Travel Advisory:
Why SEPTA Must Dump Dirty Diesel

By the Pennsylvania Public Interest Research Group Education Fund
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Table of Contents

Executive Summary

Air pollution is causing a public health crisis in Pennsylvania. From urban centers such as Philadelphia and Pittsburgh, to more rural areas such as Lancaster and Greensburg, Pennsylvanians are breathing in a complex mixture of chemicals that wreak havoc on our health. Air pollution is linked to numerous health problems, ranging from respiratory illnesses like asthma and chronic bronchitis to reproductive and developmental disorders. Ultimately, air pollution leads to the premature death of thousands of Pennsylvanians each year.

The pollutants responsible for such health effects are often found in Pennsylvania s air at levels far above what the Environmental Protection Agency (EPA) considers safe. During the summer of 1999, air pollution monitors in the state recorded more than 512 violations[1] of the EPA s health-based standard for ozone. In a recent report, the EPA also estimated that the air in Philadelphia County exceeds their safe cancer risk by 297 times. [2]

There may not be a more recognizable or offensive form of air pollution than the emissions from diesel powered vehicles. The thick, black, noxious exhaust spewing from the tailpipes of heavy-duty diesel trucks and buses plagues everyone urban residents living near heavily trafficked bus depots; commuters stuck on the expressway behind a diesel-powered vehicle belching out the offensive smoke; bicyclists maneuvering down city streets in a cloud of soot from the city buses in front of them. While significant strides have been made in the last thirty years to reduce emissions from mobile sources such as cars, diesel vehicles emitted *more* soot and smog pollution in 1997 than they did in 1970 when the Clean Air Act was passed.[3]

City transit buses, such as those operated by the Southeastern Pennsylvania Transportation Authority (SEPTA) contribute a significant amount of the diesel emissions in Philadelphia County. This report finds that in 1996, SEPTA s urban transit buses *alone* emitted an estimated 28% of the total smog-forming nitrogen oxide (NOx) emissions from mobile diesel sources in Philadelphia County.

The pollutants emitted from these transit buses can be just as deadly as those from power plants and manufacturing facilities located miles away, and are significantly more hazardous than emissions from gasoline powered vehicles. This report outlines those dramatic public health implications, the contribution of one transit agency (SEPTA), as well as the technology and resources available to improve air quality in Pennsylvania.

Some of the key findings of this report include:

- SEPTA urban transit buses emit an estimated 3.75 million pounds of smog-forming nitrogen oxide (NOx) pollution into the region s air annually. This accounts for approximately 28% of the on-road diesel NOx emissions in Philadelphia County.

- Each year, these same buses emit approximately 44,000 pounds of particulate matter (PM), the tiny soot particles that contribute to respiratory infection and premature death.

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[1] According to the EPA s 8-hour standard for ozone
[2] Natural Resources Defense Council (NRDC) fact sheet, May 1999; available at www.nrdc.org/nrdcpro/cep
[3] National Air Pollutant Emission Trends Update 1970-1997, U.S. EPA.

- Each year, SEPTA s urban transit buses are also responsible for emitting more than 397 million pounds of carbon dioxide (CO2), the main cause of global warming.

- Dozens of public transit agencies across the nation, including SunLine Transit in Thousand Palms, California and Pierce Transit in Tacoma, Washington have found great success with cleaner transit buses that achieve lower emissions while operating economically and efficiently.

- If SEPTA were to immediately replace its entire fleet of diesel buses with the cleanest available technology, its emissions of smog-forming nitrogen oxide would be cut by about half, particulate matter could be virtually eliminated, and carbon dioxide emissions could be cut by approximately 26%.

- Several state and federal entities, including the Pennsylvania Department of Environmental Protection (PA DEP) and Congress have created programs to provide financial assistance in the form of grants and rebates to encourage the purchase of alternative fuel vehicles (AFVs) for public transit agencies.

- SEPTA received more than 8 million dollars in grants in 1995 to purchase alternatively fueled vehicles (AFVs). However, as of May 2000, the agency has not ordered a single AFV and is effectively sitting on the grant money while the public s health is adversely impacted by their continued reliance on diesel.

While the public health implications outlined in this report should be enough to prompt transit authorities to dump diesel, this report will highlights several other reasons why agencies such as SEPTA must lead the way with emerging technologies that offer clean emissions.

If SEPTA truly is Serious About Change, as their slogan suggests, the agency must commit to protecting the health of the community they serve by phasing out dirty diesel buses. This requires an immediate commitment to making a significant investment in buses that offer the greatest public health benefits by reducing emissions, with the goal of replacing its entire fleet with clean buses by 2020.

Public transit is an indispensable tool in the battle for clean air and healthy communities. A system that is clean, efficient, accessible and widely used will improve air quality, reduce congestion and protect open spaces from development. Local officials who determine which fuels and vehicles SEPTA will use to carry us into the 21st century have an enormous opportunity before them. Their decisions will greatly impact the health of our communities, and must include a commitment to Dump Diesel Now!

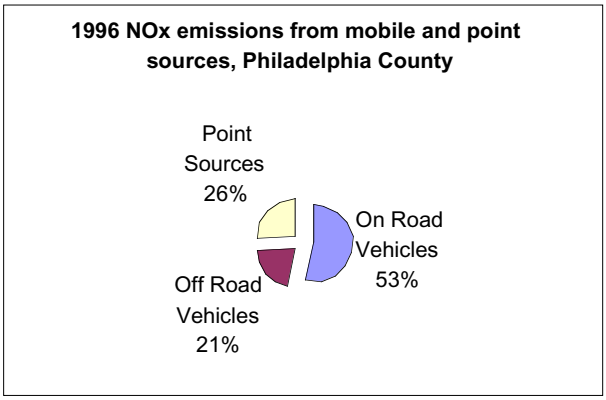
The Dangers of Diesel: How our Health and Environment Suffer

As citizens demand clean air, a great amount of attention has been paid to the highly polluting and toxic nature of diesel exhaust. Notably, the California Air Resources Board (CARB) recently completed years of scientific study and public review, prompting the State of California s Scientific Review Panel to unanimously label diesel exhaust as a Toxic Air Contaminant (TAC). These and other actions have had national implications, prompting the U.S. EPA to further analyze the toxicity of diesel exhaust and propose new regulations to protect public health.

Recent scientific analyses have found that diesel exhaust is a complex mixture of hundreds of chemical compounds, including extremely high quantities of smog-forming nitrogen oxides, fine particulate matter which contributes to premature death, and more than 40 chemicals that are known to cause cancer or other adverse health effects.[4] This section outlines some of the worst pollutants contained in diesel exhaust, as well as the health and environmental problems associated with these contaminants.

Nitrogen Oxide

Nitrogen oxide (NOx) is the primary ingredient in ground-level ozone, also known as smog. Smog pollution is our nation s most prevalent air contaminant, and is formed when NOx combines with volatile organic compounds (VOCs) in the presence of heat and sunlight. Due to the necessary ingredient of heat, smog levels are at their highest during the summer months between May and September.



Point source refers to stationary sources of air pollution such as power plants or manufacturing facilities; off-road vehicles refers to vehicles such as airplanes, trains, construction equipment, and other vehicles that do not operate on traditional roads or highways; on-road vehicles refers to cars, trucks, buses and other automobiles that operate on traditional roads and highways.

When inhaled, ozone burns through cell walls in the lungs. This causes the lungs to become swollen and inflamed, eventually causing scarring and a decrease in the amount of oxygen that can be delivered to the body with each breath. People who are exposed to ozone are also more susceptible to infections, since ozone decreases the ability of the lungs to expel foreign matter.

Pennsylvania has a severe smog problem. During the summer smog season of 1999, monitors across the Commonwealth recorded 512 violations of the EPA s 8-hour health-based standard for smog. This ranks the state fourth worst in the nation, behind California (1217), Texas (555) and North Carolina (539).[5] The health effects associated with this smog pollution are staggering. In 1997, smog pollution in Pennsylvania triggered an estimated:

- 370,000 asthma attacks;
- 3,200 respiratory hospital admissions;

[4] California Air Resources Board (CARB); Health Effects Institute (HEI); Clean Air Trust

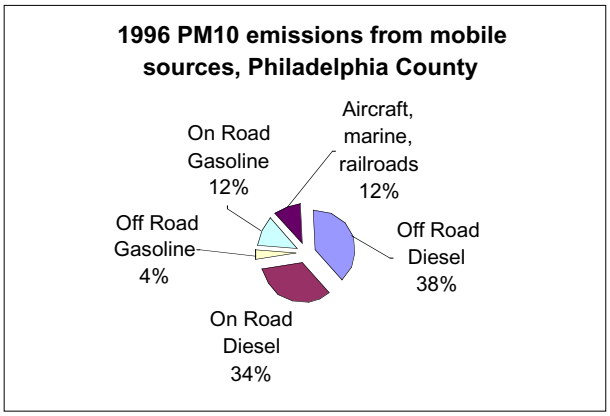
[5] Danger in the Air, U.S.PIRG, January 2000

- 840 cardiovascular hospital admissions;
- 9,600 respiratory emergency room visits;
- 860 asthma emergency room visits;
- 4.9 million minor symptoms such as cough or sore throat; and
- 16,000 cases of shortness of breath.[6]

On-road mobile sources, such as cars, trucks and buses were responsible for approximately 53% of all NOx emissions in Philadelphia County in 1996.[7] Diesel vehicles alone were responsible for approximately 22% of the mobile source NOx emissions during that same time period.[8]

Particulate Matter

Large particulate matter (PM), also known as soot, is the type of pollution you can actually *see* in the air. This pollutant causes the haze commonly seen over city skylines during summer months. When inhaled, larger particles are captured by fine hairs and mucus in the nose, throat, and airways and quickly cleared from the body. However, very small particles (less than 10 microns in diameter) become deeply lodged in the lungs and cannot be expelled by coughing, swallowing or sneezing. As they sit in the lungs, they can cause varying degrees of irritation as well as the loss of heart and lung function.



Fine particulate matter is associated with increased asthma hospitalization, bronchitis, cancer, emphysema and premature death. A 1996 report by the Natural Resources Defense Council (NRDC) estimates that these tiny soot particulates in our air contribute to more than 2,599 premature deaths in Philadelphia each year, more than four times the number of annual deaths from automobile accidents.[9]

The fine particles in diesel exhaust are particularly dangerous. These tiny, airborne particles are coated with a mixture of chemicals such as benzene, dioxin, and other toxins. The particles act as a delivery system that places toxic chemicals deep within our bodies, further exposing us to substances that have been linked to birth defects, cancer, and developmental disorders.

PM is particularly hazardous to urban residents who tend to experience a higher concentration of this pollutant. Areas between high buildings in cities create concentrated diesel exhaust levels leading to increased health problems. To make matters worse, these tiny particles are released at street level directly into densely populated urban environments.

In light of the danger associated with the smallest particles, in 1997 the EPA adopted new standards for particles less than 2.5 microns in diameter (PM2.5). Beginning in 2002, based on three years of monitoring data, EPA will designate which areas do not meet health-based criteria for that new standard. Many cities, including Philadelphia, have been meeting the weaker

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[6] Out of Breath, Abt Associates, Inc., October 1999
[7] Environmental Defense Fund s Scorecard at www.scorecard.org
[8] U.S. EPA s AIRS database
[9] Breathtaking, NRDC, 1996

standards for particles less than 10 microns in diameter (PM10) but are likely to be in non-attainment with the PM2.5 standards.[10]

Toxic Chemicals

Diesel exhaust contains more than 40 chemicals that researchers have classified as toxic air contaminants, known human carcinogens, probable human carcinogens, reproductive toxins or endocrine disrupters. Substances such as arsenic, benzene, cyanide compounds, dioxins, dibenzofurans, formaldehyde, and a host of chemicals are spewed from the tailpipes of diesel-powered vehicles upon acceleration.

Toxins found in diesel are known to cause other negative short and long-term health effects. Benzene is known to cause disorders of the blood and blood-forming tissues, formaldehyde and acetaldehyde can cause irritation of the eyes, nose and throat. Toluene, lead, cadmium, and mercury are known to cause birth defects and other reproductive problems. Dioxins are toxic to the immune system, interfere with hormone function, and are toxic to reproduction.

Below is a partial list of the toxic air contaminants found in diesel exhaust, as well as the negative health effects associated with them.[11]

ACRYLAMIDE
Potent neurotoxicant at low levels; acute inhalation may cause central nervous system damage; carcinogen.

ARSENIC
Irritating to the eyes, nasal mucosa, and bronchi; may cause nasal septum ulceration and perforation, respiratory tract irritation, peripheral neuropathy, vascular disorders, neurological disturbances, and adverse reproductive effects, nausea, diarrhea, abdominal pain, skin irritation; carcinogen.

BENZENE
May cause nervous system depression, nausea, tremors, drowsiness, dizziness, headache, intoxication, unconsciousness; irritating to the eyes and respiratory tract; carcinogen, including increased incidences of leukemia.

1,3-BUTADIENE
Irritating to the eyes and mucous membranes; causes blurred vision, fatigue, headache, vertigo; probably human carcinogen.

CYANIDE COMPOUNDS
Impairs cellular respiration, inhalation can be rapidly lethal to humans; central nervous system effects.

FORMALDEHYDE
Highly irritating to the eyes, respiratory tract. Causes nausea, headache, difficulty breathing; probably human carcinogen.

NAPHTHALENE
May cause kidney damage, eye irritation, cataracts, headache, nausea.

PHOSPHOROUS
Potentially fatal; may adversely affect the liver, kidney, cardiovascular and gastrointestinal systems.

SELENIUM COMPOUNDS
Overexposure may cause eye, skin, respiratory tract irritation, pulmonary edema, depression, nervousness, dermatitis, gastrointestinal upset, loss of fingernails or hair.

TOLUENE
Irritating to the eyes and respiratory tract; may cause cardiac arrhythmias, liver and kidney injury, developmental effects including attention deficit and craniofacial and limb abnormalities.

[10] Heavy Duty Emissions in the Northeast, The Northeast States for Coordinated Air Use Management (NESCAUM), May 1997

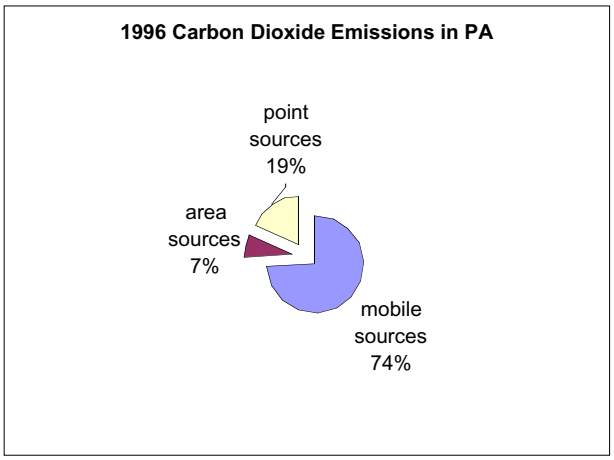
[11] Data on health affects associated with these contaminants from the California Environmental Protection Agency (CalEPA) Air Resources Board Toxic Air Contaminant Summary, accessed through The Environmental Defense Fund s www.scorecard.org

Unfortunately, the air in Philadelphia County is frighteningly toxic. In 1998, the EPA completed a study analyzing the cumulative exposure risk for air toxins in several major metropolitan cities. The results of this study showed that ***the air in Philadelphia County exceeds EPA s safe cancer level by 297 times.***[12]

Carbon Dioxide

Finally, while the above negative health problems are cause enough for a shift to cleaner technologies, it is important to note that diesel pollution is responsible for damage to our natural environment as well. The burning of fossil fuels (such as diesel) emits carbon dioxide (CO2), the main trigger of global warming.

According to an article published in the Philadelphia Inquirer, a panel of scientists recently found that global warming is so real and hard to stop that Americans will have to learn to cope with a hotter and quite different lifestyle in coming generations. [13] The article points to increases in the frequency and severity of weather events such as floods and heat waves as proof of the severity of a slight change in global temperature. An EPA study projects that during a typical summer, Philadelphia will see an increase in heat related deaths by 90% by 2050 (from close to 130 heat-related deaths per summer to over 240).[14]



A point source refers to a stationary source, such as a factory; mobile sources refers to cars, trucks and buses; area sources refer to small sources such as dry cleaners, gas stations and auto body shops.

SEPTA s Contribution to air pollution in the Philadelphia area

In 1997, SEPTA s urban transit buses traveled approximately 4.2 million miles on streets and highways in the Philadelphia area.[15] With each mile traveled, these buses spewed highly toxic and polluting substances into an urban environment already plagued with poor air quality. Over the course of a year, the entire fleet of buses was responsible for emitting an estimated:

Nitrogen Oxide: **3,749,821 pounds**

Particulate Matter: **44,662 pounds**

Carbon Dioxide: **397,127,453 pounds**

[12] Results compiled by NRDC, 1999. More info available at www.nrdc.org/nrdcpro/cep
[13] Climate study warns U.S. to prepare now, Borenstein, Seth; The Philadelphia Inquirer, February 2000
[14] Data taken from an EPA web site at www.epa.gov/globalwarming/impacts/stateimp/index.html
[15] American Public Transportation Association (APTA)

Clean Diesel?

Some argue that many of the above negative health and environmental effects can be mitigated with technology designed to burn diesel cleaner, but scientists and researches claim that this fuel can never truly be considered clean. A new, dedicated diesel bus designed to the latest environmental standards will still emit as much soot over its lifetime as 110 modern automobiles.[16] Moreover, recent evidence has demonstrated that efforts to reduce the total mass of soot (particulates) an engine generates may actually *increase* the number of the ultra-fine particles that pose the greatest health hazards.[17]

In addition, the high sulfur content of diesel fuel actually *destroys* pollution control technology in the engine, making the emissions dirtier with each mile traveled.

Furthermore, engine manufacturers cannot be relied upon to produce cleaner burning engines. Alarmingly, diesel engine manufacturers have even attempted to circumvent current emission standards by illegally installing devices in their engines that defeat emission controls. In October 1998, the EPA announced a settlement with seven major engine manufacturers that will require them to pay more than one billion dollars in penalties for these actions, making it the largest environmental enforcement in history.[18]

All of the above leads advocates for public health and the environment to the same conclusion: ***it s time to dump diesel.***

Case Study #1
The California Air Resources Board

The California Air Resources Board (CARB) recently adopted a resolution calling for an end to diesel powered school and public transit buses. As part of the resolution, CARB calls for the buses to be replaced with natural gas powered units, starting with the oldest pre-1977 school buses. For public transit buses, CARB calls for the remaining 5000 diesel fueled buses to be replaced by 2010, and for all new bus purchases to be exclusively AFVs. CARB anticipates utilizing $340 million in federal funds, and an additional $48 million in local/state matching funds to purchase the vehicles.
Source: California Air Resources Board

Breaking News:
EPA proposes tough new rules aimed at cutting diesel emissions

On Wednesday, May 17th, the EPA issued a proposal to drastically reduce pollution from heavy duty vehicles like buses, 18-wheelers, and garbage trucks, as well as clean up the diesel fuel that powers most of them. If adopted, the proposed rule would require a cut in soot pollution by 90% in 2006 and a requirement to clean up diesel fuel by 97% in 2007. Unfortunately, the rule allows for a three-year long phase-in of new standards to reduce smog-forming pollution by 95%. The rule also lacks incentives to move the market towards non-diesel alternatives such as fuel cells and electric buses.

The proposed rule will be open for public comment until August, 2000 and must be approved by the President before implementation.

[16] Northeast States for Coordinated Air Use Management (NESCAUM)
[17] Particle Trap Effects on Heavy-Duty Diesel Engine Emissions, Bagley, et al; Health Effects Institute Research Report Number 56
[18] EPA press release, October 1998

Steering Us Right: Why Urban Transit Buses Must Lead the Way

The arguments are clear for phasing out the use of diesel fuel as well as the need for tough emission standards for existing vehicles. However, some argue that heavy-duty trucks bear most of the responsibility for diesel emissions, while transit authorities like SEPTA only contribute a small amount to the total picture. While heavy duty diesel vehicles that travel along our highways *do*contribute to a significant air pollution problem, it is important to recognize that urban transit buses operate in heavily congested areas such as city streets and neighborhoods where air quality most directly affects residents. The diesel exhaust from these buses contains extremely high levels of particulate matter, probably the most harmful of all the pollutants discussed in this report. In urban settings, street canyons in between buildings tend to gather high levels of particulate matter from this exhaust, creating unusually high concentrations of these deadly particles where residents live and work.

Research done by the New York State Department of Environmental Conservation estimates that 52.8 percent of the airborne particles found in Manhattan s street canyons come from diesel tailpipes alone. Based on scientific studies, this concentration of diesel exhaust is expected to potentially lead to a lifetime risk of eight cancers among every one thousand people exposed.[19] There is no reason to think that a similar problem does not exist in Philadelphia, given the similarities between the two environments.

Case Study #2
New York City Metropolitan Transportation Authority (MTA)
After a seven year campaign waged by environmental group NRDC (Natural Resources Defense Council), New York s MTA marked the thirtieth anniversary of Earth Day by committing to a fleet-wide strategy to drastically reduce air emissions.

The agency committed to completely eliminate dirty diesel buses and to create the world s cleanest transit fleet. In order to achieve that goal, the MTA agreed to: 1) add 300 CNG and 250 hybrid electric buses to the fleet and build three new bus depots that are CNG compatible; 2) use low-sulfur fuel and install advanced emission controls on over 3,000 remaining diesel buses by the end of 2003; 3) accelerate the phase-out of the oldest, dirtiest diesels in the fleet; 5) establish a process led by the New York State Department of Environmental Conservation to create a vehicle-based emissions standard that would require all new buses purchased to meet CNG emissions levels, regardless of the fuel used, and to establish new York State s first emissions testing facility for diesel buses and trucks.

This commitment will eliminate more than 95 percent of the fleet s toxic soot emissions, according to a full-page ad placed by NRDC in the New York Times on April 20th, 2000.

Also included in the ad is a message that SEPTA must take to heart, If we can do it here, you can do it everywhere.
Source: Natural Resources Defense Council

In addition to these public health concerns, there are several other reasons why public transit authorities such as SEPTA must lead the way to cleaner transit:

- Transit agencies normally own and operate their own centralized re-fueling stations, making experiments with emerging fuel technologies such as fuel cells ideal and compatible.
- Many of the emerging technologies for alternatively fueled vehicles could save transit agencies operating costs through lower maintenance and fuel consumption.
- Urban buses are highly visible, and the perfect opportunity to promote clean technologies among the general public, local businesses and local governments.

[19] Exhausted by Diesel , Solomon, et al; NRDC; April 1998

- Given their high visibility, cleaner technology buses can be promoted as the environmentally friendly transportation option for potential riders, thus improving public opinion of the agency and increasing rider-ship.
- Federal and state entities, such as the Pennsylvania Department of Environmental Protection (DEP) and Congressionally funded programs such as the Congestion Mitigation and Air Quality (CMAQ) grants provide assistance to public transit companies for the purchase of alternative fuel buses.

Dumping Diesel: The Alternative Route

Dozens of scientists and researchers have recognized the public health, environmental and economic risks associated with a continued reliance on diesel fuel. This has led to millions of dollars being spent developing engines that run on alternative fuels designed to deliver clean emissions. Research into development of engines powered by fuels such as natural gas, hydrogen, biomass[20] and even pond scum have made news as having potential for replacing petroleum.

Alternatively fueled vehicles are rapidly advancing in popularity as the nation and the world struggles to protect public health and reverse global warming. Several technologies promise to deliver not only cleaner exhaust, but also lower fuel and maintenance costs, and even a quieter ride.

Following is a brief overview of a few alternatives to diesel, as well as information on use and availability. It is important to note that this list is by no means complete, and only highlights the most widely used and quickly advancing options.

Natural Gas

Natural gas also known as methane is a colorless, odorless fuel found naturally under the earth s surface. Unlike petroleum, most of the natural gas used in the United States is produced domestically, which helps to reduce U.S. reliance on foreign oil. Due to the gaseous nature of the fuel, it must be stored in a compressed state (compressed natural gas, or CNG) or a liquefied state (liquid natural gas, or LNG). While both CNG and LNG can be used for transit buses, CNG has been much more popular in transit operations due to easier storage of the fuel on the vehicle.

Case Study #3:
Lower Merion School District
After neighbors complained about the noise and exhaust from diesel-powered school buses, the Lower Merion School District invested in compressed natural gas (CNG) buses.

The Commonwealth of Pennsylvania contributed more than $1 million in grants under the Alternative Fuels Incentive Grant program (AFIG). The funds covered a portion of the cost to construct a re-fueling station, and helped to purchase 51 CNG buses. A second CNG refueling station is currently under construction.

Their experience with the CNG buses has been quite positive by the end of the 2000 school year, the fleet will surpassed the 2.3 million-mile mark. In addition, Lower Merion reports cleaner oil at regular maintenance checks, which is a sign for reduced maintenance in the future.

Over the four year period of the project, the Lower Merion School District has displaced more than 4,000 gallons of diesel fuel.
Sources: Greater Philadelphia Clean Cities Program, Alternative Fuel Success Stories brochure; *Pennsylvania Department of Environmental Protection.*

As a fuel, natural gas (NG) has been widely used for nearly one hundred years. However, NG vehicles only entered the market in the 1980 s. Over the last twenty years, the experience of NG users spurned great advances in the design and handling of the buses, prompting the popularity of NG vehicles to rise steadily among U.S. transit bus purchasers. Buses that used natural gas in some form or another (CNG, LNG, NG hybrids) comprised 3.8% of the buses in 97, then jumped to 4.9% in 98.[21] Finally, while natural gas vehicles (NGVs) are probably the most successful and widely used alternative to diesel buses,

[20] According to the Department of Energy s Alternative Fuels Data Center, the term biomass refers to organic compounds, such as agricultural and forestry wastes, municipal solid wastes, industrial wastes and crops. These substances are then converted into fuel through combustion or other processes.
[21] Transit Vehicle Data Book, American Public Transportation Association (APTA)

they have also become extremely popular for lighter vehicles such as shuttles, light duty vans and cars.

Case Study #4:
SunLine Transit
In 1996, SunLine Transit in Thousand Palms, California became the first public transit agency in the nation to park a diesel fleet and switch overnight to buses powered 100% by compressed natural gas (CNG).

SunLine received over $2 million from the Federal Transit Administration s Section 3 money, was awarded a $12 million procurement grant from local funding sources, partnered with the Southern California Gas Company to develop a refueling station, and convinced a local community college to train its mechanics.

The fleet of CNG buses transports 8,000 passengers per weekday, and has logged over 63,000 annual miles per bus. The management of SunLine reports that maintenance problems are reduced with the CNG buses compared to their diesel counterparts, and fuel costs have also been reduced.

Richard Cromwell III, General Manager of SunLine commented, We believe we re enhancing our community s quality of life with cleaner air. Environmentally, CNG is simply the right thing to do.

The success of SunLine s fleet has received international attention. Delegates from transit authorities in Canada, China, Egypt, England, France, Mexico, South America, and Sweden have visited the city to learn about their alternative fuel program. In fact, Egypt s Ministry of Petroleum and Ministry of State for Environmental Affairs were so impressed, they contacted SunLine after the visit to see if the agency could help them find a consultant to construct alternative fueling stations in Egypt.
Source: SunLine Transit Agency

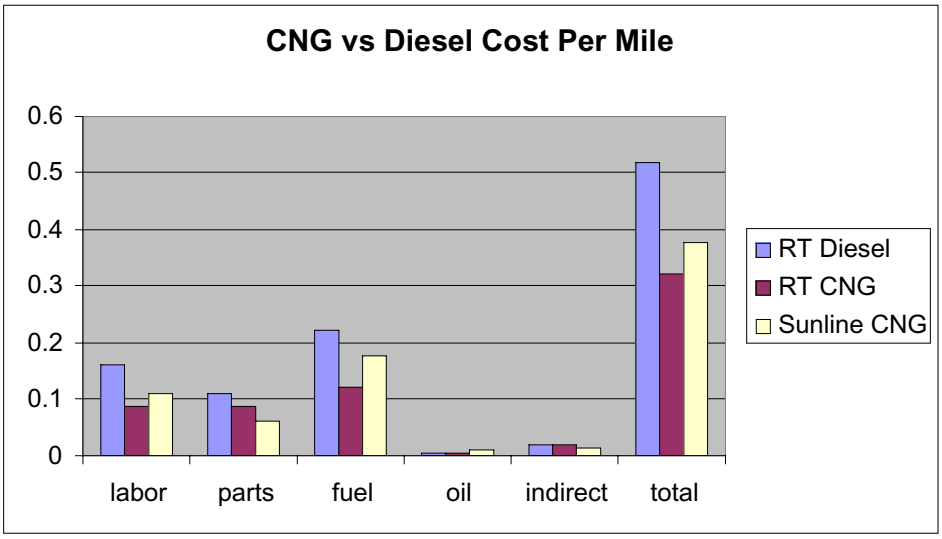
Availability of Fuel:
According to the U.S. Department of Energy, a sixty-five year supply of natural gas is currently available in the United States. Much like petroleum, pipelines deliver the fuel to fueling stations, including more than 1,200 natural gas fueling stations in the U.S. Pennsylvania is home to 46 stations, including four in the City of Philadelphia. Since public transit authorities like SEPTA traditionally require private fueling stations, a new station to quickly deliver and compress the fuel would need to be built if the agency employs a significant number of CNG vehicles. These fueling stations, where a three-minute quick fill is achievable, can cost $1 million or more.[22] As in the purchase of the vehicles, federal and state monies can be used to partially subsidize or pay entirely for the construction of these facilities.

Public Health and Environmental Benefits:
Natural gas burns much cleaner than most other fossil fuels, making it an attractive alternative to diesel. According to recent tests comparing model year 1999 natural gas to diesel buses, the NG vehicles emitted approximately 47% less nitrogen oxide; emissions of particulate matter were virtually eliminated; and carbon dioxide was cut by approximately 20%.[23] During that same test, one NG vehicle that ran on a different drive cycle [24] achieved as much as a 70% cut in NOx compared to the dirtiest diesel vehicle operating in the same drive cycle.

Economics:
On a gallon-equivalent basis, natural gas as a fuel is generally less expensive than gasoline and diesel. Natural gas prices also tend to remain stable, while petroleum prices can change dramatically in a fairly short period of time. In fact, in early 2000, a petroleum shortage brought on by low supply was further evidence of the instability of petroleum markets as prices for diesel fuel and other petroleum products skyrocketed across the northeastern United States.

[22] International Association for Natural Gas Vehicles
[23] Hybrid-Electric Drive Heavy-Duty Vehicles Testing Project, M.J. Bradley & Associates, Inc.; February 2000
[24] A drive cycle is categorized by how often the vehicle accelerates, idles and brakes over a certain period of time.

While natural gas vehicles are more expensive than their gasoline or diesel counterparts (a heavy duty CNG engine, such as those in trucks and buses, typically costs $30,000 to $50,000 more than a standard dedicated diesel engine[25]), they can end up being cheaper to operate over the long run. In 1997, two California transit agencies used their own experiences with diesel and CNG buses to compile a cost-by-cost analysis of the two vehicles. Their study showed that when considering labor, parts, fuel, oil and other indirect costs, operating a CNG fleet cost them an average of $.3495 per mile while the diesel fleet cost an estimated $.519 per mile. Assuming the same costs and savings for SEPTA, the agency would save an estimated $6.8 million dollars annually with a 100% fleet conversion to natural gas.



Note: In the chart above, CNG buses run by SunLine Transit Agency are compared to similar CNG and diesel buses run by the Sacramento Regional Transit District (RT).
Source: Three year comparison of Natural Gas and Diesel Transit Buses, Sacramento Regional Transit District and SunLine Transit Agency; August 1999

The biggest investment involved with converting a transit fleet to CNG lies in the changes in infrastructure. Re-fueling stations must be built, enclosed bus depots must be modified to allow for proper ventilation, and workers need to be re-trained on the handling of the fuel as well as maintenance of the vehicles. Although such a dramatic change in infrastructure presents a challenge to public transit agencies, the investment would be a worthwhile one. The funds for such expenses can be subsidized or paid for entirely by grants from state and federal governments. The long-term savings in operation and maintenance costs could also offset the expense of such a venture. More importantly, the public health benefits that would be achieved by making this investment greatly outweigh any financial costs incurred.

Safety:
Some concerns have been raised about the flammability of natural gas. However NG is actually lighter than air, causing it to dissipate into the atmosphere in the event of an accident or spillage. It also has a narrow range of flammability, making accidental ignition or combustion unlikely.

Disadvantages:
Although the benefits of natural gas make a strong case for increased investment in the technology, it is by no means a permanent solution to our air pollution problems. However,

[25] International Association for Natural Gas Vehicles

maintaining a reliance on diesel poses such greater health and environmental problems that a switch to a cleaner alternative is immediately necessary. Using CNG vehicles is a step in the right direction, and a good interim solution until buses are available that are emission free and powered by a renewable resource.

Vehicle Use and Availability:
There are dozens of major bus companies currently manufacturing NG buses across the U.S., including Blue Bird Corp., New Flyer of America, North American Bus Industries, and Orion Bus Industries.

Natural gas buses are used by many transit agencies and other private companies in dozens of cities around the United States, including Pierce Transit in Tacoma, Washington; RTD in Sacramento California; and Sunline Transit in Palm Desert, California. NG vehicles are also widely used by the United States Postal Service in Connecticut, UPS, the Lower Merion Township Police Department in Pennsylvania, and PECO Energy in Philadelphia.

Fuel Cells

The fuel cell, originally invented in 1839, is an electrochemical device that produces electricity directly from the reaction of hydrogen and oxygen. The necessary oxygen can be pulled directly from the air, while the hydrogen must be obtained from fuels such as natural gas, methanol, petroleum, or biomass. NASA has used fuel cell technology extensively in the last century, and fuel cell power plants around the world currently produce power in small batches for institutions like hospitals and hotels.[26]

Out of the dozens of new technologies being developed for transportation applications, fuel cells seem to elicit the most enthusiasm from public health advocates, environmentalists, automobile manufacturers, and transit authorities due to their extremely low emissions and potential for low operating costs.

Public Health and Environmental Benefits:
When the hydrogen comes from renewable sources, hydrogen fuel cell vehicles emit only pure water vapor. Fuel cell vehicles that obtain the hydrogen from methanol as the primary fuel will release very small amounts of pollution from fuel evaporation and processing, but the levels are small enough to qualify the vehicle as a zero emission vehicle (ZEV).

Availability of Fuel:
As mentioned above, fuel cells need only hydrogen and oxygen to operate. While oxygen can be pulled directly from the air, supplying the vehicle with hydrogen is a bigger challenge. Hydrogen can come from many sources, such as fossil fuels (coal, oil or natural gas), from ammonia, methanol, or alternative resources such as biomass and waste material. Hydrogen can also be produced by water electrolysis, which uses electricity to split hydrogen and oxygen elements.

The biggest challenge in introducing fuel cell vehicles into the consumer market is setting up an infrastructure to deliver the fuel. Pipelines that deliver natural gas and petroleum products are massive and extensive, and modifying or replacing that system to accommodate another fuel will take time and effort. However, some methods of hydrogen production, especially those from

[26] Zeroing Out Pollution, The Promise of Fuel Cell Vehicles, Mark, Jason; Union of Concerned Scientists, May 1996

renewable sources like biomass, are suitable for small-scale production close to the fueling station. This makes public transit agencies the perfect starting ground for this technology, as they tend to own and operate smaller fueling stations that are dedicated to providing service to their fleet only.

Case Study #5:
Chicago Transit Authority
In 1998, the Chicago Transit Authority made history by welcoming the first customers aboard the CTA Clean Machines, the agency s zero-emission fuel cell buses.

Three buses, which feature a fuel cell engine built by Ballard Power Systems of Burnaby, British Columbia, hit the streets of Chicago as a test program in conjunction with the City of Chicago Department of the Environment.

CTA s fuel cell buses are fueled by compressed hydrogen gas from a fueling station built by Air Products & Chemicals. Air Products & Chemicals, based in Allentown, PA, also maintains the facility and supplies the CTA with the fuel.

The CTA fuel cell buses were paid for with capital investment funds that were specially earmarked for environmental air quality improvement projects. Federal CMAQ (Congestion Mitigation and Air Quality) grants, from the Federal Transit Administration and the Regional Transportation Authority s local share provided $6.7 million for the project. All told, a total of $9.6 million was allocated for the project, including spare parts, maintenance, training, engineering, construction of the fueling stations, hydrogen fuel, modifications to a CTA bus garage to house the buses, additional site work, labor costs, and additional monitoring systems.

CTA President Frank Kruesi commented, The CTA has become a pioneer in the development of fuel cell bus technology. Though the investment in this project is great, we cannot put a price tag on cleaner air for future generations. In our commitment to move people and provide on-time, clean, safe and friendly service, we are dedicated to preserving the environment for years to come.
Source: Chicago Transit Authority

Despite some of these challenges, there is at least one Pennsylvania company that has experience handling and producing hydrogen for use as a fuel for automobiles. Air Products & Chemicals, Inc. in Allentown has already built and is currently maintaining a fueling facility for three experimental fuel cell buses for the Chicago Transit Authority (CTA). The facility has been supplying the CTA with hydrogen fuel since 1997.

Economics:
Much like any new technology, fuel cells will be significantly more expensive than other vehicles as they enter the market. However, those involved in the research and development of the technology predict that demand for the vehicles will eventually result in comparable costs. In the long run, fuel cell vehicles may be even cheaper to operate due to their efficiency and projected lower fuel costs.

As mentioned above, the Chicago Transit Authority became the first transit company in the nation to purchase and use fuel cell buses. The cost for their small pilot program was significant -- in total, $9.6 million was allocated for the project, including spare parts, maintenance, training, engineering, construction of the fueling station, supply of hydrogen fuel, and three buses. While this was an enormous initial investment, it s a small price to pay considering the potential of fuel cells as an emission free, renewable source of power.

Vehicle Use and Availability:
Fuel cell engines for vehicles are not commercially available as of May 2000. However, a few small pilot programs have been underway in the United States. Programs testing or researching fuel cells for buses, cars, and light trucks have been conducted by the Department of Energy, South Coast Air Quality Management District, Department of Transportation, Chicago Transit

Authority, General Motors, Chrysler, Ford, Allied Signal, Ballard and others.[27] Although it is difficult to pinpoint exactly when fuel cell buses will become commercially available, some observers have predicted commercial use within ten years.

Diesel-Electric Hybrid Vehicles

A hybrid vehicle pairs two power sources together to drive the vehicle. In this case, a battery-powered motor is recharged by a diesel-powered generator to drive the bus. The battery also receives additional charges when the driver brakes the vehicle. Unlike typical electric vehicles, this hybrid is not plugged in to electrical outlets for recharging, since all of its power comes from the diesel-powered generator. A small number of hybrids powered by alternate fuels, such as CNG, have also been in service in the United States.

Public Health and Environmental Benefits:
The engine of a diesel-electric hybrid runs at a constant speed, avoiding excessive emissions as a bus accelerates. This helps to cut down emissions and increase fuel economy. However, there is disagreement about the actual emission reductions that are achievable with diesel-electric hybrids. While all parties agree that this type of a vehicle is certainly cleaner than dedicated diesel, only a small amount of emissions testing has been done on the hybrid electric vehicles.

Lockheed Martin, which is the only manufacturer of diesel-electric hybrid engines for application in transit buses, has claimed that their diesel-electric hybrid engine is actually cleaner than a CNG engine.[28] However, many researchers and environmental advocates have challenged those reports, claiming the statistics Lockheed Martin uses are outdated and an unfair comparison.

In the spring of 2000, West Virginia University s Transportable Heavy-Duty Vehicle Emissions Testing Laboratory traveled to New York and Boston to test diesel-electric hybrid buses currently in use against comparable models of CNG and dedicated diesel buses. Tests showed that the hybrid buses, much like natural gas, could produce such small levels of particulate matter (PM) that engineers machines could not detect it. The hybrid buses also produced less carbon dioxide, a significant greenhouse gas. However, the hybrid buses did produce more smog forming nitrogen oxide (NOx) than natural gas.[29]

While the results of the tests are encouraging, they do not give an entirely realistic picture of emissions reductions from the hybrids. The hybrid buses used in the test were fueled with low-sulfur diesel, but this fuel is not readily available nationwide and would not be used by a transit agency such as SEPTA until there is wider distribution. In addition, the researchers did not analyze the toxic qualities of the particulate matter, which is a significant concern with diesel exhaust. As stated earlier, the tiny particles in diesel exhaust act as a delivery system for highly toxic compounds, as they attach themselves to the particles that become deeply lodged into our lungs. More research is needed to analyze the toxicity of the particles in diesel-electric hybrid exhaust.

[27] Zeroing Out Pollution, The Promise of Fuel Cell Vehicles, Mark, Jason ; Union of Concerned Scientists, May 1996.
[28] New York s Clean Efficient Transit Alternative, Lockheed Martin
[29] As measured by grams released per mile for each pollutant.

Economics:
Like most of the new technologies already discussed, diesel-electric hybrids are not only significantly more expensive than their diesel counterparts, but also more costly than comparable CNG buses. SEPTA reports that each diesel-electric hybrid bus could cost approximately $400,000, compared to CNG buses that run from $300,000 to $325,000. However, the transition to hybrids would be easy and less expensive since they are fueled by diesel and easily adapted to current infrastructure. Unlike CNG, diesel electric hybrids do not require new refueling stations or major bus depot modifications.

Availability and Use of Vehicles:
As mentioned above, Lockheed Martin is the only company currently manufacturing and marketing diesel-electric hybrid engines for transit buses. Honda introduced a two-seat passenger gasoline-electric hybrid car in 1999, and Toyota planned on introducing a four-seat car in 2000. Other automakers have also announced their intention to begin marketing hybrids within a few years.

The MTA in New York City has run at least six hybrid buses using Lockheed Martin engines over the last few years, and recently ordered another 125 for delivery in 2002. The MBTA in Boston has also been running two of these buses in a side-by-side comparison to CNG and traditional diesel since June of 1999.

Disadvantages:
Little is known about the problems associated with hybrid buses, since it is still an experimental technology. However, a spokesperson for the MBTA in Boston commented anecdotally that they have experienced more minor difficulties with the hybrid buses compared to the CNG buses they are also running. It is expected that these vehicles will continue to have maintenance and operative problems just like any new technology, but that many of the kinks can be worked out with experience and development.

Dedicated Electric Vehicles

Electric vehicles (EVs) are recharged from an electric source powered by a motor stored in a battery pack. Most vehicles can be easily plugged in to existing electrical outlets much like those in our homes. Some electric vehicles, like trolleys, are constantly connected to that power supply by power lines. SEPTA currently operates dozens of such trolleybuses, but the number in operation has declined over the last few years in favor of diesel-powered buses.

Public Health and Environmental Benefits:
Electric vehicles produce zero emissions while on the road, but are responsible for some pollution emitting from the source of the electricity. The vehicle must be charged by some power source, such as an electrical outlet, which ultimately pulls energy from power plants that use coal, oil or nuclear power.

Despite the emissions from power plants associated with EVs, they still promise to deliver major gains in the fight for clean air. According to the Union of Concerned Scientists, electric vehicles can be up to 99 percent cleaner than conventional vehicles, even when power-plant emissions are included.[30] It is also important to note that renewable forms of energy such as wind, solar power or biomass can also fuel the power plants that supply electricity. In fact, Pennsylvania is

[30] Battery Electric Vehicles, Union of Concerned Scientists briefing paper

currently home to two new wind power plants that should begin generating power for residential customers soon. Electric vehicles that are powered by energy from power plants such as these would be pollution free in the true sense of the word.

Economics:
Much like all the new technologies discussed, electric vehicles cost significantly more than their gasoline or diesel counterparts. Again, the cost of the vehicles is expected to drop as popularity and availability increases. Dedicated electric vehicles use no fuel, in the traditional sense, but the cost of the electricity used to power the vehicle must be considered. Those costs vary greatly depending on the electric company producing the power.

Availability and Use of Vehicles:
Electric vehicles have been in use for several years, and the technology has advanced greatly. However, EVs that are not constantly connected to their power source and must be recharged are primarily used for smaller vehicles that require less power than a large city transit bus, such as passenger cars and shuttles. A few larger buses are currently in use, including a few 35 and 40-foot vehicles (by comparison, a traditional urban transit bus is approximately 44 feet long). For example, Chattanooga, TN operates one 31-foot electric bus; Santa Barbara, CA operates one 35-foot electric bus; Denver, Colorado operates six 40-foot vehicles. Dozens of other cities also use smaller electric vehicles for shuttles.

Case Study #6:
Pierce Transit
If you think you re going to be in business 10 years from now, you should be looking at some other way to do business that provides fuel price stability and availability as well as environmental improvements, says Ron Shipley, Director of Maintenance for Pierce Transit in Tacoma, Washington.

The bus fleet operated by Pierce Transit includes 193 vehicles, 72 of which are powered by CNG. The agency s experience with CNG began in 1986 with the conversion of two General Motors buses to run on a combination of CNG and diesel. Although the experiment achieved some success, fuel efficiency for this hybrid system was a problem. Following that experience, Pierce decided to phase in the use of dedicated CNG buses.

Despite the fact that the CNG buses cost Pierce $30,000 to $50,000 more apiece, the agency recognized the long-term benefits gained from such an expense. For example, natural gas prices are more stable than diesel prices, which protects Pierce Transit when the price of petroleum products increases. After ten years of experience, Pierce has reached the point where CNG operating costs are almost the same as those for diesel, taking into account repairs, inspections, cleaning, rebuilding, fuels, and lubricants.

Shipley predicts that the capital costs for CNG and diesel engines will be equal soon, but not because the CNG engines will be cheaper. He predicts that diesel engine prices will rise due to tighter emission standards. The CNG buses already meet the predicted tougher standards, unlike many of the most modern diesel engines on the market today.
Source: U.S. Department of Energy Case Study, Taking the Alternative Route. Fueling the Future

Companies such as GM, Chrysler, Nissan, Ford, Toyota and Solectria were manufacturing electric vehicles as of 2000.

Disadvantages:
The weight and power limitations of the battery have prevented the technology from being widely used or developed for standard urban transit buses. The buses also need to be recharged frequently, as the most advanced buses run out of fuel after 100 miles, making them less attractive for vehicles in heavy use. The low range does not completely eliminate electric buses as an option for SEPTA, as an average SEPTA bus travels 100 miles per day. As with all of the vehicles highlighted in this report, increased research and development is expected to advance the range of EVs, making them more attractive for future heavy-duty use. Electric trolleybuses, which have been in use for many years, have decreased in popularity due to the necessity of unattractive power lines overhead. Since they are exposed, these lines are also frequently damaged, causing an interruption in the service of the vehicle. Trolleybuses that can still operate

despite such an interruption are in development. SEPTA has indicated an interest in purchasing more of these vehicles in the future, but no concrete plans have been made.

The Path to Clean Air: How the Alternatives Compare

While the purpose of this report is not endorse any particular fuel or propulsion system, it is clear that some alternatives are cleaner than others. Obviously, buses that use a renewable fuel and qualify as zero emission vehicles (ZEVs) will do the most to solve our air pollution problems. As outlined in this report, the most promising technologies are fuel cell or dedicated electric vehicles. Both vehicles achieve zero or near zero emissions, and can generate fuel from a non-polluting renewable energy source. Unfortunately, it may be several years before these systems are available for applications in transit buses. Transit authorities like SEPTA must actively push for the development of these vehicles, but must take steps now to reduce their contribution to Philadelphia s pollution problems.

Much debate has centered on what steps SEPTA should take. Ultimately, transit authorities must choose vehicles that will achieve the most significant benefits for public health by offering the lowest emissions available.

Several analyses of emissions from urban transit buses have been completed over the last few years, the most recent of which was released in late February 2000. This particular study compares the emissions of dedicated diesel, diesel-electric hybrid and compressed natural gas buses in use in New York City and Boston.

The buses ran on several drive cycles, designed to mimic emissions on a typical urban bus route. The emission results vary greatly depending on the drive cycle used. For example, an urban transit bus that frequently accelerates, then slows, idles and accelerates again will emit very different levels of pollution that the same bus traveling at a constant speed on a highway.

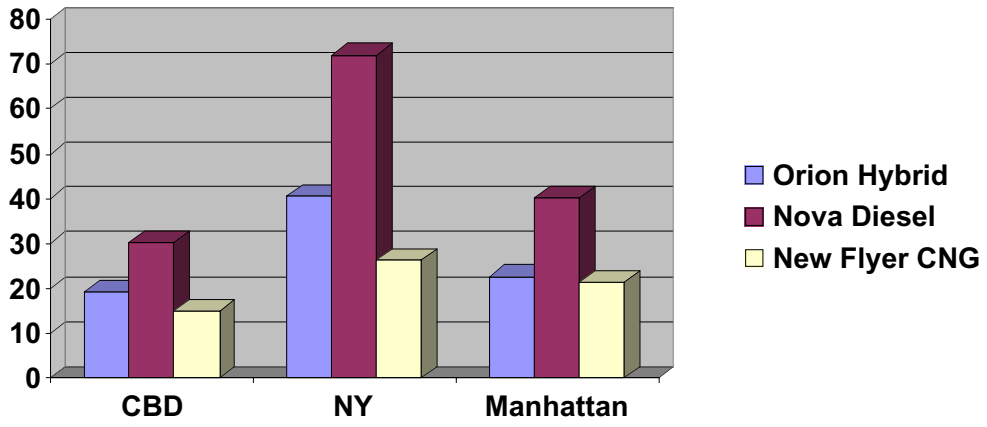
The CBD cycle (Central Business District) is the recommended practice according to the Society of Automotive Engineers (SAE), a clearinghouse for automotive research. This cycle consists of acceleration to 20 mph, a cruise at 20 mph, braking to a stop, then dwell (or idle). The researchers felt as though this cycle did not accurately reflect service routes in New York City, where many of these buses were in service. So in addition to CBD testing, the project team developed two other cycles they felt were more representative — the Manhattan and the New York Bus cycles. The Manhattan cycle was developed by using actual in-use data logged by the NYC Metropolitan Transit Authority (MTA) on acceleration, average speed and other variations typical of buses actually in service. The New York cycle was developed similarly, but is statistically derived from data collected by transit buses and trucks in the 1970 s.

The emission results vary greatly from cycle to cycle, so we have included results from all three cycles for comparisons. However, the Manhattan cycle appears to most accurately compare to drive cycles typical of SEPTA due to the similarities in acceleration, idling and braking of SEPTA buses and MTA buses.

The study also evaluated several different buses that utilize several different engines. Factors such as model year, weight and engine design will affect the emission results greatly. In order to accurately evaluate the results, the tables following compare three buses that operated in *all* of the above drive cycles.

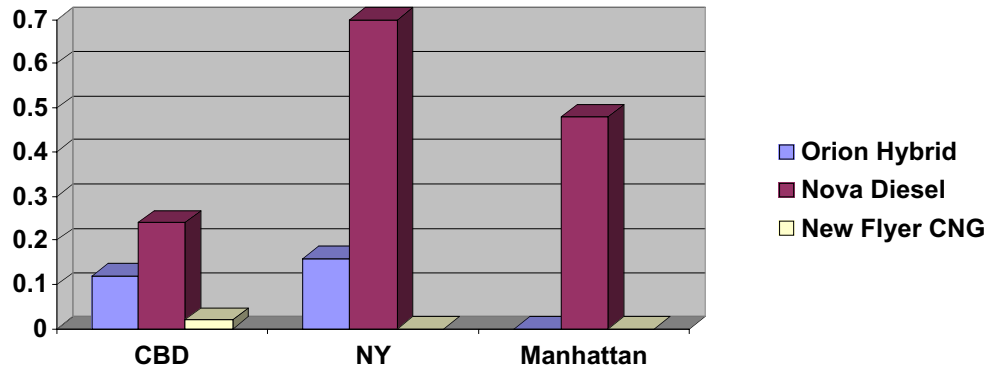
Analysis of the data shows that both CNG and diesel-electric hybrid buses offer significant emission reductions, especially for NOx and PM.

Figure 1-NOx emissions (grams per mile)



Source: Hybrid-Electric Drive Heavy Duty Vehicle Testing Project, Northeast Advanced Vehicle Consortium; February 2000

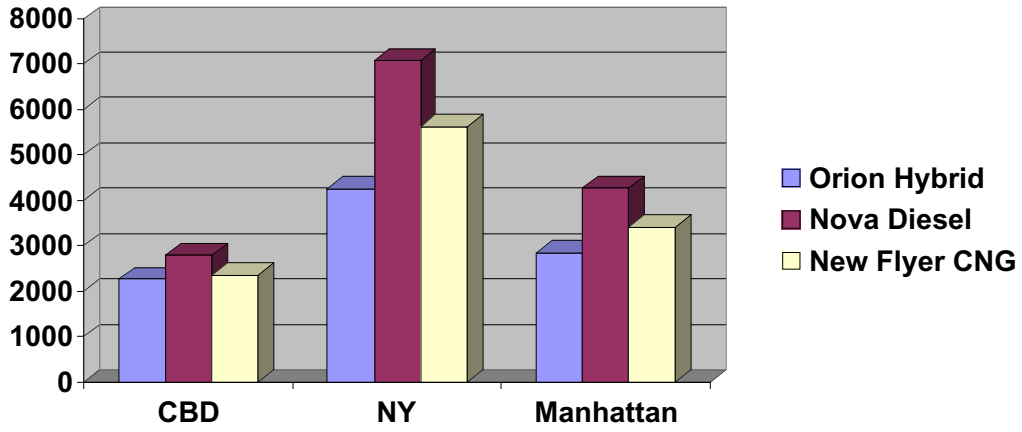
Figure 2- PM Emissions on 3 bus cycles (grams per mile)



Source: Hybrid-Electric Drive Heavy Duty Vehicle Testing Project, Northeast Advanced Vehicle Consortium; February 2000

Engineers and scientists have raised some concern about the results of the particulate matter measurements highlighted above. The hybrid buses used low-sulfur fuels and employed particulate matter traps, both of which are not widely available today. Also, although the mass of PM may appear low in the test results, there may still be a significant particle count the smaller, ultra-fine particles that pose the greatest health risks may be too small to be detected by the engineer s machines. Finally, the toxicity of the diesel particles was not measured in the study. As mentioned earlier in this report, the toxic compounds of diesel exhaust are particularly harmful to public health.

Figure 3-CO2 emissions on 3 bus cycles (grams per mile)



Source: Hybrid-Electric Drive Heavy Duty Vehicle Testing Project, Northeast Advanced Vehicle Consortium; February 2000

As seen above, the hybrid buses achieved the best performance in reducing carbon dioxide, the main cause of global warming.

Getting You There: Funding for the Purchase of Clean Buses

The costs associated with a switch to cleaner vehicles for public transit agencies can be significant, especially for agencies like SEPTA that are struggling to improve rider-ship. That is where federal and state governments have a responsibility to provide the financial assistance necessary to spur advances in technology.

Public transit is a public service that offers opportunities for economic growth, cleaner air and land preservation. Federal, state and regional governments that have recognized this value have offered subsidies and programs designed to aid public transit.

Millions of dollars have been made available in grants and tax breaks to foster the development of cleaner technologies for transit agencies. As a transit authority operating in an area in severe non-attainment for health-based standards for ozone pollution, SEPTA can and should take full advantage of programs designed to assist in the purchase of cleaner vehicles.

Alternative Fuels Incentive Grant (AFIG)

AFIG is a state-run program, created in 1992 and administered by the Pennsylvania Department of Environmental Protection (DEP), with the purpose of:

- Reducing the Commonwealth s dependence on imported oil;
- Improving the Commonwealth s environmental quality;
- Fostering economic development by encouraging the transfer and commercialization of innovative energy technologies and the use of fuels indigenous to the Commonwealth.

The AFIG program receives between $3.5 to $4 million dollars annually from Pennsylvania s general fund. The amount is determined based upon the total amount of gross receipts tax revenue collected each year from regulated utilities in the Commonwealth. The AFIG program currently covers up to 30% of the cost of a project, including the purchase of vehicles and re-fueling stations. However, after July 2001, current law requires that the DEP ratchet down the percentage of a project s allowable funding to 20% of the cost of the project.

Public transit agencies, school districts, municipalities, corporations and individuals in Pennsylvania are eligible for funding. The program covers alternative fuels as defined by the Energy Policy Act of 1992, including natural gas, ethanol, hydrogen, electricity, biomass, and others.

The AFIG program has awarded approximately $3.6 million to Pennsylvania transit agencies to assist in the purchase of CNG buses and the construction of refueling stations, including:

*$917,000 to the Centre Area Transit Authority (CATA);
*$1 million to the Erie Metropolitan Transit Authority (EMTA);
*$353,000 to the Port Authority of Allegheny County (PAT);
*$362,000 to the York Area Transit Authority (YATA);
*$417,000 to the Area Transportation Authority of North Central PA (ATA).

The AFIG program has helped to leverage more than $25 million additional dollars from federal and local sources for the purchase of alternatively fueled vehicles in Pennsylvania. Due to the

success of their programs and assistance from the AFIG program, several of the transit agencies listed above also plan on adding additional CNG vehicles to their fleets, including CATA in Centre County and EMTA in Erie County.

The Congestion Mitigation and Air Quality Improvement program (CMAQ)

The CMAQ program was reauthorized in the recently enacted transportation legislation entitled TEA-21 (Transportation Equity Act for the 21st Century). The purpose of the CMAQ program is to fund transportation projects and programs in areas that are not meeting federal air quality standards (also known as non-attainment) in order to reduce transportation-related emissions. Specifically, CMAQ monies are designed to reduce carbon monoxide (CO), ozone (O3) and particulate matter (PM). Philadelphia is in severe non-attainment for ozone, thus receives a large amount of money each year under this program.

CMAQ money is distributed through Municipal Planning Organizations (MPOs), such as the Delaware Valley Regional Planning Commission (DVRPC) in Philadelphia. In order to receive funding, programs must demonstrate the potential for significant decreases in CO, O3, or PM. Programs that employ alternatively fueled public transit vehicles are prime candidates for funding.

When the program was created, the Philadelphia metropolitan area was allocated approximately $150 million annually to fund eligible programs. Congress must still allocate the funds annually, and has the authority to increase or decrease the funding with each appropriations budget.

The Clean Fuels Formula Grant Program of the Federal Transit Administration

The Clean Fuels Formula Grant Program was designed to advance the use of alternative fuel bus technologies. This program provides funding to assist transit systems in areas in non-attainment for air pollution standards to purchase low emission buses and related equipment. This funding also includes the construction of fueling facilities, modification of garages, and other expenses.

Funds are distributed according to a formula based on the number of vehicles in the bus fleet and the number of passenger miles, weighted by severity of the ozone and carbon monoxide problems in the area. Unfortunately, Congress has failed to allocate funding for this program in the last few years, forcing the program to become dismantled.

Dollars and Sense: What a Our Reliance on Diesel Costs

One of the biggest barriers to switching a bus fleet like SEPTA s to alternative fuels is simply the expense of such a dramatic change in infrastructure and investment in new technologies.

All of the emerging technologies that promise clean air come with a hefty initial price tag. In addition to the cost of the vehicles, expenses include the construction of fueling facilities, re-training of workers, modifying bus depots, and other incidental costs associated with any new venture. For example, the fuel cell pilot program undertaken by the Chicago Transit Authority cost more than $9 million dollars. SunLine Transit s fleet conversion to natural gas cost at least $14 million. Pierce Transit in Tacoma reports that their CNG buses cost an average of $30,000 to $50,000 more than their diesel counterparts.

Is it worth it?

When you analyze the overwhelming costs associated with continued reliance on diesel vehicles, the prevailing opinion is a resounding yes . One calculation completed by the Union of Concerned Scientists estimates that in Los Angeles, the emissions saved over the life of one natural gas bus are worth $56,000 in avoided costs for controlling industrial air pollution, while one hydrogen fuel cell bus would achieve savings of $151,000 in these costs over its lifetime.[31] Assuming these same avoided costs for Philadelphia, the city would save between 56 and 151 million dollars in these avoided costs if SEPTA replaced 1,000 of their diesel buses with natural gas or fuel cell vehicles.[32] Transportation systems that utilize fuels that are clean, efficient, and renewable promise to revolutionize the way we move from place to place. They offer the opportunity to increase rider-ship, improve the health of our communities and protect valuable natural resources.

1. IMPROVING PUBLIC HEALTH

   The financial implications of dirty air is staggering. In addition to the medical costs associated with treating cancer, asthma, respiratory distress, and other related adverse health affects, there are many other incidental costs. Asthma is one of the leading causes of missed school days for children and the parents of these asthmatic children are often forced to miss work to care for their ailing child thus adding to the negative financial effects. According to a report published by the American Lung Association, an estimate of the direct and indirect costs of asthma total close to 19 billion dollars annually. Included in that figure is:

   - 1.2 billion dollars as a result of lost school days;
   - 1.1 billion dollars as a result of loss of work;
   - 1.4 billion dollars as a result of mortality;
   - 7.5 billion as a result of direct medical expenditures such as hospital care, medication, and physician services.[33]

   The facts are clear — investing in cleaner air is not only the right thing to do, but it also saves money in the long run. The EPA, as mandated by the Clean Air Act, has performed

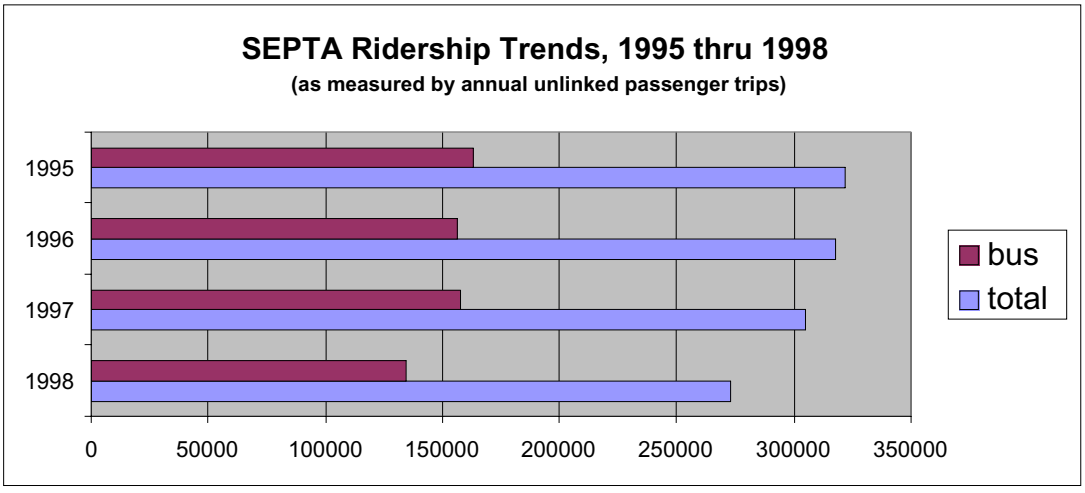
[31] Consumers and businesses would otherwise absorb these avoided costs to meet clean air requirements.
[32] Savings calculated over the life of a vehicle; average vehicle life is 12 to 16 years.
[33] Trends in Asthma Morbidity and Mortality, American Lung Association, November 1999

several studies analyzing the cost and benefits of emission controls. In the most recent study, EPA found that for every dollar spent implementing the Clean Air Act and associated programs, the nation will gain four dollars in health and ecological benefits by 2010.[34]

2. INCREASING RIDERSHIP — In the early 1990 s after the twentieth anniversary of Earth Day, consumers demanded products made with the environment in mind. From coffee filters to beauty products, industries that marketed themselves and their products as green made the environment big business. The fact remains that the image of a good corporate citizen wins big with consumers. SEPTA can take advantage of public sentiment for a cleaner environment and adopt policies that will attract the green consumer. Should SEPTA embrace the idea of being a partner in improving air quality in the region, the opportunities to partner with local businesses, city government, and even environmental groups to promote the agency s image as a solution to our air quality problems are boundless.

   This strategy worked well for the transit agency in Santa Barbara, California. After introducing electric buses, rider-ship increased fivefold. Several bus operators have even testified that riders will actually let diesel buses pass them by in order to wait to board an electric bus.[35] Similarly, SunLine Transit in California, which operates a fleet comprised entirely of CNG buses, has seen the number of passengers carried each year increase steadily, reaching over 3 million for the first time in 1997.[36]

   It s an investment SEPTA can t afford *not* to make. Bus rider-ship for the nation s fourth largest transit authority has decreased steadily over the last few years, as residents have opted to drive their own cars more often. Also, a crippling strike in the early summer of 1998 forced many SEPTA riders to find other transit options. Complaints abound that SEPTA s buses are dirty and noisy, making them the least desirable mode of travel. Advanced technologies that promise a clean, quiet, smooth ride could change that image and help make buses an attractive way to go.



Source: American Public Transportation Association (APTA), Public Transportation Ridership Statistics

[34] EPA Press Release; November 16, 1999
[35] Shifting Gears, Mark, Jason and Davis, Laurence R., Union of Concerned Scientists, April 1998
[36] SunLine on top of its game, The Desert Sun Opinion Editorial; January 1998

3. PROTECTING NATURAL RESOURCES

The production and use of energy is the largest source of pollution and environmental destruction. Outside of the health effects already discussed in this report, the ramifications of continuing our reliance on fossil fuels is staggering. Consider:

Drilling for fossil fuels destroys environmentally sensitive areas. Drilling for oil and gas requires the construction of hundreds of miles of roads and pipelines, massive production facilities, millions of cubic yards of gravel from nearby ponds and rivers, and a location for waste disposal. These activities often take place in environmental sensitive areas, and seriously threaten or endanger the existence of species that rely on these areas.

As the United States works to reduce our dependence on foreign oil, many have pushed to open more areas of our nation s wilderness for oil and gas drilling. From Alaska s northern slope, to California s coastline, to the shores of North Carolina and Florida, oil companies are pressuring Congress to allow for drilling while environmental activists fight to save these areas. A reduced dependence on petroleum products such as diesel fuel could help to protect environmentally sensitive areas from drilling.

Devastating oil spills wreak havoc on our natural environment. According to the U.S. EPA, more than 14,000 oil spills are reported each year. Some of these spills have been considered the most destructive environmental disasters the world has ever seen. In 1989 the Exxon Valdez oil tanker ran aground in Alaska, spilling more than 11 million gallons of crude oil over 3,000 square miles of a sensitive ecosystem. Ten years after the spill, only two of the twenty species affected have fully recovered — the bald eagle and the river otter. In February 2000, the Philadelphia area was victim to a spill at the John Heinz wildlife refuge in South Philadelphia. This spill, which was caused by a cracked pipeline owned by Sunoco, dumped at least 170,000 gallons of crude oil into a refuge that is home to threatened and endangered species, including the red-bellied turtle. The spill was called the largest pipeline accident involving crude oil since data collection began in 1968.[37] Reducing our consumption of petroleum products such as diesel fuel can reduce the amount of oil transported through our nation, thus reducing the potential for devastating oil spills.

Acid rain caused by the burning of fossil fuels hurts forests and landmarks. Acid rain is created when emissions of sulfur dioxide (SO2) and nitrogen oxide (NOx) react in the atmosphere with water, oxygen and other contaminants. Mobile sources such as cars, buses and trucks contribute significantly to these pollutants. Pennsylvania has among the most acidic rain in the nation, as was evident in the Fall of 1999 when 90% of the Sugar Maples in the Susquhannock State Forest in Potter County, PA were dead or dying from acid rain.[38] Acid rain also contributes to the corrosion of metals and deterioration of stone and paint on buildings, cultural objects and cars. The authorities in a number of European nations have commented that ancient buildings and sculptures have weathered more during the last 20 years than in the preceding 2,000 as a result of acid rain.[39] Philadelphia

[37] Crude oil spill at Tinicum refuge more than double first estimates, Bauers, Sandy; Philadelphia Inquirer; February 26, 2000

[38] Fall Foliage and Acid Rain in Pennsylvania: Where Have All The Colors Gone? Clean Em Up Campaign Press Release; October 4, 1999.

[39] Ministry of Environment — Norway, Norwegian Pollution Control Authority

is home to some of the nation s most precious historic monuments including Independence Hall that could be affected by such pollution. Reducing the amount of acid rain pollution that is spewed into our air will help to lower the acidity of Pennsylvania s rain and prevent future damage to our soils, forests and historic landmarks.

Reducing our reliance on fossil fuels offers significant benefits to public health, the environment and the economy. Transit agencies that commit to investing in alternatives can help lead the nation towards that goal, and must start now in order to demonstrate the viability of cleaner alternatives.

Getting on Track: Laws and Regulations to Clean Up Diesel

Due to recent scientific evidence about the toxicity of diesel exhaust as well as public outcry for action, the EPA (Environmental Protection Agency) has recently proposed new emission standards for heavy-duty trucks and buses. These standards, if adopted and implemented, will reduce pollution from urban transit buses and other diesel vehicles.

Specifically, the proposal calls for a cut in smog-forming NOx pollution by 95% by 2010, and a cut in soot pollution by 90% by 2006. The proposal also calls for a diesel fuel that will be 97% cleaner by 2007.

While the EPA s actions are a step in the right direction, it is absolutely critical that SEPTA immediately and voluntarily commits to dumping diesel in order to improve air quality and protect public health.

These tough new standards are still just proposed, meaning they are susceptible to being weakened or abandoned by the EPA or Congress under pressure from the automobile and oil industries.

This is incredibly relevant as the Presidential and Congressional races heat up. In an election year, the auto and oil industries give tremendous financial support to Presidential and Congressional candidates. This inevitably affects decisions to establish tough standards affecting these industries. As these politics and priorities change, these tough new standards could easily end up on the cutting room floor.

Optimistically, even if the EPA proposes and then the President adopts the tough emission standards, there are several other obstacles to be faced. At the earliest, requirements for low-sulfur fuel, reduction in particulate matter, and further NOx reductions would not begin until 2006 or beyond. This is far too late for the thousands of children and adults that suffer from the effects of dirty air.

Also, actions by the EPA such as those above have been under increased scrutiny by the courts and Congress. In fact, in 1999 a lawsuit brought forth in part by the trucking industry prompted a U.S. District Court in Washington D.C. to revoke tough health-based standards for NOx pollution. While supporters of the standards are confident that they will be re-instated, this is a prime example of how special interests can tie up new pollution standards for years through the courts and with political allies. All the while, public health and the environment continue to suffer.

Given the uncertainty of any new regulations aimed at reducing auto emissions, SEPTA must commit to moving ahead independently. Not only will such actions improve public health in Southeastern Pennsylvania, but will also demonstrate to the EPA, Congress and the courts that cleaner emissions from diesel vehicles are both feasible, economical and in the public interest.

SEPTA — Serious About Change?

In 1994, SEPTA applied for and received 8.3 million dollars for the purchase of natural gas vehicles, including $8 million of CMAQ money and $365,000 from the state-run AFIG program. However, as of March 2000, not one dime of that money has been used to purchase a single alternative fuel vehicle.

SEPTA officials claim that their initial efforts to build a natural gas re-fueling facility came under fire from residents and local officials concerned about the safety of the fuel. Despite the low-risk of fire or accidents from natural gas, the objections of the residents provided SEPTA with the excuse they needed to avoid proceeding with this challenging task. Intrigued by the development of diesel-electric hybrid buses, SEPTA decided instead to use the CMAQ and AFIG funds to purchase a small number of these diesel-electric hybrids. SEPTA currently plans to purchase twelve hybrid buses at a cost of approximately $400,000 each. At the earliest, these vehicles will not be delivered until 2002 provided that SEPTA places an order in the spring of 2000.

While we applaud SEPTA s decision to utilize the CMAQ and AFIG funds to purchase buses that are cleaner than dedicated diesel, SEPTA s current proposal does little to offer cleaner air to Philadelphians.

First and foremost, the purpose of CMAQ and AFIG money is to improve air quality in the region. While the diesel-electric hybrid buses offer cleaner emissions than the dedicated diesel buses currently used by SEPTA, it is unclear what level of emission reductions would be achieved with such vehicles once in service. In order to achieve emission reductions comparable to natural gas, SEPTA would need to fuel the vehicle with a low-sulfur diesel fuel. Currently, this fuel is not widely available in the U.S., and may not be for several years without strong demand from consumers or regulatory requirements from government. Any decision from SEPTA to invest in diesel electric hybrid buses must come with a commitment to find a supplier that will deliver this low-sulfur fuel.

In addition, concern over the mass of particles from the hybrid buses needs to be addressed before SEPTA relies on these buses as their only AFVs (alternatively fueled vehicles). Finally, SEPTA must also evaluate whether or not the toxicity of the particles from the hybrid exhaust pose a significant health threat.

SEPTA favors diesel electric hybrid buses over natural gas solely due to the ease of transition from their current system. This decision was not based on which option would achieve the most significant benefit for public health and air quality.

Regardless of which type of AFV SEPTA ends up using, its current plan is little more than wait and see. Management at the transit authority has no goals for air quality benefits, no timeline for the phase-in of AFVs (alternatively fueled vehicles), and no commitment to phase out diesel. Without such a plan, it is likely that SEPTA will continue to purchase a significant number of new dedicated diesel buses every year, with little or no additional investment in AFVs. Considering that SEPTA purchases an average of one hundred new buses annually, Philadelphians miss a tremendous opportunity for cleaner air and improved public health without a firm plan for cleaner buses.

If SEPTA really is serious about change, as their slogan suggests, they must establish a clear set of goals and adopt a concrete plan for achieving them.

PennPIRG and the PennPIRG Education Fund suggests the following:

Recommendations

Over the long term, all vehicles in SEPTA s fleet should operate with the Best Available Technology (BAT[40]) for emission reductions. We do not advocate for the use of any particular fuel, engine, or vehicle manufacturer. Rather, we advocate for propulsion systems that will achieve the most significant environmental and health benefits to Pennsylvanians.

In order to achieve this goal, we advocate for the following:

1. By 2020, all vehicles in SEPTA s fleet should be the cleanest Alternatively Fueled Vehicles (AFVs[41]) available. In addition, SEPTA must continuously evaluate new technologies that offer even more significant emission reductions as they become commercially available. SEPTA must experiment with and use such technologies until zero-emission vehicles fueled by renewable forms of energy comprise its entire bus fleets.

2. Beginning in 2001, either one-half (or fifty, whichever is greater) of new buses purchased by SEPTA should be BAT AFVs. For each purchase after that, the number of BAT AFVs should increase by 25% until *all* new vehicles purchased are BAT AFVs.

3. By 2001, SEPTA must begin using low-sulfur diesel fuel to power any vehicles that operate with diesel fuel. Should low-sulfur diesel fuel not be commercially available in Pennsylvania at that time, transit authorities must commit to using such fuel as soon as it becomes available. Transit authorities must also actively pressure fuel suppliers in the state to offer such fuel.

[40] Best Available Technology is defined as the technology (engine) that is the least polluting and is commercially available by at least one manufacturer.
[41] The definition of AFVs is determined by the Energy Policy Act of 1992 and the Clean Air Act of 1990.

Closing: Diesel s Legacy

It is likely that Rudolph Diesel never imagined his name would become synonymous with thick, black, toxic soot and smoke. The engine he created was more efficient than steam or gasoline engines of the time, thus the diesel engine was once considered a marvel of the modern age. Unfortunately, Diesel s invention has become an instrument of serious public health and environmental problems. The fuel it uses and subsequent exhaust created dirties our air and sickens thousands. Meanwhile, our over-reliance on this technology hinders the development of what could become this century s technological marvel fuel cell vehicles.

The common adage necessity is the mother of invention, could not be applied more appropriately than to this public health dilemma. Once SEPTA officials determine that a healthy community is necessary to doing business in Philadelphia, the only logical next step is a commitment to invest in clean vehicles and to dump diesel now.