



**BENZENE**



**ETHYLBENZENE**



**TOLUENE**



**XYLENE**

## What's in our gasoline is killing us

# Mobile Source Air Toxics (MSATs) and the Threat to Public Health



A Fact Book from

**CFDC**

**CLEAN  
FUELS  
DEVELOPMENT  
COALITION**

In cooperation with

URBAN **AIR** INITIATIVE

## DEAR READER:



"There is no safe exposure level to benzene; even tiny amounts can cause harm. The US Department of Health and Human Services (DHHS) classifies benzene as a human carcinogen. Long-term exposure to excessive levels of benzene in the air causes leukemia...As benzene is ubiquitous in gasoline and hydrocarbon fuels are in use everywhere, human exposure to benzene is a global health problem...Left unquestioned, unchallenged and unregulated, aromatics will continue to contribute to birth defects, life-long illnesses, cancers, lung disease, heart disease, brain disorders – and the growing healthcare bill of individuals and federal and state governments."<sup>2</sup>

– Centers for Disease Control,  
Agency for Toxic Substances  
and Disease Registry, Toxic  
Substances Portal  
[www.atsdr.cdc.gov/](http://www.atsdr.cdc.gov/)

Today's gasoline additives share the same storyline and shameless history of deceit with lead (i.e., a now banned additive to gasoline<sup>1</sup>), tobacco and #Dieselgate. This Fact Book, *What's in Our Gasoline is Killing Us: Mobile Source Air Toxics (MSATs) and the Threat to Public Health*, is intended to educate and inform the reader that the public has been victim to 25 years of exposure to mobile source air toxics (MSATs) since the phase out of lead in gasoline, only to be replaced by even more dangerous additives. We cannot allow the tobacco/lead/gasoline history to continue without toxic and carcinogenic aromatic compounds being properly regulated.

Popular petroleum-based additives used to increase octane include benzene, toluene, xylene and several derivatives of benzene referred to as BTX or BTEX. These comprise almost half the aromatic compounds in gasoline and are classified as known, probable or possible carcinogens. These various forms of benzene are present both in volume in the fuels as well as being created through the combustion of all aromatics. We believe there is a demonstrated history of private interest manipulating government responsibility to protect the public interest—with personal health left hanging in the balance.

**The American Petroleum Institute (API) stated in 1948 that "it is generally considered that the only absolutely safe concentration for benzene is zero."<sup>3</sup>**

Despite the clear and present danger of benzene, it was not until the 1990 Clean Air Act amendments—*more than 40 years after the startling admission by API*—that action was taken to control it. In federal reformulated gasoline used in highly polluted urban areas, benzene is limited to .06% by volume. Yet fuel samples tested show levels as high as 2.5% *volume*—and that does not account for benzene emissions that are formed by other compounds as they exit the tailpipe.

There are alternatives. We do have choices. This Fact Book should alarm you. It alarmed us as we have been compiling information on the health effects of gasoline for years—and the more we researched the more alarmed we have become. And, we have reached a tipping point as we find the nation at a vulnerable crossroads.

The automobile can no longer be burdened with being a mobile incinerator for the oil industry's toxic aromatic compounds dumped into gasoline, and the resulting negative health effects. The nation needs cleaner fuels if we are to protect public health through cleaner and safer air. As the data in this fact book illustrates, the U.S. has a shockingly disproportionate share of global petroleum consumption in terms of our population and a similarly disproportionate percentage of lung cancer deaths. There is a connection.

The facts are clear: Gasoline is a health hazard and needs to be addressed. We hope this research, painfully collected and chronicled over several years, can serve as a catalyst to change. Change that has been resisted by industry and the very federal agencies that are charged with doing so.

A handwritten signature in black ink that reads "Douglas Durante".

Douglas Durante  
Executive Director

## FOREWORD

### URBAN AIR INITIATIVE

On behalf of the board and supporters of the Urban Air Initiative, we are pleased to support this important Fact Book on Mobile Source Air Toxics. Light duty vehicle exhaust emissions are the predominant source of the most dangerous urban emissions. These lethal pollutants can be directly traced to the 25 – 30% of gasoline that petroleum refiners use to increase gasoline octane ratings: aromatic hydrocarbons, commonly known as BTEX. The oil industry's favored boosters—tetraethyl lead and aromatic hydrocarbons—are known poisons and carcinogens/mutagens.

Congress was aware of the serious environmental and health threats posed by the petroleum industry's octane boosters by the time of the 1990 Clean Air Act Amendment (CAAA) debates. At the same time it was banning lead, Congress also wrote mandatory language into the law that required EPA to reduce BTEX gasoline content to the greatest achievable extent as technologies presented themselves.

Unless gasoline BTEX levels are reduced, advanced direct injection engines will make the most dangerous emissions worse. This Fact Book is consistent with research we have conducted at the Urban Air Initiative that shows a direct and disturbing linkage between gasoline emissions and a range of respiratory and even neurological ailments.

The issues raised here are both important and timely. The US Environmental Protection Agency and the National Highway Traffic Safety Administration are currently considering final action on a critically important rulemaking on greenhouse gases and fuel efficiency regulatory policy that will dictate U.S. gasoline composition—and thus Light Duty Vehicle emissions—for decades, perhaps generations, to come.

Based upon the evidence before us, we believe that regulatory barriers should be dismantled so free market forces can be allowed to work, and high-octane fuels with ethanol can compete on a level playing field with petroleum-based octane enhancers.

Not only is the health of our children, elderly, and other vulnerable groups at stake: higher octane, cleaner burning gasoline would benefit the nation's automakers, consumers, farmers, trade balance, workers, and environment.

Sincerely,



Dave VanderGriend,  
President, Urban Air Initiative

**To Our Readers: Douglas Durante, Introduction and Overview**..... 1

**Foreword: Dave VanderGriend, Urban Air Initiative**.....2

**Section I: A Picture Paints a Million Deaths**.....5

The Cost of Our Unhealthy Dependence on Crude Oil and Petroleum Products

- Linking Petroleum Usage and Public Health
- The U.S. Leads in Disturbing Categories

**Section II: Fuel Quality Is Not a New Problem**..... 9

A Historical Assessment of Fuel Quality Concerns

- Congress and the Clean Air Act and the Clean Air Act Amendments of 1990
- Air Pollution Is Killing People

**Section III: A World Look at Air Pollution**..... 13

Sickness, Disease and Death

- Death by Breath
- All Particulate Matter Is Not Equal

**Section IV: Mobile Source Air Toxic Pollution and the Connection to Public Health**..... 15

- The Connection Between MSATs and Public Health
- The Effect of Fossil Fuels on Human Health
  - Pregnancy and the Unborn
  - Lungs and Cancer
  - Hearts and Heart Attacks
  - Autism and Neurological Ailments
  - Diabetes, Kidneys, and Efficacy of Antibiotics
  - Direct Ties to Mortality/Death

**Section V: Cleaning Up Fuel & Mobile Source Air Toxics**..... 30

Protecting Health and Providing a Great Return on Investment

- The Real Cost of Gasoline
- The Cost of Oil Production, Refining, and National Security
- Return on Investment

**Section VI: Conclusion: All Things Considered, What Can We Do?**.....33

- Next Steps and Solution
- A Call to Action

**Thanks to Our Fact Book Sponsors and Supporters** .....37

**References and Footnotes: Go to [www.cleanfuelsdc.org/MSATFactBook](http://www.cleanfuelsdc.org/MSATFactBook)** ..... 38

# A Picture Paints a Thousand Deaths



## The Cost of Our Unhealthy Dependence on Crude Oil and Petroleum Products



### What's in our gasoline is killing us.

We're currently living in and breathing a toxic airborne soup brewed up by aromatics in gasoline—and the impact on all of us is incredibly sobering.

In this *Fact Book*, we will outline the research and science behind each “milestone” along this pathway, leading to the unequivocal conclusion that improving fuel quality is critical to human health and reducing healthcare costs around the globe.

This threat is especially relevant in the U.S., where we lead the world in a number of categories that make Americans especially susceptible and vulnerable.

The pathway from our heavy reliance on petroleum to the clear need to improve fuel quality can be summed up as follows:

**Petroleum consumption**  
= Mobile Source Air Toxic (MSAT) pollution from gasoline emissions, primarily aromatics = Disease and death = Cost in terms of human lives and healthcare  
**= Clear need to improve fuel quality by properly regulating the aromatic content of gasoline**

The U.S. has **4.4%** of the world's population, yet consumes **25%** of the world's oil supply, and owns just **1.5%** of proven reserves.

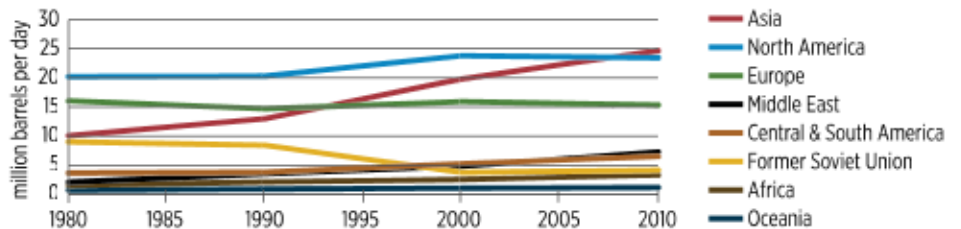
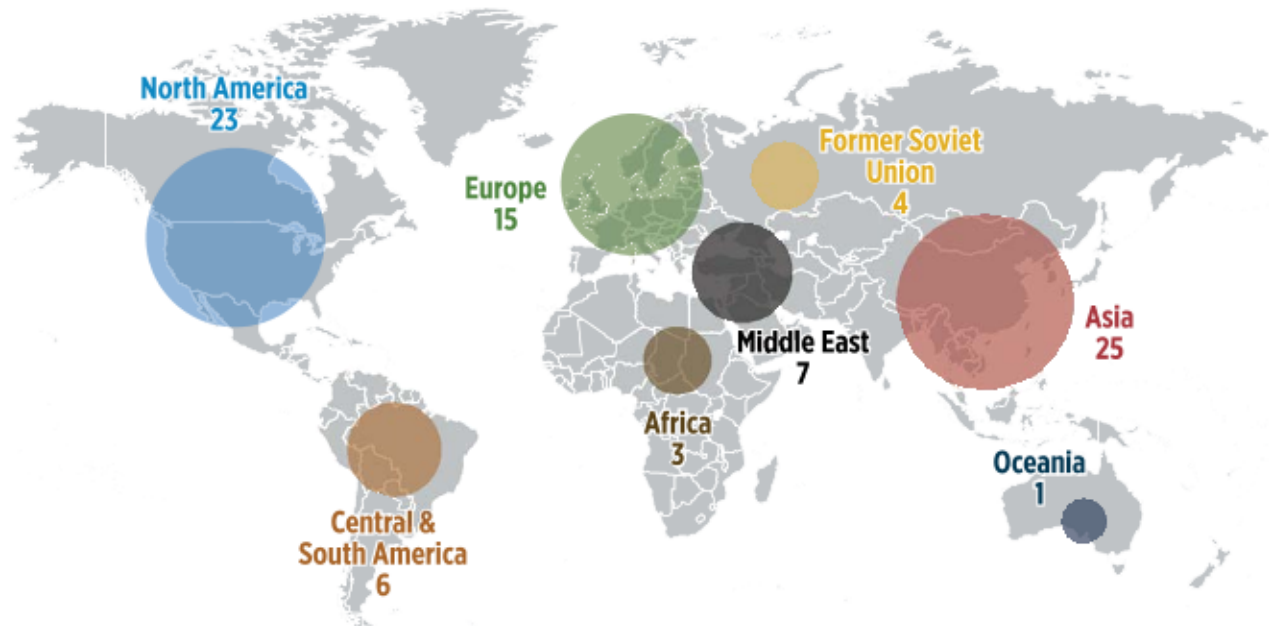
## The U.S. Is a World Leader in Gasoline Consumption<sup>4</sup>

The U.S. has 4.4% of the world's population, consumes 25% of the world's oil supply, and owns 1.5% of proven reserves. Other emerging democracies will try to replicate our petroleum and personal vehicle driven economy.

The U.S. relies on petroleum for 98% of transportation needs. Transportation accounts for 70% of total U.S. oil consumption and 65% of that total is personal vehicles using gasoline.

In 2017 the U.S. imported 25% of its oil needs from OPEC at a cost of about \$60 billion. The U.S. consumes about 140 billion gallons of gasoline that contain 31 billion gallons of aromatics. Several billion gallons are still benzene and billions more are benzene derivatives. The 14 billion gallons of ethanol used to comply with the U.S. Renewable Fuel Standard (RFS) have displaced what would have been another 8 billion gallons of aromatics. — DOE/EIA, CFDC

### WORLD GASOLINE CONSUMPTION BY REGION 1980-2010

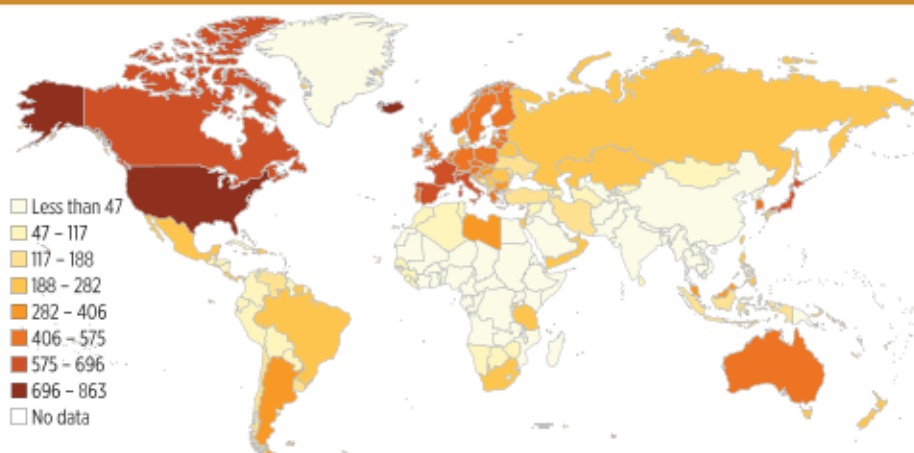


Source: U.S. Energy Information Administration, *International Energy Statistics*

## The U.S. Is the World Leader in Cars Per Capita<sup>5</sup>

Personal vehicles fuel the nation's economy and standard of living. The U.S. leads the world with 829 vehicles per thousand people, which explains the leadership in world oil consumption.

### WORLDWIDE TOTAL MOTOR VEHICLES per 1,000 people

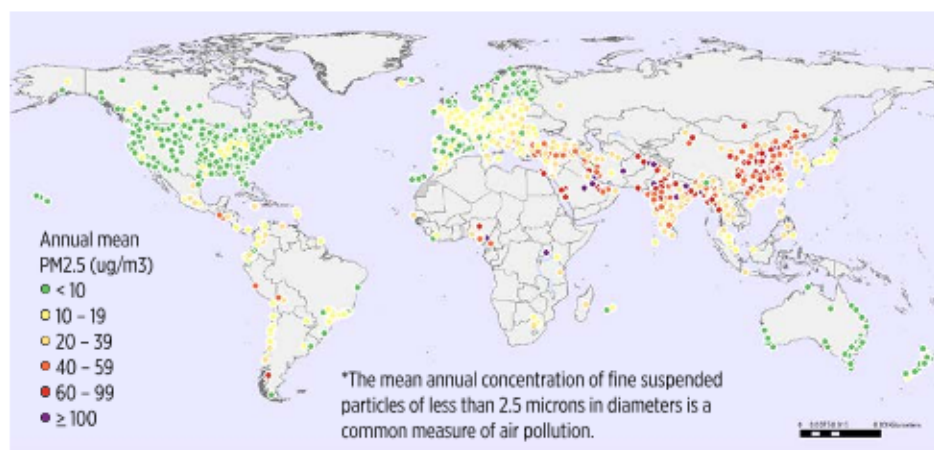


## The U.S. Is a World Leader in Fine & Ultrafine Particulate Matter Pollution (UFP)<sup>6</sup>

Globally, the major source for urban outdoor UFP concentrations is vehicles/motor fuel/traffic.<sup>7</sup>

Particulate matter (PM) air pollution is like lead pollution and is fueled by the aromatic/benzene/BTEX content of gasoline.<sup>8</sup>

### CONCENTRATION OF PARTICULATE MATTER PM<sub>2.5</sub> or less



Source: World Health Organization  
©WHO 2016 All rights reserved.

“There is **no safe exposure** threshold for benzene. Research also shows no safe threshold for air pollution—even at levels far below current standards, including in the rural areas.”<sup>9</sup>

*Death Rates Among People Over 65 Higher in Regions with More Fine Particulate Air Pollution – Medicare in New England Study, Harvard T.H. Chan School of Public Health, June 2015*



Writing for the *Physicians for Social Responsibility*, Dr. Doug Brugge from Tufts University School of Medicine said:

“Most Americans are unaware that particulate pollution is the **single most deadly pollution** they face... nor is there much awareness that existing regulations are inadequate...the smaller the tiny airborne particles are the more toxic they become.”<sup>12</sup>

## The U.S. is a World Leader in Lung Cancer Deaths<sup>10</sup>

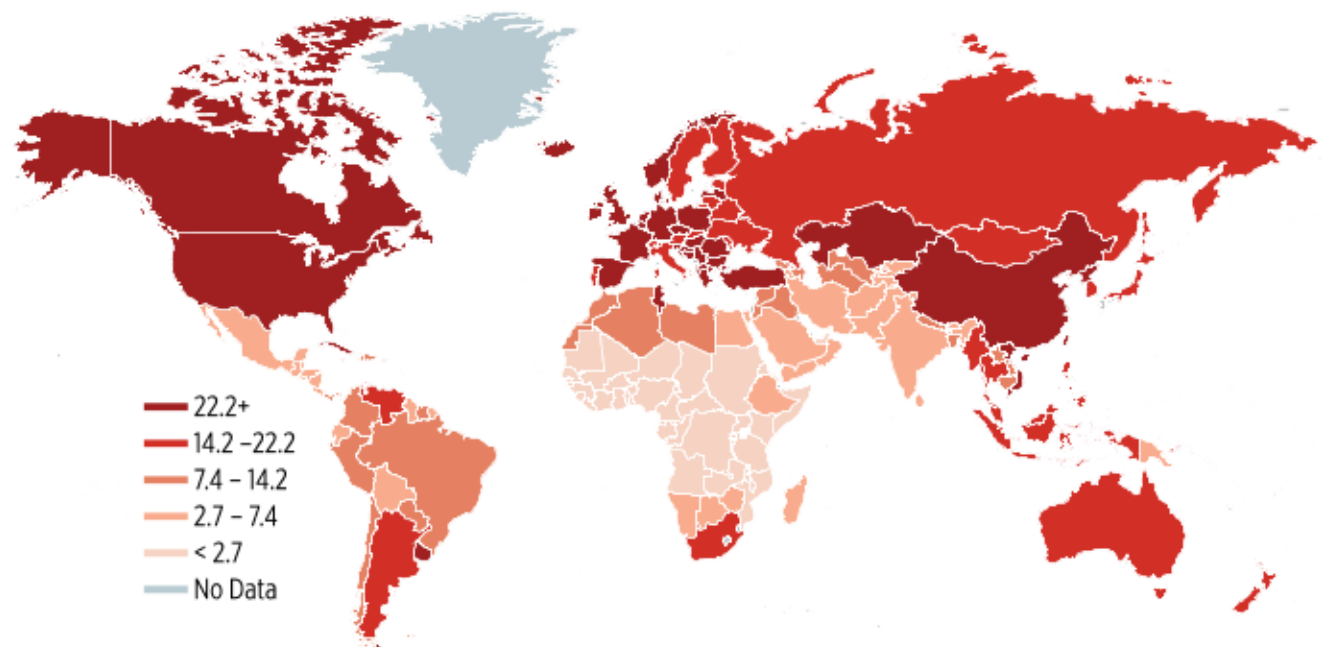
Research estimates that 90% of lung cancers can be attributed to smoking. Research also shows that two primary carcinogens in tobacco smoke are nitrosamines and polycyclic aromatic hydrocarbons (PAH), and that cigarette smoke also contains benzene, toluene, and formaldehyde.<sup>11</sup>

This Fact Book research also shows there are significant PAH, benzene, toluene, and formaldehyde emissions in the toxic soup of mobile source air toxics (MSATs) caused by burning aromatics/BTEX that are added to or produced in the process of making gasoline.

Seven of the top ten causes of death in the United States can also be attributed/connected to the emissions from gasoline. See Section IV.

### LUNG CANCER

Mortality rate per 100,000 – both sexes



## An Historical Assessment of Fuel Quality Concerns

### Congress and the Clean Air Act Amendments

The 1990 Clean Air Act Amendments (CAAA) addressed a range of critical pollution issues, but none more important than the mobile source motor fuel provisions.

As lead used for octane was being phased out of gasoline, it was known that likely alternatives included toxic compounds called aromatics. Congress preferred—and identified—clean-burning alcohols as an octane enhancer.

It is absolutely critical to recognize Congress had made its own endangerment finding and **addressing toxics was not an option but an order**. This action transcended partisan politics: Bill Richardson, a Democrat from New Mexico, Ed Madigan, a Republican from Illinois, and Henry Waxman, a Democrat from California, worked across the aisle and Congressional intent was clear in directing EPA: *Get this stuff out of gasoline!*

### U.S. Senate also warned EPA of the dangers of gasoline emissions

Specifically, section 202(l) of the Clean Air Act Amendments of 1990 (CAAA) directs the U.S. Environmental Protection Agency (EPA) to continually reduce toxics in gasoline as new technologies became available.

The ever increasing volumes of ethanol, coupled with continually improving vehicle technology, provide the tools to reduce the toxic and carcinogenic compounds in gasoline—but levels of these compounds remain dangerously high.

Areas of the U.S. under federal fuel requirements called Reformulated Gasoline (RFG) are subject to benzene controls of 1.0% volume; but the remaining aromatic compounds actually form benzene through tailpipe emissions.

Areas outside of the RFG requirements have been found to contain benzene levels of 3-4%. It bears repeating that, as far back as 1989, these dangers were understood by the medical community.

**“Gasoline can, and must be made cleaner.** The toxic and aromatic compounds can be replaced with much cleaner alcohols.”<sup>13</sup>

– U.S. House of Representatives, *Dear Colleague Letter*, Henry Waxman, Bill Richardson, Ed Madigan et al, **May 1990**

“Aromatic hydrocarbons in gasoline include benzene, toluene, and xylene (BTEX). Benzene is a known carcinogen, one of the worst air toxics. 85% of all benzene in the air we breathe comes from motor vehicle exhaust. Xylene from automobile exhaust in the morning rush hour will form ozone [smog] in sunlight to choke our lungs by the afternoon trip home. Toluene, another aromatic, usually forms benzene during the combustion process and thus becomes carcinogenic along with benzene in the gasoline.”<sup>14</sup>

–U.S. Senator Tom Harkin (D-IA) *Congressional Record*, 101st Congress, *Clean Air Act Amendment: Amendment No. 1423 to Amendment No. 1293*. Note: All aromatics are benzene-ringed molecules. Incomplete combustion of aromatics results in higher levels of benzene from the tailpipe.

“Gasoline is more dangerous than ever...benzene is produced by combustion of aromatic hydrocarbons even in benzene free gasoline...Leukemia and brain and other cancers in refinery workers... API suppressed and trivialized the 142% increase in kidney cancer in American males from 1950-1985... it is clear that gasoline, in all phases of production, use and disposal, is a major source of environmental and occupational carcinogens and preventable cancers.”<sup>17</sup>

—Writing in the *Los Angeles Times*,  
Dr. Samuel Epstein, M.D. Professor of  
Environmental Medicine, University of  
Illinois College of Medicine, **March 17,**  
**1989**

Despite the dire warnings from the medical community, the unambiguous directives from Congress—and just plain common sense—the problem has only worsened:

- From 1990 to today U.S. gasoline consumption has increased from 100 billion gallons to 140 billion gallons per year.
- In spite of the warning and directives from Congress, toxic/carcinogenic aromatic/BTEX related compounds still account for about 25% to 30% of the content in gasoline.<sup>15</sup>
- In 2018, an estimated 1.7 million new cases of cancer will be diagnosed and 609,640 people will die. Estimated national expenditures for cancer care in the United States in 2017 were \$147.3 billion. Globally, the number of new cancer cases per year is expected to rise to 23.6 million by 2030.
- Research links air pollution to autism. The latest estimate of autism prevalence—1 in 68—is up 30% (from the 1 in 88 rate reported in 2008), and more than double the 1 in 150 rate in 2000.<sup>16</sup>

Failing to see the connection between gasoline and the threat to public health is negligent on the part of lawmakers, regulators, and public health officials.

Taking a closer look at air pollution and MSATs will lead any reasonable person to the obvious conclusion that petroleum-based motor fuels present a significant health hazard.

### **This is about saving lives.**

While there may be disagreement about carbon dioxide and the impact fossil fuels have on changing the climate, there can be no dispute that air pollution is killing people.

Research regarding death and air pollution goes back to the 1600’s—with the evidence mounting every day that air pollution directly impacts our health.

Similar to the misinformation regarding lead and tobacco, we believe the public has been misled about the present public health dangers of the emissions from gasoline—specifically benzene and aromatics that have been added to gasoline to increase the octane and improve vehicle performance. These toxic and carcinogenic additives increase MSATs, particulate matter (PM), and other pollutants—pollutants which the Environmental Protection Agency acknowledges are a public health risk.

## 7 of the Top 10 Causes of Death Are Connected to Air Pollution and the Emissions from Aromatics in Gasoline

Nearly 75% of all deaths in the U.S. are attributed to just ten causes, with the top three of these accounting for over 50% of all deaths.

This Fact Book links seven of the top ten causes of death in the U.S. to the harmful health effects of air pollution, including emissions from gasoline.

According to the Massachusetts Institute of Technology, there are about 200,000 premature deaths annually from air pollution—and 53,000 can be attributed to transportation.

Based on new science and measuring equipment, CFDC believes the death and disease estimates from transportation are low. We believe EPA needs to place more emphasis on MSATs research, monitoring, health effects, and enforcing existing CAAA regulations to restrict the aromatic content in gasoline.

This truly is a matter of life and death.

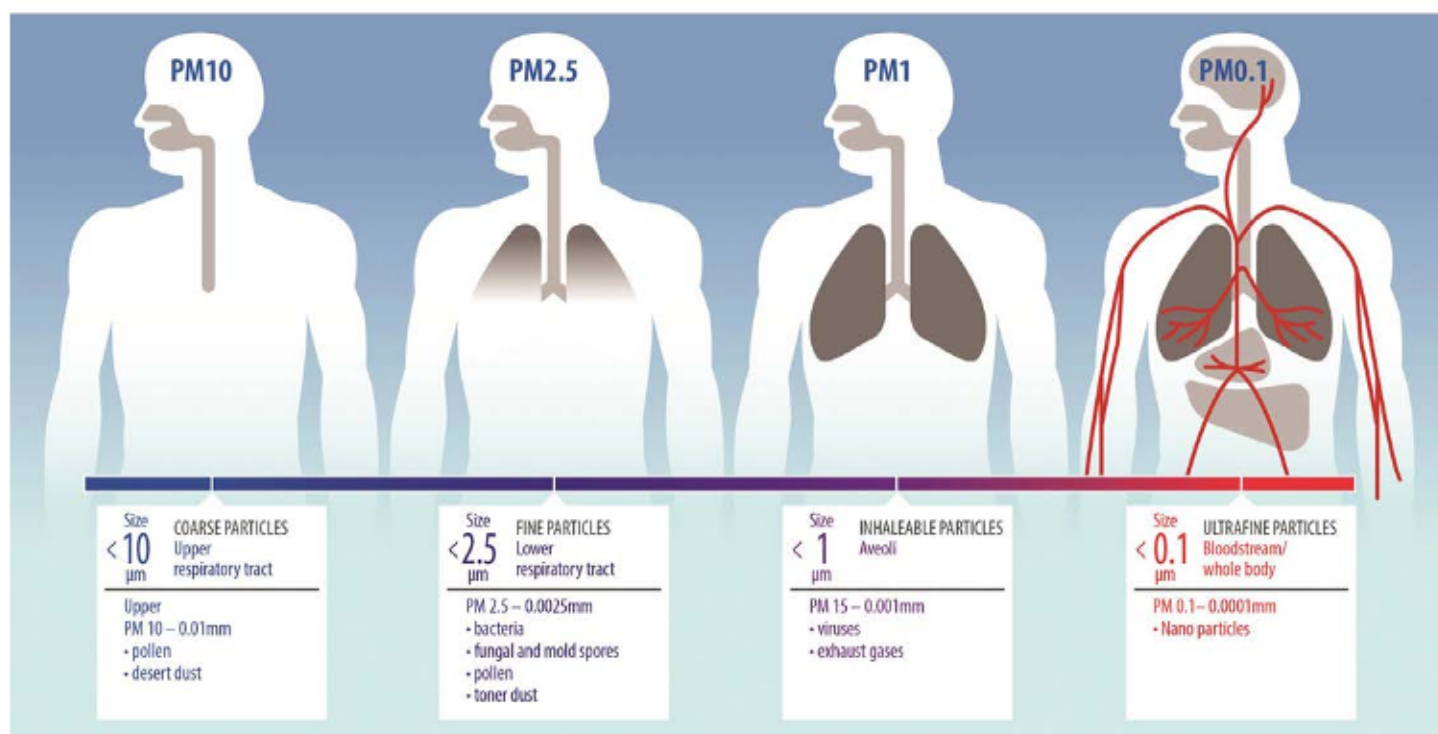
### Top Causes of Annual Deaths in the United States

(7 out of 10 causes are related to health effects of air pollution)

1. Heart Disease: 614,348 deaths
2. Cancer: 591,699
3. Respiratory disease/COPD: 147,101 deaths
4. Accidental: 136,053 deaths
5. Stroke: 133,033 deaths
6. Alzheimer's: 93,541 deaths
7. Diabetes: 76,488 deaths
8. Influenza and pneumonia: 55,227 deaths
9. Kidney Disease: 48,146 deaths
10. Suicide: 42,773 deaths

*Note: Does not count birth defects, climate change, or deaths from conflicts/wars to protect U.S. and world oil supplies.*

## PENETRATION OF PARTICLES INTO THE BODY (THE SMALLER THE PARTICLE, THE MORE DANGEROUS THEY ARE)



## The Breathtaking Economic Cost of Air Pollution

This is not only a national public health crisis on the same level as the tragic opioid epidemic, it's a tremendous economic issue that drains limited resources on a global scale.

- According to a World Bank report, air pollution costs the global economy more than \$5 trillion annually in welfare costs, with the most devastating damage occurring in the developing world. Only considering lost income, air pollution costs the global economy \$225 billion annually.<sup>18</sup>
- According to the World Health Organization (WHO), the annual economic cost of premature deaths from air pollution across the countries of the WHO European Region stood at US \$1.431 trillion; and the overall annual economic cost of health impacts and mortality from air pollution, including estimates for morbidity costs, stood at US \$1.575 trillion.<sup>19</sup>



## Sickness, Disease and Death Death-By-Breath

In compiling the research for this publication, it became clear there is an urgent need to address the impact of particulate matter (PM) and toxics on human health. There is a critical need to increase measuring, monitoring, and regulating the smaller ultrafine/nano PM (PM<sub>1</sub>).

Size matters significantly when you consider particulates. Coal plants and diesel fuel produce the most common particulates at PM<sub>10</sub> and PM<sub>2.5</sub>. Ultrafine particles are smaller, more dangerous, potent, toxic, and cell reactive—and they enter the bloodstream and organs.

- WHO links air pollution to the epidemic of non-communicable diseases such as heart disease, stroke, lung disease, and cancers—among the top five causes of death, or 25-33% of deaths from these diseases are due to air pollution. — *World Health Organization (WHO), September 12, 2017*
- More than 90% of the world's population breathes in air that violates air quality guidelines set by the WHO<sup>21</sup>, increasing their risk of lung cancer and respiratory infections, but also conditions including stroke, cardiovascular disease, and chronic obstructive pulmonary disease.<sup>22</sup> The situation has reached a tipping point, despite efforts to curb the issue — *Sumita Khatri, co-director of the Asthma Center at the Cleveland Clinic*.
- Air pollution has become the world's single biggest environmental health risk, linked to around seven million—or nearly one in eight deaths in 2012—according to the World Health Organization (WHO). These new figures are more than double previous estimates and suggest air pollution kills more people than smoking, road deaths and diabetes combined.<sup>23</sup>



**More people die from just breathing air than from smoking cigarettes.**

Each day we eat 1 kg of food, drink 2 kg of water and breathe 20 kg of air. Environmental inequality and air pollution is a global pandemic that affects everyone but **we usually ignore it because we can't actually "see" it.**<sup>20</sup>

**About 50% of the air pollution in the U.S. is attributed to mobile sources** (i.e., transportation). Therefore, a portion of the cost of negative public health effects should be attributed accordingly to emissions from gasoline.

“According to EPA, in the United States alone, there are 45 million people living, working or attending school within 300 feet of a major road, airport, or railroad.”

— *The Environmental and Energy Study Institute*

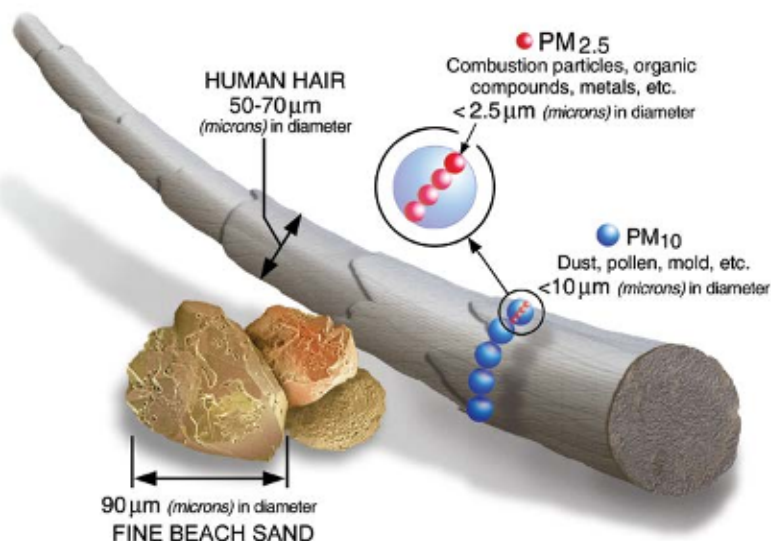
- Each year in the UK, around 40,000 deaths are attributable to exposure to outdoor air pollution which plays a role in many of the major health challenges of our day. It has been linked to cancer, asthma, stroke and heart disease, diabetes, obesity, and changes linked to dementia.<sup>24</sup>
- More than 80% percent of people living in cities are breathing unsafe air. Urban air pollution has nearly doubled in 3,000 cities over the past two years. Cities with populations over 100,000 have air pollution levels that do not meet WHO guidelines. A reduction in air pollutants could lessen deaths from particulate matter by 15%.<sup>25</sup> — *WHO: 80% of Urban Residents Breathe Unsafe Air.*

### Where you live really matters

The American Lung Association’s Annual “State of the Air”<sup>26</sup> Report revealed 125 million Americans live in counties with unhealthy levels of either ozone or particle pollution.<sup>26</sup>

The highest exposure to pollution you are likely to experience is in your car. If you live within a mile of<sup>27</sup> a major roadway, you are exposed to up to 10 times higher pollution levels in your car when compared to U.S. EPA’s air monitor data that comes from higher air levels.<sup>28</sup>

### Particulate Matter Should Not Be Considered Equal: Size Matters



Particulate matter in air pollution is the same particle size as designed by doctors to get the medicine in inhalers and nebulizers into the bloodstream through the lungs. This means, roughly, about one-thirtieth the size of a human hair. PM<sub>2.5</sub> is so dangerous because the particles are small enough to penetrate into the deepest part of the lungs. This, in turn, means they are directly linked to asthma, bronchitis, and chronic respiratory illness. Scientists have also linked PM<sub>2.5</sub> to low birth weight babies, heart disease, some cancers, and premature deaths in elderly people.<sup>29</sup>

# Mobile Source Air Toxic Pollution and its Connection to Public Health

## SECTION IV(a)

### Linking Air Pollution → to Mobile Sources → to Gasoline → to Aromatics → to Benzene and traffic related emissions → to the Impact on Public Health

The Health Effects Institute has acknowledged the distinctions between gasoline and diesel exhaust. “Typically, gasoline UFPs (ultrafine particles) contain a higher fraction of heavy polycyclic aromatic hydrocarbons (PAHs) than diesel exhaust (DE) which may have implications for the differential toxicity of these particles...” HEI Study on Ultrafine Particulates, Feb. 2013, p. 21.<sup>1</sup>

### Gasoline, MSATs, Traffic and Your Health

About 50% of the air pollution inventory in the U.S. was divided between stationary sources (e.g., electricity generation and manufacturing) and mobile sources (i.e., transportation). There is an emerging and critical link between the generic term of “Air Pollution” vs. the new and mounting information and science surrounding fine, ultrafine, and nano particulate matter PM<sub>1</sub> and MSATs found in “Air Pollution”—especially those generated from gasoline, specifically aromatics, and emphatically BTEX.

New research shows that PM<sub>1</sub>, air toxics and secondary precursors to ozone such as secondary organic aerosol (SOA) formation from the photo oxidation of polycyclic aromatic hydrocarbons (PAHs), which EPA does not measure or regulate, have even more dramatic health consequences when compared to “air pollution” which historically has been focused on diesel fuel and stationary sources (e.g., electricity generation and manufacturing) and NOT gasoline.

The emissions from gasoline are microscopic particles that defy air filters and can by-pass the lungs and directly enter the bloodstream. It is for this reason the linkage to neurological ailments is now understood.

**Fossil Fuel Combustion Threatens Children’s Health**<sup>2</sup> — “The single most important action we can take for our children and their future is to cure our addiction to fossil fuels. It is the root cause of much of the ill health and developmental impairment of today’s children and their highly uncertain future. The multiple toxic effects of emitted pollutants, polycyclic aromatic hydrocarbons (PAH), particles (PM), sulfur oxides, nitrogen oxides, metals and the broad health impacts of global climate change are attributable in large part to carbon dioxide released by fossil fuel burning.<sup>3</sup> Because of their inherent biological vulnerability, children now bear a disproportionate burden of disease from both pollution and climate change.” — *Dr. Frederica Perera, Ph.D., Director Columbia Center for Children’s Environmental Health.*

“Traffic-related air pollution is a main contributor to unhealthy ambient air quality, particularly in urban areas with high traffic volume. Motor vehicle emissions represent a complex mixture of criteria air pollutants, including carbon monoxide (CO), nitrogen oxides (NO<sub>x</sub>), and particulate matter (PM), as well as hydrocarbons that react with NO<sub>x</sub> and sunlight to form ground-level ozone. Individually, each of these pollutants is a known or suspected cause of adverse health effects. Taking into consideration the entire body of evidence on primary traffic emissions, a recent review determined that there is sufficient evidence of a causal association between exposure to traffic-related air pollution and asthma exacerbation and suggestive evidence of a causal association for onset of childhood asthma, non-asthma respiratory symptoms, impaired lung function, all-cause mortality, cardiovascular mortality, and cardiovascular morbidity.”<sup>4</sup>

—*Center for Disease Control, Agency for Toxic Substances and Disease Registry at [atsdr.cdc.gov](http://atsdr.cdc.gov) November 2013*



**Premature Deaths in the European Union** EU Transport Commissioner Violeta Bulc has said motorists should start to pay a great deal more to mitigate the damage they cause to the environment...Bulc said there were 50,000 premature deaths in the EU due to transport emissions. — *Forbes*, January 24, 2019

### Additional Research

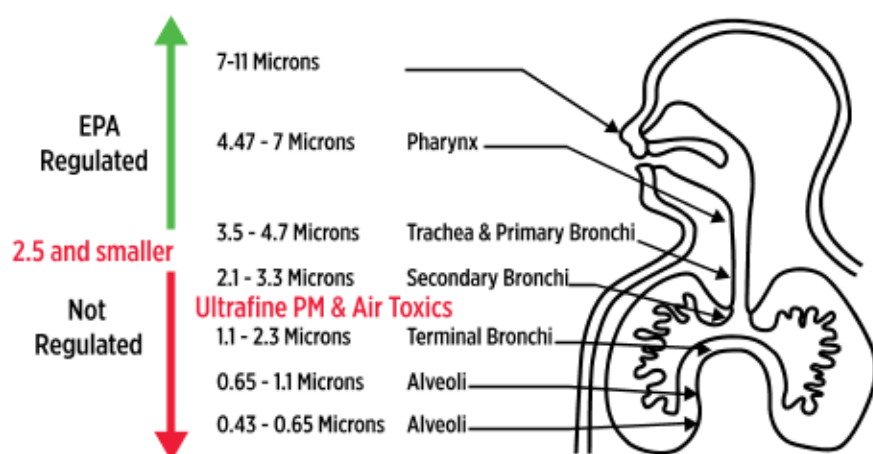
- Stuck in traffic jams for long? It may increase risk of cancer.<sup>5</sup> — *WHO study*, August 2017.
- Personal Exposures to Traffic-Related Air Pollution and Acute Respiratory Health among Bronx Schoolchildren with Asthma.<sup>6</sup> (53 Studies Cited) *Nelson Institute of Environmental Medicine, New York University School of Medicine*.
- Near-highway pollutants in motor vehicle exhaust: A review of epidemiologic evidence of cardiac and pulmonary health risks.<sup>7</sup> *Tufts Study (101 studies cited)*, August 9, 2007.
- At least 8 percent of the more than 300,000 cases of childhood asthma in Los Angeles County can be attributed to traffic-related pollution at homes within 75 meters (a little less than 250 feet) of a busy roadway.<sup>8</sup>— Near-roadway air pollution a major contributor to asthma in Los Angeles County. *University of Southern California (USC). Environmental Health Perspectives*, Sept. 24, 2012.
- Stoplights are hot spots for airborne pollution.<sup>9</sup> — *Kate Baggaley, Science News*, February 12, 2015.



## Mobile Source Air Toxics (MSATs)

**Mobile source air toxics (MSAT) are measured by EPA.**<sup>10</sup> These MSATs include benzene (a proven carcinogen) and other hydrocarbons, 1,3-butadiene, formaldehyde, acetaldehyde, acrolein, and naphthalene. The problem is this category does not include other ultrafine emissions related to gasoline exhaust and emissions you breathe. These additional pollution components are diesel particulate matter, emissions from unburned octane enhancers toluene and xylene, and Polycyclic aromatic hydrocarbons (i.e., PAH which is similar to tobacco smoke) and Secondary Organic Aerosols (SOAs) a major component of fine particle pollution (PM<sub>2.5</sub> and PM<sub>10</sub>). Motor vehicle emissions account for around 46–90% of the mass of individual PAHs in ambient air particles in urban areas.<sup>11</sup>

### Deposition potential for particles of varying sizes



- The chemicals [i.e., aromatics in gasoline] — benzene, toluene, ethylbenzene and xylene [MSAT]...have been linked to reproductive, respiratory and heart problems, as well as smaller babies. Health impacts may be due to the chemicals' ability to interfere with people's hormones at low exposure levels.<sup>12</sup> — *New Look at BTEX: Are Ambient Levels a Problem? – The Endocrine Disruption Exchange, Dept. of Integrative Physiology, Univ. of Colorado Boulder.*
- Leukemia, or cancer of the blood cells, is the most common cancer among children younger than age 15.<sup>13</sup> — *U.S. National Cancer Institute.*

“The evidence seems to be pointing toward an association between traffic emissions and childhood leukemia.”<sup>14</sup>

—*Benzene in traffic emissions tied to childhood leukemia – Institute National de la Santé et de la Recherche Medical (INSERM) based in Paris.*

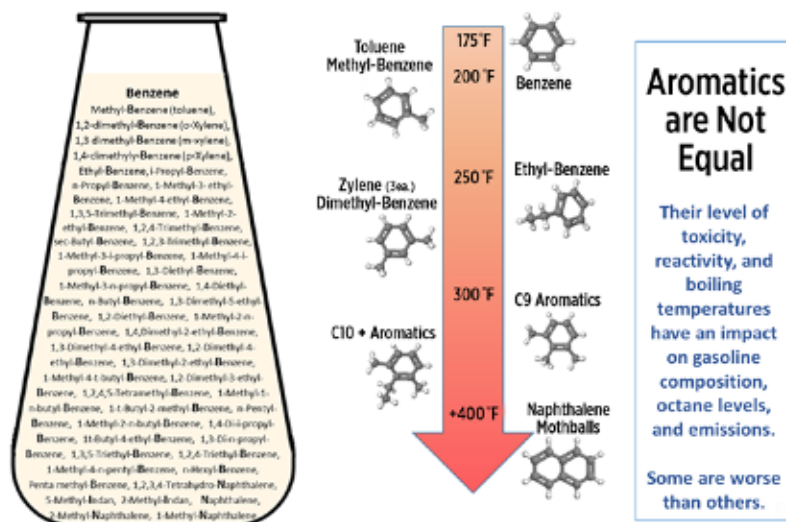
“Since the mid-1990s...all ‘criteria’ air pollutants have been linked to birth outcomes. Our own studies found most consistent associations for carbon monoxide and particles (PM). Traffic exhaust toxins are possible causative agents, but air monitoring data relied on by almost all existing studies inadequately capture their intracommunity variability in concentrations.”<sup>15</sup>

—*School of Public Health, University of California, 2008*

## Aromatics in Gasoline Cause Negative Health Effects

**Growing Chorus of Complaints on Chemicals in Gasoline**<sup>16</sup> - "Aromatics in gasoline are the new lead," said Carol Werner, executive director of the Environmental and Energy Study Institute, a Washington-based group that advances policy solutions for clean and sustainable energy. The general scientific community agrees that benzene, a known carcinogen, is the most hazardous. - April 22, 2015.

### Aromatics: Welcome to the Benzene Family of Hydrocarbons



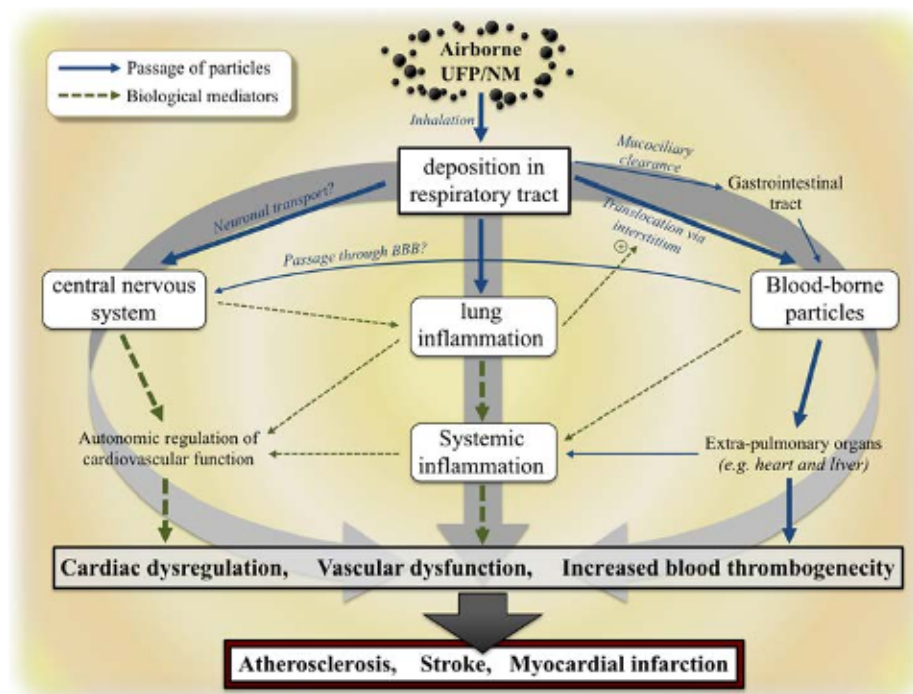
### From Womb-to-Tomb

Tobacco and leaded gasoline share a similar and shameless history of sickness, disease, death, and misinformation with aromatics. Considering a large portion of policy makers and consumers want to protect the life of the unborn—this effort should start with protecting the pregnant mother from exposure to MSAT pollution from gasoline and benzene. These harmful health effects are generally life-long, creating a long-term price impact on the personal health care pool and government subsidized health care costs.

The following research illustrates why there is growing concern over the negative health effects of air pollution (which MSATs are part of) on:

- Pregnancy, fetal development, and children
- Lungs and Cancer
- Hearts and Heart Attacks
- Autism
- The Brain
- Diabetes, Kidney Disease and Efficacy of Antibiotics
- The Elderly
- Death and Taxes
- Greenhouse gases from oil production, refining, and the war on terrorism to protect oil supplies?

## What Happens When You Breathe Ultrafine PM



Schematic illustrating some of the key mechanisms through which inhaled ultrafine particles (UFPs) may influence secondary organs and systemic tissues, with emphasis on the means through which inhaled particles may cause cardiovascular events. Note that there are three main pathways linking the pulmonary and cardiovascular systems (grey arrows, left to right): autonomic regulation, passage of inflammatory mediators, and particle translocation. The arrows between these three pathways highlight the degree of interaction between mechanistic pathways and the challenges involved in broad categorization of the wide-ranging biological actions of inhaled UFPs. Added to these pathways is the potential for desorbed components to exert effects.

Source: Nanomaterials Versus Ambient Ultrafine Particles: An Opportunity to Exchange Toxicology Knowledge. Environmental Perspectives, October 10, 2017 <https://ehp.niehs.nih.gov/ehp424/#tab2>

“Sixty-two studies met the following inclusion criteria. There is a clear association between  $PM_{2.5}$  exposure throughout pregnancy and risks of preterm birth and term low birth weight, further supporting the hypothesis that  $PM_{2.5}$  exposure increases the risk of adverse birth outcomes.”<sup>6, 7, 8</sup>

## Health Effects of Air Pollution & MSATs: Pregnancy, the Unborn, and Children

### Birth Defects and other Long-Term Diseases With Life-Long Impacts

Public health is a sector with high cost and long term implications. This is also an area that involves significant government support due to the economic situation of a large number of families—many of whom are affected by urban air quality.<sup>1,2,3</sup>

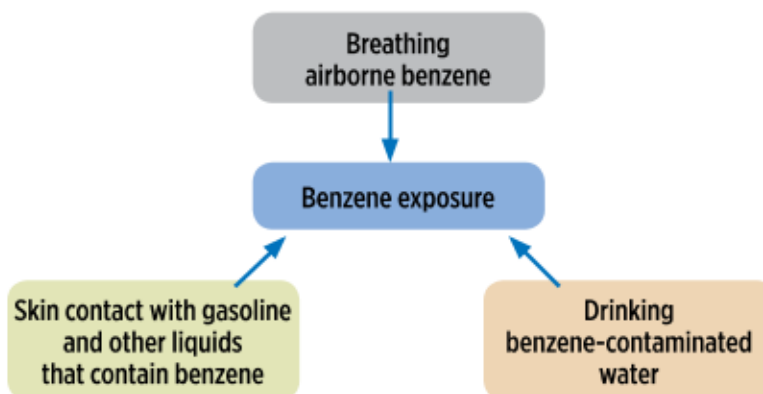
**There is no doubt that air pollution can affect the fetus**, either indirectly through the health of the mother or directly by affecting developing fetal organs and systems.

### Premature Birth and Low Birth Weight & Long-term Illness and Disease

“Get as far away from the roadsides as possible. The mother is responsible for the child’s circulations while it is in the womb. What the mother eats and breathes is translated through these membranes into the growing fetus. Therefore, the unborn child is very vulnerable... Low growth rates in the womb are a major hazard for future health. Pollution causes inflammation which is the body’s response to an insult and the body mobilizes its immune defense...These problems manifest at different ages into chronic diseases.”<sup>4,5</sup>



### How does exposure to benzene occur?



- During pregnancy, benzene can pass from the mother to the baby.

Source: CA.gov

**Birth Defects** - “Air pollution in pregnancy influences postnatal lung development and respiratory health. Air pollution in pregnancy leads to adverse birth effects.<sup>6</sup>

**Low Birth Weight** -“(45 Studies Cited) Exposure to fine particles (PM<sub>2.5</sub>) during pregnancy has been linked to lower birth weight.”<sup>7</sup>- *Prenatal Exposure to Fine Particulate Matter and Birth Weight*.<sup>8</sup> Yale University, School of Forestry and Environmental Studies, Yale University, School of Medicine, Harvard School of Public Health.

**Brain Development** - <sup>9</sup>Studies confirm the notion that pollution coming from fossil fuels, such as gasoline and coal, can inflict lasting damage on the human brain development, especially in fetuses, babies and toddlers. Study concludes exposure to polycyclic aromatic hydrocarbons (PAH), a residue of fossil fuel combustion, is correlated to the reduction of white matter in the brain. Those disturbances in brains...include attention deficit disorder and hyperactivity (ADD and ADHD), typical symptoms of impulsive children and children with learning problems.<sup>9</sup>

**Brain Development** - Exposure to high levels of environmental toxicants during pregnancy might interfere with normal in utero processes of brain development. PM<sub>2.5</sub>, and especially ultrafine particles (<0.1µm in diameter) were shown to penetrate the subcellular environment and induce strong oxidative stress and mitochondrial damage in vitro. These effects were associated with the organic carbon and polycyclic aromatic hydrocarbon (PAH) contents of the particles.<sup>10</sup>

**Brain Development** - “The results suggest that exposure to PAH encountered in New York City air may play a role in childhood Attention Deficit Hyperactivity Disorder behavior problems. Polycyclic aromatic hydrocarbons (PAH) are widespread urban air pollutants from combustion of fossil fuel and other organic material shown previously to be neurotoxic.”<sup>11</sup> — *Early-Life Exposure to Polycyclic Aromatic Hydrocarbons and ADHD Behavior Problems*, November, 5, 2014, Dr. Frederica P.

**Brain Development** - “If confirmed, our findings have important public health implications given the ubiquity of PAHs in air pollutants among the general population. Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous and neurotoxic environmental contaminants. Prenatal PAH exposure is associated with subsequent cognitive and behavioral disturbances in childhood.”<sup>12</sup>— *Effects of Prenatal Exposure to Air Pollutants (Polycyclic Aromatic Hydrocarbons) on the Development of Brain White Matter, Cognition, and Behavior in Later Childhood*<sup>13</sup> - *American Medical Association, Institute for the Developing Mind, Children’s Hospital Los Angeles, January 19, 2015. See Related Story: Air pollution takes a double toll on babies’ brains.*<sup>14</sup>

**Heart Disease (later in life)** - Recent evidence suggests that in utero exposure to PM<sub>2.5</sub> or less affects normal fetal development in humans. David Barker introduced the concept that early-life stress contributes to later illness...cardiovascular disease later in life... diseases of the central nervous system of the fetal brain are vulnerable processes that may be disturbed by toxic insults and potentially by in utero exposures to air pollution.<sup>15</sup>

**Cancer** - “Our data suggest that in utero and infancy exposures to air toxics generated by industrial and road traffic sources may increase the risk of PNET.” — *In Utero and Early-Life Exposure to Ambient Air Toxics and Childhood Brain Tumors: A Population-Based Case-Control Study in California, USA.*<sup>16</sup>

**Cancer** — “Our data suggest that in utero and infancy, exposures to **air toxics generated by industrial and road traffic sources may increase the risk of PNET.**” — *In Utero and Early-Life Exposure to Ambient Air Toxics and Childhood Brain Tumors: A Population-Based Case — Control Study in California, USA.*

**Asthma** - “Children whose mothers lived near freeways during their pregnancy carried the highest risks for asthma at 25 percent. Moreover, babies who were born premature had the highest risk. Our study results highlight the importance of exposure to pollution while babies are still in the womb.”<sup>17</sup> - Exposure To Air Pollution During Pregnancy Ups Asthma Risk In Babies<sup>18</sup> - *University of British Columbia, European Respiratory Journal, December 2015*. See Related Story: Air pollution increases the odds of incident asthma from 0 to 5 years, especially in low-term-birthweight children.<sup>19</sup>

**Asthma & Genetic Changes** - The prevalence of respiratory and allergic diseases in early childhood has been rising globally, which is unlikely to be attributable to genetic changes only...Traffic-related air pollution (TRAP) is known to worsen existing respiratory disease...childhood exposure to Traffic Related Air Pollution (TRAP) contributes to their development of asthma.<sup>20</sup>

**Asthma** - Over a period of four years, that is a significant deficit in lung function compared with kids growing up in low-pollution neighborhoods.<sup>21</sup> Air pollution has an impact with children with asthma too.<sup>22</sup> See Related Story: Air pollution linked to asthma in children and teens.<sup>23</sup> For more information.<sup>24</sup>

**Mental Illness** - Air pollution linked to increased mental illness in children<sup>25</sup> - Swedish Study, 2016, (The Guardian Association between neighborhood air pollution concentrations and dispensed medication for psychiatric disorders in a large longitudinal cohort of Swedish children and adolescents.<sup>26</sup>) *BMJ Open Journal*.

**Allergies** - “Children who are exposed to outdoor air pollution during their first year of life are more likely to develop allergies to food, mold, pets and pests. Sensitivity to allergens was associated with exposure to traffic-related air pollution during infancy.”<sup>27</sup> - *Babies Exposed To Air Pollution May Have A Higher Risk Of Developing Allergies, BC Canada study*.

**Food & Other Allergies (Atopy)** - “Using refined exposure estimates that incorporated temporal variability and residential mobility, we found that traffic-related air pollution during the first year of life was associated with atopy.” (allergic rhinitis<sup>28</sup>, asthma<sup>29</sup> and atopic dermatitis eczema<sup>30</sup>) - *Perinatal Exposure to Traffic-Related Air Pollution and Atopy at 1 Year of Age in a Multi-Center Canadian Birth Cohort Study School of Population and Public Health<sup>31</sup>, University of British Columbia, March 2015*.

**Sudden Infant Death** - “Nine studies have evaluated the association between exposure to air pollution and the incidence of SIDS (especially particles and some gaseous pollutants).” - *Air pollution and sudden infant death syndrome: a literature review.<sup>32</sup> School of Public Health, Queensland University of Technology*.

**Sudden Infant Death** - “Our results add to the growing body of literature implicating air pollution in infant death from respiratory causes and sudden infant death syndrome and provide additional information for future risk assessment.”<sup>33</sup> - *Air pollution and infant death in southern California, 1989-2000. Department of Epidemiology, School of Public Health, University of California*.

## Health Effects of Air Pollution & MSATs: Lungs and Cancer

**Breast Cancer** - A major U.S. Study found Higher Air Pollution exposure was linked to denser breast tissue and that women with high breast density were 20% more apt to be living in places where fine particulate matter concentrations are higher.<sup>1</sup>



**Lung Disease** - People living in cities with high ozone levels, such as Houston or Los Angeles, had an over 30% increased risk of dying from lung disease.<sup>2</sup> Long-term exposure to [bad] ozone<sup>3</sup> has been shown to increase risk of death from respiratory illness.

**Lung Cancer** - As the pollution levels rise the risk of dying goes up. Studies show definitively that lung cancer increases with the level of exposure to pollution. Long term exposure to air pollution, and especially to fine PM, is associated with the increased risk of mortality. For lung cancer, living in a more polluted city is associated with approximately a 20% increase in residents' risks of dying from lung cancer. This is roughly comparable to the cancer risk of passive smoking exposure from living with a smoker.<sup>4</sup>

**Lung Cancer** - It [air pollution] belongs in the same category as asbestos, tobacco, and ultra violet radiation. More people die from lung cancer than any other type of cancer. In 2010, 233,000 deaths, or about 16%, were attributed to air pollution. "We consider air pollution to be the most important environmental carcinogen, more so than passive smoking."<sup>5</sup> — *Dr. Durt Straif, Section Head October 17, 2013, Pollution Causes Cancer: 1,000 Study Study, International Agency for Research on Cancer, World Health Institute.*

**Asthma Attacks** - "In talks to emergency room doctors about the impact of ozone, particulate matter air pollution and its ability to trigger asthma attacks—follow your air quality index, don't go outdoors and don't exercise."<sup>6</sup> - *Dr. Randy Martin, Nov 16, 2014.*

The Center for Disease Control (CDC) linked childhood leukemia and exposure to high levels of auto exhaust. Children diagnosed with leukemia were 50% more likely to live near busy roads than children without leukemia.



## Health Effects of Air Pollution & MSATs: Hearts and Heart Attacks

**Heart Disease** – “I don’t feel like we need another study to convince us. Now it’s time for action. This work provides the evidence, at least for cardiovascular disease outcomes.” — *Johns Hopkins Bloomberg School of Public Health* See Related Story: Higher levels of air pollution in major urban areas linked to heart attack risks in people 65 and older.<sup>1</sup>



**Heart Attacks** – “Hospital admissions for several cardiovascular and pulmonary diseases acutely increase in response to higher ambient PM concentrations. The existing body of evidence is adequately consistent, coherent, and plausible enough to draw several conclusions...short-term exposure to elevated PM significantly contributes to increased acute cardiovascular mortality, particularly in certain at-risk subsets of the population.”<sup>2</sup> — *American Heart Association*

**Heart Attacks** – Exposure to PM triggers heart attacks. The 1993 “six city study” in the United States showed that risk of dying from cardio respiratory disease increased by 37% in the most polluted compared to the least polluted city in the United States.<sup>2</sup> — See *video for list*.<sup>3</sup>

**Heart Attacks** – “Air pollution is one of the leading causes of heart attacks and death worldwide. This is principally caused by nanoparticles generated by the combustion of fossil fuels and vehicle engine emissions”<sup>3</sup>

**Heart Disease** – “Don’t exercise during rush hour. The air we breathe can be an invisible catalyst to cardiovascular disease.”<sup>4</sup> According to a human study of real world near-road way emissions, *Inhaling a Heart Attack*.<sup>5</sup>

**Heart Disease** – “Those at risk of heart disease are at twice the risk for experiencing a heart attack during bad air days. Air pollution is not just a lung problem, it’s a heart problem.”<sup>6</sup> — *Medical Center Heart Institute*

**Heart Disease** - Ischemic Heart Disease Events Triggered by Short-Term Exposure to Fine Particulate Air Pollution<sup>7</sup>. — *American Heart Association Journal*. December 5, 2006.

**Heart Disease** – There is a link between the pollutants and heart disease deaths even after controlling for more than two dozen other risk factors, including smoking, drinking and exercise.<sup>8</sup> California scientists link tiny particles in car exhaust to heart disease.

## Health Effects of Air Pollution & MSATs: Autism

“UCLA researchers compared levels of air pollutants, mostly related to vehicle traffic, during pregnancy gestation periods of 7,603 children with autism and 75,635 children without autism, born from 1995 to 2006 in Los Angeles.”<sup>1</sup> — *Study Links Autism with Prenatal Exposure to Traffic Pollution. November 2014.*

“Babies who are exposed to lots of traffic-related air pollution in the womb and during their first year of life are more likely to become autistic, suggests a new study. The findings support previous research linking how close children live to freeways with their risk of autism, according to the study’s lead author.”<sup>2</sup> — *Traffic pollution tied to autism risk: study.*

Harvard draws link between autism and air pollution.<sup>3</sup> — *Utah study 2014.*

“Research from the University of Rochester Medical Center describes how exposure to air pollution early in life produces harmful changes in the brains of mice, including an enlargement of part of the brain that is seen in humans who have autism and schizophrenia.”

“Women exposed to air pollution during pregnancy face twice the risk of having an autistic child. One in 68 children is diagnosed with autism according to the Centers for Disease Control.”<sup>4</sup> — *Fine particulate matter and the risk of autism spectrum disorder, Environmental Research.*

“Autism spectrum disorders are lifelong conditions for which there is no cure and limited treatment options, so there is an urgent need to identify any risk factors that we could mitigate, such as pollution.”<sup>5</sup> — *Air pollution may increase autism risk in kids - University of Pittsburgh, School of Public Health.*

“There have now been some six epidemiological studies that have reported associations between air pollution and autism, and two studies that have reported associations between air pollution and schizophrenia.”<sup>6</sup> — *Autism: Something in the Air - University of Rochester.*

**Autism** - “Women who are exposed to high levels of air pollution during their third trimester of pregnancy may be twice as likely to give birth to a child with autism. It’s really the pollution doing it.”<sup>34</sup>  
— *Harvard School of Public Health*

For more information: View videos @ New Evidence Links Air Pollution to Autism, Schizophrenia, Dr. Deborah Cory-Slechta, Professor of Environmental Medicine, University of Rochester Medical Center, June 11, 2014. Study links air pollution to autism, Harvard School of Public Health, Centers for Disease Control, December 19, 2014. [https://www.youtube.com/watch?v=csi8GLmkt\\_g](https://www.youtube.com/watch?v=csi8GLmkt_g) And <https://www.youtube.com/watch?v=UJ-jM8Mmv>, by Andrea Roberts.

## Health Effects of Air Pollution & MSATs: Other Neurological Issues

**Dementia** - The Link Between Road Pollution and Dementia Just Got Stronger.<sup>7</sup> — *Public Health Ontario, January 2017.*

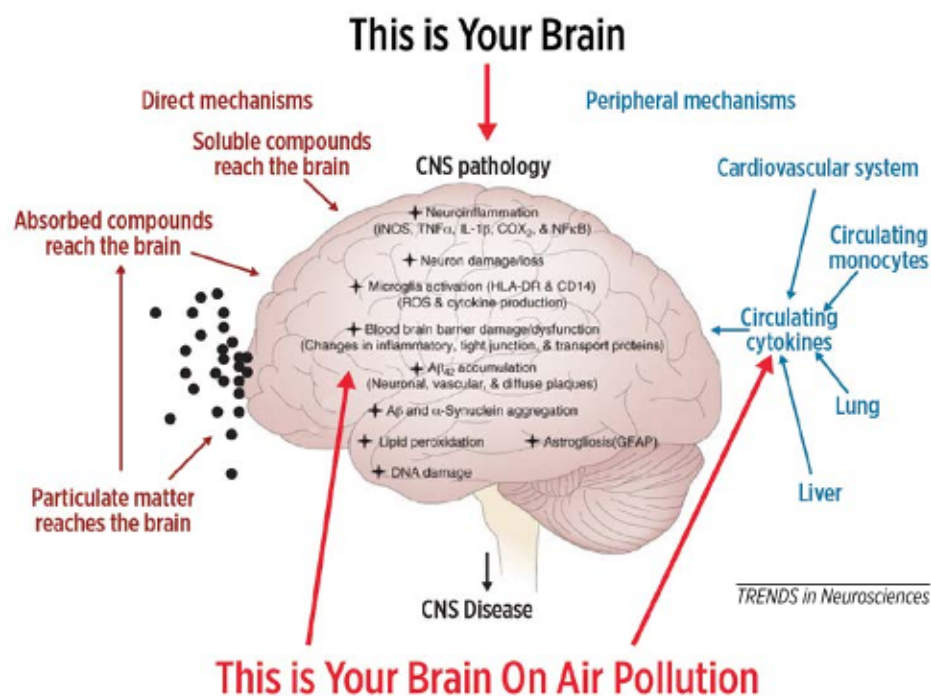
**Alzheimer's** - "Although the link between air pollution and Alzheimer's disease is a new scientific frontier, we now have evidence that air pollution, like tobacco, is dangerous to the aging brain. The study suggests that older women who breathe particles from the polluted air, such as car exhausts fumes, are at twice the risk of developing dementia.<sup>8</sup> — *University of Southern California (USC).*

**Alzheimer's** - Air pollution is a global health crisis that kills more people than malaria and HIV/AIDS<sup>9</sup> combined and it has long been linked to lung and heart disease and strokes. But research is uncovering new impacts on health, including degenerative brain diseases such as Alzheimer's, mental illness<sup>10</sup> and reduced intelligence.<sup>11</sup> - Toxic air pollution particles found in human brains.<sup>12</sup> — *University of Texas/Lancaster Study; April 2016.*

**What's That?!** - Recent discovery that for the first time millions of tiny magnetic crystals were found inside human brains – that should NOT be there. Where do they come from? They look strikingly similar to particles in the airborne pollution mix – which come from vehicles, particularly the combustion of fuel.<sup>13</sup>

**Brain Damage** - "Long-term exposure to air pollution is linked to brain shrinkage. A small increase in fine PM was associated with hidden brain damage linked to impaired cognitive function. Long-term exposure to air pollution showed harmful effects on the brain even at low levels, particularly with older people and even those who are relatively healthy."<sup>14</sup>

— *American Heart Association Rapid Access Journal Report*



Source: Air pollution: mechanisms of neuroinflammation and CNS disease. Trends in Neurosciences. September 2009. Michelle L. Block, Lilian Calderon-Garciduenas. <https://www.cell.com/trends/neurosciences/fulltext/S0166-2236-09-00128-3>

## Health Effects of Air Pollution & MSATs: Diabetes, Kidney Disease and Efficacy of Antibiotics

**Diabetes** – Air pollution may account for 1 in 7 new diabetes cases.<sup>1</sup> *Anne Harding, Reuters, July 6, 2018.* About 14% of diabetes in the world occurs because of higher levels of air pollution, that's one in seven cases. Risks exist at levels that are below what's now currently considered safe by the U.S. EPA and also by the World Health Organization. — *Dr. Ziyad Al-Aly of Washington University and the VA Saint Louis Health Care System*

**Type 1 Diabetes** – Several studies have already linked the likelihood of death by respiratory and circulatory illness to the level of fine dust particles in the air. A Munich study now shows that high levels of fine dust pollution could increase the risk of type 1 diabetes among children.<sup>2</sup> *Institute for Diabetes Research at the Helmholtz Centre.*

**Kidney Disease** – Chronic kidney disease risk linked to air pollution<sup>3</sup> – *China/US Study, September 2016.*

**Efficacy of Antibiotics** – Air pollution can change efficacy of antibiotics, says study.<sup>4</sup> *University of Leicester's Department of Genetics, March 2017.*

## Health Effects of Air Pollution & MSATs: The Elderly

**Premature Death** – “A new study of 60 million Americans — about 97% of people age 65 and older in the U.S. — shows that long-term exposure to airborne fine particulate matter (PM<sub>2.5</sub>) and ozone increases the risk of premature death, even when that exposure is at levels below the National Ambient Air Quality Standards.”<sup>6</sup> — *Harvard T.H. Chan School of Public Health, June 28, 2017.*

### Adverse Health Effects –

“Although elderly retirees generally spend most of their time indoors, a major portion of the [ultrafine] PM<sub>0.25</sub> particles they are exposed to comes from outdoor mobile sources—The Cardiovascular Health and Air Pollution Study. Indoor-infiltrated particles



from mobile sources are more strongly correlated with adverse health effects observed in the elderly subjects living in the studied retirement communities compared with other particles found indoors.”<sup>7</sup> — *University of Southern California, February 2010.*

**Kidney Disease** – “There is emerging evidence over the past several years that particulates, when they are small enough, make their way through the lungs to the blood vessels...they go to the liver, they go to the pancreas, they go to the kidneys. These particles are noxious. They irritate tissue and they damage tissue, they create oxidative stress, they create inflammation.”<sup>5</sup>  
— Air pollution may account for 1 in 7 new diabetes cases, *Washington University and the Veteran Affairs Saint Louis Health Care System.*

“Air pollution continues to take a toll on the health of the most vulnerable populations – women, children and the older adults. **For people to be healthy, they must breathe clean air from their first breath to their last.**”<sup>5</sup>

— Dr. Flavia Bustreo, Assistant Director General at WHO, September 2016.

## Health Effects of Air Pollution & MSATs: Death & Mortality

While there is disagreement about carbon dioxide and the impact fossil fuels have on changing the climate, there is no public dispute about the fact that air pollution is killing people. Death-by-Breath doesn't come quickly like an opioid overdose or a car accident. In most cases, death associated with air pollution is “premature,” which studies say takes about 10 years of life (on average)

from normal life expectancy. The air pollution-associated “premature deaths” stem from a range of birth defects or diseases contracted later in life from exposure to air pollution in the womb and/or in the environment. These diseases are also generally associated with expensive long-term health care and an extended hospital stay towards the end of life. Then there is the lost economic opportunity to consider when losing 10 years of productivity.



**Premature Deaths** – The Massachusetts Institute of Technology (MIT) placed premature deaths in the U.S. associated with air pollution at 200,000 per year. Emissions from road transportation were the most problematic, causing approximately 53,000 premature deaths in 2005.<sup>1</sup> In EPA's Benefits and Costs of the Clean Air Act (CAA) 1990-2020, the Second Prospective Study,<sup>2</sup> EPA proudly states the CAA will have prevented 230,000 deaths (i.e., mortalities) during the timeframe, but it does not provide the actual number of premature deaths caused.

**Premature Deaths** – “Each year in the UK, around 40,000 deaths are attributable to exposure to outdoor air pollution...air pollution plays a role in many of the major health challenges of our day, and has been linked to cancer, asthma, stroke and heart disease, diabetes, obesity, and changes linked to dementia. Neither the concentration limits set by government, nor the World Health Organization's air quality guidelines, define levels of exposure that are entirely safe for the whole population. When our patients are exposed to such a clear and avoidable cause of death, illness and disability, it is our duty as doctors to speak out.”<sup>3</sup> — *Study by the Royal College of Pediatrics' and Child Health (RCPCH) and the Royal College of Physicians (RCP). February 2016.*

**Premature Deaths** – “Exposure to PM<sub>2.5</sub> is the leading environmental risk factor for death, accounting for about 4.2 million deaths and ranks 5th worldwide among all risks,<sup>4</sup> including smoking, diet, and high blood pressure. Decades of research conducted in numerous cities throughout the world show that when air pollution levels increase, so do the numbers of people dying. — *World Health Organization.*

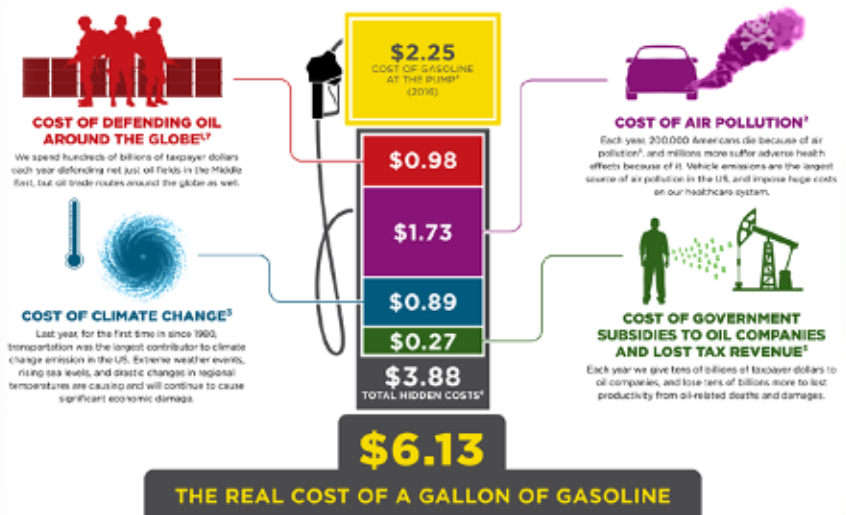
**Calculating Premature Deaths** – Understanding the Burden of Disease Deaths and Disability-Adjusted Life-Years (DALYs): The burden of disease due to exposure to a pollutant is calculated using an estimation of the number of deaths DALYs. The number of deaths attributable to air pollution in a given year includes deaths that have likely occurred months or even years earlier than might be expected in the absence of air pollution (as in the case of a child dying from a lung related infection).” — State of Global Air 2017: A Special Report on Global Exposure to Air Pollution and its Disease Burden, Institute for Health Metrics, and Health Effects Institute. See Related Story: Air pollution around the world takes a staggering toll<sup>4</sup> — *Washington Post* Editorial Board, March 5, 2017, Institute for Health Metrics, and Health Effects Institute.<sup>5</sup>



## Cleaning Up Gasoline & Mobile Source Air Toxics

### Protecting Public Health and Providing a Great Return on Investment The Real Cost of Gasoline

#### WHAT ARE WE ACTUALLY PAYING FOR A GALLON OF GASOLINE?



**GAS ISN'T AS CHEAP AS IT SEEMS. AND UNTIL WE BREAK OIL'S MONOPOLY AT THE PUMP, WE'LL CONTINUE TO PAY THE PRICE — NO MATTER HOW HIGH.**



If nothing else, addressing air pollution is a pocketbook issue. Now let's drill down on transportation and gasoline specifically. According to research in *Lives per Gallon: The True Cost of our Addiction to Oil*, "The Institute for Transportation Studies at the University of California at Davis places the minimum external cost of air pollution from motor vehicles in the U.S. at \$24.3 billion each year."<sup>1</sup> That estimate alone places a health tax on gasoline at 17 cents per gallon of gasoline purchased. UC Davis' work and related studies suggest the costs may be far higher when values are added for things like early deaths and lost productivity.

For example, other estimates show direct health care costs associated with air pollution of \$54.7 billion to \$672.3 billion each year, which includes everything from headaches to hospitalization, asthma attacks to respiratory illness, and chronic illness to mortality (i.e., Death).<sup>2</sup> Many feel EPA's cost estimates are on the low side. If reasonable people could agree that about half or \$280 billion is a fair number, then the extra cost for healthcare from mobile sources is about **\$2 per gallon of gasoline**.

## The Societal Cost of Oil Production, Refining, and National Security

While an in-depth discussion on this topic falls outside the scope of this Fact Book, consideration of these issues should not be excluded from the decision-making process.

- The exploration, drilling, refining, and distribution of gasoline also creates many stationary source emissions that contribute to the “air pollution” pie. This *Fact Book* just focuses on mobile sources.
- While the degree of responsibility and acceptability may vary, oil also needs to be charged to some degree with the amount of energy, pollution and lives we consume to protect the oil supplies of our allies around the world and in the Middle East. The U.S. military is the largest industrial consumer of oil in the world and pollution from war is self-evident.
- Oil clearly must be held accountable for their role in climate change. The burning of fossil fuels is undeniably linked to carbon emissions and related pollutants.

### The U.S. Military is the Largest Institutional Consumer of Oil in the World





“According to data cited by the Council of Economic Advisors in 2009, 18% of Americans under the age of 65 are Medicare or Medicaid beneficiaries (i.e., poverty line) or receive healthcare from the military. About 16% are not insured – and the rest are self-paying healthcare plans or their employees are paying for the plan as part of a benefit. In any form or percent we all pay. With regard to the impact on premature death and air pollution on the elderly, for Americans above the age of 65, the Centers for Disease Control reported that 94% are enrolled in Medicare. Therefore, large portions of all healthcare costs are borne by federal, state, and municipal governments. It follows that health care savings due to improved air quality are realized by all of these groups.”<sup>4</sup>

— *How the Clean Air Act Has Saved \$22 Trillion in Health-Care Costs*, Alan H. Lockwood, *The Atlantic*, September 7, 2012. Note: For the purpose of this Fact Book nationwide and California numbers were combined. California will take a little longer to achieve the results.

## Return on Investment

### Benefits of Clean Fuels Standards Far Outweigh Costs

EPA’s most recent study (2012) says for every \$1 invested in reducing pollution we get \$30 back. EPA’s calculation of the cost of meeting the CAA air quality standards increased \$65 billion for the period 1990 to 2020 and put the benefits at \$2 trillion. “When the federal Office of Management and Budget (OMB) evaluated for Congress the benefits and costs of all federal regulations in 2007, it found the largest estimated benefit was from reduction in air pollution from a single air pollutant: fine particulate matter (PM<sub>2.5</sub>). The benefits were estimated at between \$18.8 billion and \$167.4 billion per year, compared to a cost of \$7.3 billion per year. That translates to a benefit-cost ratio of between 2.5 to 1 or possibly up to 20 to 1. These are pretty astounding numbers for the benefits initiated by Harvard’s 1993 Six Cities Study publication. That specific study ultimately led to a new agenda for air pollution research, new air quality standards, improved air quality, and evidence of the benefits of cleaner air.”

On Oct. 1, 2015, EPA strengthened the National Ambient Air Quality Standards (NAAQS) for ground-level ozone to 70 parts per billion (ppb, from a 2008 standard of 75 ppb) based on extensive scientific evidence about ozone’s effects on public health and welfare. The updated standards will improve public health protection, particularly for at-risk groups including children, older adults, people of all ages who have lung diseases such as asthma, and people who are active outdoors, especially outdoor workers. They also will improve the health of trees, plants and ecosystems.

Setting air quality standards is about protecting public health and the environment. By law, EPA cannot consider costs in doing that. States ultimately will decide the best mix of measures to meet the standards in their nonattainment areas. However, to inform the public, EPA analyzes the benefits and illustrative costs of implementing the standards as required by Executive Orders 12866 and 13563 and guidance from the White House Office of Management and Budget (OMB).

In conducting these analyses, EPA uses widely accepted, peer-reviewed economic practices and follows OMB guidance on economic analyses. EPA estimates meeting the 70 ppb standards will yield health benefits valued at \$3.5 to \$8 billion annually in 2025. These annual benefits include the value of avoiding a range of harmful health effects, including:

- 440 to 880 premature deaths
- 3,900,000 asthma attacks in children
- 280,000 days when kids miss school
- 32,300 missed work days
- 910 asthma-related emergency room visits
- 404 cases of acute bronchitis in children

Protect Yourself: The National Ambient Air Quality Standards: *Overview of EPA’s Updates to the Air Quality Standards for Ground Level Ozone.*<sup>3</sup>

### Next Steps and Solutions & A Call to Action

We've shared a lot of information and data in this Fact Book. And in total, it creates a sobering—if not terrifying—picture of the threat MSATs pose to the health of every human being. In this Fact Book we have shown that:

- Hundreds of peer-reviewed studies (associated with 1,000+ more) confirm traffic-related pollution and the aromatics in gasoline are the predominant source of numerous dangerous emissions that contribute to disease and death. These emissions are up to 13 times higher than estimated by EPA.
- These emissions come from petroleum-derived octane, the most expensive, energy intensive, and harmful compounds in oil—toxic/carcinogenic aromatics (i.e. benzene, toluene methylbenzene, ethylbenzene, and xylene dimethylbenzene, or BTEX).
- While benzene is classified as a known Category 1/Group A carcinogen, benzene emissions are also formed through the combustion of the other aromatics from the tailpipe.
- Ultra-Fine Particulates (UFPs) from gasoline combustion become carriers of benzene and are linked to a range of respiratory and neurological problems and premature death.
- EPA is not using its authority to limit and reduce these toxic/carcinogenic aromatic compounds because the Clean Air Act states: “[Fuel and Vehicle] Standards must reflect the greatest degree of emissions reduction EPA determines achievable through the application of technology that will be available, taking into account cost and other factors.”

Such technology and alternatives exist. Clean, renewable ethanol-blended fuel is available at every gasoline station in the United States. Ethanol is lower-priced, non-carcinogenic, reduces greenhouse gases, lowers aromatic content, reduces toxic emissions, and is approved by automakers and EPA. Higher volumes of ethanol can significantly lower toxic content and particulate emissions.

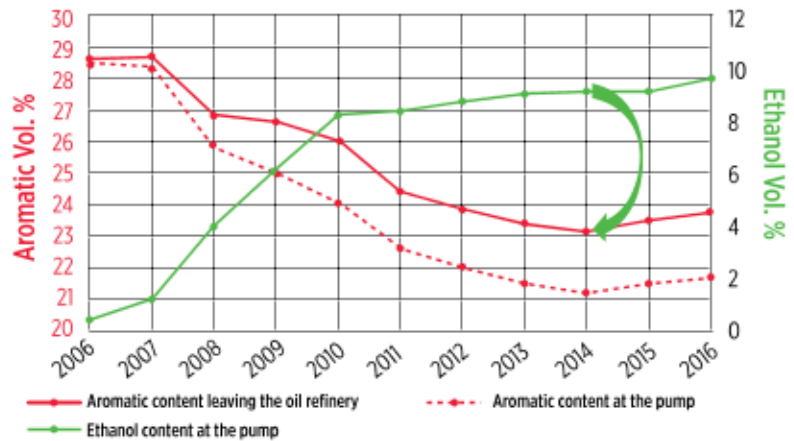
Overlay this with the reality that it takes 17 years for the consumer fleet of vehicles to turn over. This means the internal combustion engines and gasoline will remain the primary source of transportation for decades. Therefore, there is an urgent need to take action now to reduce aromatics to make gasoline safer for public health.

The United States and much of the world have recognized the health risks of leaded gasoline, tobacco, asbestos, and responded with adequate controls. Today's consumer gasoline deserves the same attention.

**General Motors 2012:**

Ethanol can be used to produce newer high octane fuels...using ethanol to increase octane of fuels could be a cost effective means to reduce CO<sub>2</sub>.

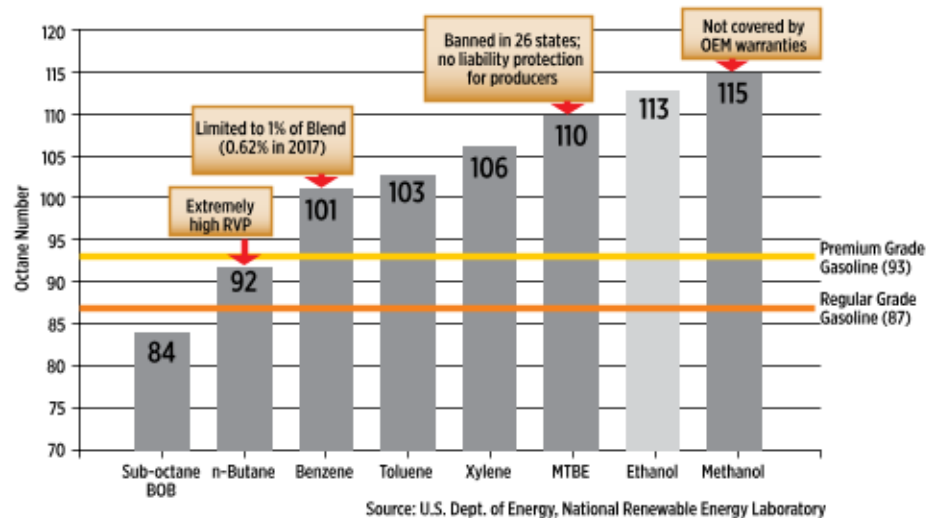
**EPA'S Summer Conventional Gasoline Summary Report**



The validation of ethanol as a superior octane additive comes from sources outside the ethanol industry, including the U.S. Environmental Protection Agency (EPA), the auto industry, and health and environmental groups.

First of all, ethanol is a price performer and the most effective octane enhancer available. The U.S. Department of Energy has stated ethanol supplies lower gasoline prices by up to \$.50/gallon and lower the price of crude oil which, considering the role of oil in so many aspects of modern life, lowers the price of almost all products. Any other octane additive is either more costly, toxic or simply cannot provide the increase necessary.

**Ethanol's Octane Advantage**  
 "Blending Octane" Values for Various Gasoline Components



Secondly, ethanol is a low carbon source of octane that meets several other requirements and public policy objectives. Replacing hydrocarbons with biofuel such as ethanol provides a range of benefits—but importantly can be seamlessly integrated into the current system. Automakers have made this point for the last decade.

In a 2012 Ford Motor Company research paper, the authors said “It appears that substantial societal benefits may be associated with capitalizing on the inherent high octane rating of ethanol in future higher octane number ethanol gasoline blends”.

In subsequent papers, presentations, and technical documents, Ford and other major automakers have all endorsed ethanol as a high octane, low carbon fuel.

Third is the fact EPA acknowledges ethanol’s superior octane properties. But in a 2007 Cost Benefit Analysis, EPA used faulty assumptions in assessing the cost benefit of replacing aromatics with ethanol, including insufficient supply. If a new cost benefit were to be done today it would tell a far different story. This is a specific example of action that is needed. Less costly ethanol is currently replacing 8 billion gallons of carcinogens and tons of greenhouse gases generated from gasoline but that could be significantly increased with commensurate health and consumer benefits.

In the Tier 3 rulemaking of 2017, which is a periodic update to standards required by the Clean Air Act, EPA stated:

A higher octane, higher ethanol fuel could:

- “Help automakers raise compressions ratios to improve vehicle efficiency”
- “Help provide a market incentive to increase ethanol use beyond E10”
- “Enhance the environmental performance of ethanol as a transportation fuel by using it to enable more fuel efficient engines”

We could not agree more, yet EPA actions do not match their words. The agency’s own data confirms the fact that since 2000, as ethanol increased to the point of comprising 10% of the gasoline pool, aromatics have been significantly reduced. Higher ethanol blends would continue to drive aromatics out of our gasoline and provide maximum protection of public health rather than the bare minimum.

### United States Environmental Protection Agency Fuel Trends Report (Released October 2017)



| Property         | 1990     | 2000        |            | 2016 RFG |      | 2016 CG |      |
|------------------|----------|-------------|------------|----------|------|---------|------|
|                  | Baseline | RFG Average | CG Average | Average  | 95%  | Average | 95%  |
| Sulfur (ppm)     | 339      | 126         | 324        | 23.1     | 48.2 | 22.5    | 51.0 |
| Benzene (vol%)   | 1.53     | 0.59        | 1.15       | 0.51     | 0.86 | 0.63    | 1.27 |
| RVP (psi)        | 8.7      | 6.78        | 8.27       | 7.1      | 7.47 | 9.08    | 10.0 |
| Aromatics (vol%) | 32       | 19.3        | 28.5       | 17.12    | 27.3 | 21.76   | 32.1 |
| E200 (vol%)      | 41       | 47.6        | 45.2       | 47.9     | 54.8 | 53.0    | 61.4 |
| E300 (vol%)      | 83       | 84.7        | 80.7       | 85.6     | 92.0 | 84.8    | 91.1 |
| Olefins (vol%)   | 13.1     | 10.6        | 11.8       | 10.5     | 18.7 | 8.38    | 16.4 |
| Ethanol (vol%)   | 0.6      | 1.14        | 0.84       | 9.61     | 9.97 | 9.28    | 9.8  |

*Note: These are Summertime Fuels, Aromatics in Wintertime Fuels are even lower*

**Chrysler 2012:** Ethanol offers low carbon content and offers the most expedient and least expensive means to lessen CO<sub>2</sub> for liquid fuels.

## Take Action to Protect Yourself and Your Family

Now armed with facts and ABC's (and BTEX's) of what's in your gasoline, we urge you to consider joining a growing movement calling on EPA to protect public health by enforcing Section 202(l) of the Clean Air Act and to adopt the higher clean octane standard CFDC proposed to EPA in its SAFE/GHG rulemaking that will reduce toxic carcinogens in your gasoline and air.

- A. In spite of the intent of public law, nearly 30 years of growing scientific and market place evidence, and pressure from public health advocates, EPA is still failing to take enough action to avoid this clear and present danger to public health.
- B. EPA has failed to take action to remove many of its unnecessary regulatory barriers and to update their MOVES emission computer model to accurately reflect the cost, emissions, carbon footprint, and other factors they have in place that penalize ethanol and other alternatives to aromatics. EPA's inaction decreases competition, increases gasoline prices, and only serves to protect the oil industry's market for additional billions of gallons of benzene-laced aromatics that remain in gasoline and will only increase over time. EPA's actions are NOT aligned with public policy and are NOT protecting our environment or your health.
- C. EPA has an opportunity to take action. It can protect public health by adopting a national clean octane standard proposed to EPA by CFDC in its SAFE/CAFE Rulemaking comments (i.e., The Proposed Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks). The SAFE rule is part of the new Corporate Average Fuel Economy (CAFE) standards designed to protect consumers by increasing vehicle efficiency and reducing greenhouse gases and toxic/carcinogens in gasoline. At a minimum the SAFE Rule can recognize the role of clean octane and set the stage for a follow-up rulemaking to address the issue of Mobile Source Air Toxics.

Please take just one next step—one action—that will fight for cleaner and safer fuels that will result in safer and healthier air for you and your family. Sign the Citizen's Education & Awareness Petition encouraging EPA to protect us with SAFE fuels and cars. The petition instructs EPA how to enforce existing laws and include a higher clean octane standard in the new SAFE/CAFE law.

You've read the scientific studies. You've seen the documented statistics. You've discovered the documented and horrific proof that the gasoline we are using in our vehicles is killing our children, our elderly—indeed, killing all of us.

Take action today and sign the petition. It's time we demanded that EPA do its job and protect the hearts, lungs, brains and the very future of all Americans.

Go to [www.Change.org](http://www.Change.org) and sign the **"EPA: Make Gasoline SAFE"** Petition to EPA. <https://www.change.org/p/environmental-protection-agency-epa-make-gasoline-safe>

Please join a growing number of civic minded organizations and educated consumers demanding EPA reduce benzene and other toxic emissions to the greatest extent possible by enforcing your Clean Air Act.

And finally, visit YouTube and search "Jack's Gasoline PSA" or "GasolineGate" for a series of informative videos on these issues.

---

## Acknowledgments

We would like to thank the many individuals and organizations that helped make this Fact Book possible and share our dedication to clean air and cleaner fuels.

Early support from CFDC Members Urban Air Initiative and the South Dakota Farmers Union, along with the Kansas and Nebraska Corn Boards was key to beginning our research.

### Supporters of the Fact Book:

- Urban Air Initiative
  - National Farmers Union
  - South Dakota Farmers Union
  - Farmers Union Enterprises
  - Minnesota Farmers Union
  - North Dakota Farmers Union
  - Renewable Fuels Foundation
  - Clean Fuels Foundation
  - ICM
  - Glacial Lakes Energy
  - Husker Ag
  - CoBank
  - Lallemand Biofuels & Distilled Spirits
  - Poet Ethanol Products
  - Nebraska Ethanol Industry Coalition
  - KATZEN International
- 
- Kansas Corn Growers
  - Nebraska Corn Growers
  - Illinois Corn Growers
  - Colorado Corn Growers
  - Iowa Corn Growers
  - Kentucky Corn Growers
  - Michigan Corn Growers
  - Missouri Corn Growers
  - Ohio Corn Growers

Thanks to Senior Researcher Burl Haigwood and our technical reviewers Carol Werner of the Environmental and Energy Study Institute, Steffen Mueller of the Energy Resources Center, University of Illinois Chicago, and Todd Sneller, Sneller Associates and Board Chair of the Clean Fuels Foundation.

Thanks also to our longtime publishing partner Dave Buchholz of David & Associates for their editorial and design work.

Please visit the websites of all these organizations for more information on ethanol, clean fuels, and related issues.

## Sections I-III Pages 5-14

- 1 <https://en.wikipedia.org/wiki/Tetraethyllead>
- 2 Centers for Disease Control, Agency for Toxic Substances and Disease Registry. Toxic Substance Portal. <https://www.atsdr.cdc.gov/>
- 3 American Petroleum Institute. September 1948. *API Toxicological Review, Benzene*. Agency for Toxic Substances and Disease Registry. Department of Health and Human Services. On file. EPAS Benzene Toxicological Review.
- 4 <https://www.eia.gov/todayinenergy/detail.php?id=5130>
- 5 <http://chartsbin.com/view/1114>
6. <https://www.vox.com/energy-and-environment/2017/11/22/16666808/india-air-pollution-new-delhi>
- 7 Kuma P. May 2014. *Ultrafine particles in cities*. Environment International.
- 8 American Petroleum Institute. September 1948. *API Toxicological Review, Benzene*. Agency for Toxic Substances and Disease Registry. Department of Health and Human Services. On file. EPAS Benzene Toxicological Review.
- 9 <https://www.azocleantech.com/>
- 10 World Health Organization. International Agency for Research on Cancer (IARC) <https://www.theglobeandmail.com/life/health-and-fitness/healthy/five-maps-that-put-cancers-global-spread-into-focus/article16679285/>
- 11 <https://www.webmd.com/lung-cancer/lung-cancer-causes#1>
- 12 Brugge D. Tufts University School of Medicine. Physicians for Social Responsibility.
- 13 Waxman H, Richardson B, Madigan E. et al, May 1990. Dear Colleague Letter. U.S. House of Representatives.
- 14 Harkin T. U.S. Senator (D-IA). Congressional Record. 101st Congress. 1989-1991. *Clean Air Act Amendment: Amendment No. 1423 to Amendment No. 1293*.
- 15 National Cancer Institute. 27 April 2018. <https://www.cancer.gov/about-cancer/understanding/statistics>
- 16 Wright J. 2 March 2017. *The Real Reasons Autism Rates Are Up in the U.S. Spectrum*. Scientific American. <https://www.scientificamerican.com/article/the-real-reasons-autism-rates-are-up-in-the-u-s/>
- 17 Epstein S. 1989 March 17. Health Requires That We Replace Gasoline. Los Angeles Times (California/Local). <http://articles.latimes.com/1989/mar/17>
- 18 World Bank. On file 2016. *The Cost of Air Pollution: Strengthening the Economic Case for Action*. <http://documents.worldbank.org/curated/en/781521473177013155/The-cost-of-air-pollution-strengthening-the-economic-case-for-action>
- 19 World Health Organization. On file 2015. *Economic cost of the health impact of air pollution in Europe: Clean air, health and wealth*. <http://www.euro.who.int/en/media-centre/events/events/2015/04/ehp-mid-term-review/publications/economic-cost-of-the-health-impact-of-air-pollution-in-europe>
- 20 Lacombe R. TEDxAthens, *Global Pandemic – Air Pollution*, video recording, YouTube, viewed 30 April 2015. <https://www.youtube.com/watch?v=FKBvWx8dVhI>
- 21 <http://who.int/mediacentre/news/releases/2016/air-pollution-estimates/en>
- 22 Senthilingam M, Osseiran N, *Air Quality Warning*, video recording, viewed 11 January 2017. <http://www.cnn.com/2017/01/11/health/pollution-smog-air-filter-protection-explainer/index.html>.  
Chriscaden K, WHO Department of Communications, <http://www.who.int/mediacentre/news/releases/2016/air-pollution-estimates/en/>
- 23 World Health Organization. 2014. *Burden of disease from Household Air Pollution for 2012*. Public Health, Social and Environmental Determinants of Health Department. [http://www.who.int/phe/health\\_topics/outdoorair/databases/FINAL\\_HAP\\_AAP\\_BoD\\_24March2014.pdf?ua=1](http://www.who.int/phe/health_topics/outdoorair/databases/FINAL_HAP_AAP_BoD_24March2014.pdf?ua=1)
- 24 Royal College of Physicians. February 2016. *Every Breath We Take: The Lifelong Impact of Air Pollution*. <https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution>
- 25 <https://learningenglish.voanews.com/a/urban-residents-breathe-unsafe-air/3347253.html>
- 26 <https://www.accuweather.com/en/weather-news/4-in-10-americans-live-with-unhealthy-pollution-levels-in-their-communities-2017-state-of-the-air-report-finds/70001429>
- 27 American Lung Association. 2017. *State of the Air*. <http://www.lung.org/assets/documents/healthy-air/state-of-the-air/state-of-the-air-2017.pdf>
- 28 Lindsay M, Lovell W. 2017. 15 *Ground Level Gasoline MSAT Measuring Studies*. <https://www.accuweather.com/en/weather-news/4-in-10-americans-live-with-unhealthy-pollution-levels-in-their-communities-2017-state-of-the-air-report-finds/70001429>
- 29 Carey P. Clean Air Board. *Air Pollution: A Medical Perspective*, video recording, YouTube, viewed 14 November 2008. <https://www.youtube.com/watch?v=AuezaUVUopY>

## Section IV (a) Pages 15-19

- 1 Health Effects Institute. February 2013. *Study on Ultrafine Particulates*, page 21.
- 2 <https://www.youtube.com/watch?v=5w3Ozy2RLeU&feature=youtu.be>
- 3 Perera F. *Children Are Likely to Suffer Most from Our Fossil Fuel Addiction*. Environmental Health Perspectives. Columbia University. Volume 116(8): 987-990. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2516589/>
- 4 Boehmer TK, Foster SL, Henry JR, Woghiren-Akinnifesi E. Yip FY. 22 November 2013. *Morbidity and Mortality Weekly Report (MMWR), Residential Proximity to Major Highways — United States, 2010*. National Center for Environmental Health, CDC Agency for Toxic Substances and Disease Registry, Division of Environmental Hazards and Health Effects, CDC. Supplements. <https://www.cdc.gov/mmwr/preview/mmwrhtml/su6203a8.htm>
- 5 <https://indianexpress.com/article/lifestyle/health/stuck-in-traffic-jams-it-may-increase-risk-of-cancer-2998586/>
- 6 Spira-Cohen A, Chen LC, Kendall M, Lall R, and Thurston GD. 7 January 2011. *Personal Exposures to Traffic-Related Air Pollution and Acute Respiratory Health among Bronx Schoolchildren with Asthma*. (53 Studies Cited) Nelson Institute of Environmental Medicine, New York University School of Medicine, Environmental Health Perspectives. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3080941/>
- 7 Brugge D, Durant JL, Rioux C. 9 August 2007. *Near-highway pollutants in motor vehicle exhaust: A review of epidemiologic evidence of cardiac and pulmonary health risks*. (101 studies cited). Tufts Study. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1971259/>
- 8 Perez L, Lurmann F, Wilson J, Pastor M, Brandt SJ, Kunzli N, McConnell R. 24 September 2012. *Near-roadway air pollution a major contributor to asthma in Los Angeles County*. University of Southern California (USC). Environmental Health Perspectives.
- 9 Baggely K. 12 February 2015. *Stoplights are Hot Spots for Airborne Pollution*. Science News. News in Brief. <https://www.sciencenews.org/article/stoplights-are-hot-spots-airborne-pollution?tgt=nr>
- 10 U.S. EPA. 15 December 2016. *Gasoline Mobile Source Air Toxics*. <https://www.epa.gov/gasoline-standards/gasoline-mobile-source-air-toxics>
- 11 U.S. EPA. February 2007. *Control of Hazardous Air Pollutants from Mobile Sources: Final Rule to Reduce Mobile Source Air Toxics*. Regulatory Announcement. Office of Transportation and Air Quality. <https://nepis.epa.gov/Exec/zyPDF.cgi/P1004KVV.PDF?Dockey=P1004KVV.PDF>
- 12 Bolden A, Kwiatkowski CF, Colborn T. April 2015. *New Look at BTEX: Are Ambient Levels a Problem?* The Endocrine Disruption Exchange (TEDX), Department of Integrative Physiology, University of Colorado Boulder. Environmental Science & Technology. <http://pubs.acs.org/doi/abs/10.1021/es505316f>. See Related Story.
- 13 Doyle K. 6 October 2015. *Benzene in traffic emissions tied to childhood leukemia*. Reuters. Health News. <https://www.reuters.com/article/us-health-airpollution-kids-leukemia/benzene-in-traffic-emissions-tied-to-childhood-leukemia-idUSKCNDS02Q520151006>
- 14 Houot J, Marquant F, Goujon S, Faure L, Honoré CMH, Hénon RD, Clavel J. 15 October 2015. *Residential Proximity to Heavy-Traffic Roads, Benzene Exposure, and Childhood Leukemia—The GEOCAP Study, 2002–2007*. American Journal of Epidemiology. Institute National de la Santé et de la Recherche Médicale (INSERM). Paris. <https://doi.org/10.1093/aje/kwv111>. See Related Story.
- 15 School of Public Health. 2008. University of California.
- 16 Burroughs D. 22 April 2015. *Growing Chorus of Complaints on Chemicals in Gasoline*. Morning Consult. News. <https://morningconsult.com/2015/04/22/growing-chorus-of-complaints-on-chemicals-in-gasoline/>

## Section IV (b) Pages 20-22

- 1 Stieb DM, Chen L, Eshoul M, Judek S. June 2012. *Ambient air pollution, birth weight, and preterm birth: A systematic review and meta-analysis*. Environmental Health Science and Research Bureau. Health Canada. Department of Epidemiology and Community Medicine, University of Ottawa. <https://cabinairtechcom.files.wordpress.com/2017/10/fetus-study-stieb-ambient-air-pollution-birth-weight.pdf>
- 2 Li, X., et al. March 2017. *Association between ambient fine particulate matter and preterm birth or term low birth weight: An updated systematic review and meta-analysis*. Environmental Pollution. <http://dx.doi.org/10.1016/j.envpol.2017.03.055>  
<https://www.ncbi.nlm.nih.gov/pubmed/28457735>
- 3 Perera P. September 2004. *A Summary of Recent Findings on Birth Outcomes and Developmental Effects of Prenatal ETS, PAH, and Pesticide Exposures*. Columbia Center for Children's Environmental Health, Mailman School of Public Health, Columbia University.
- 4 Hedley A. University of Hong Kong. *How air pollution impacts the unborn and children's health*, video recording, YouTube, viewed 13 July 2010. <https://www.youtube.com/watch?v=q76-gICUoBU>
- 5 Hricko A. Southern California Environmental Health Center, *Mom's & Doctors Discuss Air Pollution Impacts on Children*, video recording, YouTube, viewed December 2007. [https://www.youtube.com/watch?v=Fnr\\_uM4IQ6s](https://www.youtube.com/watch?v=Fnr_uM4IQ6s)
- 6 Korten I, Inelspital, Ramsey K, Latzin P. August 2016. *Air pollution during pregnancy and lung development in the child*. Mini-Symposium: *Maternal Diseases affecting the newborn*. <https://cabinairtechcom.files.wordpress.com/2017/10/fetus-study-korten-air-pollution-during-pregnancy-and-lung-development-in-the-child.pdf>
- 7 Bell ML, Belanger K, Ebisu K, Gent J, Lee HJ, Koutrakis P, Leaderer BP. September 2010. *Prenatal Exposure to Fine Particulate Matter and Birth Weight*. (45 Studies Cited). Yale University, School of Forestry and Environmental Studies. Yale University, School of Medicine. Harvard School of Public Health. <https://insights.ovid.com/pubmed?pmid=20811286>
- 8 Peterson BS, Rauh V, Bansal R, Hao X, Toth Z, Nati G, Walsh K, Miller R, Arias F, Semanek D, Perera F. June 2015. *Effects of Prenatal Exposure to Air Pollutants (Polycyclic Aromatic Hydrocarbons) on the Development of Brain White Matter, Cognition, and Behavior in Later Childhood*. June 2015. JAMA Psychiatry. 2015;72(6):531-540. doi:10.1001/jamapsychiatry.2015.57. Related Articles: LA Times <http://www.latimes.com/science/sciencenow/la-sci-sn-air-pollution-baby-brains-20150324-story.html> , Sierra Club <https://www.sierraclub.org/planet/2015/05/sierra-tierra-no-brainer-strengthen-air-quality-standards>



- 9 Mohan G. 15 March 2015. *Air pollution takes a double toll on babies' brains*. LA Times. <https://www.latimes.com/science/sciencenow/la-sci-sn-air-pollution-baby-brains-20150324-story.html>
- 10 Li N, Sioutas C, Cho A, Schmitz D, Misra C, Sempf J, Wang M, Oberley T, Froines J, Nel A. April 2003. *Ultrafine Particulate Pollutants Induce Oxidative Stress and Mitochondrial Damage*. Environmental Health Perspectives. Volume 111, Number 4, April 2003. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1241427/pdf/ehp0111-000455.pdf>
- 11 Perera F. 5 November 2004. *Early-Life Exposure to Polycyclic Aromatic Hydrocarbons and ADHD Behavior Problems*. <https://doi.org/10.1371/journal.pone.0111670> <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0111670>
- 12 Peterson B. 19 January 2015. *Effects of Prenatal Exposure to Air Pollutants (Polycyclic Aromatic Hydrocarbons) on the Development of Brain White Matter, Cognition, and Behavior in Later Childhood*. American Medical Association. See Related Story: *Air pollution takes a double toll on babies' brains*
- 13 Peterson BS, Rauh V, Bansal R. June 2015. *Effects of Prenatal Exposure to Air Pollutants (Polycyclic Aromatic Hydrocarbons) on the Development of Brain White Matter, Cognition, and Behavior in Later Childhood*. JAMA Psychiatry. <https://jamanetwork.com/journals/jamapsychiatry/fullarticle/2205842>
- 14 Mohan G. 25 March 2015. *Air pollution takes a double toll on babies' brains*. LA Times. <https://www.latimes.com/science/sciencenow/la-sci-sn-air-pollution-baby-brains-20150324-story.html>
- 15 Saenen ND, Plusquin M, Bijlens E, Janssen BG, Gyselaers W, Cox B, Fierens F, Molenberghs G, Penders J, Vrijens K, De Boever P, Nawrot TS. August 2015. *In Utero Fine Particle Air Pollution and Placental Expression of Genes in the Brain-Derived Neurotrophic Factor Signaling Pathway: An ENVIRONAGE Birth Cohort Study*. Environmental Perspectives. August 2015. Volume 123. Issue 8. <https://ehp.niehs.nih.gov/1408549/#r35>
- 16 von Ehrenstein OS, Heck JE, Park AS, Cockburn M, Escobedo L, Ritz B. 1 July 2016. *In Utero and Early-Life Exposure to Ambient Air Toxics and Childhood Brain Tumors: A Population-Based Case-Control Study in California, USA*. Environmental Health Perspectives. <https://ehp.niehs.nih.gov/doi/10.1289/ehp.1408582>
- 17 University of British Columbia. December 2015. *Exposure to Air Pollution During Pregnancy*. European Respiratory Journal.
- 18 Derla K. 10 February 2016. *Exposure To Air Pollution During Pregnancy Ups Asthma Risk In Babies*. Tech Times. December 2015. <https://www.techtimes.com/articles/132254/20160210/exposure-to-air-pollution-during-pregnancy-ups-asthma-risk-in-babies.htm>
- 19 Sbihi H, Tamburic L, Koehoorn M, Brauer M. Perinatal air pollution exposure and development of asthma from birth to age 10 years. European Respiratory Journal. 2016. Volume 47. Issue 4. 1062-1071; DOI: 10.1183/13993003.00746-2015 <https://erj.ersjournals.com/content/47/4/1062?ctkey=ERJtw074615>
- 20 Khreis H. November 2016. *Exposure to traffic-related air pollution and risk of development of childhood asthma: A systematic review and meta-analysis* Environ Int. <http://dx.doi.org/10.1016/j.envint.2016.11.012> <https://www.ncbi.nlm.nih.gov/pubmed/27881237>
- 21 Markuze K, Hricko A, Saltzman J. California Air Resources Board and University of Southern study. *A Breath of Air: What Pollution Does to Our Children*, video recording, YouTube, viewed 23 November 2008. <https://www.youtube.com/watch?v=Ud8z1agrPwo>
- 22 Science & Journalism Program at University of North Carolina-Chapel Hill. *Air Pollution & Asthma*, video recording, YouTube, viewed 10 November 2008. <https://www.youtube.com/watch?v=U69QWNexA0o>
- 23 Rapaport L. 20 November 2015. *Air pollution linked to asthma in children and teens*. Reuters Health News. [https://in.reuters.com/article/us-health-airpollution-children-asthma/air-pollution-linked-to-asthma-in-children-and-teens-idINKCN0192DB20151120?feedType=RSS&feedName=health&utm\\_source=feedburner&utm\\_medium=feed&utm\\_campaign=Feed%253A+reuters%252Fhealth+%2528News+%252F+IN+%252F+Health%2529](https://in.reuters.com/article/us-health-airpollution-children-asthma/air-pollution-linked-to-asthma-in-children-and-teens-idINKCN0192DB20151120?feedType=RSS&feedName=health&utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%253A+reuters%252Fhealth+%2528News+%252F+IN+%252F+Health%2529)
- 24 *How Air Pollution Affects Babies in the Womb* – JAMA Psychiatry. *Air pollution linked to higher risk of preterm birth for mothers with asthma* – National Institutes of Health. *Researchers link high exposure to air pollution to increased risk of premature birth* – Center for Prevention of Preterm Birth at Cincinnati Children's. *Prenatal Exposure To Air Pollution May Give Birth To Bad Behavior: What Pregnant Women Should Know* - Columbia Center for Children's Environmental Health and New York State Psychiatric Institute. *Longitudinal effects of prenatal exposure to air pollutants on self-regulatory capacities and social competence* – Journal of Child Psychology and Psychiatry.
- 25 Carrington D. 13 June 2016. *Air pollution linked to increased mental illness in children*. The Guardian. <https://www.theguardian.com/environment/2016/jun/13/air-pollution-linked-to-increased-mental-illness-in-children>
- 26 Oudin A, Bråbäck L, Åström DO. *Association between neighbourhood air pollution concentrations and dispensed medication for psychiatric disorders in a large longitudinal cohort of Swedish children and adolescents*. BMJ Open 2016;6:e010004. doi: 10.1136/bmjopen-2015-010004 <https://bmjopen.bmj.com/content/6/6/e010004>
- 27 UniversityHerald Reporter. 4 May 2015. *Babies Exposed to Air Pollution May Have A Higher Risk Of Developing Allergies*. Environmental Health Perspectives. <https://www.universityherald.com/articles/18598/20150504/babies-exposed-to-air-pollution-may-have-a-higher-risk-of-developing-allergies.htm#ixzz3rCNkskXW>
- 28 <https://www.aaaai.org/conditions-and-treatments/allergies/rhinitis>
- 29 <https://www.aaaai.org/conditions-and-treatments/asthma>
- 30 <https://www.aaaai.org/conditions-and-treatments/allergies/skin-allergy>
- 31 Sbihi H, Allen RW, Becker A, Brook JR, Mandhane P, Scott JA, Sears MR, Subbarao P, Takaro TK, Turvey SE, Brauer M. 2015. *Perinatal exposure to traffic-related air pollution and atopy at 1 year of age in a multi-center Canadian birth cohort study*. Environ Health Perspect 123:902-908. <http://dx.doi.org/10.1289/ehp.1408700> <https://www.ncbi.nlm.nih.gov/pubmed/25826816>

- 32 Tong S, Colditz P. 13 September 2004. Air pollution and sudden infant death syndrome: a literature review. Wiley Online Library. <https://doi.org/10.1111/j.1365-3016.2004.00565.x> <https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-3016.2004.00565.x>
- 33 Wilhelm RB, Zhao Y M. August 2006 *Air pollution and infant death in southern California, 1989-2000*. Department of Epidemiology, School of Public Health, University of California, Los Angeles. Pediatrics. <https://www.ncbi.nlm.nih.gov/pubmed/16882800>
- 34 Cortez MF. 18 December 2014. *Air Pollution Exposure in Pregnancy Linked to Autism in Study*. <https://www.bloomberg.com/news/articles/2014-12-18/air-pollution-exposure-in-pregnancy-linked-to-autism-in-study?hootPostID=73e99b5ae1e1a3bb6db052bceb9858e9> Harvard School of Public Health. 18 December 2014. *Fine particulate air pollution linked with increased autism risk*. <https://www.hsph.harvard.edu/news/press-releases/fine-particulate-air-pollution-linked-with-increased-autism-risk/>

#### Section VI (c) Page 23

- 1 Pease J. 6 April 2017. *Higher air pollution exposure linked to denser breast tissue*. University of Florida College of Medicine, Department of Epidemiology, UF Health Cancer Center. <https://ufhealth.org/news/2017/higher-air-pollution-exposure-linked-denser-breast-tissue>
- 2 Jerrett M, Burnett RT, Pope C, Arden III, Ito K, Thurston G, Krewski D, Shi Y, Calle E, Thun M. 12 March 2009. "Long-Term Ozone Exposure and Mortality". N. Engl. J. Med. 360 (11): 1085-1095. PMC 4105969 PMID 19279340. doi:10.1056/NEJMoa0803894. Jump up". Wilson EK. 16 March 2009. "Ozone's Health Impact". Chemical & Engineering News. 87 (11): 9. doi:10.1021/cen-v087n011.p009a.
- 3 Wikipedia, <https://en.wikipedia.org/wiki/Ozone>
- 4 Thurston G. Department of Environmental Medicine, NYU Langone's Perlmutter Cancer Center. *Air Pollution and Lung Cancer*, video recording, YouTube, viewed 18 November 2013. <https://www.youtube.com/watch?v=djpuYBZPuk>
- 5 Straif D. Pollution Causes Cancer: 1,000 Study, International Agency for Research on Cancer, World Health Institute. *Cancer: is Air Pollution a Major Cause?* Video recording, YouTube, viewed 17 October 2013. <https://www.youtube.com/watch?v=koYY8l8Bqa4>
- 6 Martin R. *Air Pollution Triggers Asthma Attacks*, video recording, YouTube, viewed on 16 November 2014. <https://www.youtube.com/watch?v=eN40UM6VET0https://www.youtube.com/watch?v=eN40UM6VET0>

#### Section IV (d) Page 24

- 1 News-Medical Life Science. 18 November 2015. *Higher levels of air pollution in major urban areas linked to heart attack risks in people 65 and older*. Johns Hopkins Bloomberg School of Public Health. <https://www.news-medical.net/news/20151118/Higher-levels-of-air-pollution-in-major-urban-areas-linked-to-heart-attack-risks-in-people-65-and-older.aspx>
- 2 Brook R, Franklin B, Cascio W, Hong Y, Howard G, Lipsett M, Luepker R, Mittleman M, MD, Samet J, Smith Jr SC, Tager I. 1 June 2004. *Air Pollution and Cardiovascular Disease- A Statement for Healthcare Professionals*. American Heart Association. June 1, 2004 <http://circ.ahajournals.org/content/109/21/2655.long>
- 3 Langrish J, University of Edinburgh. *Air Pollution and Cardiovascular Health*, video recording, YouTube, 20 August 2014. <https://www.youtube.com/watch?v=aGTbb3md7AE>
- 4 Newby D. University of Edinburgh. *Air Pollution and Heart Attacks*, video recording, YouTube, 3 October 2014. <https://www.youtube.com/watch?v=FqXB19DyUIQ>
- 5 Langrish J. University of Edinburgh. *Inhaling a heart attack: How air pollution can cause heart disease*, Michigan Medicine, video recording, YouTube, viewed on 4 September 2009. <https://www.youtube.com/watch?v=aGTbb3md7AE>.
- 6 Muhlestein B. Intermountain Medical Center Heart Institute. *Air pollution is a lung AND heart problem*, video recording, YouTube, viewed on 11 February 2016. <https://www.youtube.com/watch?v=Tr9dBuVWfU>
- 7 Pope CA, Muhlestein JB, May HT, Renlund DG, Anderson JL, Horne BD. 5 December 2006. *Ischemic heart disease events triggered by short-term exposure to fine particulate air pollution*. American Heart Association Journal. 2006 Dec 5;114(23):2443-8. Epub 2006 Nov 13. <https://www.ncbi.nlm.nih.gov/pubmed/17101851>
- 8 Barboza T. 2 February 2015 *California scientists link tiny particles in car exhaust to heart disease*. LA Times. <https://www.latimes.com/local/lanow/la-tiny-pollutants-linked-to-heart-disease-deaths-20150225-story.html>

#### Section IV (e) Pages 25-26

- 1 Miles K. Huffington Post. November 2004. *Study Links Autism With Prenatal Exposure To Traffic Pollution*. [https://www.huffingtonpost.com/2013/03/12/autism-pollution-study-\\_n\\_2853542.html](https://www.huffingtonpost.com/2013/03/12/autism-pollution-study-_n_2853542.html)
- 2 Seaman A. 26 November 2012. *Traffic pollution tied to autism risk: study*. Reuters. <https://www.reuters.com/article/us-traffic-pollution-autism/traffic-pollution-tied-to-autism-risk-study-idUSBRE8AP16020121126>
- 3 Warnock C. 16 March 2014. *Harvard draws link between autism and air pollution*. Daily Herald, Provo, Utah.
- 4 Talbot EO, Arena VC, Rager JR, Clougherty JE, Michanowicz DR, Sharma RK, Stacy SL. *Fine particulate matter and the risk of autism spectrum disorder*. Environmental Research. Volume 140, July 2015, Pages 414-420. <https://doi.org/10.1016/j.envres.2015.04.021> <https://www.sciencedirect.com/science/article/pii/S0013935115001449#>
- 5 University of Pittsburgh, School of Public Health. 22 May 2015. *Air pollution may increase autism risk in kids*. Environmental Research. [https://www.business-standard.com/article/news-ians/air-pollution-may-increase-autism-risk-in-kids-115052200352\\_1.html](https://www.business-standard.com/article/news-ians/air-pollution-may-increase-autism-risk-in-kids-115052200352_1.html)
- 6 Glaiusuz J. University of Rochester. 9 July 2014. *Autism: Something in the Air. Experiments link brain damage to pollution*. The American Scholar. [https://theamericanscholar.org/autism-something-in-the-air/?utm\\_source=feedburner&utm\\_medium=feed&utm\\_campaign=Feed%253A+theamericanscholar%252Fya5Q+%28The+American+Scholar%29#.XJGawChKJlU](https://theamericanscholar.org/autism-something-in-the-air/?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%253A+theamericanscholar%252Fya5Q+%28The+American+Scholar%29#.XJGawChKJlU)
- 7 Lurie J. Public Health Ontario. 4 January 2017. *The Link Between Road Pollution and Dementia Just Got Stronger*. Mother Jones. <https://www.motherjones.com/environment/2017/01/air-pollution-road-traffic-dementia-study/>

- 8 University of Southern California. *Alzheimer's disease could be triggered by heavy air pollution* (Elderly Women), video recording, YouTube, viewed on 2 February 2017. The Journal Translational Psychiatry. <https://www.youtube.com/watch?v=fm7IRTIMIP8>
- 9 Carrington D. 16 September 2016. More people die from air pollution than Malaria and HIV/Aids, new study shows. The Guardian. <https://www.theguardian.com/environment/2016/sep/16/more-people-die-from-air-pollution-than-malaria-and-hiv-aids-new-study-shows>
- 10 Carrington D. 13 June 2016. *Air pollution linked to increased mental illness in children*. The Guardian. [https://www.theguardian.com/environment/2016/jun/13/air-pollution-linked-to-increased-mental-illness-in-children?CMP=share\\_btn\\_tw](https://www.theguardian.com/environment/2016/jun/13/air-pollution-linked-to-increased-mental-illness-in-children?CMP=share_btn_tw)
- 11 Suryer J, Esnaola M, Alvarez-Pedrerol M, Fornis J, Rivas I, López-Vicente M. 3 March 2015. *Association between Traffic-Related Air Pollution in Schools and Cognitive Development in Primary School Children: A Prospective Cohort Study*. PLoS Med 12(3): e1001792. <https://doi.org/10.1371/journal.pmed.1001792> <https://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1001792>
- 12 Carrington D. 5 September 2016. University of Texas, Lancaster Study. *Toxic air pollution particles found in human brains*. The Guardian. <https://www.theguardian.com/environment/2016/sep/05/toxic-air-pollution-particles-found-in-human-brains-links-alzheimers>
- 13 Maher B. Lancaster University. *Toxic air pollution nanoparticles discovered in the human brain* (Alzheimer's), video recording, YouTube, viewed on 6 September 2016. <https://www.youtube.com/watch?v=dfXjeNkSYgA> Maher B. Lancaster University, *Can Dirty Air Contribute to Alzheimer's?* video recording, YouTube, viewed on 25 September 2016. <https://www.youtube.com/watch?v=6jFODPze2K0>
- 14 Wilker EH. 23 April 2015. *Long-term exposure to air pollution may harm your brain*. American Heart Association Rapid Access Journal Report. [https://www.eurekalert.org/pub\\_releases/2015-04/aha-let042015.php](https://www.eurekalert.org/pub_releases/2015-04/aha-let042015.php)

**Section IV (f) Page 27**

- 1 Harding A. 6 July 2018 *Air pollution may account for 1 in 7 new diabetes cases*. Reuters. <https://www.governorsbiofuelscoalition.org/air-pollution-may-account-for-1-in-7-new-diabetes-cases/>
- 2 Ziegler AG. 24 March 2015. Helmholtz Zentrum München, German Research Center for Health and Environment (GmbH), Institute for Diabetes Research at the Helmholtz Centre. <http://www.euractiv.com/sections/health-consumers/traffic-related-air-pollution-linked-type-1-diabetes-children-313182> <https://www.helmholtz-muenchen.de/df/das-institut/index.html>
- 3 Andrew D. 5 September 2016 *Chronic kidney disease risk linked to air pollution: Study*. Bel Marra Health. <https://www.belmarrahealth.com/chronic-kidney-disease-risk-linked-air-pollution-study/>
- 4 Frangoul A. 3 March 2017. *Air pollution can change efficacy of antibiotics, says study*. <https://www.cnn.com/2017/03/03/air-pollution-can-change-efficacy-of-antibiotics-says-study.html>
- 5 Harding A. 6 July 2018. *Air pollution may account for 1 in 7 new diabetes cases*. Reuters Health. <https://www.governorsbiofuelscoalition.org/air-pollution-may-account-for-1-in-7-new-diabetes-cases/>
- 6 Harvard T.H. Chan School of Public Health, June 28, 2017, <https://www.sciencedaily.com/releases/2017/06/170628183211.htm>
- 7 Arhami M, Minguillón MC, Polidori A, Schauer JJ, Delfino R, Sioutas C. February 2010. *Organic compound characterization and source apportionment of indoor and outdoor quasi-ultrafine particulate matter in retirement homes of the Los Angeles Basin*. University of Southern California, International study. *Indoor Air*. Volume 20, Issue 1. <http://onlinelibrary.wiley.com/doi/10.1111/j.1600-0668.2009.00620.x/full>

**Section IV (g) Pages 28-29**

- 1 Fabio, Caiazzo, Akshay, Ashoklan, Waitz A, Steve H, Yim L, Steven R., Barrett H. November 2013. *Air pollution and early deaths in the United States. Part I: Quantifying the impact of major sectors in 2005*. *Atmospheric Environment*, Volume 79, Pages 198-208.
- 2 EPA. March 2011. *Benefits and Costs of the Clean Air Act (CAA) 1990-2020, the Second Prospective Study*. United States Environmental Protection Agency. <https://www.epa.gov/clean-air-act-overview/benefits-and-costs-clean-air-act-1990-2020-second-prospective-study>
- 3 Harrison P. February 2016. *The air we breathe*. Research Gate. [https://www.researchgate.net/publication/295626722\\_The\\_air\\_we\\_breathe](https://www.researchgate.net/publication/295626722_The_air_we_breathe)
- 4 Institute for Health Metrics and Evaluation's Global Burden of Disease Project. Health Effects Institute. *The State of Global Air*. [https://www.stateofglobalair.org/sites/default/files/SoGA2017\\_report.pdf](https://www.stateofglobalair.org/sites/default/files/SoGA2017_report.pdf)
- 5 Osseiran N. 27 September 2016. *WHO releases country estimates on air pollution exposure and health impact*. WHO Department of Public Health, Environmental and Social Determinants of Health. <http://www.who.int/mediacentre/news/releases/2016/air-pollution-estimates/en/>
- 6 [https://www.washingtonpost.com/opinions/air-pollution-around-the-world-takes-a-staggering-toll/2017/03/05/be4b50d8-f300-11e6-a9b0-ecee7ce475fc\\_story.html?noredirect=on&utm\\_term=.db00b02f6b79](https://www.washingtonpost.com/opinions/air-pollution-around-the-world-takes-a-staggering-toll/2017/03/05/be4b50d8-f300-11e6-a9b0-ecee7ce475fc_story.html?noredirect=on&utm_term=.db00b02f6b79)

**Section V Pages 30-32**

- 1 Delucchi MA. *Environmental Externalities of Motor-Vehicle Use in the US*. *Journal of Transport Economics and Policy* 34, part 2 (December 1999): 135-168; Winer A. *Valuing the Health Benefits of Clean Air*. Washington, DC: American Association for the Advancement of Science, 1992; McCubbin DR and Delucchi MA. *The Health Costs of Motor-Vehicle-Related Air Pollution*. *Journal of Transport Economics and Policy*. 1996: 122-131, referenced in Tamminen T. *Lives Per Gallon: The True Cost of Our Oil Addiction* (p. 229)
- 2 Mark A. Delucchi, "Environmental Externalities of Motor-Vehicle Use in the US," *Journal of Transport Economics and Policy* 34, part 2 (December 1999): 135-168.
- 3 The National Ambient Air Quality Standards. 1 October 2015. Overview of EPA's Updates To The Air Quality Standards For Ground-level Ozone. [https://www.epa.gov/sites/production/files/2015-10/documents/overview\\_of\\_2015\\_rule.pdf](https://www.epa.gov/sites/production/files/2015-10/documents/overview_of_2015_rule.pdf)
- 4 Lockwood A. 7 September 2012. *How the Clean Air Act Has Saved \$22 Trillion in Health-Care Costs*. The Atlantic. <https://www.theatlantic.com/health/archive/2012/09/how-the-clean-air-act-has-saved-22-trillion-in-health-care-costs/26207/>

**About the Clean Fuels Development Coalition:** Established in 1988, the CFDC is a non profit organization supporting the use of alternative, renewable transportation fuels that can reduce dependence on petroleum and protect public health. Based in Washington D.C., CFDC has a broad base of members and supporters from the auto, agriculture and biofuels industries and has been involved in every major legislative and regulatory issue affecting ethanol of the past three decades.

**The Urban Air Initiative** is a non-profit organization dedicated to improving air quality and protecting public health by reducing vehicle emissions. We are focused on increasing the use of clean burning ethanol to replace harmful aromatic compounds in gasoline. UAI is helping meet public policy goals to lower emissions and reduce carbon in our environment through scientific studies and real-world data to promote new fuels, engine design, and public awareness.



# CFDC

CLEAN  
FUELS  
DEVELOPMENT  
COALITION

In cooperation with  
URBAN **AIR** INITIATIVE

For more information on the Clean Fuels Development Coalition,  
including how you can become a member, contact us.

Douglas Durante,  
Executive Director  
4641 Montgomery Avenue  
Suite 350  
Bethesda, MD 20814

Phone: 301-718-0077  
Fax: 301-718-0606  
e-mail: [CFDCInc@aol.com](mailto:CFDCInc@aol.com)  
web: <http://cleanfuelsdc.org/>

CFDC

CLEAN  
FUELS  
DEVELOPMENT  
COALITION

In cooperation with  
URBAN **AIR** INITIATIVE