



January 14, 2021

Environmental Defense Fund and Pennsylvania Environmental Council Comments on CO2 Budget Trading Program (#7-559)

Dear Members of the Environmental Quality Board,

On behalf of Environmental Defense Fund (EDF) and Pennsylvania Environmental Council (PEC) and our thousands of members across Pennsylvania, we respectfully submit the following comments on the Pennsylvania Department of Environmental Protection's (DEP) draft CO2 Budget Trading Program. We commend DEP for its proposal to set a declining limit on carbon pollution emitted by Pennsylvania's fossil fuel electric generating units.

We support promulgation of the draft CO2 Budget Trading Program rule and appreciate the significant opportunities that have been offered to provide written and oral comments. Linking Pennsylvania to the Regional Greenhouse Gas Initiative (RGGI) will ensure carbon emissions decline in Pennsylvania and the region. Our comments are organized as follows:

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I. Introduction

EDF and PEC support the Executive Order signed by Governor Wolf in January 2019¹ to set climate goals for Pennsylvania, including achieving a 26 percent reduction of net greenhouse gas emissions statewide by 2025 from 2005 levels, and an 80 percent reduction of net greenhouse gas emissions by 2050 from 2005 levels. We also support the October 2019 Executive Order² directing the Department of Environmental Protection to address carbon pollution from power plants. EDF and PEC strongly support the draft CO2 Budget Trading Program rule, which establishes a binding, declining limit on carbon pollution for the power sector that is compatible with RGGI. As discussed

below, Pennsylvania has expansive authority pursuant to the Pennsylvania Air Pollution Control Act³ to regulate carbon pollution. DEP's draft CO2 Budget Trading Program rule is a prudent, cost-effective, and common-sense approach to ensuring durable, real, and sustained carbon pollution reductions in the power sector Pennsylvania cannot meet its climate goals if it does not address power sector emissions, which are a leading source of greenhouse gas emissions in the state.

EDF and PEC support the overall rule and urge its swift adoption to ensure the program can start in January 2022. We agree with DEP's approach to establish a CO2 budget trading program that is compatible with RGGI and sets a declining emissions budget through 2030. In sections VI-IX below we provide recommendations for strengthening the CO2 budget trading program in four core areas that have important impacts on the effectiveness and efficiency of the overall program.

II. Legal Foundation

The Pennsylvania Air Pollution Control Act (APCA)⁴ provides DEP with broad authority to adopt the RGGI rule, issue allowances pursuant to the rule, deposit proceeds in the Clean Air Fund, and to participate in the RGGI program through informal linkage with other states.

DEP has broad authority to regulate GHG emissions and to establish cap-and-trade regulations

DEP, through the Environmental Quality Board (EQB), has expansive authority pursuant to the APCA to address carbon pollution. DEP has previously acted under its statutory authority to regulate GHG emissions, including by implementing the federal Tailoring Rule⁵ and adopting a program to limit the GHG methane from facilities in the natural gas production and supply chain.⁶

DEP's authority to regulate GHG emissions extends to the use of statewide emission budget and trading programs. Pursuant to the authority granted to the EQB under section 5(a)(1) of the APCA,⁷ the EQB has previously adopted several emissions trading programs without the need for additional legislative grants of authority. For example, in the late 1990s, DEP joined a regional emission budget trading program for nitrogen oxides (NOx) emissions from large fossil-fuel-fired combustion units.⁸ Pennsylvania also has existing programs allowing for and regulating emissions trading of criteria pollutants in non-attainment areas (NSR permitting),⁹ and trading programs under Clean Air Act, Title V permitting.¹⁰

Likewise, DEP has previously exercised its authority to adopt rules allocating tradeable allowances for different pollutants, including NOx and mercury, and has allocated emission reduction credits as part of emission trading programs.¹¹ For example, EQB adopted the Clean Air Interstate Rule (CAIR) trading program model rules, which create an interstate NOx and sulfur dioxide (SO₂) trading program, and has implemented this program for many years.¹² In addition, Pennsylvania adopted a mercury allowance program pursuant to the EPA Clean Air Mercury Rule (CAMR).^{13,a} Although the state declined to participate in the interstate cap-and-trade program option identified

^a It is EDF's view that the adoption of a cap-and-trade program was inappropriate for a highly localized health-harming pollutant like mercury, but Pennsylvania's state plan implementing CAMR nonetheless indicates that the state has ample authority to adopt flexible, mass-based trading programs.

by EPA, the program did involve the free distribution of allowances and set-asides for sources within the state.¹⁴

DEP also has the authority to design a GHG emissions reduction program so as to minimize the incentives to move GHG-emitting entities to other states, a phenomenon known as leakage. The DEP is charged with developing 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.”¹⁵ Under this broad language, DEP’s authority is not limited to sources that must obtain permits; rather, the EQB is authorized to adopt regulations “applicable to all air contamination sources regardless of whether such source is required to be under permit by this act.”¹⁶ The term “air contamination source” means “any place, facility or equipment, stationary or mobile, at, from *or by reason of which* there is emitted into the outdoor atmosphere any air contaminant.”¹⁷ The phrase “by reason of which” shows that the APCA authorizes the regulation at various places along the supply chain, not just at the location of the emission. The sale of electricity within the state would be the “reason by which” the electricity source is emitting carbon, so DEP has clear authority to regulate such sale within the state as a “source,” such as at the first point of sale in the state.¹⁸

Additionally, the legislature has recognized the importance of action on addressing greenhouse gas emissions. The Pennsylvania Climate Change Act requires not only a report on greenhouse gas impacts every three years, but also requires DEP to identify “cost-effective strategies for reducing and offsetting GHG emissions.”¹⁹

DEP is authorized to participate in RGGI by developing a regulation compatible with other state programs

The APCA grants DEP the authority to employ interstate trading, via cooperation with other states, without the need for specific legislative approval.²⁰ Pursuant to Section 4(24) of the APCA, DEP, and by extension the EQB, has authority to “[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.”²¹ The rule proposed by DEP envisions just such cooperation in order to better control electric sector emissions. Compliance by covered entities with the regulation will strictly be a matter of Pennsylvania state law and enforced by Pennsylvania agencies, designed in a way to facilitate cross-border cooperation in the form of voluntary interstate trading.

The APCA further authorizes DEP to contract with third-party vendors in order to administer a trading program, pursuant to broad enabling language.²² Accordingly, DEP can link with and participate in RGGI’s emissions trading program and utilize the services of RGGI, Inc. to administer allowance auctions.

DEP has authority to collect auction revenues as fees and deposit them into the Clean Air Fund

The APCA broadly authorizes DEP to collect fees to “to support the air pollution control program authorized by this act,” in addition to other specifically enumerate fees.²³ Fees collected by DEP are to be deposited in the state treasury, in a fund called the Clean Air Fund, in which the agency may

establish separate accounts.²⁴ It further specifies that the money in the Clean Air Fund is to be used to eliminate air pollution, providing:

[Subject to specified exceptions], 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, hereby established, which, along with interest earned, shall be administered by the department **for use in the elimination of air pollution**. The department may establish such separate accounts as may be necessary or appropriate to implement the requirements of this act and the Clean Air Act. The board shall adopt rules and regulations for the management and use of the money in the fund.²⁵

Notably, the APCA does not limit the amounts to be collected or deposited into the Clean Air Fund. The broad statutory purpose for the Clean Air Fund, combined with DEP's expansive authority to collect fees to support its air control program, indicate that the agency has ample authority to collect auction proceeds as part of a cap-and-trade program, and to use such proceeds for the further elimination of air pollution.

III. Climate Change and Pennsylvania

Increasing heat and flood risks from climate change, the result of historical and ongoing emissions of heat-trapping gases, threatens infrastructure, agriculture, and public health throughout Pennsylvania.

Pennsylvania has already warmed by about 2°F since 1970,²⁶ with three times more extremely dangerous heat days and five times as many heat wave days anticipated for 2050.²⁷ Individual cities in Pennsylvania experience even more drastic temperature increases than the state's average. Pittsburgh already experiences five more days above 90°F each year than it did in 1970.²⁸ Erie is the 15th fastest warming city in the U.S., and Philadelphia is the 17th.²⁹ By 2100, summers in Harrisburg are projected to be 11°F hotter than they are today – comparable to summers today in San Antonio, TX.³⁰ The dew point temperature in Harrisburg has increased by 4°F since the 1980s, with increased risk of heatstroke and heat exhaustion to Harrisburg's vulnerable populations from the additional moisture in the air.³¹

Higher temperatures pose threats to public health, labor productivity, recreation industries, and agricultural yields. Already, the mosquito season in Pittsburgh and Harrisburg lasts about a month longer than in the 1980s, highlighting the heightened risk from disease-carrying insects and crop pests.³² By mid-century, snow cover is projected to decline by 20 – 60 percent across Pennsylvania, and this is likely to nearly eliminate the winter outdoor recreation industry. High summer temperatures, in addition to higher levels of air and water pollution, similarly threaten outdoor summer recreation activities.³³ Impacts to Pennsylvania's livestock from increased heat include lower milk yields, reduced forage quality, and higher cooling and ventilation costs for farmers.³⁴ Higher temperatures are also likely to necessitate regional shifts in Pennsylvania's agricultural industries. By 2100, 20 Pennsylvania counties may see a 25-55 percent decrease in crop yields as compared to 2012 levels.³⁵

Average annual rainfall has increased by about 10 percent across Pennsylvania since 1901, with all counties projected to get warmer and wetter.³⁶ Philadelphia has experienced a 360 percent increase in heavy downpours relative to 1950, constituting the third highest increase in heavy downpours of

any U.S. city.³⁷ Extreme rain events threaten critical water, transportation, and energy infrastructure. Around 430,000 Pennsylvanians live in flood prone areas.³⁸ At least 4,400 homes existing today – valued at about \$1 billion – would be at risk of chronic inundation by 2100 in the absence of climate action.³⁹ Inland flooding also poses a major public health risk to Pennsylvanians. Increased precipitation events will likely carry more nutrient and sediment runoff pollution into Pennsylvania’s streams and rivers, many of which are already compromised or out of compliance. Wetlands may experience a reduced ability to absorb water and pollutants, thus flooded stormwaters will pose an ongoing public health threat.⁴⁰

Under a business-as-usual scenario, 10 Pennsylvania counties and their 5 million inhabitants may experience a 10 percent increase in energy expenditures by 2100 from the impact of climate change on energy demand. The increased need for cooling in the summers is likely to outpace any decrease in winter heating needs. Furthermore, extreme weather events threaten the reliability of energy delivery systems.⁴¹ In its most recent Electric Service Reliability Report, the Pennsylvania Public Utility Commission reported the number of reported outage events reached a record high in 2019, impacting nearly 2 million Pennsylvania customers.⁴²

Pennsylvania is also vulnerable to increased risks from coastal flooding of the Delaware Bay.⁴³ The state has experienced 304 coastal flood days since 1950,⁴⁴ with coastal flood risk projected to double by 2050 and put an additional 6,000 people at risk.⁴⁵ The highest risk areas are those bordering the tidal waters of Delaware Bay, where 7,000 people live at risk of a 100-year coastal flood.⁴⁶ Without climate action, annual coastal damages from rising sea level and more frequent coastal storms are projected to reach \$50 million by 2100.⁴⁷ Freshwater aquatic life will likely be threatened from increasing saltwater intrusion, and increased warming may also cause harmful algal blooms in lakes and reservoirs across the state.

The urgency and the stakes couldn’t be higher: the Intergovernmental Panel on Climate Change (IPCC) found that the average of modeled emission pathways limiting warming to 1.5°C show necessary greenhouse gas emission reductions of 45 percent below 2010 levels by 2030, with emissions continuing to decline dramatically through 2050.⁴⁸ Reductions secured today matter. The majority of climate change results from the cumulative buildup of greenhouse gases in the atmosphere over time. Much of the pollution we are emitting today will linger in the atmosphere for decades to come, so persistent reductions are needed – and needed urgently.

Significance of Pennsylvania’s emissions and reduction potential

According to the 2020 Pennsylvania Greenhouse Gas Inventory Report, economy-wide emissions in Pennsylvania totaled 233 million metric tons of carbon dioxide equivalent⁴⁹ in 2017, the latest year for which this data is available.⁵⁰ These emissions are equivalent to carbon dioxide emissions from over 50 million passenger-vehicles driven for one year, from over 39 million homes’ electricity usage, or from over 256 million pounds of coal burned.⁵¹

In 2018, Pennsylvania's total emissions from fossil fuel combustion were the fifth highest of all U.S. states.⁵² In 2019, its electric power sector was the fourth dirtiest in the country, emitting 77 million metric tons of carbon dioxide.⁵³ Using projected emissions trajectories from the Rhodium Group, a recent EDF analysis estimates that even under a low-emissions scenario, Pennsylvania's economy-wide emissions are still unlikely to reach stated 2025 and 2030 targets.⁵⁴

Putting a cap on carbon pollution from Pennsylvania’s power sector, and adopting the DEP’s proposed emissions budget would ensure a cut of approximately 20 million metric tons of carbon dioxide emissions in 2030.⁵⁵ This emissions reduction would have the same climate benefit as preventing emissions from either over 4 million passenger vehicles, over 5 average-sized coal-fired power plants, burning over 22 billion pounds of coal, or from over 3 million homes’ electricity use in 2030.⁵⁶

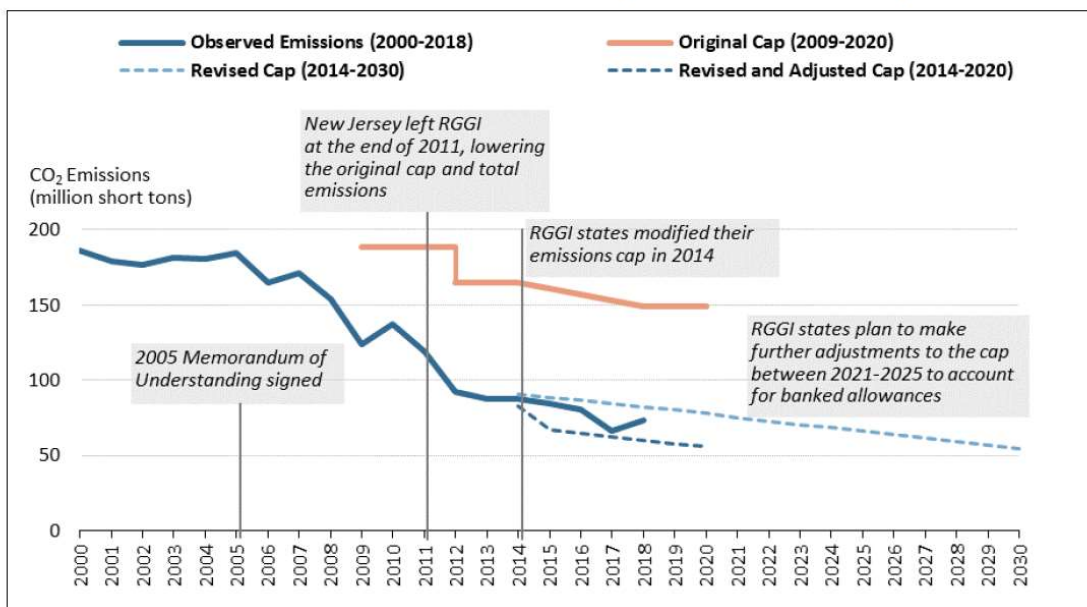
Furthermore, Pennsylvania’s participation in RGGI is projected to avoid 180 million metric tons of carbon dioxide emissions in total from 2022 to 2030. This emissions reduction would have the same climate benefit as preventing emissions over the same time period from either over 40 million passenger vehicles, over 48 average-sized coal-fired power plants, over 21 million homes’ energy use, or over 31 million homes’ electricity use.⁵⁷

IV. Economic Benefits of RGGI

Pennsylvania can build upon the decade-long experience and lessons of the RGGI program to maximize both emission reductions and economic benefits of the program. According to RGGI Inc., the RGGI program has reduced carbon emissions in the region by about 45 percent since 2005. The program has ensured a steady and durable decline in emissions—that persisted even in the recovery following the Great Recession. A 2015 analysis by Duke University’s Nicholas Institute found that “after the introduction of RGGI in 2009 the region's emissions would have been 24 percent higher without the program, accounting for about half of the region's emissions reductions during that time, which were far greater than those achieved in the rest of the United States.”⁵⁸ RGGI states have committed to build on this progress, with the program poised to deliver an additional 30 percent reduction in emissions by 2030. While further near- and long-term reductions will be necessary, locking in these emission reduction commitments now is essential to keep us on the trajectory to achieve our long-term climate goals and will ensure that RGGI states remain climate leaders and are well-positioned for the zero-carbon future. Figure 1 below from the Congressional Research Service, the non-partisan research arm of the US Congress, shows the emissions declines that occurred in RGGI states over the life of the program and the limits adopted through 2030.⁵⁹

Figure 1

Observed Emissions and the Original and Revised Caps











Source: Prepared by CRS; observed state emission data (2000-2018) provided by RGGI.

As a cap-and-trade (or cap-and-invest) program, RGGI has returned nearly \$3 billion⁶⁰ to participating states for investment in a variety of programs and projects to further emission reductions, deploy energy efficiency and renewable energy, provide electric bill assistance to consumers, and for worker training. The table below (Figure 2) synthesizes key outcomes from the RGGI program from investments made in 2017.

Figure 2

Table 1: Benefits of 2017 RGGI Investments

Category	Annual Benefits of 2017 Investments	Lifetime Benefits of 2017 Investments
 Participating Households	Program*: 294,787 Direct Bill Assistance: 100,057	N/A
 Participating Businesses	3,331	N/A
 Workers Trained	83	N/A
 Short Tons CO ₂ Avoided	438,099	8,258,236
 Equiv. Cars Off Road	84,381	1,590,604
 Megawatt-Hours Saved	699,019	13,913,252
 MMBtu Saved	1,424,199	22,637,135
 Energy Bill Savings	\$128,704,015	\$1,400,088,616

*Participants in all programs other than direct bill assistance.

Source: RGGI Inc.⁶¹

According to electricity bill analysis⁶² from the Analysis Group, the average monthly residential electricity bill will be 35 percent lower in 2031 than it is today in the RGGI region⁶³ due to investments made by member states in energy efficiency and through direct bill assistance, *even as the program ratchets down emissions by 30 percent*. Another analysis looking at employment impacts of RGGI found that “the net effect is that RGGI activity during the 2015-2017 period leads to over 14,500 new job-years, cumulative over the study period, with each of the nine states experiencing net job-year additions.”⁶⁴

There is no one-size-fits-all approach on how best to cost-effectively reduce carbon pollution. By developing a market-based program that can link with RGGI, Pennsylvania can be part of a larger marketplace to buy and sell emission allowances, which can lower the cost of compliance in Pennsylvania. Pennsylvania would not have to link with RGGI to have an effective market-based program to reduce carbon, but as we have seen in many other states, collaborating with other states can lead to cheaper pollution reductions, added flexibility for regulated entities, innovation, and better environmental outcomes. Indeed, analysis has shown that the market-based Acid Rain Program, for example, cost less than a non-market-based approach would have.⁶⁵ Linking to RGGI does not in any way limit the autonomy of Pennsylvania to devise and implement a Pennsylvania-led solution. Instead, it allows the state to capitalize on a large regional marketplace and play a leading role in creating value for the pollution reductions made in Pennsylvania.

Market dynamics continue to shift towards cost-effective cleaner energy, making Pennsylvania’s linkage with RGGI particularly timely. Putting in place a program that limits the overall allowable level of pollution can also ensure that the value of existing zero-emissions capacity in the state is more appropriately reflected in the energy market, and can help prevent the premature retirements that would make it more challenging to meet short-term and long-term emission goals. This

proposal will ensure emissions continue to go down and that the state is better-positioned and remains competitive as the nation moves towards a net-zero emissions future.

Many major electric generators and distributors in Pennsylvania have already committed to action in line with RGGI. Exelon's owned generation fleet carbon pollution emission rate is already 90 percent lower than the industry average.⁶⁶ Met-Ed, Penelec, Penn Power, and West Penn Power, which are all FirstEnergy (Energy Harbor) Companies, have committed to a 90 percent reduction in carbon pollution below 2005 levels by 2045.⁶⁷ PPL has committed to reducing carbon pollution by 80 percent below 2010 levels by 2050 across its fleet of plants that operate in multiple states.⁶⁸ In fact, the vast majority of customers in Pennsylvania are served by utilities that have made emission reduction commitments.⁶⁹ RGGI helps provide the means for both utilities and their customers to beneficially reach these goals.

There is a growing consensus among industry, investors, and businesses, both nationally and in Pennsylvania, of the importance of implementing decarbonization strategies and propelling clean energy improvement and investment. Those same voices support the market-based advantages of programs like RGGI to provide flexibility and certainty in those efforts. Pennsylvania would be taking a critical step toward preserving its role as an energy leader and innovator by advancing this proposed rulemaking.

V. Health Impacts

In addition to the climate impacts of power sector emissions, conventional pollutants such as PM2.5, NOx, SOx, and heavy metals emitted alongside greenhouse gasses have serious consequences for the health of Pennsylvanians. Pennsylvania's power sector is especially dirty in this respect: in 2019, the Pennsylvania power sector was the 6th and 9th highest emitter of sulfur dioxide and nitrogen oxide in the country, respectively.⁷⁰ Both of these pollutants are damaging to human health on their own and also react to form other health-harming pollutants. Nitrogen oxides react with other pollution to form ozone, also known as smog, which can trigger asthma attacks and cause lung damage. In the 2020 American Lung Association "State of the Air" report, nine Pennsylvania counties, including Philadelphia and Allegheny counties, received failing grades for ozone pollution levels, and Allegheny also received a failing grade for particle pollution levels.⁷¹

While the health burden of these pollutants has been well established, new studies continue to show just how deadly power sector pollution can be. A study published in October 2020 in *Lancet Planet Health* shows a clear association between annual PM2.5 exposure and hospital admissions for Parkinson's disease and Alzheimer's disease.⁷² A second study published in *Science Advances* in November 2020 found that higher historical PM2.5 exposures were associated with higher county-level COVID-19 mortality rates.⁷³ A 2019 study from the University of Minnesota makes it clear that these health burdens are not borne evenly.⁷⁴ Non-Hispanic whites are exposed to less air pollution than is caused by their consumption of goods and services, while Black and Hispanic populations are exposed to 56 percent and 63 percent, respectively, more pollution than is caused by their consumption.

The positive health impacts of linking with RGGI are proven – a 2017 report on the public health impacts of RGGI from 2009 to 2014 found that "the RGGI program improved air quality throughout the Northeast states and created major benefits to public health and productivity,

including avoiding hundreds of premature deaths and tens of thousands of lost work days.”⁷⁵ The cumulative RGGI health benefits from 2009 to 2014 include avoiding:

- 300-830 premature adult deaths
- 35-390 non-fatal heart attacks
- 420-510 cases of acute bronchitis
- 8,200-9,900 asthma exacerbations
- 13,000-16,000 respiratory symptoms
- 180-220 hospital admissions
- 200-230 asthma ER visits
- 39,000-47,000 lost workdays

These benefits total a value of up to \$8.3 billion, primarily due to the reduction of levels of fine particulate matter. Every state participating in RGGI as well as some neighboring states –including Pennsylvania – experienced the health benefits of the pollution reduction. In fact, from 2009-2014 some counties in Eastern Pennsylvania experienced a cumulative health benefit of over \$50,000,000 from RGGI.

The most dramatic health benefits across the Northeast were experienced in 2009, at the beginning of the program, suggesting that by linking with RGGI Pennsylvania could see a dramatic and immediate improvement in public health outcomes.

A follow-up study by the Columbia University School of Public Health found that the initial 2017 study had actually *underestimated* the health benefits of RGGI by failing to comprehensively capture the health benefits to children. This July 2020 study found that in the same period of 2009-2014, pollution reductions from RGGI avoided 112 preterm births, 56 cases of term low birth weight and 537 asthma cases among children.⁷⁶ The associated avoided cost estimate ranges from \$191 to \$350 million, over twenty times higher than an earlier estimate.

By linking with RGGI, Pennsylvania has the opportunity to slash deadly air pollution and protect the health of its residents. DEP modeling found that by linking with RGGI, Pennsylvania could reduce 112,000 tons of NO_x emissions and 67,000 tons of SO_x emissions.⁷⁷ DEP’s analysis also finds that these emissions reductions will prevent myriad harmful health impacts including avoiding hundreds of premature deaths and tens of thousands of hospital visits. The proven track record for health improvements under RGGI shows just how much Pennsylvanians have to gain from this program, which could save hundreds of lives and improve quality of life for residents across the Commonwealth.

VI. Emissions Budget

DEP’s proposed starting emissions budget of 78 million tons in 2022, with a decline to approximately 58 million tons in 2030, would significantly reduce power sector emissions in Pennsylvania, relative to both a business-as-usual (BAU) scenario and from current levels. This proposed emissions budget is imminently achievable and cost-effective, as demonstrated by DEP’s economic and power sector modeling⁷⁸ which showed 27,000 net jobs created, a nearly \$2 billion increase in state GDP, and long-term increases in Disposable Personal Income. Modeling conducted by EDF and MJ Bradley & Associates (discussed further below) also shows that allowance prices

are expected to remain under \$10 per ton through 2030, demonstrating the achievability and cost-effectiveness of the program. Prior modeling also found that linking with RGGI and designing the program in a way that ensures all electric power in Pennsylvania is covered under the emissions budget would produce roughly \$200 million in net savings for Pennsylvania in 2030 compared to a BAU with no carbon limit.⁷⁹ Resources for the Future also conducted analysis similarly found that linking with RGGI could lead to significant carbon pollution reductions in Pennsylvania with no observable increases in electricity prices.⁸⁰

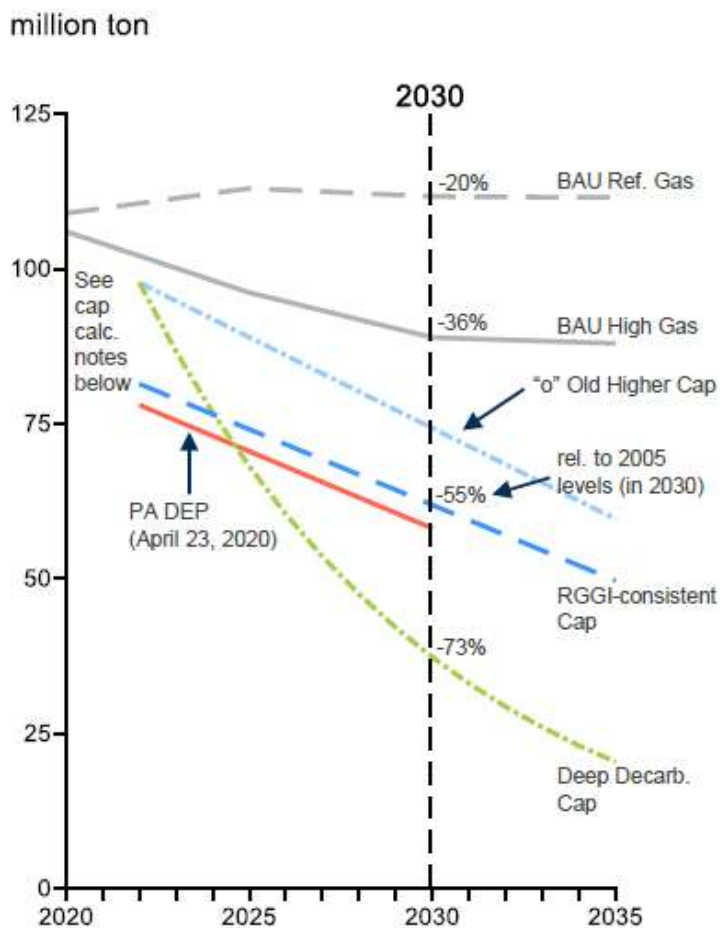
By placing an enforceable limit on the power sector, Pennsylvania protects against emissions increases expected to occur by the middle of the decade due to low natural gas prices and locks in reductions to well below projected BAU levels. EDF and M.J. Bradley & Associates have undertaken modeling analysis in the past two years to examine the implications of Pennsylvania setting a binding, declining power sector emissions budget for the state and a projected 12-state RGGI region.⁸¹ The latest analysis completed in 2020 compared a RGGI-consistent trajectory, based on a level close to DEP's proposed emissions budget of 78 million tons (81.4 million tons in 2022 declining to 61.9 million tons in 2030), to a range of possible BAU scenarios and found substantial emission reductions compared to BAU for a range of natural gas prices.

Based on the analysis, a RGGI-consistent emissions budget trajectory in the 12-state RGGI region, including Pennsylvania, would reduce annual climate warming emissions by 43 million tons in 2030 across the RGGI region compared to the scenario where Pennsylvania does not put a limit on power sector emissions.

The results show that even while emissions have declined in recent years it is anticipated they will start to rise in the middle of the decade under a business-as-usual scenario,⁸² depending on natural gas prices. A RGGI-consistent emissions budget in Pennsylvania goes far beyond what the state could achieve without a limit on carbon. Importantly, participation in RGGI will bring Pennsylvania much closer to meeting its climate goals and a fully decarbonized power sector, which will not be achieved under BAU.

Figure 3

Pennsylvania



Notes:
 reflects emissions from all in-state EGUs including those not covered under RGGI (i.e., those under 25 MW of capacity)
 2. RGGI-consistent cap calculations generally follow the methodology used by the states of NJ and VA—i.e., cap starts at projected BAU for the year in which cap goes into effect and declines each year thereafter by 3 percent of the starting year cap level. As such, starting year cap levels and subsequent trajectories calculated using this methodology are highly dependent on BAU assumptions including natural gas prices
 3. This modeling was not designed to explore the level at which CO₂ caps should be set, but rather to explore power flows and leakage dynamics in the wider region
 4. Old Higher Cap is from the 2019 modeling analysis

The analysis also shows that the benefits of the program continue to accrue with even more ambitious emission budgets, and an emission reduction trajectory aligned with deep decarbonization is imminently feasible for the region. A deep decarbonization trajectory that gets close to zero by 2040 with a leakage mitigation mechanism in place could reduce annual emissions 111 million tons across the Eastern Interconnect in 2030. Further, a deep decarbonization trajectory brings even more solar capacity into the region’s electricity generation mix and maintains all of the state’s existing nuclear fleet (except for retirements that have already been announced). Higher allowance prices resulting from a deep decarbonization trajectory would generate more proceeds for the state to invest in clean energy, energy efficiency, and other job-creating programs.

We recommend that DEP consider a more protective emissions budget to lock in additional reductions. As shown in the chart above, Pennsylvania should consider ensuring a reduction of over 70 percent in 2030, compared to 2005 levels, to stay on track for long-term goals to achieve a fully decarbonized power sector around 2040. Even higher ambition by the end of the decade is likely to

be necessary to be consistent with President-Elect Biden’s call to achieve a zero-emission electric power sector by 2035.⁸³ Under a more protective emissions budget with leakage mitigation, nuclear generation in Pennsylvania almost quadruples (essentially retaining all the existing nuclear on the system except for announced retirements) and solar generation in the state increases more than ten-fold in 2030, compared to a RGGI-consistent emission budget trajectory based on a level close to DEP’s proposed emission budget. A more protective emissions budget would also ensure greater emission reductions across the region and can help reflect changes that occurred in electricity use and generation due to the COVID-19 pandemic that would make a lower starting emissions budget in 2022 appropriate and effective.

VII. Environmental Justice

Pennsylvania must prioritize equity and justice in both the policy development process and overall program design. The pollution sources covered by this rule are significant contributors of localized air pollution that cause health problems. These burdens disproportionately fall on communities of color and communities with lower incomes because pollution impacts – both from fossil fuel development and generation – are most often concentrated in these communities. These communities often lack the resources to cope with climate change impacts like extreme heat, cold, and flooding, making them more vulnerable to both short- and long-term consequences of pollution. It is critical that the policy be designed to improve air quality, deploy clean energy, and distribute benefits to directly support the most burdened communities – including those communities impacted by energy transitioning – so every community can be healthy and thrive. Most importantly, the policy must reflect feedback received through a robust public engagement process that actively seeks input from those most impacted by air pollution from power plants and those affected by the implementation of the program.

Specifically, EDF and PEC recommend that DEP:

- Conduct a robust public engagement process that actively seeks input from communities most impacted by pollution from fossil-fueled development and power plants. The engagement process should be conducted in a way that ensures impacted communities have meaningful access, and the final policy should reflect the input collected through this process. The process should be ongoing and continue throughout implementation of the life of the program.
- Commit to ongoing monitoring of local air quality, especially in Environmental Justice areas (as defined by DEP), and address areas where local air quality is not improving or worsening after the implementation of the program. To ensure access and transparency, local air quality data should be regularly shared with impacted communities and the general public. To the extent it is available, baseline data that reflects local air quality prior to program implementation should be available for comparison to air quality data collected over the course of the program. DEP should also consider providing data broken down by region to help stakeholders understand localized impacts of the program. DEP should report annually on RGGI’s impacts on localized air pollution.
- In partnership with other agencies, as needed, identify communities whose workforces will be impacted by the transition to clean energy and implement strategies to support workforce transition in these communities. These strategies could include, but should not be limited to, establishing a Just Transition Office in partnership with Department of Community and Economic Development, to oversee transition programs, targeting job-creating clean energy

investments to impacted communities that are heavily dependent on fossil fuel jobs, providing financial support for communities reliant on income from coal plants that could face fiscal insolvency issues, and offering job-training opportunities to transition workers from fossil fuel jobs.

- Implement policies that are designed to direct air quality and economic benefits to communities disproportionately overburdened by air pollution. Strategies could include, but should not be limited to, dedicating a specified percentage of investments to benefit Environmental Justice communities, establishing an equitable green investment strategy, funding adaptation projects in communities that will face the worst impacts of climate change, and investing in renewable energy and energy efficiency projects in communities most overburdened by air pollution. These communities must have access to clean energy investments and job opportunities created from the energy transition. DEP should continue to engage directly with Environmental Justice communities to identify investment opportunities that address their specific needs. DEP should also ensure that funding opportunities are accessible to Environmental Justice communities and groups.
- Ensure any costs associated with the program do not disproportionately impact people with lower incomes. As energy costs make up a more significant portion of budgets for people with lower incomes, any impacts on electricity rates or other prices will be most felt by these residents. Partnering with the Public Utility Commission and others as appropriate, DEP should identify and put in place safeguards to prevent cost increases for people with lower incomes. This could include, but should not be limited to, direct bill assistance and funding renewable energy and energy efficiency programs that reduce dependence on grid-sourced electricity for communities with lower incomes.

In addition, the RGGI Equity Principles developed by DEP's Environmental Justice Advisory Board offer numerous critically important recommendations that should be pursued, including the establishment of an inter-agency group, as feasible, to maximize coordination around RGGI and the consideration of policies and programs outside of RGGI that can be deployed to reduce air pollution and further protections for public health, especially in areas most impacted by air pollution. DEP should continue to work closely with the Environmental Justice Advisory Board and other key stakeholders to ensure their input is incorporated and reflected in policy decisions. EDF and PEC also recommend that DEP consider the input received through the development of its revised EJ Public Participation Policy to ensure that feedback is reflected in the Department's approach to engaging the public, specifically in engaging overburdened communities.

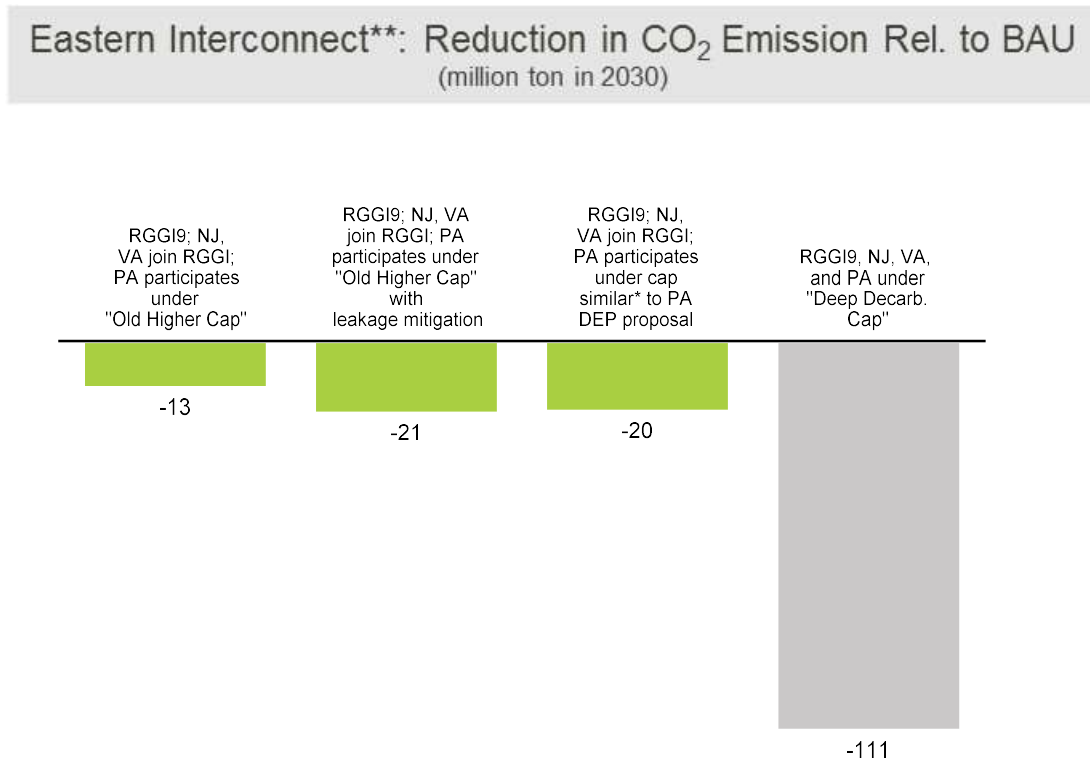
VIII. Regional Considerations

Emissions Leakage

Pennsylvania's linkage with RGGI will ensure power sector emissions decline in Pennsylvania and the region. An update to a previous analysis that EDF presented to PJM,⁸⁴ based on FACETS model runs of the U.S. electric sector, shows significant environmental benefits stemming from Pennsylvania's proposed plan to establish a budget for power sector carbon emissions and participate in RGGI. By putting its power sector emissions under an emissions budget, Pennsylvania's policy will reduce annual carbon emissions in the Eastern Interconnect by roughly 20 million tons in 2030. In other words, even after accounting for shifts in power generation among states in the region, including those participating in RGGI as well as others that do not, the

modeling results show that participation of Pennsylvania in RGGI results in a *net* reduction in carbon emissions (see Figure 4 below).

Figure 4
Eastern Interconnect⁸⁵ - Reduction in CO₂ Emission Relative to BAU
 (million ton in 2030)



This result demonstrates that while some emission leakage – the shifting of emissions out-of-state due to increased electricity imports – may occur, the magnitude is not large enough to significantly undo the climate benefits of Pennsylvania’s participation in RGGI, which results in a meaningful *net* reduction in carbon emissions below BAU levels in 2030. Even when emissions leakage is not mitigated, the vast majority of emissions reductions (nearly two-thirds) achieved by Pennsylvania are retained within the region under our modeling. This finding is consistent with 2019 modeling by Resources for the Future, which similarly projected about two-thirds of the emissions reductions made by a Pennsylvania carbon limits program would be maintained even with leakage occurring.⁸⁶ While other studies may show varying levels of leakage due to differing assumptions regarding natural gas price trajectories, baseline resource mixes, continued availability of existing zero-carbon resources, etc., their findings are generally consistent in showing overall *net* emission reduction benefits of Pennsylvania participating in RGGI. Thus, we urge DEP to proceed with Pennsylvania implementing an emissions budget on its power generators and linking with RGGI.

In addition, we recommend that Pennsylvania undertake a process to identify an effective leakage mitigation mechanism such as placing emissions associated with imported electricity under the emissions budget, to ensure the state can achieve even greater regional reductions and ensure

greater net retention of reductions made by Pennsylvania's program. We strongly support DEP's continued partnership with the Public Utility Commission (PUC) to engage with PJM to "promote the integration of this program in a manner that preserves orderly and competitive economic dispatch within PJM and minimizes emissions leakage" and its continued participation in the PJM Carbon Pricing Senior Task Force.⁸⁷ Pennsylvania can be a leader in those conversations and work to ensure that regional and sub-regional carbon pricing mechanisms are adopted into PJM's wholesale electricity market. Several other RGGI states participate in PJM and have placed similar priority on addressing this issue.

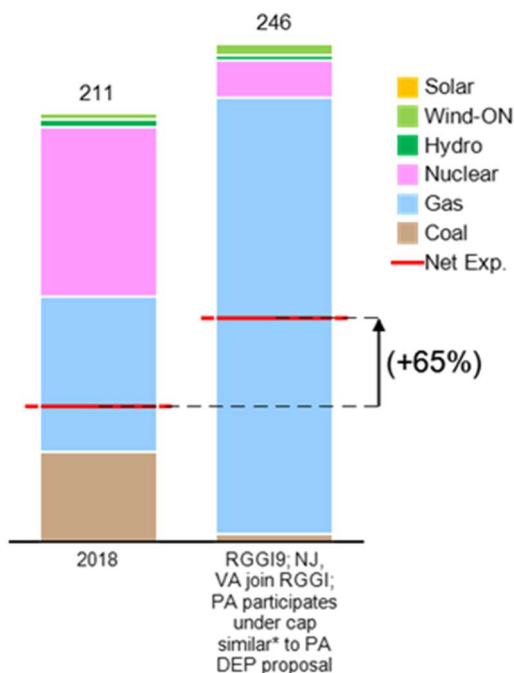
We also note that DEP can take steps to partner with PJM to monitor any emissions leakage that may occur as a result of implementing RGGI and respond accordingly. We recommend that DEP and the PUC request any information from PJM that may be necessary or helpful to assess and minimize emissions leakage. One additional option, as noted above, that we recommend DEP consider is covering imported power under the emissions budget. This option would require partnership with PJM for necessary data and updates to its framework, but would be an effective way to ensure Pennsylvania's imported power faces the same regulatory system and cost for carbon emissions as in-state resources. EDF will include its own proposed framework as Attachment A to these comments.

Electricity Exports

The modeling also found, consistent with DEP's finding, that Pennsylvania can implement RGGI while maintaining significant electricity exports. The modeling results show a 65 percent increase in net exports in 2030 compared to 2018, as shown in Figure 5 below. This indicates that Pennsylvania can continue to generate revenue by exporting electricity while simultaneously reducing its climate impact. Most of these exports are to other RGGI states, so the overall pollution from the region is not affected.

Figure 5

**In-state Generation Mix and Est. Exports in Pennsylvania
2030**



IX. Waste Coal Set-Aside

While we recognize the remediation benefits provided by the waste coal industry in Pennsylvania, using waste coal as an energy source still produces climate-warming carbon dioxide emissions and local pollutants, like sulfur dioxide and nitrogen oxides, that harm air quality. The waste coal set-aside mitigates the incentive to reduce the environmental harm caused by these emissions. We suggest the following modifications to the waste coal set-aside in order to improve the potential to drive reductions in carbon dioxide pollution – and associated co-pollutant benefits – at these specific facilities and protect air quality across the Commonwealth.

These comments are also informed by separate policy incentives that have been enacted to support waste coal, including both tax incentives⁸⁸ and recent changes to the state Alternative Energy Portfolio Standards.⁸⁹

First, the program currently over-allocates allowances to the set-aside by setting it equal to the total of each waste coal-fired unit's highest year of CO₂ emissions from an identified 5-year period (equal to 9,300,00 tons). This creates an artificially high emissions budget that allows a greater aggregate level of emissions from these facilities than they have produced historically. The set-aside should not exceed the actual emissions from existing waste coal plants for the year during the 5-

year period in which they generated the greatest amount of emissions in aggregate. DEP should limit the size of the waste coal set-aside to no more than what the industry needs.

We also recommend that the strategic use set-aside not be contingent on unused allowances from the waste coal set-aside. The strategic use set-aside is intended to incentivize additional projects that reduce pollution and should be maintained regardless of how many emissions are produced by the waste coal industry.

Second, the set-aside should not be granted to facilities that are currently subject to any permit violations or enforcement proceedings regarding noncompliance with health and air quality protections. If a facility is not compliant with existing state or federal law – and is therefore damaging human health and the environment – the facility should be required to remedy the violation before being eligible for the set-aside.

Third, recipients of the set-aside should be required to submit a plan to either reduce their emissions by implementing both conventional pollution and GHG control technologies or commit to facility retirement by 2030. In addition to implementing available pollution controls, facilities should be required to install and operate monitoring programs to ensure that local air quality does not worsen.

Fourth, the definition of waste coal should be limited to coal abandoned prior to July 1982 and should not include any permitted disposal of coal refuse after that date.

Finally, the waste coal set-aside should have a prescribed sunset date of December 31, 2029. The Department would have the option before that date, after reviewing emission trends and the amount of pre-1982 waste coal remaining in the Commonwealth, to extend that sunset or otherwise modify the rulemaking. There should also be verification of actual remediation benefits of waste coal-fired facilities before any decision is made to continue the set aside.

X. Conclusion

EDF and PEC thank the DEP and EQB for advancing this critical rulemaking and the opportunity to provide comments. We support adoption of this rule as soon as possible to enable linkage with the RGGI program to commence no later than January 2022.

Sincerely,

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¹ Pennsylvania Executive Order 2019-01, Commonwealth Leadership in Addressing Climate Change and Promoting Energy Conservation and Sustainable Governance, signed January 8, 2019. Available at: <https://www.governor.pa.gov/newsroom/executive-order-2019-01-commonwealth-leadership-in-addressing-climate-change-and-promoting-energy-conservation-and-sustainable-governance/>

² Pennsylvania Executive Order 2019-07, Commonwealth Leadership in Addressing Climate Change through Electric Sector Emissions Reductions, signed October 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/>

³ 35 Pa. Stat. § 4001 et seq.

⁴ *Id.* Prior state legislation, the “Pennsylvania Greenhouse Gas Regulation Implementation Act,” imposed restrictions on the agency before DEP could submit a state plan pursuant to the federal Clean Power Plan, but did not otherwise limit DEP’s ability to adopt a state-only program to limit GHG emissions. 71 Penn. Stat. § 1362.1 *et seq.*

⁵ *Id.*

⁶ <https://www.dep.pa.gov/Business/Air/Pages/Methane-Reduction-Strategy.aspx>

⁷ APCA § 5(a)(1), 35 Pa. Stat. § 4005(a)(1).

⁸ 25 Pa. Code § 145.1 *et seq.*; 66 Fed. Reg. 43795 (Aug. 21, 2001) (EPA rule approving Pennsylvania State Implementation Plan); *see* 27 Pa.B. 5683 (Nov. 1, 1997) (establishing a program to limit NOx emissions from large fossil-fired combustion units), *available at* <https://www.pabulletin.com/secure/data/vol27/27-44/1776.html>; 29 Pa.B. 4899, *Interstate Ozone Transport Reduction* (Sep. 23, 2000) (final rule adopting 25 Pa. Code § 145, relating to allowance and budget trading program for NOx emissions), *available at* <https://www.pabulletin.com/secure/data/vol30/30-39/1632.html>.

⁹ 25 Pa. Code § 127.2061 *et seq.* (New Source Review permitting and offsetting new emissions with emissions reduction credits (“ERCs”)).

¹⁰ 25 Pa. Code § 127.448 (allows facilities with federally enforceable emissions caps to “trade increases and decreases in emissions between sources with Federally enforceable emissions caps at the permitted facility.”). *See also* 38 Pa.B. 1705 (Apr. 12, 2008); 25 Pa. Code § 123.106, § 123.107 (allowance transfer procedures), § 123.115 (initial allocation of allowances); § 127.531 (references use of acid rain allowances, and tracking of same pursuant to procedures established

in regulations promulgated under Title IV of the CAA”); 25 Pa. Code § 145 (regulations relating to Interstate Pollution Transport Reductions, including NOx budget trading program and CAIR NOx and SO2 trading programs).

¹¹ 38 Pa.B. 1705 (Apr. 12, 2008), *available at* <https://www.pbulletin.com/secure/data/vol38/38-15/667.html>; 25 Pa. Code §§ 123.106, 123.107 (allowance transfer procedures); 25 Pa. Code § 123.115 (initial allocation of allowances); 25 Pa. Code § 127.531 (references use of acid rain allowances, and tracking of same pursuant to procedures established in regulations promulgated under Title IV of the CAA”); 25 Pa. Code § 145 (regulations relating to Interstate Pollution Transport Reductions, including NOx budget trading program and CAIR NOx and SO2 trading programs).

¹² 38 Pa.B. 1705. (Section D).

¹³ 36 Pa.B. 3185 (Jun. 24, 2006) (proposed rulemaking); 37 Pa.B. 883 (Feb. 17, 2007) (Final rule to fulfill Pennsylvania’s requirements under CAMR, taken pursuant to DEP’s authority under APCA § 5(a)(1)); *see also* 40 Pa.B. 6517 (Nov. 13, 2010).

¹⁴ 25 PA Code § 123.201. CAMR was later invalidated by the D.C. Circuit on unrelated grounds. *New Jersey v. EPA*, 517 F.3d 574, 578 (D.C. Cir. 2008) (vacating EPA’s Delisting Rule and CAMR based on a CAA statutory violation); *see also PPL Generation, LLC v. Dept. of Envi’t Protection*, 986 A.2d 48, 61 (Pa. 2009) (vacating Pennsylvania mercury rule because it was based on CAMR).

¹⁵ APCA § 4(18), 35 Pa. Stat. Ann. § 4004(18).

¹⁶ APCA § 5 (a)(1), 35 Pa. Stat. Ann. § 4005(1).

¹⁷ APCA § 3, 35 Pa. Stat. Ann. § 4003, (emphasis supplied).

¹⁸ DEP also has separate authority to regulate “at the point of use,” which can also be relied upon to seek to reduce GHG emissions at locations other than the point of emission. APCA § 5(a)(2), 35 Pa. Stat. Ann. § 4005(a)(2).

¹⁹ 71 Pa. Cons. Stat. §§ 1361.3, 1361.7.

²⁰ Pennsylvania has previously used its authority to join interstate trading programs under APCA authority. For example, the state participated in an interstate NOx trading program through adoption of the Clean Air Interstate/ Rule (“CAIR”), pursuant to regulatory authority under APCA § 5(a)(1). 38 Pa.B. 1705 (Apr. 12, 2008) (adopting, via incorporation by reference, most of CAIR); 25 Pa. Code § 145.201 *et seq.*; *see* 37 Pa.B. 2063 (Apr. 28, 2007) (proposed rule to adopt CAIR). Any regulation adopted by DEP would need to go through the standard process of legislative review that all regulations undergo.

²¹ APCA, Section 4(24), 35 Pa. Stat. Ann. § 4004(24) (emphasis added).

²² The broad catchall authority of APCA section 4(27) to “do any and all other acts and things not inconsistent with any provision of this act” in order to enforce EQB regulations allows EQB to take such measures. APCA § 4(27), 35 Pa. Stat. Ann. § 4004(27). Contracting with a third party to effectively implement a trading program squarely qualifies as an enforcement action and thus would fall under the authority granted by the catchall provision section 4(27).

²³ APCA, § 6.3(a), 35 Pa. Stat. Ann. § 4006.3(a) (authorizing fees to support the air pollution control program authorized by the APCA and not covered by fees required by section 502(b) of the Clean Air Act).

²⁴ APCA, § 9.2, 35 Pa. Stat. Ann. § 4009.2.

²⁵ *Id.* (emphasis supplied).

²⁶ Climate Central, U.S. Warming by State (April 17, 2019) <https://www.climatecentral.org/gallery/maps/us-warming-by-state>

²⁷ States at Risk, States at Risk: America’s Preparedness Report Card (Nov. 2015)

<https://www.climatecentral.org/gallery/graphics/states-at-risk-a-preparedness-report-card>

²⁸ Climate Central, More Extremely Hot Days (Jul. 10, 2019) <https://www.climatecentral.org/gallery/graphics/more-extremely-hot-days-2019>

²⁹ Climate Central, American Warming: The Fastest-Warming Cities and States in the U.S. (2019, April 17)

<https://www.climatecentral.org/news/report-american-warming-us-heats-up-earth-day>

³⁰ Climate Central, Blistering Future Summers for 1,001 U.S. Cities (Aug. 1, 2014)

<https://www.climatecentral.org/news/summer-temperatures-co2-emissions-1001-cities-16583>

³¹ Climate Central, Steamier Summers (July 6, 2016) <https://medialibrary.climatecentral.org/resources/steamier-summer-dewpoint>

³² Climate Central, This News Bites: More Mosquito Days (Jul 29, 2020)

<https://medialibrary.climatecentral.org/resources/more-mosquito-days>

³³ Pennsylvania Department of Environmental Protection, Climate Impacts: A Changing Pennsylvania (2018)

<https://www.dep.pa.gov/Citizens/climate/Pages/impacts.aspx>

³⁴ *Id.*

³⁵ Hsiang et al. (2017) Estimating economic damage from climate change in the United States. *Science*.

<http://www.impactlab.org/research/estimating-economic-damage-from-climate-change-in-the-united-states/>

³⁶ Pennsylvania Department of Environmental Protection, Climate Impacts: A Changing Pennsylvania (2018)

<https://www.dep.pa.gov/Citizens/climate/Pages/impacts.aspx>

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- ³⁷ Climate Central, Across U.S., Heaviest Downpours on the Rise (May 27, 2015) <https://www.climatecentral.org/news/across-us-heaviest-downpours-on-the-rise-18989>
- ³⁸ States at Risk: America's Preparedness Report Card. (Nov. 2015) <https://www.climatecentral.org/gallery/graphics/states-at-risk-a-preparedness-report-card>
- ³⁹ Union of Concerned Scientists, Underwater: Rising Seas, Chronic Floods, and the Implications for US Coastal Real Estate (2018) <https://www.ucsusa.org/global-warming/global-warming-impacts/sea-level-rise-chronic-floods-and-us-coastal-real-estate-implications>.
- ⁴⁰ Pennsylvania Department of Environmental Protection, Climate Impacts: A Changing Pennsylvania (2018) <https://www.dep.pa.gov/Citizens/climate/Pages/impacts.aspx>
- ⁴¹ *Id.*
- ⁴² Pennsylvania Public Utility Commission, Electric Service Reliability in Pennsylvania, 2019. Available at: https://www.puc.pa.gov/General/publications_reports/pdf/Electric_Service_Reliability2019.pdf
https://www.puc.pa.gov/General/publications_reports/pdf/Electric_Service_Reliability2019.pdf
- ⁴³ States at Risk: America's Preparedness Report Card. (Nov. 2015) <https://www.climatecentral.org/gallery/graphics/states-at-risk-a-preparedness-report-card>
- ⁴⁴ Climate Central, Natural & Human-caused Coastal Flood Days in the U.S. (Feb. 23, 2016) <https://www.climatecentral.org/gallery/graphics/natural-human-caused-coastal-flood-days-in-the-us1>
- ⁴⁵ States at Risk: America's Preparedness Report Card. (Nov. 2015) <https://www.climatecentral.org/gallery/graphics/states-at-risk-a-preparedness-report-card>
- ⁴⁶ *Id.*
- ⁴⁷ Hsiang et al. (2017) Estimating economic damage from climate change in the United States. *Science*. <http://www.impactlab.org/research/estimating-economic-damage-from-climate-change-in-the-united-states/>
- ⁴⁸ See Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C. Available at: <https://www.ipcc.ch/sr15/chapter/spm/>. Note that model emissions pathways consistent with limiting warming to 1.5°C include reducing net carbon dioxide emissions to 45 percent below 2010 levels by 2030 and reaching net zero around 2050. Half of pathways consistent with limiting warming to 1.5°C show a reduction of 40 to 50 percent below 2010 levels by 2030 for the sum of all greenhouse gas emissions, using the standard carbon dioxide-equivalent metric with a 100-year GWP. We note that this is a simplification of specific actions needed to address long-lived and short-lived climate pollutant emissions; for example, long-lived pollutants will eventually need to reach net zero, whereas short-lived climate pollutants will need their emissions rates reduced but not to a level of zero. However, given that the policy community is focused on combined carbon dioxide-equivalent targets, we aim to be consistent with that approach in this analysis. Therefore, we use a reduction of 45 percent below 2010 levels by 2030 for all GHGs in this analysis to represent a pathway consistent with limiting warming to 1.5°C. We refer to this benchmark as the IPCC average pathway for a 1.5°C target for 2030 throughout this report.
- ⁴⁹ This report uses Global Warming Potentials (GWP) with 100-year time horizons, according to IPCC AR4.
- ⁵⁰ Pennsylvania Department of Environmental Protection, 2020 Pennsylvania Greenhouse Gas Inventory Report (Jul. 2020) <https://www.dep.pa.gov/citizens/climate/Pages/GHG-Inventory.aspx>
- ⁵¹ Equivalencies calculated using the EPA's Greenhouse Gas Equivalencies Calculator.
- ⁵² EPA, State CO₂ Emissions from Fossil Fuel Combustion, 1990-2018, https://www.epa.gov/sites/production/files/2020-10/documents/state_co2_emissions_from_fossil_fuel_combustion_1990-2018.pdf
- ⁵³ U.S. EIA, Pennsylvania Electricity Profile 2019, <https://www.eia.gov/electricity/state/pennsylvania/>
- ⁵⁴ Environmental Defense Fund, Turning Climate Commitments into Results: Progress on State-led Climate Action (Dec. 2020) [https://www.edf.org/sites/default/files/documents/FINAL_State percent20Emission percent20Gap percent20Analysis.pdf](https://www.edf.org/sites/default/files/documents/FINAL_State%20Emission%20Gap%20Analysis.pdf)
- ⁵⁵ Pennsylvania Department of Environmental Protection, Proposed Rulemaking, PA CO₂ Budget Trading Program. Proposal
- ⁵⁶ Equivalencies calculated using the EPA's Greenhouse Gas Equivalencies Calculator.
- ⁵⁷ Equivalencies calculated using the EPA's Greenhouse Gas Equivalencies Calculator.
- ⁵⁸ Brian C. Murray, Peter T. Maniloff, Why have greenhouse emissions in RGGI states declined? An econometric attribution to economic, energy market, and policy factors, *Energy Economics*, Volume 51, 2015, Pages 581-589, ISSN 0140-9883, <https://doi.org/10.1016/j.eneco.2015.07.013>.
- ⁵⁹ Congressional Research Service, The Regional Greenhouse Gas Initiative: Background, Impacts, and Selected Issues, Updated July 16, 2019. Available at: <https://fas.org/sgp/crs/misc/R41836.pdf>
- ⁶⁰ Analysis Group, The Economic Impacts of the Regional Greenhouse Gas Initiative on Nine Northeast and Mid-Atlantic States, April 2018. Available at:

https://www.analysisgroup.com/globalassets/uploadedfiles/content/insights/publishing/analysis_group_rggi_report_april_2018.pdf

⁶¹ RGGI Inc., The Investment of RGGI Proceeds in 2017, October 2019. Available at:

https://www.rggi.org/sites/default/files/Uploads/Proceeds/RGGI_Proceeds_Report_2017.pdf

⁶² Analysis Group, IPM Potential Scenario Customer Bill Analysis, September 2017. Available at:

[https://www.rggi.org/sites/default/files/Uploads/Program-Review/9-25-](https://www.rggi.org/sites/default/files/Uploads/Program-Review/9-25-2017/Customer_Bills_Results_Overview_09_25_17.pdf)

[2017/Customer_Bills_Results_Overview_09_25_17.pdf](https://www.rggi.org/sites/default/files/Uploads/Program-Review/9-25-2017/Customer_Bills_Results_Overview_09_25_17.pdf)

⁶³ Analysis does not include New Jersey, which rejoined RGGI in 2020 or Virginia, which joined RGGI in January 2021.

⁶⁴ Analysis Group, The Economic Impacts of the Regional Greenhouse Gas Initiative on Nine Northeast and Mid-Atlantic State, April 2018. Available at:

https://www.analysisgroup.com/globalassets/uploadedfiles/content/insights/publishing/analysis_group_rggi_report_april_2018.pdf

⁶⁵ Schmalensee, Richard and Robert N. Stavins, The SO₂ Allowance Trading System: The Ironic History of a Grand Policy Experiment, *Journal of Economic Perspectives*—Volume 27, Number 1—Winter 2013—Pages 103–122.

Available at: <https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.27.1.103>

⁶⁶ Exelon, “Sustainability,” <https://www.exeloncorp.com/sustainability>. Accessed January 14, 2021.

⁶⁷ 90 percent reduction in carbon pollution below 2005 levels by 2045⁶⁷

⁶⁸ PPL Website, “Climate Action,” [https://www.pplweb.com/sustainability/climate-action/80 percent below 2010 levels by 2050](https://www.pplweb.com/sustainability/climate-action/80-percent-below-2010-levels-by-2050). Accessed January 14, 2021.

⁶⁹ Smart Electric Power Alliance, “Utilities’ path to a carbon-free energy system by 2050,” <https://sepapower.org/utility-transformation-challenge/utility-carbon-reduction-tracker/>. Accessed January 14, 2021. <https://sepapower.org/utility-transformation-challenge/utility-carbon-reduction-tracker/>

⁷⁰ EIA State Electricity Profiles <https://www.eia.gov/electricity/state/pennsylvania/>

⁷¹ ALA State of the Air Report <https://www.stateoftheair.org/city-rankings/states/pennsylvania/>

⁷² Long-term effects of PM_{2.5} on neurological disorders in the American Medicare population: a longitudinal cohort study [https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196\(20\)30227-8/fulltext](https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(20)30227-8/fulltext)

⁷³ Wu et al, (2020) “Exposure to air pollution and COVID-19 mortality in the United States: A nationwide cross-sectional study,” *Science Advances*, 04 Nov 2020: Vol. 6, no. 45, eabd4049, DOI: 10.1126/sciadv.abd4049. Available at: <https://advances.sciencemag.org/content/6/45/eabd4049/tab-pdf>

<https://www.medrxiv.org/content/10.1101/2020.04.05.20054502v2>

⁷⁴ Christopher W. Tessum, Joshua S. Apte, Andrew L. Goodkind, Nicholas Z. Muller, Kimberley A. Mullins, David A. Paolella, Stephen Polasky, Nathaniel P. Springer, Sumil K. Thakrar, Julian D. Marshall, and Jason D. Hill. Inequity in consumption of goods and services adds to racial–ethnic disparities in air pollution exposure. *Proceedings of the National Academy of Sciences*, March 11, 2019; DOI: 10.1073/pnas.1818859116. Available at:

<https://www.sciencedaily.com/releases/2019/03/190311152735.htm>

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⁷⁵ Abt and Associates, Analysis of the Public Health Impacts of the Regional Greenhouse Gas Initiative, 2009–2014, 2017. Available at: <https://www.abtassociates.com/insights/publications/report/analysis-of-the-public-health-impacts-of-the-regional-greenhouse-gas>

⁷⁶ Perera et al., *Co-Benefits to Children’s Health of the U.S. Regional Greenhouse Gas Initiative*, *Environmental Health Perspectives*, July 29, 2020. Available at: <https://ehp.niehs.nih.gov/doi/10.1289/EHP6706>

⁷⁷ Pennsylvania DEP, Regional Greenhouse Gas Initiative, <https://www.dep.pa.gov/Citizens/climate/Pages/RGGI.aspx>

⁷⁸ Pennsylvania DEP, Regional Greenhouse Gas Initiative, Power Sector Modeling and Economic Sector Modeling,

<https://www.dep.pa.gov/Citizens/climate/Pages/RGGI.aspx>

⁷⁹ Environmental Defense Fund and Michael J. Bradley & Associates, Electric Sector Modeling – Summary of Results. Available at <https://www.pjm.com/-/media/committees-groups/task-forces/cpstf/20191024/20191024-item-06-carbon-pricing-modeling.ashx>

⁸⁰ Resources for the Future, Options for Issuing Emissions Allowances in a Pennsylvania Carbon Pricing Policy, October 2019. Available at: <https://www.rff.org/publications/issue-briefs/options-issuing-emissions-allowances-pennsylvania-carbon-pricing-policy/> Resources for the Future, no observable increases in electricity prices

⁸¹ Note: The EDF-M.J. Bradley analysis was based on policy specifications, inputs, and assumptions developed by M.J. Bradley & Associates at the direction and on behalf of EDF, with feedback from participating stakeholder companies. The analysis is generally consistent with major findings from DEP and we are describing it for illustrative purposes, but underscore that DEP’s economic and power sector modeling is an eminently reasonable assessment of the impacts of Pennsylvania linking with RGGI. For further details on the analysis see:

<http://blogs.edf.org/climate411/2020/08/13/updated-analysis-strengthens-the-case-for-pennsylvanias-cap-on-power-sector-emissions/>

⁸² Emissions projections vary based on modeling inputs. Natural gas price assumptions, in particular, having significant impacts on results.

⁸³ The Biden Plan to Build a Modern, Sustainable Infrastructure and an Equitable Clean Energy Future. Available at: <https://joebiden.com/clean-energy/>

⁸⁴ Environmental Defense Fund and Michael J. Bradley & Associates, Electric Sector Modeling – Summary of Results. Available at: <https://www.pjm.com/-/media/committees-groups/task-forces/cpstf/20191024/20191024-item-06-carbon-pricing-modeling.ashx>

⁸⁵ Includes all U.S. states that are partially or wholly within the Eastern Interconnect.

⁸⁶ Resources for the Future, State Policy Options to Price Carbon from Electricity, May 2019. Available at: https://www.rff.org/publications/reports/state-policy-options-price-carbon-electricity/?utm_source=Resources+for+the+Future&utm_campaign=c9ccee8342-EMAIL_CAMPAIGN_2019_02_12_04_25_COPY_01&utm_medium=email&utm_term=0_e896179bd7-c9ccee8342-100114821

⁸⁷ Pennsylvania Department of Environmental Protection, Regulatory Analysis Form, CO2 Budget Trading Program, available at:

http://files.dep.state.pa.us/PublicParticipation/Public%20Participation%20Center/PubPartCenterPortalFiles/Environmental%20Quality%20Board/2020/September%2015/04-7-559-CO2%20Budget%20Trading-Proposed_RAF%20.pdf.

⁸⁸ The Coal Refuse Energy and Reclamation Tax Credit.

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