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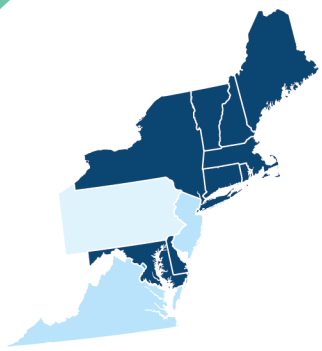

REGIONAL GREENHOUSE GAS INITIATIVE

Findings and Recommendations for the Third Program Review

APRIL 2023

EMISSIONS REDUCTIONS

ELECTRICITY PRICES

HEALTH

ENVIRONMENTAL JUSTICE IMPACTS

ECONOMIC GROWTH

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Acknowledgements:

Acadia Center would like to thank our coalition partners for their review and insights in developing this report, especially Alternatives for Community & Environment, GreenRoots Inc., American Lung Association of Connecticut, Save the Sound, Connecticut Coalition for Economic and Environmental Justice, and Dr. Mark Mitchell of the Connecticut Equity and Environmental Justice Advisory Council (CEEJAC) for their input regarding the data needed to best assess impacts of RGGI on environmental justice communities.

Executive Summary

The Regional Greenhouse Gas Initiative (RGGI) is a market-based, cap-and-invest greenhouse gas reduction program by 12 states in the Northeast and Mid-Atlantic designed to limit the amount of carbon dioxide pollution (CO_2) from electricity generating plants in the region. Since 2008, RGGI has assisted the participating states in achieving notable reductions in CO_2 and other criteria pollutants from the electric power sector. RGGI has been a pioneer of climate policy, generating $6.2 billion in proceeds for participating states over the last 14 years. RGGI is the United States' first multi-state program designed to reduce climate change-causing pollution from power plants and has provided a wealth of lessons to be incorporated into the next generation of climate policies, including successes to build on and opportunities for improvement.

Acadia Center's previous report on RGGI, **RGGI: Ten Years in Review**, was published in 2019. Since 2019, RGGI has experienced various changes, including welcoming two new states, New Jersey and Virginia, and the potential to welcome Pennsylvania soon. Additionally, the RGGI program introduced a new market mechanism – the Emissions Containment Reserve (ECR). Introduced in 2021, the ECR is designed to provide states with the ability to force greater emissions reductions by withholding up to 10% of their emissions budget if auction prices are lower than projected.

The 9 states that have consistently participated in RGGI have experienced substantial benefits from RGGI since 2008, the year the program launched. Concerns that RGGI would make states less competitive have been directly refuted by RGGI's experience – instead, the RGGI states have experienced both a more rapid *increase* in GDP per capita and a more rapid *decline* in both power sector CO_2 emissions and retail electricity prices.

Between 2008 and 2021 the 9 consistent RGGI states have experienced:

- A nearly 50% reduction in CO_2 from power plants: 10% more than the 40 states that have not consistently had a price on greenhouse gas emissions, hereinafter "the rest of the country"
- An increase in economic growth per capita of 50%: 13% more than the rest of the country
- A decline in retail electricity prices of 3.2% compared to a 7.7% *increase* in prices for the rest of the country
- A 91% decline in electricity generated from coal, and an 808% growth in solar and wind

The objective of RGGI is, first and foremost, reducing greenhouse gas emissions while supporting economic growth. Although RGGI is not directly an air quality program, because it applies to power plants, it can be an effective vehicle to deliver reductions in criteria air pollutants and better outcomes to communities that are located near power plants. RGGI has delivered important ancillary benefits like an 85% reduction in nitrogen oxides (NOx) in RGGI-regulated power plants over the entire region. Criteria emissions, particularly NOx, can have significant detrimental health impacts including damaging the respiratory tract and increasing vulnerability to respiratory infections and asthma.

However, the approach of reducing CO_2 emissions in aggregate across the region does not necessarily result in a more rapid rate of decline in NOx emissions in EJ communities compared to other areas. Acadia Center analysis found that, between 2008 and 2021:

- NOx emissions from power plants within 3 miles of a community with high EPA Environmental Justice Socioeconomic Indicators ("EPA EJSI community," see sidebar for more information) declined by 85%, compared to the rest of the RGGI power plant fleet, where NOx emissions declined by 88%
- Over a third of RGGI plants that are releasing NOx emissions near communities suffering from disproportionately high rates of asthma
- Over two-thirds of RGGI plants do not have any active air quality monitoring sites within a 3-mile radius to measure the impact on neighboring communities – and over three quarters of these unmonitored plants are located near an EPA EJSI community or high asthma communities (see the highlight at the end of this section for more details on both community classifications)

Acadia Center analysis also found that although only 41% of the census tracts in the region are classified as EPA EJSI Communities, 81% of RGGI power plants are located within 3 miles of EPA EJSI Communities. Similarly, although only 11.5% of all census tracts in the region are considered high asthma communities, 37.5% of all RGGI plants were located within 3 miles of a high asthma community. Although complicated by the fact that the 3-mile radius around each power plant often touches multiple census tracts, this comparison suggests that RGGI plants may be more likely to be located within 3 miles of an EPA EJSI community or high asthma community than a random distribution would create.

To identify some of the most problematic power plants in the RGGI region, Acadia Center developed a power plant "NOx Pollution Threat Score". This score ranges from 1-100, with a score of 100 representing the plant in the region with the highest threat score, and is calculated based on three variables – in 2021: 1) How much NOx did the plant emit? 2) How many people were living within 3 miles of that plant? and 3) Using the seven EPA environmental justice socioeconomic indicators and the asthma prevalence indicator, what was the average 8-indicator percentile for all communities within 3 miles of the plant? Acadia Center developed a NOx Pollution Threat Score for all 277 RGGI-regulated plants and the 85 plants with at least one smaller (15 -25 MW) generating unit that would be covered by RGGI if the threshold were lowered to 15 MW. Using this analysis, we were able to identify both the top 10 plants overall by this metric and the top 10 plants that lack nearby air quality monitoring. Six of the ten plants on the overall list are located in the New York City metro area.

We identified a RGGI NOx Threat Ten list of power plants that should be considered as a starting point for targeted emissions reductions. This is an initial approach to identify the relative public health threat that these power plants' NOx emissions create to inform targeting of regulations and aid states in the crafting of an updated Model Rule. Acadia Center will be providing more input on how stakeholders can use the Pollution Threat Score going forward.

Recommendations for Third Program Review

The RGGI states are currently in the early stages of the Third Program Review, expected to conclude by the end of 2023. This Report makes several recommendations for the states to consider as they evaluate how to improve RGGI's emissions caps, market mechanisms, and model regulations to take the program beyond 2030. Specifically, Acadia Center recommends that the RGGI states act during the Third Program Review to:

Align the Cap and Market Mechanisms with State Law

- Use RGGI to accelerate decarbonization by setting the RGGI cap level no higher than the level of emissions allowed under state-level clean energy and GHG reduction laws in each of the relevant years. Such a level is significantly below the existing cap: overall, the 9-state "state goals cap" would need to decline 95% below 2021 emissions levels in the 9 states by 2050 and the 12-state "state goals cap" would need to decline 89% below 2021 emissions levels in the 12 states by 2050.

- Adjust the market mechanisms to better align with state decarbonization policies by: substantially raising the Cost Containment Reserve trigger price; increasing the Emissions Containment Reserve trigger price; and increasing both the Minimum Reserve Price and its rate of escalation to align with market prices from the most recent years' auctions more closely

Ensure Environmental Justice Communities Directly Benefit

- Clearly articulate how environmental justice (EJ) communities are being defined (see end of section for more information on how this Report uses this term)

- Establish a requirement that a minimum of 40%-50% of RGGI proceeds are invested in EJ communities, setting a value that does not change even if other RGGI funds are raided

- Establish a requirement that members of EJ communities have meaningful participation in decisions regarding programs for investment

- Transparently track whether programs identified as providing EJ community investments are meeting their quantitative metrics, and adjust programs as necessary to ensure the minimum percentage investment is achieved

- Centralize this information in a frequently updated public-facing report or dashboard that is easily accessible and understandable to a wide variety of stakeholders and utilizes standardized information, allowing aggregation across the RGGI region

Use the Power of Regional Cooperation to Improve Health & Air Quality

- Explore how regional cooperation and individual state powers to regulate air quality and power plants can improve the health of disproportionately burdened communities

- Agree to target accelerated decreases in NOx emissions at power plants that pose the largest respiratory health risk to environmental justice and high asthma communities, beginning with the RGGI NOx Threat Ten

- Increase funding for and enforcement of air quality monitoring, especially for EJ communities and areas

with disproportionately high incidence of asthma located within 3 miles of a RGGI plant. The Model Rule should mandate not only that the states secure better data, but also take action to address air quality issues shown by these new data.

Lower the Threshold Capacity for RGGI Regulation

- Lower the capacity that triggers RGGI regulation to include all generating units of 15 MW or higher, and potentially even lower for co-located units, as has been recommended by some environmental justice stakeholder groups.

- If these 240 generating units at 115 power plants were brought under the RGGI cap, they would comprise a relatively small 1.4% of total RGGI CO2 emissions, and 4.8% of total NOx emissions from RGGI plants. However, such a change could have a potentially significant impact on health, as 91% of these smaller generating units are located within a 3-mile radius of an EPA EJSI community or high asthma community. This could also generate an estimated $25.9 million in RGGI proceeds (using 2021 prices).

For the purposes of this Report, Acadia Center utilized the term environmental justice community (EJ community) to refer to environmental justice, frontline, and environmentally overburdened communities that have experienced disproportionate harm caused by the impacts of the fossil fuel economy. To identify the location of these EJ communities, Acadia Center utilized U.S. EPA's Environmental Justice Screening and Mapping Tool (EJScreen) Socioeconomic Indicators. The EPA EJScreen addresses seven different factors: income, race, education, unemployment, linguistic isolation, children under 5 years of age, and adults over 64. Throughout this Report, we refer to census tracts that exceed the 90th national percentile in at least one of these indicators as EPA Environmental Justice Socioeconomic Indicator communities ("EPA EJSI communities"). Acadia Center also identified census tracts that were above the 90th national percentile for percent of adults who have been told they have asthma according to data from the White House Council on Environmental Quality (CEQ) Climate and Economic Justice Screen Tool (CEJST) and refers to these communities throughout as "high asthma communities." See Part 3 of this Report for a more detailed explanation of our methodology and findings.

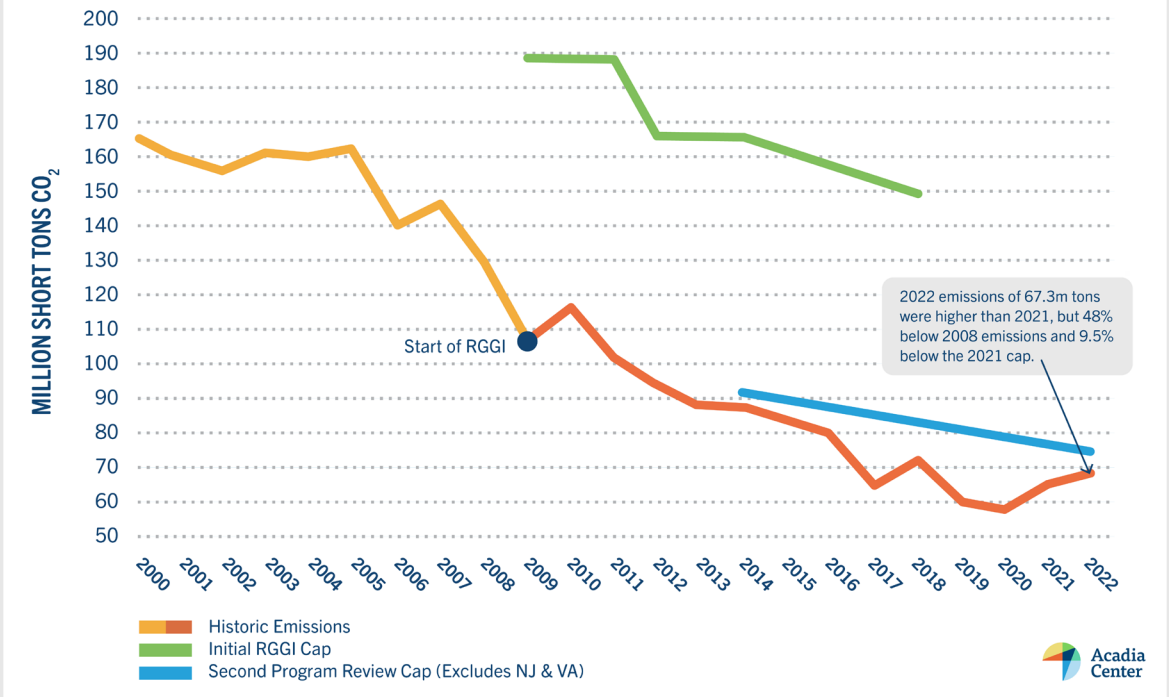
PART 1.
EMISSIONS TRENDS AND
RGGI CAP DYNAMICS

Rapid CO2 Reductions Continue to Outpace the Rest of the Country

The RGGI program limits annual CO2 emissions from power plants in participating states by requiring fossil fuel generators over a certain size to purchase allowances for each ton emitted. The number of allowances available for auction each year is set by a declining cap. The RGGI cap provides a high level of assurance that emissions will be reduced according to plan, as emissions cannot exceed the amount allotted, except in cases where reserve allowances are put on the market to keep prices within certain parameters.

To accurately evaluate the long-term impacts of RGGI participation, it is helpful to focus on the 9 states that have consistently participated in the program since its inception ("9 consistent RGGI states")[1]. Since 2008 in the 9 consistent RGGI states, CO2 emissions from the power sector have declined nearly 50%, from 129.4 million tons of CO2 in 2008 to 65.3 million tons of CO2 in 2021. Notably, the rate of decline of CO2 emissions in the power sector in the rest of the country [2] was only 40% during this same time period.[3] While the RGGI program has not been the sole factor driving rapid decarbonization of the electric sector in the 9 consistent RGGI states, earlier analysis identifies RGGI as a key driver of accelerated emissions reductions from power plants.[4]

FIGURE 1:
RGGI Cap and Historic Emissions – 9 Consistent RGGI States: 2000-2022



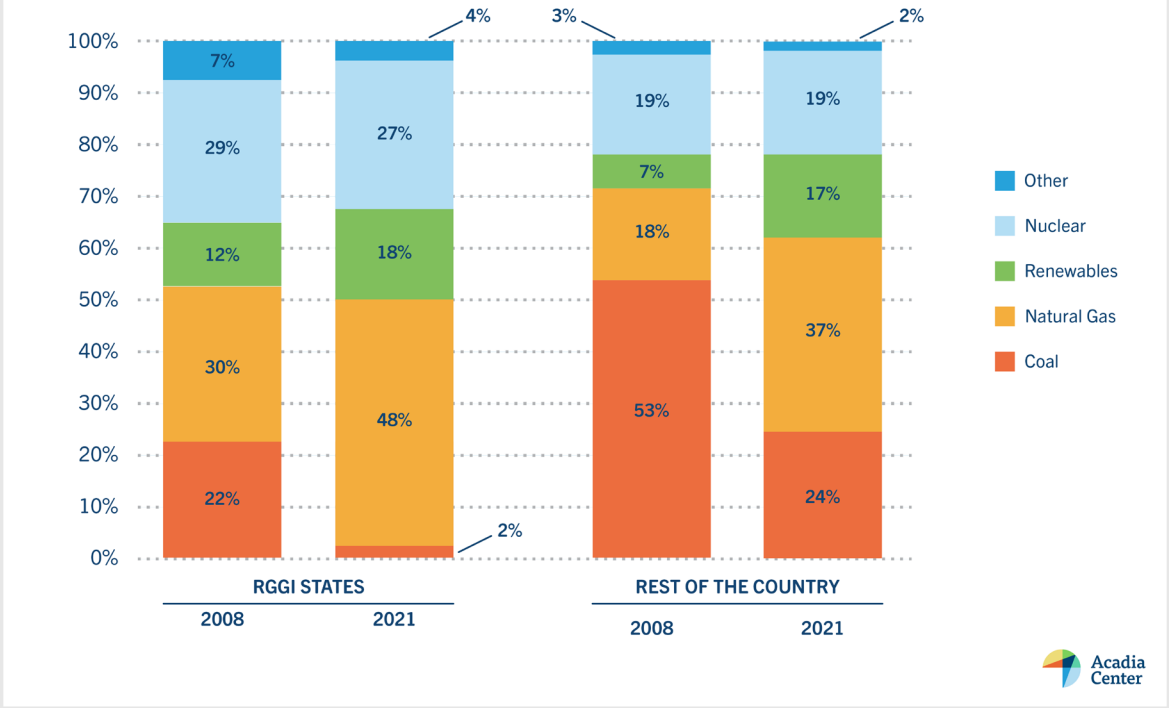
Source: RGGI, Inc.

Cleaning Up the Electricity Generation Mix

Although there are obviously multiple factors at play in driving changes in the electricity generation mix in RGGI states, the price signals sent by RGGI to power producers are part of the overall equation. Figure 2 below compares the electricity generation mix in the 9 consistent RGGI states and the rest of the country over the period of 2008 (the year of the first RGGI auction) to 2021.[5]

FIGURE 2:

Change in Electricity Generation Mix – 9 Consistent RGGI States vs. Rest of Country: 2008 & 2021



Source: Acadia Center analysis of EIA data

This comparison highlights a few notable trends:

- **Coal generation:** While coal generation has declined dramatically in the rest of the country, it has all but vanished in the 9 consistent RGGI states. In 2021, coal generation made up only 2% of total generation in the 9 consistent RGGI states, while coal still accounted for 24% of generation in the rest of the country. The 9 consistent RGGI states have seen a 91% decrease in megawatt hours (MWhs) of electricity generated by coal in the 2008-2021 timespan, while the rest of the country has seen a 53% decrease.
- **Natural gas generation:** Much of the coal generation, both among the 9 consistent RGGI states and the rest of the country, has been displaced by natural gas generation since 2008. The rest of the country saw a 2x increase in the share of gas generation (from 18% to 37%), while the 9 consistent RGGI states experienced a 1.6x increase in the share of gas generation (from 30% to 48%). The 9 consistent RGGI states have seen a 32% increase in MWhs of electricity generated by gas in the 2008-2021 timespan, while the rest of the country has seen a 103% increase.
- **Renewable generation:** The share of total generation from renewable sources has increased more rapidly in the rest of the country than in the 9 consistent RGGI states. The rest of the country saw a 2.6x increase in the share of renewables (from 7% to 17%), while the 9 consistent RGGI states experienced a 1.5x increase (from 12% to 18%). However, looking strictly at MWhs of electricity generated by wind and solar (excluding hydro and geothermal), the 9 consistent RGGI states (808% increase) have slightly outpaced the rest of the country (783% increase).

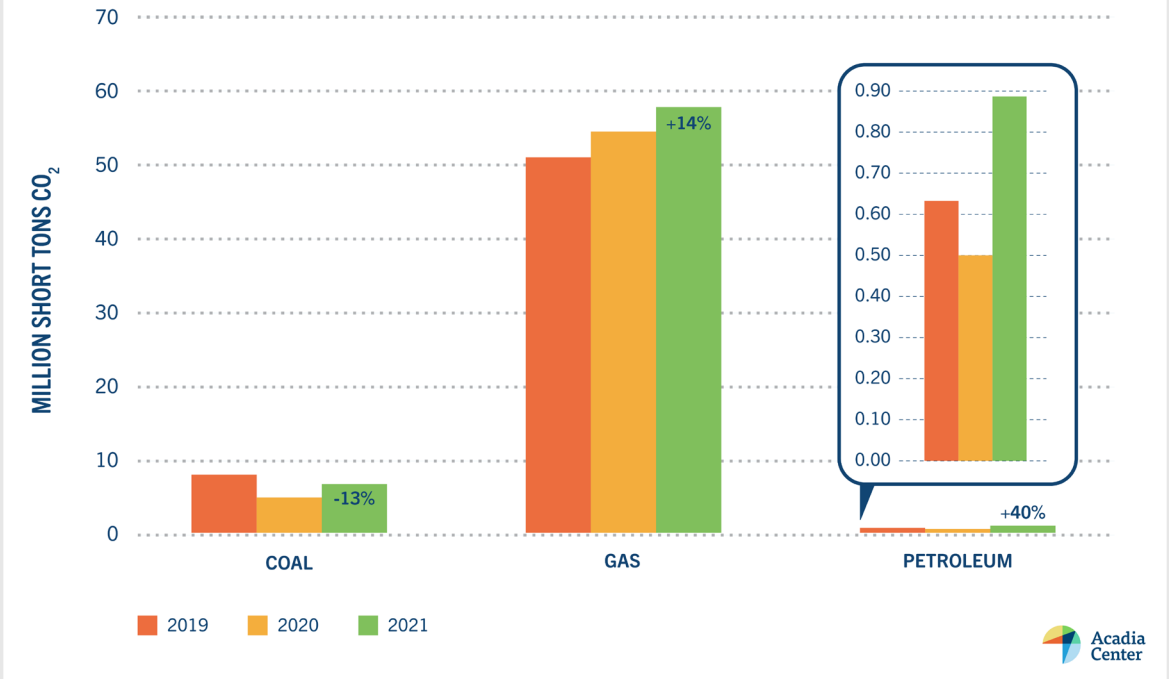
These trends highlight that while RGGI may have played a role in shifting participating states away from coal generation over the 2008-2021 time period, it has room for significant improvement in driving the deployment of renewable energy. The vast majority of coal generation in the 9 consistent RGGI states has already been replaced, and now the program must turn its attention to sending price signals that accelerate the transition from gas to renewables.

Recent Trends in Electricity Generation Emissions and Generation Mix in RGGI States

Among the 9 consistent RGGI states, total GHG emissions have increased 9.5% over the 2019-2021 time period, as illustrated by Figure 1 above. The 3.0% decline in emissions from 2019-2020 is partially explained by the COVID-19 pandemic and the 3.2% decline in net electricity generation in the 9 consistent RGGI states over that time period. However, the 12.9% increase in emissions from 2020-2021 in the 9 consistent RGGI states far exceeds the 1.2% increase in net electricity generation over that same time period, and the overall emissions trend cannot be explained by economic rebound alone.[6]

To better understand what was driving this overall GHG emissions trend, Acadia Center took a closer look at changes in emissions by fuel type for RGGI plants and changes in the overall electricity mix by fuel type in the RGGI region over this three-year period. As demonstrated in Figure 3 below, the 14% increase in GHG emissions from natural gas power plants over the three-year period was the primary driver.[7]

FIGURE 3:
Emissions from RGGI Power Plants by Fuel Type – 9 Consistent RGGI States: 2019-2021



Source: Acadia Center analysis of RGGI, Inc. and EIA data

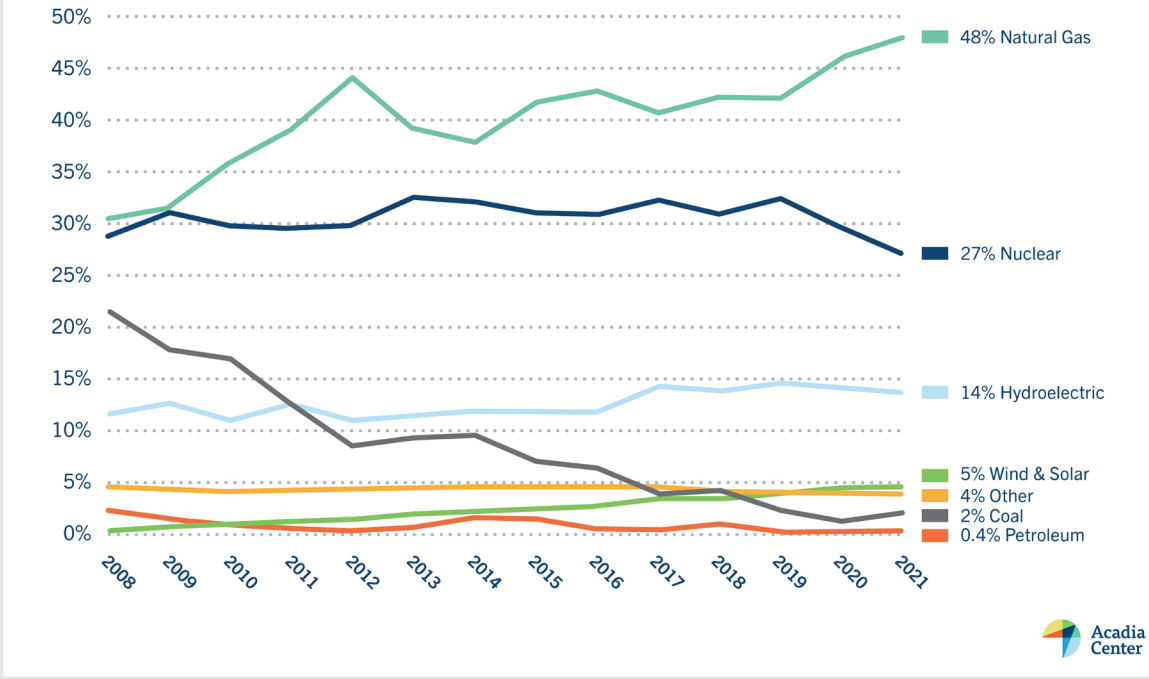
Emissions from coal plants in the 9 consistent RGGI states have fluctuated dramatically in the past three years – overall, coal emissions in 2021 were 13% below 2019 levels. However, 2021 emissions from coal plants were 54% higher than 2020 emissions from coal plants, a notable and concerning jump. Although GHG emissions from petroleum plants represented a small fraction (1.3%) of overall RGGI plant emissions in 2021, petroleum also saw a dramatic increase in emissions – increasing 40% from 2019 to 2021 and modestly contributing to the overall increase in power sector emissions seen from 2019-2021.

What Explains These Recent Natural Gas, Coal, and Petroleum Trends?

By 2021, natural gas accounted for 48% of total electricity generation in the 9-state RGGI region. While total generation from all sources decreased 2.0% in the 9-state region over the 3-year period, electricity generation from natural gas increased nearly 12%. This is at least partially driven by the decline in the second and third largest sources of electricity production in the region: nuclear and hydroelectricity. Nuclear generation accounted for 27% of total generation in the region in 2021, down from 32% in 2019 – representing more than an 18% decline in the MWh generated by nuclear plants over the 3-year period. The hydroelectric decline was less pronounced but still significant, with MWhs of hydro generation declining over 8% in the 3-year period.[8]

FIGURE 4:

Electricity Generation Mix 9 Consistent RGGI States: 2008-2021



Source: Acadia Center analysis of EIA data

The large decrease in nuclear electricity production was largely driven by the decommissioning of the Indian Point nuclear plant in New York State in 2020 and 2021, and to a lesser extent the decommissioning of the Pilgrim nuclear plant in Massachusetts in May of 2019. With the decline in nuclear, and to a lesser extent hydroelectricity, fossil fuels have filled in the gaps. This led to a nearly 12% increase in MWhs of natural gas generation from 2019 to 2021, which likely would have been higher, absent an unexpected increase in petroleum and coal generation from 2020 to 2021.

The significant jump in emissions from both coal and petroleum power plants in the 9 consistent RGGI states from 2020 to 2021 is largely explained by the near-doubling of the delivered cost of natural gas for power generators

over that time period.[9] Even prior to the Russia's invasion of Ukraine in February 2022, gas prices in the U.S. were on the rise in 2021 due to a variety of factors including reduced gas production levels due to COVID-19, increased liquified natural gas exports, one of the warmest summers on record in 2021, and decreased hydroelectricity production in the Western U.S. This instability and rise in gas prices have made the economics of running coal and petroleum plants with increased frequency more financially attractive to generators.

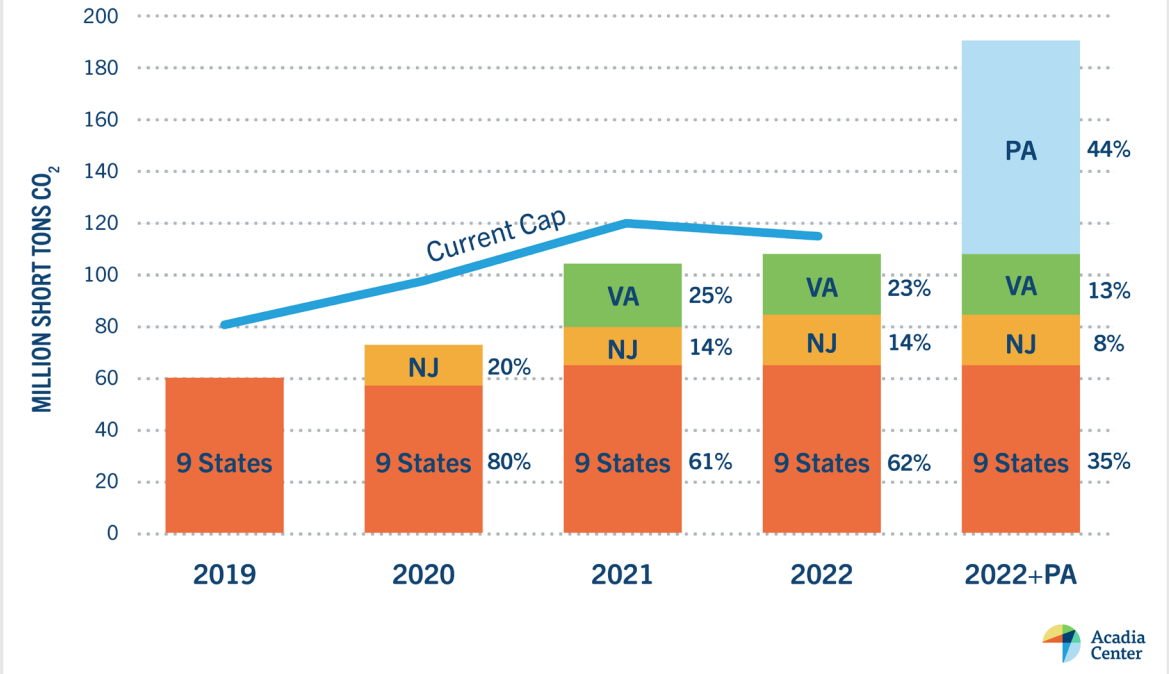
The Importance of New States in Enlarging the Benefits of RGGI

After withdrawing from the program in 2012, New Jersey resumed its RGGI participation in January 2020. Virginia initiated its RGGI participation in January 2021 and Pennsylvania followed by entering the program in April 2022. However, as of the writing of this report, although technically a RGGI participating state, Pennsylvania has yet to participate in a RGGI auction. Since July 2022, Pennsylvania's participation in the program has been held up in legal challenges to the implementing regulations. Simultaneously, in Virginia in early 2023, Governor Younkin is attempting to withdraw the state from the RGGI program by repealing the 2020 Clean Energy and Community Flood Preparedness Act, which enabled Virginia to participate in RGGI. However, as of the writing of this report, Virginia is continuing to participate in auctions. In addition, as of this report, draft rules being considered by the North Carolina Environmental Management Commission recommend joining RGGI, but no formal moves to join have been made.

Given the scale of emissions from the power sector in Virginia and Pennsylvania, their participation will maximize the benefits of RGGI in the region and to their residents. As demonstrated in Figure 5 below, in 2021, Virginia accounted for 25% of total RGGI GHG emissions. If Pennsylvania had participated in the program as planned in 2022, the two states combined would have accounted for nearly 57% of total RGGI GHG emissions.[10]

FIGURE 5:

Impact of New RGGI States on Total GHG Emissions Regulated by the Program: 2019 - 2022



Source: Acadia Center analysis of RGGI, Inc. and EPA data

Participation in RGGI also offers a significant revenue-generating opportunity to both Virginia and Pennsylvania. In the eight auctions Virginia has participated in since March of 2021, the state has generated over $523 million in revenue, an average of nearly $262 million per year.[11] If Pennsylvania had been a full participant in RGGI auctions over this same 2-year period, the state would have generated an estimated $1.92 billion in revenue, an average of over $0.96 billion per year.[12] That's enough revenue to install whole-home air-source heat pump systems in at least 13,000 Virginia homes and 96,000 Pennsylvania homes *per year*.[13] Revenue raised in these states through RGGI participation can be invested in a wide variety of programs including building electrification, energy efficiency, electric transportation, and public transportation. These programs have the potential to simultaneously reduce GHG emissions, reduce criteria pollutant emissions, improve health outcomes, reduce energy bills for consumers, and create jobs and economic growth in Virginia and Pennsylvania.

THIRD PROGRAM REVIEW

The RGGI participating states are committed to comprehensive, periodic review of the RGGI program to consider successes, impacts, and design elements. The RGGI states completed the First Program Review in 2013 and the Second Program Review in 2017, which resulted in the 2017 updates to the Model Rule. The Model Rule is a set of proposed regulations that form the basis for each RGGI state's CO_2 Budget Trading Program – essentially, it serves as a common framework that individual state regulations are built off. As of the writing of this report, the RGGI states are currently in the early stages of the Third Program Review and the preliminary timeline estimates the Program Review and updates to the Model Rule will conclude by the end of 2023.

The Program Review includes:

- Conducting technical analysis, including electricity sector modeling, to inform decision-making related to topics including the regional CO_2 emission cap
- Soliciting input from communities, affected groups, and the general public on the Program Review process, core topics and objectives, modeling assumptions and results, and other policy and design considerations
- Convening independent learning sessions with experts and other interested parties on key design elements
- Reviewing and considering recommendations raised in public comments related to environmental justice and equity

Overall, the Third Program Review offers a key opportunity for implementing RGGI policy changes, including those outlined in this report.

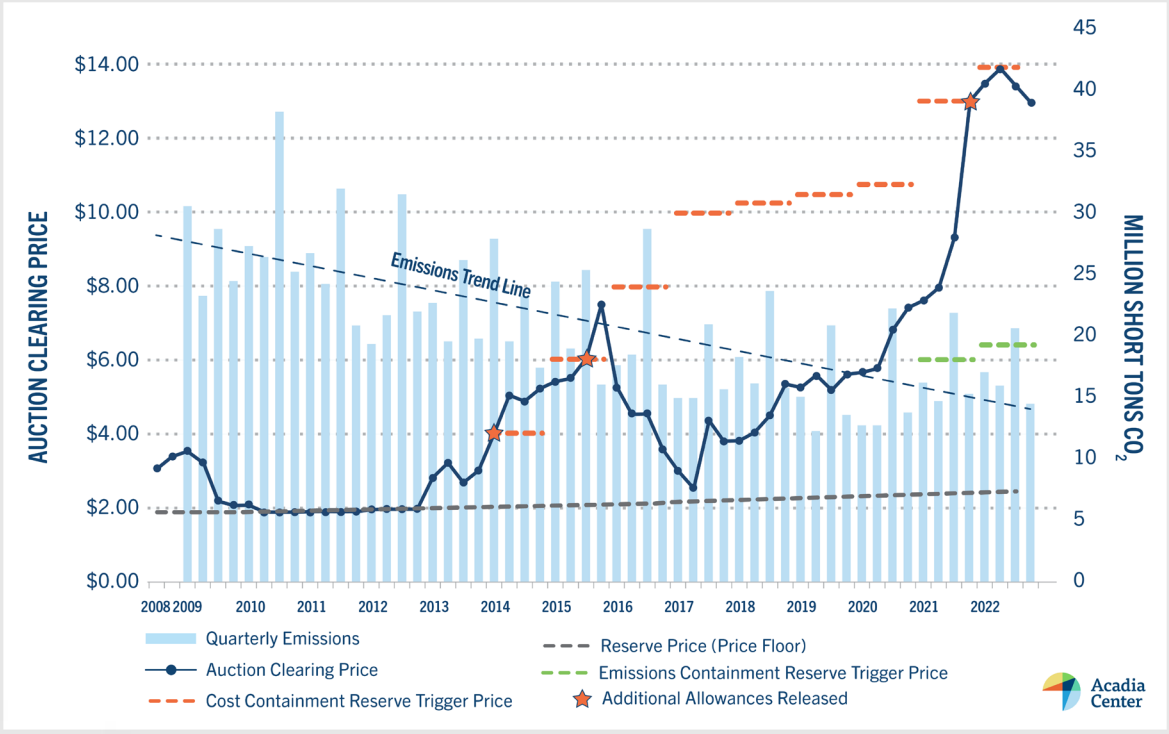
RGGI Emissions and Quarterly Auctions

Under RGGI, each state is assigned a number of allowances which, collectively, add up to the cap. Power plant owners purchase these allowances in quarterly auctions run by RGGI. Regulated entities must purchase enough allowances to cover the emissions they generate in the program's three-year compliance periods. Revenue from allowances is invested by each state in energy efficiency, GHG abatement, electricity bill assistance, and other causes that individual states deem worthwhile.

As Figure 6 below illustrates, starting in December 2019, the clearing price for allowances increased in 11 consecutive auctions. The eight most recent auctions, from March 2021-December 2022, represent the eight highest allowance prices the program has seen since its inception. In 2022, the average clearing price was $13.46, nearly *four times* higher than the average price of $3.42 in 2017. [14]

FIGURE 6:

Quarterly RGGI Emissions and Auction Clearing Prices: 2008-2022



Source: Acadia Center analysis of RGGI, Inc. data

While the forces driving the RGGI allowance prices are numerous and complex, a few potential factors explain recent high allowance prices:

- The emissions cap continues to decline, limiting the supply of allowances available in the marketplace
- Increasing emissions in recent years, caused by a variety of factors including lower levels of nuclear generation, have increased demand for allowances
- Power producers may be anticipating stricter emissions caps in the future resulting from the forthcoming Third Program Review, increasing the urgency of buying allowances now when they are priced relatively low compared to anticipated higher future prices

Market Mechanisms: CCR, ECR and Price Floor

RGGI's market mechanisms are outlined by the Model Rule, a set of prescribed rules that serves as the framework for the CO2 Budget Trading Program in each RGGI state. The Model Rule has undergone recurrent revisions since it was first created, and several mechanisms have been introduced that significantly impact the overall operation of the program.

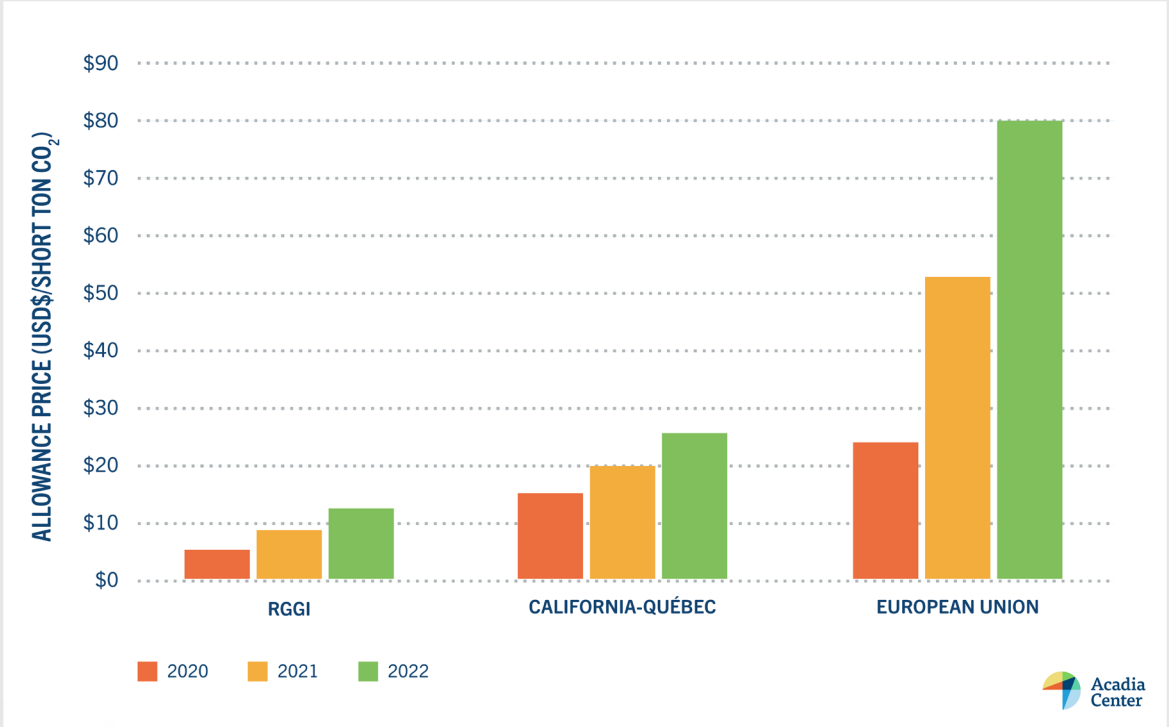
COST CONTAINMENT RESERVE

The Cost Containment Reserve (CCR) is a mechanism that was put in place to prevent the RGGI clearing price from rising above a program-wide trigger price. This trigger price is $14.88 in 2023 and is set to increase 7% each year. When allowance prices exceed the CCR trigger price, a number of additional allowances – equal to 10% of the regional cap each year – are released into the market to prevent the clearing price from rising too high. The CCR can only be triggered once per calendar year. If the CCR is triggered, the balance of allowances in reserve is replenished at the beginning of the following calendar year. While this is useful for fossil fuel power generators who want to minimize the cost of RGGI compliance, it limits the ability of the program to lower both GHG emissions and other criteria air pollutants, while simultaneously creating year-to-year uncertainty regarding the overall GHG emissions trajectory of RGGI.

Since being established in 2014, the CCR has been triggered in three years – 2014, 2015 and 2021. From 2016 to 2020, the CCR was essentially a non-factor, with the clearing price consistently coming in much lower than the CCR trigger price. Over that five-year period, the average clearing price was $4.83, well short of the average CCR trigger price of $9.91 over that same period.[15] However, this changed dramatically in December of 2021 when the clearing price rose to $13.00 and the CCR was triggered. Although the CCR was not triggered in 2022, all four auctions in 2022 came within a dollar of the CCR trigger price, highlighting the potential future significance the CCR has in dictating the total number of emissions allowances available in the market.

FIGURE 7:

Emissions Trading Systems Average Annual Carbon Price Comparison: 2020-2022



Source: Acadia Center analysis of RGGI, California Air Resources Board, and EU-ETS data

In the Third Program Review, the states should substantially raise the CCR trigger price, as a step towards reducing the power sector GHG emissions in line with state-level emissions reduction targets. The CCR trigger price is currently set well below the social cost of carbon, which is an estimate, in dollars, of the cost of damage created by emitting one ton of CO2 into the atmosphere. For example, a recent study published in Nature estimated the social cost of carbon to be approximately $168 per short ton of CO2, over 12 times higher than RGGI's average clearing price of $13.46 in 2022.[16]

Other emissions trading systems, most notably the European Union Emission Trading System (EU-ETS) and the joint California-Quebec emissions trading market, have significantly higher carbon prices than RGGI. For example, in 2022, the average EU-ETS carbon price was USD $79.64 per short ton of CO2, nearly six times higher than RGGI's 2022 average clearing price. As of February 2023, the EU-ETS had reached an all-time high of USD $99.05 per short ton.[17] In 2022, the joint California-Quebec allowance auctions averaged USD $25.81 per short ton of CO2, nearly twice as high as RGGI's in the same year.[18] Although these trading systems apply to a much larger swath of the economy than RGGI, their price levels are informative as prices that markets will bear, without resort to a mechanism like the CCR.

EMISSIONS CONTAINMENT RESERVE

The Emissions Containment Reserve (ECR) essentially serves the opposite function of the CCR. The ECR withholds allowances from circulation to secure additional emissions reduction if prices fall below an established trigger price. However, unlike the CCR, the ECR is not applicable to all states – as of the writing of this report, Maine and New Hampshire are not participating in the ECR. The size of the ECR is 10% of the CO2 budget of states implementing the ECR (i.e., all states except Maine and New Hampshire). In 2023, the ECR is $6.87 and set to increase at a rate of 7% per year. Since first implemented in the March 2021 auction, due to high clearing prices in 2021 and 2022, the ECR has yet to be triggered.

In the Third Program Review, the states should increase the ECR trigger price to reflect the aggressive emission reductions the states need to achieve. The ECR trigger price, which is currently $6.87 per ton, will only rise to $11.03 in 2030, a figure far below the average market price of $13.46 in 2022. In each of the four auctions in 2022, the market price has been at least twice the ECR trigger price and therefore has been rendered almost irrelevant, failing to reduce emissions as designed.[19]

MINIMUM RESERVE PRICE

The Minimum Reserve Price ("reserve price") was established to serve as a "price floor" for the RGGI program, ensuring that allowances will not be sold below a certain price in any given RGGI auction. In 2023, the reserve price is $2.50 per allowance and is set to increase annually at a rate of 2.5%. The reserve price has been in place since the RGGI program launched. From 2010 – 2012, the reserve price set the clearing price in ten consecutive auctions but has not been reached since the initial cap was adjusted. In recent years, the auction clearing price has been well above the reserve price.[20] For example, in 2022, the clearing price was, on average, $11.02 higher than the reserve price. In 2022, the average clearing price was over six times higher than the average clearing price in 2010, but over that same 12-year period the reserve price only increased 30%.

In the Third Program Review, the states should increase the Price Floor and establish a more ambitious rate of increase closely aligned with market prices in the most recent years' auctions. This reform will ensure that prices will stay more consistent and RGGI states will still have the proceeds necessary to encourage stable investments in renewable electricity and energy efficiency, to grow these resources and contribute to overall decarbonization.

Aligning the RGGI Cap with State Clean Energy and GHG Reduction Laws

Over time, RGGI participating states have adopted increasingly aggressive renewable energy portfolio (RPS) standards, clean energy standards (CES), and economywide GHG reduction targets. An RPS or CES is a regulatory mandate to increase production of energy from renewable or clean resources, including wind and solar. The exact list of resources that qualify under these policies varies from state to state and often extends to resources including biomass, hydroelectricity, nuclear, and other generation resources.

Table 1: RGGI States Clean Energy and Economy Wide GHG Reduction Targets Adopted in Law[21]

STATE	RPS OR CLEAN ENERGY TARGET[22]	RPS OR CLEAN ENERGY TARGET YEAR	ECONOMY-WIDE GHG REDUCTION TARGET	GHG REDUCTION TARGET YEAR
Connecticut	100%	2040	80%	2050
Delaware	40%	2035	N/A	N/A
Maine	100%	2050	80%	2050
Maryland	50%	2030	Net Zero	2045
Massachusetts	80%	2050	Net Zero	2050
New Hampshire	25.2%	2025	N/A	N/A
New Jersey	100%[23]	2035	80%	2050
New York	100%	2040	Net Zero	2050
Pennsylvania	18%	2021	80%[24]	2050
Rhode Island	100%	2033	Net Zero	2050
Virginia	100%	2050	Net Zero	2045
Vermont	75%	2032	80%	2050

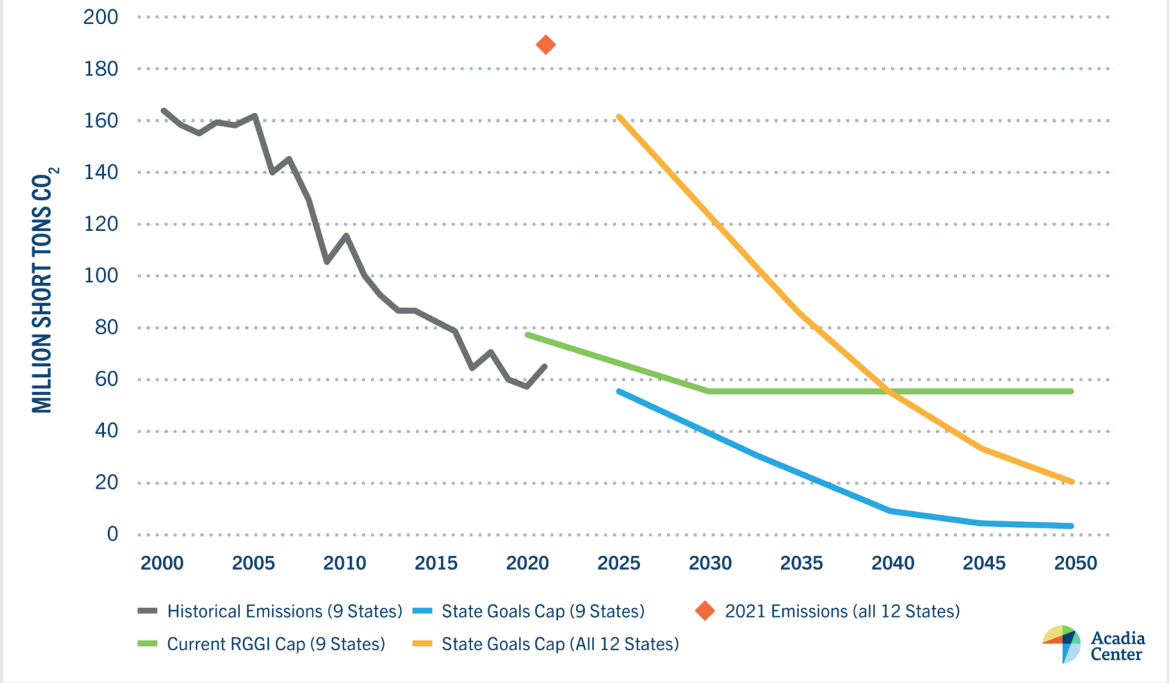
The regional RGGI emission cap is the sum of the CO2 allowance budgets implemented by the RGGI participating states. Historically, the RGGI emissions cap has been set independent of specific clean energy goals or economy-wide decarbonization goals mandated by the states. **However, the Third Program Review offers an opportunity for RGGI states to better align RGGI's cap with existing decarbonization policies at the state level.** The RGGI cap is currently set to decline at a steady annual rate of 2.275 million tons (around 2.5% of current cap) through 2030 and then be held steady thereafter. Including all eleven states currently participating in RGGI auctions, the 2030 cap is 86.9 million tons CO2,[25] but focusing on the 9 consistent RGGI states brings the 2030 cap down to 55.4 million tons CO2 (as depicted in the green line in Figure 8 below). The cap has the potential to be higher if Cost Containment Reserve allowances are released or lower if Emissions Containment Reserve allowances are withdrawn.[26]

In the early years of RGGI, the initial cap was set based on historical emissions rates, and far exceeded actual emissions from the states where emissions had already markedly declined. As RGGI is only one of a handful of policy mechanisms aimed at reducing GHG emissions from power generation within each of the states, the emissions cap must be developed with the state-level clean energy and GHG reductions laws in mind, to avoid a recurrence of the early cap, out of sync with actual emissions.

What would the RGGI emissions cap from 2025-2050 look like if it were set at level commensurate with the clean energy and GHG reduction laws in the RGGI participating states? Figure 8 below answers this question by showing a hypothetical "state goals cap" for both the 9 consistent RGGI states (blue line) and all 12 RGGI states (yellow line). **Overall, the 9-state "state goals cap" would need to decline 95% below 2021 emissions levels in the 9 states by 2050 and the 12-state "state goals cap" would need to decline 89% below 2021 emissions levels in the 12 states by 2050.** The 12-state "state goals cap" is slightly less ambitious in terms of percent reduction by 2050 because Pennsylvania, which accounts for over 40% of current total RGGI emissions, has a less ambitious 2050 target than many of the other RGGI states.

FIGURE 8:

Aligning the Future RGGI Cap with State Clean Energy & Climate Targets



Source: Acadia Center analysis using data from RGGI Inc. and state clean energy and economy-wide GHG reduction targets

As demonstrated in the Figure 8 above, the 9-state "state goals cap" is significantly more aggressive than the current RGGI cap and the gap only widens as time progress towards 2050.For example, in 2025, the 9-state "state goals cap" is 17% lower than the current RGGI cap, but by 2035 it is 58% lower and by 2050 it is 94% lower in comparison to the current RGGI cap.

Within the Third Program Review, the RGGI participating states should set the cap level no higher than the level of emissions allowed by state-level clean energy and GHG reduction laws in each of the relevant years. While Pennsylvania's and Virginia's participation in RGGI would significantly impact the overall regional emissions cap, the uncertainty around their membership can be addressed by establishing caps for individual states based on each state's most stringent clean energy or GHG reduction law, and aggregating these individual state caps to set an upper limit for the regional cap.

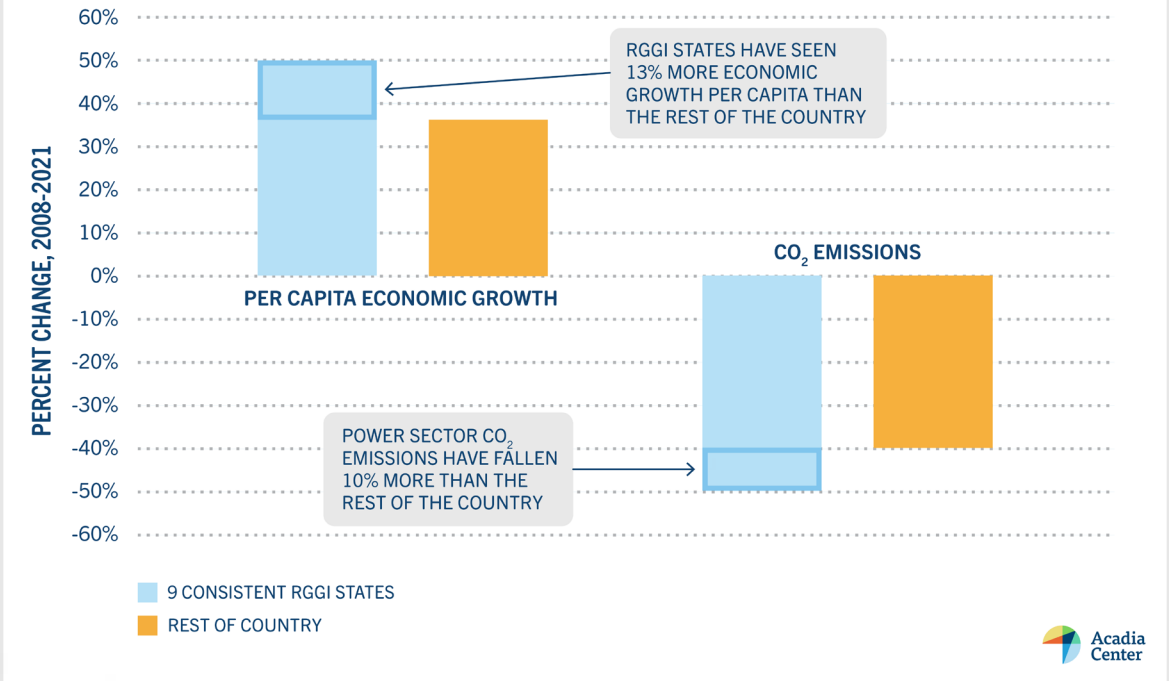
PART 2.
ECONOMIC TRENDS AND
ELECTRICITY PRICES

Achieving Economic Growth and Emissions Reductions

The 9 consistent RGGI states have successfully reduced CO2 emissions without hindering economic expansion, continuing to demonstrate that economic growth and decarbonization are compatible. Since 2008, the year of the first RGGI auction, the United States as a whole has seen an increase in per capita gross domestic product (GDP) and a decrease in CO2 emissions from electricity generation. **However, over this time period, the RGGI states have experienced both a more rapid increase in GDP per capita and a more rapid *decline* in power sector CO2 emissions.**

As shown in Figure 9 below, from 2008 to 2021, the 9 Consistent RGGI states' per capita GDP grew by 50% versus 36% in states that do not regulate or put a price on carbon emissions[27] (this group of 40 states, referred to below as the "rest of the country", also does not include California, which has similarly outpaced national growth since capping power sector carbon emissions). Over the same 2008 to 2021 period, emissions in the 9 Consistent RGGI states dropped by 50% versus 40% in the rest of the country.[28] In other words, compared to the rest of the country, these RGGI states have seen 13% more economic growth per capita, while simultaneously reducing CO2 emissions 10% more than the rest of the country.

FIGURE 9:
Change in Economic Growth and Power Sector Emissions – 9 Consistent RGGI States vs. Rest of Country: 2008 to 2021



Source: Acadia Center analysis using data from EIA, BEA, and U.S. Census

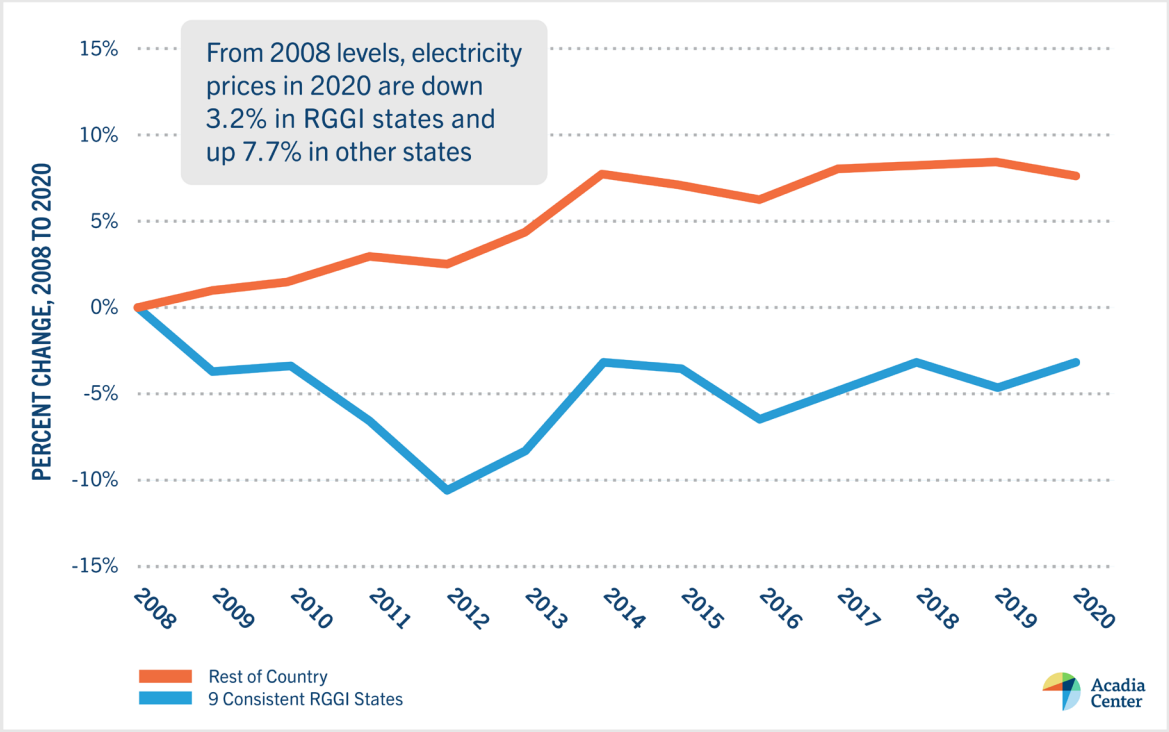
Electricity demand has historically been tied to economic growth, with electricity consumption and related emissions increasing during periods of economic expansion and decreasing in economic downturns. This correlation has been broken in the RGGI region; a new reality that appears to be mirrored—though slightly less dramatically—at the national level. Thirteen years of RGGI and decarbonization of the electric power sector shows that emissions reductions can still be achieved as the economy grows.

Lowering Electricity Prices

Average retail electricity prices in the 9 consistent RGGI states have decreased since RGGI took effect. Comparing retail electricity prices from 2008 to 2020 shows that prices have dropped, on average, by 3.2% across the region. While RGGI's direct impact on electricity prices is difficult to isolate from other factors, it is evident that the program has not caused electricity prices to rise from 2008 levels, in part due to RGGI-funded investments in energy efficiency. Concerns that climate policy will make states less competitive are directly refuted by RGGI's experience: RGGI states are faring much better than the rest of the country on electricity price trends.[29] As shown in Figure 10 below, while the 9 consistent RGGI states' electricity prices through 2020 have fallen from where they were in 2008, the rest of the country has experienced an 7.7% increase in retail electricity prices over the same period.[30]

FIGURE 10:

Average Retail Electricity Prices – 9 Consistent RGGI States vs. Rest of Country: 2008-2020



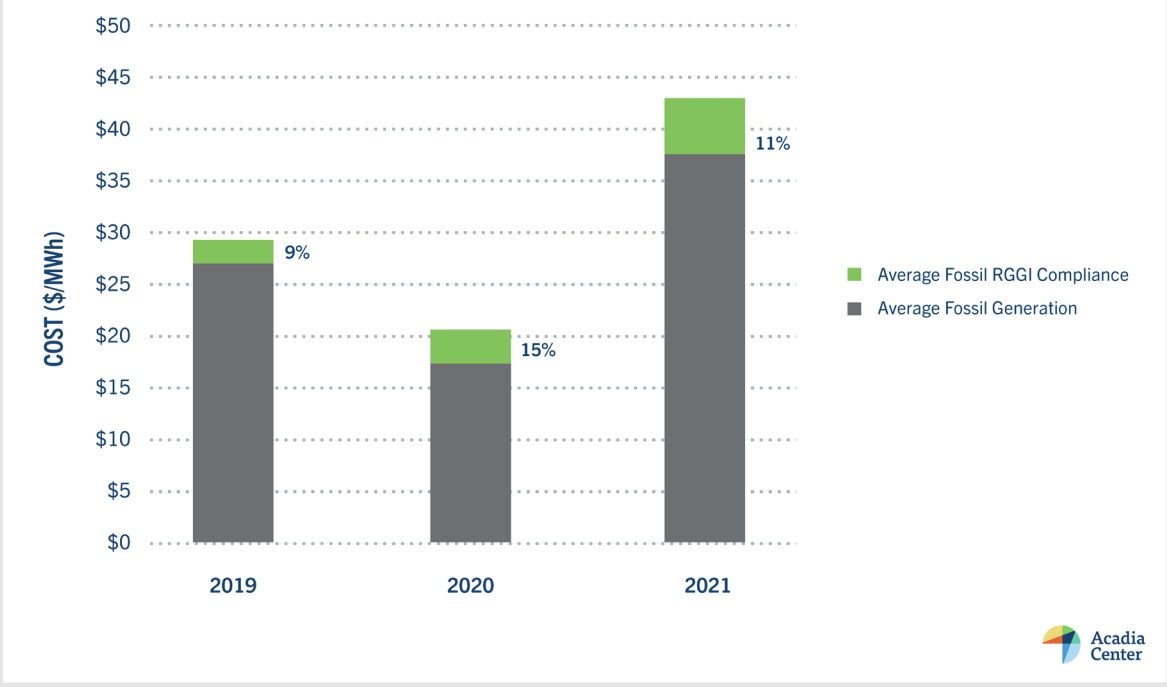
Source: Acadia Center analysis of data from EIA

RGGI Allowance Price is a Small Portion of Overall Electricity Prices

While the RGGI program cap keeps power plant emissions below a certain level, and the allowance price sends a signal to fossil fuel generators to reduce GHG emissions, the allowance price is not high enough to significantly impact the electricity bills of customers. As Figure 11 below illustrates, the average costs of fossil fuels used to generate electricity dwarfs the cost of RGGI compliance.[31]

FIGURE 11:

Electricity Generation Fuel Costs vs. RGGI Compliance Costs in New England States: 2019-2021



Source: Acadia Center analysis of data from RGGI Inc., ISO-NE and EIA

For example, in 2021, RGGI compliance in New England cost on average $4.63/MWh of electricity generated but the weighted average cost of fossil fuel generation in the same year was $38.23/MWh. In other words, on average in New England in 2021, RGGI compliance only accounted for 11% of the cost to generate a MWh from fossil fuels. When fossil fuels - namely natural gas - were significantly cheaper in 2020, RGGI compliance in New England was $3.00/MWh or 15% of the combined cost.

However, these fuel costs only represent one piece of a consumer's overall electric bill. An electric bill is comprised of three main components: 1) Supply 2) Fixed monthly charge and 3) Delivery. In basic terms, the supply charge is based on the cost of generating electricity at a power plant, while fixed charges and delivery charges are based on the cost of delivering electricity to the end user, including maintaining the poles, wires, meters, and billing systems. On a national scale, the supply portion of the electric bill comprises 56% of the total costs of a typical electric bill.[32] Applying that same proportion, on average in New England in 2021, RGGI compliance would only represent about 6% of a consumer's bill, absent the impact of varying rate design.

PART 3.
CRITERIA AIR POLLUTANT IMPACTS ON COMMUNITIES AND ALLOCATION OF RGGI PROCEEDS

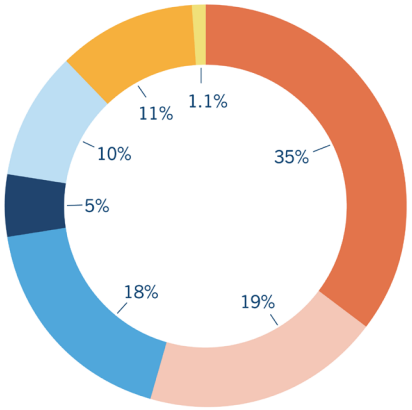
At the state and regional level, RGGI has helped reduce GHG emissions from power plants and supported overall economic growth through investment of auction proceeds in clean energy and energy efficiency investments. However, the impact of RGGI on local communities, particularly EJ communities, has not been closely examined, until this report.[33] Acadia Center evaluated two different pathways of potential impact on environmental justice communities – 1) whether RGGI proceeds have been invested in EJ communities; and 2) whether levels of key pollutants have declined in EJ communities during the tenure of RGGI.

Current RGGI Proceeds Allocation

States could significantly improve quality of life in EJ communities by making targeted investments of revenue generated in RGGI auctions to improve the quality of housing, lower energy burdens, improve air quality, and reduce associated health risks. RGGI generates a significant amount of revenue – in 2022 alone, the program generated $1.19 billion in proceeds, and this number could expand significantly if Pennsylvania begins participating consistently. For this reason, Acadia Center explored how this significant revenue stream is being allocated. To what degree are the investments stemming from RGGI proceeds benefiting EJ communities and are there potential areas of improvement?

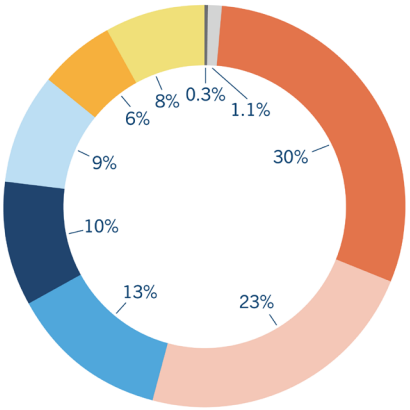
To answer this question, Acadia Center worked to find a detailed view of how RGGI proceeds have been allocated to EJ communities. Unfortunately, the states and RGGI collect frustratingly little data on this metric. While RGGI publishes **Investment of RGGI Proceeds** reports every year, these reports lack the detail necessary to effectively evaluate what proportion of overall proceeds are invested in EJ communities. The categorization of allocated proceeds, as presented in the RGGI Report, is too broad to be useful, as demonstrated below in Figure 12.[34]

FIGURE 12:
2020 RGGI Proceeds Investments by Category and Recipient Type



CATEGORY

- Energy Efficiency
- Administration
- Direct Bill Assisstance
- Beneficial Electrification
- Clean & Renewable Energy
- RGGI Inc.
- GHG Abatement



RECIPIENT TYPE

- Residential
- Business
- Municipal, State & Community
- Clean Transportation
- Low Income
- Research, Technology & Development
- Administration
- RGGI Inc.
- General Rate Relief

Acadia Center

Source: RGGI Inc.

Two of the major categories of RGGI proceed investments are "Energy Efficiency" (35% of total investment) and "Clean & Renewable Energy" (19%), however it is impossible to tell based on the data provided by RGGI what portion of these broad buckets are invested in EJ communities. Acadia Center also examined records from the state energy efficiency and renewable energy investment programs to identify where RGGI funds were being allocated, but **although many states have specific low-income efficiency and renewable energy programs, none have allocated a specific amount of RGGI funding to environmental justice communities through these programs.**

"Direct Bill Assistance" accounted for 19% of total RGGI investment in 2020, but it appears that about 47% of this assistance in 2020 is categorized as "General Rate Relief" for all customers. Even in 2019, a year unaffected by the COVID-19 pandemic, general rate relief for all customers appears to account for about 37% of all direct bill assistance.[35] Additionally, direct bill assistance, even when strictly directed to low-income residents, is by no means an adequate method of investing in EJ communities. While bill assistance can provide some level of near-term, temporary financial relief for some customers, it is not a sustainable, long-term investment that betters EJ communities in a meaningful way. In contrast, investments in residential energy efficiency in EJ communities could achieve the same bill reductions as direct bill assistance, while simultaneously providing long-term co-benefits like improved indoor air quality, health, and comfort.

Third Program Review Should Include Commitment to Invest RGGI Proceeds in EJ Communities

RGGI must address, as a priority, the significant gap in the collection and dissemination of information that is needed to ascertain the amount of RGGI funding being invested in EJ communities. States must commit, through regulations or legislation, to direct RGGI funds to investment in EJ communities and collect and make publicly available data confirming that these goals have been met. Without states taking this first, critical step related to data transparency, it is extremely challenging to comprehensively evaluate the extent to which RGGI funds are currently allocated to EJ communities and the ultimate effectiveness of the programs funded by those RGGI proceeds.

While a number of RGGI states allocate some level of proceeds to various efforts with benefits that could flow to EJ communities, New York is the lone RGGI participating state that by law requires a set percentage of total RGGI proceeds to be allocated to qualifying "disadvantaged communities" (a term defined by New York law). The CO2 Allowance Auction Program regulations implemented by the New York State Energy Research & Development Authority (NYSERDA) reflect the provision of NY's Climate Leadership and Community Protection Act "that 40%, and no less than 35%, of the overall benefits from the investment of the CO2 Allowance Auctions proceeds" will be realized in disadvantaged communities.[36] To put this in context, in 2022, New York generated over $287 million in RGGI proceeds and 40% of that figure would be just short of $115 million.[37]

However, even New York leaves room for improvement. The state's Climate Justice Working Group is, as of this report, working with only an interim definition of disadvantaged communities and low-to-moderate-income investments. Based on these interim definitions, NYSERDA estimates that 42% of post-2019 RGGI program commitments are expected to provide direct benefits to these communities, however it's not completely clear how the "estimated low- and moderate-income/disadvantaged community benefit" dollar values were calculated.[38] It's also not clear what tracking mechanisms will be put into place to ensure these investments are actually delivered to these communities.

RGGI states employ different definitions of communities that have been disproportionately burdened by the fossil fuel economy and are targeted for policies to improve environmental conditions, including: environmental justice communities, low-to-moderate income communities, disproportionately affected communities, distressed communities, and overburdened communities. Ideally, in the Third Program Review, the states would arrive at a common definition of EJ community and set a minimum allocation of proceeds for investment in EJ communities. However, even if states maintain differing definitions, they could agree on common concepts such as how to identify and define the populations targeted for direct investment, relative to current trends. In the Third Program Review, the states should be able to arrive at both a shared commitment to levels of investment in these communities, and a standardized way to collect information on how allowance revenues are spent. Being able to track the

impacts of RGGI in these targeted communities in a consistent manner is necessary even if the exact set of communities varies between states. Doing so would allow RGGI to report on spending at a regional level with the granularity of data necessary to identify whether proceeds are equitably invested in the communities targeted by the states.

To create our recommendation regarding the appropriate minimum allocation of proceeds for investment in EJ communities, Acadia Center looked to the stakeholder comments of the Northeast Regional members of the Climate Justice Alliance to RGGI of December 3, 2021. Specifically, that group of advocates recommended that:

> *For RGGI to come close to being equitable, the level of investment should be at least proportional to the percentage of the population that meets the definition of "overburdened and underserved" in each state. To ensure that investments actually reach the populations most in need of this funding, we request that the model rule specify that a minimum of 40%-50% of investments, not benefits from those investments, be allocated to our communities. This 40% mandate is in line with state and federal precedent. While RGGI revenue investments are decided by the individual participating states, there should be regional guidance to ensure there is equity across the region.*[39]

To maximize the benefits of RGGI proceeds delivered to EJ communities and ensure impactful use of these funds, Acadia Center recommends that states:

1. Clearly articulate how environmental justice communities are being defined
2. Establish a requirement that a minimum of 40%-50% of RGGI proceeds are invested in EJ communities, setting a value that does not change even if other RGGI funds are raided
3. Establish a requirement that members of EJ communities have meaningful participation in decisions regarding programs for investment
4. Transparently track whether programs identified as providing EJ community investments are meeting their quantitative metrics (e.g., energy bill savings, air quality improvements, workforce development trainings completed, etc.) and adjust programs as necessary to ensure the minimum percentage investment is achieved
5. Evaluate how RGGI proceeds are being spent and adjust programs as necessary to ensure their minimum percentage allocation is achieved
6. Centralize all this information in a frequently updated public-facing report or dashboard that is easily accessible and understandable to a wide variety of stakeholders and utilizes standardized information, allowing aggregation across the RGGI region

Trends in Criteria Air Pollutants: Impact on EPA Environmental Justice Socioeconomic Indicator Communities

Burning fossil fuels to generate electricity produces criteria air pollutant emissions in addition to GHG emissions. These criteria emissions as defined by the Clean Air Act, particularly nitrogen oxides (NOx), can have significant detrimental health impacts including damaging the respiratory tract and increasing vulnerability to respiratory infections and asthma.[40] Additionally, certain populations are more susceptible to negative impacts from air pollutants. Research has shown that residents of low-income communities may experience increased health impacts from air pollution due to many environmental, social, and economic factors.[41]

Air pollution is a major concern in communities near power plants because they are disproportionately affected by it. In addition, EJ communities are often disproportionately burdened by multiple sources of air pollution, including power plants and infrastructure like industrial facilities and highways. The American Lung Association found that people of color were 61% more likely than white people to live in a county with a failing grade for at least one criteria pollutant, and 3.6 times as likely to live in a county with failing grade for all three pollutants examined in their analysis.[42] RGGI has reduced CO2 emissions from power plants. However, RGGI has been criticized for not prioritizing the reduction of criteria air pollutants in EJ communities.

While power plants emit sulfur dioxide (SO2), nitrogen oxides (NOx), particulate matter (PM), mercury (Hg) and other pollutants, Acadia Center decided to focus this analysis particularly on NOx emissions for several reasons. Firstly, electricity generating units at fossil fuel power plants are among the largest emitters of NOx, which has been

linked to respiratory illnesses and acid rain.[43] NOx emissions also lead to the formation of fine particulate matter and ground-level ozone, both of which are harmful air pollutants that can cause serious respiratory problems. These pollutants can exacerbate asthma, lung cancer, and other respiratory diseases. [44] And finally, data on NOx emissions from individual power plants is readily available, making it possible to analyze the amount of NOx specific plants emit.

Acadia Center analyzed the impact the RGGI program has had on criteria pollutants in EJ communities to understand historical trends and help identify areas for improvement. Acadia Center utilized U.S. EPA's Environmental Justice Screening and Mapping Tool Socioeconomic Indicators ("EPA EJScreen"). The EPA EJScreen addresses seven different factors: **income, race, education, unemployment, linguistic isolation, children under 5 years of age, and adults over 64.**[45]

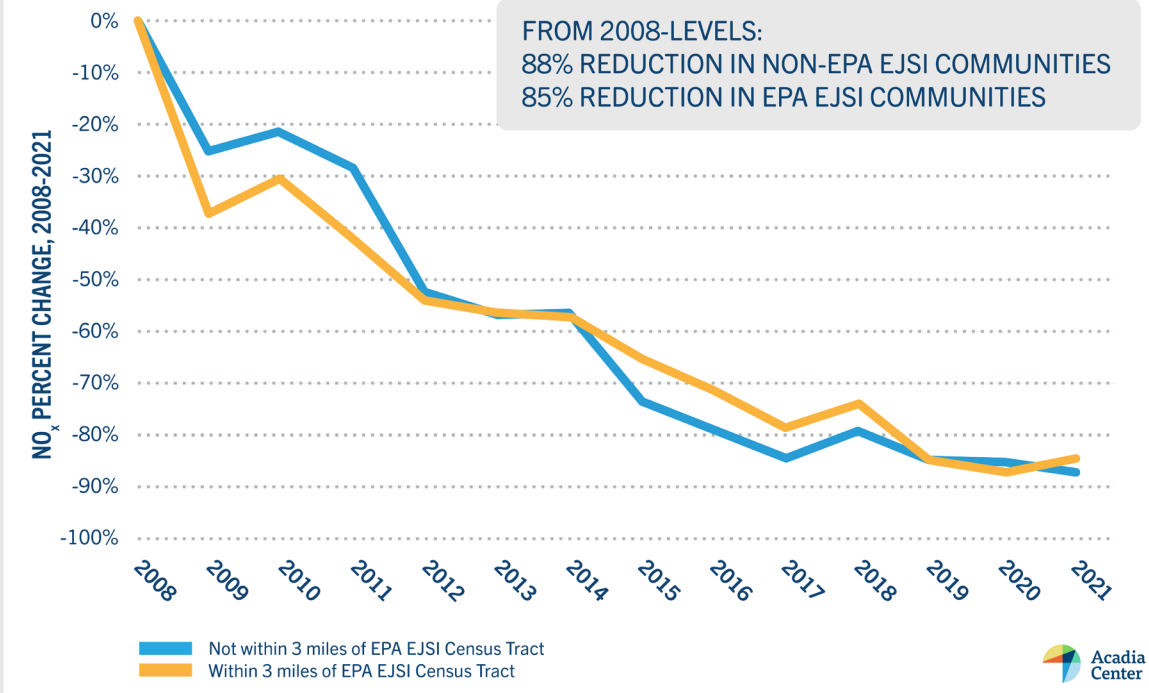
EPA EJScreen is an interactive mapping application that shows locations where environmental justice issues may be present. The tool highlights communities that have socioeconomic characteristics that put them at a higher risk of being disproportionately affected by environmental dangers. These indicators are used to identify communities that are more vulnerable to environmental hazards and may have less access to resources to mitigate their effects.

EPA also provides guidance on mapping the impact of power plants on neighboring communities stating that, *"A three-mile radius is consistent with environmental justice literature and studies, including the* ***EJ Screening Report for the Clean Power Plan****".*[46] Following EPA's guidance, Acadia Center focused its analysis on the communities within a 3-mile radius of each RGGI power plant. It is important to remember that the health impacts of criteria air pollutant emissions from power plants, including NOx emissions, do not only exist within a 3-mile radius, however these impacts are typically greatest for those living within a 3-mile radius.

A power plant was defined as in proximity to an EPA Environmental Justice Socioeconomic Indicator community ("EPA EJSI community") if there was any census tract within a 3-mile radius of that plant that scored above the 90th national percentile in *any* of the seven socioeconomic indicators from EPA EJScreen. Similarly, we defined a power

FIGURE 13:

Percent Change in NO_x Emissions from RGGI Power Plants that Are vs. Are Not Within 3 Miles of an EPA EJSI Community – 9 Consistent RGGI States: 2008-2021



Source: Acadia Center analysis of data from EPA's CAMPD and EJScreen

plant as in proximity to a "high asthma community" if it were located within a 3-mile radius of a census tract that is above the 90th national percentile for percent of adults who have been told they have asthma, according to data from the White House Council on Environmental Quality (CEQ) **Climate and Economic Justice Screen Tool (CEJEST)**. Census tracts are defined by the U.S. Census Bureau and provide the most granular geographic unit for this type of community-by-community impact analysis. There are over 17,000 census tracts in the RGGI region. Most prior analysis of the impacts of RGGI has focused on GHG emissions reductions, but Acadia Center was interested in analyzing NOx emissions trends from power plants in the RGGI region, with a focus on two research questions:

1) How much have NOx emissions from RGGI power plants declined in the 9 consistent RGGI states over the 2008-2021 time period?
2) How do reductions in NOx emissions compare between EPA EJSI communities and others?

As shown in Figure 13, Acadia Center found that between 2008 and 2021, NOx emissions from RGGI power plants located within 3 miles of an EPA EJSI community declined by 84.6%, compared to the rest of the RGGI power plant fleet, in which NOx emissions declined by 87.9%. Combined, NOx emissions across all RGGI power plants declined 85.1%.[47]

The significant decline in emissions in both sets of communities during the tenure of RGGI is laudable and reflects the overall regional impact of RGGI on criteria air pollution. Nonetheless, the fact that the rate of decline of this criteria pollutant in EPA EJSI communities is slower than the rest of the region is troubling. This analysis demonstrates that the approach of reducing CO2 emissions in aggregate across the region does not necessarily result in a more rapid rate of decline in NOx emissions in EJ communities relative to the rate of decline in non-EJ communities.

In the Third Program Review, the states and RGGI should craft rules to actively target reducing criteria pollutants in EJ communities. **RGGI participating states have an opportunity during the Third Program Review to adopt rules that specifically target accelerated decreases in NOx emissions at the plants that are located within 3 miles of EJ communities.**

RGGI Individual Power Plant Mapping Analysis

While it is useful to evaluate the aggregate impact of RGGI on a regional scale, it is critical to evaluate the impact of RGGI power plants on individual communities as emissions and their associated health impacts are highly localized. For this reason, Acadia Center compiled and analyzed publicly available data from the RGGI CO2 Allowance Tracking System (COATS), the U.S. Census Bureau, the Environmental Protection Agency (EPA), the Energy Information Administration (EIA), and the Council on Environmental Quality (CEQ) and created a collection of maps to answer five sets of key research questions:

- **Map 1 – RGGI Power Plant NOx Emissions & Proximity to High Asthma Communities:** Given the respiratory health risks posed by NOx emissions, which RGGI power plants are in proximity to neighborhoods that experience disproportionately high rates of asthma?

- **Map 2 – RGGI Power Plant NOx Emissions & Proximity to EPA EJSI Communities:** Given the heavy air pollution burden already placed on EPA EJSI Communities, which RGGI power plants are in proximity to these EPA EJSI communities? How does the mapping of proximity to high asthma prevalence relate to the mapping of proximity to EPA EJSI Communities?

- **Map 3 - Top 5 NOx Pollution Threat RGGI Power Plants in Each State & Impact on EPA EJSI and High Asthma Communities:** Given that each RGGI participating state can tailor their own RGGI regulations, in each state, what are the five power plants that pose the greatest "NOx pollution threat" (see detailed definition under Map 3). Of these power plants, which are in proximity to EPA EJSI or high asthma communities?

- **Map 4 – Smaller Power Plants NOx Emissions & Impact on EPA EJSI and High Asthma Communities:** With the exception of New York, RGGI does not regulate small power plants with a capacity between 15-25 megawatts (MW). How many of these smaller plants exist and are they located in proximity to EPA EJSI and high asthma communities? Which of these smaller plants pose the biggest NOx pollution threat to these communities? If these small plants were regulated by RGGI, what would the overall emissions and proceeds generation impact be?

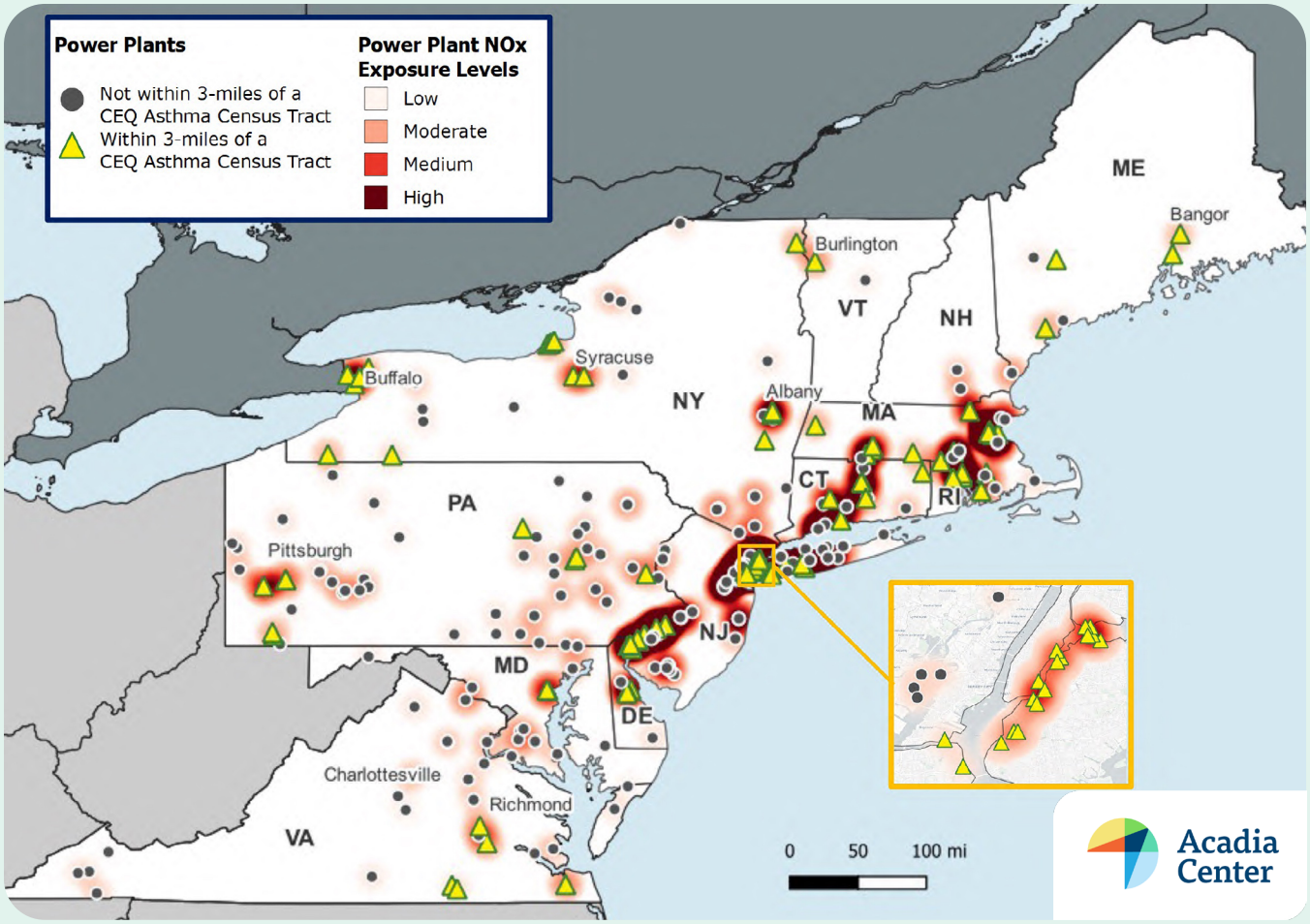
- **Map 5 – Power Plants Lacking Air Quality Monitoring & Impact on EJSI and High Asthma Communities:** Having air quality monitoring stations with publicly accessible data is essential to understanding the impact of NOx on EPA EJSI and high asthma communities. Given this importance, which RGGI power plants in proximity to EPA EJSI or high asthma communities currently lack air quality monitoring? Which of these plants pose the biggest NOx pollution threat to these communities?

As Acadia Center investigated and addressed each of these research questions, we arrived at the conclusion that the Third Program Review represents a clear opportunity for the RGGI states to adopt rules that specifically target accelerated decreases in criteria air pollutants like NOx emissions at the plants that pose the largest respiratory health risk to disproportionately burdened areas like EJSI communities and high asthma communities. While RGGI itself is aimed at reducing GHGs, states and stakeholders point to the air quality benefits produced by RGGI. During the Third Program Review, the participating states could expand the RGGI Memorandum of Understanding to directly address reducing criteria pollutants. RGGI states could also use the power of regional cooperation in the RGGI Model Rule to pursue accelerated decreases in criteria pollutants by targeting the plants that pose the largest respiratory health risk for adjustments to individual air permits.

While implementation of the Clean Air Act is a shared responsibility between the US EPA and state environmental agencies, targeted adjustments to air permits for power plants near environmental justice populations has not been broadly undertaken in the northeast. **Acadia Center recommends that the RGGI states use the opportunity of the Third Program Review and the shared success of RGGI thus far to explore how regional cooperation and individual state powers to regulate air quality and power plants can come together to improve the health of environmental justice and high asthma communities.**

Power Plant NOx Emissions in High Asthma Prevalence Communities

MAP 1. 2021 RGGI POWER PLANTS PROXIMITY TO 90TH PERCENTILE ASTHMA COMMUNITIES & HEAT MAP OF POWER PLANT NOX EMISSIONS EXPOSURE LEVELS [48]



Asthma Proximity Power Plants: The Council on Environmental Quality (CEQ) maintains a tool called the Climate and Economic Justice Screening Tool (CEJST). The CEQ maintains data at the census tract level on the percent of adults over the age of 18 who have been told they have asthma. A power plant was defined as in proximity to a high asthma prevalence community (yellow triangle) if there was any census tract within a 3-mile radius of that plant that scored above the 90th percentile in the CEQ's asthma prevalence indicator.

Power Plant NOx Exposure Levels Heat Map: The heat map is determined by multiplying the level of NOx emitted by each power plant by the number of people living in the surrounding area. White indicates relatively low NOx emissions exposure levels, while dark red indicates relatively high NOx emissions exposure levels.

Acadia Center found that of the 277 RGGI power plants in the region in 2021, 35.7% of those plants are located within a 3-mile radius of a census tract that is above the 90th national percentile for percent of the adult population that has asthma. This section refers to these census tracts as "high asthma communities." Although only 11.5% of all census tracts in the region are considered high asthma communities, we found that, across the region, 35.7% of all RGGI plants were located within 3 miles of a high asthma community. Although complicated by the fact that the 3-mile radius around each power plant often touches multiple census tracts, this comparison suggests that RGGI plants may be more likely to be located within 3 miles of a high asthma community than a random distribution would create. The 101 plants within 3 miles of high asthma communities account for 36.5% of total NOx emissions across the region.

As Map 1 indicates, there are geographic areas of concern with multiple power plants emitting NOx in proximity to high asthma communities. For example, there are a total of 20 RGGI power plants in the five boroughs of New York City and 19 of these plants, which are primarily concentrated in Queens and Brooklyn, are located within a 3-mile radius of high asthma communities. Within a 10-mile radius of downtown Boston, there are four RGGI power plants, all of which are within a 3-mile radius of high asthma communities.

Although many of the 101 plants within a 3-mile radius of an over 90th percentile asthma community are in major metropolitan areas (Boston, New York, Philadelphia), asthma incidence close to a power plant is not exclusively a concern for large cities. For example, four of the six RGGI power plants in Maine are near one of these high asthma communities. Smaller cities including Buffalo, NY; Syracuse, NY; Albany, NY and Pittsburgh, PA also show concentrations of RGGI plants releasing large amounts of NOx near high asthma communities. While all RGGI states except New Hampshire have at least one power plant located near a high asthma community, three states (NY, PA, MA) account for over 61% of all these plants in the region.

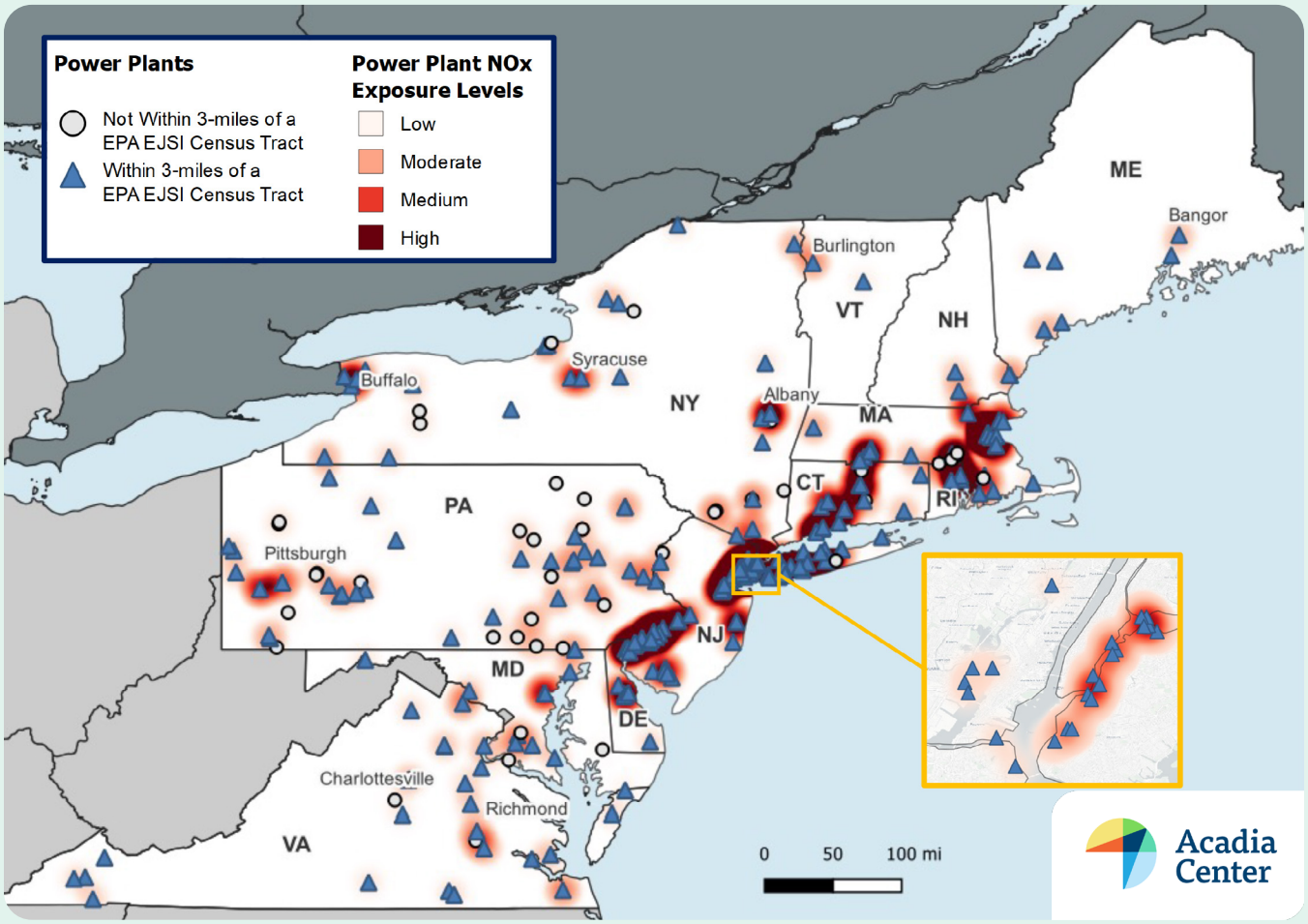
Table 2: 2021 RGGI Power Plants Proximity to 90th Percentile Asthma Communities by State

STATE	STATE RGGI PLANTS IN PROXIMITY TO CEQ ASTHMA COMMUNITY	STATE TOTAL RGGI PLANTS	% OF ALL IN-STATE RGGI PLANTS IN PROXIMITY TO CEQ ASTHMA COMMUNITY	SHARE OF REGION-WIDE RGGI PLANTS IN PROXIMITY TO CEQ ASTHMA COMMUNITY
New York	37	75	49%	37%
Pennsylvania	14	61	23%	14%
New Jersey	5	32	16%	5%
Virginia	5	27	19%	5%
Massachusetts	11	25	44%	11%
Connecticut	9	16	56%	9%
Maryland	2	14	14%	2%
Deleware	7	9	78%	7%
Maine	4	6	67%	4%
New Hampshire	0	6	0%	0%
Rhode Island	6	4	100%	6%
Vermont	1	2	50%	1%
REGIONAL TOTAL	**101**	**277**	**36%**	**100%**

While RGGI has played a key role in reducing overall NOx emissions 85% since 2008, there remain a number of RGGI plants that are releasing significant levels of NOx emissions in close proximity to communities suffering from disproportionately high rates of asthma. **RGGI participating states have an opportunity during the Third Program Review to agree to specifically target accelerated decreases in NOx emissions of the plants that pose the largest respiratory health risk to these disproportionately burdened areas**.

Power Plant NOx Emissions in EPA EJSI Communities

MAP 2. 2021 RGGI POWER PLANTS PROXIMITY TO 90TH PERCENTILE DEMOGRAPHIC ENVIRONMENTAL JUSTICE INDICATOR COMMUNITIES & HEAT MAP OF POWER PLANT NOX EMISSIONS EXPOSURE LEVELS [49]



EPA EJSI Proximity Power Plants: The EPA maintains data on 7 key socioeconomic indicators in their Environmental Justice Screening and Mapping Tool (EJScreen). A power plant was defined as in proximity to an EPA EJSI community (blue triangle) if there was any census tract within a 3-mile radius of that plant that scored above the 90th percentile in any of the seven EPA socioeconomic indicators.

Power Plant NOx Exposure Levels Heat Map: The heat map is determined by multiplying the level of NOx emitted by each power plant by the number of people living in the surrounding area. White indicates relatively low NOx emissions exposure levels, while dark red indicates relatively high NOx emissions exposure levels.

To examine whether the RGGI power plants still in operation in 2021 were located near EJ communities, Acadia Center again used the EPA EJScreen socioeconomic indicators. Although only 41% of the census tracts in the region are considered EPA EJSI Communities, we found that, across the region, 83% of RGGI power plants were located within 3 miles of EPA EJSI Communities. Although complicated by the fact that the 3-mile radius around each power plant often touches multiple census tracts, this comparison suggests that RGGI plants may be more likely to be located within 3 miles of an EPA EJSI community than a random distribution would create. Some states' concentration of RGGI plants located near EPA EJSI communities were even higher – in five states (NJ, DE, ME, NH, VT) 100% of RGGI plants were located close to at least one EPA EJSI community, as well as the vast majority of plants in Virginia (93%), Connecticut (88%), and New York (87%). **Collectively, this set of 231 power plants located near EPA EJSI communities accounts for 71% of total NOx emissions from RGGI plants.**

Table 3: 2021 RGGI Power Plants Proximity to 90th Percentile Demographic Environmental Justice Indicator Communities by State

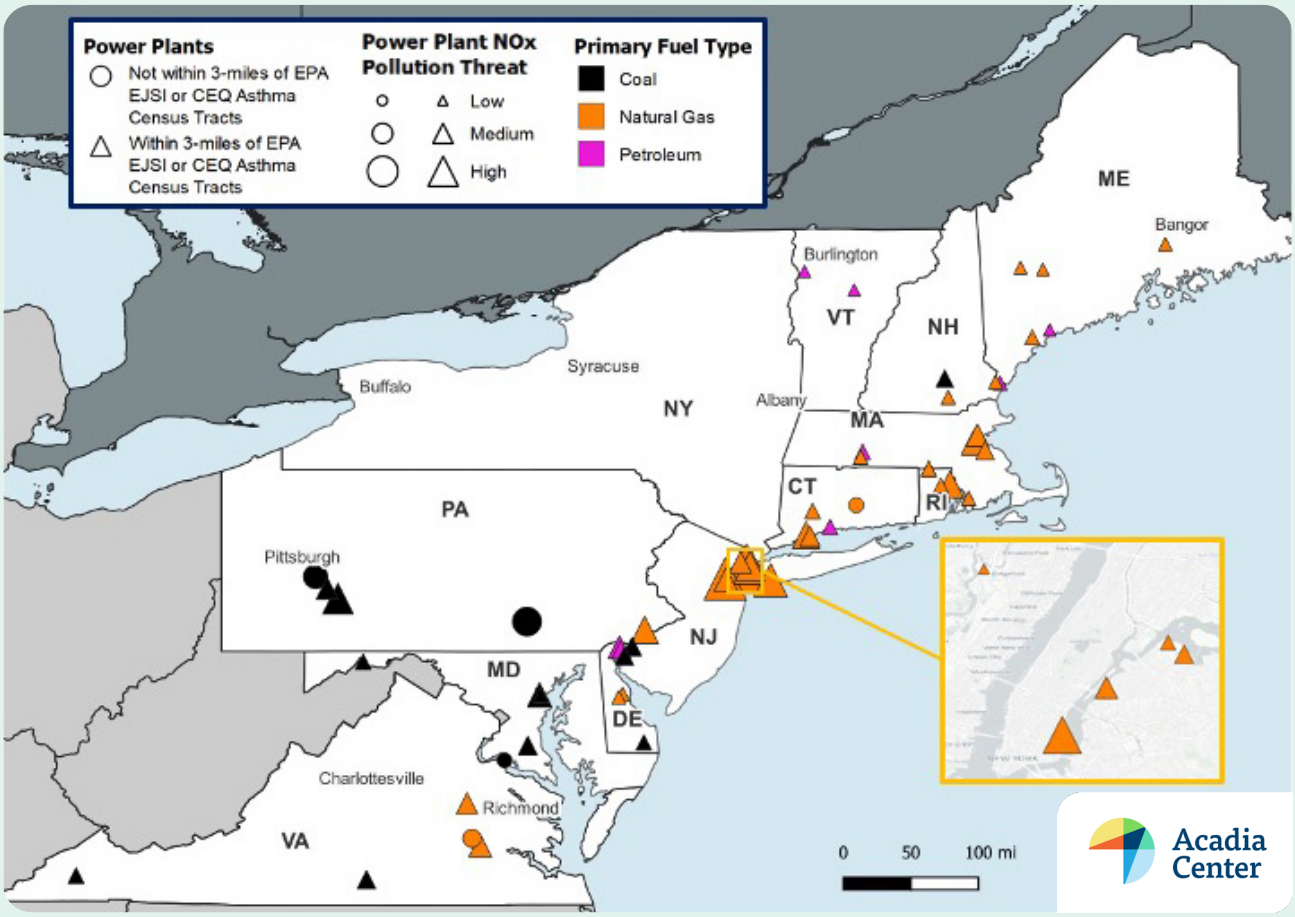
STATE	RGGI PLANTS IN PROXIMITY TO EPA EJSI COMMUNITY	TOTAL RGGI PLANTS	% OF ALL IN-STATE RGGI PLANTS IN PROXIMITY TO EPA EJSI COMMUNITY	SHARE OF REGION-WIDE RGGI PLANTS IN PROXIMITY TO EPA EJSI COMMUNITY
New York	65	75	87%	28%
Pennsylvania	40	61	66%	17%
New Jersey	32	32	100%	14%
Virginia	25	27	93%	11%
Massachusetts	19	25	76%	8%
Connecticut	14	16	88%	6%
Maryland	11	14	79%	5%
Deleware	9	9	100%	4%
Maine	6	6	100%	3%
New Hampshire	4	6	100%	2%
Rhode Island	4	4	67%	2%
Vermont	2	2	100%	1%
REGIONAL TOTAL	**231**	**277**	**83%**	**N/A**

As in Map 1, where we mapped RGGI plants in close proximity to high asthma communities, Map 2 visually highlights geographic areas of concern with multiple power plants emitting NOx in proximity to EPA EJSI communities. For example, all 20 RGGI power plants in the five boroughs of New York City are within a 3-mile radius of an EPA EJSI community. In Connecticut, running along the central I-95/I-91 Corridor that includes Bridgeport, New Haven, and Hartford, all nine RGGI plants are in proximity to an EPA EJSI community. Both Boston and Philadelphia each have four RGGI power plants within a 10-mile radius of the city center, all of which are in proximity to an EPA EJSI community. While all RGGI states have at least one plant located within 3 miles of an EPA EJSI community, the majority of the plants come from 3 key states, New York (30%), Pennsylvania (19%) and New Jersey (14%). If Virginia, Massachusetts, and Connecticut are added to this list, these six states contain 88% of all RGGI plants in proximity to EPA EJSI communities.

As with the information we uncovered in Map 1, Map 2 demonstrates that while RGGI has played a key role in reducing overall NOx emissions 85% since 2008, there remain a number of RGGI plants that are releasing significant levels of NOx emissions in close proximity to EJ communities. **RGGI participating states have an opportunity during the Third Program Review to agree to specifically target accelerated decreases in NOx emissions of the plants that pose the largest respiratory health risk to these disproportionately burdened areas.**

Targeting Power Plant NOx Emissions in EPA EJSI & High Asthma Communities

MAP 3. 2021 TOP FIVE NOx POLLUTION THREAT RGGI POWER PLANTS IN EACH STATE BY FUEL TYPE AND PROXIMITY TO AN EPA EJSI COMMUNITY OR 90TH PERCENTILE ASTHMA COMMUNITY [50]



NOTE: New Hampshire and Vermont have fewer than 5 RGGI power plants. All RGGI plants for those states shown.

EPA EJSI and Asthma Proximity Power Plants: The EPA maintains data on 7 key socioeconomic indicators in their Environmental Justice Screening and Mapping Tool (EJScreen) at a census tract level and the Council on Environmental Quality maintains data on the percent of adults over the age of 18 that have been told they have asthma at the census tract level. A power plant was defined as in proximity to either an EPA EJSI or high asthma community (and marked by a triangle on map) if there was any census tract within a 3-mile radius of that plant that scored about the 90th percentile in any of the EPA socioeconomic indicators or above the 90th percentile in CEQ's Asthma Prevalence Indicator.

Primary Fuel Type: Some power plants combust more than one type of fuel over the course of a year. The map above uses the "primary fuel" for the plant which is the fuel most commonly combusted over the course of the year.

To identify some of the most problematic power plants in the RGGI region, Acadia Center developed a power plant "NOx Pollution Threat Score". This score ranges from 1-100, with a score of 100 representing the plant in the region with the highest threat score, and is calculated based on three variables – in 2021: 1) How much NOx did the plant emit? 2) How many people were living within 3 miles of that plant? and 3) Using the seven EPA environmental justice socioeconomic indicators and the asthma prevalence indicator, what was the average 8-indicator percentile for all communities within 3 miles of the plant? It is important to note that this NOx Pollution Threat Score attempts to quantify the impact of individual power plants, not the aggregate impact on individual communities. For example, some communities will be impacted by multiple nearby power plants, not to mention other sources of NOx, exacerbating negative health impacts. It's also important to note that this metric only examines power plant NOx emissions in a given calendar year (2021), but the negative health consequences associated with cumulative exposure to NOx are also important to consider and could be the topic of future research.

Map 3 above displays the top five power plants in each state with the highest NOx Pollution Threat Score and Table 4 below highlights the top ten power plants in the region in terms of NOx Pollution Threat Score, the RGGI NOx Threat Ten.

Table 4: 2021 RGGI Top 10 Plants: NOx Pollution Threat

RANK	LOCATION	PLANT NAME	PRIMARY FUEL TYPE	PLANT ANNUAL NO_x EMISSIONS (TONS/YEAR)	POPULATION WITHIN 3-MILE RADIUS OF PLANT	3-MILE RADIUS POPULATION EPA EJSI AND ASTHMA INDICATOR AVERAGE PERCENTILE	TOTAL NO_x POLLUTION THREAT SCORE (1-100)	EPA EJSI OR ASTHMA INDICATORS OVER 90TH PERCENTILE
1	Manhattan, NY	East River Generating Station	GAS	3,191	917,505	42	100	Asthma, Income, Race, Education, Unemployment, Linguistic Iso., <5 age, >64 age
2	Queens, NY	Ravenswood Generating Station	GAS	1,432	818,365	43	41	Asthma, Income, Race, Education, Unemployment, Linguistic Iso., <5 age, >64 age
3	Linden, NJ	Linden Cogeneration Facility	GAS	2,884	169,032	69	27	Income, Race, Education, Unemployment, Linguistic Iso., Children <5 age
4	Queens, NY	Astoria Energy	GAS	577	616,802	57	16	Asthma, Income, Race, Education, Unemployment, Linguistic Iso., <5 age, >64 age
5	Island Park, NY	EF Barrett Generation Staton	GAS	4,084	117,698	38	15	>64 age
6	New Florence, PA	Conemaugh Generating Stations	COAL	22,026	12,412	53	12	>64 age
7	Queens, NY	Poletti 500 MW CC	GAS	317	672,440	60	10	Asthma, Income, Race, Education, Unemployment, Linguistic Iso., <5 age, >64 age
8	York Haven, PA	Brunner Island Power Plant	COAL	9,890	25,283	48	10	<5 age
9	Philadelphia, PA	Grays Ferry Cogen Power Station	GAS	404	424,397	59	8	Asthma, Income, Race, Education, Unemployment, Linguistic Iso., <5 age, >64 age
10	Bridgeport, CT	Bridgeport Harbor Station	GAS	969	146,482	69	8	Asthma, Income, Race, Education, Unemployment, Linguistic Iso., <5 age, >64 age

The East River Generating Station in Manhattan ranks #1 on our list in terms of NOx Pollution Threat Score and provides an illustrative example of how the score works. The plant emitted a significant amount of NOx in 2021 (3,191 tons), and there are over 900,000 people living within a 3-mile radius of the plant, exposed to this high level of NOx. The communities surrounding the plant had a fairly average percentile in terms of EPA EJSI and asthma prevalence indicators (42nd percentile 8-indicator average), but, being in the middle of New York City, this average represents both concentrations of EJ communities as well as some of the wealthiest neighborhoods in the country. This plant scored highly on the NOx pollution threat score because of this large population's exposure to high levels of NOx. That is to say, even though the population within a 3-mile radius of the plant is fairly average in terms of the 8-indicator percentile, there are still a large number of EJ populations that are negatively impacted by this plant, largely as a result of the sheer number of people living close to it. As a result, the East River Generating Station scores 2.4x higher than *any other* plant in the entire RGGI region by this metric.

Population density is a key reason why four of the top ten plants in terms of NOx pollution threat are in one of the five New York City boroughs, and an additional two plants on the top ten list, in Linden, NJ and Island Park, NY, are in the greater New York metro area. The two gas plants on the top ten list that are not within the New York City metro are both located in densely populated cities (Philadelphia, PA and Bridgeport, CT). The gas plants in Linden, NJ and Bridgeport, CT are notable for both having a 69th percentile average score on the 8-indicators, tied for the highest among any plants on the top ten list – that is, the highest concentration of EJ and high asthma communities.

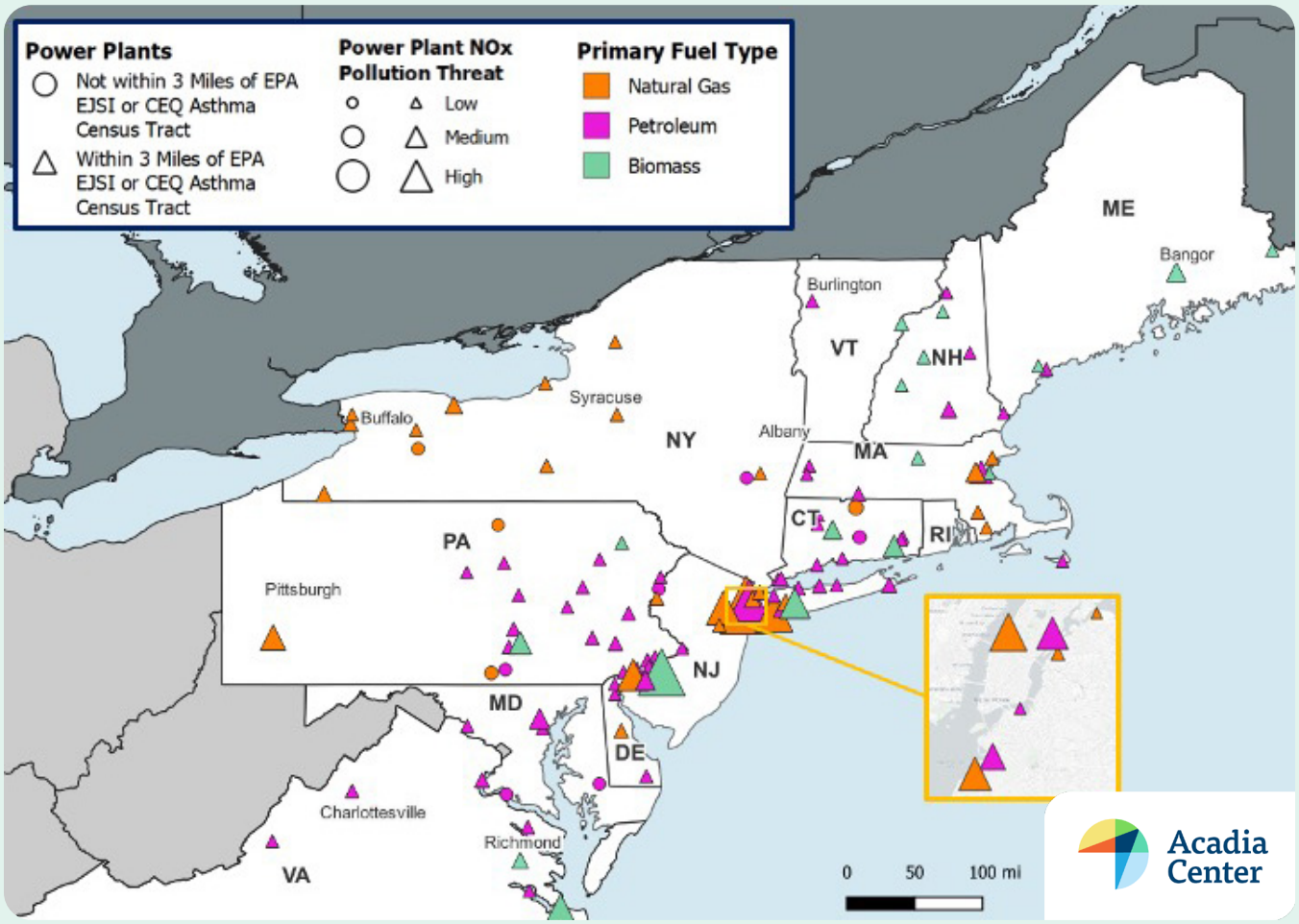
At first glance, it's somewhat surprising that only two coal power plants appear on the top ten list given the typically very high levels of NOx emissions. However, a key reason for this, as demonstrated by Map 3 above, is that natural gas plants in the RGGI region tend to be located in more densely populated urban areas. For example, the two coal plants on the top ten list emitted, on average, over 9x more NOx than the eight gas plants on the top ten list. However, those gas plants had, on average, nearly 26x more people living within a 3-mile radius of them than the two coal plants, and people living within 3 miles of the gas plants had a higher 8-indicator average percentile (55th percentile) compared to those living near the coal plants (51st percentile).

As part of the Third Program Review, Acadia Center recommends that the **participating states agree to target accelerated decreases in NOx emissions at power plants that pose the largest respiratory health risk to EJ communities and high asthma communities.** This top 10 list of plants with the highest NOx pollution threat scores, the RGGI NOx Threat Ten, are a key set of plants to target as an initial step.

Lower the RGGI Power Generating Unit Capacity Threshold from 25 MW to 15 MW to Ensure More Plants are Subject to RGGI Regulations

Some power plants have a single "generating unit" while other plants have multiple generating units. The capacity of a generating unit is a measure of how much electricity the unit can produce when running at its maximum output. Smaller generating units below a capacity of 25 megawatts (MW) are currently not subject to the RGGI emissions cap, except for units operating in New York state, where the state rule has extended the RGGI cap to generating units with a capacity of 15 MW or above.[51] A number of organizations are advancing the recommendation that the threshold for RGGI regulation be lowered to a capacity of 15 MW or higher across the region, and even lower for co-located plants.[52] At the request of our partners, including Alternatives for Community and Environment (ACE) and GreenRoots, Acadia Center conducted an analysis to evaluate the magnitude and importance of establishing a RGGI-wide rule to lower this capacity threshold. Acadia Center analyzed the locations of these smaller generating units, their proximity to EPA EJSI or high asthma communities, the NOx pollution threat they pose, and their GHG emissions.

MAP 4. 2021 POWER PLANTS WITH SMALL GENERATING UNITS (15-25 MW CAPACITY) BY FUEL TYPE AND PROXIMITY TO AN EPA EJSI COMMUNITY OR 90TH PERCENTILE ASTHMA COMMUNITY [53]



EPA EJSI and Asthma Proximity Power Plants: The EPA maintains data on **7 key socioeconomic indicators** in their Environmental Justice Screening and Mapping Tool (EJScreen) at a census tract level and the Council on Environmental Quality (CEQ) maintains data on the percent of adults over the age of 18 that have been told they have asthma at the census tract level. A power plant was defined as in proximity to either an EPA EJSI or high asthma community (triangle on map) if there was any census tract within a 3-mile radius of that plant that scored about the 90th percentile in any of the EPA socioeconomic indicators or above the 90th percentile in CEQ's asthma prevalence indicator.

Primary Fuel Type: Some power plants combust more than one type of fuel over the course of a year. The map above uses the "primary fuel" for the plant which is the fuel most commonly combusted over the course of the year.

NOx Pollution Threat Score: Acadia Center was interested in developing a "NOx Pollution Threat Score" for each power plant based on 3 variables: 1) How much NOx does the plant emit? 2) How many people live within 3 miles of that plant? And 3) Using the seven EPA environmental justice socioeconomic indicators and the asthma prevalence indicator, what is the average 8-indicator percentile for communities within 3 miles of the plant?

In total, there are 240 generating units between 15-25 MW in capacity spread across 115 power plants in the RGGI region. If RGGI were expanded to include these units, the smaller units would make up 1.4% of total CO2 emissions from all RGGI plants but 4.8% of total NOx emissions from all RGGI plants. Of the 115 power plants containing at least one smaller generating unit, 91% (105) are located within a 3-mile radius of an EPA EJSI or high asthma community. In 2021, if all generating units between 15-25 MW were regulated by RGGI, these plants would have generated an estimated $25.9 million in RGGI proceeds in that year (or $19.2 million excluding plants in New York State).

While it's admirable that New York has begun to regulate GHG emissions from these smaller generating units through RGGI, it's worth noting that these smaller units in New York still account for 9.2% of total NOx emissions from all RGGI-regulated plants in the state. New York accounts for about 36% of all the smaller units in the RGGI region - excluding New York, there are 154 smaller generating units spread across 85 power plants in the RGGI region. Of these 85 power plants, 91% (77) are located within a 3-mile radius of an EPA EJSI or high asthma community. Again excluding New York, if RGGI were expanded to include these smaller plants, the smaller plants would make up 1.2% of total CO2 emissions from non-New York RGGI plants but 3.8% of total NOx emissions from non-New York RGGI plants.

As demonstrated in Table 5 below, these smaller generating units are present in all RGGI states with the exception of Rhode Island. Excluding New York, five states (PA, CT, MA, NH, VA) collectively account for 78% all power plants in the region that both have at least one generating unit between 15-25 MW and are in proximity to either an EPA EJSI or high asthma community.

Table 5: 2021 RGGI Power Plants With at Least One Generating Unit of 15-25 MW Capacity and Proximity to EPA EJSI or High Asthma Communities by State

STATE	PLANTS WITH AT LEAST 1 15-25 MW GENERATING UNIT IN PROXIMITY TO EPA EJSI OR HIGH ASTHMA COMMUNITY	ALL PLANTS WITH AT LEAST 1 15-25 MW GENERATING UNIT	% OF IN-STATE PLANTS WITH AT LEAST 1 15-25 MW GENERATING UNIT IN PROXIMITY TO EPA EJSI OR HIGH ASTHMA COMMUNITY	% SHARE OF REGION-WIDE PLANTS WITH AT LEAST 1 15-25 MW GENERATING UNIT IN PROXIMITY TO EPA EJSI OR HIGH ASTHMA COMMUNITY
New York	28	30	93%	27%
Pennsylvania	23	27	85%	22%
Connecticut	10	12	83%	10%
Massachusetts	11	11	100%	10%
New Hampshire	8	8	100%	8%
Virginia	8	8	100%	8%
Maryland	3	5	60%	4%
Delaware	4	4	100%	4%
Maine	4	4	100%	4%
New Jersey	4	4	100%	3%
Vermont	2	2	100%	2%
Rhode Island	0	0	N/A	N/A
TOTAL	**105**	**115**	**91%**	**100%**

As demonstrated below in Table 6, excluding New York, three states (VA, NJ, PA) collectively account for 71% all NOx emissions from these smaller generating units. The percentage of total power plant NOx emissions in each state attributable to these smaller units varies widely. For example, in Vermont and Maine, where there are fewer power plants in general, these smaller units account for 91% and 51% of total NOx emissions from power plants respectively. Even in more populated states with a greater number of total plants, these smaller units can still account for a significant percent of total power plant NOx emissions – for example Connecticut (14%) and New Jersey (11%).

Table 6. 2021 RGGI Power Plants With at Least One Generating Unit of 15-25 MW Capacity NOx and CO2 Emissions by State

STATE	15-25 MW GENERATING UNITS NOX EMISSIONS (TONS/YR)	15-25 MW GENERATING UNITS CO2 EMISSIONS (TONS/YR)	% OF TOTAL IN-STATE POWER PLANT NOX EMISSIONS FROM 15-25 MW GENERATING UNITS	% OF TOTAL IN-STATE POWER PLANT CO2 EMISSIONS FROM 15-25 MW GENERATING UNITS
New York	2,168	706,507	8%	2%
Virginia	1,516	674,599	9%	2%
New Jersey	973	341,802	11%	2%
Pennsylvania	922	368,766	1%	0%
Connecticut	501	284,233	14%	3%
Maine	425	83,402	51%	5%
New Hampshire	152	26,695	9%	1%
Vermont	148	381	91%	11%
Massachusetts	87	169,353	4%	2%
Maryland	80	52,936	1%	0%
Delaware	32	29,782	1%	2%
Rhode Island	N/A	N/A	N/A	N/A
TOTAL	**7,004**	**2,738,456**	**4.6%**	**1.4%**

Additionally, many of the smaller generating units that would be subject to a lowered RGGI threshold have significant NOx emissions – for example the cumulative NOx emissions from all 15-25MW units at the Wheelabrator Portsmouth plant in Portsmouth, VA are higher than four of the plants on RGGI Threat Ten list (see Table 4 above). Because New York regulates 15-25 MW generating units through RGGI, New York plants were excluded from the below list in order to highlight the smaller generating units in the region with the highest NOx Pollution Threat score that are completely unregulated by RGGI. If New York plants were included in the below list, they would take up the top three spots on the list with NOx Pollution Threat scores of 7.5 (74th St. Power Station in Manhattan), 7.4 (59th St. Powerhouse in Manhattan), and 6.0 (Narrows Generation Station in Brooklyn).

The plants in the below list score lower, on average, in terms of NOx Pollution Threat compared to plants on the RGGI Threat Ten (Table 4) list for a few reasons. On average, in 2021, the larger plants in the top ten emitted about 14.6x more NOx, had 2.4x as many people living within a 3-mile radius, and had an 8-indicator percentile that was slightly higher (54th percentile versus 48th percentile). The lower population density, in particular, is partially a result of excluding the New York plants from the below list.

Table 7. 2021 Top 10 Plants (Excluding New York State) With At Least One 15-25 MW Generating Unit: NOx Pollution Threat

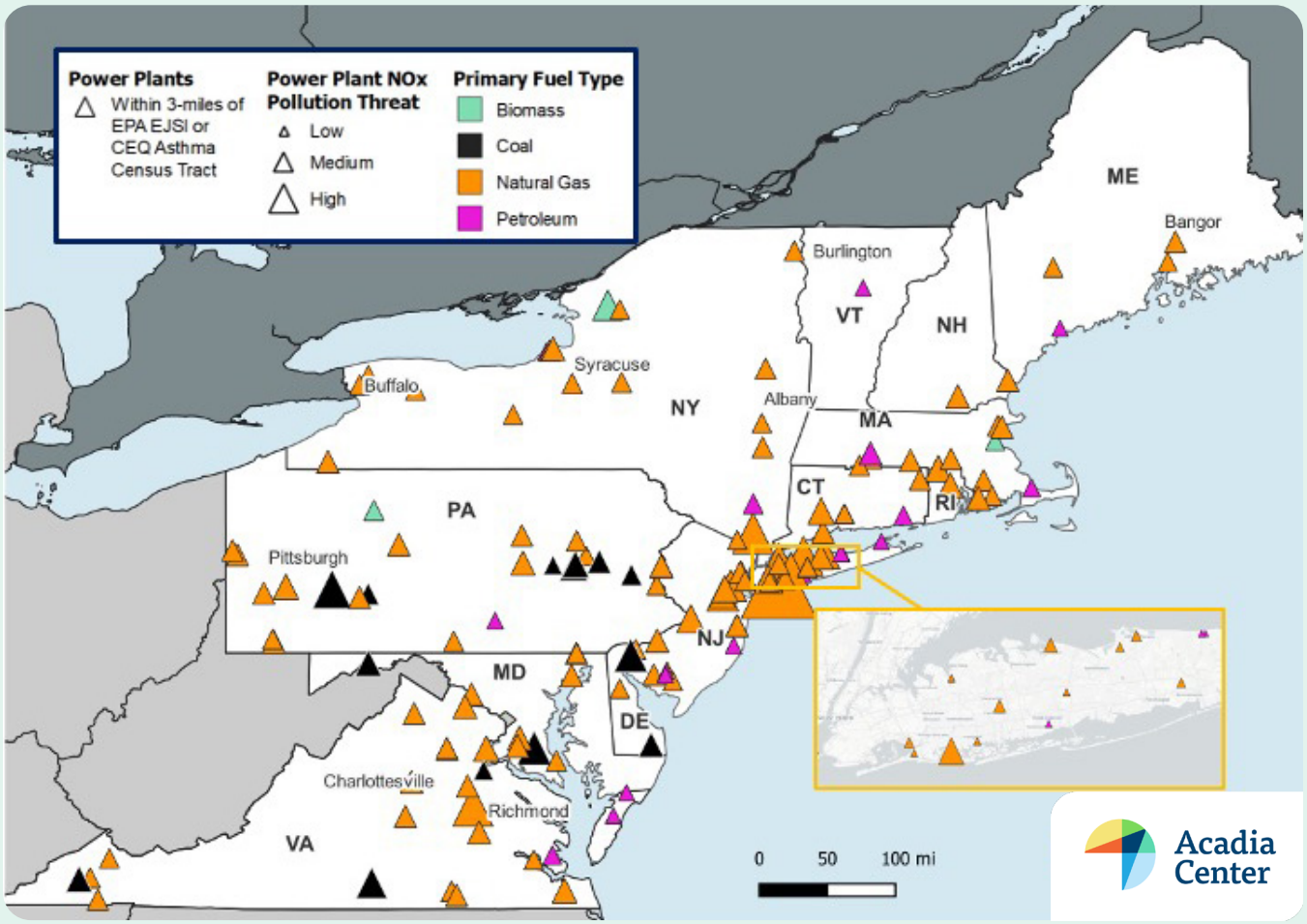
RANK	LOCATION	PLANT NAME	PRIMARY FUEL TYPE	CUMULATIVE NO_x EMISSIONS FROM ALL 15-25 MW UNITS AT PLANT (TONS/YEAR)	POPULATION WITHIN 3-MILE RADIUS OF PLANT	3-MILE RADIUS POPULATION EPA EJSI AND ASTHMA INDICATOR AVERAGE PERCENTILE	TOTAL NO_x POLLUTION THREAT SCORE (1-100)	EPA EJSI OR ASTHMA INDICATORS OVER 90TH PERCENTILE
1	Portsmouth, VA	Wheelabrator Portsmouth	BIOMASS	1,215	106,278	46	4.8	Asthma, Income, Race, Education, Unemployment, Linguistic Iso., <5 age
2	Camden, NJ	Camden Resource	GAS	544	152,458	45	3.0	Income, Education, Unemployment, Linguistic Iso., <5 age, >64 age
3	Chester, PA	Chester Operations	BIOMASS	322	117,208	51	1.5	Asthma, Income, Education, Unemployment, Linguistic Iso., <5 age
4	Kenilworth, NJ	Kenilworth Energy Facility	GAS	162	210,819	52	1.4	Income, Education, Unemployment, Linguistic Iso., <5 age, >64 age
5	Clairton, PA	Clairton Works	OIL	293	65,133	45	0.7	Asthma, Income, Unemployment, <5 age, >64 age
6	Baltimore, MD	Philadelphia Road Generating Station	GAS	34	287,852	56	0.4	Asthma, Income, Education, Unemployment, Linguistic Iso., <5 age, >64 age
7	Harrisburg, PA	Harrisburg Facility	OIL	109	84,610	51	0.4	Asthma, Income, Race, Education, Unemployment, Linguistic Iso., <5 age, >64 age
8	Bristol, CT	Covanta Bristol Energy	BIOMASS	111	81,752	52	0.4	Asthma, Income, Education, Unemployment, <5 age, >64 age
9	Cambridge, MA	Kendall Square Station	GAS	28	481,559	34	0.4	Asthma, Income, Education, Unemployment, Linguistic Iso., <5 age, >64 age
10	Preston, CT	Covanta Southeastern Connecticut Company	GAS	323	24,879	44	0.3	<5 age

Improve Air Quality Monitoring

Map 1, above, demonstrates that 36% of RGGI power plants are located within a 3-mile radius of a high asthma community and Map 2, above, demonstrates 81% of RGGI power plants are located within a 3-mile radius of an EPA EJSI community. Gathering more information on air quality within those communities provides one potential vehicle for helping to address these hot spots. Air quality monitoring in the region can be challenging due to factors like harsh weather and difficult terrain. Inadequate monitoring stations and limited funding for air quality monitoring and enforcement only exacerbate these problems.

Acadia Center sought to determine where the 530 active EPA air quality monitoring sites within the RGGI region are located, and, significantly, how many RGGI plants are within a 3-mile radius of an EJSI or high asthma community, but not within a 3-mile radius of a monitor.

MAP 5. 2021 RGGI POWER PLANTS LACKING AIR QUALITY MONITOR WITHIN 3-MILE RADIUS OF POWER PLANT AND ALSO LOCATED IN PROXIMITY TO AN EPA EJSI COMMUNITY OR 90TH PERCENTILE ASTHMA COMMUNITY [54]



EPA EJSI and Asthma Proximity Power Plants: The EPA maintains data on 7 key socioeconomic indicators in their Environmental Justice Screening and Mapping Tool (EJScreen) at a census tract level and the Council on Environmental Quality (CEQ) maintains data on the percent of adults over the age of 18 that have been told they have asthma at the census tract level. A power plant that falls within a 3-mile radius of a census tract that exceeds the 90th percentile in any of these eight indicators was marked on the map above (triangle).

NOx Pollution Threat Score: Acadia Center was interested in developing a "NOx Pollution Threat Score" for each power plant based on 3 variables: 1) How much NOx does the plant emit? 2) How many people live within 3 miles of that plant? And 3) Using the seven EPA environmental justice socioeconomic indicators and the asthma prevalence indicator, what is the average 8-indicator percentile for communities within 3 miles of the plant?

Air Quality Monitor Locations: Acadia Center used data from EPA's Air Quality System (AQS) on the unique geographic location for each air quality monitoring site. Only active sites were included.

Acadia Center found that of the 277 RGGI power plants in the region in 2021, 68% (187) do not have an active air quality monitoring site within a three-mile radius of the plant. Of those 187 plants, 79% (147) are located within a three-mile radius of an EPA EJSI or high asthma community. It is distressing both that over two thirds of RGGI plants do not have an active air monitoring site nearby to measure the impact on neighboring communities, and that over three quarters of these unmonitored plants are close to EPA EJSI or high asthma communities.

Acadia Center's research and discussions with air quality experts leads us to the conclusion that in the Third Model Rule process, the states should work to agree among themselves to step up their funding and enforcement of air quality monitoring. The Model Rule should mandate that the states not only secure better data regarding the impacts on environmental justice communities and pollution hot spots stemming from the RGGI power plants, but also that they address disparities in air quality shown within the data provided by this additional monitoring.

As demonstrated below in Table 8, four states (NY, PA, VA, NJ) collectively account for 73% of all RGGI plants in the region that both lack nearby air quality monitoring and are within 3 miles of EPA EJSI or high asthma communities. For the RGGI plants that lack nearby air quality monitoring in each state, the percentage of those plants that are also near an EPA EJSI or high asthma community varies widely. In half the states, all of the plants that lack nearby monitoring are also near EPA EJSI or high asthma communities. Pennsylvania (59%) and Massachusetts (65%) score the best on this metric, in that both have a number of plants without nearby monitors that are *not* close to EPA EJSI or high asthma communities, but that is faint praise. There is obviously significant room for improvement across the board, and the need for funding and enforcement of air quality monitoring is great.

Table 8: 2021 RGGI Power Plants Lacking Air Quality Monitor Within 3-mile Radius of Power Plant and Also Located in Proximity to an EPA EJSI Community or High Asthma Community – By State

STATE	RGGI PLANTS WITH NO NEARBY AQ MONITORING IN PROXIMITY TO EPA EJSI OR HIGH ASTHMA COMMUNITY	TOTAL RGGI PLANTS WITH NO NEARBY AQ MONITORING	% OF ALL IN-STATE RGGI PLANTS WITH NO NEARBY AQ MONITORING IN PROXIMITY TO EPA EJSI OR HIGH ASTHMA COMMUNITY	SHARE OF REGION-WIDE RGGI PLANTS WITH NO NEARBY AQ MONITORING IN PROXIMITY TO EPA EJSI OR HIGH ASTHMA COMMUNITY
New York	37	46	80%	25%
Pennsylvania	26	44	59%	18%
Virginia	24	26	92%	16%
New Jersey	20	20	100%	14%
Massachusetts	11	17	65%	7%
Maryland	9	12	75%	6%
Connecticut	7	9	78%	5%
Maine	4	4	100%	3%
Rhode Island	4	4	100%	3%
Delaware	2	2	100%	1.4%
New Hampshire	2	2	100%	1.4%
Vermont	1	1	100%	0.7%
TOTAL	**147**	**187**	**79%**	**100%**

Acadia Center also looked at the top ten plants by NOx pollution threat in the region that lack nearby air quality monitoring in Table 9 below. What stands out from this list is the differences when compared against Table 4, above, which looked at top ten NOx pollution threat RGGI plants across the region (regardless of proximity to air quality monitoring). For the top ten list considering all plants, the average population within a 3-mile radius of the plants was 392,000 – that's 8.7x higher than the average population within a 3-mile radius of the top ten plants in Table 9 below that lack air quality monitoring. In other words, since air quality monitoring stations are more common in dense urban areas, many of the plants on the original top ten list were weeded out.

Table 9. 2021 RGGI Top 10 Plants Lacking Air Quality Monitoring: NOx Pollution Threat

RANK	LOCATION	PLANT NAME	PRIMARY FUEL TYPE	ANNUAL NO_x EMISSIONS	POPULATION WITHIN 3-MILE RADIUS	EPA EJSI 8-INDICATOR AVERAGE PERCENTILE	TOTAL NO_x POLLUTION THREAT SCORE (1-100)	EPA EJSI OR ASTHMA INDICATORS OVER 90TH PERCENTILE
1	Island Park, NY	E F Barrett Power Station	GAS	4,084	117,698	39	15	>64 age
2	York Haven, PA	Brunner Island Steam Electric Station	COAL	9,890	25,283	46	10	High in multiple indicators but none above 90th
3	Shelocta, PA	Keystone Generating Station	COAL	21,925	7,007	41	5	High in multiple indicators but none above 90th
4	Homer City, PA	Homer City Generating Station	COAL	6,288	14,409	48	4	Unemployment
5	Ashland, VA	Doswell Energy Center	GAS	4,363	20,160	45	3	Education
6	Haverstraw, NY	Bowline Generating Station	GAS	1,145	64,711	50	3	Education, Unemployment, Linguistic Iso., <5 age, >64 age
7	Fort Salonga, NY	Northport Power Station	GAS	4,344	24,184	24	2	>64 age
8	Aquasco, MD	Chalk Point Generating Station	COAL	2,798	19,948	44	2	Unemployment
9	Hicksville, NY	Bethpage Energy Center	GAS	412	142,707	36	2	<5 age, >64 age
10	Colver, PA	Colver Power Project	COAL	2,637	12,184	59	2	Education, Unemployment, <5 age

What's left are primarily plants in more rural locations that lack nearby air quality monitoring. For example, five coal plants – which emit large amounts of NOx but only have an average population of about 16,000 living within 3-miles of each plant – are on this list whereas the previous list only contained two coal plants. Four of the top ten plants are located in New York State (all gas plants) and four are located in Pennsylvania (all coal plants). The EF Barret Power Station in Island Park, NY (a Long Island suburb of New York City) scores highest in terms of NOx pollution threat, largely due to the combination of having a high population within a 3-mile radius (118,000) and significant levels of NOx emissions.

One additional point of interest in this top ten list is that none of the plants cracked the 90th percentile in the people of color, low-income, or asthma prevalence indicators. This is in sharp contrast to Table 4, above, showing the top ten plants in terms of NOx pollution threat score (regardless of proximity to air quality monitoring) where seven of the ten plants were close to EPA EJSI communities over the 90th percentile in people of color and low-income and six of the plants were near communities that exceeded 90th percentile for asthma prevalence. This highlights some of the socioeconomic differences between the two groupings of ten power plants, one being more urban and one being more rural.

Summary of Policy Recommendations

The 9 states that have consistently participated in RGGI have experienced substantial benefits from RGGI since 2008, the year the program launched. While the objective of RGGI is, first and foremost, reducing greenhouse gas emissions while supporting economic growth, because it applies to power plants, it can be an effective vehicle to deliver reductions in criteria air pollutants and better outcomes to communities that are located near power plants. RGGI has delivered important ancillary benefits like an 85% reduction in NOx in RGGI-regulated power plants over the entire region. But RGGI can do more to address localized air quality. Acadia Center analysis found that between 2008 and 2021:

- NOx emissions from power plants within 3 miles of a community with high EPA Environmental Justice Socioeconomic Indicators ("EPA EJSI community," see sidebar for more information) declined by 85%, compared to the rest of the RGGI power plant fleet, where NOx emissions declined by 88%

- Over a third of RGGI plants that are releasing NOx emissions near communities suffering from disproportionately high rates of asthma

- Over two-thirds of RGGI plants do not have any active air quality monitoring sites within a 3-mile radius to measure the impact on neighboring communities – and over three quarters of these unmonitored plants are located near an EPA EJSI community or high asthma communities

Acadia Center analysis also found that although only 41% of the census tracts in the region are classified as EPA EJSI Communities, 81% of RGGI power plants are located within 3 miles of EPA EJSI Communities. Similarly, although only 11.5% of all census tracts in the region are considered high asthma communities, 37.5% of all RGGI plants were located within 3 miles of a high asthma community. Although complicated by the fact that the 3-mile radius around each power plant often touches multiple census tracts, this comparison suggests that RGGI plants may be more likely to be located within 3 miles of an EPA EJSI community or high asthma community than a random distribution would create.

The RGGI states are currently in the early stages of the Third Program Review, expected to conclude by the end of 2023. This Report makes several recommendations for the states to consider as they evaluate how to improve RGGI's emissions caps, market mechanisms, and model regulations to take the program beyond 2030. Informed by our findings in this Report, Acadia Center recommends that the RGGI states use the Third Program Review to explore how regional cooperation and individual state powers to regulate air quality and power plants can improve the health of disproportionately burdened communities.

Specifically, Acadia Center recommends that the RGGI states act during the Third Program Review to:

ALIGN THE CAP AND MARKET MECHANISMS WITH STATE LAW

- Use RGGI to accelerate decarbonization by setting the RGGI cap level no higher than the level of emissions allowed under state-level clean energy and GHG reduction laws in each of the relevant years. Such a level is significantly below the existing cap: overall, the 9-state "state goals cap" would need to decline 95% below 2021 emissions levels in the 9 states by 2050 and the 12-state "state goals cap" would need to decline 89% below 2021 emissions levels in the 12 states by 2050.

- Adjust the market mechanisms to better align with state decarbonization policies by: substantially raising the Cost Containment Reserve trigger price; increasing the Emissions Containment Reserve trigger price; and increasing both the Minimum Reserve Price and its rate of escalation to align with market prices from the most recent years' auctions more closely

ENSURE ENVIRONMENTAL JUSTICE COMMUNITIES DIRECTLY BENEFIT

- Clearly articulate how environmental justice communities are being defined

- Establish a requirement that a minimum of 40%-50% of RGGI proceeds are invested in EJ communities, setting a value that does not change even if other RGGI funds are raided

- Establish a requirement that members of EJ communities have meaningful participation in decisions regarding programs for investment

- Transparently track whether programs identified as providing EJ community investments are meeting their quantitative metrics, and adjust programs as necessary to ensure the minimum percentage investment is achieved

- Centralize this information in a frequently updated public-facing report or dashboard that is easily accessible and understandable to a wide variety of stakeholders and utilizes standardized information, allowing aggregation across the RGGI region

USE THE POWER OF REGIONAL COOPERATION TO IMPROVE HEALTH & AIR QUALITY

- Agree to target accelerated decreases in NOx emissions at power plants that pose the largest respiratory health risk to environmental justice and high asthma communities

- Increase funding for and enforcement of air quality monitoring, especially for EJ communities and areas with disproportionately high incidence of asthma located within 3 miles of a RGGI plant. The Model Rule should mandate not only that the states secure better data, but also take action to address air quality issues shown by these new data.

LOWER THE THRESHOLD CAPACITY FOR RGGI REGULATION

- Lower the capacity that triggers RGGI regulation to include all generating units of 15 MW or higher, and potentially even lower for co-located units, as has been recommended by some environmental justice stakeholder groups

- If these 240 generating units at 115 power plants were brought under the RGGI cap, they would comprise a relatively small 1.4% of total RGGI CO2 emissions, and 4.8% of total NOx emissions from RGGI plants. However, such a change could have a potentially significant impact on health, as 91% of these smaller generating units are located within a 3-mile radius of an EPA EJSI community or high asthma community.

Conclusion

RGGI has successfully demonstrated its viability to reduce CO2 emissions from the power sector while generating benefits for participating states. RGGI's experience has disproven the concerns most frequently associated with capping emissions from the power sector. Emissions have declined rapidly, far more dramatically than projected, without stifling economic growth. RGGI's reinvestment model has benefited the regional economy and increased employment while accelerating deployment of renewable energy and funding energy efficiency programs. The region's residents now pay lower electricity prices than before the program began and breathe cleaner air.

As the RGGI states review the program in this Third Program Review, we urge the states and RGGI, Inc. to do more to ensure the program maximizes its impact in reducing climate emissions, aligning with state climate goals, and providing direct benefits to the communities most damaged by the health and economic harms of a fossil fuel economy. Redesigned and recommitted to its goals, RGGI can continue to benefit the public in coming years.

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Endnotes

1 This report makes multiple references to the "9 consistent RGGI states". This list includes Connecticut, Delaware, Maine, Massachusetts, Maryland, New Hampshire, New York, Rhode Island, and Vermont. This list excludes New Jersey, Virginia, and Pennsylvania.

2 Throughout this report, the term "rest of the country" refers to a group of 40 states. It excludes the 9 states that have consistently participated in RGGI since its inception and also excludes California (which has a separate cap-and-invest program to reduce power generation CO2 emissions).

3 In order to provide an "apples-to-apples" comparison between emissions trends in the 9 consistent RGGI states and the rest of the country, the 2008-2021 power sector emissions trends for both regions was calculated using U.S. Energy Information Administration (EIA) Form EIA-923 https://www.eia.gov/electricity/data/eia923/

4 Brian Murray and Peter Maniloff, Why Have Greenhouse Emissions in RGGI States Declined? An Econometric Attribution to Economic, Energy Market, and Policy Factors, Duke Nicholas Institute, August 2015. https://nicholasinstitute.duke.edu/environment/publications/why-have-greenhouse-emissions-rggi-states-declined-econometricattribution-economic

5 Acadia Center analysis using data from U.S. EIA on net generation by state by energy source. "Other" includes the following EIA energy sources: Other, Other Biomass, Other Gases, Petroleum, Wood, and Wood Derived Fuels. "Renewables" includes the following EIA energy sources: Geothermal, Hydroelectric Conventional, Solar Thermal and Photovoltaic, Wind: https://www.eia.gov/electricity/data/state/

6 Data on net electricity generation in the 9 consistent RGGI states from U.S. Energy Information Administration (EIA) "Historical State Data" EIA-923 Power Plant Operations Report https://www.eia.gov/electricity/data/state/

7 Estimated plant-level GHG emissions by fuel source are provided by U.S. Energy Information Administration (EIA). The analysis only considered RGGI-regulated plants that are included in the RGGI CO2 Allowance Tracking System (COATS) https://www.eia.gov/electricity/data/emissions/

8 Data on net electricity generation in the 9 consistent RGGI states from U.S. Energy Information Administration (EIA) "Historical State Data" EIA-923 Power Plant Operations Report https://www.eia.gov/electricity/data/state/

9 U.S. Energy Information Administration "U.S. Coal-fired Generation Declining After Brief Rise Last Year" https://www.eia.gov/todayinenergy/detail.php?id=54419#:~:text=In%20contrast%2C%20coal%2Dfired%20generation,up%20from%2020%25%20in%202020

10 The "Current Cap" line in Figure 5 is different than the "Second Program Review Cap" in Figure 1 because the Second Program Review Cap in Figure 1 does not include the states that joined in 2020 (New Jersey) and 2021 (Virginia). With those two states joining, the cap for 2022 increased by 44.8% relative to the 2019 cap. Emissions data was obtained from RGGI COATS for all states, with the exception of Pennsylvania data which was obtained from EPA's CAMPD.

11 RGGI Auction Results, Cumulative Allowances and Proceeds: https://www.rggi.org/auctions/auction-results

12 Combined hypothetical 2021 and 2022 Pennsylvania RGGI proceeds were estimated using 2021 Pennsylvania power generation emissions from EPA and average annual RGGI clearing prices from 2021 and 2022. 2022 power generation emissions were not available as of the writing of this report but were assumed to be the same as 2021 for this exercise.

13 These estimates are based on cost results from the Massachusetts Clean Energy Center's (MassCEC's) Whole-Home Heat Pump Pilot which ran from 2019-2021 and found the median cost of an existing building whole-home heat pump retrofit to be $20,000. Installed costs in milder climates, like Virginia, would likely be significantly lower. https://www.masscec.com/blog/masscec-pilot-showcases-success-whole-home-heat-pumps

14 Data on clearing prices, trigger prices, and price floor from RGGI "Allowance Prices and Volumes" and data on quarterly emissions from RGGI CO2 Allowance Tracking System (COATS). https://www.rggi.org/auctions/auction-results https://www.rggi.org/allowance-tracking/rggi-coats

15 Data on clearing prices and trigger prices from RGGI "Allowance Prices and Volumes" https://www.rggi.org/auctions/auction-results

16 Rennert, K., Errickson, F., Prest, B.C. et al. Comprehensive evidence implies a higher social cost of CO2. Nature 610, 687–692 (2022). https://doi.org/10.1038/s41586-022-05224-9

17 Data on historic European Trading System (EU-ETS) carbon prices from Trading Economics "EU Carbon Permits" https://tradingeconomics.com/commodity/carbon

18 Data on California- Québec emissions trading market carbon prices from California Air Resources Board California Cap-and-Trade Program Summary of California-Québec Joint Auction Settlement Prices and Results https://ww2.arb.ca.gov/sites/default/files/2020-08/results_summary.pdf

19 Data on clearing prices and trigger prices from RGGI "Allowance Prices and Volumes" https://www.rggi.org/auctions/auction-results

20 Data on clearing prices and reserve prices from RGGI "Allowance Prices and Volumes" https://www.rggi.org/auctions/auction-results

21 Data on state-level GHG reduction goals and RPS/CES goals compiled by Acadia Center based on state law mandating clean energy and/or economy-wide GHG reduction targets achieved by a specific year. In the case of states that have executive orders that are significantly more aggressive than statute (Pennsylvania and New Jersey), those executive orders were also incorporated into the table. Center for Climate and Energy Solutions (C2ES) maintains interactive maps that summarize both state-level GHG reduction targets and RPS/CES targets. https://www.c2es.org/content/state-climate-policy/ https://www.c2es.org/document/renewable-and-alternate-energy-portfolio-standards/

22 The specific electricity generation resources that qualify as "renewable" or "clean" and the accounting mechanisms around renewable energy credits vary from state to state. This table is only intended to provide a high-level summary of existing state-level renewable and clean energy policies.

23 Executive Order No 315 established New Jersey's target of 100% clean energy by 2035, but the target is not adopted in statute. https://www.nj.gov/governor/news/news/562023/20230215b.shtml

24 Pennsylvania's Executive Order 2019-01 calls for the state to "… strive to achieve 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" but the target is not adopted in statute. https://www.oa.pa.gov/Policies/eo/Documents/2019-01.pdf

25 RGGI Program Review: Topics for Public Consideration https://www.rggi.org/sites/default/files/Uploads/Program-Review/9-13-2021/RGGI%20Topics%20for%20Public%20Participation_2021-09-07.pdf

26 The emissions reduction trajectory of the "state goals cap" in Figure 8 is informed by the most aggressive clean energy or economy-wide decarbonization policy that each state has adopted, as summarized in Table X above. For example, in Pennsylvania, the goal of an 80% reduction in gross economy-wide emissions, which is much more aggressive than the state's RPS requiring approximately 18% alternative energy resources by 2021, was used to inform the "state goals cap."

27 GDP per capita at a state level is calculated using historic state-level real gross domestic product data from the U.S. Bureau of Economic Analysis and historic population data from the U.S. Census Bureau. https://www.bea.gov/data/gdp/gdp-state

28 Data on historic power sector GHG emissions by state from U.S. Energy Information Administration "Emissions by Plant and by Region" https://www.eia.gov/electricity/data/emissions/

29 This timeframe excludes the significant retail price increases experienced across much of the Northeast during the winter of 2022-2023.

30 The average retail electricity prices shown in Figure 10 are volume-weighted and take into consideration each state's average retail electricity price and the electric load in that state for each given year. Data from U.S. Energy Information Administration (EIA) Form 826 https://www.eia.gov/electricity/data/eia861m/

31 Weighted average generation costs and weighted average RGGI compliance costs by fuel type in New England were calculated by Acadia Center using generation fuel cost data from ISO New England's 2021 Annual Markets Report Table 1-1, Figure 1-6, and data from U.S. EIA on net historic net generation by state. https://www.iso-ne.com/static-assets/documents/2022/05/2021-annual-markets-report.pdf https://www.eia.gov/electricity/data/state/

32 The percent of a customer's total electricity bill attributable to electricity supply can vary considerably across states, utilities, and years but EIA analysis found that generation accounted for 56% of the average price of electricity in the U.S. in 2021: https://www.eia.gov/energyexplained/electricity/prices-and-factors-affecting-prices.php

33 In this Report, Acadia Center utilized the term "EJ community" to refer to environmental justice, frontline, and environmentally overburdened communities that have experienced disproportionate harm caused by the impacts of the fossil fuel economy.

34 Figure developed by Acadia Center using source data from "The Investment of RGGI Proceeds in 2020" report Chart 2 and 3 https://www.rggi.org/sites/default/files/Uploads/Proceeds/RGGI_Proceeds_Report_2020.pdf

35 The Investment of RGGI Proceeds in 2019, Charts 2 & 3 https://www.rggi.org/sites/default/files/Uploads/Proceeds/RGGI_Proceeds_Report_2019.pdf

36 New York's Regional Greenhouse Gas Initiative Operating Plan Amendment for 2022, page 2 https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Researcher-and-Policymakers/Regional-Greenhouse-Gas-Initiative/2022-RGGI-Op-Plan-Amendment.pdf

37 "Cumulative Allowances and Proceeds" for New York: https://www.rggi.org/auctions/auction-results

38 New York's Regional Greenhouse Gas Initiative Operating Plan Amendment for 2022, page 12 https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Researcher-and-Policymakers/Regional-Greenhouse-Gas-Initiative/2022-RGGI-Op-Plan-Amendment.pdf

39 Northeast Environmental Justice and Climate Justice Region Wide Stakeholder Comments to RGGI, December 3, 2021, p. 6, available at: https://www.rggi.org/sites/default/files/Uploads/Program-Review/2021_Comments/Session2/CJA_Public_Comment_2021-12-03.pdf

40 Kowalska M, Skrzypek M, Kowalski M, Cyrys J. Effect of NOx and NO2 Concentration Increase in Ambient Air to Daily Bronchitis and Asthma Exacerbation, Silesian Voivodeship in Poland. Int J Environ Res Public Health. 2020 Jan 24;17(3):754. doi: 10.3390/ijerph17030754. PMID: 31991627; PMCID: PMC7037218.

41 U.S. Environmental Protection Agency "EPA Research: Environmental Justice and Air Pollution" https://www.epa.gov/ej-research/epa-research-environmental-justice-and-air-pollution

42 American Lung Association, State of the Air 2020 Report Key Findings https://www.lung.org/research/sota/key-findings

43 U.S. Government Accountability Office "Air Emissions and Electricity Generation at U.S. Power Plants https://www.gao.gov/products/gao-12-545r

44 Agency for Toxic Substances and Disease Registry "Nitrogen Oxides ToxFAQs" https://www.atsdr.cdc.gov/toxfaqs/tfacts175.pdf

45 U.S. Environmental Protection Agency (EPA) Environmental Justice Screening and Mapping Tool (EJScreen) "Overview of Socioeconomic Indicators in EJScreen" https://www.epa.gov/ejscreen/overview-socioeconomic-indicators-ejscreen

46 U.S. Environmental Protection Agency "Power Plants and Neighboring Communities" https://www.epa.gov/power-sector/power-plants-and-neighboring-communities

47 Figure 13 is an output of Acadia Center GIS analysis that leveraged a combination of EPA CAMPD NOx data, RGGI COATS power plant data and EJScreen EJSI data. See Appendix 1. Methodology for more details.

48 Map developed based on Acadia Center analysis of multiple data sources: Power plant location and NOx emissions data from RGGI COATS, EIA, and EPA's Clean Air Market Data, asthma prevalence data from CEQ's CEJST, and population data from U.S. Census. See Appendix 1 Methodology for more details.

49 Map developed based on Acadia Center analysis of multiple data sources: Power plant location and NOx emissions data from RGGI COATS, EIA, and EPA's Clean Air Market Data, EJ socioeconomic indicator data from EPA EJScreen, and population data from U.S. Census. See Appendix 1 Methodology for more details.

50 Map developed based on Acadia Center analysis of multiple data sources: Power plant location and NOx emissions data from RGGI COATS, EIA, and EPA's Clean Air Market Data, EJ socioeconomic indicator data from EPA EJScreen, asthma prevalence data from CEQ's CEJST, and population data from U.S. Census. See Appendix 1 Methodology for more details.

51 6 CRR-NY 242-1.4, https://govt.westlaw.com/nycrr/Document/Ibaff59a7ebf311dda772d657453a78af?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)

52 The Northeast Regional members of the Climate Justice Alliance recommended in their December 3, 2021 comments to RGGI that the RGGI threshold be lowered to 15MW for standalone facilities and 10MW for co-located units. CJA Northeast Environmental Justice and Climate Justice Region Wide Stakeholder Comments to RGGI, December 3, 2021, p. 5 https://www.rggi.org/sites/default/files/Uploads/Program-Review/2021_Comments/Session2/CJA_Public_Comment_2021-12-03.pdf For ease of analysis, Acadia Center evaluated a threshold for 15MW units, whether they are standalone or co-located.

53 Map developed based on Acadia Center analysis of multiple data sources: Power plant location and NOx emissions data from EIA and EPA's Clean Air Market Data, EJ socioeconomic indicator data from EPA EJScreen, asthma prevalence data from CEQ's CEJST, and population data from U.S. Census. See Appendix 1 Methodology for more details.

54 Map developed based on Acadia Center analysis of multiple data sources: Power plant location and NOx emissions data from RGGI COATS, EIA, and EPA's Clean Air Market Data, EJ socioeconomic indicator data from EPA EJScreen, asthma prevalence data from CEQ's CEJST, air quality monitoring station data from EPA, and population data from U.S. Census. See Appendix 1 Methodology for more details.

Appendix 1: Methodology

Acadia Center developed this Report to provide insights into the strengths and limitations of the RGGI program and potential areas for improvement. To achieve this goal, we collected and analyzed data from various sources using quantitative analysis tools. This methodology section outlines the data sources, data collection, data analysis techniques, and limitations of the study. This methodology is not intended to be an exhaustive, step-by-step description of every step taken in Acadia Center's analysis. Rather, it is intended to provide a high-level overview of the types of data sources used and overall approach. References and hyperlinks to specific data sources used for individual figures and tables can be found in the main body of the report and endnotes section of this report.

Key Data Sources in Acadia Center Analysis:

- BEA's historic state-level gross domestic product data
- CEQ's Climate and Economic Justice Screening Tool (CEJST)
- EIA's Form EIA-923
- EIA's Form EIA-860
- EIA's emissions by plant and by region dataset
- EPA's Environmental Justice Screening and Mapping Tool (EJScreen)
- EPA's Clean Air Markets Program Data (CAMPD)
- EPA's Air Quality System
- RGGI CO2 Allowance Tracking System (RGGI COATS)
- RGGI historic data on allowance prices and volumes
- U.S. Census historic state-level population data

Plant Plant-specific Data: Generation, Emissions, Fuel, & Location

Acadia Center utilized RGGI COATS as the primary data source for plant-specific data including annual CO2 emissions and the specific list of plants covered by RGGI in a given year. We supplemented RGGI COATS data with data from EIA. EIA plant-specific data includes plant-specific geographic location, primary fuel type, annual CO2 emissions, annual NOx emissions, and nameplate capacity. Some gaps existed in available EIA data sources – for example not all plants in the EIA datasets included data on NOx emissions or plant location. For any gaps in generator specific data, we further supplemented RGGI COATS and EIA with EPA's Clean Air Market Data. The data curation process involved cleaning the data and extracting the relevant data from the sources listed above. To minimize human error, Acadia Center developed Python scripts to automate the data curation process.

Socioeconomic and Health Indicators Analysis: Definitions

To investigate the NOx pollution impacts of specific power plants on particular communities, Acadia Center first had to define which census tracts were of interest. Acadia Center relied on both conversations with Environmental Justice groups and academic research to inform our decision to use EPA's EJScreen and CEQ's CEJST as the key data sources to inform this indicator-based analysis.

EPA's EJScreen addresses seven different indicators at the census tract level: race, income, unemployment, linguistic isolation, education, children under 5 years of age, and adults over 64. These seven socioeconomic indicators formed the basis of Acadia Center's analysis.

Table 10. EPA Environmental Justice Screening and Mapping Tool (EJScreen) Socioeconomic Indicators

People of color	The percent of individuals in a block group who list their racial status as a race other than white alone and/or list their ethnicity as Hispanic or Latino. That is, all people other than non-Hispanic white-alone individuals. The word "alone" in this case indicates that the person is of a single race, not multiracial.
Low-income	The percent of a block group's population in households where the household income is less than or equal to twice the federal "poverty level."
Unemployment rate	The percent of a block group's population that did not have a job at all during the reporting period, made at least one specific active effort to find a job during the prior 4 weeks, and were available for work (unless temporarily ill).
Limited English speaking	Percent of people in a block group living in limited English speaking households. A household in which all members age 14 years and over speak a non-English language and also speak English less than "very well" (have difficulty with English) is limited English speaking.
Less than high school education	Percent of people age 25 or older in a block group whose education is short of a high school diploma.
Under age 5	Percent of people in a block group under the age of 5.
Over age 64	Percent of people in a block group over the age of 64.

CEQ's CEJST maintains data at the census tract level on the percent of adults over the age of 18 who have been told they have asthma. Given that NOx pollution damages the respiratory tract and increases vulnerability to respiratory infections and asthma, Acadia Center selected asthma prevalence as its eighth indicator to include in this analysis.

Power Plant GIS Analysis: Plant Proximity to EPA EJSI Community or High Asthma Community, Quantification of NOx Pollution Threat, and Air Quality Monitoring Locations

Acadia Center used QGIS – a free open-source cross-platform desktop geographic information system application – to perform a mapping analysis demonstrating the proximity of RGGI power plants to EPA EJSI and high asthma communities, the proximity of those plants to air quality monitoring stations, and the relative NOx threat posed by those plants.

Acadia Center defined a power plant as in proximity to an EPA EJSI community if there was any census tract within a 3-mile radius of that plant that scored above the 90th national percentile in any of the seven EPA EJ socioeconomic indicators. Similarly, we defined a power plant as in proximity to a "high asthma community" if it were located within a 3-mile radius of a census tract that is above the 90th national percentile for percent of adults who have been told they have asthma according to data from CEQ's CEJST.

It's worth noting that **EPA's Power Plant and Neighboring Communities Tool** highlights power plants where the average population within a 3-mile radius of the plant exceeds the 80th national percentile for six demographic indicators (all seven of the EPA EJ socioeconomic indicators listed above with the exception of unemployment rate). Based on Acadia Center's research and conversations with environmental justice partners, we felt this approach of only considering the *average* national percentile for the entire population within a 3-mile radius of the plant was not comprehensive enough. For this reason, in our analysis, Acadia Center defined plants as in proximity to EPA EJSI communities if *any* census tract within a 3-mile radius of the plant exceeded the 90th national percentile for any of the seven EPA EJ indicators described above. We utilized a similar approach for plants within a 3-mile radius of any census tract that exceeded the 90th national percentile for asthma prevalence.

To identify some of the most problematic power plants in the RGGI region, Acadia Center developed a power plant "NOx Pollution Threat Score". This score ranges from 1-100, with a score of 100 representing the plant in the region with the highest threat score, and is calculated based on three variables – in 2021: 1) How much NOx did the plant emit? 2) How many people were living within 3 miles of that plant? and 3) Using the seven EPA EJ socioeconomic indicators and the asthma prevalence indicator, what was the average 8-indicator percentile for all communities within 3 miles of the plant? Acadia Center intends to do further work with this tool and will provide more input on how stakeholders can use this tool going forward.

To integrate the location of air quality monitoring stations into this GIS analysis, Acadia Center used EPA's pre-generated data files which contain national air quality monitor site location data. Unique sites are identified by a combination of state code, county code, and site number. Closed sites were filtered out of the dataset.

Electricity Generation Fuel Mix Trends and Generation Cost Trends

Acadia Center collected and analyzed EIA data on historic state-level net electricity generation by fuel type to analyze fuel mix trends in RGGI states in comparison to the rest of the country. For the New England region, Acadia Center collected and analyzed data from ISO New England's Annual Market Reports to better understand trends in the weighted average fossil generation fuel costs in the region.

Regional Economic Trends and Retail Electricity Prices

Acadia Center collected and analyzed data from the U.S. Bureau of Economic Analysis on historic gross domestic product (GDP) by state and data from the U.S. Census Bureau to compare changes in per capita GDP between RGGI states and the rest of the country. Acadia Center collected and analyzed data from EIA on historic state-level retail electricity prices and electricity load to calculate volume-weighted average retail electricity prices for the RGGI region and the rest of the country.

Global Carbon Markets Data

Acadia Center collected and analyzed historic RGGI market data from RGGI Inc. This data included historic auction clearing prices, generated proceeds, cost containment reserve trigger prices, emissions containment reserve trigger prices, price floors, and current and historic emissions caps. In order to make comparisons between historic RGGI clearing prices and global carbon markets, Acadia Center also collected and analyzed data from the California Air Resources Board and European Union Emissions Trading System (EU-ETS) on historic carbon prices in those markets.