SICK *of* SOOT

HOW THE EPA CAN SAVE LIVES BY CLEANING UP FINE PARTICLE AIR POLLUTION

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JOHN GRAHAM, PH.D., an atmospheric scientist at **CLEAN AIR TASK FORCE**, served as project manager in the production of *Health Benefits of Alternative $PM_{2.5}$ Standards*.

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AMERICAN LUNG ASSOCIATION is the leading organization working to save lives by improving lung health and preventing lung disease through education, advocacy and research.

CLEAN AIR TASK FORCE is a nonprofit organization dedicated to reducing atmospheric pollution through research, advocacy and private sector collaboration.

EARTHJUSTICE is a nonprofit public interest law firm dedicated to protecting the magnificent places, natural resources and wildlife of this earth, and to defending the right of all people to a healthy environment.

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INTRODUCTION

The U.S. Environmental Protection Agency (EPA) must soon update national health standards for fine particulate matter air pollution ($PM_{2.5}$), commonly referred to as soot—a major cause of premature death and a widespread threat to those who suffer from lung and heart disease. The national health standards are critical tools that drive the cleanup of soot pollution across the country.

According to the EPA, fine particle pollution:

- **Causes early death (from both short- and long-term exposure);**
- **Causes cardiovascular harm (e.g., heart attacks, stroke, heart disease, congestive heart failure);**
- **Likely causes respiratory harm (e.g., worsened asthma, worsened COPD, inflammation);**
- **May cause cancer; and**
- **May cause developmental and reproductive harm.**

The EPA will choose an updated national health standard from a range of possible options. In April 2011, staff scientists at the EPA made a series of recommendations to Administrator Lisa Jackson. These recommendations were based on a review of current research on the health effects of $PM_{2.5}$, conducted by the EPA National Center for Environmental Assessment and vetted by the Clean Air Scientific Advisory Committee (CASAC), an independent body that offers technical advice to the EPA on ambient air quality standards. *Health Benefits of Alternative $PM_{2.5}$ Standards,*[1] a new analysis prepared for the American Lung Association, Clean Air Task Force and Earthjustice, examines these and other options and estimates the life- and cost-saving potential for each scenario of reduced soot pollution.

Based on the analysis, the options currently under consideration at the EPA are not strong enough to protect public health with an adequate margin of safety. These organizations recommend that the EPA adopt a health standard at the strongest end of the range of options considered by the analysis—an annual standard of 11 micrograms per cubic meter (μg/m³) and a daily standard of 25 μg/m³.

Meeting this standard could prevent as many as 35,700 premature deaths every year, in addition to delivering major reductions in harm to people with heart and respiratory disease. Overall, the nation could benefit by as much as $281 billion every year from reduced costs associated with premature death and disease.

The Clean Air Act requires the EPA to follow science and protect public health. To comply with the law, it should adopt the $PM_{2.5}$ health standard recommended by this report.

> Meeting the health standard recommended by this report could prevent as many as 35,700 premature deaths every year.

FINDINGS AND RECOMMENDATION

If the EPA strengthens the current standard of 15 μg/m³ annually and a daily limit of 35 μg/m³ to the recommendation of this report—an annual limit of 11 μg/m³ and a daily limit of 25 μg/m³—the analysis[2] predicts that, every year, Americans will be spared from as many as:

- **35,700 premature deaths;**
- **2,350 heart attacks;**
- **23,290 visits to the hospital and emergency room;**
- **29,800 cases of acute bronchitis;**
- **1.4 million cases of aggravated asthma; and**
- **2.7 million days of missed work or school due to air pollution-caused ailments.**

These health benefits—which are estimates based on improvements relative to current air quality conditions—far outweigh the benefits from any standard the EPA is currently considering.

FIGURE 1. RECOMMENDED $PM_{2.5}$ HEALTH STANDARD PREVENTS MORE PREMATURE DEATHS ANNUALLY

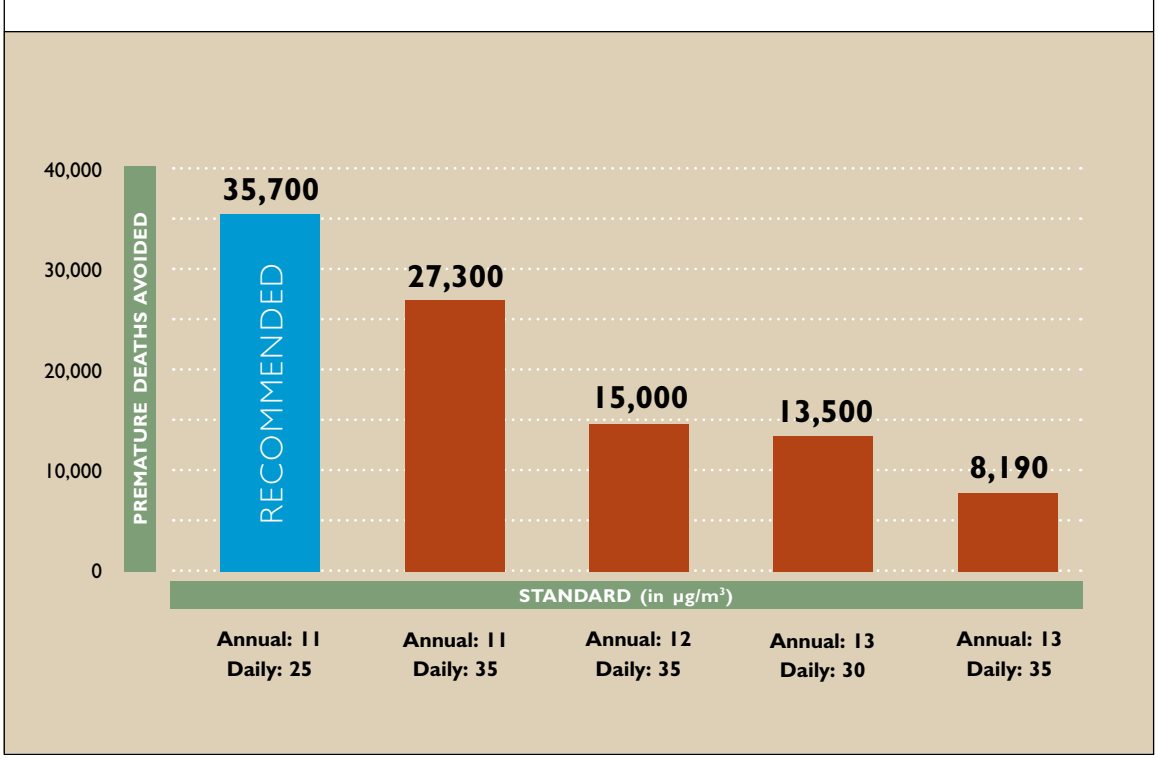

FIGURE 1. This graph compares the premature deaths avoided due to the PM2.5 health standard recommended by this report (in blue) against four standards that are currently under consideration at the EPA. In each case, the estimated number of avoided premature deaths was calculated using an exposure-response function from an epidemiological study by Laden *et al.* (2006).[3]

Overall, the number of premature deaths that could be avoided every year from the most protective standard is equivalent to the size of a sold-out crowd at Fenway Park, Boston's historic baseball stadium. The same epidemiological study used in Figures 1, 2 and 3 found that the current standard—15 μg/m³ (annual) and 35 μg/m³ (daily)—could prevent up to 5,240 premature deaths every year. Strengthening the soot standard to 13 μg/m³ (annual) and 35 μg/m³ (daily), the weakest option that the EPA is considering, could prevent 2,950 additional premature deaths and be important progress. Yet, adopting the standard recommended by this report could prevent an additional 30,460 premature deaths every year—more than 10 times the current number. To maximize the potential of these important health protections to prevent premature death and illness, it is clear that the EPA must set a strong soot standard of 11 μg/m³ (annual) and 25 μg/m³ (daily).

Overall, the nation will benefit by as much as $281 billion each year from reduced costs associated with premature death and disease.

The health benefits bring major financial benefits as well. Strengthening the annual $PM_{2.5}$ standard to 11 μg/m³ and the daily standard to 25 μg/m³ will lead to economic benefits for the American public of $281 billion every year from reduced costs associated with premature death and disease.

FIGURE 2. RECOMMENDED $PM_{2.5}$ HEALTH STANDARD PROVIDES GREATER ECONOMIC BENEFITS ANNUALLY

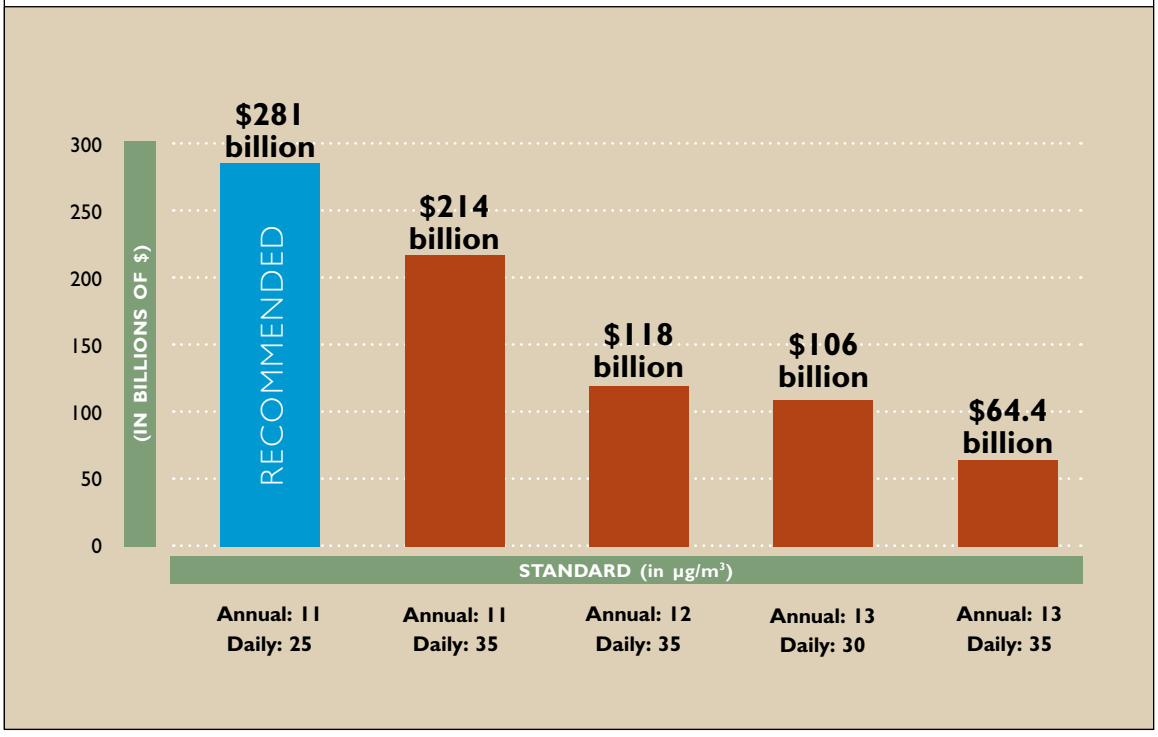

FIGURE 2. **This graph compares the economic benefits due to the PM2.5 health standard recommended by this report (in blue) against four additional standards that are currently under consideration at the EPA. In each case, the estimated economic benefits from an updated PM2.5 health standard were calculated using an exposure-response function from an epidemiological study by Laden *et al.* (2006).[4]**

While health benefits will be distributed across the nation, 10 major metropolitan areas stand to benefit significantly.

To estimate these health and economic benefits, recent air quality data from the EPA's monitoring network were incorporated into the same computer modeling program that the agency uses in its own regulatory impact analyses. This analysis, however, goes beyond the findings published in the EPA's *Quantitative Health Risk Assessment for Particulate Matter*[6] in several important respects:

- **It is national in scope. The EPA's analysis only focuses on 15 urban areas in the continental U.S.**
- **It examines a wider range of daily and annual health standard combinations than the EPA has considered.**
- **It uses more current data. The air quality monitoring data used in this report comes from 2007–2009, whereas the EPA risk assessment, which was completed in 2010, relied on older data from 2005–2007. The more current data used in this report are closer to today's actual air quality conditions. Air quality has improved considerably in recent years due to a number of factors, including cleaner cars entering the fleet and the economic downturn. Consequently, it should be easier for the nation to meet the health standard recommended by this report because current conditions are in fact closer to that standard than the EPA's older modeling has shown.**

FIGURE 3. METROPOLITAN AREAS THAT WILL BENEFIT MOST FROM THE RECOMMENDED $PM_{2.5}$ STANDARD IN PREMATURE DEATHS AVOIDED

RANK	METROPOLITAN AREA	AVOIDED PREMATURE DEATHS, ANNUALLY
1	Los Angeles-Long Beach-Santa Ana, CA	4,230
2	New York-Newark-Edison, NY-NJ-PA	3,290
3	Chicago-Naperville-Joliet, IL-IN-WI	2,240
4	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	1,550
5	Riverside-San Bernardino-Ontario, CA	1,360
6	Pittsburgh, PA	1,270
7	Detroit-Warren-Livonia, MI	970
8	Atlanta-Sandy Springs-Marietta, GA	930
9	Cleveland-Elyria-Mentor, OH	780
10	Cincinnati-Middletown, OH-KY-IN	650

FIGURE 3. This graph displays the number of premature deaths that could be avoided in the 10 major metropolitan areas that will benefit most from an annual limit of 11 $\mu g/m^3$ and a daily limit of 25 $\mu g/m^3$. For each city, the estimated number of avoided premature deaths was calculated using an exposure-response function from an epidemiological study by Laden *et al.* (2006).[5]

WHY THE ENVIRONMENTAL PROTECTION AGENCY MUST ACT NOW

The Clean Air Act directs the EPA to review particulate matter standards every five years to consider the latest scientific evidence and ensure that public health is being adequately protected.[7] The last review ended in October 2006, which means the EPA should have completed the current review by October of this year.

To follow the Clean Air Act, the EPA needs to act promptly and choose the most protective standards. Despite recent improvements to air quality, soot still poses a major threat to public health. As a result, the existing standards—an annual limit of 15 μg/m^3 (established in 1997) and a daily limit of 35 μg/m^3 (revised in 2006)—fail to protect the public from serious, life-threatening risks.

Powerful evidence for this conclusion showed up in the EPA's most recent review of the scientific research on particulate matter.[8] The agency enlisted the help of a panel of expert scientists, the Clean Air Scientific Advisory Committee (CASAC), to review the evidence—in particular, studies published between 2002 and 2009.

From this review, the agency concluded that fine particle pollution:

- **Causes early death (both short- and long-term exposure);**
- **Causes cardiovascular harm (e.g., heart attacks, stroke, heart disease, congestive heart failure);**
- **Likely causes respiratory harm (e.g., worsened asthma, worsened COPD, inflammation);**
- **May cause cancer; and**
- **May cause developmental and reproductive harm.**

In April 2011, the EPA's scientific staff recommended to the administrator that the $PM_{2.5}$ health standards be strengthened to adequately protect against avoidable death and disease.[9] But none of these recommended standards (see red bars in Fig. 1 and Fig. 2) go far enough. To best protect public health, the agency should pursue the standard recommended by this report: an annual limit of 11 μg/m^3 and a daily limit of 25 μg/m^3.

The EPA's pending action is also required by a 2009 court decision won by Earthjustice on behalf of the American Lung Association, Environmental Defense Fund and National Parks Conservation Association. The court ruled the soot standards adopted in 2006 by the Bush Administration deficient, and sent them back to the EPA to ensure adoption of standards adequate to protect public health. The court concluded

SARAH JACKSON/EARTHJUSTICE

A resident of California's Central Valley—notorious for its problems with particulate matter pollution—calls on the EPA to protect public health at a clean air rally that coincided with EPA Administrator Lisa Jackson's visit to the area.

The EPA needs to act promptly. Despite recent improvements to air quality, soot still poses a major threat to public health.

that the EPA had ignored the advice of its own scientists—the Clean Air Scientific Advisory Committee—who recommended that the annual average $PM_{2.5}$ standard needed to be strengthened to prevent sickness and premature death.*

WHAT IS $PM_{2.5}$ AND WHY IS IT DANGEROUS?

Fine particulate matter ($PM_{2.5}$ or soot) is a mixture of solid particles and liquid droplets, usually made up of several different types of chemicals. Diesel vehicles and equipment and coal-fired power plants are among the biggest sources of this pollution. Tailpipe and smokestack emissions, which include unhealthy levels of sulfur dioxide (SO_2) and nitrogen oxides (NO_x), are transformed in the atmosphere with other chemicals to form fine particulate matter.[10] Other sources include wood stoves, agricultural burning and additional forms of industrial combustion.

The particles that comprise $PM_{2.5}$ are so small—1/30th the width of a human hair—that they can't be seen with the naked eye. In areas of high pollution, however, soot shows up in the aggregate as a hazy cloud made visible by light that scatters off those tiny particles. This phenomenon is a familiar sight in many major American cities.

The particles' microscopic size allows them to bypass the body's natural ability to expel larger particles with a cough or a sneeze. As such, soot can lodge deep within the lungs, causing adverse health effects such as aggravation of asthma and other respiratory disease, heart attacks and other cardiovascular problems and even death. Those with preexisting lung or heart disease, diabetics, the elderly and children are most at risk, as are people with low incomes, because they often live in areas of high traffic and industrial activity, where soot pollution is at its worst.[11]

Children are at high risk because 80 percent of their respiratory system develops after birth. Additionally, according to the American Academy of Pediatrics, "Children have increased exposure to many air pollutants compared with adults because of higher minute ventilation and higher levels of physical activity. Because children spend more time outdoors than do adults, they have increased exposure to outdoor air pollution."[12] Prenatal exposure to $PM_{2.5}$ pollution may cause low birth weight and infant mortality, and childhood exposure can decrease lung function.[13]

> "Because children spend more time outdoors than do adults, they have increased exposure to outdoor air pollution."
>
> –AMERICAN ACADEMY OF PEDIATRICS

Diabetics face increased risk, at least in part, because of their higher risk for cardiovascular disease.[14,15] A 2010 study examined the prevalence of diagnosed diabetes in relation to fine particle pollution in 2004–2005. The evidence suggested that air pollution is a risk factor for diabetes.[16] Because people with low incomes often live closer to the sources of soot pollution and have less access to medical care, they have a higher likelihood of heart disease, lung disease and diabetes.

DANGEROUS EXPOSURES: DEATH AND DISEASE

Both short- and long-term exposure to fine particles pose significant health threats, including premature death. Short-term exposure—usually exposure lasting hours or days—can aggravate lung disease and cause asthma attacks or acute bronchitis, sometimes leading to missed days of school or work or even hospital and emergency room visits.[17] Long-term exposure contributes to cardiovascular disease, triggers asthma attacks and heart attacks and worsens other respiratory and cardiovascular diseases.[18]

* The EPA is also required to set limits on soot that are adequate to protect visibility from the brown haze caused by this kind of pollution. Visibility impacts are beyond the scope of this report, but will be addressed elsewhere by groups sponsoring the report.

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SHORT-TERM EXPOSURE CAN BE DEADLY

First and foremost, short-term exposure to particle pollution can kill. Peaks or spikes in particle pollution can last from hours to days. Deaths can occur on the very day that particle levels are high, or within one to two months afterward. Particle pollution does not just make people die a few days earlier than they might otherwise — these are deaths that would not have occurred if the air were cleaner.[19]

Some of the deadliest air pollution events in history lasted just a few days. In October 1948, thousands became ill and 20 people died in Donora, Pennsylvania, when a temperature inversion trapped air pollution from local industry in the valley where the town is located.[20,21] The entire event lasted just five days. An event in London was even more deadly. A swirl of coal smoke settled over the city for four days in 1952, killing thousands. An analysis published in *Environmental Health Perspectives* indicates the death toll may have been as high as 12,000.[22]

Fortunately, air pollution levels in the United States are much cleaner than in the middle of the last century, but even levels seen today cause early deaths. Researchers from Harvard University recently tripled the estimated risk of premature death following a review of newer evidence from fine particle monitors in 27 U.S. cities.[23]

In addition to causing premature death, short-term exposure to particle pollution also diminishes lung function, necessitates greater use of asthma medications and increases school absenteeism, emergency room visits and hospital admissions. Other adverse effects can be coughing, wheezing, cardiac arrhythmias and heart attacks. According to the findings from some of the latest studies, short-term increases in particle pollution have been linked to:

- **death from respiratory and cardiovascular causes, including strokes;**[24,25,26,27]
- **increased mortality in infants and young children;**[28]

- **increased numbers of heart attacks, especially among the elderly and in people with heart conditions;**[29]
- **inflammation of lung tissue in young, healthy adults;**[30,31]
- **increased hospitalization for cardiovascular disease, including strokes and congestive heart failure;**[32,33,34]
- **increased emergency room visits for patients suffering from acute respiratory ailments;**[35,36]
- **increased hospitalization for asthma among children; and**[37,38]
- **increased severity of asthma attacks in children.**[39]

YEAR-ROUND EXPOSURE CAN KILL, TOO

Breathing high levels of particle pollution day in and day out also can be deadly, as landmark studies in the 1990s conclusively showed.[40] Chronic exposure to particle pollution can shorten life by one to three years.[41,42] Other impacts range from premature births to serious respiratory disorders, even when the particle levels are very low. Harm from exposure can begin before birth and can be compounded over a lifetime. Year-round exposure to particle pollution has also been linked to:

- **increased hospitalization for asthma attacks for children living near roads with heavy truck or trailer traffic;**[43,44]
- **slowed lung function growth in children and teenagers;**[45,46]
- **significant damage to the small airways of the lungs;**[47]
- **increased risk of dying from lung cancer; and**[48]
- **increased risk of death from cardiovascular disease.**[49]

To safeguard against health impacts from short- and long-term exposure to fine particles, the EPA sets two complementary standards: an annual standard and a daily ("24-hour") standard. The annual standard is intended to protect us against the average daily exposure to fine particle pollution over the course of a year, while the 24-hour standard provides additional protection against peak pollution levels on any one day, or over a few days to a few weeks.

The EPA needs to strengthen both the annual and the daily standards, not just one or the other. Setting a stronger annual standard does not mean that the daily concentrations will drop enough. In addition, the 24-hour standard forms the basis for air quality alerts to the public when air pollution reaches dangerous levels.

Ana Corona takes medication for her asthma while her daughter watches. Corona lives in the Central Valley of California, which is notorious for air pollution problems. She visited the emergency room for breathing problems seven times in the past year, and she is worried that the region's air pollution problems will affect her children in the same way that they have affected her.

Given the high dangers associated with short- and long-term exposure to $PM_{2.5}$, the EPA needs to set a strong standard to protect health, namely an annual limit of 11 μg/m³ and a daily limit of 25 μg/m³. The evidence is even stronger now than in 2006 when the EPA failed to follow the recommendations of the CASAC to set a much more protective annual standard.

THE CLEAN AIR ACT AND EPA'S RESPONSIBILITY TO PROTECT PUBLIC HEALTH

The Clean Air Act provides a science-based approach to set and meet public health standards that has allowed the nation to achieve much cleaner air. The daily (24-hour) standard for fine particle pollution works in combination with the annual standard to set the official goals for cleaning up soot pollution levels all across the nation. Once the EPA sets the standards, the federal government and the states work to develop a plan to cut soot pollution sufficiently to meet the standards.

The Clean Air Act requires that the EPA protect public health with an adequate margin of safety. In setting or revising the health-based air quality standards, the EPA cannot consider the economic impact of the standard—only the impact on public health.

Instead, economic factors are used in determining how to clean up the pollution. The Clean Air Act allows the EPA to consider costs in setting some pollution control requirements and states develop local plans to determine the best way to cut pollution in each community.

Predictions that strong clean air standards will drag the economy down have consistently proven false. Total emissions of six major air pollutants, including particulate matter, have decreased by more than 41 percent over the past 20 years — in no small part because of the Clean Air Act—while gross domestic product (GDP) over the same period increased by more than 64 percent.[50] Additionally, the economic benefits of reducing soot and smog pollution are projected to reach $2 trillion in 2020.[51]

The Clean Air Act requires that the EPA protect public health with an adequate margin of safety.

Given the mandate to protect public health, it is clear that the EPA must set standards that provide the greatest protection, which means going beyond the options currently under consideration. The EPA should set an annual standard of 11 μg/m³ coupled with a daily standard of 25 μg/m³.

SUMMARY

The EPA is required by the Clean Air Act to protect public health with an adequate margin of safety. To do so, the agency should strengthen the national standard for fine particulate matter to an annual standard of 11 μg/m³ coupled with a daily standard of 25 μg/m³. This standard could prevent as many as 35,700 premature deaths every year, significantly more than any of the standards that the EPA is currently considering. It will also prevent illness, tens of thousands of hospital visits and millions of days of lost productivity, while providing up to $281 billion annually in benefits associated with reducing premature death and disease.

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Marlene Duran of Arvin, California, holds the hand of her daughter Mariann, 5, while she takes her asthma medication. Nearly one in four children in the town, including all three of Marlene's children, has asthma. "There have been nights where more than one child is having an asthma attack at the same time," says Duran. "And that's very scary for me as a mother."

Marti Blake points at the coal-fired power plant that dominates the view from her living room, just outside of Pittsburgh, Pennsylvania—a city notorious for its problems with soot pollution. "I spend most of my life thinking and worrying about the pollution that's coming out of that plant," says Blake, who has lived underneath the stacks for nearly 20 years and has had health problems the entire time. She suffers from chronic allergies and a constant shortness of breath—problems that she didn't have before moving to the area. All across the country, pollution sources such as coal-fired power plants, diesel vehicles and agriculture burning are making people sick of soot.

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