OUR AIR | HEALTH AND EQUITY IMPACTS OF PENNSYLVANIA'S POWER PLANTS

NEXTGEN CLIMATE AMERICA

PSE Healthy Energy
Physicians Scientists & Engineers

01. INTRODUCTION

Pennsylvania's coal and natural gas power plants create health risks and harms across the state and beyond. The distribution of these impacts falls unevenly among Pennsylvanians, and the state's most vulnerable residents bear a disproportionate burden from these large polluting facilities.

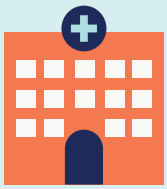
The Clean Power Plan, which sets carbon emission reduction goals for Pennsylvania's power sector, also provides the Keystone state with an opportunity to achieve public health and environmental justice benefits.

FIG 01. DIRTY POWER PLANTS HURT ALL PENNSYLVANIANS – ESPECIALLY OUR MOST VULNERABLE RESIDENTS

But the scale and distribution of these benefits will depend on choices the state makes in implementing the plan.

This report is based on a comprehensive public health and environmental hazard analysis authored by the energy science and policy institute, PSE Healthy Energy.[1] The study examines demographic, social, and economic characteristics of communities located near fossil fuel plants, as well as the environmental health burdens and environmental hazards these neighborhoods face. The study also models the regional public health impacts of particulate matter associated with combustion at Pennsylvania's power plants in 2015. This information can inform community-centered planning with broad incorporation of health, environmental, and equity dimensions that will help to ensure a more effective and fair Pennsylvania State Plan for Clean Power Plan compliance.

FIG 01.[2]



2,300
PREMATURE DEATHS &
$20 BILLION
IN HEALTH BURDENS

Caused by particle pollution from burning coal and gas in Pennsylvania power plants in 2015 alone.

85% OF PENNSYLVANIA'S POWER PLANTS

In neighborhoods with more low income and minority familes than the state median.

65% HIGHER
CONCENTRATION OF LOW INCOME FAMILIES

Near coal and gas power plants in Pennsylvania than the state median.

IN THIS REPORT:

02 The Clean Power Plan Is an Opportunity to Improve Health and Environmental Equity in Pennsylvania

03 The Deadly Cost of Burning Coal and Natural Gas for Electricity in Pennsylvania

04 Findings & Recommendations

05 Endnotes

02. THE CLEAN POWER PLAN IS AN OPPORTUNITY TO IMPROVE HEALTH AND ENVIRONMENTAL EQUITY IN PENNSYLVANIA

The Clean Power Plan sets a target for Pennsylvania to reduce carbon pollution from the state's power plants. Cutting carbon pollution from coal and natural gas power plants will help Pennsylvania do its part to fight global climate change. However, carbon pollution is just one of the many types of harmful pollution produced when fossil fuels are burned to generate electricity.

The environmental and health burdens of electricity generation in Pennsylvania currently weigh disproportionately on vulnerable and disadvantaged communities. 85% of fossil fuel power plants in Pennsylvania regulated by the Clean Power Plan are sited in areas with higher concentrations of low-income and/or minority populations than the statewide median.[3] Half of the fossil fuel plants are located in or near areas designated by the state as Environmental Justice Areas, where 20 percent or more of the individuals live in poverty, and/or 30 percent or more of the population is minority.[4]

When Pennsylvania prepares its plans for carbon reduction it has the opportunity to also address the serious health and equity harms of non-climate pollutants produced from burning dirty fossil fuels.

Pennsylvania has tremendous flexibility to implement its State Plan in a way that will work best for Pennsylvanians. All plans must limit carbon pollution, but not all plans will result in the same level of health benefits or address environmental injustices that currently exist. Some plants have roughly equivalent carbon pollution levels, but dramatically different levels of other harmful pollution, such as fine particles (PM 2.5), sulfur dioxide (SO2), and nitrogen oxides (NOx). Prioritizing pollution cuts at the dirtiest plants will help to prevent more asthma attacks, heart attacks, and premature deaths than a plan that only looks at carbon pollution.

Pennsylvania should implement a comprehensive plan that considers health-damaging pollutants in addition to carbon dioxide. Moreover, regulators should engage communities near power plants as a central component of the planning process. This community engagement can help ensure the most effective, fair, and healthy Pennsylvania State Plan.

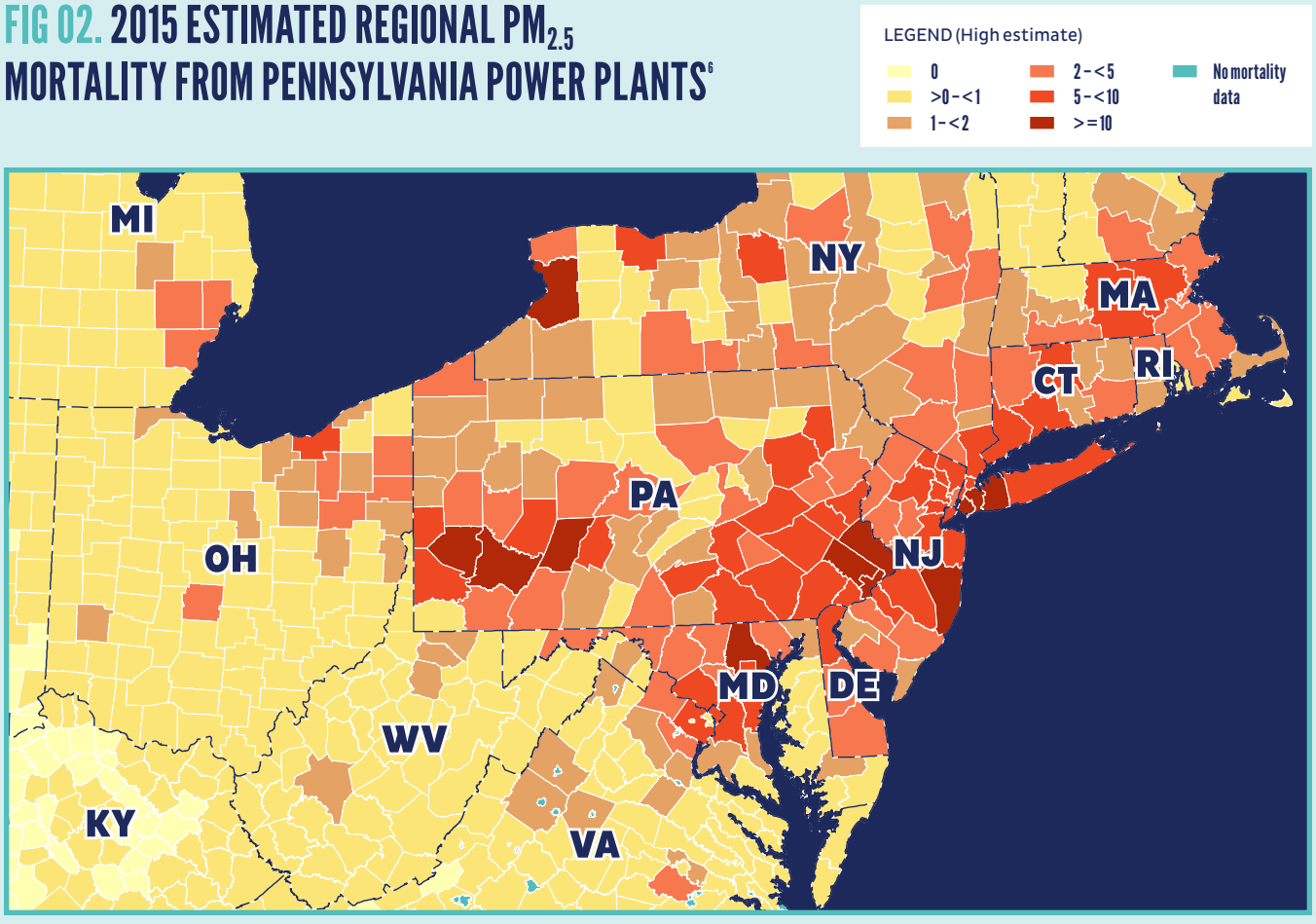
KEY FINDINGS:

1 Pollution from Pennsylvania coal and natural gas power plants is responsible for thousands of premature deaths a year – as many as 2,300 premature deaths from particulate pollution alone. This pollution also causes tens of thousands of asthma attacks and other dangerous health effects. These harms are most pronounced near and downwind of coal-burning power plants, and in major population centers such as Philadelphia and Pittsburgh.[5]

2 Pennsylvania power plants are located disproportionately in low-income communities, and natural gas combined cycle (NGCC) plants are heavily concentrated in low-income minority communities. Populations living near many of these plants are also more burdened by multiple socioeconomic, health and environmental stressors than the Pennsylvania state median.

3 In addition to their air pollution impacts, Pennsylvania power plants are associated with numerous other environmental health hazards, such as coal ash impoundments and toxic releases, that magnify the burdens placed on communities located near dirty power plants.

FIG 02. 2015 ESTIMATED REGIONAL $PM_{2.5}$ MORTALITY FROM PENNSYLVANIA POWER PLANTS[6]



03. THE DEADLY COST OF BURNING COAL AND NATURAL GAS FOR ELECTRICITY IN PENNSYLVANIA

In addition to the health impacts of climate change, the burning of fossil fuels for electric power directly causes a wide range of negative public health impacts. In 2015 alone, particle pollution attributable to Pennsylvania's power plants was responsible for up to 2,300 deaths nationwide, and cost Americans approximately $20 billion in health costs, mostly attributable to Pennsylvania's aging coal power plants. [7,8]

FIG 03.

Health burdens from Pennsylvania power plants' fine particle pollution in 2015.

2015 EMISSIONS IMPACT	COBRA (high)
COST OF HEALTH BURDEN ($ BILLION)	**20**
ADULT MORTALITY (US)	**2,300**
ADULT MORTALITY (PA ONLY)	**685**
NON-FATAL HEART ATTACKS	**1,280**
RESPIRATORY SYMPTOMS	**43,000**
ASTHMA ATTACKS	**27,000**

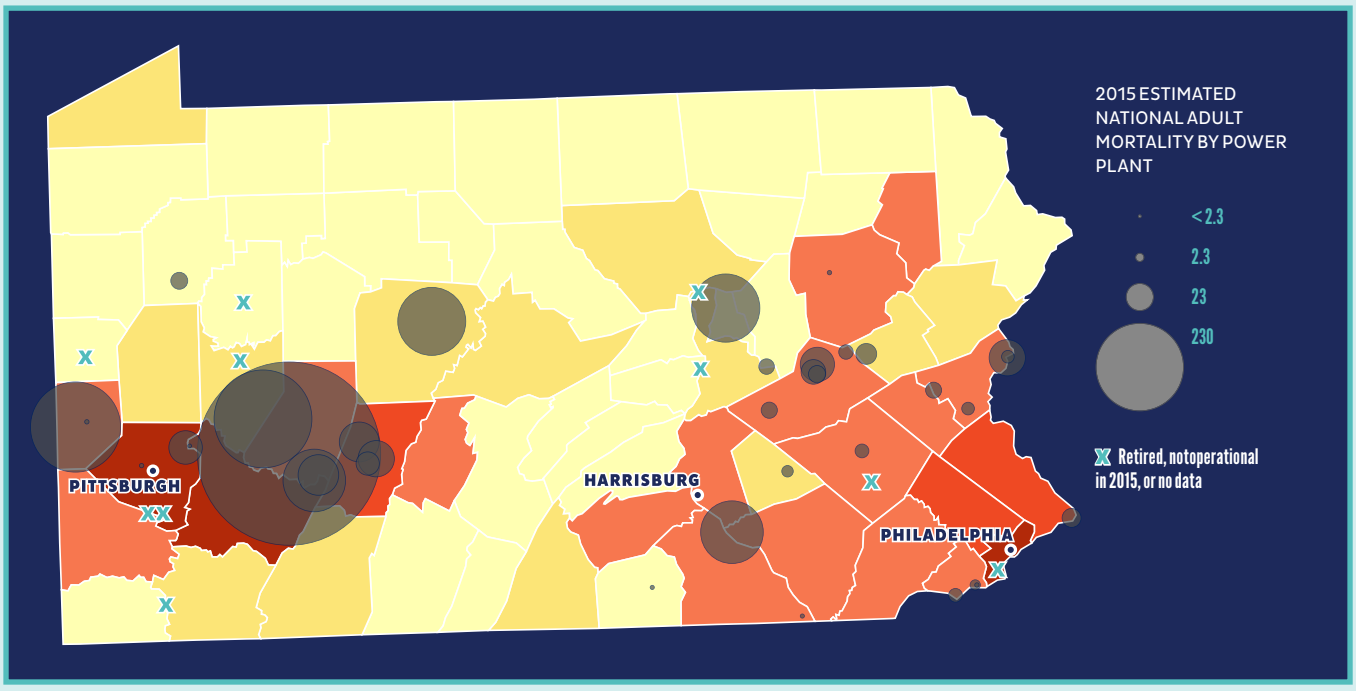
Five coal-burning power plants, all located in the Western part of the state, were responsible for more than three quarters of the health impacts and deaths. These plants (Homer City, Keystone, Bruce Mansfield, Montour, and Shawville) were responsible for over 1,760 deaths in 2015 alone. Mortality related to pollution from these plants will likely remain very high in 2016 and beyond, but may be substantially reduced due to Shawville's transition from burning coal to burning natural gas, and Homer City's eventual installation of technological controls that will somewhat reduce its SO2 and NOx pollution. [9]

The effects of this pollution can be felt for hundreds of miles. In 2015, pollution from Pennsylvania power plants was responsible for hundreds of deaths in the Northeast and Mid-Atlantic, and in other areas of the United States. [10]

Pollution from these plants can cause harm over a vast geographic area. In Philadelphia and the surrounding areas, for example, dozens of deaths were caused in 2015 by coal-burning power plants located on the opposite side of the state. [11] But the health effects of these plants are felt most acutely in the areas near the power plants. [12]

In 2015 alone, in addition to premature mortality, dirty power plants also caused thousands of heart attacks, respiratory symptoms such as acute bronchitis severe enough to warrant emergency room visits, and sometimes life-threatening asthma attacks. [14] They also created a major drain on our economy and financial

FIG 04. ADULT MORTALITY FROM $PM_{2.5}$ ATTRIBUTABLE TO PENNSYLVANIA POWER PLANTS [13]

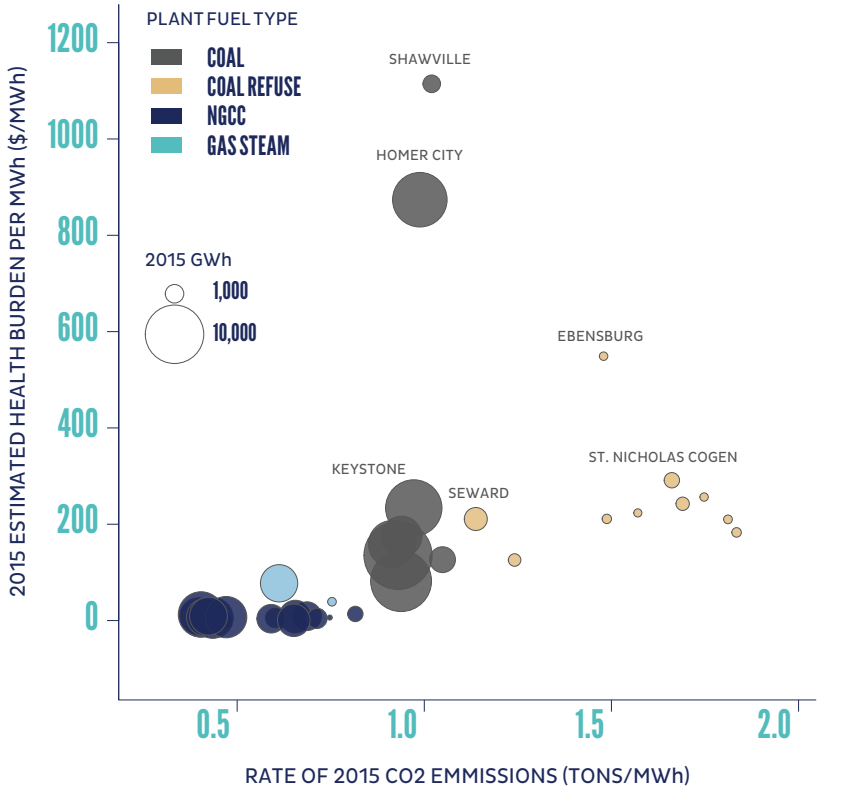


burdens for families by causing 127,000 lost work days nationwide.

These health burdens are caused in part by fine particulate matter associated with operating these power plants. In addition to direct emissions of particulate matter, fossil fuel combustion also releases pollutants, such as nitrogen oxides and sulfur dioxide, that can form these same types of hazardous fine particles through chemical reactions in the atmosphere. Nitrogen oxides can also react in the atmosphere to cause tropospheric ozone, a strong respiratory irritant which can contribute to a wide range of cardiovascular and respiratory health problems, particularly among members of already-vulnerable populations (e.g. low-income, minority, the elderly, and those with pre-existing diseases). [15]

Not only does fossil fuel combustion degrade air quality, but it also poses issues of toxic waste disposal and other environmental hazards in communities that host these facilities. [16]

Both operating and retired power plants, particularly coal plants, are often associated with other human and environmental health hazards. The fact that well water is a large source of



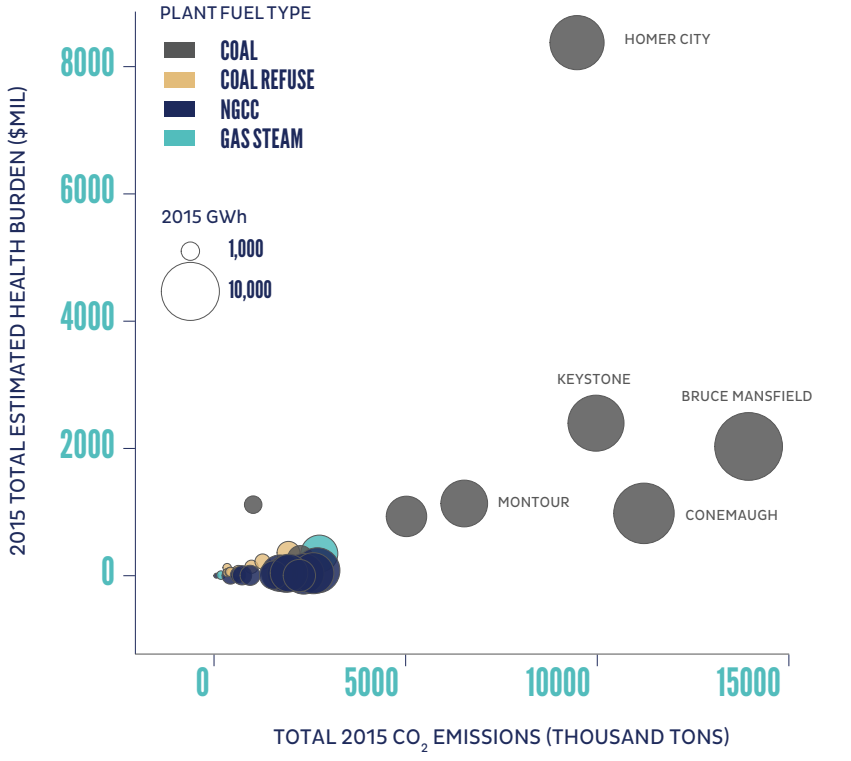


FIG 05 & 06.

The health benefit of eliminating one ton of carbon pollution can vary significantly even among plants of the same type (Fig 5), but overall, the most-polluting plants are also the most dangerous to our health (Fig 6).

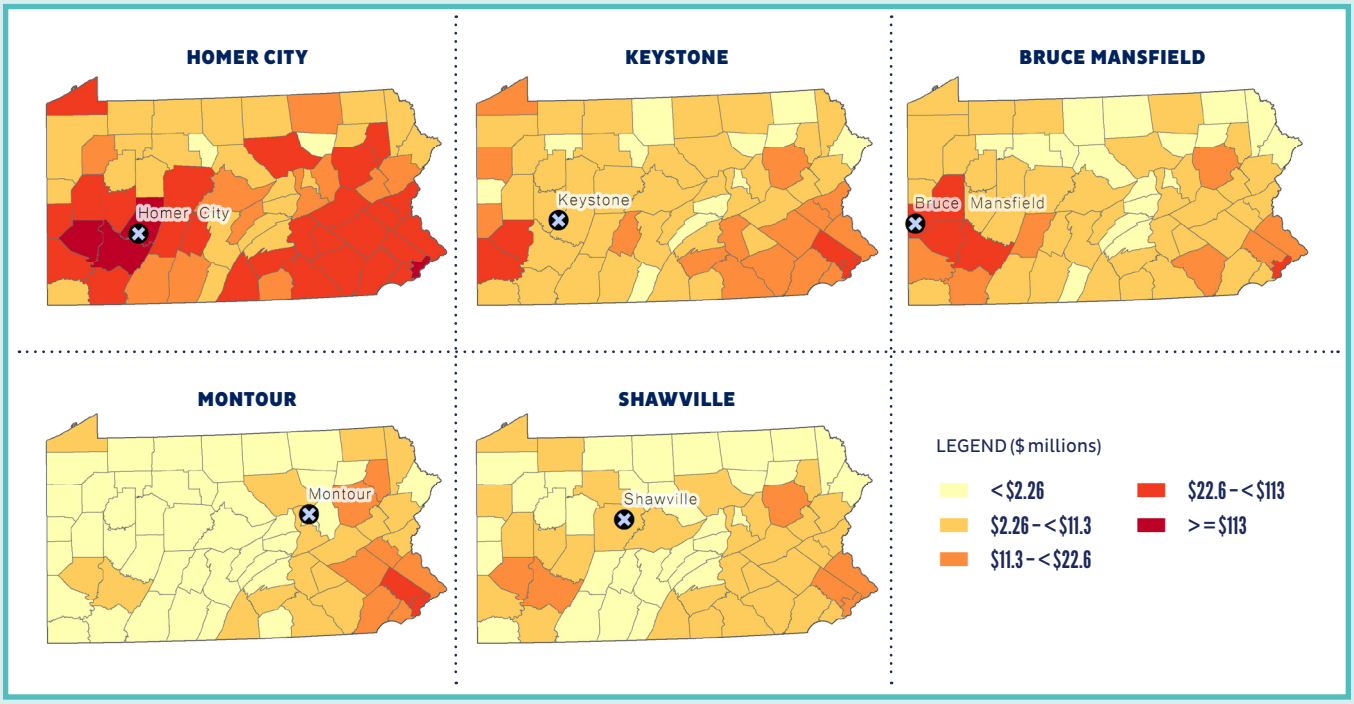
drinking water for rural residents near coal plants in Pennsylvania is cause for special concern.[17] Burning coal creates a toxic waste product known as coal ash, which makes up one of the largest volumes of industrial waste in the United States.[18]

According to recent data, wells near coal ash ponds show levels of lead, arsenic, and other contaminants at concentrations many times higher than the EPA's maximum allowable levels.[19] Although all toxic exceedances cannot necessarily be attributed to these coal ash ponds, both the level of exceedance and the physical proximity to drinking water represent environmental and health risks in these communities. There is also a risk that these coal ash ponds can leak or spill, causing widespread water contamination and health and environmental impacts.

A key characteristic of fossil fuel combustion is the connection between carbon emissions and the release of other harmful pollutants. The relationship may vary depending on whether we consider total emissions or rate of emissions per MWh but it is undeniable that reducing Pennsylvania's reliance on the types of energy that emit carbon pollution will also mean reducing environmental pollutants associated with these fuels.

Pennsylvania's State Plans to reduce carbon emissions will drive shifts in the amount of energy generated from different types of fossil fuel plants; policymakers need to look at the characteristics of the local communities in which all of these plants operate in order to ensure that these shifts maximize health improvements, minimize hazards and risks, and prioritize

FIG 07. 2015 COST ESTIMATE OF HEALTH IMPACTS BY COUNTY FROM PENNSYLVANIA'S 5 DIRTIEST PLANTS[20]



equity across the state.[21]

PATTERNS OF INEQUITY

Power plants are often located near marginalized communities that have higher proportions of low-income, minority, less-educated, and linguistically isolated individuals. For example, half of power plants covered by the Clean Power Plan are within three miles of an Environmental Justice Area, as designated by the Pennsylvania Department of Environmental Protection.[22]

On average, the concentration of low-income families in the areas surrounding coal and natural gas power plants in Pennsylvania is 62% higher than the statewide median.[23] There are also notable patterns across the different types of fossil fuel plants. Communities near natural gas plants, for example, have a higher percentage of low-income households, and much higher proportions of minority households than communities near coal plants.[24]

HALF OF POWER PLANTS COVERED BY THE CLEAN POWER PLAN ARE WITHIN 3 MILES OF AN ENVIRONMENTAL JUSTICE AREA.

If Pennsylvania cuts power plant carbon pollution by relying more on existing natural gas plants and less on existing coal plants, pollution reductions will result in fewer negative health effects and improvements in air quality overall. But these health and environmental benefits will accrue unevenly across the state. More benefits will be concentrated in the Western part of the state, where the dirtiest plants are located. But if reductions in coal usage are accompanied by increased usage of existing natural gas plants in the Eastern part of the state, additional pollution from burning natural gas will partially undercut the benefits of cutting pollution from coal.[25]

Natural gas plants are heavily concentrated in or near urban areas in the Southeastern part of the state, with high concentrations of low-income and minority families living in the shadow of these plants. Coal plants tend to be located in rural areas with lower-than-average concentrations of minority households. A coal-to-gas switching strategy of reducing carbon dioxide emissions would therefore shift a portion of environmental and health burdens from rural areas with many low-income non-minority families to urban areas with many low-income minority families.

Often, communities near power plants are also starting from a place of poorer health quality, experiencing low rates of health insurance and high prevalence of disability.[26] The steeper socioeconomic obstacles these communities face mean they are less equipped to deal with the negative health impacts of power plant pollution. These socioeconomic factors are often compounded by

FIG 08 & 09.
NATURAL GAS PLANTS ARE HEAVILY CONCENTRATED IN OR NEAR URBAN AREAS IN THE SOUTHEASTERN PART OF THE STATE, WITH HIGH CONCENTRATIONS OF LOW-INCOME AND MINORITY FAMILIES.

FIG 08.

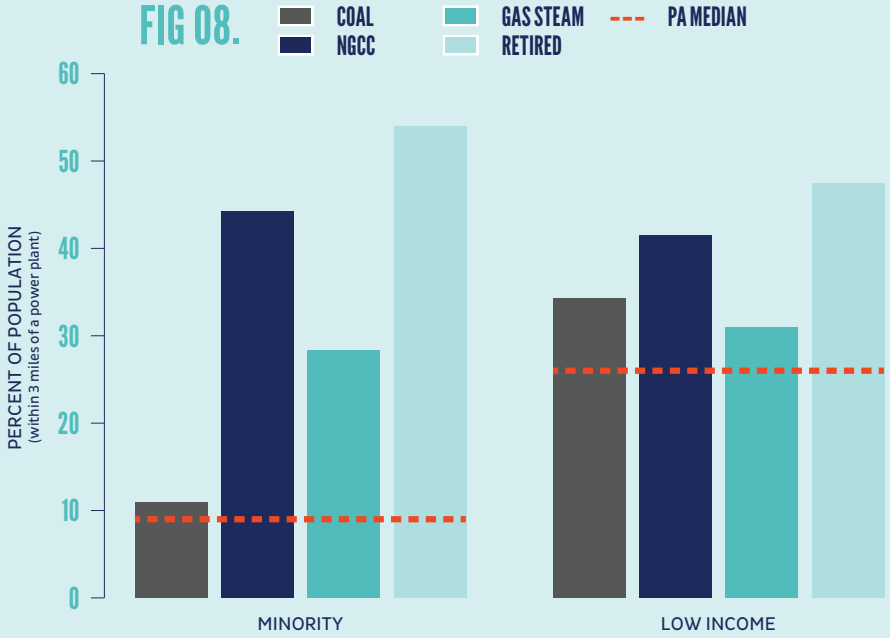


FIG 09.

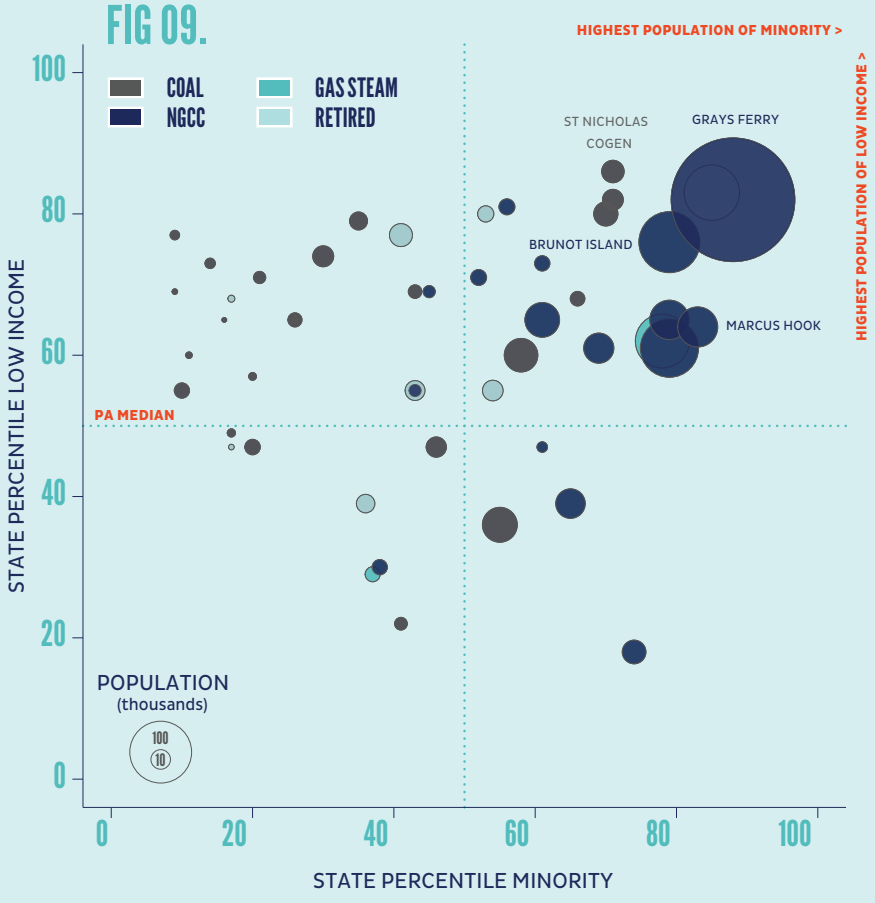


FIG 10.

Percentage of on-site toxic chemicals released near PA Environmental Justice Areas, 2010 –2014. Includes persistent bioaccumulative toxic chemicals (PBTs), and dioxins and dioxin-like compounds, and all other Toxic Release Inventory (TRI) qualified chemicals.

	% DIOXINS NEAR EJ AREA	% PBTs NEAR EJ AREA	% OTHER CHEMICALS NEAR EJ AREA
COAL	**53%**	**44%**	**24%**
NGCC	**100%**	**100%**	**61%**
GAS STEAM	**38%**	**100%**	**100%**

other environmental stressors like poor air quality, proximity to traffic congestion, and toxic exposures from industrial activities.

Not only are people near plants routinely exposed to pollution, but in addition they are on the front lines for exposure when plants violate state and federal statutes. Because the majority of plants are located near low-income populations, the total number of violations received between 2011-2015 were also primarily in low-income areas. But a deeper analysis shows that while coal received more violations and inspections than other plants, natural gas combined cycle plants near state-designated Environmental Justice Areas had a 1.5 times higher rate of violations than coal plants.[28] Conversely, inspection rates at plants near Environmental Justice areas are nearly 1.5 times higher for coal than natural gas combined cycle. So while the rate of violations is higher at plants that tend to be located in urban areas with higher concentrations of minority households, these plants are inspected far less frequently. Increasing reliance on these existing natural gas plants may therefore risk exacerbating the burdens placed on already overburdened communities. These trends suggest that the environmental hazards associated with these violations could potentially be reduced or eliminated through reduced energy generation at these facilities under the Clean Power Plan. But these data also underscore the need for careful, consistent and more frequent inspections of power generation sites, especially in disproportionately vulnerable communities.

These patterns matter because they indicate how shifts in energy production could affect different communities in different ways.

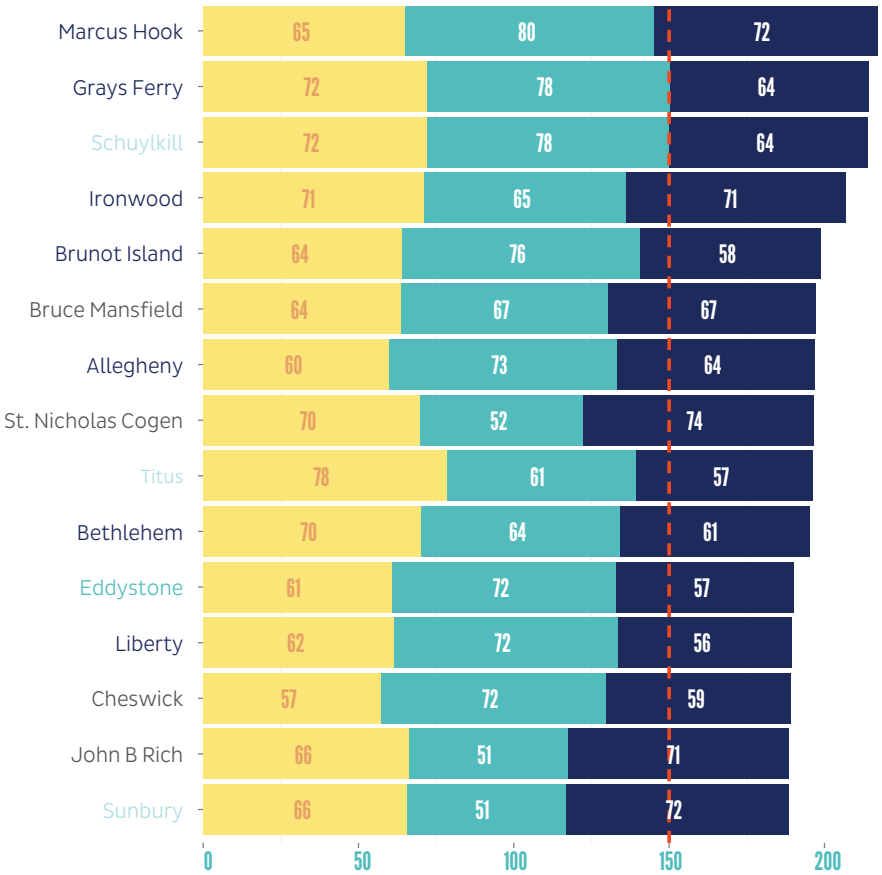


FIG 11. CUMULATIVE VULNERABILITY INDEX[27]

Cumulative index of demographic, environmental and health indicators for populations living near PA power plants.

PLANT FUEL TYPE

Coal
NGCC
Gas steam
Retired

PA Median
Demographic
Environmental
Health

For example, we found that four of Pennsylvania's five most vulnerable communities living near power plants are near natural gas combined cycle plants. This means that replacing coal generation by running these gas plants more frequently could mean increasing burdens on these most vulnerable communities. On the other hand, moving to renewable generation or decreasing total energy production through efficiency measures would avoid this increase in disproportionate impacts.

The Environmental Protection Agency has instructed states that State Plans must not disproportionately impact vulnerable and overburdened communities.[29] Past and present environmental and health inequities must be taken into consideration as policymakers look at designing the state's Clean Power Plan pathway to maximize benefits and improve fairness going forward.

PATHWAYS TO MAXIMUM BENEFITS

The Clean Power Plan requires states to reduce carbon emissions from coal and natural gas power plants. States have flexibility to map their own unique pathways to accomplish this goal. When evaluating different policy pathways to meet its state target, Pennsylvania has the opportunity to design a program that prioritizes health and equity outcomes for all of its communities.

There are many potential strategies for Clean Power Plan compliance. These approaches could include shifting the generation from coal to existing natural gas combined cycle plants, increasing energy efficiency and ramping up generation from renewables like wind and solar, or a combination of these strategies.

Given the presence of vulnerable communities near existing natural gas combined cycle generation, an emphasis on renewables and efficiency, rather than increased natural gas generation, may be the best way to realize the benefits of the Clean Power Plan without placing a disproportionate impact on vulnerable communities. Deployment of renewables and efficiency at faster rates than required to meet Clean Power Plan targets is another way to achieve significant improvements in air and water quality without increasing reliance on gas.

Given the wide distribution of burdens on communities living near all types of power plants, extensive community input and careful modeling of possible changes in generation are needed. Changes in the electricity generation levels at power plants throughout the state will affect the associated health burdens in vulnerable communities. The concerns of these communities should be front and center; the best people to represent these concerns are the members of these communities themselves.

WHEN EVALUATING DIFFERENT POLICY PATHWAYS TO MEET ITS STATE TARGET, PENNSYLVANIA HAS THE OPPORTUNITY TO DESIGN A PROGRAM THAT PRIORITIZES HEALTH AND EQUITY OUTCOMES FOR ALL OF ITS COMMUNITIES.

04. FINDINGS AND RECOMMENDATIONS

- Targeting carbon reductions at plants with high emission rates for multiple pollutants has the potential to achieve both carbon goals and health benefits.
- Shifting generation to natural gas plants near already disadvantaged and vulnerable communities may increase health and environmental burdens in these communities, while deployment of efficiency and renewable energy to meet the Clean Power Plan targets could lessen some of these burdens.
- Engaging communities can provide further insight into environmental and health concerns at a local level as communities assess how reduced fossil fuel reliance will impact them.

CONCLUSION

Pennsylvania's state strategy to meet the federal Clean Power Plan provides the Keystone state with an opportunity to achieve public health and environmental justice co-benefits. Fossil fuel combustion for energy produces air and water pollutants and toxic releases. The combustion of fossil fuels for electricity in Pennsylvania causes thousands of premature deaths every year, non-fatal heart attacks, respiratory symptoms, asthma attacks, and other health issues. Our study found that communities already disproportionately burdened with a lower socioeconomic status and environmental hazard challenges are the most likely to be affected, positively or negatively, by shifts in Pennsylvania's energy generation sector. Pennsylvania should approach its State Plan by maintaining a focus both on greenhouse gas reductions and protecting public health, especially among the most currently overburdened communities. The state should adopt a community-centered approach that prioritizes cutting both carbon dioxide and health damaging air pollutants especially from the worst offenders, and should aim to reduce pollution as much as possible, rather than merely meeting the minimum requirements of the Clean Power Plan.

APPROACHES TO CLEAN POWER PLAN COMPLIANCE THAT INTEGRATE HEALTH, ENVIRONMENT AND EQUITY GOALS SIMULTANEOUSLY HOLD POTENTIAL TO MITIGATE CLIMATE CHANGE, REDUCE PUBLIC HEALTH RISKS, AND HELP TO ALLEVIATE ENVIRONMENTAL BURDENS ON THE MOST VULNERABLE POPULATIONS.

ENDNOTES

1 Krieger, E, et al., "The Clean Power Plan in Pennsylvania; Analyzing power generation for health and equity," June 2016. https://nextgenamerica.org/news-reports/our-air-pa-technical/.

2 Id. p. 55; p. 16 (Figure 3.3); p. 14 (Figure 3.2).

3 Id. p. 16 (Figure 3.3).

4 PA-DEP, \Environmental Justice Areas of Pennsylvania," Pennsylvania Department of Environmental Protection, Tech. Rep., 2014.

5 PSE Healthy Energy," The Clean Power Plan in Pennsylvania; Analyzing power generation for health and equity," June 2016, p. 57 (Figure 5.8). https://nextgenamerica.org/news-reports/our-air-pa-technical/.

6 Id. p. 58 (Figure 5.9).

7 Id. p. 55 (Table 5.2).

8 Id. p. 55 (Table 5.2).

9 Id. p. 81 (Table 4). Shawville is expected to convert to burn natural gas in 2016, and additional scrubbers are planned for some of the remaining coal plants to meet emission regulations. Under these changes, the five highest impact plants are projected to be Bruce Mansfield, Homer City, Keystone, Conemaugh, and Montour, and models suggest they will still contribute to hundreds of premature mortalities per year.

10 Id. p. 58 and p. 58 (Figure 5.9).

11 Id. p. 57 (Figure 5.7).

12 Id. p. 59 (Figure 5.10)

13 Id. p. 57 (Figure 5.7).

14 Id. p. 55 (Table 5.2).

15 EH&E, "Emission of hazardous air pollutants from coal-red power plants," Environmental Health & Engineering, for the American Lung Association, Needham, MA, Tech. Rep., 2011. The health impacts of ozone pollution from power plants are substantial, but were not modeled in this study. The impacts modeled in this study are therefore likely an underestimate of the total health and environmental burden associated with air pollution from Pennsylvania's power plants.

16 PSE Healthy Energy," The Clean Power Plan in Pennsylvania; Analyzing power generation for health and equity," June 2016, p. 23. https://nextgenamerica.org/news-reports/our-air-pa-technical/.

17 Id. p. 25.

18 US EPA, "Coal Ash (Coal Combustion Residuals, or CCR)," 4/11/16. https://www.epa.gov/coalash

19 PSE Healthy Energy," The Clean Power Plan in Pennsylvania; Analyzing power generation for health and equity," June 2016, p. 31. https://nextgenamerica.org/news-reports/our-air-pa-technical/.

20 Id. p. 60 (Figure 5.12).

21 Id. p. 14 (Figure 3.2).

22 PA-DEP, \Environmental Justice Areas of Pennsylvania," Pennsylvania Department of Environmental Protection, Tech. Rep., 2014.

23 PSE Healthy Energy," The Clean Power Plan in Pennsylvania; Analyzing power generation for health and equity," June 2016, p. 13 (Figure 3.1). https://nextgenamerica.org/news-reports/our-air-pa-technical/.

24 Id. p. 16 (Figure 3.3).

25 Id. p. 35 (Table 4.2).

26 Id. p. 21 (Figure 3.7).

27 Id. p. 22 (Figure 3.8).

28 Id. p. 41 (Table 4.3).

29 Id. p. 1 (Box 1.0.1)