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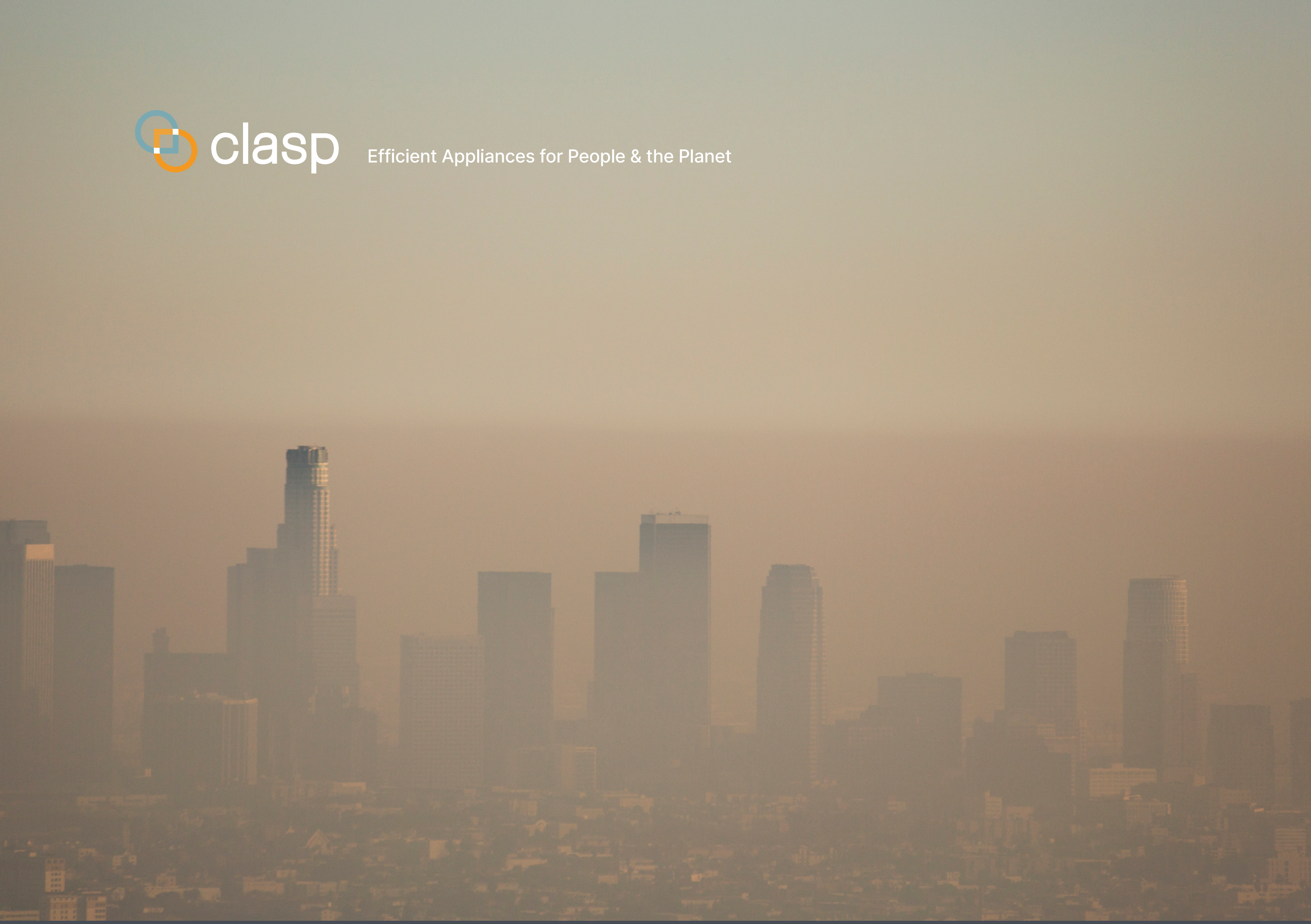

How National Appliance and Equipment Energy Conservation Standards Can Improve Public Health and Advance Justice40 Initiative Goals

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DISCLAIMER

CLASP's research aims to bridge the gap between analysis and action to hit net zero emissions in the appliances sector by 2050. Read ***Net Zero Heroes: Scaling Efficient Appliances for Climate Change Mitigation, Adaptation & Resilience*** to learn more about our net zero strategy.

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A modeling study finds that national appliance standards have reduced energy demand and resulting fine particulate matter ($PM_{2.5}$) and $PM_{2.5}$ precursor emissions in the United States, leading to a decline in $PM_{2.5}$-related mortality. These public health benefits have been distributed equitably, showing that appliance standards can contribute meaningfully to national environmental justice efforts like the Justice40 Initiative (Justice40).

KEY FINDINGS

- National appliance standards have led to significant reductions in $PM_{2.5}$ and $PM_{2.5}$ precursor emissions, preventing hundreds of thousands of tons of pollutants in the year studied, 2017.
- These standards prevented between 1,900 and 4,400 $PM_{2.5}$-related deaths in 2017, translating to monetary benefits of $18 to $41 billion.
- Health benefits from national appliance standards have been distributed relatively equitably. Communities designated as disadvantaged by Justice40, representing 33% of the total population, have received 36% of the health benefits from standards.

RECOMMENDATIONS

- To enhance public health benefits, the US Department of Energy (DOE) should meet legally binding deadlines for updating appliance efficiency standards.
- Governments should expand outreach initiatives and incentives to encourage the adoption of efficient appliances, focusing on disadvantaged communities, renters, and low-income households.
- DOE should consider indicators that assess health impacts when quantifying the benefits of covered investments under Justice40.
- Disadvantaged communities and people of color must be engaged throughout the policy development and implementation process.

This report serves to inform DOE and policymakers of the public health benefits of national appliance and equipment energy conservation standards (appliance and equipment standards) and suggest ways to measure their contribution towards Justice40 goals.

Appliance efficiency standards reduce energy demand and lower household energy bills while delivering additional public health benefits. By conserving energy, these standards reduce both indirect emissions (from power generation) and direct emissions (from fossil fuel appliances), decreasing exposure to $PM_{2.5}$, a dangerous category of particulate pollution that can enter the lungs and bloodstream, contributing to increased incidences of respiratory diseases and negative effects on the cardiovascular system that increase the risk of heart attacks and premature death.[i]

National appliance and equipment standards have had a positive impact on public health in the United States. By avoiding the release of $PM_{2.5}$ and $PM_{2.5}$ precursors like nitrogen oxides (NO_x), sulfur dioxide (SO_2), volatile organic compounds (VOC_s), and ammonia (NH_4) from power plants and fossil fuel-burning appliances, standards can reduce the health risks associated with exposure to fine particulate matter and lower $PM_{2.5}$-related mortality over time.

This report estimates the impact of appliance efficiency standards adopted over a 30-year period on public health in the United States and quantifies the reduction in $PM_{2.5}$-related mortality attributed to national appliance efficiency standards in 2017. It also explores how appliance efficiency standards could contribute to the Biden Administration's Justice40 Initiative, which mandates that 40% of the overall benefits from certain federal investments flow to disadvantaged communities.[1,ii] Finally, this report examines how reductions in $PM_{2.5}$-related mortality are distributed by race.

Our analysis finds that national appliance efficiency standards have led to large reductions in $PM_{2.5}$ and $PM_{2.5}$ precursor emissions. These reductions have had a positive impact on public health in the United States. We estimate that standards adopted over the past 30 years prevented between 1,900[2] and 4,400[3] $PM_{2.5}$-related deaths in 2017 alone. We estimate the value of these benefits at between $18 and $41 billion.[4]

The reductions in $PM_{2.5}$-related mortality we modeled were distributed relatively equally. For example, Justice40 disadvantaged communities made up 33% of the United States population and received 36% of the public health benefits (i.e., reduced $PM_{2.5}$-related mortality) from national appliance and equipment standards in 2017. Similar trends were observed across some minority groups. Black populations made up 13% of the population and received 15% of the public health benefits from appliance standards.

The Biden Administration and DOE have the opportunity to update roughly 50 national standards for appliances by January 2025. If adopted, these standards could avert 3 billion tons of greenhouse gas emissions while saving households $230 annually on utility bills.[iii] DOE should continue to adhere to its ambitious timeline to ensure the remaining standards are updated this year. The findings of this report help strengthen the case for doing so. By updating standards this year, the Biden Administration and DOE can help to ensure that standards continue to save energy, lower utility bills, and save lives.

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1 In this report, we define disadvantaged communities as those identified by the Council on Environmental Quality's (CEQ) Climate and Economic Justice Screening Tool (CEJST). Federal agencies will use the tool to help identify disadvantaged communities that will benefit from programs included in the Justice40 Initiative. The CEJST has an interactive map and uses datasets that are indicators of burdens in eight categories (climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development). The tool uses this information to identify communities that are experiencing these burdens.

2 Our mortality "low" estimate was calculated using the concentration response function defined in Krewski, Daniel, Michael Jerrett, Richard T. Burnett, Renjun Ma, Edward Hughes, Yuanli Shi, Michelle C. Turner, et al. "Extended Follow-up and Spatial Analysis of the American Cancer Society Study Linking Particulate Air Pollution and Mortality." Research Report (Health Effects Institute), no. 140 (May 2009): 5–114; discussion 115–136.

3 Our mortality "high" estimate was calculated using the concentration response function defined in Lepeule, Johanna, Francine Laden, Douglas Dockery, and Joel Schwartz. "Chronic Exposure to Fine Particles and Mortality: An Extended Follow-up of the Harvard Six Cities Study from 1974 to 2009." Environmental Health Perspectives 120, no. 7 (July 2012): 965–70. https://doi.org/10.1289/ehp.1104660.

4 We calculated the monetary value of the mortality impacts by multiplying the mortalities estimates calculated using InMAP by the value of a statistical life, which we valued at approximately $9.5 million in 2017 dollars.

Background & Purpose

Appliances and equipment contribute to ambient (outdoor) air pollution, negatively impacting human health.

Appliances directly (through fuel combustion) or indirectly (through fuel combustion at electric power-generating facilities) emit fine particulate matter ($PM_{2.5}$), and $PM_{2.5}$ precursors like nitrogen oxides (NO_X), sulfur dioxide (SO_2), volatile organic compounds (VOC_S), and ammonia (NH_3), which may chemically react in the atmosphere to form secondary $PM_{2.5}$.

$PM_{2.5}$ is a dangerous form of particulate matter typically 2.5 micrometers or smaller in size that, when inhaled, can embed itself deep within the lungs or enter the bloodstream, causing a variety of negative respiratory, cardiovascular, and neurological health impacts.[iv] These health complications may even contribute to premature death. In the United States, $PM_{2.5}$ is responsible for 85,000 to 200,000 excess deaths per year.[v,vi] Due to its negative impact on human health, $PM_{2.5}$ is defined as a criteria air pollutant[5] under the Clean Air Act and is regulated by the US Environmental Protection Agency (EPA).[vii] The Clean Air Act requires EPA to set National Ambient Air Quality Standards (NAAQS) for criteria pollutants that specify a maximum amount of a pollutant averaged over a specified period that can be present in outdoor air without harming public health.

While NAAQS are in place to help protect human health, certain communities are exposed to more pollution than others. Racial and ethnic disparities in air pollution exposure and other environmental hazards are well documented in the United States.[viii,ix,x] Disparities in air pollution exposure have persisted despite an observed decrease in $PM_{2.5}$ emissions.[xi,xii,xiii,xiv] These trends align with a robust body of literature that identifies social determinants like race and class as fundamental drivers of health inequalities.[xv,xvi] Environmental justice seeks to address issues of inequality by working to ensure that all people and communities have equal environmental protection under the law and equal involvement in environmental decision-making processes regardless of income, race, color, national origin, or income.

In January 2021, President Biden signed Executive Order 14008, establishing the Justice40 Initiative, the first comprehensive federal goal to advance environmental justice. Justice40 aims to deliver 40% of the overall benefits of federal climate investments to disadvantaged communities.[xvii] Covered programs[6] under Justice40 span seven areas and include energy efficiency.[xviii] In August 2022, the Biden Administration announced that the Building Technologies Office within DOE's Office of Energy Efficiency and Renewable Energy (EERE) would be included under the list of covered programs under Justice40.[xix] The EERE oversees the Appliance and Equipment Standards Program and therefore could be counted towards the 40% target.

National appliance standards were established by the Energy Policy and Conservation Act of 1975 (EPCA). EPCA requires DOE to update or establish standards at levels that "achieve the maximum improvement in energy [or water] efficiency . . . which the Secretary determines is technologically feasible and economically justified."[xx] Today, the national standards program covers roughly 60 product categories, including major home appliances such as refrigerators; commercial and industrial equipment like motors; heating and air-conditioning equipment; lighting; and electronics.[xxi] Energy-saving standards for new appliances and equipment are reviewed every six years and are generally updated every eight years.

National appliance standards are a proven and cost-effective way to save energy. In 2020 alone, energy and water conservation standards adopted from 1987 through 2020 saved an estimated 5.4 quads of primary energy, equivalent to 5.3% of total US energy consumption.[xxii] These savings have helped to lower energy demand; reduce criteria air pollution and greenhouse gas emissions; improve electric system reliability; and cut consumer energy bills.

5 The Clean Air Act requires the US Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards for six common air pollutants called criteria air pollutants. These pollutants harm human health and the environment in addition to causing property damage. EPA regulates criteria air pollutants by developing human health-based and/or environmentally based criteria (e.g., science-based guidelines) for permissible exposure levels and by setting standards that specify the maximum amount of a pollutant averaged over a specific period that can be present in outdoor air. The criteria air pollutants regulated under the Clean Air Act include particle pollution, ground-level ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, and lead.

6 A covered program is a federal government program that makes covered investment benefits in one or more of the following seven areas: 1. climate change, 2. clean energy and energy efficiency, 3. clean transportation, 4. affordable and sustainable housing, 5. training and workforce development (related to climate, natural disasters, environment, clean energy, clean transportation, housing, water and wastewater infrastructure, and legacy pollution reduction, including in energy communities), 6. remediation and reduction of legacy pollution, and 7. critical clean water and waste infrastructure.

This report aims to establish a clear link between national appliance efficiency standards and positive impacts on public health. Specifically, it estimates the reduction in $PM_{2.5}$-related mortality that can be attributed to national appliance standards adopted over a 30-year period. It also explores how those benefits are allocated to Justice40-designated disadvantaged communities (DACs) and different racial and ethnic groups. While this analysis does not include state appliance standards, its findings are relevant to state appliance standards programs because they deliver similar energy, economic, and public health benefits.

By demonstrating the added health benefits that can be attributed to national appliance and equipment standards, this report makes a clear case for why the Biden Administration should deliver on its commitment to update roughly 50 standards and demonstrates how DOE could use a similar methodology to quantify standards' contribution towards Justice40 goals.

Results

Impact on Emissions

Appliance standards avoided the release of hundreds of thousands of tons of $PM_{2.5}$ and $PM_{2.5}$ precursors in 2017 (Table 1). Notably, standards for residential fossil fuel appliances avoided the release of over 7,800 tons of NO_X and 1,300 tons of NH_3, while standards from electrical residential, commercial, and industrial appliances avoided the release of over 250,000 tons of SO_X emissions and nearly 210,000 tons of NO_X emissions through avoided electricity generation. These avoided emissions are based on the estimated energy savings from standards adopted between 1987 and 2017.

Impact on $PM_{2.5}$-Related Mortality

National appliance standards prevented between 1,900 and 4,400 $PM_{2.5}$-related deaths in 2017 (Table 2). Using the value of a statistical life,[7] we estimate the value of these benefits to be between $18 and $41 billion.

Standards for residential fossil fuel appliances avoided between 50 and 130 $PM_{2.5}$-related deaths in 2017, with monetary benefits totaling over $1 billion. While this estimate is smaller than the avoided $PM_{2.5}$-related deaths from electricity generation, fossil fuel appliances still account for between 1,530 and 3,440 premature deaths each year, highlighting the opportunity to transition to zero-emission electric alternatives. Finally, the benefits reported consider only residential fossil fuel appliances. We expect that the avoided premature $PM_{2.5}$-related deaths would be greater if commercial fossil fuel appliances and equipment were included.

> National appliance standards prevented between 1,900 and 4,400 PM2.5-related deaths in 2017.

Our mortality estimates from electricity generation are similar to those presented in the literature. Within the power sector, a 2019 study estimated that in 2014, power plant emissions led to 16,400 $PM_{2.5}$-related premature deaths per year, with roughly 91% of those deaths attributable to coal-fired power plants.[xxiii] A separate 2020 study estimated deaths from electricity generation at somewhere between 9,280 and 14,960.[xxiv] Our mortality estimates in both actual and counterfactual scenarios fall within a similar range. For example, mortality from electricity generation was estimated to fall between 10,060 and 22,180 in our actual scenario. Our mortality estimates from residential fossil fuel appliances were lower when compared to a comparable study estimating that emissions from residential cooking and heating contributed to between 7,550 and 10,850 $PM_{2.5}$-related deaths in 2014.[xxv]

As the energy sector decarbonizes, the health benefits from electricity savings will decline, particularly as coal-fired power plants are replaced with less-polluting alternatives. However, the monetary benefits of standards, particularly from energy bill savings, will persist. While this report focuses solely on the health benefits of national appliance and equipment standards, the benefits of standards extend far beyond their impact on air quality. For example, national appliance standards save households hundreds of dollars each year on their energy bills. In 2020, the savings in operating costs from national appliance and equipment standards for households and businesses totaled $83.8 billion, with the average household saving $508 in operating costs.[xxvi] These savings illustrate the need to continue to set strong energy efficiency standards even as the energy sector decarbonizes.

7 We estimate the value of a statistical life to be approximately $9.5 million in 2017 dollars.

TABLE 1 Avoided Emissions from National Appliance and Equipment Standards (2017)

AVOIDED EMISSIONS (TONS)	NH_3	NO_x	$PM_{2.5}$	SO_x	VOC
Residential fossil fuel appliances	1,310	7,890	150	50	460
Electricity generation	3,490	201,370	18,900	250,050	4,830
Total	**4,800**	**209,260**	**19,050**	**250,100**	**5,290**

Source. *CLASP analysis*
Note. The avoided emissions from national appliance and equipment standards were calculated by comparing the difference between actual scenarios and the estimated emissions in a counterfactual scenario without standards. This approach will be explained in more detail in the methodology section at the end of the report.

TABLE 2 Annual $PM_{2.5}$-Related Mortality from Residential Fossil Fuel Appliances and Electricity Generation Using Two Different Concentration-Response Functions (2017)

SCENARIO	EMISSIONS SOURCE	MORTALITY+ "LOW" ESTIMATE INCIDENCES	MORTALITY* "HIGH" ESTIMATE INCIDENCES	MONETARY IMPACT+ "LOW" ESTIMATE ($ BILLION)	MONETARY IMPACT* "HIGH" ESTIMATE ($ BILLION)
Actual	Residential fossil fuel appliances	1,530	3,440	14	33
	Electricity generation	10,060	22,740	96	216
	Total	**11,590**	**26,180**	**110**	**249**
Counterfactual	Residential fossil fuel appliances	1,580	3,570	15	34
	Electricity generation	11,930	26,980	113	256
	Total	**13,510**	**30,550**	**128**	**290**
Total Benefit (Difference between actual and counterfactual scenarios)		**1,920**	**4,370**	**18**	**41**

Source. *CLASP analysis of InMAP model outputs*
Note. +Krewski et al., 2009; *Lepeule et al., 2012. Estimates are calculated using InMAP-grid shapefiles.

Impacts on Justice40 Disadvantaged Communities

Based on 2017 data, disadvantaged communities represent 33% of the US population[xxvii] and receive 36% of the public health benefits[8] from appliance standards. Table 3 shows the distribution of benefits from national appliance and equipment standards. Thirty-eight percent of the benefits from residential fossil fuel appliance standards (emissions source: residential fossil fuel appliances) are realized in disadvantaged communities, while 36% percent of the total benefits from standards for electric appliances (emissions source: power generation) are realized in disadvantaged communities. Our results suggest that the health benefits from national appliance standards have been distributed equitably among the United States population.

We acknowledge that the total benefits from national appliance standards experienced in disadvantaged communities are less than the Justice40 40% threshold. However, Executive Order 14008 does not require each project or investment to meet the 40% target. Instead, it states that “40 percent of the overall benefits” of federal investments from covered programs should flow to disadvantaged communities, meaning that all programs collectively rather than individually must meet the 40% target.

We also acknowledge that we selected a very specific indicator when assessing health impacts, $PM_{2.5}$-related mortality. When assessing contributions to Justice40, DOE may select from several indicators ranging from financial investments to health outcomes and economic impacts.[xxviii] The share of benefits may have changed if we had selected another indicator, such as exposure to $PM_{2.5}$, morbidity, or utility bill savings.

> Justice40 disadvantaged communities represent 33% of the population but received 36% of the health benefits from appliance standards

The share of public health benefits flowing to disadvantaged communities differed by state. In 35 states, the share of the benefits from national appliance standards exceeds their share of the total population (Figure 1). In 15 states, the distribution of reduced $PM_{2.5}$-related mortality in disadvantaged communities met or exceeded the 40% threshold, indicating that appliance standards are an effective way to improve public health and deliver Justice40 goals (see Appendix A: Share of Public Health Benefits by Justice40 Community and State).

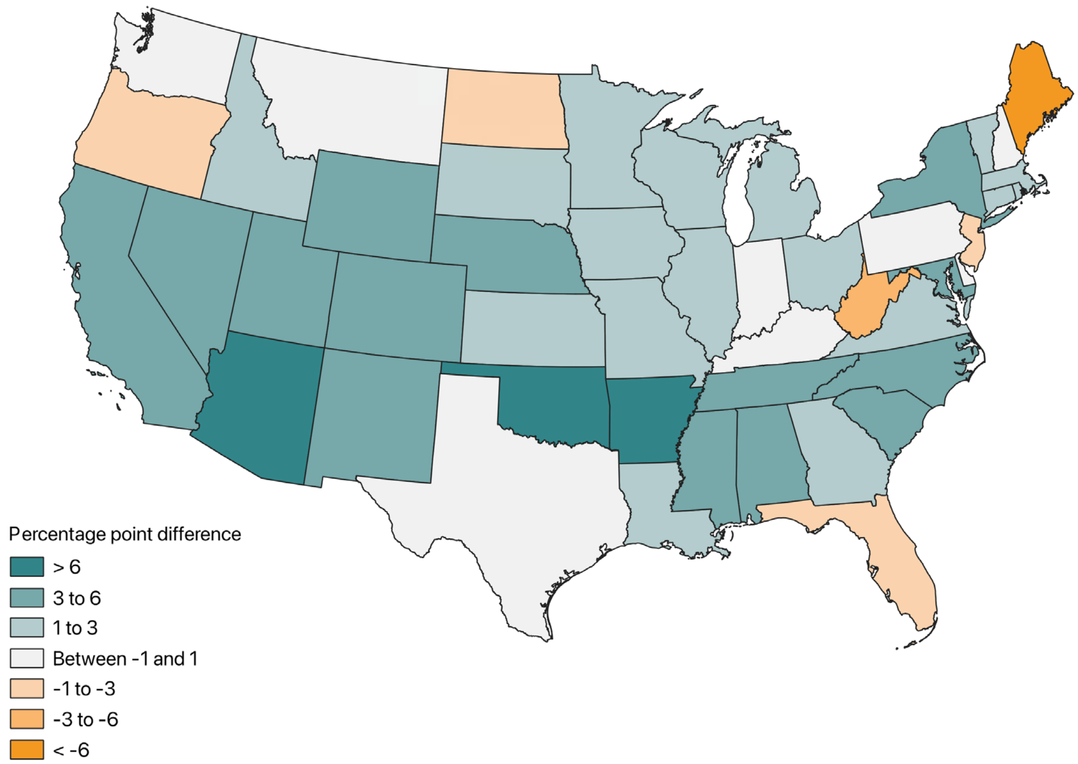
TABLE 3 Share of Public Health Benefits from National Appliance and Equipment Standards Realized in Justice40 Disadvantaged Communities (2017)

STANDARD TYPE	SHARE OF HEALTH BENEFITS	SHARE OF POPULATION
Residential fossil fuel appliances standards	38%	33%
Electric appliance standards	36%	33%
All standards	36%	33%

Source. *CLASP analysis of InMAP model outputs and Council on Environmental Quality, 2022*

8 We define public health benefits as the estimated reduction in $PM_{2.5}$-related mortality measured as the difference in mortality between the actual and counterfactual scenarios in this analysis.

FIGURE 1 Share of Public Health Benefits to Justice40 Disadvantaged Communities from National Appliance Standards for the Contiguous United States Relative to Share of Justice40 Disadvantaged Community Population (2017)



Source. *CLASP analysis of InMAP model outputs*
Note. This map compares the share of benefits (i.e., avoided $PM_{2.5}$-related mortality) from national appliance and equipment standards delivered to DACs to their share of the population of each state for the contiguous US. Areas shaded in teal show states where the share of benefits realized in DACs is greater than their share of the population. Areas shaded in orange show states where the share of benefits realized in DACs is less than their share of the population. Hawaii and Alaska were excluded from the analysis because InMAP is only able to analyze changes in $PM_{2.5}$ concentrations for the contiguous US.

Impacts by Race and Ethnicity

When we explored the distribution of benefits from past national appliance standards by race and ethnicity in addition to Justice40 communities, we found that White and Black people benefit slightly more than Latino,[9] Asian, and Native American people (Table 4). White people made up 63% of the population in 2017 and received 68% of the public health benefits from past standards.[xxix] Similarly, Black people represented 13% of the US population in 2017 and received 15% of the benefits.[xxx] Latino people made up 18% of the US population in 2017 but received only 12% of the public health benefits from standards.[xxxi]

We also analyzed the distribution of benefits by race at the state level to assess whether there was a difference between the allocation of public health benefits by race at the subnational level. A detailed table comparing the distribution of benefits to the percentage of the total population for the five racial and ethnic classifications included in this analysis is available in Appendix B: Distribution of Public Health Benefits by Race.

9 Includes all races.

While the share of benefits from national appliance and equipment standards distributed to different racial and ethnic groups within the United States more or less reflects each group's share of the population, our analysis finds that communities of color are still disproportionately impacted by $PM_{2.5}$ pollution. Emissions from electricity generation in 2017 led to higher mortality rates for Black and White people compared to the overall population, with Black people having a 1.2-times higher mortality rate and White people having a 1.1-times higher mortality rate than the overall population (Table 5). Black, Latino, and Asian people had higher mortality rates than the overall population for emissions from residential appliances. Asian people had the highest mortality rates, which were 1.6 times higher than the overall population. Disproportionate health impacts between different racial and ethnic groups are well-documented in the peer-reviewed literature for both the residential and power sectors.

Our findings align with similar peer-reviewed literature demonstrating exposure disparities from different sources of $PM_{2.5}$ emissions. Tessum et al. conducted a nationwide analysis of $PM_{2.5}$ exposure disparities and found similar results.[xxxiii] Their analysis employed a similar methodology, analyzing NEI emissions data using InMAP. They found that Black populations are exposed to 18% more $PM_{2.5}$ pollution from coal electric generation than average. Notably, White populations were exposed to 8% more $PM_{2.5}$ pollution from coal electric generation compared to the general public.[xxxiv] Our results show a similar trend, with White populations having a mortality rate 1.1 times greater than the average American. Similarly to our results, Latino and Asian populations were exposed to less $PM_{2.5}$ from coal electric generators than average (–38% and –18%, respectively).[xxxv]

TABLE 4 Share of Public Health Benefits from National Appliance and Equipment Standards by Race/Ethnicity (2017)

	WHITE	BLACK	LATINO	NATIVE AMERICAN	ASIAN
Share of benefits (%)	68%	15%	12%	1%	3%
Share of population (%)[10]	61%	13%	18%	1%	5%

Source. *CLASP analysis of InMAP model outputs and US Census Bureau, 2018*

TABLE 5 Annual Per Capita Mortality by Race and Ethnicity (2017)

SCENARIO	EMISSIONS	BLACK $ per capita	LATINO $ per capita	NATIVE $ per capita	ASIAN $ per capita	WHITE $ per capita	OVERALL $ per capita
Actual	Residential fossil fuel appliances	154	114	48	163	87	104
	Electricity Generation	827	454	558	435	747	687

Source. *CLASP analysis of InMAP model outputs*
Note. Estimates are calculated using InMAP-grid shapefiles and the Leupeule et al.[xxxii] concentration-response function. Mortality estimates converted into per-capita monetary values using $9.5 million (in 2017$) as the value of a statistical life.

10 2017 population data were sourced from the US Census Bureau's American Community Survey's Five-Year Data for the years 2013–2017.

Recommendations

1. DOE must meet its legally binding deadlines provided under the National Appliance Energy Conservation Act (NAECA) of 1987 for updating appliance efficiency standards in a timely manner.

Our findings show that national appliance and equipment efficiency standards have helped avoid the release of large quantities of harmful pollution and have delivered public health benefits. DOE must continue to update existing standards as technology advances and, when warranted, implement new standards for products not currently covered; otherwise, inefficient products will remain on the market, leading to unnecessary energy waste, higher operating costs, and increased pollution.

2. Governments should expand appliance efficiency outreach efforts and incentivize efficient appliance purchases, especially among disadvantaged communities.

Most disadvantaged communities have large populations of minority and/or low-income residents. These demographic groups are more likely to be renters and have little influence over appliance purchase decisions or the efficiency of their homes.[xxxvi,xxxvii,xxxviii,xxxix] State and local governments, utilities, nonprofits, and consumer advocacy groups should proactively promote opportunities for savings to both homeowners and landlords available through federal funding. The Inflation Reduction Act includes funding for several rebates and tax credits for energy-efficient or electric appliance and equipment upgrades at the state or utility level. Ensuring that incentives designed to target low- or moderate-income households (e.g., homeowner managing energy savings [HOMES] rebates or the Department of Housing and Urban Development's Green and Resilient Retrofit Program, as well as low-income rebates through utilities, states, and other parties that use ENERGY STAR specifications and products lists to determine eligibility) reach their intended beneficiaries will be crucial. Efforts should also address long-term maintenance and repair to ensure that energy-efficient appliances remain in good working condition, especially in rental properties. The impact of these efforts could result in a greater share of health benefits going to disadvantaged communities and help alleviate the high energy burdens facing many renters and people of color.[xl]

3. DOE should consider indicators that assess health impacts when quantifying the benefits of covered investments under the Justice40 Initiative.

Decreasing exposure to pollutants and environmental burdens is one of the eight policy priorities guiding DOE's implementation of Justice40. Current examples of these benefits include avoided emissions and decreased exposure in disadvantaged communities.[xli] DOE may also wish to understand whether these benefits reduce gaps in life outcomes, like mortality. Such outcomes demonstrate whether a policy or program ultimately serves broader social and economic ends. Tools like EPA's BenMAP or InMAP can help implementing agencies assess both the environmental and public health impact of specific policies.

4. Include disadvantaged communities and people of color at all levels.

Community members and advocates should be engaged in the design of appliance efficiency policies. DOE should consider hiring equity advisors as a part of the standards development process. Existing nonprofit and advocacy organizations already working in appliance efficiency should form new partnerships with community-based organizations to ensure that all voices are heard when standards are under development. Inclusion should not stop at policy design. Efficiency programs at all levels should seek to employ people from disadvantaged communities or communities of color and engage community leaders in the execution of policies, programs, and initiatives.

Methodology

We used InMAP to model the distributional public health impacts of residential fossil fuel appliances and the power sector. InMAP is a reduced-complexity air quality model[11] that can be used to estimate the human health impacts caused by air pollutant emissions and infer how those impacts are distributed among different groups of people. The model is capable of estimating $PM_{2.5}$ concentrations and related human health impacts for the contiguous United States.

InMAP works by reading user-provided annual total emissions (primary $PM_{2.5}$[12] and $PM_{2.5}$ precursors[13]) and calculating the change in $PM_{2.5}$ concentrations caused by the input emissions. It then estimates changes in human $PM_{2.5}$ exposure. The model can be configured to use epidemiological relationships to estimate $PM_{2.5}$-related health impacts (e.g., $PM_{2.5}$-related mortality, aggregated asthma, hospital admissions) based on emissions data. InMAP also contains existing racial demographic information, which this study used to assess how health benefits from past appliance standards were distributed to disadvantaged communities and different racial and ethnic groups. Users can also provide their own demographic information to account for differences in baseline mortality across different groups. Our analysis used the default population and mortality data provided by InMAP.

We defined public health benefits in this study as the reduction in $PM_{2.5}$-related mortality attributed to DOE's Appliance and Equipment Standards Program. To estimate this benefit, we constructed two emissions scenarios to run in InMAP:

- A scenario that represented the reported emissions in the 2017 National Emissions Inventory (NEI) for fuel combustion from electric generation (power sector)[14] and residential fuel combustion (fossil fuel appliances),[15] and
- A counterfactual scenario that estimated what emissions would have been for the same sectors in the absence of national appliance and equipment standards.[16]

We estimated the public health benefits of national appliance standards to be the difference in modeled $PM_{2.5}$-related mortality between the two scenarios, i.e., the avoided $PM_{2.5}$-related premature deaths that we can attribute to national appliance standards. We ran InMAP four times to estimate the health benefits from standards for fossil fuel appliances and electric appliances separately.

After running InMAP, we mapped the gridded model outputs to census tracts (the level at which Justice40 communities are defined) to support the further elucidation of the public health benefits. We used the Climate and Economic Justice Screening Tool's (CEJST) communities list to obtain a comprehensive list of census tracts that meet Justice40's criteria for a disadvantaged community.[xlii,xliii] The CEJST uses datasets that are indicators of burdens in eight categories: climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development.

11 InMAP is a marginal change model, meaning it is designed to be used to evaluate the impacts of changes in atmospheric $PM_{2.5}$ concentrations rather than the total atmospheric concentrations. InMAP estimates the marginal changes in annual-average outdoor $PM_{2.5}$ using information about emissions and a series of scientific calculations. These calculations account for the evolution of emissions in the atmosphere, including atmospheric transport, chemistry, and deposition. InMAP has been peer-reviewed and is widely used in the scientific literature to estimate air quality and health impacts in the contiguous US (i.e., excluding Alaska and Hawaii). Our analysis was run using InMAP version 1.9.0.

12 $PM_{2.5}$ is referred to as "primary" if it is directly emitted into the air as solid or liquid particles.

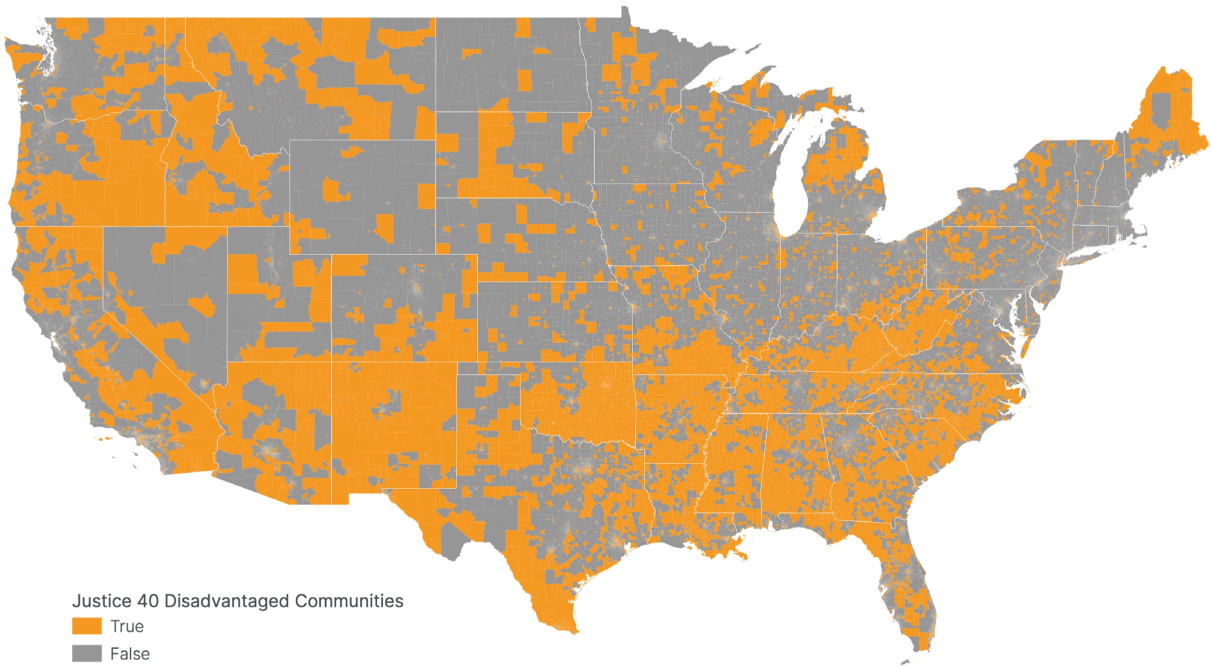
13 $PM_{2.5}$ precursors include NO_X, SO_X, NH_3, and VOC_S. $PM_{2.5}$ precursors can mix in the atmosphere, undergoing chemical reactions to form secondary $PM_{2.5}$. Major sources of secondary $PM_{2.5}$ are electric power plants and industrial processes like oil refining.

14 2017 NEI emissions data include fuel combustion from electric generation for the following sources: coal, natural gas, oil, biomass, and other.

15 2017 NEI emissions data include residential fuel combustion emissions for the following fuel categories: gas, oil, and other. Common uses of energy associated with this category include space heating, water heating, and cooking. Residential heating includes the combustion of fuel, including coal, distillate oil, kerosene, natural gas, and liquefied propane gas (LPG) to heat homes.

16 This counterfactual scenario was developed using 2017 NEI data (fuel combustion for electric generation and residential fuel combustion) and 2017 energy savings estimates from national appliance and equipment standards (electric appliances and residential fossil fuel appliances) provided by the Appliance Standards Awareness Project (ASAP) for standards adopted over a 30-year period (1987-2017). Electric appliances and equipment included residential, commercial, and industrial products while residential fossil fuel appliances were restricted only to fossil-fuel based appliances intended for use in residential settings.

FIGURE 2 Map of Justice40 Disadvantaged Communities (Contiguous US Only)



Source. [Climate and Economic Justice Screening Tool (CEJST)]

In Version 1 of the CEJST, communities are considered disadvantaged if they are in census tracts that meet the thresholds for at least one of the tool's categories of burden[17] or if they are on land within the boundaries of federally recognized tribes.[xliv] The map of current CEJST-defined disadvantaged communities is shown in Figure 2.

Omitted from the CEJST are indicators of race and ethnicity. This decision was intended to avoid legal challenges from opposition groups.[xlv] Evidence shows that people of color in the United States are exposed disproportionately to $PM_{2.5}$.[xlvi] As a result, this analysis also takes into consideration how the health benefits from national appliance standards are distributed across different racial and ethnic groups in addition to Justice40 disadvantaged communities.

To compare the distribution of public health benefits, we compared the difference in mortality in each scenario for disadvantaged and non-disadvantaged communities at the national and state levels. We determined the impact of national appliance standards to be the difference in $PM_{2.5}$-related mortality between the two scenarios, i.e., avoided $PM_{2.5}$-related deaths that can be attributed to national appliance standards. We summed the difference between the two scenarios for disadvantaged communities and divided that figure by the total number of avoided $PM_{2.5}$-related deaths to determine the proportion of total health benefits going to Justice40 disadvantaged communities. We then compared the share of benefits delivered to disadvantaged communities to their share of the total population to assess how equitably benefits were distributed. We applied the same approach when comparing the distribution of public health benefits by race and ethnicity.

There are several limitations to our analysis. First, our counterfactual scenario was developed based on the percentage increase in electricity demand in 2017 if those

17 Disadvantaged communities may be identified according to specific burden categories, but implementing federal agencies are instructed to use the comprehensive list of communities as a starting point.

standards had not been adopted. To meet this additional demand, new power plants would likely have been needed and/or older power plants may have remained operational for longer. Rather than model the changes in installed capacity needed to support this additional demand, we uniformly scaled 2017 NEI emissions data proportionate to the estimated increase in electricity demand. This choice may have resulted in an overestimation in emissions from baseload electricity generation and an underestimation from peaking electricity generation. Additionally, this decision assumes that the emissions in the counterfactual scenario follow the same geographic distribution as they do in the actual scenario and does not consider the location of new facilities that would be needed to meet the added demand. We applied a similar approach when estimating emissions in the counterfactual scenario for residential fossil fuel appliances. The emissions estimates in the counterfactual scenario reflect the emissions factors the NEI used to estimate residential emissions in 2017. These emissions factors are more conservative than what one could expect in a scenario without standards.

There are also some limitations to using a reduced-complexity air quality model. InMAP uses simplified calculations to estimate atmospheric $PM_{2.5}$ concentrations, compared to state-of-the-science chemical-transport models that model the atmospheric processes more explicitly. Recent studies have demonstrated that reduced-form models, including InMAP, provide significant computational advantages with only a minor loss in fidelity.[18] Given that InMAP is a reduced-form model, we also note that the $PM_{2.5}$ concentrations modeled by InMAP represent the marginal impacts of emissions rather than the absolute impacts, meaning that InMAP outputs cannot be compared directly to the National Ambient Air Quality Standards (NAAQS) or ambient air quality monitors.

Despite the limitations presented above, we believe our results provide a snapshot of national appliance and equipment standards' positive impact on public health in the United States. Future analyses may wish to adopt a more detailed methodology that addresses the limitations of our analysis and use more advanced chemical-transport models such as EPA's Community Multiscale Air Quality (CMAQ) model.

18 Gilmore, Elisabeth A., Jinhyok Heo, Nicholas Z. Muller, Christopher W. Tessum, Jason D. Hill, Julian D. Marshall, and Peter J. Adams. "An Inter-Comparison of the Social Costs of Air Quality from Reduced-Complexity Models." *Environmental Research Letters* 14, no. 7 (July 2019): 074016. https://doi.org/10.1088/1748-9326/ab1ab5.

Appendix A: Share of Public Health Benefits by Justice40 Community and State

STATE	JUSTICE40 DISADVANTAGED COMMUNITIES
Alabama	
Share of benefit	46%
Share of population	50%
Arizona	
Share of benefit	35%
Share of population	46%
Arkansas	
Share of benefit	55%
Share of population	62%
California	
Share of benefit	38%
Share of population	42%
Colorado	
Share of benefit	19%
Share of population	23%
Connecticut	
Share of benefit	20%
Share of population	21%
Delaware	
Share of benefit	13%
Share of population	13%
District of Columbia	
Share of benefit	33%
Share of population	33%
Florida	
Share of benefit	40%
Share of population	38%
Georgia	
Share of benefit	34%
Share of population	35%

STATE	JUSTICE40 DISADVANTAGED COMMUNITIES
Idaho	
Share of benefit	33%
Share of population	35%
Illinois	
Share of benefit	29%
Share of population	31%
Indiana	
Share of benefit	29%
Share of population	29%
Iowa	
Share of benefit	17%
Share of population	20%
Kansas	
Share of benefit	25%
Share of population	28%
Kentucky	
Share of benefit	45%
Share of population	45%
Louisiana	
Share of benefit	49%
Share of population	51%
Maine	
Share of benefit	29%
Share of population	23%
Maryland	
Share of benefit	15%
Share of population	19%
Massachusetts	
Share of benefit	20%
Share of population	22%

STATE	JUSTICE40 DISADVANTAGED COMMUNITIES
Michigan	
Share of benefit	30%
Share of population	32%
Minnesota	
Share of benefit	13%
Share of population	14%
Mississippi	
Share of benefit	59%
Share of population	64%
Missouri	
Share of benefit	34%
Share of population	37%
Montana	
Share of benefit	31%
Share of population	31%
Nebraska	
Share of benefit	22%
Share of population	26%
Nevada	
Share of benefit	35%
Share of population	41%
New Hampshire	
Share of benefit	7%
Share of population	7%
New Jersey	
Share of benefit	25%
Share of population	24%
New Mexico	
Share of benefit	52%
Share of population	58%
New York	
Share of benefit	35%
Share of population	39%

STATE	JUSTICE40 DISADVANTAGED COMMUNITIES
North Carolina	
Share of benefit	37%
Share of population	41%
North Dakota	
Share of benefit	9%
Share of population	7%
Ohio	
Share of benefit	29%
Share of population	31%
Oklahoma	
Share of benefit	72%
Share of population	84%
Oregon	
Share of benefit	27%
Share of population	26%
Pennsylvania	
Share of benefit	24%
Share of population	24%
Rhode Island	
Share of benefit	25%
Share of population	26%
South Carolina	
Share of benefit	40%
Share of population	45%
South Dakota	
Share of benefit	27%
Share of population	30%
Tennessee	
Share of benefit	41%
Share of population	46%
Texas	
Share of benefit	40%
Share of population	40%

STATE	JUSTICE40 DISADVANTAGED COMMUNITIES
Utah	
Share of benefit	14%
Share of population	20%
Vermont	
Share of benefit	14%
Share of population	15%
Virginia	
Share of benefit	21%
Share of population	23%
Washington	
Share of benefit	19%
Share of population	19%
West Virginia	
Share of benefit	56%
Share of population	52%
Wisconsin	
Share of benefit	16%
Share of population	18%
Wyoming	
Share of benefit	14%
Share of population	18%
Contiguous United States	
Share of benefit	36%
Share of population	33%

Appendix B: Distribution of Public Health Benefits by Race

STATE	WHITE	BLACK	LATINO	NATIVE AMERICAN	ASIAN
Alabama					
Share of benefit	68%	24%	4%	0%	1%
Share of population	66%	27%	4%	1%	1%
Arkansas					
Share of benefit	50%	4%	33%	8%	3%
Share of population	73%	15%	7%	1%	1%
Arizona					
Share of benefit	73%	17%	6%	1%	1%
Share of population	56%	4%	31%	4%	3%
California					
Share of benefit	35%	7%	41%	0%	14%
Share of population	38%	6%	39%	1%	14%
Colorado					
Share of benefit	69%	4%	21%	1%	3%
Share of population	69%	4%	21%	1%	3%
Connecticut					
Share of benefit	68%	10%	16%	0%	4%
Share of population	68%	10%	15%	0%	4%
District of Columbia					
Share of benefit	64%	21%	9%	0%	4%
Share of population	36%	48%	11%	0%	4%
Delaware					
Share of benefit	35%	49%	10%	0%	4%
Share of population	63%	22%	9%	0%	4%
Florida					
Share of benefit	66%	14%	15%	0%	3%
Share of population	55%	16%	25%	0%	3%
Georgia					
Share of benefit	58%	29%	9%	0%	3%
Share of population	54%	31%	9%	0%	4%
Iowa					
Share of benefit	83%	1%	12%	1%	1%
Share of population	87%	3%	6%	0%	2%

STATE	WHITE	BLACK	LATINO	NATIVE AMERICAN	ASIAN
Idaho					
Share of benefit	71%	13%	11%	0%	3%
Share of population	83%	1%	12%	1%	1%
Illinois					
Share of benefit	84%	7%	5%	0%	2%
Share of population	62%	14%	17%	0%	5%
Indiana					
Share of benefit	88%	3%	5%	0%	2%
Share of population	80%	9%	7%	0%	2%
Kansas					
Share of benefit	80%	5%	10%	1%	2%
Share of population	76%	6%	12%	1%	3%
Kentucky					
Share of benefit	85%	8%	3%	0%	1%
Share of population	85%	8%	3%	0%	1%
Louisiana					
Share of benefit	60%	33%	4%	1%	1%
Share of population	59%	32%	5%	1%	2%
Massachusetts					
Share of benefit	94%	1%	2%	0%	1%
Share of population	73%	7%	11%	0%	6%
Maryland					
Share of benefit	55%	29%	8%	0%	5%
Share of population	52%	30%	10%	0%	6%
Maine					
Share of benefit	73%	7%	11%	0%	6%
Share of population	94%	1%	2%	1%	1%
Michigan					
Share of benefit	74%	16%	5%	0%	3%
Share of population	75%	14%	5%	1%	3%
Minnesota					
Share of benefit	82%	5%	5%	1%	4%
Share of population	81%	6%	5%	1%	5%

STATE	WHITE	BLACK	LATINO	NATIVE AMERICAN	ASIAN
Missouri					
Share of benefit	56%	39%	3%	0%	1%
Share of population	80%	12%	4%	0%	2%
Mississippi					
Share of benefit	78%	14%	3%	0%	2%
Share of population	57%	38%	3%	0%	1%
Montana					
Share of benefit	84%	0%	3%	9%	1%
Share of population	87%	0%	4%	6%	1%
North Carolina					
Share of benefit	80%	5%	10%	1%	2%
Share of population	64%	21%	9%	1%	3%
North Dakota					
Share of benefit	45%	10%	32%	1%	8%
Share of population	86%	2%	3%	5%	1%
Nebraska					
Share of benefit	91%	1%	3%	0%	2%
Share of population	80%	5%	10%	1%	2%
New Hampshire					
Share of benefit	60%	13%	17%	0%	8%
Share of population	91%	1%	3%	0%	3%
New Jersey					
Share of benefit	40%	2%	43%	12%	1%
Share of population	56%	13%	20%	0%	9%
New Mexico					
Share of benefit	52%	16%	20%	0%	9%
Share of population	38%	2%	48%	9%	1%
Nevada					
Share of benefit	66%	20%	8%	1%	2%
Share of population	50%	9%	28%	1%	8%
New York					
Share of benefit	89%	1%	2%	4%	1%
Share of population	56%	16%	19%	0%	8%

STATE	WHITE	BLACK	LATINO	NATIVE AMERICAN	ASIAN
Ohio					
Share of benefit	81%	12%	3%	0%	2%
Share of population	80%	12%	4%	0%	2%
Oklahoma					
Share of benefit	67%	6%	8%	9%	1%
Share of population	66%	7%	10%	7%	2%
Oregon					
Share of benefit	74%	2%	13%	1%	5%
Share of population	77%	2%	13%	1%	4%
Pennsylvania					
Share of benefit	80%	10%	6%	0%	3%
Share of population	77%	11%	7%	0%	3%
Rhode Island					
Share of benefit	73%	6%	15%	0%	3%
Share of population	73%	6%	15%	1%	3%
South Carolina					
Share of benefit	64%	28%	5%	0%	1%
Share of population	64%	27%	5%	0%	1%
South Dakota					
Share of benefit	84%	1%	3%	8%	1%
Share of population	83%	2%	3%	9%	1%
Tennessee					
Share of benefit	73%	19%	5%	0%	1%
Share of population	74%	17%	5%	0%	2%
Texas					
Share of benefit	52%	14%	28%	0%	4%
Share of population	43%	12%	39%	0%	5%
Utah					
Share of benefit	80%	1%	13%	2%	2%
Share of population	79%	1%	14%	1%	2%
Virginia					
Share of benefit	93%	1%	2%	0%	1%
Share of population	63%	19%	9%	0%	6%

STATE	WHITE	BLACK	LATINO	NATIVE AMERICAN	ASIAN
Vermont					
Share of benefit	66%	19%	7%	0%	5%
Share of population	93%	1%	2%	0%	2%
Washington					
Share of benefit	70%	4%	12%	1%	8%
Share of population	70%	4%	12%	1%	8%
Wisconsin					
Share of benefit	93%	3%	1%	0%	1%
Share of population	92%	4%	1%	0%	1%
West Virginia					
Share of benefit	81%	7%	7%	1%	2%
Share of population	92%	4%	1%	0%	1%
Wyoming					
Share of benefit	84%	2%	10%	2%	1%
Share of population	84%	1%	10%	2%	1%

Other examples include the increased likelihood of hazardous facilities being located in communities of color[xlvii,xlviii,xlix,l] and greater exposure risk to air pollution in neighborhoods with more Black and Latino residents,[li,lii,liii] lower-income residents,[liv] and single female–headed households.[lv]

Bibliography

i Shaolong Feng et al., "The Health Effects of Ambient PM2.5 and Potential Mechanisms," *Ecotoxicology and Environmental Safety* 128 (June 1, 2016): 67–74, https://doi.org/10.1016/j.ecoenv.2016.01.030.

ii "Tackling the Climate Crisis at Home and Abroad" (Code of Federal Regulations, 2021), https://www.federalregister.gov/documents/2021/02/01/2021-02177/tackling-the-climate-crisis-at-home-and-abroad.

iii Joanna Mauer and Andrew deLaski, "A Powerful Priority: How Appliance Standards Can Help Meet U.S. Climate Goals and Save Consumers Money" (Washington, DC: ACEEE, 2020), https://www.aceee.org/research-report/a2001.

iv "Global Burden of 87 Risk Factors in 204 Countries and Territories, 1990–2019: A Systematic Analysis for the Global Burden of Disease Study 2019 - The Lancet," accessed September 19, 2023, https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30752-2/fulltext.

v Institute for Health Metrics and Evaluation (IHME), GBD Compare Data Visualization, n.d., http://ghdx.healthdata.org/gbd-results-tool.

vi Richard Burnett et al., "Global Estimates of Mortality Associated with Long-Term Exposure to Outdoor Fine Particulate Matter," *Proceedings of the National Academy of Sciences* 115, no. 38 (September 18, 2018): 9592–97, https://doi.org/10.1073/pnas.1803222115.

vii "42 USC Ch. 85: AIR POLLUTION PREVENTION AND CONTROL," accessed February 9, 2024, https://uscode.house.gov/view.xhtml?path=/prelim@title42/chapter85&edition=prelim.

viii Robert D. Bullard, "Solid Waste Sites and the Black Houston Community*," *Sociological Inquiry* 53, no. 2–3 (April 1983): 273–88, https://doi.org/10.1111/j.1475-682X.1983.tb00037.x.

ix Anjum Hajat, Charlene Hsia, and Marie S. O'Neill, "Socioeconomic Disparities and Air Pollution Exposure: A Global Review," Current Environmental Health Reports 2, no. 4 (December 1, 2015): 440–50, https://doi.org/10.1007/s40572-015-0069-5.

x Jean D. Brender, Juliana A. Maantay, and Jayajit Chakraborty, "Residential Proximity to Environmental Hazards and Adverse Health Outcomes," American Journal of Public Health 101, no. S1 (December 2011): S37–52, https://doi.org/10.2105/AJPH.2011.300183.

xi Christopher W. Tessum et al., "Inequity in Consumption of Goods and Services Adds to Racial–Ethnic Disparities in Air Pollution Exposure," Proceedings of the National Academy of Sciences 116, no. 13 (March 26, 2019): 6001–6, https://doi.org/10.1073/pnas.1818859116.

xii Jiawen Liu et al., "Disparities in Air Pollution Exposure in the United States by Race/Ethnicity and Income, 1990–2010," Environmental Health Perspectives 129, no. 12 (December 2021): 127005, https://doi.org/10.1289/EHP8584.

xiii Jonathan Colmer et al., "Disparities in PM2.5 Air Pollution in the United States," Science 369, no. 6503 (July 31, 2020): 575–78, https://doi.org/10.1126/science.aaz9353.

xiv Christopher W. Tessum et al., "PM2.5 Polluters Disproportionately and Systemically Affect People of Color in the United States," Science Advances 7, no. 18 (n.d.): eabf4491, https://doi.org/10.1126/sciadv.abf4491.

xv Greta R. Bauer, "Incorporating Intersectionality Theory into Population Health Research Methodology: Challenges and the Potential to Advance Health Equity," Social Science & Medicine 110 (June 2014): 10–17, https://doi.org/10.1016/j.socscimed.2014.03.022.

xvi Ichiro Kawachi and S. V. Subramanian, "Social Epidemiology for the 21st Century," Social Science & Medicine 196 (January 1, 2018): 240–45, https://doi.org/10.1016/j.socscimed.2017.10.034.

xvii United States: National Archives and Records Administration: Office of the Federal Register, "Federal Register. Vol. 86, No. 19" (Office of the Federal Register, National Archives and Records Administration, February 1, 2021), 7619, https://www.govinfo.gov/app/details/FR-2021-02-01.

xviii Shalanda D. Young, Brenda Mallory, and Gina McCarthy, “Interim Implementation Guidance for the Justice40 Initiative” (Executive Office of the President, Office of Management and Budget, July 20, 2021), https://www.whitehouse.gov/wp-content/uploads/2021/07/M-21-28.pdf.

xix White House, “Justice40 Initiative Covered Programs List v 3.1” (White House, August 18, 2022), 8, https://www.whitehouse.gov/wp-content/uploads/2022/07/Justice40-Covered-Programs-List_v1.2_07-25-2022.pdf.

xx US Congress, “Energy and Policy Conservation Act,” Pub. L. No. Public Law 94-163 (1975), https://www.govinfo.gov/content/pkg/COMPS-845/pdf/COMPS-845.pdf.

xxi ASAP, “ASAP Appliance Standard Awareness Project,” accessed February 13, 2024, https://appliance-standards.org/products-and-links.

xxii Stephen Meyers et al., “Energy and Economic Impacts of U.S. Federal Energy and Water Conservation Standards Adopted From 1987 Through 2020” (Berkeley, CA: Lawrence Berkeley National Laboratory, 2021), https://eta-publications.lbl.gov/sites/default/files/standards_1987-2020_impacts_overview_final_ed.pdf.

xxiii Maninder P. S. Thind et al., “Fine Particulate Air Pollution from Electricity Generation in the US: Health Impacts by Race, Income, and Geography,” Environmental Science & Technology 53, no. 23 (December 3, 2019): 14010–19, https://doi.org/10.1021/acs.est.9b02527.

xxiv Sumil K. Thakrar et al., “Reducing Mortality from Air Pollution in the United States by Targeting Specific Emission Sources,” Environmental Science & Technology Letters 7, no. 9 (September 8, 2020): 639–45, https://doi.org/10.1021/acs.estlett.0c00424.

xxv Thakrar et al.

xxvi Meyers et al., “Energy and Economic Impacts of U.S. Federal Energy and Water Conservation Standards Adopted From 1987 Through 2020.”

xxvii Council on Environmental Quality, “Communities List Data,” 2022, https://screeningtool.geoplatform.gov/en/downloads.

xxviii Young, Mallory, and McCarthy, “Interim Implementation Guidance for the Justice40 Initiative.”

xxix US Census Bureau, “American Community Survey 5-Year Data (2013 - 2017),” 2018, https://www.census.gov/programs-surveys/acs/.

xxx US Census Bureau.

xxxi US Census Bureau.

xxxii Johanna Lepeule et al., “Chronic Exposure to Fine Particles and Mortality: An Extended Follow-up of the Harvard Six Cities Study from 1974 to 2009,” Environmental Health Perspectives 120, no. 7 (July 2012): 965–70, https://doi.org/10.1289/ehp.1104660.

xxxiii Tessum et al., “PM2.5 Polluters Disproportionately and Systemically Affect People of Color in the United States.”

xxxiv Tessum et al.

xxxv Tessum et al.

xxxvi Marilyn A. (ORCID:0000000332457948) Brown et al., “High Energy Burden and Low-Income Energy Affordability: Conclusions from a Literature Review,” Progress in Energy 2, no. 4 (October 29, 2020), https://doi.org/10.1088/2516-1083/abb954.

xxxvii Qiang Wang et al., “Racial Disparities in Energy Poverty in the United States,” Renewable and Sustainable Energy Reviews 137 (March 1, 2021): 110620, https://doi.org/10.1016/j.rser.2020.110620.

xxxviii Xiaojing Xu and Chien-fei Chen, “Energy Efficiency and Energy Justice for U.S. Low-Income Households: An Analysis of Multifaceted Challenges and Potential,” Energy Policy 128 (May 1, 2019): 763–74, https://doi.org/10.1016/j.enpol.2019.01.020.

xxxix Michael Carliner, “Reducing Energy Costs in Rental Housing: The Need and the Potential,” Research Brief (Cambridge, MA: Joint Center for Housing Studies of Harvard, 2013), https://www.jchs.harvard.edu/research-areas/research-briefs/reducing-energy-costs-rental-housing.

xl Ariel Drehoble and Lauren Ross, “Lifting the High Energy Burdens in America’s Largest Cities: How Energy Efficiency Can Improve Low-Income and Underserved Communities,” Energy Access for All (ACEEE, April 2016), https://www.aceee.org/research-report/u1602.

xli United States Department of Energy Office of Economic Impact and Diversity, “Justice40 Initiative,” Energy.gov, accessed August 3, 2023, https://www.energy.gov/diversity/justice40-initiative.

xlii Council on Environmental Quality, “Biden-Harris Administration Launches Version 1.0 of Climate and Economic Justice Screening Tool, Key Step in Implementing President Biden’s Justice40 Initiative” (Executive Office of the President, November 22, 2022), https://www.whitehouse.gov/ceq/news-updates/2022/11/22/biden-harris-administration-launches-version-1-0-of-climate-and-economic-justice-screening-tool-key-step-in-implementing-president-bidens-justice40-initiative/.

xliii Council on Environmental Quality, “Instructions to Federal Agencies on Using the Climate and Economic Justice Screening Tool (‘CEJST Instructions’)” (Executive Office of the President, January 2023), 5, https://static-data-screeningtool.geoplatform.gov/data-versions/1.0/data/score/downloadable/CEQ-CEJST-Instructions.pdf.

xliv White House Council on Environmental Quality, “Climate and Economic Justice Screening Tool Technical Support Document Version 1.0” (U.S. Digital Service, November 2022), https://static-data-screeningtool.geoplatform.gov/data-versions/1.0/data/score/downloadable/1.0-cejst-technical-support-document.pdf.

xlv Lisa Friedman, “White House Takes Aim at Environmental Racism, but Won’t Mention Race,” The New York Times, February 15, 2022, sec. Climate, https://www.nytimes.com/2022/02/15/climate/biden-environment-race-pollution.html.

xlvi Tessum et al., “PM2.5 Polluters Disproportionately and Systemically Affect People of Color in the United States.”

xlvii OAR US EPA, “Power Plants and Neighboring Communities,” Data and Tools, January 24, 2021, https://www.epa.gov/power-sector/power-plants-and-neighboring-communities.

xlviii Heather E. Campbell, Laura R. Peck, and Michael K. Tschudi, “Justice for All? A Cross-Time Analysis of Toxics Release Inventory Facility Location,” Review of Policy Research 27, no. 1 (2010): 1–25, https://doi.org/10.1111/j.1541-1338.2009.00424.x.

xlix Paul Mohai, David Pellow, and J. Timmons Roberts, “Environmental Justice,” Annual Review of Environment and Resources 34, no. 1 (2009): 405–30, https://doi.org/10.1146/annurev-environ-082508-094348.

l Manuel Pastor, Jim Sadd, and John Hipp, “Which Came First? Toxic Facilities, Minority Move-In, and Environmental Justice,” Journal of Urban Affairs 23, no. 1 (2001): 1–21, https://doi.org/10.1111/0735-2166.00072.

li Kerry Ard and Clair Bullock, “Chapter 12 - Concentrating Risk? The Geographic Concentration of Health Risk from Industrial Air Toxics across America,” in Spatiotemporal Analysis of Air Pollution and Its Application in Public Health, ed. Lixin Li, Xiaolu Zhou, and Weitian Tong (Elsevier, 2020), 277–92, https://doi.org/10.1016/B978-0-12-815822-7.00012-1.

lii Liam Downey and Brian Hawkins, “Race, Income, and Environmental Inequality in the United States,” Sociological Perspectives 51, no. 4 (December 2008): 759–81, https://doi.org/10.1525/sop.2008.51.4.759.

liii Raoul S. Liévanos, “Race, Deprivation, and Immigrant Isolation: The Spatial Demography of Air-Toxic Clusters in the Continental United States,” Social Science Research 54 (November 1, 2015): 50–67, https://doi.org/10.1016/j.ssresearch.2015.06.014.

liv Downey and Hawkins, “Race, Income, and Environmental Inequality in the United States.”

lv Liam Downey, Kyle Crowder, and Robert J. Kemp, “Family Structure, Residential Mobility, and Environmental Inequality,” Journal of Marriage and Family 79, no. 2 (April 2017): 535–55, https://doi.org/10.1111/jomf.12355.

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