Clean Cars, Cleaner Air

Curbing Air Pollution and Protecting Public Health in Minnesota with the Clean Cars Program

Environment Minnesota
Research & Policy Center

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Executive Summary

Air pollution from cars and light-duty trucks in Minnesota harms public health, contributing to cancer, asthma and respiratory disease. Moreover, pollution from cars and light-duty trucks contributes to global warming, which threatens much of what makes Minnesota special, from the Boundary Waters wilderness to our vast forests to the health of our 10,000 lakes.

The good news is that automakers can make cars and light-duty trucks that release less pollution, without compromising the performance or availability of any vehicle models. By requiring car manufacturers to build and sell cleaner cars and light-duty trucks, Minnesota can improve its air quality and protect special places from harm. Through 2025, switching to cleaner cars and light-duty trucks could prevent as much pollution as removing half of all the light-duty vehicles in Minnesota from the road for a full year. Moreover, adopting the Clean Cars Program can save consumers money at the pump and reduce our dependence on oil.

Air pollution from cars and light-duty trucks in Minnesota contributes to respiratory disease and cancer.

- State air quality officials rated the air quality in the Twin Cities and the Rochester area as "good" on only half the days of 2007. In areas such as Duluth, Brainerd and Marshall, air quality rated less than good on at least one out of every five days during 2007. Long-term exposure to elevated levels of pollution can cause cancer, exacerbate asthma, and contribute to respiratory illness in otherwise healthy people.

- Gasoline-powered highway vehicles produce more than half of the state's emissions of toxic benzene, along with a fifth of Minnesota's emissions of smog-forming nitrogen oxides, and a quarter of the state's emissions of volatile organic compounds, which also contribute to smog.

Air pollution from cars and light-duty trucks threatens Minnesota's special places and contributes to global warming.

- Winters in northwest Minnesota warmed by 12° F between 1960 and 2001. The ice on Minnesota's lakes has been breaking open an average of 1.3 days earlier every decade since the mid-1960s. Scientists at the University of Minnesota predict that the Boundary Waters habitat could change to look more like that of southern Minnesota in 50 years if global warming continues unchecked.

- Transportation is responsible for a quarter of Minnesota's global warming pollution and emissions from cars and light-duty trucks have been increasing rapidly. Between 1990 and 2005, carbon dioxide emissions from gasoline use in transportation increased by 39 percent.

Air pollution from cars and light-duty trucks is preventable.

- Readily available technology can make vehicles cleaner and more efficient. Through advanced emission controls and simple energy-saving changes, cars and light-duty trucks can emit less pollution and travel further on a gallon of gas, helping to reduce air pollution.

- Fourteen states across America have taken action to increase the use of cleaner vehicle technology through a policy known as the Clean Cars Program. In these states, cleaner, more efficient versions of many well-known vehicles, including large vehicles such as SUVs as well as flex-fuel vehicles (FFVs) operating on E85 ethanol, can be purchased.

The Clean Cars Program will reduce air pollution from Minnesota's cars and light-duty trucks.

- Air pollution officials in the Northeastern states estimate that the Clean Cars Program will cut smog-forming nitrogen oxide pollution from cars and light-duty trucks by 15 percent by 2025 and will reduce toxic air pollution by 8 percent or more compared to current federal standards.

- Under the Clean Cars Program, by 2025 Minnesota would avoid 13.1 million metric tons of carbon dioxide pollution that contributes to global warming. That is as much pollution as would be averted by taking 2.5 million vehicles off the road for a year.

Clean cars and light-duty trucks benefit the economy and consumers.

- The Clean Cars Program would reduce Minnesota's oil consumption by as much as 785 million gallons through 2020, reducing America's dependence on oil.

- This translates into savings for the consumer. At prices of $1.74 per gallon, Minnesota drivers would save $1.4 billion on gasoline between now and 2020.

- Under the program, a Minnesota consumer who buys a new car in 2016 will save $3 to $7 per month, with lower spending on gasoline outweighing the higher costs of his or her auto loan. After the loan is paid off, the consumer will save $24 to $27 per month compared to a car purchased under old federal fuel economy standards.

Minnesota should require auto manufacturers to produce and sell cleaner

cars and light-duty trucks.

Minnesota should adopt the Clean Cars Program to reduce air pollution from on-road passenger vehicles, and should take other steps to reduce the impact of driving on Minnesota's air and on our state's natural treasures.

Introduction

Over the past century, cars have become a mainstay of life in Minnesota. Every day, millions of Minnesotans from Duluth to Rochester get in cars and light-duty trucks on their way to work, study or play. The advent of the affordable, personal automobile in the early 20th century marked a turning point in individual mobility and economic growth for the entire country, spurring development and prosperity.

But cars have always had their downsides, especially the tailpipe pollution that triggers severe health problems and fouls the skies over many American cities. By the mid-1970s, a number of Minnesota cities—including Duluth, Rochester, and the Twin Cities metro area—had dangerous smog levels that violated federal Clean Air standards.[1]

In public, the Big Three automakers expressed their concern about clean air, but in testimony before Congress, they claimed that new federal clean air standards could ruin the automobile industry. A GM spokesman, speaking before Congress in 1973, warned that a federal requirement to put catalytic converters on vehicles could result in an "unreasonable risk of business catastrophe" with the potential for "complete stoppage of the entire production."[2]

Ultimately, despite a series of delays won by the automakers, catalytic converters became standard equipment. The air got cleaner. The automobile industry did not die. And millions of people breathed easier as a result.

Three decades later, the cars and light-duty trucks that Minnesotans depend on are still triggering serious health and environmental problems in our state. Minnesota's air *is* cleaner, but scientific study has also shown that even today's less-polluted air can still harm the health of many Minnesotans. Moreover, traditional concerns about smog and soot pollution from vehicles have now been joined by a new threat: global warming.

Just as automobile engineers found solutions to reduce air pollution in the 1970s, today's engineers are finding technological solutions for today's air pollution problems. Fourteen states have taken action to require the automakers to bring these advanced technologies to consumers by adopting the Clean Cars program.

Minnesota should take the next step forward and embrace today's generation of better technology. Cars make up an important part of our daily routine, but the pollution they create is not inevitable. By using vehicles built with more advanced technology and by establishing tighter emissions limits for cars and light-duty trucks, we can make our air healthier for all Minnesotans.

Air Pollution from Vehicles Causes Health and Environmental Problems in Minnesota

Air Pollution from Cars and Light-Duty Trucks Threatens Minnesotans' Health

Automobile exhaust has long been tied to air pollution problems. Stronger vehicle emission standards have led to today's vehicles being far cleaner than those of previous decades, and Minnesota's air has become cleaner as a result.

Still, air pollution from cars and light-duty trucks continues to threaten the health of people in Minnesota and across the country. In 2007, state air quality officials rated the air quality in the Twin Cities and Rochester areas as "good" on only half the days of the year. Even in smaller urban areas such as Duluth, Brainerd and Marshall, air quality in 2007 was less than "good" on more than one out of every five days of the year.[3]

Scientists and physicians have studied the impact of air pollution on the body, and they have regularly discovered significant health impacts at levels of air pollution once considered "safe." As a result, Minnesota must remain vigilant about reducing air pollution from all sources, including vehicles.

Vehicle tailpipes, engines and systems release a variety of dangerous substances into our air: smog-forming nitrogen oxides and volatile organic compounds, as well as soot, carbon monoxide, and an array of toxic chemicals. Of these pollutants that come from cars and light-duty trucks, two categories are of particular concern: pollutants that contribute to ozone smog and toxic air pollutants.

Smog

Smog is a major contributor to lung ailments. Smog results when a mixture of nitrogen oxides (NOx) and volatile organic compounds (VOCs) reacts in the presence of sunlight to form ozone. Unlike the ozone layer in the stratosphere that protects humans from harmful radiation, ground-level ozone is a significant threat to human health. For example, ozone is often used to purify water, destroying any infectious organisms, thereby making the water safe to drink. Not surprisingly, the chemical has the same effect on our lungs—when inhaled, it damages lung

tissue and causes short-term swelling. With long-term exposure at even low levels, it causes permanent damage.

Ozone also causes reddening and swelling and reduces the elasticity of lung tissues over time.[4] Ozone makes lung tissues more sensitive to allergens and less able to ward off infections.[5] It can even scar airway tissues. Children exposed to ozone develop lungs with less flexibility and capacity than normal. For example, a study of University of California-Berkeley freshmen found that those who have lived in places with less ozone pollution can exhale more forcefully than students from more polluted areas.[6] Even otherwise healthy people can have trouble breathing normally during high smog days.[7]

Exposure to ozone has even been correlated with higher incidence of asthma in children.[8] Children who exercise frequently in smoggy areas are more than three times as likely to develop asthma as those in cleaner parts of the country.

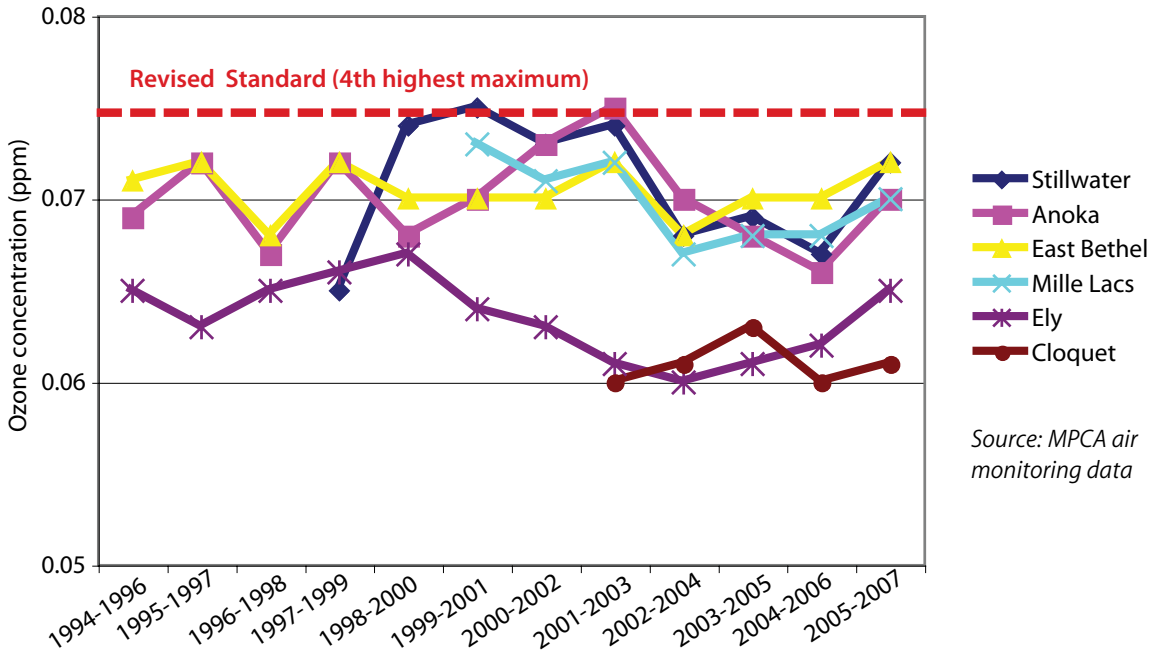
Thankfully, levels of ground-level ozone have decreased in Minnesota and across the country over the last several decades—a testament to the effectiveness of stronger emission standards for vehicles and other regulatory efforts to curtail air pollution.

However, Minnesota's smog problem is far from solved.

Indeed, scientists have continually found negative health impacts from ozone at levels well below those once considered "safe," and even below the federal government's existing air quality standards. For example, a study of asthmatic children found that symptoms such as wheezing, shortness of breath and chest tightness increased at levels of ozone exposure well below federal air quality standards. Those results were consistent with those of other recent studies that have shown the potential of low-level ozone exposure to worsen asthma symptoms.[9]

Reviewing the scientific evidence, the EPA's Scientific Advisory Board unanimously recommended that the Bush administration establish an ozone standard no higher than 70 parts per billion (ppb) and consider reducing the standard to as

Figure 1. Ozone Trends in Selected Minnesota Cities, 1994-2007[12]



Source: MPCA air monitoring data

low as 60 parts per billion (ppb), due in particular to the dangers smog poses to children's developing lungs.[10] Ultimately, the Bush administration overruled the scientists and set the standard at 75 ppb—a measure that will prevent between 1,300 and 3,500 premature deaths per year (compared to the previous 80 ppb standard), but that falls far short of the 3,000 to 9,200 premature deaths that would have been prevented with a stronger 65 ppb standard.[11]

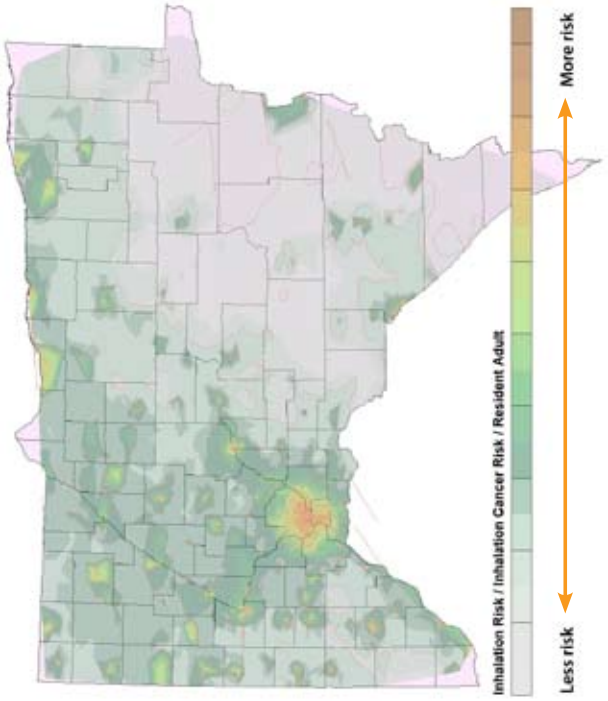
As can be seen in Figure 1 (previous page), ozone readings in many of Minnesota's more urban and suburban areas generally meet the Bush administration's more lax ozone standard, but fail to comply with the more stringent thresholds for ozone pollution that are justified to protect public health.

Levels of ozone as measured by pollution monitors, however, fail to adequately describe the risks posed to those who live in close proximity to busy highways. Research has shown that children living near busy roads were more likely to have asthma, to suffer symptoms such as wheezing, and to need to use asthma medication.[13] The impacts of living near highways appear to be particularly acute for very young children. One study found that children under two years of age who moved to a residence next to a highway were among those with an increased risk of developing asthma.[14]

Research conducted by the Minnesota Center for Environmental Advocacy found that there are tens of thousands of children in the Twin Cities area—many of them poor—living close enough to busy highways to face higher risks of health problems. The study found that more than 25,000 children live in "high exposure" areas and more than 6,000 children live in "very high exposure" areas near highways.[15]

In other words, while Minnesotans can take pride in reducing smog and other air pollutants over the past several decades, there is still more work to be done to truly protect public health.

Figure 2. Estimated Risk of Cancer from Toxic Air Pollution in Minnesota in 2002[19]



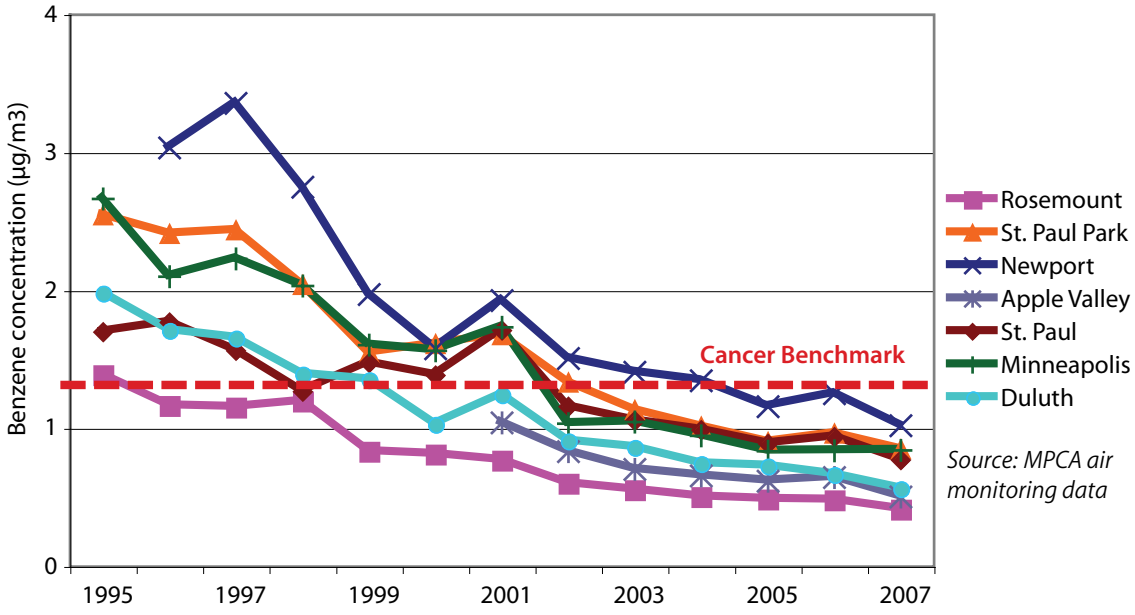
Toxic Pollutants

Most Minnesotans are familiar with smog as an air pollution threat, but few are aware of the dangers posed by toxic air pollutants. As of 1996, Americans had a 1-in-2,100 risk of developing cancer from exposure to outdoor toxic air pollutants—a risk 500 times greater than the one-in-a-million cancer risk threshold established by the EPA.[16]

While there are many sources of toxic air pollutants, including factories, power plants and heavy-duty diesel trucks, cars and light-duty trucks are responsible for a significant amount of toxic air pollutants. The EPA estimates that nationally, half of all cancer cases caused by outdoor air toxics come from cars, trucks and other mobile sources.[17]

In 2005, there were 146 million pounds of toxic air pollutants released in Minnesota,

Figure 3. Benzene Trends in Minnesota, 1995-2007[231]



31 percent of which came from cars and trucks.[18]

The term "air toxics" refers to hundreds of different chemicals. Among the air toxics associated with automobile exhaust are benzene and formaldehyde.

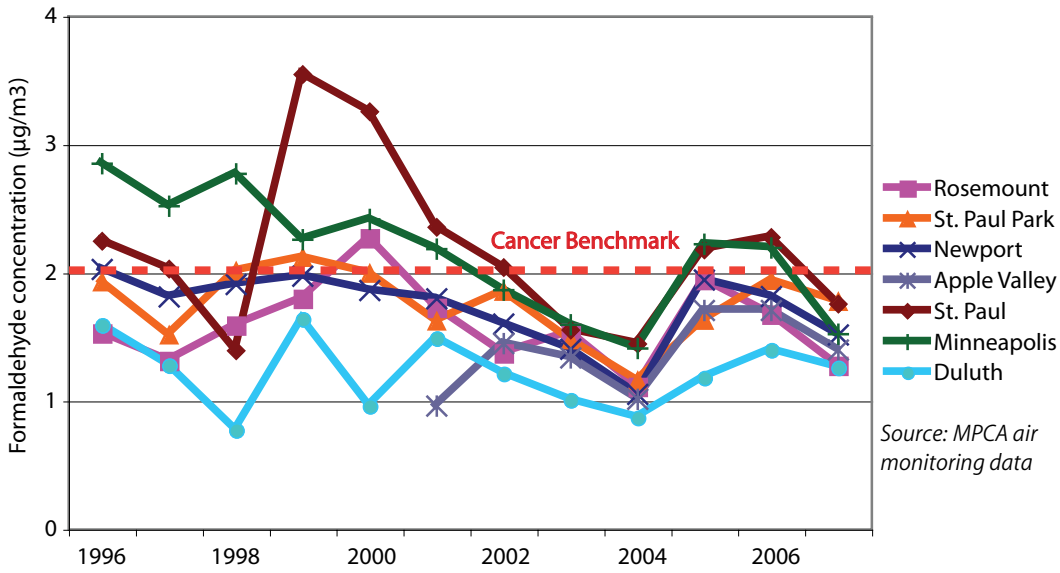
Benzene has been known to cause leukemia.[20] Breathing benzene over the long term can also cause blood disorders such as lower numbers of red blood cells. Until recently, levels of benzene in Minnesota's air were typically well above the 1-in-100,000 cancer risk benchmark set by the Minnesota Pollution Control Agency (PCA).[21] By reducing the amount of benzene in gasoline, Minnesota was able to lower the amount of benzene in the air below the benchmark.[22] However, benzene, like other air toxics, can be found in higher concentrations in "hot spot" areas, including near major roads.

Formaldehyde is another toxic air pollutant of concern in Minnesota. Breathing formaldehyde over the long term can harm our respiratory systems, and very likely can cause lung cancer.[24] In addition to being emitted when gasoline is burned, formaldehyde is also formed in the atmosphere when other air toxics break down.[25] Formaldehyde concentrations in areas such as the Twin Cities periodically approach or exceed the cancer risk benchmark established by the PCA.

When evaluated against the stronger, one-in-a-million cancer risk benchmark established by the U.S. EPA, however, concentrations of many toxic air pollutants present an excess risk to Minnesotans. Among them are pollutants such as acetaldehyde, which is also present in automobile exhaust.[27]

The impacts of air toxics extend well beyond cancer. Recent research suggests that even prenatal exposure to certain air toxics may contribute to the development of asthma. A 2009 study found that toxic air pollutants called polycyclic aromatic hydrocarbons, often found in higher concentrations near busy highways, can cross the placental barrier, affecting genes in

Figure 4. Formaldehyde Levels in Selected Minnesota Areas, 1996-2007[26]



such a way as to increase the likelihood of developing asthma in childhood.[28]

In addition, there are many air toxics for which we have only limited information about their concentrations, human exposure, or their health effects. And we know even less about how these many toxic chemicals interact when they find their way into the body. A study conducted by the PCA estimated that the combined cancer health risk posed by toxic chemicals in Minnesota's air ranged from 2.5 to 6 cases of cancer per 100,000 people.[29]

As a result, Minnesota must continue to look for opportunities to reduce emissions of air toxics.

Vehicles are Major Contributors to Minnesota's Air Pollution Problems

Air pollution in Minnesota comes from many sources. But cars, vans, pickup trucks, SUVs and other light-duty vehicles are major contributors to Minnesota's air pollution problems.

For example:

- Vehicles produced more than half of Minnesota's emissions of benzene and 26 percent of the state's emissions of formaldehyde—both of which are air toxics.[30]

- Gasoline-powered highway vehicles produce a fifth of Minnesota's emissions of smog-forming nitrogen oxides and a quarter of the state's emissions of VOCs, which contribute to smog and also contain several air toxics.

To clean up Minnesota's air and protect public health, the state needs to take action to reduce pollution from all sources. Cleaning up cars and light-duty trucks must be an important part of that effort.

Air Pollution Threatens Minnesota's Special Places and Contributes to Global Warming

Smog and toxic air pollutants can pose a direct and immediate threat to Minnesotans' health. But another set of pollutants from vehicles poses an even more dramatic and long-term threat to the state's future. Carbon dioxide and other global warming pollutants contribute to climate change, which is already beginning to reshape Minnesota's natural environment and could have dramatic impacts in the years and decades to come.

Global Warming Impacts on Minnesota

Global warming pollutants, such as carbon dioxide, warm the planet by trapping heat in the earth's atmosphere. Temperatures worldwide have already begun to rise: global average temperatures increased during the 20th century by about 1.3° F (0.74° C), an increase unprecedented in the last 1,300 years of world history.[31]

Climate scientists warn that the world faces dire consequences unless we find a way to reduce our emissions of global warming pollutants deeply and soon. The Intergovernmental Panel on Climate Change, in its 2007 *Fourth Assessment Report*, analyzed the impacts of a scenario in which population, economic output and fossil fuel consumption continue to grow dramatically. Under that scenario, global average temperatures by the end of the century would be approximately 7.2° F (4.0° C) higher than in 1990, and temperatures would continue to rise for generations to come.[32]

The rise in temperatures that has been observed globally has been taking place in Minnesota as well. The State Climatology Office determined that temperatures in Minnesota have risen 1.8° F since 1894. This temperature change has been even more dramatic in northwest Minnesota, where temperatures between 1960 and 2001 increased 12° F in the winter and 4° F in the summer.[33] Scientists predict that, if nothing is done to curtail emissions, summer weather in much of Minnesota could feel like the current summer weather in Kansas by the end of this century.[34] In addition, winters are likely to become wetter and summers drier in the Great Lakes region, leading to greater risk of drought.[35]

Warming of this magnitude would change Minnesota's treasured natural places—our 10,000 famous lakes, the cherished Boundary Waters wilderness, and vast forests—forever. Indeed, some changes have already begun.

Lakes, forests, and animal populations have already begun to show the effects of global warming. The ice on Minnesota's lakes has been breaking open in the spring an average of 1.3 days earlier every decade since the mid-1960s.[36] This early melting is not only an inconvenience to ice fishers, but it also changes the character of the lakes, allowing for greater evaporation and, combined with warmer temperatures, likely resulting in lower water levels in the future. Warmer waters in rivers, streams and lakes may also make it impossible for cold-water fish such as walleye, northern pike, and trout to continue to live in some of the waterways in which they live today.[37]

Minnesota's forests are also in danger of being permanently altered. Lee Frelich, director of the Center for Hardwood Ecology at the University of Minnesota, warned in the *University of Minnesota News*, "Unless we take steps now, the forests we have today simply won't be there anymore."[38] Frelich believes that rising temperatures will kill the northerly species of trees in the Boundary Waters, such as jack pine, red pine, balsam fir and black spruce. In their place, southerly species of trees such as red maple or oak will grow if there is sufficient water.[39] If the warmer

Global Warming and Smog

Global warming and health-threatening air pollution might seem to be separate issues, but they are related. In a warming world, Minnesota will experience more of the hot days on which smog formation occurs. A recent study estimated that, if pollutant levels remain constant, the number of days on which ozone exceeds health benchmarks will increase by 68 percent in 50 eastern and midwestern U.S. cities.[43]

weather brings drought, however, the Boundary Waters area itself could begin to resemble oak savannahs, dominated by grassy prairies and intermittent stands of oak trees.[40]

These changes in habitat and climate will have massive ramifications for native animal populations. Scientists believe that global warming may be one reason why moose herds have dwindled in the state. While moose population trends in northeast Minnesota are harder to discern, in northwest Minnesota, the moose population has declined from approximately 4,000 in the mid-1980s to less than 100 today.[41] One study found that the moose population growth rate was inversely related to average summer temperatures, with the possibility that moose are weakened by expending energy to keep cool. The same study projected that "the northwest Minnesota moose population likely would not persist over the next 50 years."[42]

Cars and Trucks Are a Major Source of Global Warming Pollution in Minnesota

Minnesota is a large producer of global warming pollution. In 2005, the state emitted 157 million metric tons of carbon dioxide equivalent (CO_2e), which amounted to 2.4 percent of net emissions in the United States.[44] Gasoline use for transportation in Minnesota (the vast majority of which goes into cars and light-duty trucks) produced 23.4 million metric tons of carbon dioxide in 2005—that is more carbon dioxide than is produced by the entire economies of 137 of the world's nations, including Croatia and Lebanon.[45]

Transportation is responsible for a quarter of Minnesota's global warming pollution and emissions from cars and light-duty trucks have been increasing rapidly.[46] Between 1990 and 2005, carbon dioxide emissions from gasoline use in transportation increased by 39 percent as Minnesotans drove more miles—often in less-efficient vehicles.[47]

Increasing Vehicle Travel Would Create More Pollution

Although today's cars produce less health-threatening pollution per mile than did those of a few decades ago, those gains have been undercut to a degree by rising vehicle travel on Minnesota's highways.

It has been assumed that the number of miles driven on the state's highways would continue to increase, as it has historically. For example, the number of miles traveled on Minnesota's highways increased by 37 percent between 1992 and 2007—twice the rate of population growth.[48] The state of Minnesota has projected that, from 2004

to 2030, vehicle-miles traveled (VMT) will increase at an annual rate of 1.7 percent, meaning that by 2030, Minnesotans would be driving 55 percent more miles each year than they did in 2004.[49] Continued VMT increases at this level would challenge both Minnesota's ability to continue to meet air quality goals as well as the ability to meet targets for global warming pollution reductions set by Governor Pawlenty and the state legislature through the Next Generation Energy Act of 2007.

Recently, however, partly as a result of high gasoline prices in the early part of 2008 and the current recession, Minnesotans have been driving fewer miles, bucking the historical trend. For the 11 months ending November 2008, VMT on Minnesota's highways had decreased by 3.5 percent from the year before.[50]

It is difficult to know whether the recent decline in vehicle travel is the result of temporary factors such as gasoline prices and economics, or is a sign of longer-term changes. But to protect Minnesotans' health and the future of our state's special places, we need to establish standards for automobile pollution strong enough to withstand future growth in vehicle travel.

Fortunately, there are many technologies available to reduce pollution from cars and light-duty trucks. In states across the country that have adopted the Clean Cars Program, those vehicles are already beginning to hit the road.

Clean Vehicles Are a Sensible Solution for Minnesota

Cars and pollution do not need to go hand in hand. The technology to markedly reduce air and global warming pollution from our cars and light-duty trucks exists today, and new technologies can reduce pollution even further.

States that have adopted the Clean Cars Program are beginning to see these clean new vehicles take to the highways. And those states will be the first in line for the innovative new vehicles of the future.

Clean Technologies Already Exist that Can Reduce Pollution from Cars and Light-Duty Trucks

Car-based pollution gets into our air in two main ways: in the exhaust from burning gasoline and the evaporative pollution from the vehicle's fuel system. Cleaner car technology allows consumers to cut pollution while maintaining the safety, comfort, speed, and the size of their vehicles. In fact, versions of many models well-known to Minnesota consumers are already manufactured with cleaner emissions technology or higher gas mileage.

Cleaner Gasoline Cars

When it comes to tailpipe emissions of smog-forming and other dangerous pollution, today's cars are a big improvement from the pollution-belching behemoths of yesteryear. Today's cars are approximately 90 percent cleaner, on average, than those of 30 years ago—although the near-tripling in vehicle travel nationwide since 1970 has resulted in vast amounts of pollution still being spewed into the air.[51] Those improvements have been driven by the strong, technology-forcing emission standards imposed by California and other states, many of which have later been adopted at the federal level. Cleaner cars have been made possible by a variety of innovations, including cleaner-burning engines, better control of engine systems through computerization, cleaner fuels, and advanced emission control technologies.

In evaluating health-threatening pollution from gasoline-powered vehicles, the Clean Cars Program's partial zero emission vehicle (PZEV) rating is the "gold

standard" by which all other vehicles are judged. Vehicles certified to the PZEV standard are not only 90 percent cleaner than the average vehicle sold in 2004, but they also have near-zero evaporative emissions and have warranties that ensure that they will remain clean for 150,000 miles.[52]

At least 50 models of 2009 vehicles have been certified to the PZEV standard. These vehicles are on sale now in states with the Clean Cars Program, in configurations similar to those of vehicles in Minnesota showrooms. These vehicles span the gamut—from economy cars to luxury models and from compact cars to four-wheel drive vehicles. They include the economical Hyundai Elantra, the sporty Mitsubishi Lancer, the family-sized Toyota Camry sedan, and the Dodge Journey and Jeep Compass SUVs. What these vehicles share is advanced emission control equipment, and in some cases advanced engines, that virtually eliminate smog-forming pollution. (See Table 1.)

In addition to making vehicles that produce far less smog-forming pollution, manufacturers are also making vehicles that produce less global warming pollution using technologies designed to increase vehicle fuel economy. In some cases, these technologies are largely invisible to drivers—innovations such as continuously variable transmissions and cylinder deactivation

Table 1. Sample List of 2009 Ultra-Clean (PZEV) Gasoline Vehicles[53]

Mfr.	Vehicle	Mfr.	Vehicle
Audi	A3	Mazda	Tribute Hybrid
BMW	128i		Mazda 3
	328Ci		Mazda 6
	328i	Mercedes-Benz	C350
Buick	Lucerne		E350
	Lacrosse	Mercury	Mariner Hybrid
Chevrolet	Cobalt		Milan
	Malibu	Mitsubishi	Galant
Chrysler	Sebring		Lancer
Dodge	Caliber	Nissan	Altima
	Avenger		Altima Hybrid
	Journey	Pontiac	G6
Ford	Escape Hybrid		G5
	Fusion	Saturn	Aura
	Focus	Subaru	Forester
Honda	Accord		Legacy
	Civic GX CNG		Outback
	Civic Hybrid	Toyota	Camry Hybrid
Hyundai	Elantra		Camry
	Sonata		Prius
Jeep	Patriot	VW	V50
	Compass		GTI
Kia	Rondo		Jetta
	Spectra		New Beetle
			S40
			Rabbit

(which shuts down some cylinders in a car's engine when they are not needed). Other innovations, such as fuel-efficient hybrid-electric vehicles, have delivered large gains in fuel economy.

Gasoline/Electric Hybrid Cars

Perhaps the most iconic of hybrid cars on sale in the United States, the Toyota Prius is just one of a wide variety of vehicles that combine a gas-burning engine with an electric motor. In these gasoline/electric hybrids (also called "hybrid-electric vehicles"), a gasoline engine is used to operate a conventional drive train. The gasoline engine is supplemented by an electric motor, whose battery is charged by re-capturing kinetic energy that is lost in conventional vehicles during braking. The electric motor is additionally used to drive the vehicle at certain speeds, and an on-board computer directs seamless switching between the vehicle's gasoline and electric modes. In many hybrids, the gasoline engine also shuts down during idling, which creates further pollution savings.

Today, there are at least 18 models of hybrid-electric vehicles available to American car-buyers. The most advanced hybrid-electric vehicles can deliver highway fuel economy of greater than 40 miles per gallon. Other hybrid vehicles do not post such large fuel economy numbers but help reduce emissions in important segments of the automobile market. Hybrid SUVs such as the Ford Escape, Mercury Mariner and Toyota Highlander, for example, provide significant fuel savings versus conventional SUVs.

There are an increasing number of vehicles that achieve both state-of-the-art emission levels and incorporate advanced hybrid technologies. These vehicles earn the advanced technology PZEV (AT-PZEV) certification in the Clean Cars Program. Among these vehicles are the hybrid versions of the Ford Escape, Honda Civic, Mazda Tribute, Nissan Altima, Toyota Camry and Toyota Prius.[54]

Beyond cutting air pollution, these vehicles deliver additional benefits to consumers. Hybrids save drivers money at the gas pump by burning less gasoline, and the electric motors of hybrid cars offer the added bonus of a quieter, more pleasant ride.

Compressed Natural Gas Cars

Compressed natural gas (CNG) vehicles use internal combustion engines, but burn natural gas rather than gasoline. Natural gas is a cleaner, less polluting fuel, and CNG vehicles generally produce lower amounts of health threatening pollution than gasoline powered vehicles. CNG vehicles still produce carbon dioxide, but depending on the vehicle, may deliver re-

Table 2. Model Year 2009 Hybrid Vehicles[55]

Mfr.	Model
Cadillac	Escalade
Chevrolet	Malibu Silverado Tahoe
Ford	Escape*
GMC	Sierra Yukon
Honda	Civic*
Lexus	GS450h LS600hL
Mazda	Tribute*
Mercury	Mariner*
Nissan	Altima*
Saturn	Aura Vue
Toyota	Camry* Highlander Prius*

* certified AT-PZEV, signifying extremely low emissions of health threatening pollutants

ductions in global warming pollution. Just one mass-produced CNG car, the Honda Civic GX CNG, is available to U.S. consumers. It is also possible to retrofit other, gas-burning cars with CNG fuel, though this method is not widely used.

Plug-in Hybrids and Zero-Emission Battery Electric Cars

While cleaner gasoline-burning cars and light-duty trucks are good, and hybrids are largely better when it comes to air pollution, the best technology would emit no tailpipe pollution whatsoever. Researchers and the automobile industry are eyeing several technologies, including electric vehicles, to meet this goal.

Over the past two decades, a small number of zero-emission battery-electric cars have been placed on America's roads, mostly in California. These vehicles run exclusively on battery power—using no gasoline—and are charged during periods when they are not in use. Most can travel at highway speeds over a distance of 100 to 120 miles before requiring a re-charge. With improved battery capacity on the horizon, this travel range could jump to nearly 250 miles by 2015.[56] Since 78 percent of Americans drive fewer than 40 miles per day to and from work, battery-electric vehicles could meet the day-to-day travel needs of many Americans.[57]

Automakers are also pursuing a type of vehicle that, while not zero-emission, has the potential to be far more energy efficient and far cleaner than today's vehicles. "Plug-in" hybrids combine the attributes of conventional hybrid vehicles with battery-electric cars. Like conventional hybrids, plug-ins contain a gasoline engine that provides some of the vehicle's power. But, like battery-electric cars, plug-in hybrids can be recharged from the electric grid, meaning that plug-ins could go between 20 and 40 miles on battery power alone.

While there are no mass-produced electric or plug-in hybrid highway vehicles on sale today, automakers are moving rapidly toward commercialization of these technologies. Both General Motors and Toyota have committed to marketing a plug-in hybrid vehicle by 2010 (the proposed Chevy Volt would be GM's entry, while Toyota is working on a plug-in version of the Prius). Several automakers are planning to introduce battery-electric vehicles in the years to come.[58]

The super-clean vehicles described above—clean gasoline vehicles, hybrids, natural gas vehicles, plug-in hybrids and electric cars—are dramatic improvements in automobile technology. But while these vehicles are leading the industry, it will take incremental improvements to a wide variety of vehicles to clean up Minnesota's air and reduce our contribution to global warming.

Setting tough standards for vehicle emissions and giving auto manufacturers substantial leeway in how to meet those standards can drive environmental improvements throughout the vehicle fleet—from compact cars to large pickups—while promoting the development of the super-clean cars that will raise the bar for vehicle performance in the future.

The Clean Cars Program Will Get Cleaner Cars and Light-Duty Trucks on Minnesota's Roads

The technology currently exists to make the cars and light-duty trucks on Minnesota's roads dramatically cleaner and to reduce their impact on global warming. Even more exciting technologies are on the way. The Clean Cars Program—now adopted by 14 states—can help put these vehicles in the hands of Minnesota's drivers.

The Clean Cars Program exists because of a special provision in the federal Clean

The EPA and the Global Warming Pollution Standard

The Clean Air Act requires that California receive a waiver from the federal Environmental Protection Agency before it, or any other state adopting the Clean Cars Program, can enforce the standards. Historically, the granting of the waiver has been a formality: before the Bush administration came into office, the EPA had never denied California a waiver for its air pollution control programs.[59]

However, the Bush administration EPA denied California the necessary waiver for enforcing the global warming emission standards portion of the Clean Cars Program. As a result, neither California nor the other states that have adopted the program can currently enforce that portion of the standards. The Obama administration has pledged to review the EPA's decision on the waiver. Should the waiver be granted, states with the Clean Cars Program can finally begin to reduce global warming pollution from cars and light-duty trucks– a move that will both benefit the environment and contribute to reducing America's dependence on oil.

Air Act that allows the state of California to design and impose its own emission standards for cars in order to deal with air pollution concerns. The Clean Air Act also allows other states to adopt California's stricter standards in lieu of weaker federal standards.

Over the past several decades, the Clean Cars Program has succeeded in pushing automakers to design new emission control technologies that have led to dramatic improvements in air quality across America. The key elements of the program are the Low-Emission Vehicle (LEV) standards to reduce emissions of smog-forming and toxic pollutants from vehicles, and the global warming pollution standards.

Low-Emission Vehicle (LEV) Standards

The goal of the Low-Emission Vehicle portion of the Clean Cars Program is to reduce vehicular emissions of smog-forming and toxic pollution, which threaten the health of Minnesotans. Under the standards, automobile manufacturers must meet a declining "fleet average" standard for a key set of smog-forming pollutants. The standards give automakers several levels of tailpipe emissions to choose from—manufacturers may sell some "dirtier" vehicles, so long as they are balanced by the sale of cleaner vehicles. As the standards become stricter over time, manufacturers will be required to sell a greater share of clean vehicles.

Global Warming Pollution Standards

The Clean Cars Program also includes limits on tailpipe global warming pollution. The limits are designed to require the maximum, cost-effective reduction in global warming pollution from vehicles. Like the LEV standards, the global warming pollution standards work on a fleet average basis—manufacturers can sell higher-polluting vehicles, such as large light-duty trucks or SUVs, so long as they also sell cleaner vehicles. Over time, as the standard for global warming pollution declines, manufacturers will be required to reduce the amount of global warming pollution that comes from their entire fleet, reducing the threat cars and light-duty trucks pose to the global climate.

The Clean Cars Program Will Reduce Air Pollution

The Clean Cars Program is an important tool Minnesota can deploy to reduce air pollution. The program limits the emission of health-threatening pollutants that create smog and increase our risk of developing cancer. In addition, the program can help protect Minnesota's natural resources by limiting global warming pollution from vehicles.

Clean Cars and Light-Duty Trucks Will Reduce Health-Threatening Air Pollution

The Clean Cars Program is one of the most effective tools available for states to reduce health-threatening air pollution from passenger vehicles. With tighter controls on tailpipe and evaporative pollution, plus a mechanism to advance vehicle technologies, the Clean Cars Program can help Minnesota move toward cleaner air.

Studies of the Clean Cars Program from locations across the country confirm that the program delivers real value.[60] One of the most comprehensive and detailed analyses was performed by an association of state air quality agencies in the Northeast. The association found that, under the Clean Cars Program:[61]

- Tailpipe emissions of smog-forming NOx from light-duty vehicles would fall by more than 15 percent by 2025 compared to current federal standards, and
- Passenger vehicle emissions of toxic and smog-forming volatile organic compounds (VOCs) would fall by more than 6 percent beyond what federal limits deliver.[62]

In addition, the association estimated that the Clean Cars Program will reduce emissions of some toxic air pollutants from vehicles by an additional 8 percent or more.[63] In particular, the program will help reduce emissions of benzene and formaldehyde, two cancer-causing chemicals flagged as a concern by the Minnesota Pollution Control Agency.[64]

Moreover, the Clean Cars Program lays the groundwork for new, advanced zero-emission vehicle technologies. For

example, automakers responded to the original creation of the Clean Cars Program in 1990 by increasing research and development around clean electric vehicle technology.[65] These efforts helped pave the way for today's popular hybrid-electric vehicles. Similarly, today's Clean Cars Program is paving the way for the zero-emission technologies of the future.

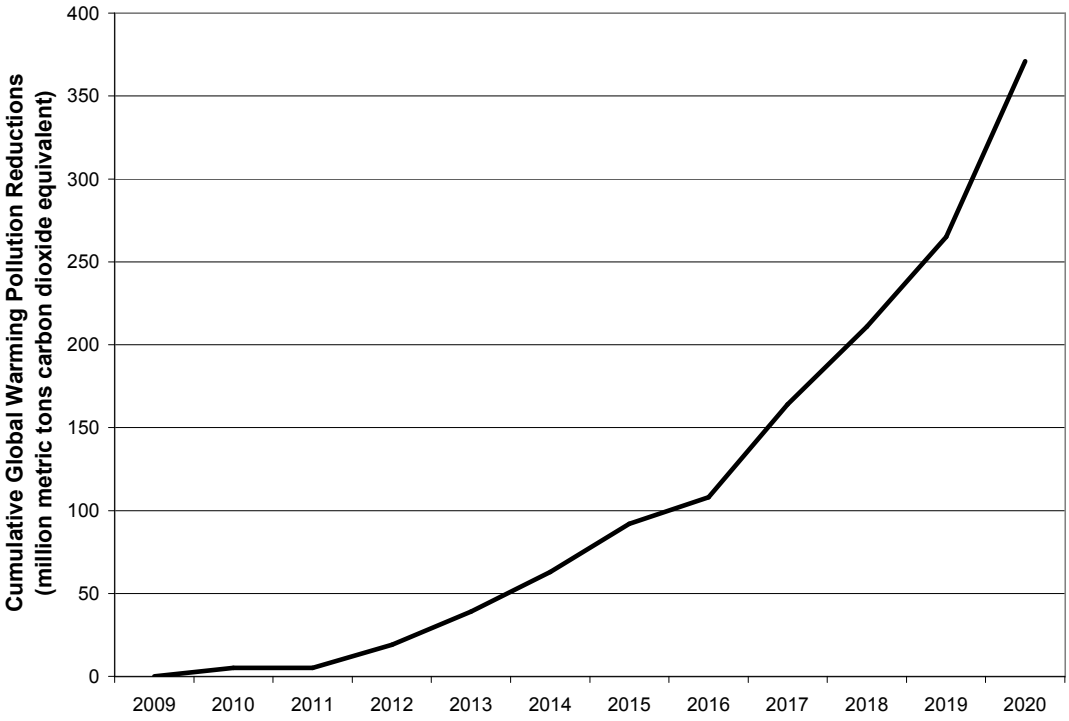
Clean Cars and Light-Duty Trucks Will Curb Global Warming Pollution

In addition to reducing public health hazards, the Clean Cars Program can help protect Minnesota's natural treasures by reducing vehicle emissions of global warming pollution.

In Minnesota, experts expect on-road gasoline vehicles to release 22.7 million metric tons of carbon dioxide pollution (or its equivalent) every year through 2025.[66] Emissions will remain relatively constant over the next decade, as updated federal fuel economy regulations set to begin with the 2011 model year offset the effects of increasing vehicle travel.[67]

Under the Clean Cars Program, however, automakers would introduce technological advances ranging from improved air conditioning systems to efficient transmissions. Compared to 2002 vehicles, by 2015 new vehicles under the Clean Cars Program would emit 34 percent less global warming pollution on average, and light-duty trucks 25 percent less pollution.[68] By 2020, new cars and light-duty trucks would produce 40 percent less global warming pollution.[69]

Figure 5. Cumulative Benefit of the Clean Cars Program, Were It Adopted by all 50 U.S. States[73]



As a result, under the Clean Cars Program, passenger vehicles in Minnesota would produce 13.1 million metric tons less global warming pollution (CO_2 equivalent, CO_2e) between now and 2025.[70] That is as much pollution as would be reduced by taking nearly 2.5 million vehicles off the road for a year.[71]

If every state in America adopted the Clean Cars Program, it would prevent more than 370 million metric tons of global warming pollution (CO_2e) through 2020—41 percent beyond what could be achieved under federal regulations alone.[72] (See Figure 5.)

Other Benefits of Clean Cars and Light-Duty Trucks

Beyond the obvious health and environmental benefits of clean vehicles, there are many other benefits Minnesotans can enjoy by adopting the program.

The Clean Cars Program Will Save Consumers Money at the Pump

In the long run, the Clean Cars Program will save Minnesotans a significant amount of money. Clean and fuel-efficient cars have lower operating budgets and consume less fuel, saving consumers money throughout the life of their vehicles.

Clean cars and light-duty trucks do cost more up front. The technological changes needed to meet the 2016 global warming targets for cars and the lightest light-duty trucks could cost an additional $1,064. For heavier light-duty trucks, there would be a $1,029 increase in costs.[74]

However, the Clean Cars Program will create significant savings for consumers over the life of their vehicles. With gas prices at $1.74 per gallon, the Minnesota Climate Change Advisory Group determined that Minnesota consumers would save upwards of an additional $260 million by 2025, beyond any benefits of proposed increased federal fuel economy standards.[75] At those gasoline prices, a consumer who buys a new car in 2016 will save $3 to $7 per month compared with what he or she would have spent under former federal fuel economy standards, with lower spending on gasoline outweighing the potentially higher costs of his or her auto loan. After the loan is paid off, the consumer will save $24 to $27 per month compared to a car purchased under old federal fuel economy standards.[76] And if gasoline prices return to $3 per gallon, consumers will save even more: $20 to $27 per month while paying back their loans and $41 to $47 per month after the loans are paid back, again compared to old federal fuel economy standards.[77]

Actual benefits for consumers are likely to be even higher than these estimates. History has shown that both automakers and regulators tend to overestimate production and retail costs.[78] For example, in 1994 the automakers claimed that the cost of meeting the California "Transitional LEV" standard would be $862. The actual cost of production, though, turned out to be $120, and the costs to consumers in some cases were even lower.[79] Regulators are already predicting that the incremental costs of clean vehicles will decline in the next decade.[80] Thus, it is likely that consumers will enjoy even greater savings as the initial costs decline.

The Clean Cars Program Will Reduce America's Dependence on Oil

Adopting the Clean Cars Program will also help to reduce America's dependence on oil. By 2020, the California vehicle fleet (subject to the Clean Cars Program) will have an average fuel efficiency standard of 43 miles per gallon, compared to 35 miles per gallon for cars following the federal corporate average fuel economy (CAFE)

standards.[81] In Minnesota, the gasoline savings would amount to 146 million gallons per year by 2020—the same amount of gasoline as would be saved by taking nearly 245,000 of today's vehicles off the road. Cumulatively, the gasoline savings between now and 2020 would equal 785 million gallons, reducing gasoline expenditures by $1.4 billion.[82]

Conclusion and Policy Recommendations

Air pollution continues to threaten public health in Minnesota, while global warming pollution threatens the future of much that makes Minnesota unique: from the Boundary Waters wilderness to our vast forests to the health of our 10,000 lakes. Pollution from cars and light-duty trucks is a leading contributor to both our air pollution troubles and to global warming, and reducing that pollution must be a key public policy goal.

Adoption of the Clean Cars Program is one of the most effective steps Minnesota can take to address these challenges. In addition, Minnesota should consider other steps to reduce pollution from vehicles, including:

- Financial incentives for the purchase of energy efficient and advanced technology vehicles.
- Investments in public transportation and other alternatives to driving.
- Changes in land-use planning that encourage the development of compact, walkable communities where driving is an option, not a requirement.
- State government purchases of energy efficient and advanced technology vehicles.
- Regulatory efforts to reduce pollution from diesel trucks.

By adopting the Clean Cars Program and pursuing a broad strategy to reduce pollution from vehicles, the state can protect the health of Minnesota residents and take concrete action to reduce its contribution to global warming.

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