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# **The U.S. Leads the World in Clean Air: The Case for Environmental Optimism**

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# The U.S. Leads the World in Clean Air: The Case for Environmental Optimism

by Kathleen Hartnett White and Brent Bennett, Ph.D.

## Executive Summary

Over the past 50 years, the U.S. has achieved robust economic growth while dramatically reducing emissions of air pollutants. From 1970 to 2017, the aggregate emissions of the six criteria pollutants identified in the Clean Air Act have declined by 73 percent. This improvement has occurred alongside a 262 percent increase in Gross Domestic Product (GDP), a 189 percent increase in vehicle miles traveled, and rising population and energy consumption.

These achievements should be celebrated as a public policy success story, but instead the prevailing narrative among political and environmental leaders is one of environmental decline that can only be reversed with a more stringent regulatory approach.<sup>1</sup> In contrast to this doomsday narrative, consider the data. Since 1990, the ambient concentrations of these six pollutants—measures of what we inhale with each breath—have decreased by an average of 64 percent. Ambient concentrations of lead, sulfur dioxide, and carbon monoxide have declined by 98 percent, 88 percent, and 77 percent, respectively, since 1990. Airborne emissions of mercury and mercury compounds in the U.S. have declined by 74 percent since 2000. Ambient concentrations of benzene, a well-known carcinogen and the most widespread hazardous pollutant, declined by more than 66 percent from 1994 to 2013.

What made these achievements possible were advances in emissions control technologies and the economic prosperity that enabled the widespread implementation of those technologies, as well as the means to monitor their effect on air quality. History has shown that economic prosperity and enduring environmental quality go hand-in-hand. Given current trends, air quality in America should continue to improve as older emission control technology is replaced with new equipment.

According to the World Health Organization, cities in developing countries such as China, India, and Pakistan have average pollutant levels (PM2.5) five to twenty times higher than U.S. cities. Furthermore, indoor air pollution from the use of solid biomass for cooking affects billions more people, especially in Africa. These problems of pollution and energy poverty, which are either unknown or distant memories for the vast majority of Americans, are a daily reality for many of the world's population. The U.S. should celebrate what it has achieved and help the rest of the world by exporting its pollution control technologies and its ideals of economic freedom and limited government.

## Key Points

- Despite pervasive negativity about the state of the environment in the U.S., air pollution has declined dramatically over the past 50 years.
- This achievement was made possible by technological innovations and the prosperity afforded by economic growth, a free market economy, and a limited government.
- Regulations always need to take into account true costs and benefits and be feasible for cities and states to accomplish. The Obama-era EPA attempted to manipulate these metrics in order to justify more regulations.
- Air quality in the developing world is sorely lacking. The time has come to pro-actively share the ideas and technologies behind America's environmental success.

<sup>1</sup> This paper serves to highlight the incredible improvements in U.S. air quality over the past 50 years, but it is not an attempt to weigh in on the debate about what constitutes a "safe" level of air quality.

## Introduction

Which one of the two statements below is true?

*One of the largest public policy success stories in the past 50 years is the dramatic improvement of our nation's air quality* ([Hayward, 31](#)).

*"We're actually at the point in many areas of this country where on a hot summer day, the best advice we can give you is don't go outside. Don't breathe the air, it might kill you."*

—former EPA Administrator Lisa Jackson's statement in an appearance on *Real Time with Bill Maher* (quoted in [Reis](#)).

With such polarized perspectives, it is no wonder the public is confused about environmental protection.

Objective measurement of U.S. air quality provides compelling data confirming just how clean our air has become.<sup>2</sup> Yet, the former heads of the Obama-era EPA claimed that air pollution was so severe that it killed thousands of Americans every year ([EPA 2010a, G-6-G-7](#); [Jackson, 2,4](#); [McCarthy, 1](#)). The empirical data from air quality monitors, however, show that the U.S. is leading the world with dramatic declines of key pollutant levels. According to information compiled by the World Health Organization, the United States is the only nation with more than 50 million

people that meets WHO's safe limits for healthy air quality ([WHO 2018](#)).

After decades of pessimistic environmental outlook, there is increasing evidence across the U.S. to support an optimistic outlook. Given current trends, air quality in America should continue to improve as older emission control technology is replaced with new equipment. As journalist Warren Brookes once wrote, "... regulatory overkill is very likely to give us a worse environment, as well as a worse economy, because the effect of that regulatory overkill will be to slow this nation's advance along the technological learning curve, a curve that I maintain is bright green" ([Brookes](#)).

The magnitude of improvement in air quality is stunning. As a single example among many, from 1995 to 2017, coal-fired power plants equipped with a mix of advanced control technologies decreased their emissions of NO<sub>x</sub> by 82 percent and SO<sub>2</sub> by 89 percent ([EPA 2018a](#)).

An extensive system of air quality monitors across our country confirms the first statement above and refutes the chilling second statement. According to WHO, the United States has some of the cleanest air in the world when measured by concentrations of average annual fine particulate matter (PM<sub>2.5</sub>)<sup>3</sup>. PM<sub>2.5</sub>, also known as soot, is one of the

<sup>2</sup> For a more comprehensive study of the remarkable improvements in the air quality of the United States, see [The Greatest Story Seldom Told](#) prepared by the Association of Air Pollution Control Agencies (AAPCA), April 2017.

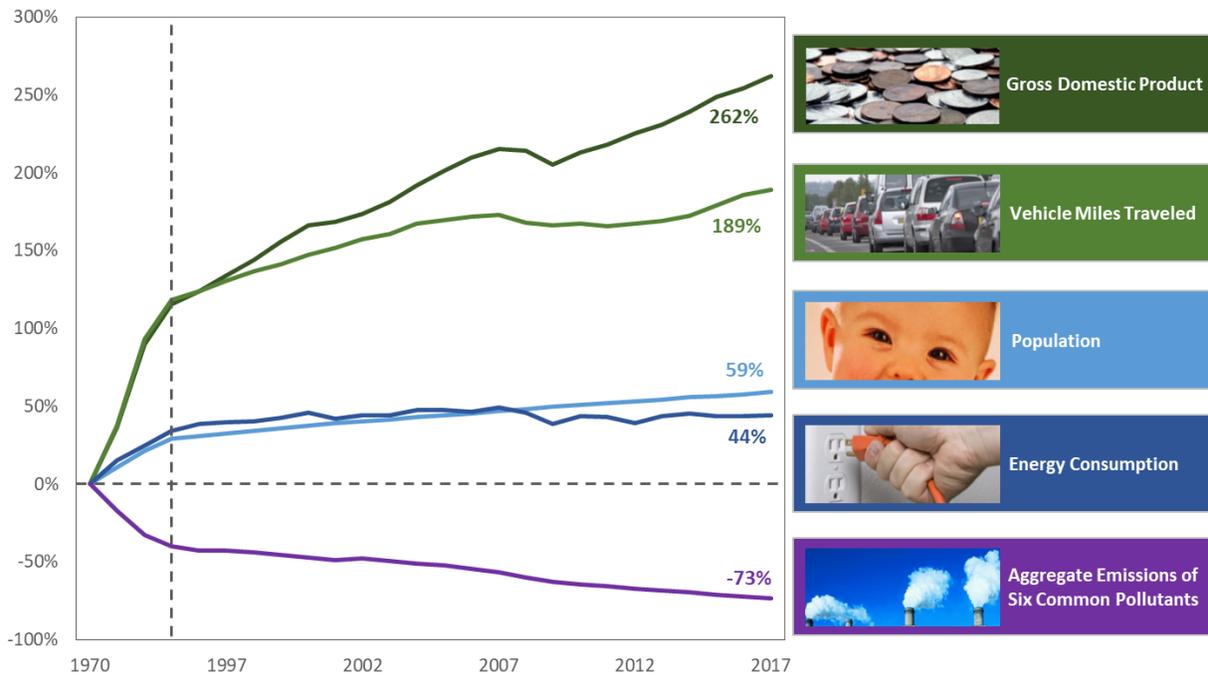
<sup>3</sup> This paper will use the acronym "PM<sub>2.5</sub>" for the pollutant known as fine particulate matter of 2.5 microns in diameter or smaller. To simplify the technical language, the paper will refer to levels of PM<sub>2.5</sub> numerically without repeated reference to the unit of measure "micrograms per cubic meter."

This report will use the pollutant known as particulate matter to characterize the environmental progress achieved by the United States. Particulate matter (PM) is one of the CAA's criteria pollutants and is broadly used by WHO and other organizations as an indicator of general air quality. On this crustal planet, PM is omnipresent: the sum of all solid and liquid particles suspended in the air from natural or human-induced activity.

The major components of PM are elemental carbon (EC), organic carbon (OC), sulfate and nitrate compounds, and crustal materials such as soil and ash, commonly known as dirt and sand ([EPA 2018c](#)). EPA distinguishes between particulate matter (PM) 10 microns in diameter or below and particulate matter 2.5 microns in diameter or below. A micron is

approximately half the width of a human hair. Toxicologists, medical doctors, and environmental scientists generally agree that the smaller particulates could be more harmful. Yet, opinions vary about what levels and exposures to PM<sub>2.5</sub> may adversely impact human health ([Lepeule et al.](#)).

General air pollution is often characterized as "soot" or "smog." Soot usually refers to airborne solids or particulate matter. The English first used the term smog as a combination of smoke and fog. Smog is now used to refer to the criteria pollutant ozone (O<sub>3</sub>). Ozone is not a directly emitted pollutant. O<sub>3</sub> is a result of a chemical reaction between oxides of nitrogen and volatile organic compounds in the presence of sunshine and heat.

**Figure 1.** Economic growth and declining emissions from 1970 to 2017

Source: [EPA 2018b](#)

six criteria pollutants listed in federal law and is often used as surrogate indicator for general pollution.

Although rarely recognized or outright ignored, the environmental record of the United States is one of dramatically declining air pollution over the past several decades. This remarkable progress remains poorly understood by the public and even by many environmental professionals.

In his book, *Where We Stand: A Surprising Look at the Real State of Our Planet*, Dr. Seymour Garte recalls an environmental conference in Europe where he was startled by data showing “steadily declining air pollution trends.” “Even though I was a professor of environmental health and had been actively involved in many aspects of air pollution research for many years, *that simple fact had somehow escaped me*” (Garte 2007, 58-59, italics added).

And Dr. Garte is not alone. Environmental pessimism remains well-entrenched within the media, academia, government agencies, and activist organizations. As Gregg Easterbrook masterfully sizes up the challenge, “It’s time we began reading from a new script, one that reconciles the ideals of environmentalism with the observed facts of the natural world” (Easterbrook). This paper is devoted to “this simple fact” that air quality in the U.S. has been continuously improving for decades.

As **Figure 1** shows, this remarkable progress occurred during a period of substantial economic growth, demonstrating that “win-win” outcomes for the environment and the economy are quite possible. An example is the extraordinarily high quality of air achieved in the heavily industrialized petrochemical complex located in the densely populated region around Houston along the Texas Gulf Coast.

Air quality is foremost among environmental variables because it can directly impact human health and the welfare of living populations. In other words, we are exposed to outdoor or indoor air quality with each of the 12-20 breaths that we take per minute. In a staggering contrast to America’s environmental progress, big cities in developing countries such as China, India, and Pakistan have average pollutant levels (PM2.5) five to twenty times higher than our country ([WHO 2018](#)). Although it appears that China has made progress in reducing air pollution, levels of pollution globally increased by around 8 percent from 2011 to 2015 ([WHO 2016, 4](#)). This decline in air quality is attributed to rapid industrialization in the absence of emission control technologies or enforceable standards.

The 19th century is noted for the industrial revolution literally “fueled” by huge volumes of energy derived from fossil fuels converted to mechanical power. A major achievement of the 20th century is the food revolution that increased agricultural productivity to a level more than capable of

feeding a then rapidly growing global population. The 21st century may well be the century known for sweeping gains in environmental quality, energy abundance, and economic growth across the world—if economic freedom prevails.

### U.S. Air Quality Now Better Than Ever

According to “Our Nation’s Air 2018,” the EPA reports that air pollution, measured in aggregate emissions of the six main pollutants listed in the federal Clean Air Act (CAA), has declined by almost 75 percent since 1970. Even more remarkable, air pollution fell while the economy grew by more than 260 percent, vehicle miles traveled rose by almost 200 percent, and population and energy consumption increased ([EPA 2018b](#)).

The improvements are major, but of course, the challenge remains ongoing. Vigorous, effective efforts based on rigorous science to maintain and enhance air quality should continue. With average ambient concentrations of pollutants in many developing countries still five to ten to twenty times higher than in the United States, the time has come to pro-actively share the American environmental success

by leading the developing world to healthy air quality and abundant, affordable clean energy.

Not unlike the environmental deterioration now challenging many developing countries, industrializing regions in the U.S. during the early part of the 20th century experienced high levels of air pollution. However, from 1925 to 1970, airborne pollution fell in many areas—before enactment of the federal Clean Air Act. As noted in the *2011 Almanac of Environmental Trends*, “The rapid decline in the early years ... is attributable to the simple efficiency gains from industry’s upgrading its technology. The industrial drive for cost-saving efficiency typically leads to cleaner technology” ([Hayward, 7](#)). A striking example of these improvements is the dramatic transformation from dirty to clean skies in Pittsburgh, Pennsylvania, shown in **Figure 2**.

As a broadly shared American value to protect public health, concern about air quality was legally institutionalized in the 1970s with the enactment of federal environmental laws, such as the Clean Air Act. Under the Clean Air Act, the EPA is required to set National Ambient Air Quality Standards (NAAQS) at a level to protect human

**Figure 2.** The corner of Liberty and Fifth Avenues in Pittsburgh ca. 1940 and in 2017.



*Note:* The older picture was taken at 8:38 AM in the morning, after sunrise.

*Source:* [Historic Pittsburgh](#) and [Google Maps](#).

and ecological health. The states are required to implement the national standards. This framework should facilitate pollution reduction *as economic productivity allows*. EPA, however, has continuously extended the scope and stringency of air quality regulation ([White](#)).

The prevalent narrative that economic growth is the enemy of environmental quality no longer stands when faced with these substantial and long-standing positive trends. As argued in Jack Hollander's book *The Real Environmental Crisis*, poverty—not prosperity—is the foe of the environment. It is affluence that motivates and sustains ongoing environmental protection (Hollander, 2-3).

The U.S. record on air quality is a stunning achievement but it is scarcely recognized. Even many senior officials within the environmental arena are unaware of the magnitude of this achievement. And in the media's rare coverage of environmental developments, environmental success is rarely acknowledged. Evidently, bad news about the environment sells better than good news.

EPA's most recent 2018 report on the quality of our air should be an eye opener for those polled in Gallup's regular surveys on environmental opinion. Without much change in opinion over the years, a majority of Americans apparently think that our air quality is worse than ever ([Gallup](#)), while EPA's data overwhelmingly shows that our air is better than ever.

Among the elites, environmental pessimism has become this era's zeitgeist, expressed through bleak predictions of "premature death" and irreversible environmental disasters as if caused by human ignorance, greed, and sheer size of the human population. The media bombards the public with this doom-saying rhetoric formulated by the environmental activist organizations and federal bureaucracies. It is odd that during a period when the U.S. was accelerating successful efforts to improve air quality and extended life span, the environmental elites were predicting thousands of "early deaths" and apocalyptic devastation on a planetary scale.

Free and prosperous societies have a history of fixing things. John Hollander reminds that "One of the great success stories of the recent half-century is, in fact, the remarkable progress the industrial societies have made, during a period of robust economic growth, in reversing the negative environmental impacts of industrialization" (Hollander, 3).

The environmental progress is visible in many of our nation's cities whose skies are now remarkably clean. Blankets of smog and soot no longer cap our clouds. The American public needs to look skyward and enjoy the beauty restored.

Americans so deserve to be made aware of "this simple fact" that remarkable progress in cleaning our air has enhanced human health and welfare.

### **Air Quality Is Complex but the Data Can't Lie**

The technical and legal aspects surrounding air quality involve highly complex subject matter, understandably unfamiliar to the general public. We here offer some simplified background.

The federal Clean Air Act (CAA) was enacted in 1970, expanding the scope of a first, weaker version in 1963. The CAA requires EPA to determine and enforce NAAQS for six common "criteria" pollutants: Carbon Monoxide (CO), Lead (Pb), Nitrogen Dioxides (NO<sub>2</sub>), Ozone (O<sub>3</sub>), Sulfur Dioxide (SO<sub>2</sub>), and Particulate Matter (PM).

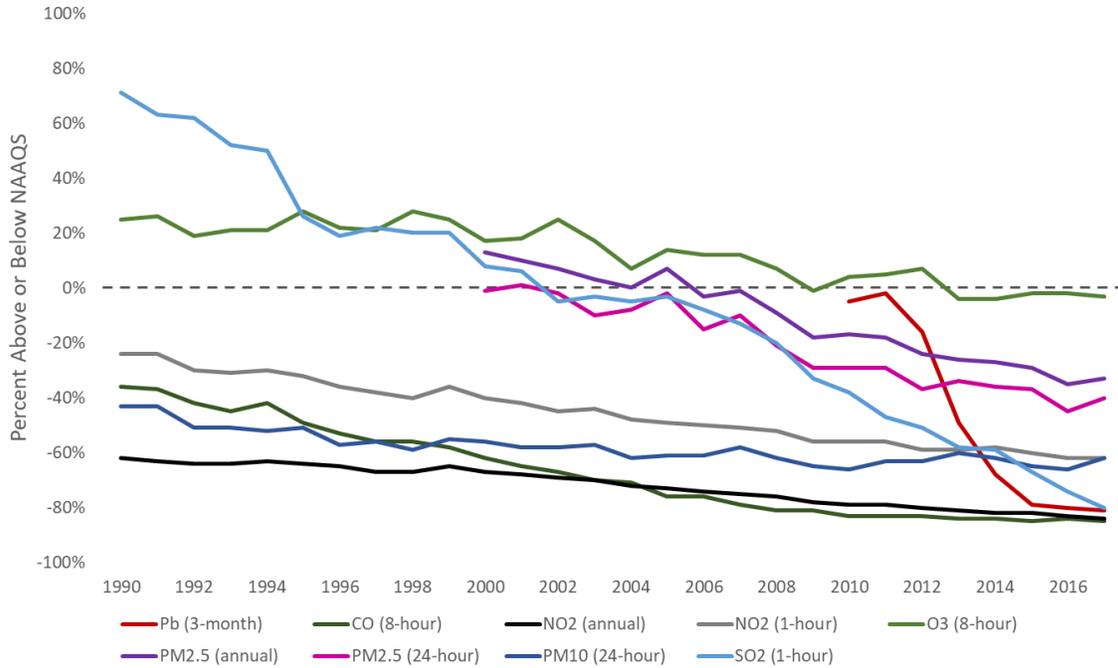
EPA sets a national standard for particles of 10 microns or larger (PM10) and sets two standards (24-hour and annual) for finer particles no larger than 2.5 microns in diameter (PM2.5). EPA's health-based standard for annual PM2.5 is now set at 12 micrograms per cubic meter, comparable to the WHO's standard of 10 micrograms per cubic meter.

The act further requires that each state develop an enforceable State Implementation Plan (SIP) to attain the NAAQS for each of the criteria pollutants. The primary NAAQS for each criteria pollutant are conservative, health-based standards. The secondary NAAQS cover public welfare to include crops, vegetation, visibility, and ecological protection. The national standards must be "requisite to protect the public health" with "an adequate margin of safety" ([Clean Air Act 42 U.S.C. §7409\(b\)\(1\)](#)).

Measuring the level and behavior of airborne pollution relies upon sophisticated ground level monitors, satellites, and continuous emission monitors. Most critically, this extensive system of thousands of monitors across the United States provides objective data that can facilitate reducing emissions. Air quality monitors are expensive to buy and operate. Developing countries with by far the highest levels of air pollution often cannot afford to utilize these essential tools. In stark contrast, the state of Texas alone draws upon data gathered from nearly 230 monitors across the state ([TCEQ](#)).

The many improvements in U.S. air quality merit a closer look. Where possible, the figures in this section are derived from average annual "ambient concentrations" measured by the monitors. "Emissions" are measured from less precise inventories and models. Ambient concentrations are the most important because they are objective and reflect the composition—or dose—of the air inhaled with every breath. Few pollutants are inherently harmful to human health.

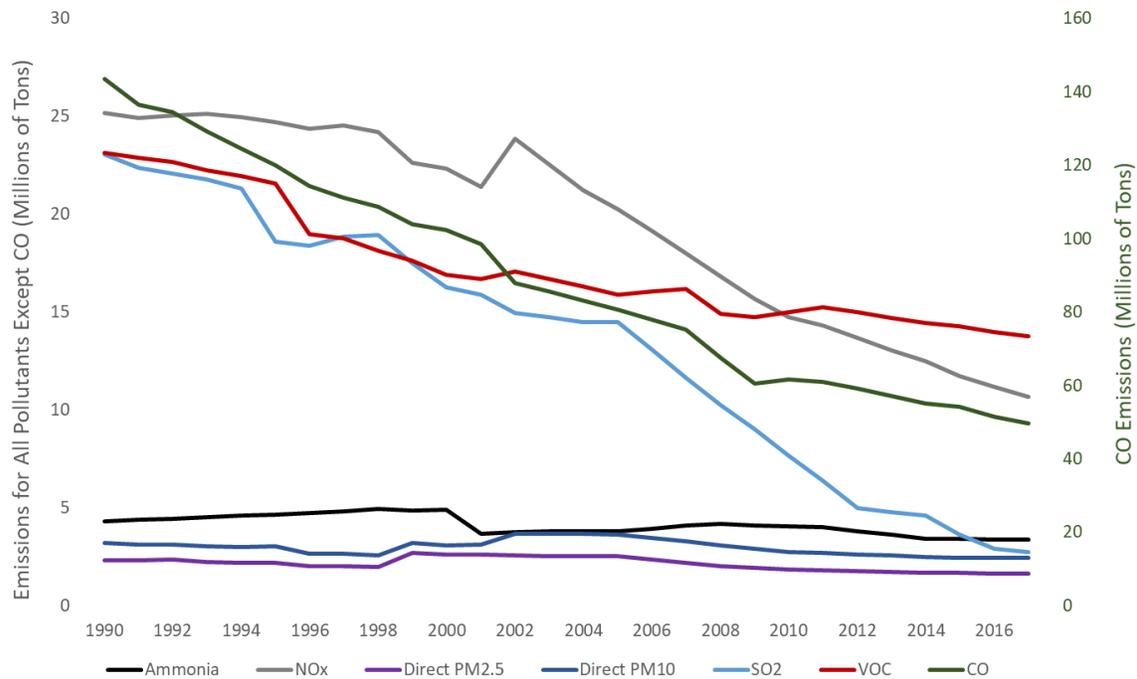
**Figure 3a.** Ambient concentrations of criteria pollutants from 1990 to 2017



Pollutant	Carbon Monoxide (8-hour)	Lead (3-month)	Nitrogen Dioxide (annual)	Ozone (8-hour)	PM2.5 (annual)	Sulfur Dioxide (1-hour)
Decrease since 1990	77%	98%	56%	22%	41%	88%

Source: [EPA 2018c](#)

**Figure 3b.** Emissions of criteria air pollutants from 1990 to 2017



Source: [EPA 2018c](#)

They may become harmful, however, if the dose and the individual exposure to the pollution reaches a certain level.

**Figure 1** compares the 73 percent decline in the aggregate emissions of the six criteria pollutants from 1970 to 2017 with a 262 percent increase in Gross Domestic Product (GDP), a 189 percent increase in vehicle miles traveled, and rising population and energy consumption. The ambient concentrations of these six pollutants have decreased by an average of 64 percent since 1990 ([EPA 2018b](#)). The coincidence of a major decline of air pollutants during robust economic growth questions the long-held belief that industrialization and economic growth are inimical to environmental protection. In fact, prosperity, economic freedom, and environmental quality go hand-in-hand.

**Figure 3a** shows the sharp reduction from 1990 until the present in ambient concentrations of criteria pollutants.

**Figure 3b** clearly highlights the reduction of emissions of criteria pollutants.

U.S. air quality is not just slightly cleaner than in the rest of the world. The disparity is huge, especially in developing countries. India, Pakistan, China, and Southeast Asia have average levels of annual air pollution five to ten times higher than the WHO's guideline values ([Vidal](#)).

Virtually the entire U.S. attains the CAA's current NAAQS, and as of August 2018, only 20 out of 3,007 counties in

the U.S. fail to meet the standard for PM<sub>2.5</sub> ([EPA 2018d](#)). While the standard for ozone has been challenging for some states, the trend is positive. In 1997, EPA classified 113 metropolitan areas as ozone non-attainment ([EPA 2018e](#)). That number would be 35 areas as of September 2018 ([EPA 2018f](#)), but the Obama-era EPA changed the standard such that 52 areas are currently designated as non-attainment ([EPA 2018g](#)). Of those 52 areas, only 11 areas are classified as having moderate to extreme ozone levels.

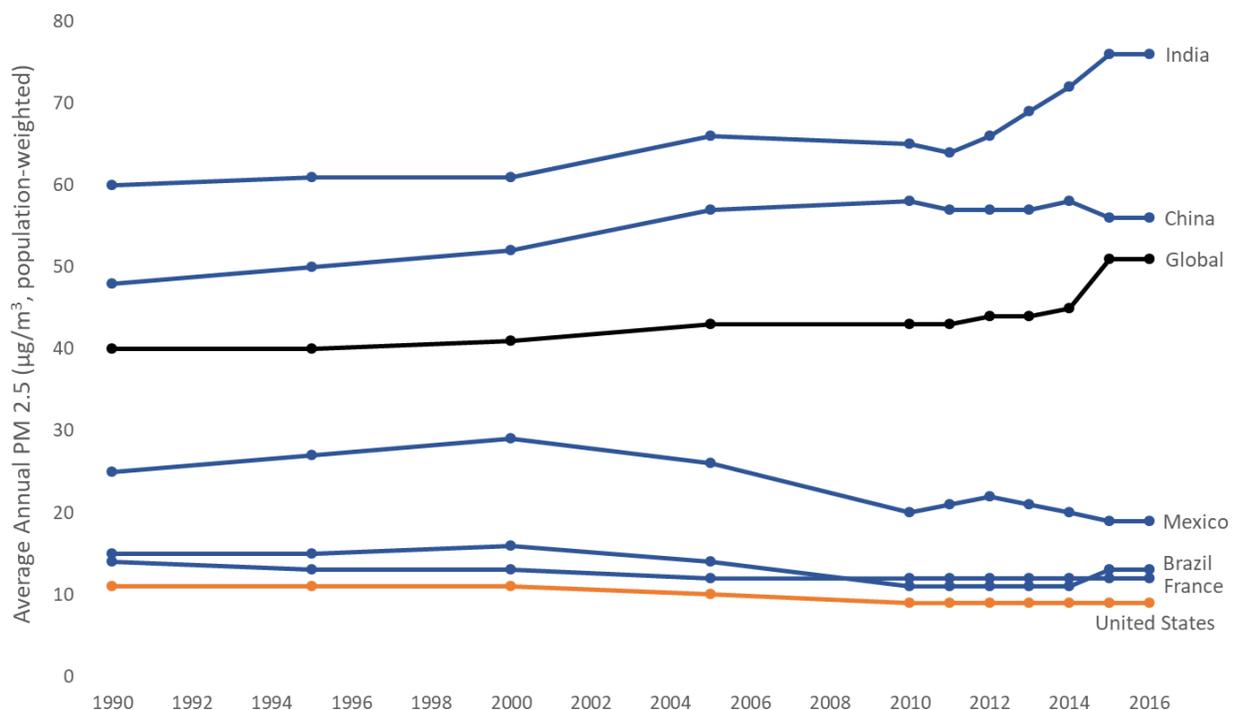
The CAA also requires that EPA track releases of 187 hazardous or toxic pollutants listed in the CAA in the 1990 amendments. The EPA reports that air releases of these pollutants fell by 68 percent from 1990 to 2014 ([EPA 2018b](#)), with a 58 percent reduction from 2006 to 2016 ([EPA 2018h, 2](#)), and nearly 22,000 facilities now submit data to the Toxics Release Inventory ([EPA 2018h, 1](#)).

The doomsayers' grim forecasts about irreversible environmental degradation were simply wrong. A win for human health and welfare at the same time as a win for economic growth and prosperity should bolster our environmental optimism.

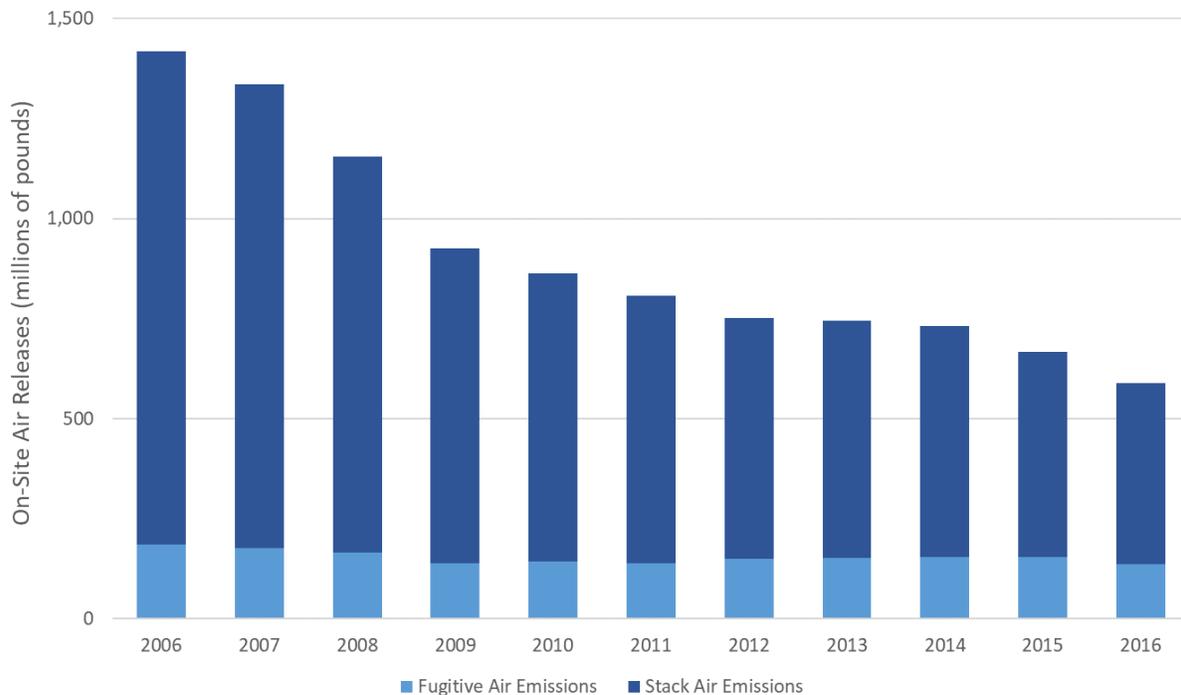
Consider more examples of America's clean air achievements:

Between 1990 and 2008, factory emissions of airborne pollutants in the U.S. fell by 60 percent, according to a study

**Figure 4.** PM 2.5 concentrations for select countries from 1990 to 2016



Source: [HEI](#)

**Figure 5.** On-site air releases of pollutants

Source: [EPA 2018i](#)

by two economists at University of California at Berkeley ([Shapiro and Walker](#)).

Over the past several decades, tailpipe emissions have been reduced dramatically even as vehicle miles traveled have increased. According to the EPA, new passenger vehicles are 98-99 percent cleaner for most tailpipe pollutants compared to the 1960s ([EPA 2018j](#)).

Lead has been practically eliminated from the air we breathe, with a 99 percent reduction in ambient levels since 1980 ([EPA 2018b](#)). In the 1970s, 88 percent of children between 1 and 5 had blood levels of lead above the current threshold for health risks ([Pirkle](#)). By 2016, the affected population of children fell to 0.5 percent ([CDC, 8](#)).

Airborne emissions of mercury and mercury compounds in the U.S. have declined by 74 percent since 2000 ([EPA 2018k](#)). The Centers for Disease Control and Prevention's recent survey finds mercury levels among young women are well below the extremely conservative risk levels for exposure and are falling ([EPA 2018l](#)).

Ambient concentrations of benzene, a well-known carcinogen and the most widespread hazardous pollutant, declined by more than 66 percent from 1994 to 2013 ([EPA 2018m](#); [EPA 2010b](#)).

While industry, power plants, manufacturers, and small businesses were making remarkable reductions in emissions of airborne pollutants, the EPA was focusing on exaggerated, dire scenarios about “early death” caused by air pollution. The so-called early deaths and lives at risk were statistical constructs and not living persons. The EPA however made no qualification and let the public believe that air pollution was so severe that it “caused” the deaths of thousands of people every year. We welcome the current EPA's efforts to set the record straight. Current debate about the questionable science on which the Obama-era EPA justified this avalanche of infeasible regulations continues within federal agencies, the U.S. Congress, and the federal courts.

The Obama administration largely ignored this great news about air quality while the agency carried on an unprecedented regulatory spree of multibillion-dollar rules ([WSJ Editorial Board](#)). Thankfully, the new administration has highlighted the data demonstrating the remarkable progress in air quality and the strong trends for ongoing improvement ([EPA 2018b](#)).

A recent report in the Proceedings of the National Academy of Science expressed surprise that after decades of substantial improvements in air quality, progress was slowing over the last few years, especially with ozone and PM<sub>2.5</sub> ([Zhang et al.](#)). As noted by Hank Campbell, a slightly slower rate of improvement “was no surprise to people who recognize that

the curve of reduction started to flatten because there is little new improvement to be made unless we completely ban cars and trucks” ([Campbell](#)). “Going to zero” is an impossible task because “you can’t regulate nature out of existence.” Natural ozone formation will still occur even when the precursors (VOCs and NO<sub>x</sub>) decline. And as the two most populous countries (China and India) industrially develop, their emissions may be “exported” to the air shed of the U.S.

### How Did the U.S. Clean Our Skies?

Many would attribute substantial environmental improvements entirely to EPA’s strict, enforceable regulatory mandates. Yet, little would have been accomplished without continuously enhanced innovative technologies, operational methods developed by the private sector, and a prosperous economy to pay for the costs of environmental protection.

EPA’s regulations under the Clean Air Act played a key role, but the main engines driving this transformation were technological advances in emission control and efficiencies—innovations spurred and made possible by economic growth and the prosperity it begets within the dynamics of the free market.

The U.S. now produces more with less inputs and waste. The affluence made possible by economic growth has allowed business and consumers to absorb the steep cost of elaborate emission controls. The Obama era’s infeasible mandates, however, coupled with multibillion-dollar compliance costs threatened the very existence of many electric utilities, energy industries, manufacturing and the growth of the shale revolution across the country. Policies under the Trump administration are emerging that once again are igniting the unparalleled productivity, creativity, and job-creating vigor for which the U.S. has always been famous.

A return to empirical science, innovative technologies, and entrepreneurial investments of capital: these hallmarks of the free market, if allowed to function, will fuel continual environmental enhancements and improved human health.

Studies such as [Yale’s Environmental Performance Index \(EPI\)](#) and [Fraser Institute’s Economic Freedom of the World](#) demonstrate that countries which structurally enshrine economic freedom under the rule of law and private property rights also achieve environmental quality.

According to the “[Environmental Kuznets Curve](#)” (named for economist Simon Kuznets), environmental quality deteriorates during the early stages of economic growth but begins to improve after a certain level of income is reached. Similarly demonstrated, the EPI’s data shows a strong correlation between prosperity and environmental health.

Without sufficient economic growth, absorbing the extra costs of state-of-the-art emission control technologies may be impossible for poor countries without foreign aid. When physical survival is in question for a significant percentage of a population, environmental efforts appear to recede in importance. This is the key challenge for many developing countries. Their pursuit of economic growth demands basic infrastructure such as reliable and accessible electricity, fuel for mechanical power in manufacturing industries, and at least rudimentary emission control technologies. Adding all the environmental control technologies to the cost of construction and operation may be unaffordable, particularly when the buildout is done at a high speed.

Current multilateral lending programs to assist developing countries have regrettably conditioned financing on the use of diffuse, intermittent renewable energies, namely solar and wind. These energy sources mean limited, expensive and unreliable energy systems more apt to perpetuate poverty than to stimulate economic growth and facilitate environmental protection ([Darwall, 4-5](#)).

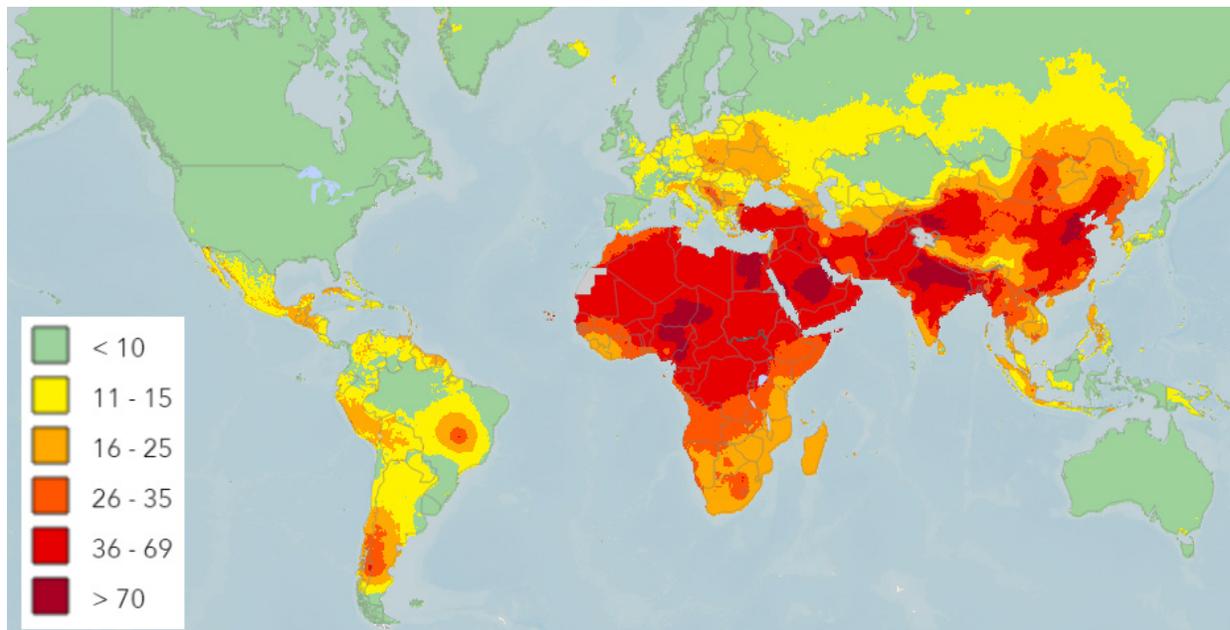
Governance that supports human welfare is also a critical factor for environmental progress. As an example, Russia’s poor air quality and other environmental problems involving water quality and toxic wastes stem from decades of military and industrial development carried out by government planners in a centralized economy in which concern for public health cannot be addressed through market responses. In April 2018, the *Moscow Times* reported that 16 million Russians lived in highly polluted air. In response to public concern, Vladimir Putin established an environmental initiative to check increasing air and water pollution. The initiative may be in name only, as the program reportedly faces a budget cut of four billion dollars ([Moscow Times](#)).

### Global Air Quality

The disparity between average air quality in the U. S. and in developing countries is stunning. In our country, we may quibble about relatively small changes in our national air quality standards. In the world’s two most populous countries (China and India), however, their citizenry lives with levels of air pollution 10 to 20 times higher than in the U.S. At such levels and exposures, air quality may be a major public health issue. In 2017, India declared that air pollution had created a public health emergency when ambient concentrations exceeded WHO’s safe limit by 17 times ([BBC News](#)).

India now dominates WHO’s list of the world’s most polluted cities, with 16 cities in the top 30 ([BBC News](#)). Delhi, the capital of India, is now the world’s 6th-worst polluted city, with annual concentrations of PM2.5 reaching 143 micrograms per cubic meter. With PM2.5 at average annual

**Figure 6.** Average population-weighted exposure to ambient PM<sub>2.5</sub> in 2016, measured in micrograms per cubic meter,  $\mu\text{g}/\text{m}^3$



Source: [WHO 2018](#)

levels of  $173 \mu\text{g}/\text{m}^3$ , the city of Kanpur in northern India is the most polluted city in the world. In comparison, the U.S. NAAQS for PM<sub>2.5</sub> is  $12 \mu\text{g}/\text{m}^3$ .

According to WHO's most recent study of 3,000 cities, air pollution rose 8 percent globally from 2011 to 2015 ([WHO 2016, 4](#)), while U.S. air pollution continued to fall. Long dominating the lists for most polluted cities, it appears that China's air pollution is beginning to decline in response to public demand for concerted action to reduce pollution.

If PM<sub>2.5</sub> is used as a general indicator of overall air quality, the United States enjoys some of the cleanest air in the world. **Figure 6** shows that the U.S. is the only populous nation with annual ambient concentrations of PM<sub>2.5</sub> below the WHO's safe limit of  $10 \mu\text{g}/\text{m}^3$  ([WHO 2018](#)). The few countries that surpass the U.S., such as Canada, Sweden, and Australia, have much smaller populations. That the massive petrochemical industrial complex along the Texas Gulf Coast complies with the WHO's safe limit for PM<sub>2.5</sub> is truly remarkable ([WHO 2018](#)). These facts should be regarded as a global achievement, but, as mentioned earlier, they have eluded even environmental professionals oblivious to the big picture or apparently more accustomed to perpetuating the dismal narrative about air pollution. Nevertheless, these simple facts remain.

The quality of the air in the United States exceeds not only the air quality in relatively poor developing countries but also in economically developed countries. Now lagging

significantly behind the air quality of North America, European Union countries have also fallen behind the wealthier Asian countries like Japan, South Korea, and Singapore ([Goode](#)).

Some blame the European Union's refusal or inability to enforce existing environmental laws. Others blame the amount of bio-diesel consumed in car engines and machines. Still others blame the increased use of coal and wood now serving as heavily subsidized back-up electric power for intermittent renewable energy sources.

Indoor household pollution from burning solid fuel is a major health problem in many developing countries, especially China, India, and African countries. According to a 2015 report by the International Energy Agency, "an estimated 1.2 billion people – 17% of the global population – remain without electricity, and 2.7 billion people – 38% of the global population – put their health at risk through reliance on the traditional use of solid biomass for cooking" ([IEA, 23](#)). Without effective ventilation, burning biomass in close quarters is associated with many chronic, life-threatening cardio-vascular diseases (Yadama). Such an acute scarcity of subsistence energy damages the environment, local economies, and human health.

Access to the simplest of modern electric systems, "the electricity that makes modern lives, jobs, productivity, living standards, health, communication, computers, entertainment and life spans possible" ([Driessen and Wojick](#)),

would transform the lives of these billions. Electrification is the gateway to modernity and to the human welfare and environmental quality made possible in prosperous modern societies.

To the average American, it is likely unimaginable that two to three billion of the current 7.6 billion members of the human race live in acute energy poverty with severe air pollution. Like the hunter-gatherers thousands of years before them, families who depend upon the combustion of wood scraps for sheer survival are consigned to the many miseries of abject poverty unless liberated by simple technologies and accessible, affordable, concentrated energy sources.

## Conclusion

The United States has achieved robust economic growth, universal access to electricity, and mobility, all while dramatically improving its air quality. We have shown that these achievements are not antithetical but in fact go hand

in hand. If developing nations follow this example and embrace open energy markets and new technologies, their road to healthy air today may not be as difficult, slow, or expensive as it was for the United States over the past 50 years. England's Industrial Revolution took three centuries to gather steam, while South Korea's industrialization took only four decades.

Our country has already developed many creative technologies to reduce air emissions and increase efficiencies applicable to large cities in developing countries. We have successfully trodden the path where economic growth enables investments in effective technologies to improve environmental quality and human health. Rather than impose "sustainability" goals and renewable energy directives that restrict the options for developing nations, the developed world should allow developing nations to choose their energy sources and forge a viable path to economic prosperity and a clean environment.

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