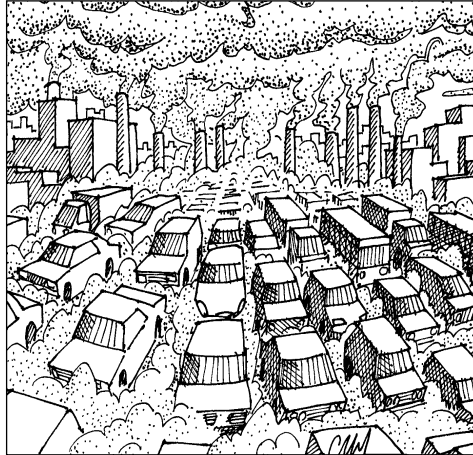


HEALTH, POLLUTION, AND SAFETY: THE CHALLENGE

Air pollution from vehicles has been a problem since the smell of exhaust from horseless carriages replaced the smell of horse manure. The smell is no longer the chief concern. Pollutants that cause health problems, smog, acid rain, and greenhouse gases (those gases that contribute to global warming and climate change) have become much more important, especially as the number of vehicles has grown.

Air pollution, which causes high levels of smog and respiratory problems, was first linked to traffic in the Los Angeles basin in the early 1950s. Within 20 more years, air pollution had grown across the country, and in 1970 the United States adopted the first Clean Air Act to promote clean air for all. This act identified six major pollutants caused by industry and transportation and established standards for clean air; the U.S. Environmental Protection Agency began to closely monitor the air for these "criteria" pollutants: carbon monoxide, lead, nitrogen oxides, ozone, particulate matter, and sulfur dioxide. (These are explained in more detail in the handout *Automobile-Related Emissions*.)

Between 1970 and 1997, the U.S. population increased 31 percent, while vehicle miles driven increased 127 percent. During that time, thanks to clean air regulations and improvements in industrial and automotive technology, total emissions of the six criteria pollutants decreased 31 percent. Unleaded gasoline replaced leaded gasoline, eliminating emissions of this pollutant from tailpipes. The use of reformulated gasoline in some areas of the country reduced carbon monoxide levels. More efficient engines, better tires, and aerodynamic styling reduced the amount of fuel needed per mile of travel, thereby reducing emissions per mile. Improved emission controls cut emissions further.



HEALTH

Despite this progress, approximately 107 million people still live in "non-attainment" areas, or counties that do not meet national standards for air quality. High levels of ozone, prevalent in some regions of the country especially during summer months, are a special concern to nearly 102 million people. The widespread use of mass transit and bicycles can speed the progress toward clean air for all; the popularity of large vehicles getting low mileage can easily reverse it.

In addition to the six criteria pollutants, emissions from petroleum fuels contribute a large percentage of our nation's air toxins. Gasoline is the largest source of human-made substances known to cause cancer. It contributes three-quarters of the U.S. total of these substances, with diesel fuel adding another eighth (Clean Fuels Foundation, 2000).

CLIMATE

By the end of the 20th century, the accumulation of greenhouse gases in the atmosphere was also added to our list. The greenhouse effect is a warming of the Earth and its atmosphere as solar energy is trapped by natural and human-made gases, including carbon dioxide—a major greenhouse gas—which results from the burning of fossil fuels. (See diagram, *Products of Combustion*.) The Intergovernmental Panel on Climate

Change, representing more than 2000 of the world's leading climate scientists, has concluded that human actions are influencing the world's climate. The *U.S. Climate Action Report 2002* documented the potential effects of a changing climate on the United States. Some of these effects include a rise of sea level resulting in a loss of coastal wetlands and barrier islands and an increased danger to coastal homes from storm surges; an increased potential for drought and the disruption of snow-fed water supplies; and the loss of ecosystems such as the Rocky Mountain meadow and certain coral reefs.

Passenger cars emit 20 percent of the carbon dioxide emissions produced in the United States. In fact, cars in the United States produce 5 percent of the world's carbon dioxide emissions. (This is more than the emissions of any single country except the United States, China, Russia, and Japan.) In 1997, the international community developed a treaty on global warming known as the Kyoto Protocol. This treaty seeks to reduce net worldwide emissions of carbon dioxide and other greenhouse gases to pre-1990 levels. The United States' Bush administration rejected the treaty in 2001. Despite this setback, it is likely that the protocol will take effect and become international law. By 2002, most of the world's nations, including all of the European Union and Japan, had ratified the protocol. Russia's cabinet had given preliminary approval to the treaty.

ENVIRONMENT

In cars with combustion engines, pollutants and greenhouse gases are produced in inefficient engines and emitted from tailpipes. They leak from vapor lines and crankcases onto highways and parking lots. They escape during fuel processing, and evaporate from storage or fuel tanks and during vehicle refueling.

Periodically, lubricants and batteries must be changed; these and parts contaminated with toxic chemicals must be disposed of. Electric cars are themselves much cleaner than conventional vehicles. But pollutants are produced at the utility plants that supply their power, and the disposal

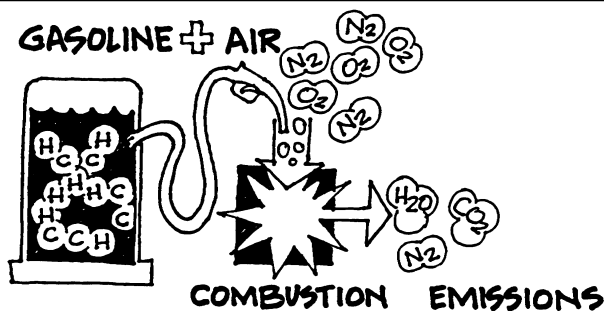
of batteries and other parts may create environmental problems.

Each fuel and drivetrain now being researched and developed has advantages and disadvantages in easing the problems above. As alternative fuels are developed for transportation, technologies for safe

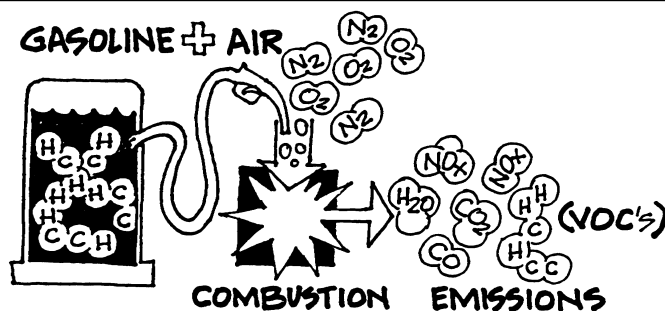
storage, delivery, and use also need to be developed. No one fuel may be the perfect solution for the country at large, but in some regions of the country safe use of alternative fuels can greatly reduce health and environmental problems. In combination with mass transit or bicycling, the impact is even greater.

PRODUCTS OF COMBUSTION

"PERFECT" COMBUSTION



TYPICAL COMBUSTION



fuel (hydrocarbons) + air (oxygen and nitrogen)	=	carbon dioxide + water + unaffected nitrogen
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fuel (hydrocarbons) + air (oxygen and nitrogen)	=	unburned hydrocarbons + nitrogen oxides + carbon dioxide + carbon monoxide + water
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Source: EPA Office of Transportation Technologies, previously the Office of Mobile Sources

PRODUCTS OF COMBUSTION

Gasoline and diesel fuels are formed from a combination of petroleum and natural gas. They are mixtures of hydrocarbons, compounds that contain hydrogen and carbon atoms.

In a "perfect" engine, oxygen in the air would combine with all the hydrogen in the fuel to produce water, and with all the carbon to produce carbon dioxide, a greenhouse gas. Nitrogen, which is naturally found in the air, would remain unaffected.

In reality, the combustion process is not perfect. The result is a mix of unburned hydrocarbons, nitrogen oxides, and carbon monoxide,

which have ill effects on human health, on crops and vegetation, and consequently on animals.

All gasoline is not the same. While some fuels have additives that increase octane for more power, others contain ingredients to change the end products of combustion. For example, oxygenates (additives containing hydrogen, carbon, and oxygen) promote more complete combustion, reducing tailpipe emissions. Common oxygenates include ethanol and methyl tertiary butyl ether (MTBE), which is made from methanol. Oxygenated fuels are especially useful during cold winter months, when carbon monoxide levels increase.

Some fuel additives have been found to present serious health risks. At one time lead was added to gasoline to increase power, but it was phased out of use in the 1970s because of the health risks it presented, especially to children. MTBE is now being found unburned in the environment and is appearing in freshwater supplies. It is being phased out in some states because of its high toxicity.

"Reformulated gasoline," or RFG, is a blend of gasoline with a minimum of 2 percent oxygen and a maximum of 1 percent benzene (an air toxin) but no heavy metal additives such as lead (which increase octane). This formula reduces hydrocarbons and toxic emissions. It is considered a clean fuel, not an alternative fuel.