. 2d, State and Local Taxation, § 6). If anything, the auction revenue might be better characterized as a state bond.

[45] Sinclair Paint Co. v. State Bd. of Equalization, 15 Cal. 4th 866, 870, 937 P.2d 1350, 1351 (1997) (holding that a policy is a regulatory fee rather than a tax when the policy is intended to "mitigate the

plaintiffs in the litigation argued,[46] and the courts agreed, that the auctions were "unlike a traditional regulatory fee" in that "the charges are not intended to shift the costs of a specific regulatory program. . . . The proceeds of the sales will be used to pay for a wide range of (as-yet-undetermined) regulatory programs (ostensibly) related to AB 32."[47] In *California Chamber of Commerce*, the appellate court rejected the dichotomy between a tax and a regulatory fee and simply held that the auction revenues were part and parcel of the police regulation, thus entirely avoiding the question of whether the revenues were proportional or related to the regulatory program.[48] This line of analysis would be one possible avenue for Pennsylvania, and the one most consistent with the fact that a cap-and-trade system is simply a market-based regulation in design,[49] but as of now the Pennsylvania courts have not recognized the "other" category, at least not explicitly.

An alternative avenue would be to adopt the reasoning of the trial court in the *California Chamber of Commerce* case. There, the court followed the tax/regulatory fee distinction and classified the auction revenues as regulatory fees despite the fact that they were to be used for a variety of purposes.[50] Nevertheless, the trial court held that the fee was proportional under the *Sinclair* analysis. There is undoubtedly some play in the joints in terms of how proportionate to regulatory purposes the spending needs to be, and the trial court's approach was to find authority

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actual or anticipated adverse effects of the fee payers' operations, and under the Act the amount of the fees must bear a reasonable relationship to those adverse effects").

[46] *California Chamber of Commerce*, 10 Cal. App. 5th at 650 ("Plaintiffs and allied amici curiae contend that under various statutes the money-raised by 'an unelected, politically-appointed state board'—is being used to support diverse programs that would otherwise be paid for from general fund sources. Their point is the Legislature has effectively adopted a cash cow sired by the Board and is milking it for a purportedly endless number of programs that have at best a tenuous connection to the discharge of GHGs by covered entities. At oral argument this was referred to pejoratively as a 'slush fund.'")

[47] *Id.* at 637 (quoting trial court opinion).

[48] *Id.* at 640, 650-51.

[49] *See supra* Part 2.1.1.

[50] 10 Cal. App. 5th at 636-38 (summarizing trial court holding).

for the auction in that play. Courts in Pennsylvania could do the same, [51] as the Pennsylvania caselaw governing fees describes the proportionality and relationship between the fee and the regulatory scheme in sufficiently capacious terms to conclude that any number of uses of the revenue—from energy efficiency to direct bill assistance and beyond—promotes the public, regulatory purpose of the cap.[52] To the extent that costs of compliance with RGGI are passed on to ratepayers, such programs directly offset these costs and ensure that the program actually incentivizes carbon dioxide emissions reductions. EQB could easily defend these uses of auction revenue as consistent with the legal construct of the regulatory fee by emphasizing that the revenue, however it is spent, achieves its regulatory purposes (reducing carbon dioxide emissions) by setting a market-driven price for the license to pollute.

### 2.2 Issue #2: Does the Air Pollution Control Act Give EQB Authority to Enact the Cap on Carbon Dioxide?

In Pennsylvania, the general police power may be delegated to administrative agencies[53] such that administrative agencies may retain discretion to choose the precise form that a policy will

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[51] *See, e.g.*, Jackson Morris, *Yes, the PA DEP Has Legal Authority to Do a RGGI Rule*, NRDC (Sep. 3, 2020), *available at* https://www.nrdc.org/experts/jackson-morris/yes-pa-dep-has-legal-authority-do-rggi-rule#:~:text=Upon%20Pennsylvania%20joining%20RGGI%2C%20the,of%20CO2%20they%20emithttps://www.nrdc.org/experts/jackson-morris/yes-pa-dep-has-legal-authority-do-rggi-rule#:~:text=Upon%20Pennsylvania%20joining%20RGGI%2C%20the,of%20CO2%20they%20emit (arguing that directing RGGI revenues to clean energy programs could be found by reviewing courts to be "part of the administrative costs of implementing the 'air pollution control program' under APCA, and therefore *do not* constitute an impermissible tax").

[52] Nat'l Biscuit Co. v. City of Philadelphia, 374 Pa. 604, 615, 98 A.2d 182, 187 (1953) ("A true license fee is defined in *Pennsylvania Liquor Control Board v. Publicker Commercial Alcohol Co.*, 347 Pa. 555, 560, 32 A.2d 914, 917, as 'a charge which is imposed by the sovereign, in the exercise of its police power, upon a person within its jurisdiction for the privilege of performing certain acts and which *has for its purpose the defraying of the expense of the regulation of such acts for the benefit of the general public*; it is not the equivalent of or in lieu of an excise or a property tax, which are levied by virtue of the government's taxing power solely for the purpose of raising revenue.'" (emphasis added)).

[53] Pennsylvania Builders Ass'n v. Dep't of Labor & Indus., 4 A.3d 215, 221 (Pa. Commw. Ct. 2010) ("The General Assembly may, however, delegate rule-making authority. This Court has declared that '[t]he Legislature may ... authorize an agency to carry out the legislative intent described in general terms through rules, regulations and standards established by the agency.' (quoting *Bortz Coal Co. v. Air Pollution Comm'n*, 2 Pa.Cmwlth 441, 279 A.2d 388, 392 (1971)).

take.[54] Statutes do not have to spell out in painstaking detail every action that an agency might take in using its delegated legislative rule-making power to fulfill the general policy established by the legislature, but instead may allow the agency to "fill in details of the policy with regulations."[55] Thus, "when an agency adopts a regulation pursuant to its legislative rule-making power, as opposed to its interpretive rule-making power, it is valid and binding upon courts as a statute so long as it is (a) adopted within the agency's granted power, (b) issued pursuant to proper procedure, and (c) reasonable."[56] Moreover, the "delegation of authority to an agency is construed liberally when the agency . . . is concerned with protecting the public's health and welfare,"[57] and "[o]ne measure of the breadth of an administrator's authority is the purpose for which the authority has been conferred."[58] For all of these reasons, "an agency's interpretation of its enabling statute is entitled to great weight and will not be overturned unless it is clearly erroneous."[59]

Despite this potentially quite broad scope of delegated authority, one question that may emerge is whether the Air Pollution Control Act (APCA), whose main provisions were passed in 1960, gives DEP and EQB authority to promulgate regulations setting up a novel cap-and-trade program for carbon dioxide.[60] Given that carbon dioxide was not likely understood as an air pollutant at passage due to the limited understanding of climate change, and given that market-based regulatory mechanisms have only taken off around the country and the world in recent

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[54] *Administrative discretion*, 36 Standard Pennsylvania Practice 2d § 166:16 (contrasting discretionary from ministerial powers, functions, and duties).

[55] Pennsylvania Builders Ass'n v. Dep't of Labor & Indus., 4 A.3d 215, 221 (Pa. Commw. Ct. 2010).

[56] Tire Jockey Serv., Inc. v. Com., Dep't of Envtl. Prot., 591 Pa. 73, 108, 915 A.2d 1165, 1186 (2007).

[57] DRB, Inc. v. Dept' of Labor & Indus., 853 A.2d 8, 19 (Pa.Cmwlth.2004); Com., Dep't of Envtl. Res. v. Locust Point Quarries, Inc., 483 Pa. 350, 360, 396 A.2d 1205, 1210 (1979) ("Because regulations implementing the Air Pollution Control Act are promulgated pursuant to a grant of legislative power, they enjoy a presumption of reasonableness.").

[58] Source of and general limitations on power, 36 Standard Pennsylvania Practice 2d § 166:12.

[59] Eagle Envtl. II, L.P. v. Com., Dep't of Envtl. Prot., 584 Pa. 494, 511, 884 A.2d 867, 878 (2005).

[60] Again, such a challenge was presaged by the litigation in *Thrun v. Cuomo* over New York's RGGI regulations, *see supra* note **Error! Bookmark not defined.**, although that litigation did not yield any determination on the merits.

decades, the likely argument would be that a cap-and-trade system for carbon dioxide would be the creation of climate policy rather than the mere "filling in" of details.[61] However, close examination of the APCA confirms that it is broad enough and flexible enough to accommodate regulation of carbon dioxide, and to do so using flexible market-based regulatory mechanisms like a cap-and-trade system.

### 2.2.1 Scope of the APCA and a Comparison to New York

The starting point in understanding the breadth of the delegation of authority the APCA is its declaration of policy (Section 4002):It is hereby declared to be the policy of the Commonwealth of Pennsylvania to protect the air resources of the Commonwealth to the degree necessary for the (i) protection of public health, safety and well-being of its citizens; (ii) prevention of injury to plant and animal life and to property; (iii) protection of the comfort and convenience of the public and the protection of the recreational resources of the Commonwealth; (iv) development, attraction and expansion of industry, commerce and agriculture; and (v) implementation of the provisions of the Clean Air Act in the Commonwealth.[62]

In addition, Section 4004 of the act spells out the Department of Environmental Protection's powers and duties in fulfilling this purpose. It includes, *inter alia*, the power to "[implement the provisions of the [federal] Clean Air Act in the Commonwealth,"[63] to "[p]repare and develop a general comprehensive plan for the control and abatement of existing air pollution and air contamination and for the abatement, control and prevention of any new air pollution and air contamination, recognizing varying requirements for the different areas of the Commonwealth,

[61] The U.S. Supreme Court's recent decision in *Bostock* holding that Title VII of the Civil Rights Act bars discrimination against sexual orientation and gender identity provides helpful clues as to the evolving debate over whether courts should interpret broadly worded language in statutes as it would likely have been understood at the time of passage or whether contemporary courts should construe broadly worded language however far it appears to go. *See* Bostock v. Clayton Cty., Georgia, 140 S. Ct. 1731, 1737 (2020). The Court's decision suggests that any implicit limits in the understanding of a statute's language at the time of passing should not trump the contemporary understanding of the explicit terms promulgated.

[62] 35 Pa. Stat. Ann. § 4002 (West).

[63] 35 Pa. Stat. Ann. § 4004(1) (West).

and to submit a comprehensive plan to the board for its consideration and approval,"[64] and generally to "[d]o any and all other acts and things not inconsistent with any provision of this act, which it may deem necessary or proper for the effective enforcement of this act and the rules or regulations promulgated under this act."[65]

In terms of nuts and bolts, Section 4005 creates the EQB and says that its powers and duties will be to [a]dopt rules and regulations, for the prevention, control, reduction and abatement of air pollution, applicable throughout the Commonwealth or to such parts or regions or subregions thereof specifically designated in such regulation which shall be applicable to all air contamination sources regardless of whether such source is required to be under permit by this act. Such rules and regulations may establish maximum allowable emission rates of air contaminants from such sources, prohibit or regulate the combustion of certain fuels, prohibit or regulate open burning, prohibit or regulate any process or source or class of processes or sources, require the installation of specified control devices or equipment, or designate the control efficiency of air pollution control devices or equipment required in specific processes or sources or classes of processes or sources."[66]

Further, EQB can "[e]stablish and publish maximum quantities of air contaminants that may be permitted under various conditions at the point of use from any air contaminant source in various areas of the Commonwealth so as to control air pollution,"[67] "[b]y rules or regulation, classify air contaminant sources, according to levels and types of emissions and other characteristics which relate to air pollution."[68] Once a rule for the prevention, control, reduction and abatement of air pollution is adopted by the EQB, the operator of a stationary air contamination source subject to the rule must apply for a license from DEP and cannot operate without such approval.[69] This exceptionally broad language would seem squarely to cover the

[64] 35 Pa. Stat. Ann. § 4004(18) (West).

[65] 35 Pa. Stat. Ann. § 4004(27) (West).

[66] 35 Pa. Stat. Ann. § 4005(a)(1) (West).

[67] 35 Pa. Stat. Ann. § 4005(a)(2) (West).

[68] 35 Pa. Stat. Ann. § 4005(a)(3) (West).

[69] 35 Pa. Stat. Ann. § 4006.1 (West).

imposition of a cap on carbon dioxide emissions (assuming it can be considered an air pollutant under the act[70]) as part of a "comprehensive plan for the control and abatement" of existing or new air pollution in the interest of protecting public health and property.[71]

That inference is strengthened by comparison to the only other state that entered RGGI through administrative action using existing statutory authority. In New York, the Department of Conservation (NYDEC) promulgated carbon dioxide budget regulations[72] while the State Energy Research and Development Administration (NYSERDA) separately promulgated regulations for the auctioning of carbon dioxide allowances and the distribution of revenues from those auctions to various programs around the state.[73] These regulatory programs were based on existing statutory authorities that, like the APCA, dated back to the 1960s. For instance, NYDEC relied heavily on Section 19-0103 of the Environmental Conservation Law (ECL), which

> declare[s] […] the policy of the state of New York to maintain a reasonable degree of purity of the air resources of the state, which shall be consistent with the public health and welfare and the public enjoyment thereof, the industrial development of the state, the propagation and protection of flora and fauna, and the protection of physical property and other resources, and to that end to require the use of all available practical and reasonable methods to prevent and control air pollution in the state of New York.[74]

As with the APCA, the policy and purpose sections of the ECL gave NYDEC broad authority to control air pollution for the purposes of protecting public health and property. Likewise, Section 09-0301 of the ECL gives NYDEC many of the same powers that Section 4004 of the

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[70] *See infra* Part 2.2.2.

[71] It bears mentioning that the APCA's broad purpose is likely to be understood in light of the Environmental Rights Amendment. *See* Funk v. Wolf, 144 A.3d 228, 233 (Pa. Commw. Ct. 2016), *aff'd*, 638 Pa. 726, 158 A.3d 642 (2017) (describing the Environmental Rights Amendment in a case involving greenhouse gases and their regulation).

[72] 6 NYCRR Part 242.

[73] 21 NYCRR Part 507.

[74] N.Y. Envtl. Conserv. Law § 19-0103 (McKinney); *see also* N.Y. Envtl. Conserv. Law § 19-0105 (McKinney) ("It is the purpose of this article to safeguard the air resources of the state from pollution by: (1) controlling or abating air pollution which shall exist when this artcle shall be enacted and (2) preventng new air pollution, under a program which shall be consistent with the declaration of policy above stated and in accordance with the provisions of this article.").

APCA gives to DEP, such as the power to "[f]ormulate, adopt and promulgate, amend and repeal codes and rules and regulations for preventing, controlling or prohibiting air pollution . . . ."[75] The New York ECL now contains explicit authority for the promulgation of "rules and regulations targeting reductions in emissions of carbon dioxide that would apply to major electric generating facilities that commenced construction after the effective date of the regulations,"[76] but this authority was added in 2011 only *after* NYDEC had already promulgated the carbon dioxide budget regulations in 2008.[77] This fact bears special emphasis, as opponents of RGGI have implied that New York has explicit authority to enter RGGI and therefore the case is not instructive. At the time New York promulgated its RGGI regulations, it was in the same shoes as Pennsylvania—it could rely only on general provisions of its environmental laws.

The close similarity between the New York ECL and the Pennsylvania APCA would make for a powerful argument that Pennsylvania, like New York, has all of the delegated authority it needs to promulgate valid legislative rules to regulate carbon dioxide emissions. When pressed by commenters during the rulemaking process for the source of NYDEC's authority to promulgate these rules, NYDEC confidently asserted that "[p]rincipally, the Department has the authority to enact the Program pursuant to New York State Environmental Conservation Law (ECL) Sections 19-0103 and 19-0301."[78] If these two barebones provisions were sufficient for New York to undertake a novel cap-and-trade system for control of carbon dioxide emissions, they should be sufficient for Pennsylvania.

### 2.2.2 Carbon Dioxide is an Air Pollutant under the APCA

The only argument against this interpretation might be that carbon dioxide cannot be an air contaminant under the APCA. The APCA does adopt a slightly different set of definitions

[75] N.Y. Envtl. Conserv. Law § 19-0301 (McKinney).

[76] N.Y. Envtl. Conserv. Law § 19-0312 (McKinney).

[77] POWER NY ACT OF 2011, 2011 Sess. Law News of N.Y. Ch. 388 (A. 8510) (McKinney).

[78] *See* New York State CO Budget Trading Program, 30 N.Y. Reg. (Sep. 24, 2008), *available at* https://govt.westlaw.com/nyreg/Document/I2984f665c9b811e0b63a0000845b8d3e?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default).

around the concept of air pollution than other environmental protection statutes at the state and federal level, but these differences are not enough to materially distinguish the scope of the statute from the definitions of air pollution in other statutes where carbon dioxide is considered an air pollutant.

Since EQB's power to promulgate regulations extends to the control of air pollution, we can start there. Section 4003 of the APCA defines "air pollution" as the

> presence in the outdoor atmosphere of any form of contaminant, including, but not limited to, the discharging from stacks, chimneys, openings, buildings, structures, open fires, vehicles, processes or any other source of any smoke, soot, fly ash, dust, cinders, dirt, noxious or obnoxious acids, fumes, oxides, gases, vapors, odors, toxic, hazardous or radioactive substances, waste or any other matter in such place, manner or concentration inimical or which may be inimical to the public health, safety or welfare or which is or may be injurious to human, plant or animal life or to property or which unreasonably interferes with the comfortable enjoyment of life or property.[79]

The APCA further defines "air contaminant" as "[s]moke, dust, fume, gas, odor, mist, radioactive substance, vapor, pollen or any combination thereof."[80]

There are two principal differences between these definitions and the analogous definitions in the federal Clean Air Act, which were held in *Massachusetts v. EPA* to encompass carbon dioxide.[81] First, there is the reference to "contaminant" rather than "pollutant" to define the object of regulation. At a functional level, the Clean Air Act's definition of air pollutant covers very similar substances to the substances covered by the APCA's definition of contaminant: namely, it covers "any air pollution agent or combination of such agents, including any physical, chemical, biological, radioactive . . . substance or matter which is emitted into or otherwise

[79] 35 P.S. § 4003. Again, New York's ECL tracks Pennsylvania's APCA closely, providing a strong precedent for using existing authority to enter RGGI administratively. *See* N.Y. Envtl. Conserv. Law § 19-0107.3 (McKinney) ("'Air pollution' means the presence in the outdoor atmosphere of one or more air contaminants in quantities, of characteristics and of a duration which are injurious to human, plant or animal life or to property or which unreasonably interfere with the comfortable enjoyment of life and property throughout the state or throughout such areas of the state as shall be affected thereby; excluding however all conditions subject to the requirements of the Labor Law and Industrial Code.").

[80] 35 P.S. § 4003. Again, New York's ECL tracks this definition almost verbatim. *See* N.Y. Envtl. Conserv. Law § 19-0107 (McKinney) ("'Air contaminant' means a dust, fume, gas, mist, odor, smoke, vapor, pollen, noise or any combination thereof.").

[81] Massachusetts v. EPA, 549 U.S. 497, 528-32 (2007).

enters the ambient air."[82] The APCA definition is more specific, but nothing about that specificity would suggest that carbon dioxide would not fit—carbon dioxide is clearly a gas. The second difference is that the APCA embeds in the definition of "air pollution" the public health and welfare language that was located separately in the Clean Air Act. This suggests that air pollution does not exist as a definitional matter in Pennsylvania if it does not endanger public health or welfare, whereas in *Massachusetts v. EPA*, the Supreme Court remarked at the "sweeping" breadth of the definition of air pollution as "embrac[ing] all airborne compounds of whatever stripe" and without regard to their impact.[83] For the *Massachusetts* Court, that meant that the Court had to separately analyze whether EPA properly exercised its judgment in declining to regulate carbon dioxide despite it being an air pollutant under the Clean Air Act. Here in Pennsylvania, the question would collapse into one, but it is not clear that this makes any difference at present because DEP and EQB are attempting to regulate carbon dioxide, and carbon dioxide has been determined to endanger public health and welfare. [84] In sum, as long as carbon dioxide is a gas, it can be considered an air contaminant under the APCA, and as long as DEP and EQB make the determination that carbon dioxide is being emitted in such concentrations in Pennsylvania that it is "inimical or which may be inimical to the public health, safety or welfare or which is or may be injurious to human, plant or animal life or to property or which unreasonably interferes with the comfortable enjoyment of life or property," [85] any jurisdictional prerequisites for regulation are satisfied.

Any doubt about this interpretation of the scope of the APCA is dispelled by the Commonwealth Court's decision in *Funk v. Wolf*. In that case, concerned citizens sued to force agency action to address climate change through a writ of mandamus. While the Court declined to grant mandamus relief (an extraordinary remedy in administrative law at any level) under the Environmental Rights Amendment, it affirmed that there is a "Climate Change Legislative Scheme" in Pennsylvania comprising the Climate Change Act and the APCA. Specifically, the

[82] 42 U.S.C. § 7602(g).

[83] *Massachusetts*, 549 U.S. at 529.

[84] Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 66, 496 (Dec. 15, 2009).

[85] 35 P.S. § 4003.

Court acknowledged that "the General Assembly, through the APCA, bestowed upon [respondents] a duty to promulgate and implement rules and regulations to reduce CO2 and GHG emissions."[86]

### 2.2.3 DEP and EQB Have a Wide Berth to Adopt an Allowance Trading System and to Auction Allowances to Accomplish the Delegated Goal of Controlling Carbon Dioxide Emission

As discussed above, the APCA explicitly codifies the more general administrative law rule that DEP has the power to "[d]o any and all other acts and things not inconsistent with any provision of this act, which it may deem necessary or proper for the effective enforcement of this act and the rules or regulations promulgated under this act."[87] For its part, EQB also has broad authority to make specific design choices in promulgating legislative rules within the general framework delineated by the APCA, including creating a trading system for pollution allowances.[88] In fact, EQB has promulgated regulations implementing a trading system before in the context of interstate smog regulations. Pursuant to the amendments to the federal Clean Air Act in 1990, states gained the authority to join a new quasi-public entity—the Northeast Ozone Transport Commission (NOTC)—in order to coordinate the development of state regulatory programs for the control of nitrogen oxide (NOx).[89] Pennsylvania joined NOTC and entered into a memorandum of understanding with neighboring states to develop a regional cap-and-trade program similar to RGGI.[90] Subsequently, EQB promulgated rules for the allocation of allowances and trading of allowances, citing as authority the Air Pollution Control Act's general delegation of authority to "[a]dopt rules and regulations, for the prevention, control, reduction, and abatement of air pollution, applicable throughout the Commonwealth . . . which shall be

[86] Funk v. Wolf, 144 A.3d 228, 250 (Pa. Commw. Ct. 2016), *aff'd*, 638 Pa. 726, 158 A.3d 642 (2017).

[87] 35 P.S. § 4004.

[88] *See generally* 35 P.S. § 4005.

[89] 27 Pa. Bull. 5683-99 (1997) (citing 42 U.S.C. § 7511c).

[90] *Id.*

applicable to all air contamination sources regardless of whether such source is required to be under permit by this act."[91]

The NOx cap-and-trade program provides strong support for the conclusion that the APCA provides authority to enter into a carbon dioxide cap-and-trade program. While the allowance allocations were challenged in a pre-enforcement review action on a number of grounds,[92] neither the allowance allocations nor the trading regulations were challenged on the ground that EQB lacked statutory authority to issue the regulations. And while this cap-and-trade program arose from a complicated cooperative federalist scheme with the federal government (what is known as a "SIP Call," or "State Implementation Plan" Call under the Clean Air Act),[93] EQB made clear in its announcement of the final regulations that it understood itself to be "pursu[ing] regulatory actions under state law to implement control strategies."[94] The absence of any challenge to the authority to promulgate these regulations under state law tacitly approves any effort to develop a trading scheme as part of efforts to control carbon dioxide emissions by implementing model RGGI rules. And while the state assembly did pass legislation approving of the state's participation in the NOTC, that language did not purport to delegate any additional authority to DEP and EQB, but rather to acknowledge that following control strategies "approved by an interstate transport commission and by the Commonwealth's representatives and set forth in memoranda of understanding shall be considered commitments by the executive to pursue subsequent actions to implement the control strategies."[95] In other words, the statute affirms that it is the executive's prerogative to determine what subsequent actions might be taken under the APCA to implement any regional cap-and-trade program that Pennsylvania joins.

Similarly, these precedents would strongly suggest that DEP and EQB could elect to allocate allowances in whole or in part through auctions. In the NOx rules, EQB decided to develop a

[91] *Id.* (citing 35 P.S. § 4005(a)(1)).

[92] Duquesne Light Co. v. Com., Dep't of Envtl. Prot., 724 A.2d 413, 415 (Pa. Commw. Ct. 1999).

[93] 27 Pa. Bull. at 5684 ("These final-form regulations are part of the Commonwealth's SIP to meet the reasonable further progress and attainment requirements of the Clean Air Act.").

[94] *Id.* at 5683.

[95] 35 P.S. § 4007.4.

complicated methodology for allocating initial allowances to individual sources.[96] The decision to distribute allowances via auction rather than via a formula or other means is simply a design choice, so if the authority exists to allocate tradable allowances through a formula or methodology, it surely exists to determine allocations through auctions.[97]

## 2.3 Issue #3: What Authorities Do DEP and EQB Have to Allocate Revenue from Allowance Auctions?

The decision to allocate at least some carbon dioxide pollution permits through an auction mechanism means that at least some monies will be generated through sales. According to initial analyses, DEP expects revenues from $179 million to $320 million on a yearly basis through 2030.[98] Current drafts of the implementing regulations proposed by DEP suggest that DEP will "retain control over the proceeds associated with the sale of all of Pennsylvania CO2 allowances, whether sold in a multistate or Pennsylvania CO2 allowance auction and will credit the proceeds to the Clean Air Fund established pursuant to the [APCA]."[99] This section will examine the discretion DEP has to follow this course and utilize the Clean Air Fund, the scope of the discretion to fund various programs under the Clean Air Fund, and other options for managing auction revenue. Overall, DEP has wide discretion to manage and spend auction revenues.

### 2.3.1 DEP May Direct Auction Revenue to the Clean Air Fund

The APCA provides that "all fines, civil penalties and fees collected under this act shall be paid into the Treasury of the Commonwealth in a special fund known as the Clean Air Fund,

[96] 25 Pa. Code § 123 APPENDIX E.

[97] The only argument otherwise would be that the auction is a prohibited tax, but that argument is dealt with separately *supra* Part 2.1.2.

[98] Pa. Dep't Envtl. Prot., *Final AQTAC PA CO2 Budget Trading Program, Presentation* (May 7 2020), *available at* http://files.dep.state.pa.us/Air/AirQuality/AQPortalFiles/Advisory%20Committees/Air%20Quality%20Technical%20Advisory%20Committee/2020/5-7-20/AQTAC%20PA%20CO2%20Budget%20Trading%20Program.pdf.

[99] Draft Rule § 145.401(e).

hereby established, which, along with interest earned, shall be administered by the [DEP] for use in the elimination of air pollution."[100] As discussed above, allowance auction revenue is probably best understood as a market-following civil penalty, or, if not that, a regulatory fee. Either way, the APCA sets up a presumption that the monies will be directed to the Clean Air Fund and controlled by DEP.

The one exception to this presumption involves civil penalties of at least $50,000: if an "incident" results in a civil penalty exceeding that amount, then DEP is statutorily bound to return 25 percent of the monies to the "municipality in which the violation occurred" so that such municipality can use the monies "for projects that eliminate or reduce air pollution or for parks, recreation projects, trails or open spaces."[101] It is not clear that this exception would apply, as there is arguably no "incident" connected to the sale of allowances as there is with a traditional civil penalty. Moreover, the only thing that could possibly be considered an "incident" under this language would be an individual sale of an allowance to cover one ton of carbon dioxide pollution, and, since the prices for allowances on RGGI markets have historically remained well below $50,000 per ton (and will continue to do so due to cost-containment reserves), the statutory threshold would not be triggered.

Thus, DEP will be able to direct all of the monies to the Clean Air Fund using its authority to "establish separate accounts"[102] to sequester the RGGI auction revenues from any other civil penalties or fees that might be subject to the exception.

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[100] 35 P.S. § 4009.2(a).

[101] 35 P.S. § 4009.2(a.1).

[102] 35 P.S. § 4009.2(a). The Clean Air Fund is a "special fund" which currently consists of two separate accounts: the Title V Account and the Non-Title V Account. The Title V Account comprises monies collected from fees under the federal Clean Air Act Title V permitting program, whereas that Non-Title V Account is for all other state programs. The language allowing DEP to establish new accounts as may be necessary suggests DEP could create a special RGGI account for auction revenue.

### 2.3.2 DEP Has Broad Statutory Discretion to Distribute Monies in the Clean Air Fund So Long as There Is Some Plausible Nexus with the Goal of Reducing Air Pollution

As a general matter, a "special fund in a state treasury may properly be created by the legislature and is one dedicated to a special purpose."[103]The statutory standard for expenditure of monies in the Clean Air Fund is quite broad: DEP is supposed to administer the funds "for use in the elimination of air pollution."[104] DEP has used its authority to "adopt rules and regulations for the management and use of the money in the fund"[105] to spell out in slightly more detail the kinds of projects that it believes can currently be undertaken using monies in the Clean Air Fund. Specifically, DEP's regulations provide that monies "paid into the Clean Air Fund may be disbursed *at the discretion* of the Secretary for use in the elimination of air pollution" and, "the full and normal range of activities of the Department shall be considered to contribute to the elimination of air pollution."[106] For illustrative purposes, DEP provided that disbursement of Clean Air Fund monies "may therefore be made for, but may not be limited to" the "[p]ayment, in whole or in part, of the costs of a public project necessary to abate air pollution whether or not the exclusive purpose of that project is the abatement of air pollution," provided that for "projects where multiple purposes will be served, monies from the Clean Air Fund may be used to cover that proportion of the total expense that is estimated to be attributable to abate the air pollution portion of the project."[107]

While this regulatory language first suggests that DEP understands its authority as extending to the full range of activities associated with air pollution—basically parroting the broad delegation of authority in the statute—it then goes on to specify that when it comes to one category of spending (i.e., spending on public projects), DEP currently intends only to spend monies in the Clean Air Fund on the portion of those projects that is directly necessary for

[103] 81A C.J.S. States § 400.

[104] 35 P.S. § 4009.2(a).

[105] 35 P.S. § 4009.2(a).

[106] 25 Pa. Code § 143.1(a), (b).

[107] 25 Pa. Code § 143.1(b).

reducing air pollution.[108] In other words, the regulation arguably limits the expenditure of Clean Air Fund monies to those activities that themselves directly target air pollution reduction. This reading would seem to preclude using monies to fund the entirety of a project that has multiple goals, some of which are not directly related to air pollution reduction. For instance, a community restoration project that combined broad community reinvestment with the conversion of a polluting factory would only be fundable through Clean Air Fund monies for the part associated with the conversion of the factory, not to the rest of the community reinvestment.

This is a narrower interpretation of DEP's authority than is necessary under existing principles of statutory interpretation and administrative law. When an administrative agency promulgates a legislative rule pursuant to a statutory delegation of authority,[109] the rule will "enjoy a presumption of reasonableness" and will be "accorded a particularly high measure of deference—often denominated *Chevron* deference—by reviewing courts."[110] Pennsylvania, in other words, basically follows the federal courts' approach to questions of agency statutory interpretations.[111] Under the well-known two-step *Chevron* analysis, a court confronts two questions in such cases:

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[108] It is possible to read the regulation as offering this latter limitation solely for illustrative purposes. Subsection (b) specifically states that "[d]isbursement of Clean Air Fund monies may therefore be made for, but may not be limited to, the following purposes . . . ." 25 Pa. Code § 143.1 (b). Thus, every one of the examples listed in subsection (b)(1-6) may be read as limited by the more general principle that DEP may spend monies on anything related to air pollution.

[109] One possible argument against this classification would be that regulations for the administration of the Clean Air Fund are not legislative rules, but rather interpretive rules, and as such are only valid if they "genuinely track the meaning of the underlying statute." Slippery Rock Area Sch. Dist. v. Unemployment Comp. Bd. of Review, 603 Pa. 374, 382, 983 A.2d 1231, 1236 (2009). However, this is not the appropriate classification: a legislative rule is differentiated from an interpretive rule by the fact that legislative rules are "mandatory and binding" and interpretive rules are those that "merely construe[] and do[] not expand upon the terms of a statute." *Id.* Since the rules for the administration of the Clean Air Fund are mandatory and binding on DEP, they are legislative rules.

[110] Nw. Youth Servs., Inc. v. Com., Dep't of Pub. Welfare, 620 Pa. 140, 157, 66 A.3d 301, 311 (2013).

[111] *See* Brian Slipakoff & Joseph Pangaro, *The Future of Administrative Deference in Pennsylvania*, Duane Morris Appellate Review (May 19, 2017), *available at* https://blogs.duanemorris.com/appellatelaw/2017/05/19/the-future-of-administrative-deference-in-pennsylvania/.

First, always, is the question whether Congress has directly spoken to the precise question at issue. If the intent of Congress is clear, that is the end of the matter; for the court, as well as the agency, must give effect to the unambiguously expressed intent of Congress. If, however, the court determines Congress has not directly addressed the precise question at issue, the court does not simply impose its own construction on the statute, as would be necessary in the absence of an administrative interpretation. Rather, if the statute is silent or ambiguous with respect to the specific issue, the question for the court is whether the agency's answer is based on a permissible construction of the statute.[112]

In other words, a reviewing court in Pennsylvania applying the federal *Chevron* framework for deference would first identify whether the statute leaves any ambiguity, and then if it does the court would have to defer to any reasonable interpretation of the statutory authority by the agency *even if the court disagrees with the agency about the best reading of the statute*.

The relevant statutory language in this case is "for use in the elimination of air pollution."[113] Thus, the first question is whether this language evinces any specific legislative intent to require the reading arguably currently articulated in DEP's Clean Air Fund regulations (i.e., that it can only expend Clean Air Fund monies for the portion of a project directly necessary for abating air pollution rather than expending Clean Air Fund monies to cover the entirety of any project that has any connection whatsoever to efforts to eliminating air pollution). Since the legislative history accompanying this provision is nonexistent, the only real guide as to this first step of the *Chevron* inquiry is the text of the statute. Clearly, the language does not suggest any particular answer to the question. The phrase "use in" is fundamentally ambiguous[114]: it is consistent with both the narrow interpretation that DEP must limit the monies to activities that are directly necessary for air pollution *and* the interpretation that DEP may spend the monies on any project that has some component that is connected to air pollution, even

[112] Chevron, U.S.A. v. Nat. Res. Def. Council, 467, U.S. 837, 842-43 (1984).

[113] 35 P.S. § 4009.2(a).

[114] *Cf.* United States v. Rentz, 777 F.3d 1105, 1105-07 (10th Cir. 2015) (en banc) (interpreting 18 U.S.C. § 924(c), which imposes heightened penalties for the "use" of a firearm in the commission of a crime, and noting that the "bramble of prepositional phrases [in the statute] may excite the grammar teacher . . . but it's certainly kept the federal courts busy," such that the "better part of five decades after the statute's enactment . . . the courts are still struggling").

if that is not the entirety of the purpose of the project. As the U.S. Supreme Court has put it, the ordinary or natural meaning of "use" is to "'to convert to one's service,' 'to employ,' 'to avail oneself of,' and 'to carry out a purpose or action by means of.'"[115] While the Court has made clear that the "various definitions of 'use' imply action an implementation,"[116] that is about all it implies. The broadest meaning—carrying out a purpose—does not imply any specific relationship between the instrument (the monies) and the purpose. Reading "use in" as requiring a direct connection between each dollar spent and a concomitant reduction of air pollution is a possible reading, but by no means the only reading.

Proceeding, then, to the second step of the *Chevron* inquiry, the question would simply be whether an interpretation offered by DEP falls within the zone of possible interpretations of the ambiguous statutory language.[117] Should DEP want to, it could easily amend its Clean Air Fund regulations to encompass the funding of any project that has any nexus at all with the elimination of air pollution—the language "use in" is simply that broad. For instance, DEP could simply eliminate the second sentence of subsection (b)(6) of Section 143.1 of Chapter 25 of the Pennsylvania Code, effectively leaving it to read "Payment, in whole or in part, of the costs of a public project necessary to abate air pollution whether or not the exclusive purpose of that project is the abatement of air pollution."[118] This would very likely be enough to receive deference from any reviewing court, and it would give DEP all of the discretion it would need to fund a variety of public projects so long as it can establish some kind of connection, or nexus, to the reduction of air pollution, even if that purpose is not the primary purpose of the program. By any measure, Clean Air Fund monies would still be "use[d] in" the elimination of air pollution.

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[115] Bailey v. United States, 516 U.S. 137, 145, 116 S. Ct. 501, 506, 133 L. Ed. 2d 472 (1995) (citing Webster's New International Dictionary of English Language 2806 (2d ed.1949) and Black's Law Dictionary 1541 (6th ed.1990)).

[116] *Id.*

[117] *See* Peter L. Strauss, *'Deference' is Too Confusing—Let's Call Them 'Chevron Space' and 'Skidmore Weight,'* 112 Colum. L. Rev. 1143 (2012) (synthesizing case law and suggesting that step 2 of the *Chevron* inquiry allows agencies to select any interpretation from within a "space" of delegated discretion).

[118] 25 Pa. Code § 143.1. Note that amending this portion of the Pennsylvania Code would be preferable to simply announcing the changed position in the course of implementation, as deference would be less substantial in the latter case.

Additionally, DEP might consider eliminating the word *necessary* from this regulation, as it unnecessarily constrains the broader statutory delegation of authority and might introduce case-by-case uncertainty as to whether a project is truly critical to reducing air pollution. There is no reason for introducing such subjective criteria when the statutory grant of power to administer the special fund is more capacious.

This broad understanding of the statutory authority DEP is working with will ultimately have to be applied to concrete projects. Assuming DEP codifies the "nexus" approach, it would be entitled to deference in its interpretation of those regulations in concrete applications so long as its interpretation of the regulatory language is not "plainly erroneous or inconsistent with the . . . regulation" or "inconsistent with the statute under which it is promulgated."[119]

Applying these principles, DEP would likely be able to argue that a wide range of potential projects have a nexus to air pollution reduction insofar as a reasonably foreseeable consequence of their adoption would be reduced pollution. For instance, energy efficiency programs, subsidies for electric vehicles and rooftop solar panels, clean energy workforce development, green financing, and other related programs designed to either reduce carbon dioxide emissions attributable to energy production or to reduce energy consumption regardless of the source of that energy would seem to lead logically to a reduction of air pollution, both in the form of CO2 and other co-pollutants, even if they do not resemble the kind of air pollution control regulations that DEP has historically used.

However, there are probably limits to the nexus approach. For instance, one popular program in other RGGI states is direct bill assistance, where revenues from auctions are used to offset any rise in electric rates for lower income individuals and small businesses. It would be difficult to see how this could satisfy any nexus to the elimination of air pollution—if anything, the price signals from direct bill assistance would push in the other direction, reducing the incentives to curb air pollution by reducing electricity use created by rising prices. Similarly, programs aimed at curbing non-air pollution, such as drinking water safety, would likely not pass this test.

[119] Joyce Outdoor Advert., LLC v. Dep't of Transp., 49 A.3d 518, 524 (Pa. Commw. Ct. 2012).

### 2.3.3 The Broadest Possible Reading of the Clean Air Fund Statute Would Permit Any Spending on Any Program Because the Spending Furthers the Cap on Air Pollution

While the analysis in Section 2.3.2 gets DEP to the point where it can fund the majority of projects undertaken by other RGGI states, there is another interpretation of the statutory delegation of authority that would cover essentially any project. Here we briefly outline this possible argument, but caution that, unlike the previous interpretation, this one would be more tenuous and uncertain should it be challenged in court. The argument would be that the very fact of spending monies in the Clean Air Fund makes the spending "for use in the elimination of air pollution" because the collection of revenue and its expenditure put teeth in the cap on carbon dioxide pollution. Without the collection of auction revenue and spending (on whatever projects DEP chooses), the cap on carbon dioxide would be enforced largely through noncompliance penalties, and the success of the program in eliminating air pollution would depend on the cap and the number of allowances that are allocated. Many other cap-and-trade programs that rely on formulaic distribution of "free" allowances have failed because of the difficulty of determining the correct price of allowances, as well as other administrative difficulties.[120] Auctioning allowances lets the market set a more efficient regulatory price of carbon, which makes the cap-and-trade system as a whole a more effective regulatory instrument. Since the entire purpose of the RGGI cap-and-trade program is to reduce carbon dioxide emissions, the argument could be made that it is irrelevant what the revenue from auctions is spent on: whatever it is, it has already performed its "use in" the reduction of air pollution by optimally setting the price of allowances.

This argument may, however, prove too much. While it is not inconsistent with the linguistic ambiguity of the relevant statutory language "for use in the elimination of air pollution," the interpretation's virtually limitless authorization of spending might lead to some absurd conclusions. Under this interpretation, DEP would seemingly be able to fund not only energy-related programs or projects like direct bill assistance, but also funding of schools, fixing of potholes, and other projects that bear no relationship with energy or the environment. Even more

[120] *See generally* Dallas Burtraw, *Robust Carbon Markets: Rethinking Quantities and Prices in Carbon Pricing*, Kleinman Ctr. for Energy Pol'y (Jan. 9, 2020), *available at* https://kleinmanenergy.upenn.edu/policy-digests/robust-carbon-markets (describing the advantages of auctions of allowances and praising RGGI's adoption of the auction mechanism in response to failures in the EU stemming from the free allocation of allowances).

telling, the interpretation would possibly see nothing wrong with DEP simply sitting on the revenue and using it to build fancy offices. Thus, it seems likely that, unless there was some kind of limiting principle developed, a court would conclude that while this might be a permissible linguistic interpretation of the rather vague statutory language, the interpretation would be unreasonable at step two of the *Chevron* inquiry because of its perverse consequences.

### 2.3.4 Legal Boundaries on the Interaction Between RGGI Revenue Expenditures and Act 129

Because many of the expenditures that DEP may wish to make using RGGI monies overlap with other state policies regarding energy efficiency and conservation, questions arise about whether DEP can use Clean Air Fund monies to support other policy programs that have independent funding and management. In particular, Act 129, a 2008 law amending the Public Utility Code, "set in motion a multi-phase implementation process that addresses electric distribution companies and default service provider responsibilities, conservation service providers, smart meter technology, time-of-use rates, real-time pricing plans, default service procurement, market misconduct, alternative energy sources, and cost recovery."[121] Assuming that many of these initiatives would satisfy the "elimination of air pollution" nexus, DEP could effectively supplement Act 129's programs, or even potentially displace them, perhaps permitting refunds to ratepayers for avoided costs under Act 129 as a kind of de facto direct bill assistance. This subsection will examine two legal arguments that might constrain these possibilities.

## 2.4 Act 129 Does Not Displace Separate Energy Efficiency Programs Where There Is Sufficient Statutory Authority to Support Action

Some might argue that Act 129 represents the Commonwealth's policy on energy efficiency and bars any other energy efficiency spending even if that spending is done independently and separately. This argument is likely to fail. The key provision of Act 129 is Section 2806.1 of

[121] Romeo v. Pennsylvania Pub. Util. Comm'n, 154 A.3d 422, 424 (Pa. Commw. Ct. 2017).

Title 66 of the Pennsylvania Consolidated Statutes. This section outlines the PUC's duty to develop an energy efficiency and conservation program designed to meet certain standards, as well as the duties of electric distribution companies (EDCs) in submitting compliance plans to the PUC for approval.[122] Nothing about the language in this section comes close to suggesting that this program is supposed to be the exclusive energy efficiency and conservation program in the state.[123] Indeed, such a limitation would stand at odds with the numerous other energy efficiency programs operated by other entities in the state under other statutory authority. For instance, the Pennsylvania Energy Development Authority (PEDA), which was created separately from Act 129, offers clean energy financing programs, including for demand management.[124] The Department of Community and Economic Development (DCED) also manages programs that aim to promote energy efficiency and conservation, including high-performance buildings[125] and weatherization assistance.[126] Even DEP's Energy Programs Office (EPO) manages programs relating to energy efficiency.[127] "In addition, DEP, DCED and [the Department of Agriculture] . . . meet periodically to coordinate various projects and

[122] 66 Pa. C.S.A. § 2806.1(a)-(e).

[123] *Cf.* 66 Pa. C.S.A. § 2806.1(a)(6) (providing authority to the PUC to "make recommendations as to additional measures that will enable an electric distribution company to improve its plan and exceed the required reductions in consumption under subsections (c) and (d)").

[124] *See* Pennsylvania Energy Development Authority (PEDA), Dep't of Envtl. Prot., https://www.dep.pa.gov/Business/Energy/OfficeofPollutionPrevention/FinancialOptions/Pages/PEDA.aspx (last accessed Aug. 8, 2020); *see generally* Pa. Dep't of Envtl. Prot., The Pennsylvania Energy Development Plan (Oct. 16, 2014), *available at* http://files.dep.state.pa.us/Energy/Office%20of%20Energy%20and%20Technology/OETDPortalFiles/Pollution%20prevention%20and%20Energy%20assiatance/PEDA/0120-BK-DEP4454%20combined.pdf.

[125] Energy Programs: The Alternative Energy Investment Act, Pa. Dep't of Comm. & Econ. Development, https://dced.pa.gov/programs-funding/commonwealth-financing-authority-cfa/energy-programs/ (last accessed Aug. 4, 2020).

[126] Weatherization Assistance Program (WAP), Pa. Dep't of Comm. & Econ. Development, https://dced.pa.gov/programs/weatherization-assistance-program-wap/ (last accessed Aug. 4, 2020).

[127] Energy Programs Office, Pa. Dep't of Envtl. Prot., https://www.dep.pa.gov/Business/Energy/OfficeofPollutionPrevention/Pages/default.aspx (last accessed Aug. 4, 2020).

programs."[128] In sum, these activities run contrary to any assertion that Act 129 represents an exclusive energy policy for the state that would displace or otherwise prevent any parallel energy efficiency and conservation spending.

The only provision of Act 129 that comes close to providing any traction for the argument against parallel spending is Section 2806.1(g), which states that the "total cost of any plan required under this section shall not exceed 2% of the electric distribution company's total annual revenue as of December 31, 2006."[129] In other words, EDCs cannot be required under Act 129 to incur costs exceeding a certain threshold set by historical revenues. This is clearly a limitation on PUC's ability to require EDCs to develop Act 129, but the language "under this section" prevents it from limiting anything else supported by other legislation. So long as any program operates formally separate from the Act 129 energy efficiency and conservation approval process, this 2 percent cap on spending on energy efficiency and conservation does not apply. This formal line is likely maintained so long as an EDC does not seek cost recovery above and beyond the 2 percent cap for a particular initiative undertaken with support from DEP's RGGI revenue under the procedures outline in Section 2806.1.

### 2.5 DEP and PUC Acting Together May Be Able to Effect a De Facto Direct Bill Assistance Program

As discussed above, direct bill assistance—a measure favored and implemented by many RGGI states to ease the burden on ratepayers from increases in energy prices associated with the cap-and-trade program[130]—likely lacks the necessary nexus to the elimination of air pollution to allow DEP to directly support such a program with RGGI revenues funneled through the Clean Air Fund. However, DEP and the PUC could come close to effecting a direct bill assistance program by attempting to coordinate energy efficiency and conservation spending so that the

[128] Pa. Dep't of Envtl. Prot., The Pennsylvania Energy Development Plan, at 6 (Oct. 16, 2014), *available at* http://files.dep.state.pa.us/Energy/Office%20of%20Energy%20and%20Technology/OETDPortalFiles/Pollution%20prevention%20and%20Energy%20assiatance/PEDA/0120-BK-DEP4454%20combined.pdf.

[129] 66 Pa. C.S.A. § 2806.1(g).

[130] *See* Investment of RGGI Proceeds in 2018, Reg. Greenhouse Gas Initiative, at 11 (July 2020), *available at* https://www.rggi.org/sites/default/files/Uploads/Proceeds/RGGI_Proceeds_Report_2018.pdf.

PUC could order EDCs to provide a rebate to ratepayers at a later date for rates paid to cover Act 129 programs that were rendered unnecessary.

Here's the logic: if DEP was to disburse funds from the Clean Air Fund to EDCs for the purpose of covering expenses incurred as part of an approved Act 129 program, at the end of the current Act 129 phase, the PUC could order EDCs to refund ratepayers for the offset of previously collected revenue that assumed a need for cost recovery. This might not happen until the end of the current Act 129 phase (*i.e.*, 2026), but it would be tantamount to direct bill assistance because it would retroactively reduce rates that were imprudent and unreasonable—imprudent and unreasonable because they would otherwise be windfall profits. The question is simply whether there are any legal barriers to this plan. While this is certainly a novel situation and there are no certain legal answers, the best reading of the law is that this is not something that is explicitly addressed by any statute, and the plan would arguably fit within the demarcations of the legislative scheme.

The main argument against this plan would likely be that this kind of coordination would effectively rewrite Act 129 by permitting DEP, rather than PUC, to set Act 129 policy. Specifically, opponents might argue that this plan would contradict certain portions of Act 129 that state that the PUC is to include "[c]ost recovery to ensure that measures approved are financed by the same customer class that will receive the direct energy and conservation benefits."[131] Perhaps the argument would be that the plan for coordination would mean that those energy efficiency programs are not actually financed by ratepayers with approval from the PUC, as Act 129 seems to presuppose, but rather by DEP.

However, this is only one characterization of what would be happening. Another one would simply be that PUC decided to set Act 129 policy by considering what other instrumentalities of government were doing that might affect the need for a previously approved rate, and simply refunding ratepayers when external circumstances changed in such a way as to render an approved rate imprudent and unreasonable. This kind of decision is hardly unprecedented. In 2018, the PUC ordered 17 Pennsylvania utilities to refund $320 million to ratepayers after considering that the federal government's Tax Cuts and Jobs Act of 2017 lowered the corporate

[131] 66 Pa. C.S.A. § 2806.1(a)(10).

tax rate from 35 percent to 21 percent.[132] The PUC approved this "pass through" of tax savings even over objections that they would "violate longstanding utility ratemaking prohibitions against retroactive and single-issue ratemaking.[133] As this episode demonstrates, the PUC has some limited authority to issue such refunds when rates become, or are recognized to be, unjust and unreasonable.[134] These authorities apply generally to any rate set by the PUC, including one

[132] David P. Zambito & Jonathan Nase, *Democrat-Controlled PA PUC Touts Trump Tax Savings to Ratepayers, Denies Infrastructure Reinvestment*, Cozen O'Connor (May 21, 2018), *available at* https://www.cozen.com/news-resources/publications/2018/democrat-controlled-pa-puc-touts-trump-tax-savings-to-ratepayers-denies-infrastructure-reinvestment. In fact, the PUC approved the refund with interest on the theory that "the tax savings were akin to a loan from ratepayers and ratepayers should, therefore, benefit from the utilities' earnings." *Id.*

[133] *Id.*

[134] *See* 66 Pa. C.S.A. § 1312(a) ("*If, in any proceeding involving rates, the commission shall determine that any rate received by a public utility was unjust or unreasonable, or was in violation of any regulation or order of the commission, or was in excess of the applicable rate contained in an existing and effective tariff of such public utility, the commission shall have the power and authority to make an order requiring the public utility to refund the amount of any excess paid by any patron, in consequence of such unlawful collection, within four years prior to the date of the filing of the complaint, together with interest at the legal rate from the date of each such excessive payment*. In making a determination under this section, the commission need not find that the rate complained of was extortionate or oppressive. Any order of the commission awarding a refund shall be made for and on behalf of all patrons subject to the same rate of the public utility. The commission shall state in any refund order the exact amount to be paid, the reasonable time within which payment shall be made, and shall make findings upon pertinent questions of fact." (emphasis added)). PUC is on the safest ground if it invokes its authority to impose a temporary rate adjustment, which it could do at the time that it learns of DEP's funding of EDC energy efficiency or conservation programs. The Public Utility Code specifies that "[*w]henever the commission, upon examination of any annual or other report, or of any papers, records, books, or documents, or of the property of any public utility, shall be of opinion that any rates of such public utility are producing a return in excess of a fair return upon the fair value of the property of such public utility, used and useful in its public service,* the commission may, by order, prescribe for a trial period of at least six months, which trial period may be extended for one additional period of six months, such temporary rates to be observed by such public utility as, in the opinion of the commission, will produce a fair return upon such fair value, and the rates so prescribed shall become effective upon the date specified in the order of the commission. Such rates, so prescribed, shall become permanent at the end of such trial period, or extension thereof, unless at any time during such trial period, or extension thereof, the public utility involved shall complain to the commission that the rates so prescribed are unjust or unreasonable. Upon such complaint, the commission, after hearing, shall determine the issues involved, and pending final determination the rates so prescribed shall remain in effect." 66 Pa. Stat. and Cons. Stat. Ann. § 1310(d) (West) (emphasis added). These procedures are similar to the federal "refund effective" date construct, *see* 16 U.S.C. § 824e(b), *i.e.*, a way of eliminating unnecessary retroactivity of rates, which is generally disfavored. *See* Popowsky v. PUC, 164 Pa. Cmwlth. 338, 344 (1994) ("Because of the prospective nature of rates, a rule against retroactive ratemaking has developed. The rule against retroactive ratemaking prohibits a public utility commission from setting future rates to allow a utility to recoup past losses or to refund to consumers excess utility profits.").

set pursuant to Act 129, and they can be invoked at any time, perhaps making it possible to refund ratepayers before the formal end of the current Act 129 cycle. Nothing about Act 129 displaces the PUC's general authority and duty to determine whether rates are just and reasonable, and a prospective change in rates previously approved could account for the offset costs.

Of course, to be successful, such a program would require significant coordination between DEP and PUC. Both agencies do appear at present to be willing to cooperate, and neither should be deterred by the novelty of such an arrangement. Agencies at both the federal and the state level routinely collaborate and coordinate the use of their respective powers.[135] As long as the PUC formally exercises the authorities given to it by Act 129 and the Public Utility Code, the law likely permits the agencies to create a de facto direct bill assistance program through retroactive refunds of Act 129 costs obviated by DEP spending. Of course, such a coordinated program, since it channels DEP spending through Act 129 programs, would be required to comply with Act 129's 2 percent cap.[136] EDCs' previously approved Act 129 plans should have already complied with that cap, so a direct offset of the costs already approved for rate recovery by PUC should likewise stay within that cap by definition. This means that there are some upper limits on how much of DEP's spending could be directed to a de facto direct bill assistance program without further legislative authorization, although it bears mentioning that At the same time, the investment cap under Act 129 does not apply to the "cost of low-income usage reduction programs established under 52 Pa. Code Ch. 58."[137] There is therefore even more flexibility to spend RGGI monies on a de facto bill assistance programs with PUC when it comes to certain low-income consumers who could likely benefit the most from efforts to provide direct bill assistance.

[135] *See* Jody Freeman & Jim Rossi, Improving Interagency Coordination in Shared Regulatory Space, Admin. & Reg. L. News, Summer 2013, at 11.

[136] *See supra* note 137 and accompanying text.

[137] 66 Pa. C.S.A. § 2806.1(g).

## 2.6 Issue #4: To What Degree Can Pennsylvania Implement Leakage Mitigation Measures Without Running Afoul of the Dormant Commerce Clause Doctrine?

Although it is not addressed in the draft proposed rule implementing RGGI, Governor Wolf's executive order directed DEP to work with PJM and the PUC to consider possibilities for minimizing leakage of emissions as a result of Pennsylvania's entry into RGGI. Emissions leakage occurs when one jurisdiction implements an emissions cap that does not apply to out-of-jurisdiction sources, creating an asymmetric regulatory regime that potentially incentivizes activities that undermine the effectiveness of the cap-and-trade program. In the absence of leakage mitigation measures, such as a border adjustment, tax, or outright ban of importation of unregulated electricity, the rising prices of generation for regulated sources drives greater importation from cheaper, unregulated electricity from outside the jurisdiction. If these sources of generation are from high carbon intensity sources, such as coal-fired plants, the net effect of the cap-and-trade system could be close to neutral—there would simply be a geographic shift of carbon-intensive generation, with concomitant deadweight losses for the regulating jurisdiction in the form of jobs.[138]

While the remedy—imposing regulatory measures to equalize the regulatory burden felt by home-grown generation and imported generation—is relatively simple, the problem is that these measures may not survive review by courts under the so-called dormant commerce clause doctrine.[139] This section first reviews the basic contours of this doctrine and then turns to a review of how courts are likely to apply this doctrine to potential RGGI mitigation measures. As is the case with several other legal issues with the RGGI program, the basic questions have largely not been tested in the courts, making it difficult to say anything with complete

[138] Of course, there would still be local co-benefits to regulation, as Penn State CELP's emissions team notes in its report. These co-benefits may even increase as leakage increases. Leakage is primarily a concern for pollutants like CO2 that accumulate in the atmosphere and affect global temperatures.

[139] Erwin Chemerinsky, Brigham Daniels, Brettny Hardy, Tim Profeta, Christopher H. Schroeder, & Neil S. Siegel, *California, Climate Change, and the Constitution*, 25 Envtl. F. 50, 52 ("In order to ensure that any reductions within California translate to actual reductions of GHGs in the global atmosphere, the state's implementing agencies will need to design a program that takes precautions to guarantee that gains from such reductions are not lost through GHG increases elsewhere. The danger in proceeding with indifference to such leakage is that it could undermine California's goals . . . . The more that California looks outward or aims its program at outsiders, the more likely it is that the dormant Commerce Clause will cause problems.").

confidence. If DEP errs on the side of caution, it has fairly limited options and needs to be careful about how it frames any leakage mitigation measure. If DEP wants to, though, it can proceed with fairly aggressive leakage mitigation measures and prepare for likely legal fights.

### 2.6.1 The Dormant Commerce Clause Doctrine

The dormant commerce clause (DCC) reflects a policy against state protectionism in interstate commerce.[140] While states have police powers that allow them to regulate in-state activities that affect the health, safety, and welfare of their citizens, and while to a point these regulatory activities can affect out-of-state economic activity without causing any constitutional concerns, the courts have long understood the framers of the U.S. Constitution to have sought to impose some limits on states' ability to use their police powers to discriminate against out-of-state economic actors or gain a competitive advantage of some sort. The fear motivating the framers was that protectionist regulation by states could create the kind of "Balkanization" that "had plagued relations among the Colonies and later among the States under the Articles of Confederation."[141] Courts have found this principle enshrined in the text of the U.S. Constitution in a negative implication from Congress's express authority to regulate interstate commerce—the delegation of power to Congress to regulate interstate commerce suggests that states lack the authority to "usurp" the same.[142]

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[140] Thomas Alcorn, *The Constitutionality of California's Cap-and-Trade Program and Recommendations for Design of Future State Programs*, 3 Mich. J. Envtl. & Admin. L. 87, 122 (2013) ("The central rationale [behind the DCC] is the need to prevent the 'evils of economic isolation and protectionism,' although the courts seek to do so without unduly hindering the ability of the states to manage local affairs and to 'safeguard the health and safety of their people.'" (quoting *Philadelphia*, 437 U.S. at 623-24)).

[141] Hughes v. Oklahoma, 441 U.S. 322, 325 (1979).

[142] Chemerinsky et al., *supra* note 139, at 53. It bears mentioning that the DCC has many skeptics and critics, including Justice Thomas and Justice Gorsuch, and some believe that there is a trend toward greater deference to state regulatory programs afoot in the courts. *See* Kevin Russell, *Judge Gorsuch on Separation of Powers and Federalism*, SCOTUSblog (Mar. 15, 2017), *available at* https://www.scotusblog.com/2017/03/judge-gorsuch-separation-powers-federalism/ (noting that now-Judge Gorsuch "has shown some skepticism of the so-called "dormant commerce clause" doctrine, a set of restrictions on state power the Supreme Court has deemed to be implied by commerce clause's assignment to Congress of power over interstate commerce").

Drawing the line between valid state police power regulations and invalid protectionist regulations is inherently difficult. Courts have therefore developed an analytical framework for finding the line in concrete contexts. First, and most importantly, courts sort state laws and policies into three basic categories: laws that facially or, in practical effect or purpose, discriminate intentionally against out-of-state actors engaged in commerce within the regulating state; those that actually regulate wholly out-of-state conduct as if the state had "extraterritorial" police powers[143]; and laws that do not do either of these things but that incidentally affect out-of-state commerce. Laws that Laws that discriminate against out of staters are subject to so-called "strict scrutiny." Laws that have extraterritorial effects are per se invalid. FinallyFinally, laws that are facially neutral but have an effect on interstate commerce are subjected to something called "*Pike* balancing." The threethree tracks that a law might take are nearly determinative of the outcome of the analysis, making the categorization of a law a very important fight in any dormant commerce clause case.[144]

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[143] While some have questioned whether the extraterritoriality line of cases is really distinct from the intentional discrimination line of cases, *see* Energy & Env't Legal Inst. v. Epel, 793 F.3d 1169, 1173 (10th Cir. 2015) ("In this light, you might ask whether the *Baldwin* line of cases is really a distinct line of dormant commerce clause jurisprudence at all."), courts and commentators often do separate it into a separate branch of analysis. Under this approach, laws that facially discriminate against out-of-state actors that seek to engage in business in the regulating state or that have that purpose or practical effect are treated as one separate category, but laws that attempt to regulate out-of-state conduct as out-of-state conduct are treated separately as "extraterritorial" laws. *See* Susan Lorde Martin, *The Extraterritoriality Doctrine of the Dormant Commerce Clause is Not Dead*, 100 Marq. L. Rev. 497, 500-501 (2016) ("Although the modern dormant Commerce Clause jurisprudence primarily is driven by concern about economic protectionism—that is, regulatory measures designed to benefit in-state economic interests by burdening out-of-state competitors, dormant Commerce Clause interpretation also includes the notion of extraterritoriality which has been described as the least understood of the Court's three strands of dormant commerce clause jurisprudence."). Extraterritorial laws are scrutinized perhaps even more than discriminatory laws—courts do not even ask questions about whether there might be a less restrictive way to accomplish the purpose, but rather simply invalidate a law upon a finding that it regulates extraterritorially, *see* Healy v. Beer Inst., 491 U.S. 324, 3336 (1989)—but the extraterritoriality doctrine is also the "most dormant" in the sense that the Supreme Court has almost never invoked it. *See Epel*, 793 F.3d at 1172. The Ninth Circuit has interpreted the Supreme Court's precedents to mean that a state's regulation will not be considered extraterritorial unless it actually sets the price of a product or ties the price of in-state prices to out-of-state prices—in other words, so long as a state steers clear of setting prices, it need not worry about extraterritoriality. *See* Ass'n des Eleveurs de Canards et d'Oies du Quebec v. Harris, 729 F.3d 937 (9th Cir. 2013) (upholding foie gras ban).

[144] There are several exceptions to dormant commerce clause scrutiny, such as the market participant exception (no dormant commerce clause scrutiny if the discrimination arises from the state's participation

Strict scrutiny involves the courts asking and answering several questions about the law, and a negative answer on any of these questions invalidates the law with no more questions asked: first, courts ask whether there is a "legitimate and substantial purpose" behind the law (i.e., one that fits within the state's traditional police powers), and, second, the court asks whether there are not less restrictive (i.e., discriminatory) means for accomplishing that legitimate and substantial purpose. For all intents and purposes, strict scrutiny is "strict in theory" but "fatal in fact." Indeed, the court has said that the application of strict scrutiny functions as "virtually a per se rule of invalidity."[145] Only one state law analyzed as intentionally discriminatory at the Supreme Court level has ever survived strict scrutiny, but, notably, it involved an environmental regulation designed to protect the health and safety of state citizens and the "integrity of its natural resources."[146] In *Maine v. Taylor*, the Supreme Court upheld a ban on the importation of live baitfish from out of state—a measure designed to prevent the introduction of parasites and invasive species in the waters of Maine—against an argument that the state could have implemented a testing regime to protect against  the threatinstead.[147] The Court said that "Maine has a legitimate interest in guarding against imperfectly understood environmental risks, despite the possibility that they may ultimately prove to be negligible."[148] If there is a way for a state law to survive strict scrutiny, analogizing to the health, safety, and environmental risk addressed by Maine in this litigation is the key.

For those laws that are not deemed discriminatory or extraterritorial in effect, the courts turn to a more forgiving test called "*Pike* balancing." As leading constitutional law and environmental law scholars have summarized it, the "Pike test requires courts to make a number of relatively subjective evaluations: whether the claimed local interest protected by the policy at issue is 'legitimate'; whether any 'less burdensome' regulatory alternatives are available; and, ultimately,

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in the market as a buyer or seller), *see* Alcorn, *supra* note 140, at 134-35, but none are applicable to the bulk the energy market, which is a predominantly a private industry.

[145] Philadelphia v. New Jersey, 437 U.S. 617, 624 (1978).

[146] Maine v. Taylor, 477 U.S. 131, 151 (1986).

[147] 477 U.S. at 147.

[148] *Id.* at 148.

whether the alleged benefits of the regulation outweigh the burdens on interstate commerce."[149] While these factors bear some resemblance to strict scrutiny analysis, there are important differences that make *Pike* balancing far more favorable for regulating states. For instance, the state's interest in regulating only has to be legitimate, not legitimate *and* substantial. In addition, the court only needs to be satisfied that the state has justified a choice for a relatively burdensome regulatory alternative, whereas under strict scrutiny courts would invalidate a law as soon as a less burdensome alternative is identified. Overall, the *Pike* balancing analysis requires the state law to pass a fairly loose cost-benefit test. Not surprisingly, given courts' lack of policy expertise, the courts most often find a state law to pass this rudimentary smell test, and some observers believe that courts treat state laws as presumptively valid under the test.

### 2.6.2 Possible Leakage Mitigation Measures in the Context of RGGI

Again, discussions about leakage mitigation are largely on the backburner in Pennsylvania while DEP focuses on developing the basic cap-and-trade system rules. This makes it difficult to anticipate the precise nature of the constitutional arguments that might surface against any eventual leakage mitigation effort, but discussion of constitutional risks requires at least some general understanding of how Pennsylvania might address the problem.

In a 2007 Memorandum of Understanding, the existing parties to RGGI "recognized the potential for emissions leakage to undermine the goals of a RGGI cap-and-trade program" and commissioned a study of potential leakage and potential solutions.[150] The resulting study recommended putting in place a framework for measuring and monitoring leakage and recommended consideration of three types of leakage mitigation measures designed to ensure that utilities procure electricity only from low-carbon resources despite the potential to shop around for lower cost high-carbon electricity. These are: 1) policies that reduce electricity demand (a "no-regrets approach" that "would also provide significant electric system reliability

[149] Chemerinsky et al., *supra* note 139, at 54-55.

[150] *Potential Emissions Leakage and the Regional Greenhouse Gas Initiative (RGGI): Evaluating Market Dynamics, Monitoring Options, and Possible Mitigation Measures*, RGGI, at ES-1 (Mar. 14, 2007) [hereinafter "RGGI Leakage Study"].

and economic benefits to the RGGI region")[151]; 2) carbon procurement adders,[152] emissions rate mechanisms,[153] or an emissions portfolio standard,[154] all of which would impose some duties on in-state utilities to procure cleaner energy for retail sale; and 3) implementing a "load-based emissions cap."[155] Another possibility—and one that is simple and intuitive, albeit potentially problematic for reasons I will articulate— is a carbon price border adjustment or tax, which tries to level the playing field between regulated and unregulated energy imports by imposing a price on carbon.[156] Rather than regulating in-state load-serving entities' procurement of electricity from any source, whether in-state or out-of-state (an approach that only has at most an indirect effect on electricity imports), a border tax adjustment addresses leakage more obliquely, by discouraging the actual transportation of energy across state lines. Finally, a simple ban on, or direct regulation of, imports, while difficult to accomplish with an interconnected grid, like the PJM Interconnection, that crosses state lines, is yet another way that a state could attempt to control the leakage of carbon dioxide emissions across state lines.

Further complicating the matter, all of these approaches to mitigating leakage could be implemented at different levels of governance. Most straightforwardly, but also most

[151] RGGI Leakage Study, *supra* note 150, at ES-5.

[152] RGGI Leakage Study, *supra* note 150, at ES-7 ("A carbon procurement adder is an analytical tool that requires [a Load-Serving Entity] planning its resource acquisitions to incorporate a 'shadow price' for carbon emissions into its financial analysis of different investment options.").

[153] RGGI Leakage Study, *supra* note 150, at ES-8 ("A carbon procurement emissions rate is a limit that is placed on the emission rate of power supplied to [a Load-Serving Entity] through a long-term power purchase agreement. This policy would require all long-term power purchases to meet a specific lbs. CO2/MWh emission rate; power could not be supplied through bilateral contracts with suppliers that exceed this emissions rate.").

[154] RGGI Leakage Study, *supra* note 150, at ES-9 ("An emissions portfolio standard (EPS) is a policy mechanism that would require [a Load-Serving Entity] to meet an average output-based emission standard (lbs. CO2/MWh) for the portfolio of supply resources the [Load-Serving Entity] uses to provide retail electricity.").

[155] RGGI Leakage Study, *supra* note 150, at ES-10 ("A load-based emissions cap would place a cap on absolute emissions related to all electricity use within a region."). Effectively, this option would impose a second cap-and-trade program applying to all in-state distribution utilities that serve end users, requiring that their overall mix of procured energy—whether in-state or out-of-state—fall under a cap on emissions.

[156] Carolyn Fischer & Alan K. Fox, *Comparing Policies to Combat Emissions Leakage: Border Carbon Adjustments Versus Rebates*, 64 J. Envtl. Econ. & Mgmt. 199 (2012).

precariously, Pennsylvania could implement any one of them alone through the exercise of its police powers. Pennsylvania could also join with other RGGI states to address the problem on a regional basis. Finally, Pennsylvania and/or other RGGI states could cooperate with regional grid operators—PJM Interconnection, New York ISO, and the New England ISO—to implement leakage mitigation measures pursuant The idea is that each firm gets "credits equal to their delegated power to regulate interstate commerce under the Federal Power Act (a sort of end run around the dormant commerce clause problem, which only arises when *states* regulate interstate commerce).[157]

output multiplied by the emissions-intensity standard" for the sector, such that the more a firm produces, the more allowances it has allocated to it.[158] "Effectively, firms get an amount of credits that corresponds to what their total emissions would have been if their emissions intensity of production had matched the standard" for the sector or subdivision.[159] This approach attempts to eliminate the incentive regulated firms might otherwise face to comply by cutting production rather than reducing emissions, with the idea being that in-state generators staying online and maintaining production (just in cleaner ways) mitigates the need to import more potentially dirty electricity.

In fact, though, RGGI states have not implemented any leakage mitigation measures at all, opting instead for further study of the scope of the problem. This hesitance to directly address the issue may have reflected RGGI's relatively modest footprint to date. The unique characteristics of Pennsylvania's generation mix might nudge the discussion over the cliff. Since Pennsylvania has a relatively carbon-intensive generation portfolio and exports a great deal of the power provided in the PJM region, the proposed carbon cap in Pennsylvania might be expected to create more leakage than has been the case before, as there will be a shortfall of electricity in the

[157] Another end run around the dormant commerce clause problem, and indeed around leakage mitigation in general, would be for the United States as a whole to implement a carbon price or cap-and-trade system. There could still be international leakage, but one uniform approach throughout the United States would eliminate all interstate leakage incentives. However, a uniform national climate policy seems very unlikely to come to fruition any time soon.

[158] Jason Dion, *Explaining Output-Based Allocations (OBAs)*, Canada's EcoFiscal Commission (May 24, 2017), *available at* https://ecofiscal.ca/2017/05/24/explaining-output-based-allocations-obas/#:~:text=An%20output%2Dbased%20carbon%20pricing,but%20not%20by%20reducing%20production.&text=This%20means%20there's%20no%20incentive,their%20emissions%20to%20other%20jurisdictions.

[159] *Id.*

RGGI region once Pennsylvania is included and starts to comply. Non-RGGI states will certainly be poised to step up to fill that gap by importing potentially carbon-intensive electricity into the RGGI states. To the extent Pennsylvania or other states respond to these probable dynamics with leakage measures, the concerns noted by scholars about vulnerability of leakage mitigation measures to dormant commerce clause analysis will become more relevant.[160]

### 2. 6. 3. Applying the Commerce Clause to Leakage Mitigation Measures

I now turn to an analysis of the risks to various courses of action in addressing leakage mitigation. It is almost entirely a guessing game to determine how courts might apply the dormant commerce clause to leakage mitigation measures. This legal uncertainty comes from two factors: first, as of yet there are few details about what specific leakage mitigation measures might be employed and by whom, and details matter a great deal in dormant commerce clause analysis; and second, the courts have provided few clues about how they might apply their dormant commerce clause jurisprudence in the context of climate and clean energy laws. Indeed, while state climate and clean energy laws have frequently been the subject of speculation about potential dormant commerce clause problems,[161] in practice few challenges have been brought, and the ones that have been brought have been almost invariably unsuccessful.[162]

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[160] The existing scholarship to analyze this question has delivered mixed verdicts. *See, e.g.*, Yvonne Gross, *Kyoto, Congress, or Bust: The Constitutional Invalidity of State CO2 Cap-and-Trade Programs*, 28 T. Jefferson L. Rev. 205 (2005); *see also* William Funk, *Constitutional Implications of Regional CO2 Cap-and-Trade Programs: The Northeast Regional Greenhouse Gas Initiative as a Case in Point*, 27 UCLA J. Envtl. L. & Pol'y 353 (2009) (arguing that some features of state cap-and-trade programs might be at risk, but highlighting the uncertainty as well); Steven Ferrey, *Goblets of Fire: Potential Constitutional Impediments to the Regulation of Global Warming*, 35 Ecology L.Q. 835, 862-81 (2008) (same); Ian Sheldon, *Economic and Legal Analysis of Climate Policy and Border Tax Adjustments: Federal vs. State Regulatio*n, 79 Ohio St. L.J. 781 (2018) (same); Darien Shanske, *State-Level Carbon Taxes and the Dormant Commerce Clause: Can Formulary Apportionment Save the World?*, 18 Chap. L. Rev. 191, 193-94 (2014) (same); Alcorn, *supra* note 140 (same).

[161] *See supra* note 160.

[162] *See* Ann E. Carlson & William Boyd, *Evaluation of Jurisdictional and Constitutional Issues Arising Under CAISO Expansion to Include PacifiCorp Assets*, at 16 (Aug. 1, 2016), https://www.caiso.com/Documents/LegalEvaluationOfISOExpansion.pdf ("To date, with one exception involving a Minnesota policy . . ., challenges to state climate and energy policies on Commerce Clause grounds have met with failure.").

A central question is whether leakage mitigation can be accomplished without facial discrimination between in-state and out-of-state economic actors.[163] The best clues we have about how courts might analyze this problem in the context of leakage mitigation are the cases where courts have applied the dormant commerce clause framework to state renewable portfolio standards (RPS), which generally require distribution utilities to procure a certain proportion of their energy from clean forms of generation. Initially, some states attempted to favor in-state generation within these programs.[164] For instance, Michigan's RPS specified that only in-state generation could satisfy utilities' requirements for renewable generation. In dicta, the U.S. Court of Appeals for the Seventh Circuit said that the provisions favoring in-state generation likely discriminated against out-of-state imports.[165] In part due to statements like this and threats from legal challengers, states have begun to eliminate such provisions favoring in-state generation,[166] although it is not clear that they have to. In one notable case, the Second Circuit held that Connecticut's policy of crediting Renewable Energy Credits (RECs) only from New England or

[163] As mentioned previously, if a hypothetical leakage mitigation strategy is able to avoid classification as a facially discriminatory, and if it does not regulate extraterritorially, the application of *Pike* balancing would strongly suggest that the strategy would pass constitutional muster. CELP's power system and air emissions modeling strongly suggests that there are a range of localized non-economic benefits (in addition to global benefits) of reducing carbon dioxide emissions. This is likely more than enough to justify such policies if the test is essentially one of costs and benefits.

[164] Ari Peskoe & Kate Konschnick, *Minimizing Constitutional Risk: Crafting State Energy Policies that Can Withstand Constitutional Scrutiny*, Harv. Envtl. Pol'y Inst. at 5 (Oct. 18, 2017), *available at* https://statepowerproject.files.wordpress.com/2017/10/harvard-epi-minimizing-constitutional-risk-10-18-2017.pdf.

[165] Illinois Commerce Comm'n v. FERC, 721 F.3d 764 (7th Cir. 2013).

[166] Peskoe & Konschnik, *supra* note 164, at 5 (noting that Colorado stripped a similar provision in response to litigation). It should be noted that courts have been much less open to the suggestion that RPSs regulate extraterritorially. In a landmark opinion in the Tenth Circuit, then-judge Neil Gorsuch upheld Colorado's RPS standard against a challenge based on an argument that the RPS regulated extraterritorially by inevitably changing the market prices for imported energy. *See* Energy & Environment Legal Institute v. Epel, 793 F.3d 1169, 1170-73 (10th Cir. 2015) (upholding a Colorado law requiring electricity generators selling electricity in Colorado to make sure that 20 percent of their generation came from renewable generation sources against an argument that this law effectively regulated out-of-state generation); *but see* North Dakota v. Heydinger, 825 F.3d 912, 920 (8th Cir. 2016) (holding that a Minnesota law banning the import of coal-fired electricity was invalid, with one judge arguing that the extraterritoriality bar was the reason and others strongly disagreeing about that reasoning but viewing the law as discriminatory at any rate).

an adjacent region did not facially discriminate against RECs generated in Georgia.[167] According to the court, RECs are a creature of state policy, and defining them in certain ways is an integral part of pursuing the state's legitimate interest in promoting local production of renewable energy.

The largely successful experience with state RPS programs yields some lessons about the likely application of dormant commerce clause concepts to leakage mitigation: as a practical matter, it is often fairly easy for states to avoid dormant commerce clause problems with RPSs by avoiding categorical distinctions between in-state and out-of-state energy (e.g., permit satisfaction of requirements with any renewable energy, whatever the source), or, even if there are some distinctions drawn, by avoiding even a whiff of protectionism.[168] It may well be that courts will be hesitant to apply a doctrine that developed to prevent states from propping up local businesses to state laws that serve a legitimate purpose of ensuring the efficacy of state police power regulations, even if those laws do incidentally distinguish between in-state and out-of-state generators. To maximize the chances of this distinction convincing courts, states "should be careful not to rationalize otherwise appropriate locational requirements based on economic benefits."[169] Adhering to these principles as much as possible may bode well for certain kinds of leakage mitigation measures. Even border adjustments could theoretically survive on the same rationale—that they are necessary to fulfill the purposes of a legitimate state police power regulation—although the bald-faced discrimination necessary to implement such an adjustment or tax (after all, distinctions will have to be drawn in the regulations about which sources are subject to the laws) may be too much for some courts.

It seems even more likely that the regulation of wholly in-state business transactions on the basis of emission rates or carbon intensity will not be deemed facially discriminatory. In *Rocky Mountain Farmers Union v. Corey*, the Ninth Circuit reviewed California's Low-Carbon Fuel Standard (LCFS), which capped the carbon intensity of motor fuel sold in California. To measure carbon intensity of fuels, California used a life-cycle analysis that considered various

[167] Allco Finance Ltd. v. Klee, 861 F.3d 82 (2d Cir. 2017).

[168] Peskoe & Konschnik, *supra* note 164, at 5; Alcorn, *supra* note 140, at 136 ("[S]tate regulators must be careful to avoid the appearance of favoring intrastate commerce over interstate commerce. If it appears that a state is attempting to gain a competitive edge for its businesses through regulation, courts are likely to scrutinize the regulation more closely and are more likely to invalidate it.").

[169] Peskoe & Konschnik, *supra* note 164, at 6.

characteristics of a variety of fuels. After California set a high life-cycle carbon intensity score for ethanol, which just so happened to be primarily produced out of state, ethanol producers challenged the low-carbon fuel standard, arguing that the score discriminated against midwestern producers. While the district court agreed, the Ninth Circuit reversed, finding that there was nothing unconstitutional about California seeking to put equally carbon-emitting sources on an equal competitive footing regardless of whether they were in-state sources or out-of-state sources.[170] That outcome was substantially reaffirmed by the Ninth Circuit just last year as the case came up again after a remand, with the court saying that the "[low-carbon fuel standard] permissibly regulated the in-state behavior of selling different mixtures of fuel, and that the use of lifecycle analysis did not amount to discrimination against interstate commerce because it disincentivized the purchase of a fuel only to the extent that fuel was relevantly different with respect to California's legitimate interest in curbing greenhouse gas emissions and climate change."[171]

At bottom, the *Corey* case confirms that facial discrimination only really exists when a law "discriminates between similarly situated in-state and out-of-state interests,"[172] and the carbon intensity of a particular form of generation could be the determinant of whether interests are in fact similarly situated. A measure that requires in-state firms to limit the total emissions of the electricity they procure to satisfy demand in their service territories, but that remains agnostic about *where* those firms procure their electricity, is consistent with this principle.[173] This logic suggests that several of the measures explored by the RGGI Leakage Study, such as a carbon adder, an emissions portfolio standard, or a load-based emissions cap would survive dormant commerce clause scrutiny. Each would leave out-of-state generation free to compete for the business of in-state load-serving entities on the same terms as in-state generation.

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[170] *See* Rocky Mountain Farmers Union v. Corey, 730 F.3d 1070, 1078 (9th Cir. 2013).

[171] *See* Rocky Mountain Farmers Union v. Corey, 913 F.3d 940, 947 (9th Cir. 2019).

[172] *Allstate Ins. Co. v. Abbott*, 495 F.3d 151, 163 (9th Cir. 2007).

[173] Probably in part because of the *Corey* case, no challenges have been made to California's regulation of electricity imports. California regulates electricity imports by placing compliance obligations on the "first deliverer" of electricity from outside the state, but it does so on the basis of carbon intensity rather than on the basis of a simple categorical distinction. The regulations are thus neutrally drawn with regard to in-state and out-of-state transactions. *See* Carlson & Boyd, *supra* note 162, at 17-18.

While a well-crafted leakage mitigation measure could likely escape classification as facially discriminatory, we're not out of the woods yet. Much of the dormant commerce clause concerns in the state climate policy space in recent years have centered on the extraterritoriality doctrine. Two recent cases demonstrate substantial uncertainty about the extraterritoriality doctrine. First, in a landmark opinion in the Tenth Circuit, then-judge Neil Gorsuch upheld Colorado's RPS standard against a challenge based on an argument that the RPS regulated extraterritorially by inevitably changing the market prices for imported energy.[174] The court came close to rejecting the extraterritoriality doctrine altogether except in narrow cases involving price controls, and it ultimately held that Colorado's RPS, while likely to make it difficult for out-of-state generators to export electricity to Colorado, was not extraterritorial.[175] This opinion would suggest that extraterritorial effects of neutrally-drawn regulations are almost never constitutionally problematic. By contrast, in a case involving a Minnesota law banning the importation of certain fossil-fuel based electricity, a panel of the Eighth Circuit debated the application of the extraterritoriality doctrine, with one judge maintaining that it applied to bar Minnesota's policy.[176] Because Minnesota is covered by a regional grid operator, the Midwestern Independent System Operator (MISO), Judge Loken believe that the Minnesota statute's application to "any person" might mean that the generator, by feeding the MISO grid, could not control the flow of electrons into Minnesota even if it wanted to do so. For Judge Loken, this meant that Minnesota's law regulated wholly extraterritorial conduct. Judge Loken's reasoning caused a great deal of confusion about the application of the extraterritoriality doctrine to the operation of the electric grid, and both his colleagues and energy experts have widely criticized the decision.[177]

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[174] *See* Energy & Environment Legal Institute v. Epel, 793 F.3d 1169, 1170-73 (10th Cir. 2015) (upholding a Colorado law requiring electricity generators selling electricity in Colorado to make sure that 20 percent of their generation came from renewable generation sources against an argument that this law effectively regulated out-of-state generation).

[175] Epel, 793 F.3d at 1174.

[176] North Dakota v. Heydinger, 825 F.3d 912, 920 (8th Cir. 2016) (holding that a Minnesota law banning the import of coal-fired electricity was invalid, with one judge arguing that the extraterritoriality bar was the reason and others strongly disagreeing about that reasoning but nevertheless striking the law on other grounds).

[177] Carlson & Boyd, *supra* note 162, at 19-20 (expressing disagreement with Judge Loken's understanding of how the grid operates and highlighting the competing analysis of Judge Murphy, who

The confusion that these two drastically opposed opinions have sowed is unfortunate, but it has so far not imperiled much in the way of state climate policy. Again, California's experience is instructive. California's cap-and-trade program for electricity addresses leakage in a blunt way: it applies the cap to imports of electricity to the state from outside the state. In 2014, the California ISO expanded outside of California's borders and opened an inter-state energy market called the Western Energy Imbalance Market (EIM). This change placed California's cap-and-trade program in a similar position to Pennsylvania's proposed RGGI program, insofar as there was a resulting risk that out-of-state generators would step up imports to California, undercutting the effects of the program. It also created a "compliance complication" that didn't exist before, insofar as imports to the state needed to be classified as such.[178] The FERC-approved market tariff for the EIM dealt with this problem by creating rules for sorting out whether a bid into the market should be counted as an import or not.[179] If it is classified as an import according to these rules, then California's cap-and-trade program applies to the EIM *bidder*'s importation to the state (not the *generator*'s out-of-state conduct). While the application of California's program to these imports is clearly neutrally drawn (the same basic emissions standards apply to in-state generation and to imported electricity), one could easily cite Judge Loken's opinion in *Heydinger* to argue that the application to imports regulates extraterritorially, and that the assignment of compliance obligations to the importing bidder rather than the wholly out-of-state generator is a legal fiction that should not shield the program. So far, however, that dog has not barked. Nobody has challenged this arrangement, which does seem to narrowly avoid application to wholly out-of-state generators by regulating only the in-state delivery of electricity.[180]

This discussion of California and the EIM points to a final takeaway. Although the analysis thus far suggests that there may be avenues for Pennsylvania or some group of RGGI states to use their police powers to enact leakage mitigation measures that do not run afoul of the dormant

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concluded that because electricity flowing onto the grid "energizes the entire grid," the only reasonable interpretation of the Minnesota law was that it had no application to an out-of-state generator who did not enter into a bilateral contract with a Minnesota utility).

[178] Matt Butner, Bethany Davis Noll, Justin Gundlach, Burcin Unel, & Avi Zevin, *Carbon Pricing in Wholesale Electricity Markets*, Institute for Policy Integrity 51 (Mar. 2020).

[179] *Id.*

[180] *Id.* at 52.

commerce clause, it is generally preferable to address leakage concerns using federal authority to regulate interstate commerce. Pennsylvania and other RGGI states could accomplish this by coordinating with one or more grid operators covering the RGGI region to impose leakage mitigation measures that might draw more scrutiny were they implemented by states that lack the power to regulate interstate commerce. It seems reasonably clear that none of the concerns about the dormant commerce clause would apply to actions taken by a regional transmission organization or independent system operator imposing measures pursuant to a delegation of federal power to regulate interstate commerce under the Federal Power Act.[181] Anything from border adjustments to outright bans of imports from other regional grids would seem to be in play should the locus of policymaking shift from the states to regional governance organizations. To be sure, there could still be challenges to the extent that regional measures merely facilitate state-based leakage mitigation measures rather than dealing with inter-regional leakage through the arm of federal power.[182]the determinant of whether interests are in fact similarly situated. As long as in-state and out-of-state generation with similar carbon intensities are regulated in the same manner, there would be no discrimination.It bears mentioning, as well, that it seems reasonably clear that that leakage mitigation measures, at least to the extent that they are directed at in-state utilities, are not likely to be run afoul of the extraterritoriality strand of dormant commerce clause doctrine. In *Environmental Legal Institute v. Epel*, the 10th Circuit made if fairly clear that regulations of in-state utilities' dealings with out-of-state utilities could not be considered extraterritorial regulation, even if the regulatory scheme strongly influenced out-of-state utilities' willingness to engage in interstate trade with the regulating state.[183] While this merely means that a leakage mitigation measure targeted at in-state utilities' procurement would not be per se invalid, that is an important ground rule to keep in mind, especially when *Maine v. Taylor* suggests that public health emergencies might actually be enough to satisfy strict scrutiny.

[181] *Id.* at 30-31 ("[T]he Dormant Commerce Clause does not apply to federal regulations. So, its relevant requirements—such as the limit on extraterritorial application of a state carbon price—will not apply to an affirmative RTO carbon-pricing rule implemented pursuant to the FPA.").

[182] See *supra* notes 178-180 and accompanying text.

[183] Environment Legal Institute v. Epel, 793 F.3d 1169, 1170-73 (10th Cir. 2015)

## 2.7 Conclusion

As other contributions to this Penn State Center for Energy Law and Policy report on Pennsylvania's entry into RGGI highlight, there is much at stake in this decision. Joining RGGI will have implications for the reduction of greenhouse gases, pollution and public health, electricity rates, and public finance. As this legal primer has shown, these serious policy implications are worth serious consideration, but the legal questions surrounding the decision to enter RGGI should not give the Commonwealth any hesitation. While legal challenges are to be expected, none should prove fatal to the efforts to join RGGI.

## 3. Modeling the Impact of RGGI on Pennsylvania's Power Grid: Costs, Emissions, and Leakage

The most immediate impacts of Pennsylvania joining RGGI will be on the operation of the wholesale regional power market operated by the PJM regional transmission organization and on the utilization of generation assets in Pennsylvania. This Section reports on the results of a power-market modeling exercise aimed at understanding the implications for power grid operations and wholesale energy costs in PJM, the incentives for different generation investment and retirement decisions, and emissions of $CO_2$ and other pollutants in Pennsylvania and surrounding states. The technical details of the model developed and used here can be found in Appendix A. We note at the outset that the scope of this modeling effort is confined to the PJM electricity market and the $CO_2$ allowance market administered by RGGI, Inc. Our analysis does not incorporate any potential energy-sector impacts of state revenue reinvestment decisions, or any broader economic impacts associated with changes in electricity costs and revenues that might come about following Pennsylvania participation in RGGI.

### 3.1 Modeling Approach

The RGGI+PJM Policy Analysis Model (RPAM) is a multi-market numerical simulation model that combines several elements:

1. A transportation model of the PJM power system;
2. The endogenous supply of new generation capacity within PJM;
3. The importation of alternative/renewable energy credits (RECs) from outside of PJM;
4. The supply of $CO_2$ abatement from non-PJM RGGI member states; and
5. The supply/demand of banked $CO_2$ allowances from current RGGI market participants.

The first three elements of RPAM reflect an existing framework that has been used to examine state and federal policies that affect the wholesale electricity market operated by PJM.[184] The fourth and fifth elements of RPAM, which concern cross-border trade between Pennsylvania and other RGGI states outside of PJM and emissions allowance banking decisions, are jointly econometrically estimated using historical data on emissions, caps, allowances sold at auction, and allowance price data from RGGI. RPAM is calibrated using data for 2016 and 2017

[184] Joel R. Landry and An Pham. Who's Ready to Trade? The Welfare Implications of Voluntary Emissions Trading Within Regional Electricity Markets. *Working Paper*, 2020.

collected from over a dozen sources and is validated using 2018 data across several dimensions: REC prices, $CO_2$ emissions, locational marginal prices (LMPs), predicted new capacity, and generation mix. RPAM operates on an annual time-step and we simulate outcomes from 2018 to 2030. The transportation model component of RPAM approximates how dispatch decisions are made by the PJM system operator to affect the flow of power across the PJM footprint. The capacity expansion component of RPAM approximates how profit maximizing generators spatially invest in new capacity across PJM in response to the spatial and temporal distribution of LMPs. Finally, the last three elements of RPAM allow us to capture the profit maximizing decisions of market participants outside of the PJM power system to supply RECs for compliance with state-level Alternative Energy/Renewable Portfolio Standards (RPSs) and $CO_2$ emissions abatement and banked allowance withdrawals for compliance with the RGGI cap and trade system.

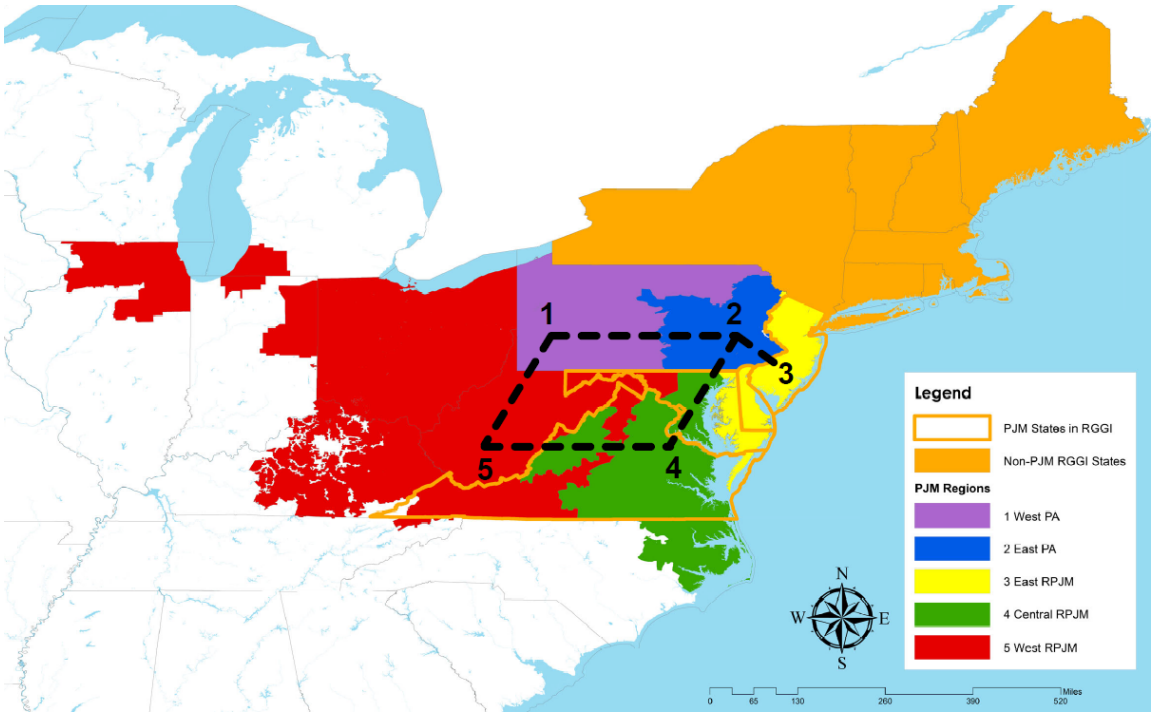


**Figure 4: RPAM model domain**

The RPAM domain is depicted in Figure 4. We model PJM as consisting of five regions or nodes that are connected by five aggregate transmission lines in which power losses are

possible.[185] Each region is an aggregation of several load zones within PJM that are adjacent and in which LMPs are approximately equal. The five lines capture the aggregate physical location of transmission lines across PJM, but transmission constraints are calibrated to replicate the generation-weighted average difference in LMPs observed between regions. We assume partially inelastic demand for electricity across 96 load segments, or 24 load segments for each of the four seasons. The supply side considers the economic decisions of 843 representative existing generation units (EGUs) which have been aggregated by state, fuel type, technology type, heat rates, emission rates, and marginal costs from a population of 3,095 EGUs located in PJM. Fuel costs facing generators vary across regions and are assumed to vary inter-temporally, reflecting observed correlation with load. Given predicted generation from representative EGUs and information on emissions of multiple pollutants from these representative EGUs, we downscale to the full population of EGUs within the PJM footprint, given their known locations. We also capture the behavior of virtual bidders within the PJM power market and allow for endogenous new capacity expansion in natural gas combined cycle (NGCC), solar, and wind. Load, fuel costs, capacity expansion costs, and pre-existing policies adjust exogenously over time. Full details on the functional forms used in the model, model calibration/estimation, and model validation are provided in the Appendix.

Within PJM, Maryland and Delaware have been members of RGGI since its inception. Recently, New Jersey decided to re-join RGGI starting in 2020 and Virginia has opted to join RGGI beginning in 2021. The counterfactual baseline from 2018 to 2030 captures these entries over time and assumes that Pennsylvania does not join RGGI between 2022 and 2030. Against this we model Pennsylvania's entry into RGGI beginning in 2022 and until 2030. Across both series of simulations, we assume that Pennsylvania retains its Alternative Energy Portfolio Standard (AEPS), which is presently set to expire at the end of 2021, and its targets remain at 2021 levels until 2030. Therefore, the difference between these two series identifies the impact of Pennsylvania joining RGGI in 2022 conditional on Pennsylvania retaining its AEPS at 2021 levels until at least 2030.[186]

[185] This model structure is taken from Pham and Landry, *supra* note 166.

[186] We have performed additional simulations in which Pennsylvania joins RGGI in 2022 and keeps its AEPS at 2021 levels until 2030 against the counterfactual in which Pennsylvania both joins RGGI in 2022 and instead terminates its AEPS after 2021. The difference between these two series of simulations identifies the impact of Pennsylvania's non-renewal of its AEPS after 2021 conditional on Pennsylvania joining RGGI in 2022. These results are available from the authors upon request.

States within PJM that are members of RGGI as of 2021 are depicted with a thick orange outline in Figure 4. Our econometric estimation effectively returns a $CO_2$ abatement supply curve for non-PJM RGGI states depicted in solid orange in Figure 4, and a bank supply/demand of allowances which reflects the profit maximizing decision to bank allowances from economic agents located within solid and outlined orange states in Figure 4. With these two curves, we are able to explicitly represent market clearing in the RGGI allowance market whereupon the equilibrium RGGI allowance price affects the inter-temporal and inter-regional flow of power across PJM in light of the $CO_2$ emissions rates of EGUs in PJM and transmission constraints across regions. Our analysis accounts for interactions with several pre-existing policies within PJM such as Title IV of the Clean Air Act, state renewable/alternative energy portfolio standards, and state nuclear subsidies.

Table 1 summarizes the characteristics of EGUs ($CO_2$ emissions intensity, capacity, and generation) and load across the five regions in RPAM that correspond to PJM for our predicted 2021 model baseline, the year before Pennsylvania would join RGGI. EGUs in the two regions in Pennsylvania (East and West) are less $CO_2$ emissions intensive on average than all three regions which comprise Rest of PJM (East, Central, and West). East and West Pennsylvania together comprise roughly 28% of total capacity and 29% of total generation in PJM, reflecting an average utilization rate of 53% compared to 51% for the three regions that comprise Rest of PJM. In addition, East and West Pennsylvania comprise around 20% of total load in PJM and are therefore significant net exporters of electricity with each exporting over 40,000 GWh of electricity in 2021. In contrast, West Rest of PJM exports around 30,000 GWh on net and East and Central Rest of PJM on net import around 45,000 and 35,000 GWh of power, respectively. Just under 34,000 GWh of electricity are lost due to transmission and distribution system losses.

**Table 1: Summary Characteristics of the PJM Electricity Market in 2021**

| | $CO_2$ Emissions Rate* (tons $CO_2$/MWh) | Capacity (GW) | Generation (1,000 GWh) | Load (1,000 GWh) |
|---|---|---|---|---|
| *West Pennsylvania:* | 0.43 | 23.05 | 102.87 | 59.91 |
| Natural Gas | 0.69 | 7.83 | 39.52 | — |
| Coal** | 1.03 | 10.58 | 40.17 | — |
| Nuclear | 0.00 | 1.89 | 14.95 | — |
| Wind | 0.00 | 1.39 | 4.73 | — |
| Solar | 0.00 | 0.06 | 0.49 | — |
| Other† | 0.53 | 1.29 | 3.02 | — |
| *East Pennsylvania:* | 0.48 | 29.38 | 140.93 | 100.21 |
| Natural Gas | 0.70 | 14.82 | 58.66 | — |
| Coal** | 1.45 | 2.14 | 9.45 | — |
| Nuclear | 0.00 | 8.09 | 63.90 | — |
| Wind | 0.00 | 0.59 | 3.35 | — |
| Solar | 0.00 | 0.10 | 0.73 | — |
| Other† | 0.55 | 3.64 | 4.84 | — |
| *East Rest of PJM:* | 0.55 | 15.05 | 53.43 | 99.65 |
| Natural Gas | 0.79 | 12.30 | 39.89 | — |
| Coal** | 1.27 | 0.64 | 0.73 | — |
| Nuclear | 0.00 | 0.59 | 5.75 | — |
| Wind | 0.00 | 0.04 | 3.86 | — |
| Solar | 0.00 | 0.60 | 1.07 | — |
| Other† | 0.71 | 0.88 | 2.13 | — |
| *Central Rest of PJM:* | 0.49 | 35.58 | 132.79 | 167.10 |
| Natural Gas | 0.84 | 17.50 | 57.84 | — |
| Coal** | 1.25 | 6.40 | 4.28 | — |
| Nuclear | 0.00 | 5.09 | 49.95 | — |
| Wind | 0.00 | 0.59 | 12.21 | — |
| Solar | 0.00 | 0.60 | 0.90 | — |
| Other† | 0.58 | 5.40 | 7.61 | — |
| *West Rest of PJM:* | 0.59 | 83.78 | 419.00 | 388.35 |
| Natural Gas | 0.90 | 25.66 | 26.78 | — |
| Coal** | 1.21 | 32.59 | 208.65 | — |
| Nuclear | 0.00 | 14.94 | 146.76 | — |
| Wind | 0.00 | 4.00 | 20.73 | — |
| Solar | 0.00 | 0.56 | 2.58 | — |
| Other† | 0.79 | 6.04 | 13.50 | — |

Notes: * reflects average emissions rate by region. ** includes waste coal. † includes hydro, oil, biomass and other fuels.

## Table 2: Impact of Pennsylvania Joining RGGI on $CO_2$ Emissions

| | 2022 | 2026 | 2030 | Cumulative |
|---|---|---|---|---|
| *Pennsylvania* | | | | |
| Baseline Total $CO_2$ Emissions (MMT $CO_2$) | 89.5 | 91.9 | 95.4 | 833.1 |
| Change from PA Joining RGGI | -32.2 | -34.6 | -42.6 | -333.0 |
| Baseline Covered $CO_2$ Emissions | 88.8 | 91.3 | 94.7 | 827.2 |
| Change from PA Joining RGGI | -32.3 | -34.8 | -42.9 | -334.9 |
| Baseline Uncovered $CO_2$ Emissions | 0.7 | 0.6 | 0.6 | 5.9 |
| Change from PA Joining RGGI | 0.1 | 0.2 | 0.3 | 1.9 |
| RGGI Allowance Budget Upon Joining | 70.8 | 61.7 | 52.7 | 555.5 |
| *Rest of PJM States in RGGI* | | | | |
| Baseline Total $CO_2$ Emissions (MMT $CO_2$) | 60.7 | 61.4 | 58.3 | 541.7 |
| Change from PA Joining RGGI | 8.2 | 5.6 | 7.2 | 61.0 |
| Baseline Covered $CO_2$ Emissions | 58.9 | 59.6 | 56.3 | 524.6 |
| Change from PA Joining RGGI | 8.2 | 5.6 | 7.2 | 60.5 |
| Baseline Uncovered $CO_2$ Emissions | 1.9 | 1.9 | 2.0 | 17.1 |
| Change from PA Joining RGGI | 0.0 | 0.0 | 0.1 | 0.5 |
| RGGI Allowance Budget | 43.5 | 50.5 | 43.3 | 396.7 |
| *Rest of PJM States Not in RGGI* | | | | |
| Baseline Uncovered $CO_2$ Emissions (MMT $CO_2$) | 231.1 | 219.2 | 224.5 | 2,019.9 |
| Change from PA Joining RGGI | 21.7 | 24.2 | 31.6 | 231.2 |
| *RGGI States Not in PJM* | | | | |
| Baseline Covered $CO_2$ Emissions (MMT $CO_2$) | 39.3 | 40.0 | 30.3 | 331.6 |
| Change from PA Joining RGGI | 2.8 | -0.1 | -1.6 | 2.8 |
| RGGI Allowance Budget | 46.6 | 42.3 | 36.3 | 374.6 |
| *Banked Permits Withdrawn*: | | | | |
| Baseline Banked Permits Withdrawn (MMT $CO_2$) | -8.1 | -13.5 | -14.2 | -84.9 |
| Change from PA Joining RGGI | 3.4 | -0.2 | -4.7 | 0.0 |
| *RGGI+PJM Combined $CO_2$ Emissions Impact* | | | | |
| Intended Emissions Reduction (MMT $CO_2$) | 18.0 | 29.6 | 42.0 | 271.6 |
| Actual Emissions Reduction | -0.5 | 4.9 | 5.4 | 38.0 |
| From PJM States | 2.3 | 4.8 | 3.8 | 40.8 |
| From RGGI States Not in PJM | -2.8 | 0.1 | 1.6 | -2.8 |
| Emissions Leakage | 18.5 | 24.7 | 36.7 | 233.6 |
| Emissions Leakage Ratio | 1.03 | 0.83 | 0.87 | 0.86 |
| Baseline RGGI Allowance Price ($/MT $CO_2$) | 6.26 | 6.03 | 8.92 | 6.98 |
| Change from PA Joining RGGI | -0.82 | 0.03 | 0.46 | -0.09 |

## 3.2 Numerical Results

### 3.2.1 Impact on $CO_2$ Emissions

Table 2 decomposes the impact of Pennsylvania's entry into RGGI on $CO_2$ emissions and the RGGI allowance market. The first panel depicts the $CO_2$ emissions impacts from covered and uncovered EGUs in Pennsylvania. In our analysis, EGUs subject to RGGI carbon budget requirements are referred to as "covered" and those that are not are referred to as "uncovered." Between 2022 and 2030, Pennsylvania's total $CO_2$ emissions decline by 333.0 million metric tons (MMT), corresponding to a decrease in emissions from covered EGUs of 334.9 MMT and a slight increase in emissions from uncovered EGUs of 1.9 MMT.[187] The reduction in emissions from covered EGUs is larger than the intended emissions reduction of 271.6 MMT over this period, or the cumulative $CO_2$ emissions from Pennsylvania's covered EGUs less their cumulative cap under RGGI (271.6 = 827.2 - 555.5). Prior to joining RGGI, Pennsylvania's covered EGUs are less $CO_2$ emissions intensive on average and thus able to reduce CO2 emissions at lower cost relative to covered EGUs in other RGGI member states. Of course covered EGUs in Pennsylvania are only willing to bear these additional abatement costs in exchange for being able to sell additional allowances to covered EGUs in other RGGI member states. As such Pennsylvania's entry into RGGI entails a shift in generation from Pennsylvania's newly covered EGUs to covered EGUs in other RGGI member states inside and outside of PJM and, relative to Pennsylvania's cumulative allowance budget over this period of 555.5 MMT, Pennsylvania is a net supplier of allowances to the RGGI market.

The final panel of Table 2 reports the baseline and change in RGGI allowance price from Pennsylvania's entry into RGGI. When Pennsylvania joins RGGI, the allowance price falls in 2022 by $0.82 per MT $CO_2$ before a nearly zero change in 2026 and then increases by $0.46 per MT in 2030. Across 2022-2030, Pennsylvania's entry into RGGI corresponds to a small average decline in the RGGI allowance price of $0.09 per MT. Together with the observation that Pennsylvania is a net supplier of allowances, Pennsylvania's entry into the RGGI allowance market will entail a positive allowance market terms of trade effect for the Pennsylvanian

[187] We report GHG emissions impacts here using metric and not short tons, although the latter is what is explicitly regulated and tracked by RGGI. Results can be converted upon observing that 1 metric ton equals 1.10231 short tons.

economy; that is the total value of permits from Pennsylvania's share of the RGGI cap will exceed the total cost of permits purchased by power generators in Pennsylvania.

The second panel of Table 2 reports the $CO_2$ emissions impacts from EGUs in PJM in those states in Rest of PJM that are members of RGGI as of 2021 (orange outline in Figure 4: Maryland, Delaware, New Jersey, and Virginia). Between 2022 and 2030, we observe an increase in total $CO_2$ emissions of 61.0 MMT, corresponding to an increase in $CO_2$ emissions from covered EGUs of 60.5 MMT and in uncovered EGUs of 0.5 MMT.

The third panel of Table 2 reports the $CO_2$ abatement from RGGI member states that are not in PJM (solid orange in Figure 4: Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, and New York). As these states are longtime participants in RGGI, they have already significantly reduced their covered $CO_2$ emissions prior to 2021. As such, between 2022 and 2030 their covered $CO_2$ emissions increase by 2.8 MMT when Pennsylvania enters RGGI. That GHG emissions increase in other RGGI states as a result of Pennsylvania's entry into RGGI reinforces the observation that GHG emissions reductions from covered EGU's in Pennsylvania are relatively cheaper to obtain than reductions from covered EGU's in other RGGI states.

The fourth panel of Table 2 reports the $CO_2$ emissions impacts from uncovered EGUs in PJM from EGUs in states in Rest of PJM that are not a part of RGGI as of 2021 (Illinois, Indiana, Michigan, Ohio, West Virginia, Kentucky, Tennessee, and North Carolina). When Pennsylvania joins RGGI, we find that uncovered $CO_2$ emissions from EGUs in PJM and located in states that are not members of RGGI increase by 231.2 MMT.

The fifth panel of Table 2 compares the intended $CO_2$ emissions reduction in Pennsylvania (equal to the baseline Pennsylvania $CO_2$ emissions from covered EGUs less Pennsylvania's RGGI emissions cap) against the actual $CO_2$ emissions reduction across the entire RGGI+PJM footprint (the sum of the change in total $CO_2$ emissions from the preceding four panels). The intended emissions reduction reflects the $CO_2$ emissions reduction from Pennsylvania's entry into RGGI were Pennsylvania to join RGGI and maintain a separate allowance market including just Pennsylvania's covered EGUs and not allow inter-state allowance trading.[188] As noted above, between 2022 and 2030, Pennsylvania's entry into RGGI corresponds to an intended emissions reduction of 271.6 MMT. If Pennsylvania's entry into RGGI had no impact on the

[188] This characterization of *intended* emissions savings is for expositional purposes only; if the regulator anticipates leakage than then they intend to achieve what is characterized as actual emissions reductions here.

regional flow of power within PJM and the RGGI allowance market, this is also the amount of $CO_2$ emissions reductions that Pennsylvania's entry into RGGI would deliver. However, Pennsylvania's entry into RGGI does alter electricity prices across PJM as well as the RGGI allowance price, which alters the spatial flow of power and $CO_2$ emissions across the combined PJM and RGGI footprint. As a result, actual emissions across PJM and RGGI states decline by only 38.0 MMT (emissions in PJM specifically decline by 40.8 MMT). From the vantage point of Pennsylvania's intended emissions reduction, changes in $CO_2$ emissions from other states in RGGI and/or PJM constitute $CO_2$ emissions leakage equal to the difference between the intended and actual emissions reductions.[189] Between 2022 and 2030, we find $CO_2$ emission leakage of 233.6 MMT as a result of Pennsylvania's decision to join RGGI. Of this, 231.2 MMT comes from what we refer to as *jurisdictional leakage* – the shift to using uncovered non-RGGI EGUs in PJM once Pennsylvania enters RGGI and EGUs in the Commonwealth become somewhat less competitive in the PJM regional market. An additional 2.4 MMT of leakage occurs in what we call *sectoral leakage* – the shift within RGGI states to using uncovered EGUs more intensively, since they are not subject to the RGGI allowance price and do not need to acquire allowances.[190] Clearly jurisdictional leakage is the largest contributor to total leakage, accounting for 98.9% of total leakage predicted.

Finally, the last row in the fifth panel of Table 2 reports the leakage ratio, or leakage normalized by intended emissions reductions. Between 2022 and 2030, for each 1 MT reduction in $CO_2$ emissions achieved as a result of Pennsylvania's entry into RGGI, 0.86 MT are leaked and only 0.14 MT of emissions reductions are actually achieved across the RGGI+PJM region. This corresponds to an estimated leakage ratio of 86% for Pennsylvania joining RGGI. While this may seem like a significant amount of leakage, the magnitude of $CO_2$ emissions leakage is less relevant from the vantage point of whether Pennsylvania's entry into RGGI passes a benefit-cost test, which critically depends upon the magnitude of the change in $CO_2$ external costs as a result of the actual emissions reductions achieved (see, Table 7), the change in external costs of as a result of changes in co-pollutants (see, Section 4) as well as the net economic costs from

[189] Antonio M. Bento, Richard Klotz, and Joel R. Landry. Are there Carbon Savings from U.S. Biofuel Policies? The Critical Importance of Accounting for Leakage in Land and Fuel Markets. *Energy Journal*, 36(3):75–109, 2015.

[190] Uncovered units include those that are 25 MW or smaller in terms of capacity and/or those that are statutorily excluded from a state's carbon budget, such as waste coal plants in Pennsylvania under the draft rule.

Pennsylvania's entry into RGGI (see, Tables 4 and 5). As we have discussed in Section 2, however, the leakage ratio has a special legal significance in that any measures to mitigate all of part of emissions leakage from Pennsylvania would need to be designed with some care. It is also worth noting that leakage is not unanticipated as it is well understood that incomplete climate policies such as those which necessarily emerge from decentralized, voluntary state-led initiatives such as RGGI will—by construction—fail to comprehensively cover $CO_2$ emissions from all sources.[191] In fact, RGGI emerged because of the failure of comprehensive climate policy in the U.S. and internationally.[192] As more and more states join RGGI and more EGUs and sectors flip from uncovered to covered, we are likely to observe leakage fall, although this need not be monotonic in the expansion of coverage and will depend upon the overlap between economic agents covered by the RGGI allowance market and $CO_2$ emissions from all agents in the economy.

Despite the high leakage ratio that we calculate, our modeling indicates that Pennsylvania's entry into RGGI will lead to a decline in $CO_2$ emissions from EGUs across the PJM footprint, not just in Pennsylvania. This can be seen from the first three panels of Figure 2. Over the study period through 2030, emissions decline by -333.0 MMT in Pennsylvania, increase by 61.0 MMT in PJM states in RGGI, and increase by 231.2 MMT in PJM states not in RGGI. This leads to an overall decline of emissions across PJM of -40.8 MMT by 2030.

The sixth panel in Table 2 reports the change in allowances withdrawn from the RGGI bank. While Pennsylvania's entry into RGGI affects the inter-temporal economic decision to withdraw allowances from RGGI's accumulated bank between 2022 and 2030 corresponding to how Pennsylvania's entry into RGGI affects the RGGI allowance price over time, we find that by 2030 all of the allowances that have been accumulated before 2022 will be completely withdrawn from the bank irrespective of Pennsylvania's decision to join RGGI.

### 3.2.2 Impact on the PJM Electricity Market and State REC Markets

Table 3 reports the impact of Pennsylvania's entry into RGGI on the PJM wholesale electricity market. The top panel depicts the impacts on the two PJM regions within

[191] Goulder, Lawrence. H. and Robert. N. Stavins. Challenges from State-Federal Interactions in U.S. Climate Change Policy. *American Economic Review* 101 (3), 253–57, 2011.
[192] Carlson, Ann E. Iterative Federalism and Climate Change. *Journal of Scholarly Perspectives*, 4(01), 2008.

Pennsylvania and the bottom panel reports the impacts on the three regions in Rest of PJM (recall that the regional definitions in our model are from Figure 4 and are not the same as load zones tracked by PJM). Pennsylvania's entry into RGGI causes the marginal costs of EGUs in Pennsylvania to increase by the allowance price multiplied by and EGU's $CO_2$ emissions rate. When transmission is not constrained, this causes EGUs in Pennsylvania to shift up the merit order and supply to shift up relative to demand, and the price of electricity to rise given the last EGU that clears the market. When transmission is constrained, the rise in the marginal costs of Pennsylvania's EGUs causes supply to rise relative to demand in the two PJM regions within Pennsylvania. This alters the net flow of power across all regions in the power system. Conditional on the presence of binding transmission constraints between regions in a given hour, the change in net flows as a result of Pennsylvania's entry into RGGI can exacerbate or relieve congestion between regions. As a consequence, Pennsylvania's entry into RGGI causes the load weighted average price of electricity in Pennsylvania to rise by $2.56 per MWh annually between 2022 and 2030 and the average price in Rest of PJM to increase by $0.95 per MWh. Prior to Pennsylvania's entry into RGGI, the Rest of PJM load weighted average annual price of electricity between 2022-2030 exceeds that in Pennsylvania by $3.70 per MWh. After Pennsylvania joins RGGI, the load weighted average annual price of electricity between 2022-2030 in Rest of PJM still exceeds that in Pennsylvania, although now the gap in average prices between the two areas is just $2.09 per MWh.

Prior to Pennsylvania's entry into RGGI, Pennsylvania exports 650,900 GWh of energy to the Rest of PJM between 2022 and 2030. When Pennsylvania joins RGGI its net exports to the Rest of PJM fall by 398,000 GWh. Higher electricity costs in Pennsylvania reduce demand nominally, by 6,200 GWh in Pennsylvania and by 12,000 GWh in the Rest of PJM over this period. Corresponding to the jurisdictional leakage discussed above, total generation falls by 411,600 GWh in Pennsylvania and increases by 391,600 GWh in the Rest of PJM between 2022 and 2030.

**Table 3: Impact of Pennsylvania's Entry into RGGI on the PJM Electricity Market**

| | 2022 | 2026 | 2030 | Cumulative* |
|---|---|---|---|---|
| *Pennsylvania:* | | | | |
| Baseline Average Electricity Price** ($/MWh) | $ 32.84 | $ 32.70 | $ 32.76 | $ 32.79 |
| Change from PA Joining RGGI | $ 2.01 | $ 2.27 | $ 3.61 | $ 2.56 |
| Baseline Net Imports (1,000 GWh) | -69.9 | -71.7 | -73.3 | -650.9 |
| Change from PA Joining RGGI | 38.4 | 41.6 | 50.6 | 398.1 |
| Baseline Demand (1,000 GWh) | 160.8 | 163.6 | 166.3 | 1,472.1 |
| Change from PA Joining RGGI | -0.5 | -0.6 | -1.0 | -6.2 |
| Baseline Total Generation | 242.5 | 247.2 | 251.7 | 2,229.9 |
| Change from PA Joining RGGI | -39.7 | -43.0 | -52.5 | -411.6 |
| Baseline Existing Generation | 240.0 | 243.5 | 248.0 | 2,198.5 |
| Change from PA Joining RGGI | -37.5 | -40.0 | -49.6 | -386.0 |
| Baseline New Generation | 2.4 | 3.7 | 3.7 | 31.5 |
| Change from PA Joining RGGI | -2.2 | -3.0 | -2.9 | -25.5 |
| Baseline AEC Price, Tier 1 ($/MWh) | $ 29.35 | $ 23.64 | $ 20.52 | $ 24.09 |
| Change from PA Joining RGGI | $ -2.21 | $ -2.98 | $ -3.47 | $ -2.88 |
| AEPS Tier 1 Target | 0.08 | 0.08 | 0.08 | 0.08 |
| *Rest of PJM:* | | | | |
| Baseline Average Electricity Price** ($/MWh) | $ 35.57 | $ 36.25 | $ 37.29 | $ 36.49 |
| Change from PA Joining RGGI | $ 0.53 | $ 1.04 | $ 1.30 | $ 0.95 |
| Baseline Net Imports (1,000 GWh) | 69.9 | 71.7 | 73.3 | 650.9 |
| Change from PA Joining RGGI | -38.4 | -41.6 | -50.6 | -398.1 |
| Baseline Demand (1,000 GWh) | 657.9 | 669.2 | 680.6 | 6,022.7 |
| Change from PA Joining RGGI | -1.0 | -1.3 | -1.9 | -12.0 |
| Baseline Total Generation | 629.9 | 640.1 | 650.7 | 5,756.2 |
| Change from PA Joining RGGI | 38.1 | 41.0 | 49.5 | 391.6 |
| Baseline Existing Generation | 628.8 | 616.7 | 618.6 | 5,587.5 |
| Change from PA Joining RGGI | 36.9 | 35.3 | 44.9 | 349.4 |
| Baseline New Generation | 1.1 | 23.4 | 32.1 | 168.8 |
| Change from PA Joining RGGI | 1.1 | 5.7 | 4.6 | 42.1 |
| Baseline Average REC Price, Tier 1† ($/MWh) | $ 14.69 | $ 15.02 | $ 12.60 | $ 14.32 |
| Change from PA Joining RGGI | $ -1.00 | $ -1.02 | $ -1.11 | $ -0.97 |
| Average RPS Tier 1 Target† | 0.10 | 0.14 | 0.15 | 0.13 |

Notes: * prices reported in Cumulative column reflects average across all years 2022-2030. ** reflects load weighted average. † reflects generation weighted average.

The last three rows in the first panel of Table 3 report the impact of Pennsylvania's entry into RGGI on Pennsylvania's Alternative Energy Portfolio Standard (AEPS) and the last three rows

in the bottom panel of Table 3 report the average impact on RPS credit markets in the Rest of PJM (given those states that have mandatory RPS policies). Pennsylvania's entry into RGGI causes Pennsylvania's Tier 1 Alternative Energy Credit (AEC) price to fall by $2.88 between 2022 and 2030 and the Rest of PJM states' average Renewable Energy Credit (REC) prices to fall by $0.97. Intuitively, conditional on the AEPS (average RPS) in Pennsylvania (Rest of PJM) these falling AEC/REC prices lower the implicit subsidy paid to eligible EGUs in the numerator in the RPS constraints and lower the implicit tax paid to eligible and non-eligible EGUs in the denominator of the AEPS/RPS constraints. As a result, Pennsylvania's entry into RGGI lowers the distortionary impact of AEPS/RPSs throughout PJM which, together with the differential rise in average electricity prices in Pennsylvania and Rest of PJM, alters the distribution of new capacity additions throughout PJM. As shown in Table 3, generation from new capacity falls in Pennsylvania by 25,500 GWh and increases by 421,100 GWh in Rest of PJM between 2022 and 2030 as a result of Pennsylvania's entry into RGGI. As shown in Appendix Table A.18, this corresponds to a fall in new wind capacity in Pennsylvania, a decrease in new solar capacity in Rest of PJM, and an increase in new wind capacity in Rest of PJM.

### 3.2.3 Impact on Transmission Owners

Panel A in Table 4 reports the impact of Pennsylvania's entry into RGGI on congestion rents in PJM. These "rents" refer to payments in the PJM electricity market by consumers that are in excess of the payments made to suppliers. They reflect the costs of congestion in the PJM power grid, and historically these rents have been revenues for transmission owners. Pennsylvania's entry into RGGI causes congestion rents from lines within Pennsylvania to rise by $209.2 million between 2022 and 2030, congestion rents from lines within the Rest of PJM to rise by $65.5 million, and congestion rents from lines between Pennsylvania and Rest of PJM to fall by $1,316.1 million. Across PJM, Pennsylvania's entry into RGGI causes congestion rents to fall by $1,041.4 million on net or 17.7% relative to the baseline, reflecting lower costs in the wholesale power system as a result of the interaction between Pennsylvania's entry into RGGI and the constrained transmission system. As shown in Appendix Table A.19, this is largely driven by the expansion in the importation of power from the Rest of PJM into West Pennsylvania and the fall in the average congestion price mark-up between these two areas after Pennsylvania joins RGGI.

### 3.2.4 Economic Impact on PJM and RGGI Market Participants in Pennsylvania

Panel B in Table 4 provides the net economic impact on PJM and RGGI market participants in Pennsylvania from its entry into RGGI. Economic benefits to electricity market participants include the higher net profits to the generation sector (additional revenue arising from higher wholesale electricity prices less new costs from the purchase of RGGI allowances) and allowance revenue accruing to allowance holders. Economic costs predominantly reflect the higher costs of purchasing bulk power by load-serving entities and direct access consumers in the PJM regional electricity market.

Between 2022 and 2030, Pennsylvania's entry into RGGI leads to a total net economic benefit of $2,590.2 million or 0.6% of the baseline net economic benefit attributable to Pennsylvania's market participants in PJM and RGGI. Consistent with the rise in the average wholesale electricity price in Pennsylvania, overall wholesale costs increase by $1,994.5 million between 2022 and 2030. Likewise, EGUs in Pennsylvania observe direct profits from selling power of $4,212.6 million. Combined the net economic benefit to Pennsylvania's ratepayers and power producers, excluding the cost of allowances purchased by Pennsylvania EGUs, is $2,218.0 million between 2022 and 2030. This reflects Pennsylvania's position, even after joining RGGI, of being a major power exporter in PJM. After accounting for the $2,982.6 million in allowances purchased by Pennsylvania's covered EGUs for compliance with RGGI, Pennsylvania power producers would still gain on net $1,230 million. In addition, Pennsylvania is slated to earn $3,354.8 million in its share of auctioned allowance revenue (inclusive of the value of allowances set aside) between 2022 and 2030. The fact that Pennsylvania is a net supplier of allowances to other RGGI states itself contributes $372.1 million in net economic benefit between 2022 and 2030.

The last two lines in panel B of Table 4 report the impact on the Pennsylvania economy of Pennsylvania's entry into RGGI, incorporating the change in congestion rents described in Sec. 3.2.3. These two cases bound the net economic benefit to Pennsylvania's electricity sector, or $2,799.3 million and $1,483.3 million between 2022 and 2030.

**Table 4: Economic Impacts of Pennsylvania's Participation in RGGI**

| | 2022 | 2026 | 2030 | Cumulative* |
|---|---|---|---|---|
| *A. Transmission Lines Within and Between Regions* | | | | |
| Baseline Econ. Ben. From Partic. in PJM (billion $) | $ 0.6 | $ 0.7 | $ 0.9 | $ 5.9 |
| Change from PA Joining RGGI (million $) | $-134.9 | $ -85.2 | $-181.6 | $-1,041.4 |
| From Lines in Pennsylvania | $ 17.3 | $ 26.1 | $ 44.3 | $ 209.2 |
| From Lines in Rest of PJM | $ 10.7 | $ 10.3 | $ 6.4 | $ 65.5 |
| From Lines Between PA and RPJM | $-163.0 | $-121.6 | $-232.2 | $-1,316.1 |
| *B. Pennsylvania* | | | | |
| Baseline Net Economic Benefit (billion $)** | $ 54.4 | $ 55.4 | $ 57.1 | $ 445.2 |
| Change from PA Joining RGGI (million $) | $ 289.5 | $ 281.6 | $ 401.8 | $2,590.2 |
| From Participation in PJM Electricity Market | $ 211.5 | $ 249.6 | $ 393.7 | $2,218.0 |
| Benefits to Consumers† | $-183.0 | $-238.2 | $-356.8 | $-1,994.5 |
| Benefits to Generators‡ | $ 394.5 | $ 487.8 | $ 750.5 | $4,212.6 |
| Covered Generators | $ 389.2 | $ 474.6 | $ 733.4 | $4,101.6 |
| Uncovered Generators | $ 5.4 | $ 13.2 | $ 17.1 | $ 110.9 |
| From Participation in RGGI Allowance Market | $ 77.9 | $ 32.0 | $ 8.1 | $ 372.1 |
| Cost of Allowances Bought | $-306.8 | $-342.0 | $-486.2 | $-2,982.6 |
| Value of Allowances Auctioned | $ 384.8 | $ 374.0 | $ 494.3 | $3,354.8 |
| Change in Net Economic Benefit to Pennsylvania + Benefits to Trans. Own. From PA Lines | $ 306.8 | $ 307.7 | $ 446.1 | $2,799.3 |
| Change in Net Economic Benefit to Pennsylvania + Benefits to Trans. Own. From PA and PA–RPJM Lines | $ 143.8 | $ 186.1 | $ 213.9 | $1,483.3 |
| *C. Rest of PJM States in RGGI* | | | | |
| Baseline Net Economic Benefit (billion $)** | $ 98.2 | $ 99.7 | $ 102.9 | $ 804.1 |
| Change from PA Joining RGGI (million $) | $-197.1 | $ -59.4 | $-189.1 | $-1,065.8 |
| From Participation in PJM Electricity Market | $-165.2 | $ -25.2 | $-115.9 | $-721.0 |
| Benefits to Consumers† | $-329.2 | $-428.6 | $-642.0 | $-3,588.5 |
| Benefits to Generators‡ | $ 164.0 | $ 403.4 | $ 526.1 | $2,867.6 |
| Covered Generators | $ 162.8 | $ 396.5 | $ 505.2 | $2,814.0 |
| Uncovered Generators | $ -25.2 | $ 5.2 | $ 46.1 | $ 37.9 |
| From Participation in RGGI Allowance Market | $ -31.9 | $ -34.2 | $ -73.2 | $-344.8 |
| Cost of Allowances Bought | $ 4.0 | $ -35.7 | $ -93.3 | $-308.3 |
| Value of Allowances Auctioned | $ -35.9 | $ 1.5 | $ 20.0 | $ -36.5 |
| *D. Rest of PJM States Not in RGGI* | | | | |
| Baseline Econ. Ben. From Partic. in PJM (billion $) | $ 143.3 | $ 144.9 | $ 149.1 | $1,169.5 |
| Change (million $) | $ 57.7 | $-194.4 | $-140.6 | $-870.4 |
| Benefits to Consumers | $-478.2 | $-622.5 | $-932.4 | $-5,212.1 |
| Benefits to Generators | $ 535.9 | $ 428.1 | $ 791.8 | $4,341.7 |

Notes: * net present value reported over 2022-2030 in 2016 $ assuming a market discount rate of 3.0 %. ** net economic benefit includes the economic benefit (possibly negative) accruing to participants in the PJM electricity market as well as the economic benefit (possibly negative) accruing to participants in the RGGI allowance market and does not include broader, general equilibrium economic impacts. † reflects the change in consumer surplus to load serving entities, the majority of which is the change in wholesale energy purchases. ‡ reflects change in profits to generators, excluding the change in the costs of allowances.

**Table 4: Economic Impacts of Pennsylvania's Participation in RGGI (continued)**

| | 2022 | 2026 | 2030 | Cumulative* |
|---|---|---|---|---|
| *E. RGGI States Not In PJM* | | | | |
| Baseline Econ. Ben. From Partic. in RGGI (billion $) | $ 0.5 | $ 0.5 | $ 0.5 | $ 4.0 |
| Change from PA Joining RGGI (million $) | $ -4.9 | $ 0.1 | $ 3.1 | $ -9.3 |
| Reduced $CO_2$ Abatement Costs | $ 16.2 | $ -0.6 | $ -14.2 | $ 16.1 |
| Cost of Allowances Bought | $ 17.3 | $ -0.6 | $ 0.5 | $ 29.7 |
| Value of Allowances Auctioned | $ -38.4 | $ 1.3 | $ 16.8 | $ -55.1 |
| *F. Holders of Allowances Banked Prior to 2022* | | | | |
| Baseline Econ. Ben. From Partic. in RGGI (billion $) | $ 0.0 | $ 0.2 | $ 0.1 | $ 1.1 |
| Change from PA Joining RGGI (million $) | $ -25.1 | $ 11.3 | $ 47.8 | $ -18.2 |
| Value of Banked Allowances | $ -0.1 | $ 9.8 | $ 0.0 | $ -16.3 |
| Cost of Allowances Bought | $ -25.0 | $ 1.5 | $ 47.8 | $ -1.9 |
| *G. PJM* | | | | |
| Baseline Net Economic Benefit (billion $)** | $ 296.5 | $ 300.6 | $ 309.8 | $2,424.7 |
| Change from PA Joining RGGI (million $) | $ 15.1 | $ -57.4 | $-109.5 | $-387.4 |
| From Participation in PJM Electricity Market | $-30.9 | $ -55.2 | $-44.4 | $-414.7 |
| Benefits to Transmission Owners | $-134.9 | $ -85.2 | $-181.6 | $-1,041.4 |
| Benefits to Pennsylvania | $ 211.5 | $ 249.6 | $ 393.7 | $2,218.0 |
| Benefits to Rest of PJM States in RGGI | $-165.2 | $ -25.2 | $-115.9 | $-721.0 |
| Benefits to Rest of PJM States Not in RGGI | $ 57.7 | $-194.4 | $-140.6 | $-870.4 |
| From Participation in RGGI Allowance Market | $ 46.0 | $ -2.2 | $ -65.1 | $ 27.3 |
| Benefits to Pennsylvania | $ 77.9 | $ 32.0 | $ 8.1 | $ 372.1 |
| Benefits to Rest of PJM States in RGGI | $ -31.9 | $ -34.2 | $ -73.2 | $-344.8 |
| *H. PJM States and RGGI States Not in PJM* | | | | |
| Baseline Net Economic Benefit (billion $)** | $ 297.1 | $ 301.2 | $ 310.4 | $2,429.8 |
| Change from PA Joining RGGI (million $) | $ -14.9 | $ -46.1 | $ -58.6 | $-414.9 |
| From Participation in PJM Electricity Market | $-30.9 | $ -55.2 | $-44.4 | $-414.7 |
| Benefits to Transmission Owners | $-134.9 | $ -85.2 | $-181.6 | $-1,041.4 |
| Benefits to Pennsylvania | $ 211.5 | $ 249.6 | $ 393.7 | $2,218.0 |
| Benefits to Rest of PJM States in RGGI | $-165.2 | $ -25.2 | $-115.9 | $-721.0 |
| Benefits to Rest of PJM States Not in RGGI | $ 57.7 | $-194.4 | $-140.6 | $-870.4 |
| From Participation in RGGI Allowance Market | $ 16.1 | $ 9.2 | $ -14.2 | $ -0.2 |
| Benefits to Pennsylvania | $ 77.9 | $ 32.0 | $ 8.1 | $ 372.1 |
| Benefits to Rest of PJM States in RGGI | $ -31.9 | $ -34.2 | $ -73.2 | $-344.8 |
| Benefits to RGGI States Not in PJM | $ -4.9 | $ 0.1 | $ 3.1 | $ -9.3 |
| Benefits to Holders of Banked Allowances | $ -25.1 | $ 11.3 | $ 47.8 | $ -18.2 |

Notes: * net present value reported over 2022-2030 in 2016 $ assuming a market discount rate of 3.0 %. ** net economic benefit includes the economic benefit (possibly negative) accruing to participants in the PJM electricity market as well as the economic benefit (possibly negative) accruing to participants in the RGGI allowance market and does not include broader, general equilibrium economic impacts. In panel G, net economic benefit excludes the value of banked allowances.

Table 5 further decomposes the economic impacts from Pennsylvania's entry into RGGI on West Pennsylvania (top panel) and East Pennsylvania (bottom panel), under the assumption that

the total value of RGGI allowances that accrues to Pennsylvania is distributed between the two regions in proportion to that region's share of the costs of allowances bought in Pennsylvania (equivalently, their regional share of abatement).[193] Between 2022 and 2030, Pennsylvania's entry into RGGI yields $1,308.7 million in net economic benefit to West Pennsylvania and $1,281.4 million to East Pennsylvania. The benefits to ratepayers from Pennsylvania's entry into RGGI in the two respective regions are -$588.0 and -$1,406.5 million between 2022 and 2030. The impacts to ratepayers are nearly 2.5 times greater in East Pennsylvania than West Pennsylvania because load in East Pennsylvania is nearly twice as large as load in West Pennsylvania and because the change in the average wholesale price of electricity from Pennsylvania's entry into RGGI in East Pennsylvania is $2.11 per MWh between 2022 and 2030 compared to $1.90 in West Pennsylvania. The change in benefits to power producers from Pennsylvania's entry into RGGI is $1,741.8 and $2,470.8 million between 2022 and 2030 in West and East Pennsylvania, respectively. The impacts to power producers is nearly 1.5 times greater in East Pennsylvania than West Pennsylvania, roughly following the difference in capacity between the two regions. Altogether we find economic gains of $155.0 and $217.1 million between 2022 and 2030 in West and East Pennsylvania from Pennsylvania's entry into RGGI. Of course this depends on the assumption regarding the intrastate allocation of allowances and other allocation rules would yield different distributional outcomes between regions.

[193] This is not meant to provide any indication as to how allowance revenue should be allocated. There are many other ways to allocate Pennsylvania's allowance revenue that can and should reflect both efficiency and equity considerations; see Section 5 for a more complete treatment of this point.

**Table 5: Economic Impacts on East and West Pennsylvania**

| | 2022 | 2026 | 2030 | Cumulative* |
|---|---|---|---|---|
| *West Pennsylvania* | | | | |
| Baseline Net Economic Benefit (billion $)** | $ 20.6 | $ 20.8 | $ 21.4 | $ 167.5 |
| Change from PA Joining RGGI (million $) | $ 136.3 | $ 145.0 | $ 218.4 | $1,308.7 |
| From Participation in PJM Electricity Market | $ 101.3 | $ 131.3 | $ 215.1 | $1,153.7 |
| Benefits to Consumers† | $ -61.6 | $ -70.4 | $ -95.2 | $-588.0 |
| Benefits to Generators‡ | $ 162.9 | $ 201.7 | $ 310.4 | $1,741.8 |
| Covered Generators | $ 160.7 | $ 196.3 | $ 303.3 | $1,695.9 |
| Uncovered Generators | $ 2.2 | $ 5.5 | $ 7.1 | $ 45.9 |
| From Participation in RGGI Allowance Market | $ 35.0 | $ 13.7 | $ 3.3 | $ 155.0 |
| Cost of Allowances Bought | $-137.9 | $-146.0 | $-196.2 | $-1,269.1 |
| Value of Allowances Auctioned◇ | $ 172.9 | $ 159.6 | $ 199.5 | $1,424.1 |
| *East Pennsylvania* | | | | |
| Baseline Net Economic Benefit (billion $)** | $ 33.8 | $ 34.6 | $ 35.7 | $ 277.7 |
| Change from PA Joining RGGI (million $) | $ 153.2 | $ 136.6 | $ 183.4 | $1,281.4 |
| From Participation in PJM Electricity Market | $ 110.2 | $ 118.3 | $ 178.5 | $1,064.3 |
| Benefits to Consumers† | $-121.4 | $-167.8 | $-261.6 | $-1,406.5 |
| Benefits to Generators‡ | $ 231.7 | $ 286.1 | $ 440.2 | $2,470.8 |
| Covered Generators | $ 228.5 | $ 278.3 | $ 430.1 | $2,405.7 |
| Uncovered Generators | $ 3.1 | $ 7.7 | $ 10.1 | $ 65.0 |
| From Participation in RGGI Allowance Market | $ 42.9 | $ 18.3 | $ 4.8 | $ 217.1 |
| Cost of Allowances Bought | $-169.0 | $-196.0 | $-290.0 | $-1,713.5 |
| Value of Allowances Auctioned◇ | $ 211.9 | $ 214.3 | $ 294.9 | $1,930.7 |

Notes: * net present value reported over 2022-2030 in 2016 $ assuming a market discount rate of 3.0 %.** net economic benefit includes the economic benefit (possibly negative) accruing to participants in the PJM electricity market as well as the economic benefit (possibly negative) accruing to participants in the RGGI allowance market and does not include broader, general equilibrium economic impacts. † reflects the change in consumer surplus to load serving entities, the majority of which is the change in wholesale energy purchases. ‡ reflects change in profits to generators, excluding the change in the costs of allowances. ◇ allowance revenues are assumed to be allocated to each region in proportion to that region's share of the cost of allowances bought.

### 3.2.5 Impact on Electricity Markets Outside of Pennsylvania

Panel C of Table 4 reports the net economic benefit from Pennsylvania's entry into RGGI on PJM and RGGI market participants located in states in Rest of PJM that are also members of RGGI. PJM and RGGI market participants in these states observe a net economic loss (or negative net economic benefit) of $1,065.8 million between 2022 and 2030 when Pennsylvania enters RGGI.

Panel D of Table 4 reports the economic benefit to PJM market participants located in states in Rest of PJM that are not members of RGGI. These states remain net importers of power and so rising average wholesale electricity prices in Rest of PJM entail increases in wholesale costs

of $5,212.1 million between 2022 and 2030 that exceed the benefit to power producers of $4,341.7 million, resulting in an economic loss to market participants in these states of $870.4 million. The latter is slightly smaller in absolute terms than the loss to the Rest of PJM states in RGGI of $1,065.8 million. However, relative to the baseline economy, Pennsylvania's entry into RGGI causes a loss of 0.13% in states in Rest of PJM that are members of RGGI and a loss of just 0.07% in states in Rest of PJM that are not members of RGGI.

Panel E in Table 4 reports the economic benefit to RGGI market participants located in RGGI member states who do not participate in the PJM wholesale electricity market. RGGI market participants in these states observe an economic loss of $9.3 million between 2022 and 2030 from Pennsylvania's entry into RGGI. They also abate less as a result of the shift to abatement from EGUs in Pennsylvania with lower marginal abatement costs, resulting in reduced abatement costs (a benefit) of $16.1 million between 2022 and 2030. This shift in abatement also affects the cost of allowances purchased by covered EGUs in these states which rise by $29.7 million between 2022 and 2030. However, this is more than offset by the fall in the value of allowances sold at auction that accrue to these states, $55.1 million. Finally, Panel F of Table 4 considers the economic benefit to holders of banked allowances from Pennsylvania's entry into RGGI. In this case, banked allowance holders incur an economic cost of $18.2 million between 2022 and 2030 which equals the change in the value of banked allowances, -$16.3 million, plus the change in the cost of allowances bought as result of changes in bank withdrawals and deposits across time, -$1.9 million.

### 3.2.6 Net Economic Impact on PJM and RGGI Market Participants

Panel G in Table 4 reports the net economic benefits from Pennsylvania's entry into RGGI on PJM and RGGI market participants within the PJM footprint. This equals the sum of net economic benefits across all PJM states reported in Panels A-D. Pennsylvania's entry into RGGI leads to a net economic loss to PJM and RGGI market participants in the PJM footprint equal to $387.4 million between 2022 and 2030, or an average annual loss of $43.0 million. Relative to baseline net economic benefits to states within the PJM footprint, this effect is quite small, a loss of just 0.02%. Thus, Pennsylvania's entry into RGGI provides an overall net economic benefit to Pennsylvania (Panel B of Table 4) but also net economic costs to Rest of PJM states. While these

net costs to Rest of PJM are small relative to baseline net economic benefit, they arise from higher wholesale market costs for power imported into Rest of PJM from Pennsylvania, and increased allowance costs as covered EGUs in states in Rest of PJM and RGGI purchase allowances from covered EGUs in Pennsylvania.

Finally, Panel H of Table 4 focuses on the net economic benefit to PJM and RGGI market participants from Pennsylvania's entry into RGGI on all states within the RPAM domain (or RGGI+PJM). This equals the net economic benefit to all PJM states from Panel G plus the sum of the economic benefits to RGGI market participants that are not in PJM and to banked allowance holders reported in Panels E and F. Across RGGI+PJM, RGGI and PJM market participants realize a net economic loss of $414.9 million between 2022 and 2030, or an average annual loss of $46.1 million. Across the entire model domain, this reflects the net economic costs from Pennsylvania's entry into RGGI in light of interactions with all modelled pre-existing federal, state, and regional policies and transmission constraints. Of these costs, 93.3% are borne by PJM and RGGI market participants in states that are partly or entirely in PJM and 6.7% by RGGI market participants in RGGI member states that are entirely outside of PJM.

### 3.2.7 Power-Sector Economic Impacts versus Climate Benefits

The private net economic costs to Pennsylvania and other states need to be weighed against the social benefits from $CO_2$ emissions reductions. Because the primary policy motivation for RGGI is the reduction in power-sector $CO_2$ emissions we focus on those in this section. Joining RGGI brings with it a number of environmental co-benefits in the form of reductions in pollutants that more directly affect local and regional air quality. We estimate that these co-benefits are substantial and devote substantial attention to these co-benefits in Section 4 of this report.

**Table 6: Impact of Pennsylvania Joining RGGI on External Costs From $CO_2$ Emissions Reductions**

| | 2022 | 2026 | 2030 | Cumulative* |
|---|---|---|---|---|
| Change in $CO_2$ Emissions (MMT $CO_2$) | 0.5 | -4.9 | -5.4 | -38.0 |
| $CO_2$ Reduction Benefits (million $) | $ -27.2 | $ 273.5 | $ 345.3 | $ 1,906.8 |

Notes: * external benefits reflect net present value reported over 2022-2030 in 2016 $ assuming a market discount rate of 3.0 %.

In Table 6 we consider the external benefits from $CO_2$ emissions reductions using recent estimates of the global social cost of carbon (SCC) as proposed by the Interagency Working Group on the Social Cost of Greenhouse Gases (formerly, the Interagency Working Group on the Social Cost of Carbon).[194] To be precise, we use annual linear interpolations based upon the SCC for 2020, 2025, and 2030 assuming a social discount rate of 3%, adjusted to 2016 dollars using the Consumer Price Index. The cumulative external $CO_2$ emissions reduction benefit reported in the last row is the net present value in 2016$ of the external benefits across years 2022-2030 assuming a 3.0% market discount rate. Corresponding to the 38.0 MMT reduction in $CO_2$ emissions (inclusive of emissions leaked outside of Pennsylvania) between 2022 and 2030 from PJM and RGGI market participants, Pennsylvania's entry into RGGI leads to external $CO_2$ emissions reduction benefits of $1,906.8 million between 2022 and 2030, or an average annual external benefit from $CO_2$ emissions reductions of $211.9 million. By comparison Pennsylvania's entry into RGGI imposes net economic costs to RGGI and PJM market participants in RGGI+PJM of $414.9 million between 2022 and 2030. Thus, even with a high $CO_2$ emissions leakage ratio and moderate net economic costs to other states, the external greenhouse gas emissions reduction benefits from Pennsylvania's entry into RGGI outweigh net economic costs to the PJM and RGGI markets.

### 3.2.8 Limitations and Caveats

The change in $CO_2$ emissions predicted by RPAM includes the change in $CO_2$ emissions from all covered and uncovered $CO_2$ emissions from EGUs in PJM as well as changes in $CO_2$ emissions from covered EGUs in states in RGGI that are not in PJM. The present analysis does

[194] Interagency Working Group on Social Cost of Greenhouse Gases. Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. August, 2016.

not consider the general equilibrium economic and $CO_2$ emissions impacts of Pennsylvania's entry into RGGI within RGGI+PJM or impacts on the national and global economic system beyond RGGI+PJM, nor does it consider how Pennsylvania's entry into RGGI may induce innovation in 'green' technologies. For these reasons, changes in net economic benefits, external benefits from changes in $CO_2$ emissions reductions, and changes in $CO_2$ emissions may be under- or over-estimates. For example, higher electricity prices may increase the price of manufactured goods produced in Pennsylvania relative to the price of manufactured goods produced by companies that are not located in RGGI member states. This may have negative economic and employment impacts on the Pennsylvania economy over and above those predicted here and this may also result in additional increases in $CO_2$ emissions from economic agents outside of RGGI+PJM as well as additional reductions in $CO_2$ emissions within Pennsylvania. Conversely, the net economic benefit that accrues to the Pennsylvania economy from Pennsylvania's entry into RGGI may stimulate the growth rate of the Pennsylvania economy relative to other states in RGGI+PJM, which would suggest that the net economic benefits to the Pennsylvania economy reported here are under-estimates. Assuming such effects are marginal, then, since both the external benefits from $CO_2$ emissions reductions and the net economic benefit to Pennsylvania from their entry into RGGI are both positive, the combined net economic and external $CO_2$ emissions benefit from Pennsylvania's entry into RGGI will be positive unless there exist other categories of economic and/or external costs that are not captured in the present analysis and these costs are sufficiently large.

## 4. Estimation of Environmental Co-Benefits of Pennsylvania Joining RGGI

### 4.1 Introduction

Fossil fuel combustion is a major contributor to both air pollutants and carbon emissions. In particular, the electricity sector currently accounts for 26.9% of national total carbon emissions,[195] along with 50.8% of sulfur dioxide ($SO_2$), 9.8% of nitrogen oxides ($NO_x$) and 1.1% of particulate matter (PM) emissions.[196] These harmful air pollutant emissions result in higher levels of human exposure to ambient pollution, which in turn lead to elevated health risks for cardiovascular and respiratory diseases. Power sector emissions are largely driven by the dominance of fossil energy in the country's current generation mix. At present, 23.5% and 38.4% of power generation comes from coal and natural gas power plants,[197] both of which are major emitters for carbon emissions. Although the air pollutant emissions from U.S. power plants have reduced dramatically since the introduction of Clean Air Act, especially owing to the wide-scale installation of end-of-pipe control technologies, burning low-quality coal for electricity remains to be a large source of air pollutants, especially for $SO_2$ and $NO_x$. Therefore, by facilitating a transition from fossil to low-carbon power generation sources, climate policies that primarily target mitigating carbon pollution can simultaneously reduce air pollution and associated health damages.

Since the health impacts of climate policies accrue sooner than the impacts from climate change, tangible health co-benefits can be more effective than the long-term climate threat in motivating immediate action to tackle climate change, on both an individual and governmental level. For individuals, while many people view climate change as a distant threat in the future,

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[195] U.S. Environmental Protection Agency, *Sources of Greenhouse Gas Emissions*. Available at: https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions.

[196] U.S. Environmental Protection Agency, *2017 National Emissions Inventory (NEI) Data*. Available at: https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data.

[197] U.S. Energy Information Administration, *What is U.S. electricity generation by energy source?* Available at: https://www.eia.gov/tools/faqs/faq.php?id=427&t=3.

health considerations are local and immediate. Framing climate action in terms of public health impacts makes climate change more personally relevant and emotionally engaging.[198] Since public health is a high-priority issue for citizens and for policymakers, climate policies that simultaneously address urgent local concerns are often more successful in gaining public support and ensuring smooth implementation.

Indeed, including health co-benefits often makes climate policies more cost-effective economically. For instance, during the policy deliberation process for the Clean Power Plan (CPP) in 2014, the U.S. Environmental Protection Agency (EPA) estimated that the proposed plan aiming at cutting carbon pollution from U.S. power plants, if implemented, would cut 20% power sector carbon emissions by 2030 relative to 2005 levels, along with 25% less air pollutant emissions that form soot and smog and impose negative health impacts.[199] By 2030, these reductions correspond to an annual reduction of 2,700 to 6,600 premature deaths as well as an annual reduction of 140,000 to 150,000 asthma attacks in children. It is also estimated that the combined climate and health benefits far outweigh the estimated costs of the plan; the estimated benefits are $55-93 billion per year in 2030, while the annual costs are only $7.3-8.8 billion. As estimated by the EPA, every dollar invested through the CPP could yield up to $7 in health benefits.[200]

The objective of this section is to examine the health co-benefits from Pennsylvania's participation in RGGI and identify key factors that are worth careful policy consideration. Specifically, we ask three major questions in this paper related to the air quality and health co-benefits:

- How much aggregated air quality-related co-benefits can be achieved from Pennsylvania's participation in RGGI?
- What types of air pollutants and which counties contribute the most to the health damages from the power sector in the PJM region, or to the health co-benefits from joining RGGI?

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[198] Myers, T. A. *et al.* (2012) 'A public health frame arouses hopeful emotions about climate change: A Letter', *Climatic Change*. doi: 10.1007/s10584-012-0513-6.

[199] U.S. Environmental Protection Agency, *Why We Need A Cleaner, More Efficient Power Sector*. Available at: https://archive.epa.gov/epa/sites/production/files/2014-05/documents/20140602fs-benefits.pdf.

[200] U.S. EPA, *supra* note 176.

- How does the inclusion of health co-benefits change the cost-benefit evaluation of Pennsylvania's decision to join RGGI?

Answering these questions not only provides critical information to understand the benefits of joining RGGI. It also identifies the key factors that will likely affect the scale and distribution of the health co-benefits, which should be carefully considered during the rulemaking process as well as in the implementation stage.

Indeed, to inform decision-making on health-oriented climate policies, decades of efforts have been made to assess the health co-benefits from a wide range of climate-friendly policies (e.g., carbon pricing, renewable portfolio standards, etc.) in a variety of countries and regions,[201] including China,[202] the E.U.,[203] as well as subregions in the U.S. such as California[204] and Massachusetts.[205] This collective literature has found significant variations in the magnitude of health co-benefits across different climate policies, regions and segments of populations. The cost-effectiveness of climate policies in addressing health and climate concerns will hence be affected by the exact policy design, targeted regions, as well as the environmental justice considerations regarding the incidence of costs and benefits imposed on different populations. Some key factors of particular importance for the electricity sector include:

- *Upstream drivers in energy activities and emissions*: e.g., How will the policy affect the generation from fossil-based power plants, as co-emitters of air pollutants and $CO_2$ emissions? Given the substantial variations in plant efficiency and emission factors (i.e.,

[201] Driscoll, C. T. *et al.* (2015) 'US power plant carbon standards and clean air and health co-benefits', *Nature Climate Change*. doi: 10.1038/nclimate2598; Buonocore, J. J. *et al.* (2016) 'An analysis of costs and health co-benefits for a U.S. Power Plant Carbon Standard', *PLoS ONE*. doi: 10.1371/journal.pone.0156308; Buonocore, J. J. *et al.* (2019) 'Climate and health benefits of increasing renewable energy deployment in the United States', *Environmental Research Letters*. doi: 10.1088/1748-9326/ab49bc; Dimanchev, E. G. *et al.* (2019) 'Health co-benefits of sub-national renewable energy policy in the US', *Environmental Research Letters*. doi: 10.1088/1748-9326/ab31d9.

[202] Li, M. *et al.* (2018) 'Air quality co-benefits of carbon pricing in China', *Nature Climate Change*. doi: 10.1038/s41558-018-0139-4.

[203] Schucht, S. *et al.* (2015) 'Moving towards ambitious climate policies: Monetised health benefits from improved air quality could offset mitigation costs in Europe', *Environmental Science and Policy*. doi: 10.1016/j.envsci.2015.03.001.

[204] Maizlish, N. *et al.* (2013) 'Health cobenefits and transportation-related reductions in greenhouse gas emissions in the San Francisco Bay Area', *American Journal of Public Health*. doi: 10.2105/AJPH.2012.300939; Wang, T. *et al.* (2020) 'Health co-benefits of achieving sustainable net-zero greenhouse gas emissions in California', *Nature Sustainability*. doi: 10.1038/s41893-020-0520-y.

[205] Buonocore, J. J. *et al.* (2018) 'Climate, air quality, and health benefits of a carbon fee-and-rebate bill in Massachusetts, USA', *Environmental Research Letters*. doi: 10.1088/1748-9326/aae62c.

amount of emissions per unit electric output), which types of power plants will be affected and hence how much primary emissions can be avoided?

- *Downstream health exposures and impact*s: e.g., Where are the power plants located (e.g., a densely populated or remote region)? How much ambient pollution will be formed from these emissions, and how will the pollution be dispersed and transported? How large and vulnerable is the exposed population?

Incorporating these key factors into the deliberation process of RGGI rules raises critical analytical challenges to carefully examine the exact climate policy designs, the actors and energy activities involved, the air pollution formation and transport processes, as well as the populations that may be affected. In general, quantifying the air quality-related health co-benefits involve three basic steps that combine energy system modeling, air quality modeling and health impact assessment: (1) Identify the baseline levels of energy activities and emissions in the absence of climate policies, as well as the health endpoints (e.g., premature mortality and/or morbidity) and populations of interest (e.g., total population and/or specific segments of population); (2) Quantify the changes in health drivers (i.e., energy use and emissions) and outcomes (e.g., mortality) driven by the implementation of climate policy; (3) Examine the uncertainties of key assumptions and assess the ranges of the health co-benefits. Following these basic steps, in this study, we first use the RGGI+PJM Policy Analysis Model (RPAM) as described in Section 3 to model the baseline levels of power generation activities and associated air pollutant emissions if Pennsylvania does not participate in RGGI, and then quantify the changes in power generation and emissions if Pennsylvania joins RGGI. Next, we utilize marginal damage estimates (i.e., monetized health damages of *emitting* one unit of air pollutant emissions) that are derived from prior analyses using fully coupled air pollution modeling and health impact assessment. By multiplying each type of air pollutant emissions (in tons) with their marginal damage (in $/ton), we quantify the health damages for the scenarios with or without Pennsylvania's participation in the RGGI, of which the differences in their health damages imply the co-benefits from joining the RGGI. Finally, we consider uncertainties in air pollution and health modeling by comparing marginal damage estimates obtained from different air quality models to simulate pollution exposure levels, different concentration-response relationships to link exposure level with mortality risks, as well as different values of statistical life to monetize the mortality impacts.

## 4.2 Air Quality and Health Outcomes Modeling Methods

### 4.2.1 Policy and emission scenarios

We use the annual plant-level emissions output from the RGGI+PJM Policy Analysis Model (RPAM, as presented in Section 3) for the years 2020 to 2030. The RPAM model is capable of conducting multi-market numerical simulations to investigate federal and state policies which affect the wholesale electricity market operated by the PJM power system. In addition to electric output, prices and $CO_2$ emissions, the model also reports the annual emissions of major air pollutant emissions at the plant level, including $SO_2$, nitrogen oxides ($NO_x$), $PM_{2.5}$, ammonia ($NH_3$) and volatile organic compounds (VOC). These five types of primary emissions reported by RPAM will be used in our further analysis to assess the air quality-related health damages.

As for the main scenarios, we consider one *Base Case* that assumes Pennsylvania remains outside of RGGI, and one *Central Case* that assumes Pennsylvania joins RGGI in 2022. The differences between these two cases reflect the changes in electricity-related air pollutant emissions driven by Pennsylvania's entry into RGGI. Specifically, the *Base Case* represents the trajectory of Pennsylvania not being a member of RGGI, while the states already in RGGI and those that have announced a timeline to join RGGI will keep their aggregate $CO_2$ emissions from the power plants below an annual emissions cap. In the *Central Case*, we assume that Pennsylvania will join RGGI in 2022 and jointly meet the regional $CO_2$ emissions cap with the other states in RGGI. As a sensitivity analysis on potential policy interactions, we further consider a *No AEPS* case that assumes a combination of Pennsylvania joining RGGI in 2022 and terminating its Alternative Energy Portfolio Standard (AEPS) in the same year, thus eliminating all credit requirements under AEPS. More detailed information on the scenario designs are described in Table 8.

**Table 8. Description of the scenarios**

| Scenario name | | Action by Pennsylvania | Action by other states in the PJM Interconnection |
|---|---|---|---|
| **Main scenarios** | **Base Case** | Not joining RGGI | NJ joining in 2020<br>VA joining in 2021 |
| | **Central Case** | Joining RGGI in 2022 | |
| **Sensitivity scenario on policy interactions** | **No AEPS Case** | - Joining RGGI in 2022<br>- Terminating the Alternative Energy Portfolio Standard (AEPS) in 2022 | |

### 4.2.2 Marginal damage (or benefit-per-ton) estimates

To quantify air quality-related health damages from the primary emissions obtained from the previous step, we utilize the marginal damages per unit emission to account for a wide range of factors that affect the air quality and health implications. These factors include the type of pollutants, the location of emitting sources, the amount of wind transport, and the size and vulnerability of exposed populations. It is worth noting that, assuming a linear relationship between marginal changes in emissions and resulting health impacts, the marginal damage estimates (i.e., the monetized health damages of *emitting* one unit of air pollutant emissions) are equivalent to benefit-per-ton (BPT) estimates (i.e., the monetized health benefits of *avoiding* one ton of pollutant emissions). We use these two terms interchangeably in this section.

We consider four marginal damage estimates that are derived from state-of-the-art modeling methods for air quality simulation and health impact assessment (major assumptions listed in Table 9). These estimates are obtained from different atmospheric chemistry and transport models using different baseline emissions. They are also reported at varying spatial resolutions for different sectors and types of primary emissions. For instance, while the EPA measure reports one national average marginal damage estimate for each of the 17 different sectors, the InMAP-ISRM, EASIER and AP3 approaches report one sector-averaged estimate but at much finer spatial resolution (i.e., more than 50,000 grids or county-level). Therefore, the inclusion of multiple marginal damage estimates allows us to examine a variety of structural and parametric uncertainties related with air pollution and health impact modeling.

**Table 9. Four marginal damage (or benefit-per-ton) estimates.**

| | | **The EPA measure**[206,207] | **InMAP-ISRM** *(InMAP source receptor matrix)*[208] | **EASIUR** *(Estimating Air Pollution Social Impact Using Regression)*[209] | **AP3** *(Air Pollution Emission Experiments and Policy v3)*[210] |
|---|---|---|---|---|---|
| **Air pollution modeling** | **Spatial resolution** | Single national number | 52,411 grid cells throughout the U.S.[211] | County | County |
| | **Emission sectors** | 17 sectors | Single number for all sectors | Single number for all sectors | Single number for all sectors |
| | **Baseline emissions year** | 2005 National Emissions Inventory (NEI) | 2011 NEI | 2005 NEI | 2008/2011/2014 NEI |
| | **Primary emissions** | $SO_2$, $NO_x$, $PM_{2.5}$ | $SO_2$, $NO_x$, $PM_{2.5}$, $NH_3$, VOC | $SO_2$, $NO_x$, $PM_{2.5}$, $NH_3$ | $SO_2$, $NO_x$, $PM_{2.5}$, $NH_3$, VOC |
| **Health impact assessment** | **Concentration-response relationships** | Krewski *et al.*, 2009[212] and Lepeule *et al.*, 2012[213] | Krewski *et al.*, 2009 | Krewski *et al.*, 2009 | Krewski *et al.*, 2009 |
| | **Monetization** (Value of Statistical Life) | $8.7 million in 2015 USD, with upward adjustment after 2015 | $8.3 million in 2011 USD | $8.8 million in 2010 USD | $8.5 million in 2014 USD |

[206] U.S. EPA. (2018a) *Estimating the Benefit per Ton of Reducing PM2.5 Precursors from 17 Sectors*. Available at: https://www.epa.gov/sites/production/files/2018-02/documents/sourceapportionmentbpttsd_2018.pdf.

[207] Fann, N., Baker, K. R. and Fulcher, C. M. (2012) 'Characterizing the PM2.5-related health benefits of emission reductions for 17 industrial, area and mobile emission sectors across the U.S.', *Environment International*. doi: 10.1016/j.envint.2012.08.017.

[208] Goodkind, A. L. *et al*. (2019) 'Fine-scale damage estimates of particulate matter air pollution reveal opportunities for location-specific mitigation of emissions', *Proceedings of the National Academy of Sciences of the United States of America*. doi: 10.1073/pnas.1816102116.

[209] Heo, J., Adams, P. J. and Gao, H. O. (2016) 'Reduced-form modeling of public health impacts of inorganic PM2.5 and precursor emissions', *Atmospheric Environment*. doi: 10.1016/j.atmosenv.2016.04.026.

[210] Clay, K. *et al*. (2019) 'External costs of transporting petroleum products: Evidence from shipments of crude oil from North Dakota by pipelines and rail', *Energy Journal*. doi: 10.5547/01956574.40.1.kcla.

[211] Grid cell sizes are 1 x 1 km for urban areas and 48 x 48 km for rural areas.

[212] Krewski, D. *et al*. (2009) 'Extended follow-up and spatial analysis of the American Cancer Society study linking particulate air pollution and mortality.', *Research report (Health Effects Institute)*.

[213] Lepeule, J. *et al*. (2012) 'Chronic exposure to fine particles and mortality: An extended follow-up of the Harvard six cities study from 1974 to 2009', *Environmental Health Perspectives*. doi: 10.1289/ehp.1104660.

### 4.2.3 Health impact assessment

We quantify the health damages by multiplying the amount of air pollutant emissions (by type and plant) with the corresponding marginal damage estimates. Specifically, for each of the three scenarios and for each year from 2020 to 2030, the health damages $D_p$ from the pollutant type $p$ is calculated as:

$$D_p = \sum_i^N MD_{i,p} * E_{i,p} \ ,$$

where $i$ represents each individual power plant, $N$ is the number of power plants in a specified region (such as those located within one specific county, throughout Pennsylvania or in the whole PJM region), $MD_{i,p}$ is the marginal damage (or benefit-per-ton) estimate, and $E_{i,p}$ is the emissions of pollutant type $p$ from the power plant $i$. In other words, the health damage is calculated for each power plant, then aggregated to the county, state, or the entire PJM region. We report the economic value of the health damages in 2016 dollars.

Since the spatial resolution and sector specification vary across different marginal damage estimates, we apply $MD_{i,p}$ using consistent assumptions. Specifically, for the EPA measure, we use the marginal damage estimate for electricity sector emissions (among 17 available sectors), and apply the same $MD_{i,p}$ to all power plants throughout the PJM region. For EASIUR and AP3, depending on which county the power plants are located in, we use county-specific $MD_{i,p}$ from low stack-height emissions (i.e., defined as < 150 m for EASIUR and < 250 m for AP3). For InMAP-ISRM, they report marginal damages for each of the 52411 grid cells for emissions from the ground level (0-57 m), low level (57– 379 m), and high level (> 379 m), respectively. Considering the national average stack height of 172 ft (52.4 m)[214], we apply ground-level marginal damage values in our analysis. While the RPAM model reports the location for most power plants, for those plants without specific location information (i.e., unmapped units and projected new additions), we use national average marginal damages for all four approaches.

As an example, Figure 5 demonstrates our calculation of $NO_x$-related health damages in 2020 (Panel c), based on the amount of $NO_x$ emissions reported by the RPAM model (Panel a) and the county-level marginal damage estimate from AP3 (Panel b).

[214] U.S. EPA. (2018a) *Estimating the Benefit per Ton of Reducing PM2.5 Precursors from 17 Sectors*. Available at: https://www.epa.gov/sites/production/files/2018-02/documents/sourceapportionmentbpttsd_2018.pdf.

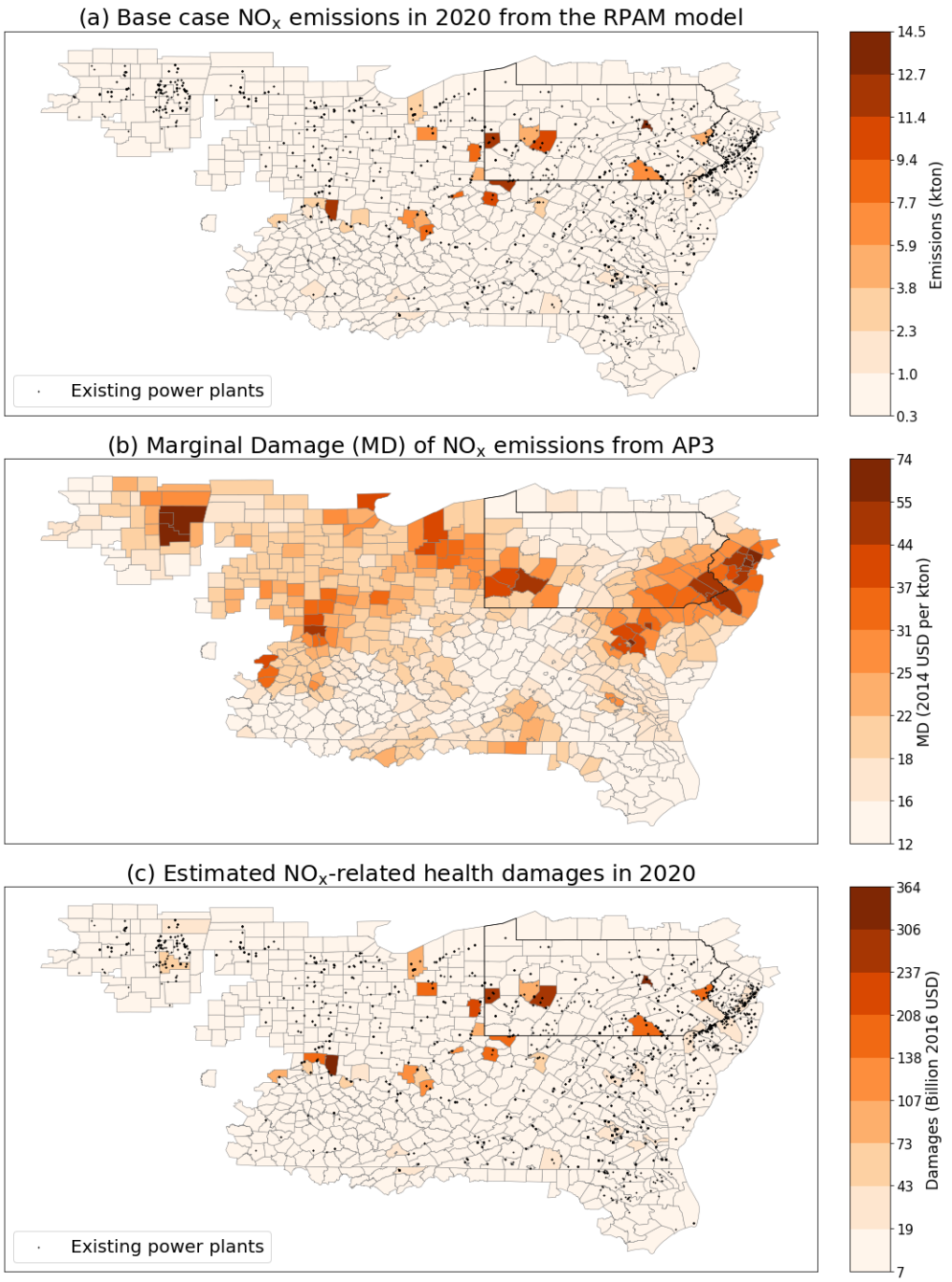


**Figure 5. An example of calculating health damages by multiplying the air pollutant emissions with the marginal damages.** Panel (a) shows the county-level $NO_x$ emissions (in kton) aggregated from the plant-level emissions from the RPAM model (the black dots represent the locations of existing power plants). Panel (b) shows the county-level marginal damage (or benefit-per-ton) estimate based on the AP3 model (in $/kton). Panel (c) shows the estimated $NO_x$-related health damages by multiplying the country-total $NO_x$ emissions in Panel (a) with

country-specific marginal damages in Panel (b). Here the maps show the entire PJM region, and we highlight Pennsylvania using black boundaries.

## 4.3 Modeling Results

### 4.3.1 Air pollutant emissions

Table 10 presents the annual air pollutant emissions from power plants located in the PJM region and Pennsylvania, respectively, as reported from the RPAM model. While the model calculates emissions for each year from 2020 to 2030, here we report the emissions in 2020 and 2030 as a benchmark for present-day emissions and the end-year for model simulation, respectively, along with two intermediate years of great policy relevance based on Pennsylvania's tentative schedule to join the RGGI: 2022 - the year Pennsylvania becomes a member of the RGGI, and 2026 - the year after the third banking adjustment finishes and the combined RGGI cap is relatively less stringent than 2025.

We highlight four main findings on air pollutant emissions. First, even in the *Base Case* (i.e., Pennsylvania not joining RGGI), most types of air pollutant emissions are projected to decrease over time from 2020 to 2026, both within Pennsylvania and throughout the PJM region. This is a combined effect of changes in fuel mix (i.e., an increasing share of natural gas and renewable power plants, accompanied with a decreasing share of coal) and new additions of end-pipe controls on fossil-based power plants. A small rebound in emissions is projected from 2026 to 2030. The likely cause is that for this time frame the effects of decreasing emission factors (i.e., emissions per unit of electric output) owing to the improvements in clean electricity transition and pollution controls is more than offset by the increase in total electricity generation.

Second, with Pennsylvania joining RGGI, we observe significant reductions in $NO_x$ and $SO_2$ emissions and modest reductions in $PM_{2.5}$ emissions, although $NH_3$ and VOC emissions can increase in some circumstances especially for the PJM region as a whole. If Pennsylvania terminates its Alternative Energy Portfolio Standard while joining RGGI in 2022, the expected reductions in air pollutant emissions will be smaller in scale, due to a lower share of zero-emitting renewables in generation mix in the *No RPS Case* as compared to the *Central Case*.

**Table 10. (a) Annual emissions by pollutant type from the power plants located in the whole PJM region and in Pennsylvania, respectively (in thousand tons).** The PJM and PA regions are shown in Figure 5.

| Scenario | Pollutant type | 2020 | | 2022 | | 2026 | | 2030 | |
|---|---|---|---|---|---|---|---|---|---|
| | | PJM | PA | PJM | PA | PJM | PA | PJM | PA |
| Base Case | $NO_x$ | 203.27 | 59.86 | 183.58 | 48.96 | 179.57 | 50.90 | 182.67 | 53.06 |
| | $SO_2$ | 228.11 | 65.41 | 209.82 | 52.83 | 200.07 | 55.84 | 206.82 | 57.96 |
| | $PM_{2.5}$ | 31.45 | 5.04 | 30.38 | 4.25 | 29.11 | 4.36 | 29.81 | 4.61 |
| | $NH_3$ | 13.97 | 4.06 | 12.44 | 3.99 | 12.27 | 4.03 | 12.16 | 4.08 |
| | VOC | 12.45 | 3.64 | 12.99 | 4.56 | 12.93 | 4.75 | 13.28 | 4.89 |
| Central Case | $NO_x$ | 203.27 | 59.86 | 165.80 | 18.86 | 159.53 | 18.13 | 161.27 | 13.78 |
| | $SO_2$ | 228.11 | 65.41 | 187.75 | 14.98 | 176.78 | 13.61 | 181.29 | 8.41 |
| | $PM_{2.5}$ | 31.45 | 5.04 | 29.40 | 1.35 | 28.32 | 1.22 | 28.95 | 0.76 |
| | $NH_3$ | 13.97 | 4.06 | 12.83 | 3.60 | 12.49 | 3.62 | 12.57 | 3.55 |
| | VOC | 12.45 | 3.64 | 13.43 | 3.68 | 13.29 | 3.82 | 13.54 | 3.75 |
| No AEPS Case | $NO_x$ | 203.27 | 59.86 | 167.92 | 23.83 | 160.10 | 21.55 | 161.11 | 13.20 |
| | $SO_2$ | 228.11 | 65.41 | 189.85 | 19.88 | 176.00 | 16.36 | 183.03 | 7.38 |
| | $PM_{2.5}$ | 31.45 | 5.04 | 29.42 | 1.78 | 28.14 | 1.49 | 29.13 | 0.67 |
| | $NH_3$ | 13.97 | 4.06 | 12.87 | 3.82 | 12.55 | 3.82 | 12.52 | 3.62 |
| | VOC | 12.45 | 3.64 | 13.63 | 3.98 | 13.49 | 4.01 | 13.52 | 3.80 |

**Table 10. (b) Changes of annual emissions, by pollutant type, relative to the *Base Case* from the power plants located in the whole PJM region and in Pennsylvania, respectively (in thousand tons).** The percent changes relative to the *Base Case* are shown in parentheses. Note that the 2020 emissions are the same across scenarios, hence not presented in this table.

| Changes relative to the Base Case | Pollutant type | 2022 | | 2026 | | 2030 | |
|---|---|---|---|---|---|---|---|
| | | PJM | PA | PJM | PA | PJM | PA |
| Central Case – Base Case | $NO_x$ | -17.78 (-9.68%) | -30.10 (-61.47%) | -20.04 (-11.16%) | -32.77 (-64.38%) | -21.39 (-11.71%) | -39.28 (-74.03%) |
| | $SO_2$ | -22.07 (-10.52%) | -37.85 (-71.64%) | -23.29 (-11.64%) | -42.23 (-75.62%) | -25.53 (-12.34%) | -49.55 (-85.49%) |
| | $PM_{2.5}$ | -0.97 (-3.21%) | -2.90 (-68.17%) | -0.79 (-2.72%) | -3.14 (-71.96%) | -0.86 (-2.88%) | -3.85 (-83.55%) |
| | $NH_3$ | 0.39 (+3.14%) | -0.39 (-9.90%) | 0.22 (+1.81%) | -0.40 (-9.97%) | 0.41 (+3.41%) | -0.53 (-12.97%) |
| | VOC | 0.44 (+3.42%) | -0.88 (-19.33%) | 0.36 (+2.79%) | -0.93 (-19.58%) | 0.26 (+1.93%) | -1.14 (-23.33%) |
| No AEPS Case – Base Case | $NO_x$ | -15.56 (-8.53%) | -25.14 (-51.34%) | -19.47 (-10.84%) | -29.35 (-57.66%) | -21.56 (-11.80%) | -39.86 (-75.12%) |
| | $SO_2$ | -19.98 (-9.52%) | -32.95 (-62.37%) | -24.07 (-12.03%) | -39.48 (-70.70%) | -23.80 (-11.51%) | -50.57 (-87.26%) |
| | $PM_{2.5}$ | -0.96 (-3.17%) | -2.47 (-58.17%) | -0.97 (-3.33%) | -2.87 (-65.89%) | -0.68 (-2.27%) | -3.93 (-85.43%) |
| | $NH_3$ | 0.43 (+3.46%) | -0.17 (-4.32%) | 0.28 (+2.28%) | -0.20 (-5.07%) | 0.36 (+2.96%) | -0.46 (-11.33%) |
| | VOC | 0.64 (+4.93%) | -0.58 (-12.81%) | 0.56 (+4.36%) | -0.74 (-15.60%) | 0.24 (+1.79%) | -1.09 (-22.33%) |

Third, the reductions in air pollutant emissions within Pennsylvania are always greater than the reductions in the PJM region. This underscores that leakage can be a major concern: while fossil-based power generation and associated air emissions within Pennsylvania decrease significantly as the Commonwealth participates in RGGI, some other states in the PJM interconnection are not subject to the RGGI rule. These states may ramp up their power production from fossil units (due to lower production costs), leading to an increase in air pollutant emissions in those regions.

Finally, we find substantially higher levels of cumulative reduction of local air pollutants (not including greenhouse gas emissions) than the estimates published by the Pennsylvania DEP in their analysis of joining RGGI.[215] For example, the DEP analysis suggests that $SO_2$ emissions through 2030 would decrease by approximately 30%, while our modeling suggests a decline of 85% in this same period. This difference is significant and influences the magnitude of health co-benefits that can be expected from RGGI (our health co-benefit estimates are presented in Section 4.3.2.) These differences are driven primarily by how coal-plant retirements in the absence of RGGI are treated. DEP's analysis suggests a more rapid rate of coal-plant retirement in the absence of RGGI than does the RPAM model described in Section 3. DEP's reference case suggests that between 2020 and 2030, annual coal generation in Pennsylvania declines by approximately 80% even in the absence of RGGI (the decline is over 90% when RGGI is implemented in DEP's analysis). The RPAM analysis from Section 3 suggests a much smaller decline in annual coal generation without Pennsylvania joining RGGI, and thus projects a higher impact on emissions attributable to joining RGGI.

Retirement decisions at coal plants or other generation stations are complex, and involve signals sent from multiple PJM markets (energy, capacity and ancillary services) as compared to the going-forward costs of specific plants. There is thus substantial uncertainty surrounding coal plant retirement decisions over the next decade in Pennsylvania. The scenarios reflected in RPAM and in the DEP model collectively represent a range of potential outcomes on how quickly coal plants in Pennsylvania will retire. The carbon emissions reductions and air quality improvements attributable specifically to RGGI are going to be sensitive to the specific coal-plant retirement scenario reflected in one model versus another, and collectively the models capture a range of potential outcomes.

### 4.3.2 Health co-benefits from joining RGGI

By further quantifying the health damages from primary emissions using various marginal damage estimates, we assess the expected air quality-related health co-benefits from Pennsylvania's participation in RGGI.

[215] "Pennsylvania RGGI Modeling Report," September 2020. Available at http://files.dep.state.pa.us/Air/AirQuality/AQPortalFiles/RGGI/PA_RGGI_Modeling_Report.pdf. Additional modeling information and results are available at https://www.dep.pa.gov/Citizens/climate/Pages/RGGI.aspx.

Our first observation is that regardless of years or scenarios, among the five types of pollutants emitted from power generation activities, $SO_2$ emissions always dominates the total health damages from power generation activities and the health co-benefits from joining RGGI, followed by $NO_x$ and $PM_{2.5}$ emissions (Figure 6). This pattern is due to the fact that: a) an outstanding amount of $SO_2$ emissions are produced from fossil-based power plants, so joining the RGGI can significantly reduce $SO_2$ emissions; and b) the atmospheric chemistry and physical reactions are quite effective in turning $SO_2$ emissions into secondary particulate matter in the air, causing high exposure of ambient PM among a large population in PJM region along with negative health effects on their respiratory and cardiovascular systems.

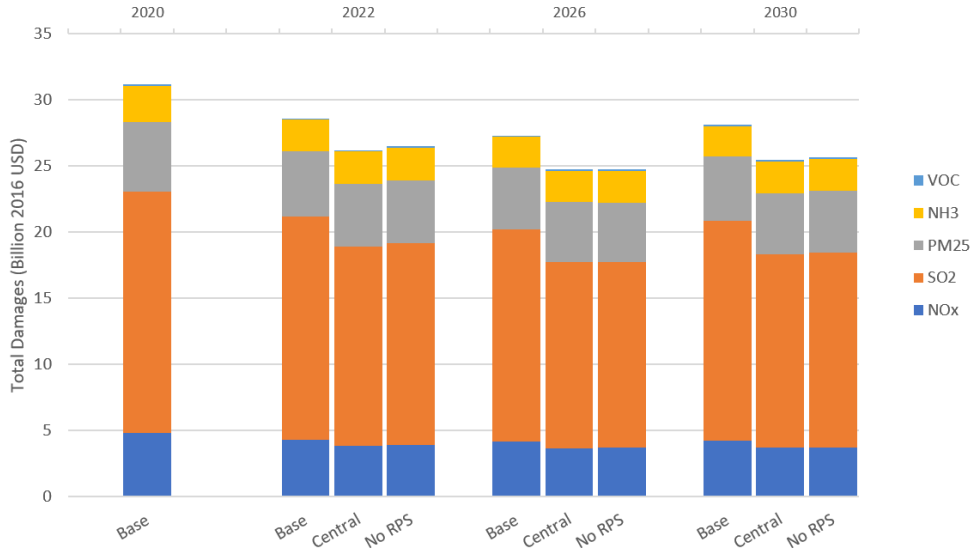


**Figure 6. Annual health damages by different types of air pollutant emissions from all power plants located in the PJM region.** The results here are based on the AP3 estimates from which the marginal damage estimates are available for all five types of air pollutants. The results from other marginal damage estimates are similar that $SO_2$ emissions are the largest contributor to the health damages.

Since $SO_2$, $NO_x$ and $PM_{2.5}$ emissions account for the majority of health impacts, we then calculate the aggregate health damages from these three types of emissions using all four marginal damage estimates (since all of the estimates report the marginal damages from these three types of pollutants). Consistent with the temporal trends for air pollutant emissions, the health damages in the *Base Case* decrease between 2020 and 2026. Despite a small increase between 2026 and 2030, the health damages in 2030 are still less than those in 2020.

With Pennsylvania joining the RGGI in 2022, comparing the *Central Case* to *Base Case*, the total health damages from all power plants in Pennsylvania decrease by $1.92-4.44 billion in 2022 (67.3-70.0%), $0.83-1.81 billion in 2026 (71-74%), and $0.53-1.19 billion in 2030 (81-84%). The range is based on varying marginal damage estimates. Prior analysis found that most of the health damages from power plants in Pennsylvania will occur within the state boundary.[216] Therefore, these reductions in health damages from Pennsylvania's power plants suggest significant local health co-benefits within Pennsylvania if the Commonwealth successfully participates in RGGI. Similar to the results on emissions, terminating the Alternative Energy Portfolio Standard will mitigate the co-benefits from joining the RGGI, though the magnitude of such a penalty is relatively small (i.e., only slightly higher health damages in the *No AEPS Case* than the *Central Case*).

However, the leakage issue leads to a redistribution of health damages (or co-benefits) between Pennsylvania and non-Pennsylvania states within the PJM region. In fact, the reduced health damages from Pennsylvania's power plants are accompanied by increased damages from the power plants located in other states in the PJM Interconnection. This is shown in Table 11 as a much smaller reduction in the health damages from all the power plants in PJM than in Pennsylvania.

To demonstrate the spatial patterns for health impacts, which underlies such redistribution effects, in Figure 7 we use the marginal damage estimates from AP3 model as an example to demonstrate the changes in total health damages throughout all PJM counties due to Pennsylvania's participation in the RGGI (i.e., comparing the *Central* or *No AEPS Case* with the *Base Case*). For many counties in Pennsylvania, the health damages are expected to be reduced from the power generation activities within the county (shown as blue colors in Figure 3b and c). Since local populations are often the most affected, it indicates potential local health co-benefits from Pennsylvania's entry into the RGGI. In comparison, for many counties outside Pennsylvania, the health damages are expected to go up from local power generation activities (designated as orange colors in Figure 7b and 7c), indicating potential local health dis-benefits if Pennsylvania joins RGGI. Our results thus underscore that the leakage issues driven by

[216] Dedoussi, I. C. *et al.* (2020) 'Premature mortality related to United States cross-state air pollution', *Nature*. doi: 10.1038/s41586-020-1983-8.

Pennsylvania's participation in the RGGI may result in environmental injustice across different PJM states, with respect to air pollution exposure and human health.

**Table 11. (a) Total annual health damages from $SO_2$, $NO_x$ and $PM_{2.5}$ emitted from the power plants located in the PJM region or in Pennsylvania (in billion 2016 USD).**

| Scenario | MD (BPT) | 2020 | | 2022 | | 2026 | | 2030 | |
|---|---|---|---|---|---|---|---|---|---|
| | | PJM | PA | PJM | PA | PJM | PA | PJM | PA |
| Base Case | EPA | 14.77 | 3.69 | 13.76 | 3.01 | 13.17 | 3.15 | 13.56 | 3.29 |
| | InMAP-ISRM | 13.59 | 4.60 | 12.56 | 3.78 | 12.04 | 3.92 | 12.44 | 4.09 |
| | EASIUR | 12.33 | 3.50 | 11.37 | 2.86 | 10.87 | 2.98 | 11.21 | 3.10 |
| | AP3 | 28.27 | 7.90 | 26.12 | 6.40 | 24.85 | 6.72 | 25.67 | 7.00 |
| Central Case | EPA | 14.77 | 3.69 | 12.64 | 0.90 | 12.01 | 0.83 | 12.29 | 0.53 |
| | InMAP-ISRM | 13.59 | 4.60 | 10.84 | 1.23 | 10.26 | 1.15 | 10.39 | 0.75 |
| | EASIUR | 12.33 | 3.50 | 10.26 | 0.93 | 9.72 | 0.87 | 9.93 | 0.58 |
| | AP3 | 28.27 | 7.90 | 23.61 | 1.96 | 22.23 | 1.81 | 22.91 | 1.19 |
| No AEPS Case | EPA | 14.77 | 3.69 | 12.74 | 1.19 | 11.95 | 0.99 | 12.38 | 0.47 |
| | InMAP-ISRM | 13.59 | 4.60 | 11.06 | 1.60 | 10.33 | 1.38 | 10.44 | 0.68 |
| | EASIUR | 12.33 | 3.50 | 10.40 | 1.22 | 9.72 | 1.04 | 9.99 | 0.53 |
| | AP3 | 28.27 | 7.90 | 23.89 | 2.56 | 22.19 | 2.17 | 23.07 | 1.07 |

**Table 11. (b) Absolute reductions in total annual health damages relative to the *Base Case* from $SO_2$, $NO_x$ and $PM_{2.5}$ emitted from the power plants located in the PJM region or in Pennsylvania (in billion 2016 USD).** The percent reductions are shown in parentheses. Note that the 2020 health damages are the same across scenarios, hence not presented in the table.

| Changes relative to the Base Case | MD (BPT) | 2022 | | 2026 | | 2030 | |
|---|---|---|---|---|---|---|---|
| | | PJM | PA | PJM | PA | PJM | PA |
| Central Case – Base Case | EPA | -1.13 (-8.19%) | -2.10 (-69.96%) | -1.16 (-8.84%) | -2.33 (-73.82%) | -1.27 (-9.38%) | -2.76 (-84.00%) |
| | InMAP-ISRM | -1.73 (-13.73%) | -2.55 (-67.37%) | -1.78 (-14.79%) | -2.77 (-70.71%) | -2.05 (-16.50%) | -3.34 (-81.68%) |
| | EASIUR | -1.11 (-9.74%) | -1.92 (-67.30%) | -1.15 (-10.58%) | -2.11 (-70.87%) | -1.28 (-11.43%) | -2.52 (-81.25%) |
| | AP3 | -2.50 (-9.59%) | -4.44 (-69.39%) | -2.61 (-10.52%) | -4.91 (-73.08%) | -2.76 (-10.76%) | -5.80 (-82.97%) |
| No AEPS Case – Base Case | EPA | -1.03 (-7.48%) | -1.82 (-60.46%) | -1.22 (-9.24%) | -2.16 (-68.50%) | -1.18 (-8.68%) | -2.82 (-85.72%) |
| | InMAP-ISRM | -1.51 (-11.99%) | -2.18 (-57.77%) | -1.71 (-14.23%) | -2.54 (-64.72%) | -2.00 (-16.06%) | -3.42 (-83.50%) |
| | EASIUR | -0.97 (-8.52%) | -1.64 (-57.45%) | -1.15 (-10.56%) | -1.93 (-64.94%) | -1.22 (-10.85%) | -2.57 (-82.92%) |
| | AP3 | -2.23 (-8.54%) | -3.84 (-60.02%) | -2.65 (-10.68%) | -4.56 (-67.75%) | -2.60 (-10.13%) | -5.92 (-84.65%) |

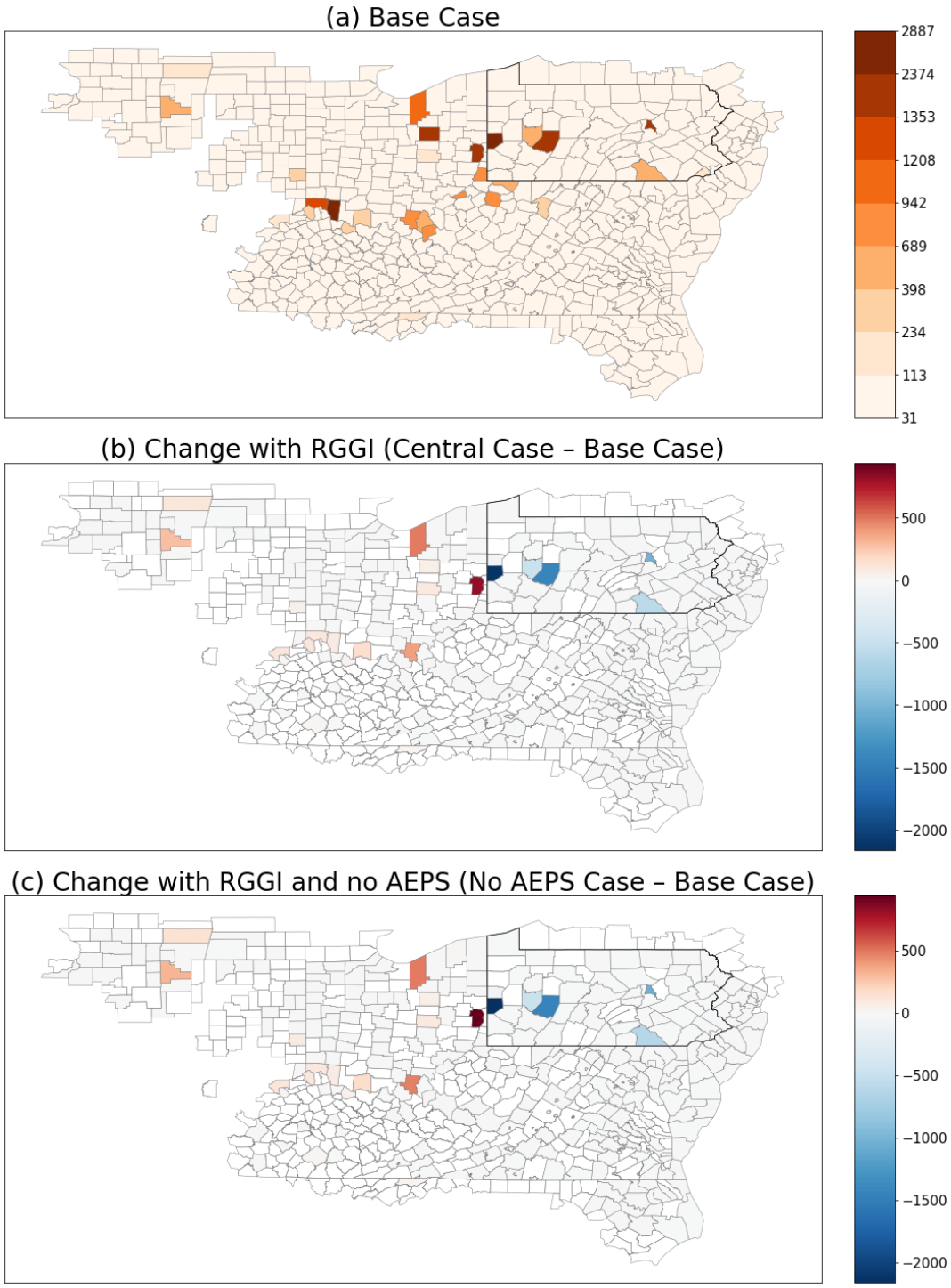


**Figure 7. Total 2030 health damages from $SO_2$, $NO_x$ and $PM_{2.5}$ emissions from the power plants in each county, calculated using AP3 marginal damage estimates (unit: million 2016 USD).** Panels (a) – (c) show the results in the *Base Case* and the differences in the *Central* and *No AEPS case* as compared to the *Base Case*. In Panels (b) and (c), the orange/blue colors indicate an increase/decrease from the *Base Case*. The maps show the entire PJM regions, and we highlight Pennsylvania using the black boundaries.

Finally, we find significant variations across four different marginal damage estimates regarding the absolute economic value of the health damages in the *Base Case*, as well as the absolute reductions in health damages from Pennsylvania's entry into RGGI. As shown in Table 4 and Figure 5, AP3 often yields the largest health damages (or co-benefits) due to the greater marginal damage estimates for almost all types of pollutants (e.g., $SO_2$, $NO_x$ and $PM_{2.5}$). The estimates from the other three marginal damage estimates (i.e., EPA, InMAP and EASIUR) are often lower and closer to each other in magnitude. Despite the substantial variations in absolute changes, the percent reductions in health damages due to Pennsylvania's participation in the RGGI are similar across all four marginal damage estimates. For instance, a comparison of the *Central Case* to the *Base Case* in 2030 reveals the percent reduction in annual total health damages from all PJM power plants is between 9.4-16.5%. The ranges for the percent reductions are even smaller for the health damages from each individual pollutant, with 11.7-16.3% for $NO_x$, 12.0-18.9% for $SO_2$ and 2.9-9.7% for $PM_{2.5}$. Therefore, if measured by percent reductions in health damages, our estimates for health co-benefits from the RGGI are robust across a wide range of marginal damage estimates.

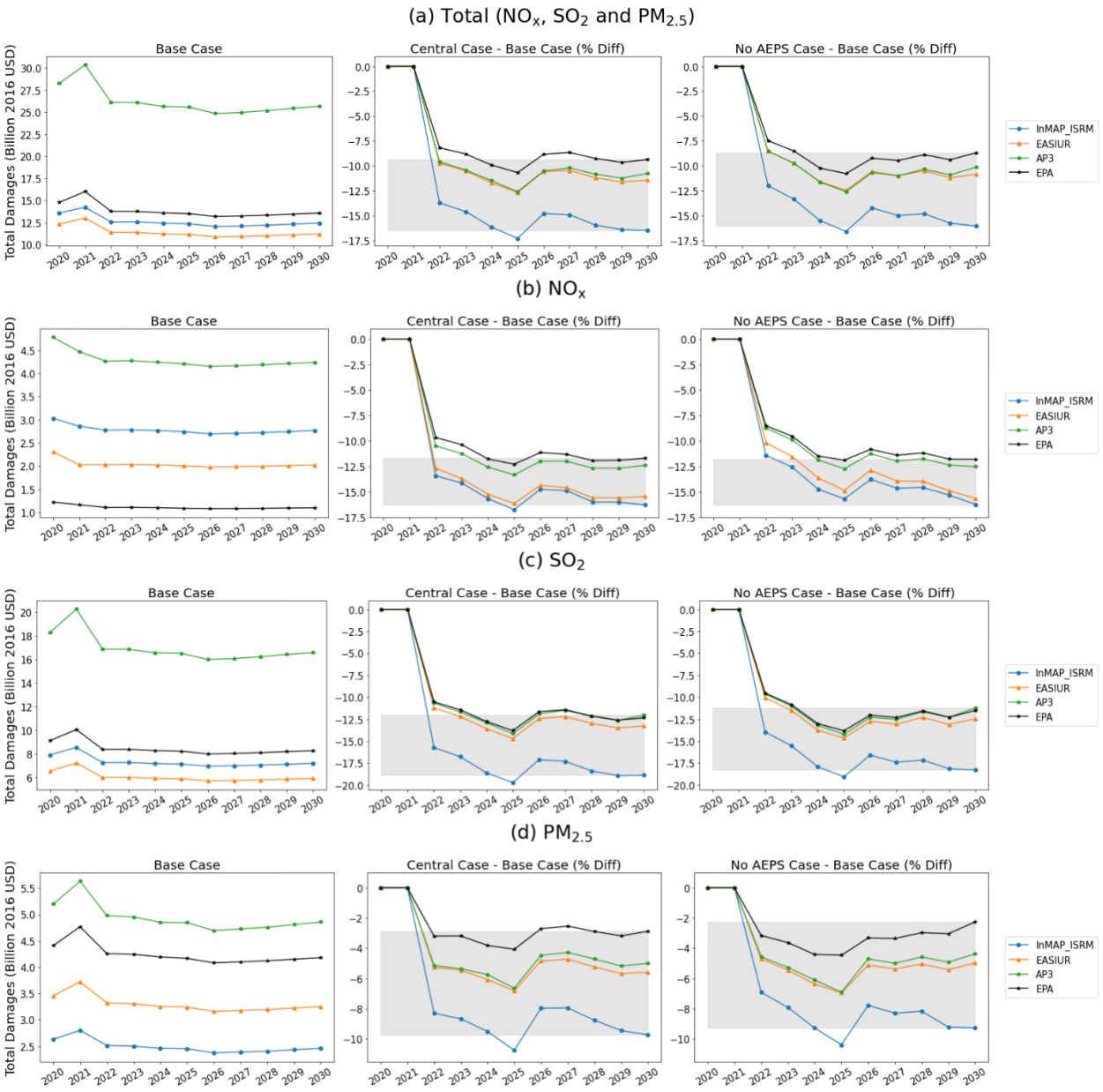


**Figure 8. Year-by-year variations in the health damages from the power plants located in the PJM region.** Panels (a) – (d) show the total damages from $NO_x$, $SO_2$ and $PM_{2.5}$ emissions, as well as the damages from these three pollutants respectively. The first column shows the results in the *Base Case*, and the second and third columns show the percent reductions in the *Central* and *No RPS case* relative to the *Base Case*. The gray space indicates the range of reduction in health damages in 2030 compared to the *Base Case*.

### 4.3.3 Monetized value of health co-benefits to inform cost-benefit evaluation

To inform the benefits of Pennsylvania's decision to participate in RGGI relative to the costs as described in Section 3, here we calculate the net present value of annual and cumulative health co-benefits to be expected in future years, by assuming a 3% discount rate from 2022. We first compare our air quality co-benefits estimates with the assessments from the Pennsylvania DEP.[217] We then compare the magnitude of health co-benefits with economic costs and climate benefits as reported in Section 3.

If Pennsylvania is to participate in RGGI, we estimate the 9-year cumulative air quality-related health co-benefits from 2022-2030 to be $9.87-22.11 billion considering the impacts from all power plants located in the PJM region, and $17.69-40.83 billion considering the impacts from all power plants located within Pennsylvania (Table 12, reduction in health damages in the *Central Case* relative to the *Base Case*). The ranges of the co-benefit estimates are driven by the variations across marginal damage estimates, reflecting the uncertainties in air quality modeling and health impact assessment.

Since the air pollution emissions and health co-benefit estimates from DEP are based on the impacts occurring within Pennsylvania we follow a similar assumption and use our co-benefit estimates that consider all power plants within Pennsylvania (instead of the entire PJM region) (Table 13). In summary, DEP estimated that by joining RGGI, Pennsylvania can avoid 66,700 and 112,700 thousand short tons (i.e. 60.51 and 102.24 kton) of cumulative $SO_2$ and $NO_x$ emissions by 2030, respectively, leading to $2.42 and 0.37 billion (converted from 2015 to 2016 dollars) of cumulative avoided health damages in Pennsylvania from 2019 through 2030. In comparison, despite the shorter time horizon we consider (i.e., 2019-2030 for DEP and 2022-2030 in ours), we estimate a much greater scale of avoided air pollutant emissions (i.e., 396 and 312 kton of avoided $SO_2$ and $NO_x$ emissions), which turns into larger co-benefits in economic terms (i.e., $10.52-28.57 billion from avoided $SO_2$ and $1.66-6.74 billion from avoided $NO_x$ emissions).

[217] Pennsylvania Department of Environmental Protection, *Regional Greenhouse Gas Initiative*. Available at: https://www.dep.pa.gov/Citizens/climate/Pages/RGGI.aspx.

**Table 12. Net present values of the total health damages (from $SO_2$, $NO_x$ and $PM_{2.5}$ emissions) from all power plants located in the PJM region or within Pennsylvania**. For the *Central Case*, values in parentheses indicate absolute reductions relative to the Base Case.

| Scenario | Marginal damage estimate (or Benefit-per-ton) | 2022 | | 2026 | | 2030 | | Cumulative (2022-2030) | |
|---|---|---|---|---|---|---|---|---|---|
| | | PJM | PA | PJM | PA | PJM | PA | PJM | PA |
| Base Case | EPA | 13.76 | 3.01 | 11.66 | 2.79 | 10.63 | 2.57 | 107.83 | 25.19 |
| | InMAP-ISRM | 12.56 | 3.78 | 10.66 | 3.47 | 9.75 | 3.21 | 98.61 | 31.43 |
| | EASIUR | 11.37 | 2.86 | 9.62 | 2.64 | 8.78 | 2.43 | 89.05 | 23.84 |
| | AP3 | 26.12 | 6.40 | 22.00 | 5.95 | 20.12 | 5.48 | 204.00 | 53.64 |
| Central Case | EPA | 12.64 (-1.13) | 0.90 (-2.10) | 10.63 (-1.03) | 0.73 (-2.06) | 9.63 (-1.00) | 0.41 (-2.16) | 97.86 (-9.97) | 5.80 (-19.39) |
| | InMAP-ISRM | 10.84 (-1.73) | 1.23 (-2.55) | 9.08 (-1.58) | 1.02 (-2.45) | 8.14 (-1.61) | 0.59 (-2.62) | 83.28 (-15.33) | 8.06 (-23.37) |
| | EASIUR | 10.26 (-1.11) | 0.93 (-1.92) | 8.61 (-1.02) | 0.77 (-1.87) | 7.78 (-1.00) | 0.46 (-1.98) | 79.19 (-9.87) | 6.16 (-17.69) |
| | AP3 | 23.61 (-2.50) | 1.96 (-4.44) | 19.68 (-2.31) | 1.60 (-4.35) | 17.96 (-2.16) | 0.93 (-4.55) | 181.89 (-22.11) | 12.82 (-40.83) |

Such differences are driven by two factors. First, and most important, the projected avoided air pollutant emissions from the RPAM model are larger than those from the DEP projection, mostly due to the difference in model assumptions regarding coal retirements. The DEP's model allows coal units to retire for economic reasons rather the end of unit life cycle, which yields a very rapid decline in PA coal capacity by 2030 in the reference case (without RGGI). In comparison, RPAM does not make the assumption of economic retirements and as such leads to a more conservative coal retirement scenario, where coal generation does not decline markedly in the *Base Case*. As a result, the different assumptions adopted in the two models largely contribute to the differences in cumulative $SO_2$ and $NO_x$ reductions between the RPAM and DEP results. In addition, at the beginning of the model period (2020), the DEP model reports $NO_x$ emissions of around 40 MT per year, whereas in RPAM the figure is close to 60 MT per year. In the final model period (2030), the $NO_x$ emissions in the two models are much closer, so the

changes in annual emissions between 2020 and 2030 is larger in RPAM (i.e., more avoided emissions).

Second, different marginal damage (or benefit-per-ton, BPT) estimates are adopted in our and DEP's analysis. DEP uses varying BPT values over time (i.e., the 2020 BPT values of $33,383 and $3,089 for $NO_x$ and $SO_2$ for 2019-2022, 2025 values of $36,663 and $3,316 for 2023-2027, and the 2030 values of $39,538 and $3,521 for 2028-2030), while we use the 2016 BPT value with a 3% discount rate starting from 2022. In addition, the DEP only considered the benefits from $SO_2$ and $NO_x$ reductions, while our assessments include other types of primary emissions, particularly the $PM_{2.5}$ emissions. Therefore, depending on years and the source of BPT estimates, our BPT values are higher than DEP's in some circumstances but lower in others.

**Table 13. Cumulative avoided emissions and health damages in PA by joining the RGGI estimated by DEP and in this study.**

| | DEP estimates (2019-2030) | Our estimates (2022-2030) |
|---|---|---|
| **NOx** | | |
| Cumulative avoided emissions (kton) | 102.24 | 312.08 |
| Cumulative avoided health damages (billion 2016 USD) | 0.37 | 1.66-6.74 |
| **SO2** | | |
| Cumulative avoided emissions (kton) | 60.51 | 395.74 |
| Cumulative avoided health damages (billion 2016 USD) | 2.42 | 10.52-28.57 |

Our analysis in Section 3, and reprinted as Tables 14 and 15 below, reports a cumulative net economic *benefit* of $2,590.2 million for Pennsylvania, but a net economic *loss* of $387.4 million for the entire PJM region (including the states within and outside RGGI). Further, the total avoided $CO_2$ emissions in the PJM region plus the RGGI states that are not in PJM contribute to a net climate benefit of $1906.8 million. In comparison, we estimate the cumulative health co-benefits (from $SO_2$, $NO_x$ and $PM_{2.5}$ emissions) to be $9.87-22.11 billion from all power plants in the PJM region, and $17.69-40.83 billion for all power plants in Pennsylvania. The health co-benefits are therefore significantly greater than the combined economic and climate benefits,

demonstrating the importance of including health co-benefit in the cost-benefit analysis for assessing Pennsylvania's entry into RGGI.

**Table 14. Economic impacts of Pennsylvania joining the RGGI on PJM and PA (adapted from Section 3).** Positive and negative changes indicate economic benefits and losses.

| | **2022** | **2026** | **2030** | **Cumulative (2022-2030)** |
|---|---|---|---|---|
| **PJM** | | | | |
| Baseline Net Economic Benefit (billion 2016 USD) | 296.5 | 300.6 | 309.8 | 2424.7 |
| Change (million 2016 USD) | 15.1 | -57.4 | -109.5 | -387.4 |
| **PA** | | | | |
| Baseline Net Economic Benefit (billion 2016 USD) | 54.4 | 55.4 | 57.1 | 445.2 |
| Change (million 2016 USD) | 289.5 | 281.6 | 401.8 | 2590.1 |

**Table 15. Impact of Pennsylvania joining the RGGI on external costs from $CO_2$ emissions (adapted from Section 3).**

| | **2022** | **2026** | **2030** | **Cumulative (2022-2030)** |
|---|---|---|---|---|
| Reductions in $CO_2$ Emissions (MMT $CO_2$) | 0.5 | 4.9 | 5.4 | 38.0 |
| Climate-related benefits (million 2016 dollars) | -27.2 | 273.5 | 345.3 | 1906.8 |

## 4.4 Conclusion and discussion

It is widely acknowledged that actions to mitigate greenhouse gas emissions from fossil energy uses can simultaneously curb air pollution and associated health impacts. In this section, we find substantial air quality-related health co-benefits from Pennsylvania's entry into the RGGI, a market-based program to reduce regional $CO_2$ emissions from the electricity sector. By designing policy and emissions scenarios using an electricity market model and then quantifying the air quality co-benefits using state-of-the-art marginal damage estimates, our integrated assessment of the health co-benefits brings three critical insights to incorporate air quality and health considerations into the deliberation of Pennsylvania's RGGI rules.

First, Pennsylvania's participation in RGGI can significantly avoid air pollutant emissions (especially $SO_2$, $NO_x$ and $PM_{2.5}$ emissions) from power generation activities within the Commonwealth. These reductions in air pollution lead to significant air quality and health co-

benefits: the net present value of the cumulative health co-benefits from 2022-2030 is estimated to be $17.69 billion to $40.83 billion for Pennsylvania, which are much higher than the anticipated climate and economic benefits. However, the health co-benefits within the Commonwealth come with potential health dis-benefits in other states that are also in the PJM electricity market but are not subject to the RGGI rule. Because only a portion of the states in the PJM region are bound by the carbon emissions cap under RGGI, the leakage issue arises due to a relocation of power generation activities and health damages from Pennsylvania to other non-RGGI states. Such leakage gives rise to environmental justice concerns across states, highlighting the need for coordinated policymaking for carbon (e.g., RGGI) and electricity markets (e.g., PJM).

Finally, for analysts, our assessment suggests that uncertainties in air quality modeling and health impact assessment can affect the magnitude of the anticipated health co-benefits, thereby influencing the cost-benefit evaluation of Pennsylvania's decision to join RGGI. In our analysis, we consider four different marginal damage estimates that are derived from different baseline emissions and air pollution models at varying spatial resolution. Given the non-trivial variation across these four estimates regarding the monetized values of co-benefits, future research should focus on identifying major uncertainties that determine the magnitude and distribution of the co-benefits, as well as key decision levers that can significantly improve the outcomes on air quality, health and health equity. For instance, one major source of uncertainty is the non-linear interactions of emissions from the power sector and non-power sectors to form secondary particulate matter (which is a key component of ambient $PM_{2.5}$). By carefully simulating the emission, transport and chemical processes, fine-resolution air pollution modeling will be valuable to quantify the effects of RGGI-induced emission changes on local air quality, including whether the anticipated reductions in power sector emissions, combined with the emissions from other sectors, can help meet the ambient air quality standards set by the EPA.

## 5. RGGI Reinvestment and the Pennsylvania's Energy Policy Environment

Two primary questions are considered in this section. First (Sections 5.1 and 5.2), we explore the feasible options for DEP in reinvesting revenues obtained from RGGI auctions. We conducted this analysis at a high level, not digging into existing programs in the Commonwealth that could be supplemented or new programs that could be developed, but beginning with the ways in which other RGGI states have spent their funds. We then address the extent to which these options are constrained by the requirements of the Air Pollution Control Act (ACPA). Second (Section 5.3), we explore potential impacts between RGGI and other hallmarks of energy policy in Pennsylvania. We specifically focus on interactions with Act 129, the Alternative Energy Portfolio Standards (AEPS), and the PUC's default service regulations. We chose these because they are broadly important for shaping the energy sector in Pennsylvania and they also have direct implications for ratepayers. We do not argue that these are the only potential interactions, but that they are potentially significant.

### 5.1 RGGI Revenue Reinvestment

An exploration of revenue expenditure trends in the ten RGGI states (including New Jersey's spending plan for its re-entry) and California's inclusive cap-and-trade program yields numerous reinvestment options. Little can be said, however, in terms of an administrative roadmap with precedent. New York, one of RGGI's initial signatories, is the only state that joined the pact administratively. The remaining nine states employed some degree of legislative authorization in their RGGI charters, with the legislatures shaping the disbursement of auction revenues.

Member state approaches to RGGI revenues vary substantially, but we also note important commonalities. Connecticut redirected half of their auction proceeds to the General Fund in 2017 to balance the budget. Maine charges a quasi-public trust (Efficiency Maine Trust) with receiving and administering RGGI revenues. In New Hampshire, per-allowance revenues exceeding $1 are returned to ratepayers. Rhode Island's RGGI participation is legislatively adjoined with the state's Renewable Energy Standard. New York distributes much of its revenue as "prize money" to encourage green competition in the private sector.

**Table 16: Categorical investment menu based on RGGI state reporting**

| INVESTMENT OPTION | DESCRIPTION | EXAMPLE STATES* |
|---|---|---|
| ***DIRECT BILL ASSISTANCE*** | General rate relief, targeted (low-income, small business, etc.), or both. | Maryland (targeted), New Hampshire (general), Rhode Island (both) |
| ***WEATHERIZATION (RESIDENTIAL AND/OR C&I)*** | Including appliance removal and rebates.<br>Home Performance with Energy Star as a vehicle for investing in in-home consultation. | Most, if not all, RGGI states (as well as CA) |
| ***ELECTRIC VEHICLE INITIATIVES (CONSUMER-LEVEL)*** | Rebates, public information, tax credits, etc. | California, Maryland |
| ***SOLAR (RESIDENTIAL AND/OR C&I)*** | Rebates, consultation, technical assistance. | Most, if not all, RGGI states (as well as CA) |
| ***STATE FOREST HEALTH*** | Fire prevention, controlled burns, soils treatment, etc. that enhance carbon sequestration. | California, New Jersey |
| ***URBAN FORESTRY*** | Mitigating heat islands, reducing electric demand, raising property value, and sequestering carbon through residential and/or municipal tree planting. | California, New Jersey, Rhode Island |
| ***CLEAN ENERGY WORKFORCE DEVELOPMENT*** | Training, public information are critical and pervasive components of clean energy transition strategies throughout RGGI. | Most, if not all, RGGI states (as well as CA) |
| ***CLEAN PUBLIC TRANSPORTATION*** | Investing in an EV or ZEV fleet of buses. | California |

**Table 16 (continued): Categorical investment menu based on RGGI state reporting**

| INVESTMENT OPTION | DESCRIPTION | EXAMPLE STATES* |
|---|---|---|
| ***STATE UNIVERSITY SYSTEM*** | Funding research and/or clean energy curriculum. | Maryland (UMD's Energy Innovation Institute) |
| ***ECONOMIC DEVELOPMENT INCENTIVES*** | Competitive funding rounds to attract green businesses to PA (Similar to Philadelphia's incentives for attracting, certifying triple-bottom-line benefit corporations). | New York |
| ***MUNICIPAL PROJECTS*** | Replacing bulbs in streetlamps with LEDs is the most popular example. | Rhode Island |
| ***"GREEN COMMUNITIES" PROGRAM*** | Clean and renewable prerequisite-based entry that yields further opportunity for grants. | Massachusetts, New York |
| ***GREEN BANK INVESTMENT*** | As a vehicle for C&I and Municipal energy efficiency and clean energy projects. | Connecticut, Maryland |
| ***FEDERALLY FUNDED, STATE ADMINISTERED PROGRAMS*** | Low-Income Home Energy Assistance Program (LIHEAP) and Weatherization Assistance Program (WAP). | Delaware |
| ***COMPETITIVE GRANTMAKING*** | As a vehicle for C&I and Municipal energy efficiency and clean energy projects. | Delaware |
| ***CARBON EMISSIONS ABATEMENT*** | R&D, project financing, and technical assistance, mostly C&I. | New Jersey, New York |
| ***DAIRY METHANE*** | Mitigation via dairy digester research, technological development, and installation financing. | California |
| ***SAFE DRINKING WATER*** | Providing household filters in at-risk communities, municipal projects (line replacement, corrosion control/treatment), public information. | California |

Pennsylvania's administratively derived RGGI entrance – not to mention its role as the first and only major energy exporter in the pact – raises the stakes for identifying the best strategy for reinvesting the substantial expected revenue from RGGI auctions. Building on the rather broad allowances of the nexus approach from Section 2.3.2, we find that nearly all of the programs that other RGGI states have used for dispensing their funds would be permissible for Pennsylvania. As noted in the legal analysis above, however, programs like direct bill assistance and safe drinking water investments would require a much broader interpretation of DEP's statutory authority (Section 2.3.3). Given the importance of some demonstrable connection between revenue spending and air pollution, we first present a categorical investment menu of options that other states have employed for reinvesting RGGI revenues. We then evaluate the connection of each to clean air, and thus their acceptability for Pennsylvania.

Table 16 outlines categorical investment options that have been found throughout RGGI to-date, illustrates those options via state-by-state investment snapshots, and discusses the administrative feasibility of those options under the Governor's directive.

### 5.1.1 State-By-State Snapshots

Different states have taken highly varied approaches to revenue reinvestment. This discussion summarizes the re-investment priorities that we have found in different states, based on their reported re-investment activities.

Connecticut[218]

Connecticut distributes the lion's share of its RGGI revenue to three recipients: the Connecticut Energy Efficiency Fund (CEEF), the Connecticut Municipal Electric energy Collective (CMEEC), and the Connecticut Green Bank. CEEF finances energy efficiency programs that are administered by five electric and gas distributors in the state. Home weatherization and Energy Star incentives are among the most frequently financed programs, as

[218] https://eregulations.ct.gov/eRegsPortal/Browse/RCSA/Title_22aSubtitle_22a-174Section_22a-174-31/ (*(f)(6) Distribution of Auction Proceeds)*; https://www.energizect.com/; https://cmeec.com/; https://ctgreenbank.com/

well as the Home Energy Solutions program's support of energy efficient subcontractors. CMEEC offers financing for a mixture of residential and municipal weatherization projects. Meanwhile, the Connecticut Green Bank uses RGGI revenues to support commercial clean and renewable energy projects with attractive loan terms.

Delaware[219]

The Delaware Sustainable Energy Utility (DESEU) – operating as an independent 501(c)(3) – receives and administers much of the state's RGGI revenues, investing them in low-interest residential solar loans and the Home Performance with Energy Star program. Of the state's auction proceeds, ten percent is earmarked for financing the federal Weatherization Assistance Program. An additional five percent is designated for the Low-Income Home Energy Assistance Program. Additionally, the state's Department of Natural Resources and Environmental Control (DNREC) administers a competitive grantmaking process for programs that reduce GHGs in Delaware. DNREC funding is reserved for initiative taken beyond what is required by law or otherwise funded through state and federal sources.

Maine[220]

RGGI revenues in Maine are housed in a special, non-transferrable fund that is administered by Efficiency Maine Trust (EMT), a quasi-state agency predating RGGI. Although the Trust invests in a broad array of consumer benefits, the single largest programmatic recipient of revenues is "General Rate Relief." EMT's largest consumer benefit program, the Home Energy Savings Program (HESP), provides loans, rebates, and consumer education under a home weatherization umbrella. After HESP, the Trust categorically invests in Distributor Initiatives, Commercial and Industrial (C&I) Prescriptive Programs, Retail Initiatives, C&I Custom Programs, and Low-Income Initiatives, in that order. Low-Income Initiatives include direct mail energy-saving installation kits, providing heat pump water heaters, and targeted weatherization for high-usage/low-income homes. The Trust also invests significantly in electric vehicle rebates, charging stations, and consumer education.

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[219] https://delcode.delaware.gov/title7/c060/sc02a/index.shtml (*§ 6046 Auction revenue*); https://www.energizedelaware.org/wp-content/uploads/2020/05/3.d.i-Budget-Report-Ending-04-30-2020-Cash-Flow.pdf

[220] http://legislature.maine.gov/statutes/35-A/title35-Asec10109.html; https://www.maine.gov/dep/rules/#2464924 (Chapters 156 and 158); https://www.efficiencymaine.com/docs/ED_Report_2020_04_28.pdf

Maryland[221]

While the state's Department of Environment administers and assumes oversight of RGGI auctions, the Maryland Energy Administration (MEA) administers auction revenues through the pre-existing Sustainable Energy Investment Fund (SEIF). SEIF subaccounts that receive RGGI revenue are tied to the MEA, the state's Environment and Human Services departments, and five other agencies. Nearly half of Maryland's RGGI revenues to-date have been invested in direct bill assistance, but the rest have been invested in a wide array of benefits. "Clean Energy Communities" is the state's second largest RGGI revenue recipient. Within those communities that have been certified by the state, grants for financing energy efficiency projects are available to low-moderate income consumers. Nonprofits and local governments are also eligible for energy efficiency funding tied to whole-building, new construction, and other projects. The state also leverages RGGI funding to invest in an electric vehicle reimbursement program (and excise tax rebate). The MD Energy Innovation Institute, serving as a green bank investment option within the state university system, receives RGGI revenues as well.

Massachusetts[222]

Massachusetts primarily invests its RGGI revenues in four categories: residential energy efficiency, commercial energy efficiency, power plant decommissioning, and a Green Communities program. The latter extends grants and technical support to communities that meet criteria outlined in the state's Green Communities Act. Massachusetts also invests in a zero-emission vehicle program through rebates and cultivating public awareness.

New Hampshire[223]

Thanks to strict legislative requirements, a majority of New Hampshire's RGGI revenues are consistently earmarked for supporting retail electric ratepayers. Revenues not earmarked for consumer rebates or recouping administrative costs are placed in the Energy Efficiency Fund (EEF). The EEF mirrors the result of utility restructuring in Pennsylvania, where an independent

[221] http://www.dsd.state.md.us/comar/SubtitleSearch.aspx?search=26.09.04*; https://law.justia.com/codes/maryland/2013/article-gsg/section-9-20b-05/; https://energy.maryland.gov/Pages/Strategic-Energy-Investment-Fund-(SEIF)-.aspx; https://energy.umd.edu/innovation; https://energy.maryland.gov/govt/Pages/CleanEnergyLMI.aspx

[222] https://malegislature.gov/Laws/GeneralLaws/PartI/TitleII/Chapter21A/Section22; https://www.mass.gov/green-communities-designation-grant-program

[223] https://www.lawserver.com/law/state/new-hampshire/nh-statutes/new_hampshire_revised_statutes_125-o_23; https://www.puc.nh.gov/Electric/NH%20EnergyEfficiencyPrograms/de_14_216_nh_statewide_energy_efficiency_prog_4thq_2017_report.pdf

501(c)(3) associated with each utilities service area provides commercial and residential energy efficiency programs to ratepayers. In New Hampshire, RGGI revenues channeled through the EEF support a revolving loan fund for residential energy efficiency projects, low income weatherization, and municipal energy efficiency. The All-Fuels Program specifically supports retail, large businesses, and industrial clients with energy efficiency measures.

New Jersey[224]

New Jersey's plan for revenue investment involves placing auction proceeds in the state's Global Warming Solutions Fund. Statutes direct 60% of proceeds to the Economic Development Authority (EDA), 20% to the Board of Public Utilities (BPU), and 20% to the Department of Environmental Protection (DEP). The EDA provides support for C&I renewables and carbon abatement projects, as well as offshore wind development. The BPU prioritizes low-moderate income support for urban residents. The DEP leverages half of its RGGI revenues for assisting local governments in planning, implementing, and monitoring GHG mitigation programs. The other half of DEP's share is dedicated to stewardship of State Forests and tidal marshes (in the interest of carbon sequestration).

New York[225]

New York boasts a robust RGGI revenue investment portfolio, featuring both competitive and non-competitive financing options for clean energy projects. The Clean Energy Communities Program resembles other green community programs that are found throughout RGGI's network, offering grant support to communities that meet clean energy criteria. The 76 West Competition aims to attract startups and entrepreneurs from outside the state relocate to the "southern tier" region. Businesses embracing clean energy can compete annually for $40 million in prize money and support services. The NY-Sun Program incentivizes home and commercial solar through loans and public information, as well as technical assistance for local governments. New York also invests substantial RGGI revenue in electric vehicle rebates and green jobs.

[224] https://www.nj.gov/dep/aqes/docs/njac7_27d.pdf; https://www.state.nj.us/rggi/docs/rggi-strategic-funding-plan.pdf#:~:text=TheRGGI%20Strategic%20Funding%20Plan%3A%20Years%202020%20through%202022%28hereafter,the%20state%20to%20100%25%20clean%20energy%20by%202050.

[225] https://www.nyserda.ny.gov/Researchers-and-Policymakers/Regional-Greenhouse-Gas-Initiative/21-NYCRR-Part-507 (*Part 507.4: The Energy Efficiency and Clean Energy Technology Account*); https://www.nyserda.ny.gov/Researchers-and-Policymakers/Regional-Greenhouse-Gas-Initiative/Auction-Proceeds

Rhode Island[226]

Rhode Island's RGGI participation is statutorily bound to its Renewable Energy Standard, and the state's investment of auction proceeds reflects that marriage. Over two-thirds of the 2020 auction revenues are earmarked for home weatherization incentives, and specifically, air-source heat pumps. Commercial-scale photovoltaic adoption, LED streetlights for municipalities, and an Energy-Saving Trees Program are additional points of emphasis for consumer benefit investment. Rhode Island also spends the most of any RGGI state on administration.

Vermont[227]

The statutory imperative for RGGI in Vermont compels auction revenues to be spent on helping ratepayers meet pre-existing building efficiency goals. Through the Electric Efficiency Fund, auction revenues are distributed to Efficiency Vermont, an energy efficiency utility otherwise funded by ratepayers. Financing for home weatherization is Efficiency Vermont's dominant expenditure, leveraging the Home Performance with Energy Star program to meet this end.

California *(endogenous cap-and-trade program)*[228]

California places the auction revenues from its cap-and-trade market in the Greenhouse Gas Reduction Fund, a pre-existing fund with diffuse investment objectives. 60% of proceeds is continuously appropriated to a host of programs targeting disadvantaged communities, including Urban Greening, Affordable Housing and Sustainable Communities, Low Carbon Transit, Intercity Rail Capital, Sustainable Agricultural Lands, and the High-Speed Rail project. Additional line item expenditures that are not exhibited in RGGI states include safe drinking water, dairy methane, and fluorinated gases emission reduction.

[226] http://webserver.rilin.state.ri.us/Statutes/TITLE23/23-82/23-82-6.HTM; http://www.energy.ri.gov/documents/rggi/2020%20Plan%20Items/2020-A%20Regional%20Greenhouse%20Gas%20Initiative%20Proposed%20Allocation%20Plan.pdf

[227] https://legislature.vermont.gov/statutes/section/30/005/00255; https://puc.vermont.gov/sites/psbnew/files/doc_library/rggi-order-2014.pdf; https://www.efficiencyvermont.com/

[228] https://ww2.arb.ca.gov/resources/documents/cci-legislative-guidance; https://ww2.arb.ca.gov/sites/default/files/classic//cc/capandtrade/auctionproceeds/priority_targets_fy1920.pdf

## 5.2 The APCA and Revenue Investment

Having presented the approaches that other RGGI states and California have taken to investing their allowance auction revenues, we now turn to discussing which of these options could be used in Pennsylvania, recognizing the need to satisfy the APCA.

*Investing via a nexus with air pollution*

As argued in Section 2, a simple air pollution control nexus would allow DEP to invest auction revenues in many of the options exhibited throughout RGGI and even California. In Table 17, items outlined in both shades of green represent investment strategies that share a palpable relationship with air quality, either through primary or secondary benefits. Save for the policies exclusive to California, each of these options have been employed by RGGI states for similar ends, even if under a broad array of administrative and legislative pretexts.

In practice, the scope of existing investment vehicles in Pennsylvania depends on how DEP may (or is willing to) distribute revenues from the Fund. If restricted solely to programs that are housed within DEP, the Alternative Fuels Incentive Grant and the Alternative Fuels Technical Assistance Program would be sound recipients of investment in clean energy and transportation. If the pool expanded to include jointly administered programs, the DEP and DCED-led High Performance Building Program would represent a logical investment in energy efficiency, as would distributing monies to the four Sustainable Energy Funds (SEFs) that resulted from utility restructuring.

This latter example, with its energy efficiency benefits targeted toward regional ratepayers, would also allow DEP to address concerns regarding environmental justice and coal transition in vulnerable communities. By adopting an "equity over equality" approach to resource distribution, DEP could prioritize the SEFs serving ratepayers who stand to be hit the hardest by increased electricity rates and coal-fired power plant closures. While, in theory, there are plenty of mechanisms for Pennsylvania to employ in ensuring the well-being of fossil fuel dependent communities during this transition, the SEFs represent existing and geographically dispersed investment infrastructure that can be immediately supported with RGGI revenues. Targeted investments through the regionally disbursed SEFs can also be one vehicle for addressing concerns of environmental justice as it pertains to the unequal distribution of

historical and current pollution, as well as the unequal economics effects of the transition to clean energy across the Commonwealth.

**Table 17: Feasibility of RGGI reinvestment options, based on consistency with APCA.**

| Investment Option | Air Pollution Control Linkage | Legal Feasibility *(via Chevron deference*)* |
|---|---|---|
| *Carbon Emissions Abatement* | Primary | Yes |
| *Clean Public Transportation* | Primary | Yes |
| *Dairy Methane* | Primary | Yes |
| *Electric Vehicle Initiatives (Consumer-level)* | Primary | Yes |
| *Solar (Residential and/or C&I)* | Primary | Yes |
| *State Forest Health* | Primary | Yes |
| *Urban Forestry* | Primary | Yes |
| *Wind Capacity* | Primary | Yes |
| *Competitive Grantmaking* | Secondary | Yes |
| *Federally Funded, State Administered Programs* | Secondary | WAP: Yes<br>LIHEAP: No |
| *Green Bank Investment* | Secondary | Yes |
| *Green Communities Program* | Secondary | Yes |
| *Municipal Projects* | Secondary | Yes |
| *Weatherization (Residential and/or C&I)* | Secondary | Yes |
| *Clean Energy Workforce Development* | Ancillary | Yes |
| *Direct Bill Assistance* | n/a | No |
| *Economic Development Incentives* | Ancillary | Yes |
| *Safe Drinking Water* | n/a | No |
| *State University System* | Ancillary | Yes |

*For a regulatory agency to be granted administrative discretion through the *Chevron deference*, a matter that has been brought to the court must: a) have not been decided legislatively, and b) represent an interpretation of the existing statute that is deemed *permissible* by the court. The court does *not* impose its own interpretation of the statute.

If DEP sought to distribute RGGI revenue through transfers to programs outside of the agency's reach, viable options could include supporting the Weatherization Assistance Program

(administered by the DCED), the Low-Income Usage Reduction Program (PUC), and the Homeowners Energy Efficiency Loan (PFHA). Such programs would substantially mitigate burdens on ratepayers resulting from price hikes. This external vehicle for investing, however, would require that funds be earmarked for acutely defined purposes. Further yet, those purposes would need to be identified as embodying "the full and normal range of activities of the [DEP]" to satisfy Chapter 143's stipulations regulating Clean Air Fund disbursements. One could argue that, given the existence of comparable programs within DEP, funding external programs in this manner would be redundant and even pernicious. The substantial red tape inherent in that process makes wholly-external revenue distribution the least likely – and least efficient – investment scenario.

*An Expansive Investment Interpretation, and the Potential for Legislative Authorization*

When employing the expansive interpretation of Chapter 143 as presented in section 3(C) of the legal analysis, the pool of available investment options expands considerably. Such an interpretation would allow DEP to disburse proceeds toward ends that many other RGGI states have targeted but that exist on the periphery of air quality. Common priorities between the administration and external proponents of RGGI, like coal community transition and ratepayer assistance, can be achieved through a variety of means whose groundwork is already laid in Pennsylvania. LIHEAP, the Budget Billing and Customer Assistance Programs of the PUC, and even Pittsburgh's own Dollar Energy Fund represent viable options for supporting vulnerable ratepayers. The diffuse goals of DEP's Growing Greener program could be supported as well, like watershed restoration and abandoned mine reclamation.

While the breadth of the investment spectrum available to DEP under a public health context could become rather tangential, the pool should be limited to such ends that garner politically sustainable support and assuage the concerns of vulnerable ratepayers. For instance, investing RGGI revenues in the watershed restoration activities of DEP's Growing Greener program – while theoretically feasible in this scenario – would struggle passing even a cursory test of association with clean air, renewable energy expansion, or ratepayer energy efficiency support, and could plausibly draw the ire of legislators (and their constituents) on both sides of the isle. Given the severe scrutiny that Wolf's RGGI order has already attracted, spending on tangential public and environmental health objectives could substantially hamper the policy's sustainability. Instead, a more plausible strategy for expanded revenue investment might include

abandoned mine reclamation, where the revitalized land might aid in the broader coal transition objectives that are intrinsic to Pennsylvania's RGGI blueprint.

In practice, adopting such an expansive interpretation of Chapter 143 appears unlikely at best. Pushing the limits of administrative discretion beyond the considerable latitude already granted by the Governor's executive order would surely invite criticism from the General Assembly, and perhaps even litigation. The opportunity cost of funding those additional program areas is significant, as Pennsylvanians already stands to benefit greatly from joining RGGI under the more conservative parameters outlined above. If RGGI revenues are to be expended upon measures that are tangential to air quality, additional legislative authority would almost certainly be required. While the fierce pushback from majority leaders in the General Assembly suggests that legislative authorization is unlikely, their cooperation with the Governor's office and DEP would allow revenue to be leveraged toward mutually held priorities that are beyond the current scope of administrative discretion, such as direct bill assistance and coal transition.

*Ratepayer Bill Assistance and RGGI Sustainability*

Direct ratepayer assistance has no nexus with improving air quality, and yet its pervasiveness in RGGI spending by other states is apparent. As evidenced in this report, bill assistance is not just an ancillary cog of RGGI revenue investment but is often legislatively mandated as a cornerstone expenditure. The palpable rate hikes passed on to consumers tend to have a regressive effect, disproportionately impacting small businesses and low-income citizens, and, as such, have been a consistent point of bipartisan concern. Regardless of whether it is viewed as a transitory or permanent remedy, easing RGGI's financial burden at the "point of sale" can be seen as both extending an olive branch to ratepayers while also ensuring the policy's political sustainability.

Even if we assume that there is a near consensus in favorability toward direct bill assistance of some kind, Pennsylvania's regulatory environment for RGGI adoption has proved such an investment to be impracticable. Save for a legislative intervention that expands DEP's investment authority, the agency has no means of subsidizing ratepayers. However, there appears to be a tenable argument for a means of *indirect* bill assistance that leverages the electric distribution companies' (EDCs) ongoing energy efficiency commitments under Act 129 (see Section 2.5 for further legal analysis). By supplementing the EDCs' Act 129 obligations with RGGI revenues, any excess rates collected under the existing electricity price regime could be

returned to ratepayers. In short, through cooperation between the PUC and EDCs, RGGI revenues could be leveraged toward ratepayer relief while still operating within the scope of DEP's administrative discretion.

Like dedicating RGGI revenues to the Sustainable Energy Funds (SEFs), curbing rate hikes through supporting EDCs in their Act 129 obligations would mitigate the regressive nature of RGGI's impact on the Commonwealth. The strategy would also represent an attainable rate relief stopgap for DEP in RGGI's nascent years. This latter point will be critical to securing the policy's political sustainability through changing administrations, as RGGI's inaugural year in Pennsylvania coincides with a gubernatorial election. Without support for low-income ratepayers and small businesses, there may be significant bipartisan support for withdrawal from RGGI, if those price increases are high. When taken in view of Pennsylvania's status as RGGI's only fossil fuel dependent state and only major energy exporter, broad political support will be a crucial component of the policy's sustainability and success, even in an environment of administrative rulemaking. As such, DEP would benefit from exploring options for indirect bill assistance – like the scenario outlined above – as the draft rule begins to solicit public feedback.

## 5.3 Policy Interactions

In considering Pennsylvania's joining RGGI, it is important to evaluate what effects this action may have on existing policies in the Commonwealth. There are many possible policy interactions that could have received our attention, but for this first report we chose three that have broad impacts for Pennsylvania citizens, businesses, and the clean energy economy: Act 129 of 2008, the Alternative Energy Portfolio Standards (AEPS), and default service regulations for electric distribution companies (EDCs). In the following, we discuss each of these policies in turn and our current understanding of how joining RGGI may affect those programs.

### 5.3.1 Act 129

Act 129 of 2008 requires the PUC to establish energy efficiency and conservation (EE&C) and peak demand reduction programs for each of Pennsylvania's EDCs that serve more than 100,000 customers (Duquesne Light, PECO, PPL, and the FirstEnergy companies). EDCs with fewer than 100,000 customers can also voluntarily participate. Act 129 is implemented in phases wherein during each phase the EDCs have targets for reducing overall and peak demand by the end of the phase. Those targets are based on July 1, 2009 to June 30, 2010 levels of usage for each company's territory. Programs can cost no more than two percent of the EDC's total

revenues for the year 2006. At the end of each phase, the Commission must once again conduct essentially a cost-benefit analysis of whether total savings in energy and capacity costs of an additional phase of EE&C and peak demand reduction programs exceed the phase's costs, assuming spending reaches the statutory cap. To date, the Commission has enacted three phases of Act 129, and issued a final order on June 18, 2020, establishing a fourth phase commencing June 1, 2021 and ending May 31, 2026.[229]

**Table 18. Annual and 5-Year EDC Budgets for Act 129 Programs (Table 26 from PUC Final Order)**

| 1. EDC | 2. Annual Budget | 3. Phase IV 5-Year Budget Limit |
|---|---|---|
| **4. Duquesne Light** | 5. $19,545,952 | 6. $97,729,760 |
| **7. PECO** | 8. $85,477,166 | 9. $427,385,830 |
| **10. PPL** | 11. $61,501,376 | 12. $307,506,880 |
| **13. FE: Met-Ed** | 14. $24,866,894 | 15. $124,334,470 |
| **16. FE: Penelec** | 17. $22,974,742 | 18. $114,873,710 |
| **19. FE: Penn Power** | 20. $6,659,789 | 21. $33,298,945 |
| **22. FE: West Penn Power** | 23. $23,562,602 | 24. $117,813,010 |

Act 129 allows the EDCs to recover all prudent and reasonable costs relating to the provision or management of their EE&C plans. For Phase IV, the total five-year budget for EE&C programs for only the EDCs required to participate is $1.2 billion. Table 18 is a replica of Table 26 from the PUC's Phase IV final order that sets out the annual and five-year budgets for each participating EDC. The PUC is required to charge the costs of Act 129 programs to the rate class that benefits (residential, commercial, or industrial), including for the distinct low income carve out. Table 19 is a replica of Table 2 in the PUC's final order that displays the consumption, peak demand, and low-income reduction targets for each EDC. Residential customers, including low income ratepayers, must bear the cost of programs focused directly on achieving the low income carve out reductions.

[229] *Energy Efficiency and Conservation Program* Final Implementation Order, at Docket No. M-2020-3015228 (entered June 18, 2020)

**Table 19. Total Phase IV Targets by EDC (Table 2 from PUC Final Order)**

| 25. EDC | 26. Consumption Reduction (MWh) | 27. Peak Demand Reduction (MW) | 28. Low Income Consumption Reduction (MWh) |
|---|---|---|---|
| **29. Duquesne Light** | 30. 348,126 | 31. 62 | 32. 18,566 |
| **33. PECO** | 34. 1,380,837 | 35. 256 | 36. 80,089 |
| **37. PPL** | 38. 1,250,157 | 39. 229 | 40. 72,509 |
| **41. FE: Met-Ed** | 42. 463,215 | 43. 76 | 44. 26,866 |
| **45. FE: Penelec** | 46. 437,676 | 47. 80 | 48. 25,385 |
| **49. FE: Penn Power** | 50. 128,909 | 51. 20 | 52. 7,477 |
| **53. FE: West Penn Power** | 54. 504,951 | 55. 86 | 56. 29,287 |

### 5.3.2 Effects of RGGI on Act 129 Compliance and Costs

The major potential interaction between RGGI and Act 129 is the dispensation of revenues from RGGI auctions. First, there is the necessity to ensure that DEP-funded reductions in consumption and peak demand are not credited as EDC compliance under Act 129. Second, and more substantial, is the complimentary and/or substitutionary effects of RGGI and Act 129 spending.

The issue of proper accounting for consumption and demand reductions appears to be straightforward. The PUC will need to update its Technical Reference Manual for Phase IV (Final Order Docket No. M-2019-3006867) to properly account for energy efficiency effects of programs established by DEP for spending RGGI revenues. That way, EDCs will not unduly receive credit for reductions in consumption and peak demand that are the results of new RGGI programs implemented within their territories.

The interaction between RGGI and Act 129 spending, however, is more complex. The two programs have distinct, yet overlapping, purposes. While the goal of RGGI is to reduce greenhouse gas emissions, improving energy efficiency to push forward a transition to a less carbon-intensive mixture of electric generation in Pennsylvania is well within that mandate.

While agnostic to generation type, Act 129's explicit purpose is to increase energy efficiency and reduce electric consumption. DEP is well within its authority and would contribute to the achievement of the purposes of RGGI, in directing RGGI auction revenues to energy efficiency programs. These actions would raise questions as to whether RGGI-funded revenue programs would supplement or supplant utility-funded programs under Act 129 and would raise related questions about ratepayer cost allocation.

From the perspective of the intent of Act 129, the potential issue raised is that even supplemental spending by DEP on energy efficiency that goes to utilities or ratepayers may be legally questionable based on an argument that this would violate the legislative intent of the Act 129 cap on EE&C spending. Our analysis of the Act 129 structure, as outlined in Section 2, does not suggest that this issue is significant – and even if significant can be managed. Specifically, our analysis suggests that the Act 129 cap only applies to Act 129 spending by the EDCs. That said, there is also a question as to whether RGGI funds can be used to directly supplant existing program spending for any programs, be they at an outside agency like the PUC or even existing programs administered by DEP.

If the programs are operating in parallel, without RGGI spending offsetting the spending of a program like Act 129, ratepayers will have to pay for both programs. (The ratepayer burden of RGGI is discussed in more detail in Section 5.3.4.) This is of special concern to low-income Pennsylvanians. Under Act 129, they benefit from additional programming that is not open to all residential ratepayers, but they also must contribute to paying for those programs. They may also be exposed to some level of rate increase because of RGGI. Many RGGI states have chosen to use a portion of their revenues to reduce the financial burden of the program on residential ratepayers through direct bill assistance. Such an approach appears to be constrained in Pennsylvania without an act of the General Assembly. Using some RGGI revenues to replace existing program spending (Act 129), however, would amount to an indirect form of bill assistance.

The timing of such indirect bill assistance would need to be determined. On one hand, the PUC did not address the potential for a return of Phase III funds to ratepayers until the process of developing Phase IV. The Commission left open the possibility of returning unused Act 129 funds to ratepayers at the conclusion of Phase III, instead of rolling those funds over to Phase

IV.[230] If the Commission would take the same approach in Phase IV, any possible return of Act 129 funds that were replaced by RGGI funds would not occur until 2026. This is not the only option, however. In 2017, the Commission ordered EDCs (as well as gas, water, and wastewater utilities) to provide negative surcharges to return windfall profits from the federal Tax Cuts and Jobs Act of 2017 to customers.[231] If the PUC and DEP were to coordinate in replacing Act 129 spending with part of available RGGI revenues, the Commission could conceivably use the same strategy to return those funds to customers right away. Granted, the structure of Act 129 would necessitate returning funds to the specific customer classes whose program funding was replaced. As noted above, directing these funds to residential customers would make the implementation of both programs less regressive. It is important to recognize, however, that bill assistance does not necessarily help DEP achieve the direct aims of joining RGGI. Bill assistance could increase energy use and GHG emissions by lowering the cost of electricity for residential customers.

Finally, we note that the discussion in Section 2 argues that it could be legal for the PUC and DEP to coordinate to provide this relief. Such inter-agency coordination could lead to innovative investments of RGGI revenues. This, however, does not preclude the General Assembly from establishing a more centralized approach to harmonizing the programs and providing bill relief for Pennsylvanians.

### 5.3.3 Alternative Energy Portfolio Standards

Act 213 of 2004 established Pennsylvania's Alternative Energy Portfolio Standards (AEPS). AEPS established the goal of attaining 18 percent of retail electricity generated from renewable resources by 2021. EDCs and energy generation suppliers (EGSs) must each obtain a certain percentage of their retail electric sales from qualifying sources that are categorized as either Tier I or Tier II resources. Figure 9 displays the sources that fall within each tier, as well as the special solar carve-out in Tier 1.[232] When 1 MWh of qualifying power is generated in the PJM

[230] Ibid.

[231] *Tax Cuts and Jobs Act of 2017*, Temporary Rates Order at Docket No. M-2018-2641242 (entered May 17, 2018).

[232] Pennsylvania Public Utility Commission. (2019). *Alternative Energy Portfolio Standards Act: Compliance for Reporting Year 2018*.

footprint, 1 alternative energy credit (AEC) is produced and these credits can be retired or bought and sold between EDCs and EGSs to meet their program requirements. The crediting of generation within all of PJM applies for all sources except for Tier 1 solar, which must be completely produced within Pennsylvania, per Act 40 of 2017.

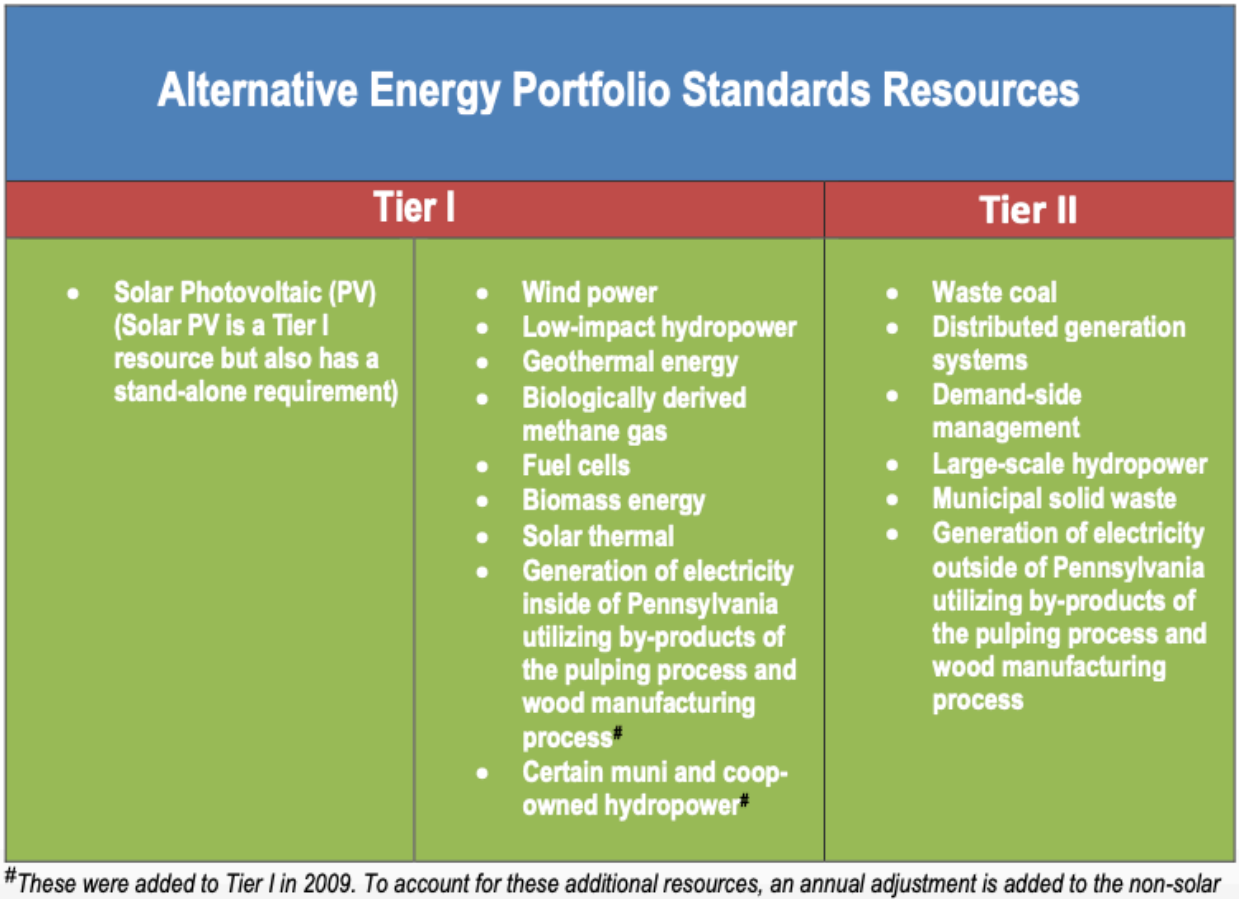


**Figure 9: Structure of Pennsylvania'**Image Source: Pennsylvania Public Utility Commission. (2019). *Alternative Energy Portfolio Standards Act: Compliance for Reporting Year 2018*. Pg. 10.

Two questions arose when considering the potential policy interactions between RGGI and AEPS. First, there is the question of timing. The goal of 18 percent renewables is set to be achieved in 2021, with Pennsylvania joining RGGI in 2022. What occurs after 2021? Without a replacement to Act 213, the 18 percent overall target will be maintained from June 1, 2021 forward. Meaning that the existing AEPS will not continue to rachet up the percentage of

renewable generation, but it will at least keep it consistent. There have been discussions in Harrisburg as to whether to increase the target, so this may yet happen. If it does, then the new AEPS target will affect the mixture of power procurement and potentially lessen the need for Pennsylvania companies to purchase RGGI allowance as renewable generation increases in the PJM footprint.

Some have argued that joining RGGI will simply make the AEPS obsolete. We view the two programs as complimentary, not substitutionary. The economic modeling in this report makes this conclusion evident. RGGI alone does not incentivize renewable energy development beyond what AEPS already requires. Thus, even if Pennsylvania simply retains AEPS after 2021, RGGI will not encourage more renewable development. Further, if Pennsylvania repealed AEPS, RGGI does not guarantee that alternative energy sources would remain 18% of the Commonwealth's generation mix.

AEPS and RGGI also have different, while overlapping, goals. RGGI's goal is to reduce carbon dioxide emissions, while the AEPS's goal is to increase the share of renewable energy used to generate electricity in Pennsylvania. RGGI will necessarily push forward a transition in the generation supply make-up of Pennsylvania, but it is largely agnostic to which lower-carbon intensity generation sources replace higher-intensity ones. RGGI does not provide incentives for particular types of generation, like renewables, and is thus not explicitly a renewable energy program. Whereas the AEPS establishes a baseline amount of renewable energy required in the Commonwealth. Given the abundance of natural gas in Pennsylvania and stark increase in hydraulic fracturing to access shale gas, it stands to reason that EDCs and EGSs may first shift to natural gas sources, not renewables or energy efficiency, when meeting Pennsylvania's RGGI targets. This is potentially costly in the long run if the energy marketplace continues to shift to renewables and away from carbon-based sources like coal and natural gas. Essentially, utilities may quickly build natural gas turbines that themselves could need to be retired in short order with increases in energy efficiency and the continuing decline in renewable energy prices. The AEPS is complimentary in that it allows Pennsylvania to be proactive in shaping the mixture of energy sources.

The second question we considered is how the presence of higher carbon-intensity sources in Tiers I and II of the AEPS would be affected by RGGI participation. Specifically, biologically derived methane gas, biomass, and wood manufacturing byproducts (in-state) are

Tier I resources, while waste coal, municipal solid waste, and wood manufacturing byproducts (out-of-state) are Tier II resources. Some are substantial sources of AEPS compliance. In 2018, for example, landfill gas (methane) was 14.4% of Tier 1 AECs and 63.7% of Tier II compliance came from waste coal.[233] Each are also sources with high carbon intensity; however, landfill gas is exempt from RGGI and serves as an offset for carbon liability. Waste coal has been provided permit set asides based on legacy emissions, meaning new waste coal would require RGGI permits, but the baseline of existing waste coal does not. This means that the expansion of waste coal generation in Pennsylvania would receive AEPS credits and would simultaneously trigger RGGI permit costs. Thus, the relative balance of costs versus benefits for expanding waste coal generation will be based on the individual circumstances of the EGS or EDC. Additional research is necessary to fully evaluating this cost-benefit calculus, as well as the possible effect of increasing Pennsylvania's AEPS goals. Pennsylvania-specific modeling is important given that past research suggests that adjusting each can have perverse effects on the other.[234] Further, it would be useful to understand the tradeoffs between a uniform energy price approach compared to an approach like a renewable portfolio standard combined with RGGI offsets that pick winners and losers. It will be important to understand potential perverse incentives for sources of generation that receive credit under AEPS and either offsets/credits under RGGI or require permitting under RGGI. Understanding these complex dynamics in Pennsylvania is important for better considering how AEPS and RGGI interact.

### 5.3.4 Default Service Regulations

The third policy interaction that we considered was how RGGI would affect default service regulations. As part of Pennsylvania's decision to restructure its electricity market to allow for competitive supply, legacy EDCs became suppliers of last resort for ratepayers who did not chose to buy their electric from an alternative supplier. While some competition has formed in Pennsylvania, most customers still rely on their EDC as their supplier. Both AEPS and Act 129 necessitated adjustments to the default service regulations that govern EDC functioning as

[233] Ibid.

[234] Tsao, C. C., J. E. Campbell, and Yishu Chen. (2011). "When Renewable Portfolio Standards Meet Cap-and-Trade Regulations in the Electricity Sector: Market Interactions, Profit Implications, and Policy Redundancy." *Energy Policy* 39: 3966-3974.

suppliers of last resort. EDCs must account for how they will meet their AEPS obligations in their default service plan. More fundamentally, Act 129 changed the requirement for EDCs from using "prevailing market prices" in purchasing power to a standard of the "least cost to customers over time."[235] Act 129 also allowed for long-term contracts (over 4 years and up to 20 years). The PUC's final rulemaking order states that "the 'prudent mix' of contracts shall be designed to ensure: (1) adequate and reliable service; (2) the least cost to customers over time; (3) compliance with the procurement methodologies described above, i.e., through auctions, requests for proposals, or bilateral agreements. 66 Pa. C.S. §§ 2807(e)(3.4) and (e)(3.1)."[236] This prudent mix is to include spot market purchases, short-term contracts (1-4 years) and long-term contracts (4-20 years).

The question we considered was whether joining RGGI would affect the default service regulations established by the PUC. The Commission is now considering new default service plans for Duquesne Light, PECO, PPL, Wellsboro/Citizens Electric, and UGI that would be in place from June 1, 2021 to May 31, 2025, which includes the period when Pennsylvania will join RGGI. Additionally, the FirstEnergy Companies have an existing approved plan for 2019 through 2023.

The answer to this interaction question proved simpler than for Act 129 or AEPS. The full requirements contracts that EDCs use to procure much of their supply include anticipated impacts on wholesale market prices in their bids for service. Meaning, default service suppliers will take upon themselves the risk of RGGI price increases. Suppliers will hedge their energy price commitment to account for these anticipated price increases, but if those price increases are higher than expected they will bear the burden through reduced margins. Default ratepayers do also bear risk. They could pay higher electricity rates if the RGGI price falls substantially. While ratepayers could conceivably switch to alternative suppliers in this case, the low rate of competition in Pennsylvania suggests that this is unlikely. The "least cost over time" standard means that price increases due to RGGI participation will change the mixture of generation over time, but this does not necessitate changes in current default service regulations.

[235] https://www.legis.state.pa.us/cfdocs/legis/li/uconsCheck.cfm?yr=2008&sessInd=0&act=129.

[236] *Implementation of Act 129 of October 15, 2008; Default Service and Retail Electric Markets* Final Implementation Order, at Docket No. L-2009-2095604 (entered September 22, 2011), page 5.

### 5.3.5 The Bigger Picture

Energy is a substantial sector in Pennsylvania's economy. The Commonwealth is the leading exporter of electricity in the entire United States. [237] It is the second largest producer of natural gas, third largest in coal, and second largest in nuclear.[238] But the American energy sector is transitioning from carbon-intensive to renewable forms of energy production. Even without RGGI, that transition will not stop and jobs, particularly coal jobs, will be lost in the energy sector.[239] Further, Appalachian counties dependent on resources for income face substantial declines in future annual income growth.[240] Pennsylvania is also reeling the from the deep COVID-19-induced recession and will still be rebuilding its economy in 2022 when the state joins RGGI. While RGGI's potential effects on electric prices and the economy have been trumpeted as arguments for opposing the pact, it is also possible to think of RGGI in broader terms as an opportunity for strategic thinking about Pennsylvania's economic and energy future. As Pennsylvania's economy rebuilds and recovers from the current pandemic, the tight existing nexus between energy and economic development can be an avenue for structuring that rebuilding. Namely, the Commonwealth can leverage RGGI, RGGI reinvestment revenues, and complimentary existing programs like Act 129 and AEPS to rebuild the economy around clean energy and improving environmental quality. RGGI revenue can thus be thought of as a useful tool to engage in deliberate and equitable decisions about economic development.

But to do this effectively, Pennsylvania will need a coordinated strategy and deliberate decision-making involving multiple arms of state government.[241] This report has suggested the possibility of beneficial cooperation between DEP and the PUC, the General Assembly can also play an important role in a coordinated reshaping of Pennsylvania's energy sector and economy. Pennsylvania is poised to enter the RGGI market in 2022, and the AEPS is set to plateau in 2021. Further, the PUC is currently in the process of hiring a third party to provide statewide evaluation and coordination of EDC plans under Act 129. These are all windows of opportunity

[237] U.S. Energy Information Administration. 2020. *Pennsylvania State Profile and Energy Estimates*.
[238] Ibid.
[239] Skibell, Arianna. 2020. "Thousands of Coal Workers Lost Jobs. Where Will They Go?" *E&E News*. June 25.
[240] Douglas, Stratford and Anne Walker. 2017. "Coal Mining and the Resource Curse in the Eastern United States." *Journal of Regional Science* 57(4): 568-590.
[241] For an example of how such a deliberate strategy could be formulated in the context of another state (New Mexico), see S. Blumsack, P. Hines, C. Moore and J. Trancik, "The Energy Transition in New Mexico," available at http://tuvalu.santafe.edu/~moore/NM-Energy-Transition-final.pdf.

for the General Assembly to develop a better coordinated energy efficiency and clean energy strategy.

Additionally, by engaging with RGGI, the General Assembly could expand the landscape for revenue reinvestment in ways that buttress efforts by DEP to address environmental justice and equity. Bringing these issues to the fore of energy policy in the state has been both a priority and challenge for many agencies. DEP's Environmental Justice Advisory Board has called on the Department to include equity and environmental justice principles in RGGI.[242] Revenue reinvestment can be a means of doing this, but DEP would benefit from broader authority, or even an explicit legislative mandate, to reinvest RGGI monies for the sake of environmental justice and equity.

[242] RGGI Equity Principles.

## 6. **Conclusion**

Pennsylvania is a major energy-producing state, and a major exporter of electricity and other energy commodities to the region and beyond. The Commonwealth's move to join the Regional Greenhouse Gas Initiative is thus a consequential step, with potential costs and benefits to industry and communities. The administrative path that Pennsylvania is taking to joining RGGI is somewhat unique among RGGI states, and its position in the interconnected PJM electricity grid also has important implications for energy costs and air emissions in the region. Pennsylvania's place in the regional energy system, as well as the important nexus between energy production, the environment and health outcomes, suggest that deliberate attention is needed to

Penn State's Center for Energy Law and Policy has assembled an interdisciplinary research team to examine the interconnected energy-system, environmental, legal and policy environment around which Pennsylvania has moved to join RGGI. In addition to this report, we have engaged (to the extent possible in the Covid era) with interested stakeholders through a series of public webinars and individual deeper conversations. Our interdisciplinary analysis has highlighted several potential outcomes associated with RGGI that will require some care and deliberation in the formation of implementation strategies. Here we synthesize these into three areas where ongoing science can perhaps best-inform policy decisions around the RGGI implementation.

First, the net benefits to Pennsylvania as a whole from joining RGGI, in terms of climate and more local environmental impacts, are likely to be positive. Policies like RGGI do generate benefits and costs that may not be shared evenly. Some sectors of Pennsylvania's energy industry are likely to be economically disadvantaged while others may benefit. Wholesale energy costs are likely to increase, at least as Pennsylvania goes through a process of reducing the carbon intensity of its generation portfolio, but how these are reflected in consumer energy bills will depend on decisions made by the PUC and other agencies.

Perhaps most significantly, our analysis suggests a high leakage rate for $CO_2$ and some other air emissions under RGGI, whereby emissions are reduced in Pennsylvania but increase in other states. Emissions leakage is a concern for policy effectiveness, since high leakage rates can reduce the overall climate impact of Pennsylvania joining RGGI. A careful approach is likely

needed to managing or mitigating leakage, involving a high level of coordination with surrounding states and PJM as the regional grid operator.

Second, the co-benefits of RGGI, which extend beyond reduction of greenhouse gas emissions, are likely to be substantial. A principal component of these co-benefits involves reductions in emissions of localized air pollutants that are directly tied to local health impacts. Our analysis suggests that the magnitude of these co-benefits in terms of improved air quality and associated health improvements may exceed the climate benefits. Further research is needed to better-understand the spatial distribution of health outcome impacts, both in terms of which areas or communities are likely to benefit and which may be harmed because of the emissions leakage that is likely to occur (without any policy measure to mitigate leakage). Putting our health outcome results in some context reveals that the total health benefits over a ten-year RGGI implementation period are likely to be highly sensitive to the rate of coal plant retirements that would have occurred in the absence of RGGI. The air-quality modeling presented in our paper reflects a scenario where a lower level of coal-plant retirement would have taken place in the absence of Pennsylvania joining RGGI, while modeling results presented by DEP reflects a scenario of higher rates of coal-plant retirement.

Third, Pennsylvania can make some deliberate decisions to use the decarbonization and revenue generation features of RGGI as part of a broader policy portfolio to address equity issues related to technology transition in energy and economic development in the post-Covid era. RGGI in and of itself does not appear to present any legal or policy tensions with other major portfolios of Pennsylvania energy policy, such as Act 129 or AEPS. Revenues generated by RGGI participation, however, could be directed in strategic ways to support various forms of equitable development that can contribute to decarbonization. Examples might include electric bill relief for low-income consumers; targeted training and deployment programs for building energy efficiency and beneficial electrification; and leveraging emerging technology and legacy skills to promote environmental improvement. Identifying and directing resources in this way would require cooperation and coordination among multiple actors in Pennsylvania's state agencies, as well as actors in the private and educational sectors that are positioned to aid with deployment.