ENVIRONMENTAL AND ENERGY STUDY INSTITUTE

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FACT SHEET ON CLEAN BUSES
Protecting Public Health, the Environment and Providing Greater Energy Security

The Status of Bus Transportation

Buses are a vital part of our nation's public transportation system. A significant number of adults and children rely on bus transportation to get to important destinations such as work and school. In fact, in 2001, transit buses carried three-fifths of public transit riders and transported 25 million children to school[1], making buses by far the most important and most common mode of mass transit service in the United States. Importantly, statistics show that demand for public transportation has been growing steadily. In the past six years transit ridership increased 24 percent, even greater than highway or air travel. Increasingly, transit planners are turning to buses and bus technologies (e.g., bus rapid transit) as cost-effective mass transportation options.

Yet, the overriding majority of our nation's bus fleet relies on conventional diesel engines[2], which negatively impact public health, the environment, and national energy security. In a survey of major transit agencies, the American Public Transportation Association (APTA) estimates that 76,075 transit buses were in active service nationwide during fiscal year 2001.[3] About 11.6 percent of transit buses represented in the APTA survey were powered by an alternative source, up from 4 percent in 1996[4]. Transit buses consumed 587 million gallons of diesel in 2001, not including the volume of diesel and gasoline consumed by the nation's school buses. The national school bus fleet, totaling 454,000 vehicles, is similarly dependent on petroleum fuels. The Union of Concerned Scientists estimates that 86 percent of school buses use diesel, while an additional 13 percent continue to use gasoline, leaving one percent which fuel with an alternative like natural gas, biodiesel or propane. Nearly half of school buses powered by alternative fuels use propane, but this number will decrease as school districts face a decreasing supply of propane bus manufacturers. Northside Independent School District, a propane bus user since 1981, is faced in 2003 with its first purchase of diesel-powered buses in 22 years. Due to low demand, manufacturers of the propane bus chassis have elected to take it out of production. Against its wishes, the school district is being forced to transition to a petroleum-powered bus fleet.

In January 2001, the U.S. Environmental Protection Agency (EPA) promulgated new heavy-duty engine and vehicle standards to reduce emissions of particulate matter and nitrogen oxides from buses. These regulations include a requirement on diesel fuel refiners to produce diesel fuel with lower sulfur content (15 parts per million) by mid-2006. New emissions standards for heavy-duty engines will take effect in model year 2007. In the interim, the EPA is encouraging the use of low-sulfur diesel in combination with new emissions control technologies. This gradual transition to low-sulfur diesel will prevent some of the problems associated with conventional diesel fuels. However, low-sulfur or "clean" diesel will continue to emit both air toxins and ultra fine particulate matter, which studies show may cause cancer and other forms of lung damage. Additionally, low-sulfur diesel does not reduce emissions of carbon dioxide, the primary greenhouse gas, nor reduce dependence on petroleum fuel. There are other alternatives to low sulfur diesel capable of resolving to a greater extent a number of these issues. Moreover, the use of advanced technologies in public transportation provides valuable on the ground experience for such products that will assist our transition to superior propulsion and energy storage systems, such as renewable hydrogen fuel cell technologies.

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[1] Bobit Publishing 2001. Fact Book Issue. In *School Bus Fleet*. http://www.schoolbusfleet.com

[2] All references to conventional diesel do not include low-sulfur diesel or after-treatment devices.

[3] APTA 2003 Public Transportation Fact Book. Statistics are taken from a Jan 1, 2002 survey performed by APTA of its members, representing about 300 transit agencies nationwide or 67 percent of all buses. There are in fact more than 2,000 transit agencies in the United States. Those not included in the survey tend to be located in small, rural areas and operate very small fleets. APTA extrapolated from its survey to get national totals.

[4] APTA January 1, 2002 survey of about 300 transit agencies. Participants in the survey own and operate about 95 percent of buses powered by alternative fuels and technologies. Diesel-powered buses fitted with particulate traps are not included in this figure.

THREATS TO HUMAN HEALTH

- Greater risk of cancer

  The National Institute of Occupational Safety and Health, the International Agency for Research on Cancer, the US EPA and the California EPA have agreed that a relationship exists between diesel exhaust exposure and lung cancer. The South Coast Air Quality Management District (SCAQMD) has found that particulate emissions from conventional diesel are responsible for 71 percent of airborne cancer risk[5]. A report by the administrators and officials responsible for state and local air pollution control estimates that in the United States, diesel could be responsible for over 125,000 additional cancers over a lifetime of exposure[6].

- Linked to asthma and other respiratory diseases

  The EPA has shown that fine particulate matter and oxides of nitrogen within diesel exhaust can impair lung function, contribute to asthma, decrease the body's respiratory defense mechanisms, and lead to acute respiratory illness. Ninety-eight percent of diesel emissions are composed of fine particulates capable of lodging deep into the lungs and inflicting respiratory damage. Poor community health as a result of particulate pollution has been linked to greater numbers of hospital stays for respiratory disease, pulmonary diseases, pneumonia, heart disease and death. In 2000 the EPA indicates that diesel vehicles like trucks and buses were significant contributors among highway vehicles of nitrogen oxide and fine particulate matter. While they produced 40.5 percent of highway vehicle emissions of nitrogen oxide, they emitted 69.4 percent of highway emissions of fine particulate matter. According to the new American Lung Association report, over 137 million Americans are exposed to unhealthy levels of ozone. Control of nitrogen oxide emissions is important since these are precursors to ozone formation.

- Greater health risks to children

  Children are among the most susceptible to the health effects of diesel exhaust exposure because of their higher breathing rates; greater time spent outdoors, and increased level of activity. The Union of Concerned Scientists has shown that children riding a school bus are exposed to diesel exhaust concentrations four times higher than if they were walking or riding beside it. A study led by the University of Southern California has shown that the inhalation of nitrogen oxides, a significant component of diesel exhaust, is related to decreased lung function growth in children.

THREATS TO THE NATURAL ENVIRONMENT

Incomplete combustion of petroleum diesel produces exhaust laden with particulates and chemical compounds, contributing to regional haze, acid rain and global warming. The U.S. transportation sector emits approximately one-third of all U.S. heat trapping gases. A 2001 study published in the journal *Nature* estimates that black carbon soot like that from diesel exhaust could be responsible for 15 to 30 percent of global warming.

GEOPOLITICAL VULNERABILITY

The U.S. transportation sector relies almost entirely on petroleum fuel. Nearly 98 percent of all transit operations use petroleum, while imports satisfied 54 percent of net petroleum consumption in 2001. The Energy Information Administration (EIA) in its 2003 Energy Outlook projects net petroleum imports to account for 68 percent of U.S. demand in 2025

ENVIRONMENTAL INJUSTICE

Pollution from diesel buses impacts a disproportionate number of low-income communities. Citizens in these communities rely upon diesel-powered buses to commute to school and to work. They are exposed more frequently and more directly to harmful diesel emissions both through travel and through proximity to bus refueling and maintenance stations.

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[5] Air Quality Management District, *Multiple Air Toxics Exposure Study II*, draft report, Nov 1999.

[6] State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials (STAAPA/ALAPCO). *Cancer Risk from Diesel Particulate: National and Metropolitan Area Estimates for the United States*, Mar 15, 2000. http://www.4cleanair.com

NATURAL GAS TECHNOLOGIES

Natural gas is a fossil fuel composed of methane, ethane and other hydrocarbons drawn from gas or crude oil wells. It is stored in compressed (CNG) or liquefied (LNG) form in high pressure cylinders and more commonly fed into spark-ignited engines. However, newer heavy-duty natural gas-powered engines without spark ignition have become available. Currently one out of every five alternatively fueled transit buses is powered by natural gas. In 2001, CNG buses accounted for one-fifth of all new bus orders[7].

Table 1 Natural Gas Emissions Compared to Conventional Diesel[8]

Carbon Monoxide	90% to 97% reduction
Carbon Dioxide	25% reduction
Nitrogen Oxides	30% to 60% reduction
Particulate Matter	90% reduction
Non-methane hydrocarbons	50% or greater reduction
Fuel Economy	15% to 20% reduction[9]

Natural gas engines produce substantially fewer emissions of particulate matter, carbon monoxide and nitrogen oxides than conventional diesel engines. Many natural gas engines already meet or exceed the 2004 EPA heavy-duty engine emission standards

In the year 2000, domestic production accounted for 84 percent of total natural gas consumption. Canadian imports account for the majority of the remaining 16% of natural gas consumed in the US..

Costs of bus fleet conversions to natural gas technologies are concentrated in the initial capital investment. The purchase cost of a CNG bus can range from $25,000 to $50,000 more than a diesel bus. This price differential is expected to grow narrower as production volumes of CNG buses increase. Also, investment in natural gas fueling infrastructure usually requires construction of a new fueling facility. These fueling facilities can be an investment in future natural gas vehicle fleets that will demand public refueling stations. The Federal Transit Administration has estimated the cost of a fueling station for a fleet of 200 buses at approximately $1.7 million. Finally, National Fire Protection Association (NFPA) codes may require modification of bus storage depots to incorporate gaseous fuel detection systems. Despite these added costs, operational and maintenance expenses tend to be lower than those for diesel-powered buses, including newer ”clean diesel” models fitted with after-treatment devices. Natural gas-powered buses save money because they do not require frequent oil changes and regular cleaning and eventual replacement of new filters. Since natural gas engines are inherently cleaner burning and experience less engine wear, normal maintenance costs tend to remain low, but these costs have varied among transit agencies.[10]

In 1993, the Los Angeles Metropolitan Transit Authority committed to purchasing only alternative fuel buses. It currently operates over 1,900 dedicated CNG buses, the nation’s largest fleet. The Metropolitan Atlanta Regional Transit Authority and New York MTA Long Island Bus Co. have also committed to alternative fuel-only purchases and operate substantial numbers of CNG buses. SunLine Transit Agency in Thousand Palms, CA became the nation’s first 100 percent CNG bus fleet in 1994 while Pierce Transit Agency in Tacoma, Washington was one of the first to use a natural gas-powered heavy-duty engine.

LNG buses are less common than CNG, although market share for LNG buses is growing rapidly. The slower market penetration is due in part to the current limitations in LNG fueling supply and distribution network. One advantage is that fuel density of LNG is higher than CNG, which means that the same BTU content (and thus, vehicle range) weighs less and may be stored in less space, typically a single cryogenic liquid tank rather than the multiple gaseous fuel storage cylinders associated with CNG units. Emissions performance is about the same as CNG because they both start as natural gas although the methane

[7] Natural Gas Vehicle Coalition, **Analysis of Transit Bus Market**, based on data as of Dec 31, 2001
[8] Source: EPA Fact Sheet, March 2002: EPA 420-F-00-03; and Leslie Eudy, Research Scientist, National Renewable Energy Laboratory. All emissions data given represent those from a heavy-duty engine.
[9] Hank Seiff, Director of Technology, Natural Gas Vehicle Coalition
[10] The average price of a gasoline gallon equivalent (GGE) of natural gas in October 2002 ranged between $0.76 in the Rocky Mountain Region and $1.40 on the West Coast. Long-term pricing contracts are often negotiated between transit agencies and natural gas suppliers to ensure security from short-term price spikes and supply shortages

content of LNG is usually slightly higher than CNG originating from pipeline gas. Transit agencies in Orange County, CA; Dallas, TX; and Phoenix, AZ operate some of the nation's largest LNG bus fleets.

BIODIESEL TECHNOLOGY

Biodiesel, a renewable fuel derived from animal fats and vegetable oils, is a diesel fuel substitute that can be used in heavy-duty diesel vehicles like trucks and buses with no engine modification. The main feedstock for biodiesel can be domestically produced from agricultural commodities like soybeans and rapeseed, or refined from used frying oil and unwanted animal fats. Currently it is more commonly found mixed at a ratio of 20 percent biodiesel to 80 percent diesel, otherwise referred to as B20.

Emissions from B20 Compared to Conventional Diesel[11]

Hydrocarbons	20% reduction
Carbon Monoxide	12% reduction
Carbon Dioxide	16% reduction over lifecycle[12]
Nitrogen Oxides	2% Increase
Particulate Matter	12% Reduction
PAH & nPAH compounds	16% to 18% reduction
Fuel Economy	2% reduction[13]

The costs associated with converting to biodiesel are relatively low. Diesel fuel storage tanks already in place can just as easily store biodiesel. Greater costs can be incurred when a fuel mixture containing a high ratio of biodiesel is used[14]. Pure Biodiesel has a tendency to act as a solvent, releasing fuel tank deposits accumulated under conventional diesel use. Costs are incurred when these deposits clog engine filters (filter clogging occurs in less than 3% of vehicles). The filters must be replaced periodically until all significant deposits have been removed.

Compared to petroleum diesel, B20 increases nitrogen oxide emissions of 2 percent. This may raise concerns for local decision makers working to decrease concentrations of ozone in their area. Research is currently underway to develop technical fixes to reduce nitrogen oxide emissions from biodiesel, like an additive to make it burn cleaner or a nitrogen oxide capture device that could be fitted on the tailpipe of the vehicle. In the meantime, this emissions characteristic poses a significant challenge to wide-scale adoption in ozone non-attainment areas.

In October 2002, the Clark County School district serving Las Vegas, Nevada and surrounding areas became the largest biodiesel fleet in the world with over 1000 vehicles. The primary source of the fuel is used frying oil taken from Las Vegas casinos. The Medford Township school district in New Jersey began using biodiesel in 1997 and has done so longer than any other fleet in the United States.

HYBRID ENGINE TECHNOLOGY

Several hybrid systems have been developed for use in bus transit applications. Hybrid propulsion systems integrate a combustion engine with one or several electric motors and can take two forms: series or parallel. A series hybrid bus is currently being demonstrated in Chattanooga, Tennessee, using a turbine engine to drive electric motors at the wheels and charge the on-board battery. The turbine engine is powered by jet fuel to keep emissions low, but any fuel like biodiesel, propane or natural gas could be used in combination with a hybrid propulsion system optimized for the chosen fuel. A parallel hybrid system allows electric and mechanical propulsion to work side-by-side. At high speeds the combustion engine drives the wheels and charges the battery, but at low speeds when the engine operates less efficiently, the on-board battery takes over and propels the vehicle. On-board batteries take advantage of regenerative braking technology, using generators in the wheels to convert forward energy into electricity to charge the batteries when braking, thereby conserving fuel. By increasing engine efficiency, hybrid systems produce fewer emissions per vehicle mile traveled.

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[11] Source: EPA Draft Technical Report, **A Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions**, October 2002

[12] National Renewable Energy Laboratory, **Life Cycle Inventory of Biodiesel and Petroleum Diesel for Use in an Urban Bus**, May 1998

[13] National Biodiesel Board (800) 841-5849

[14] The price of biodiesel has historically been higher than petroleum diesel, but this price is likely to decrease as production and distribution capacity improves. Current domestic production capacity of biodiesel stands at around 15-20 million gallons a year and is expected to grow. According to the nation's clean cities coordinators (www.ccities.doe.gov), the average price of B20 varied between $1.46 and $1.73 in October and November of 2002.

Emissions of Hybrid-Diesel Engine Compared to Petroleum Diesel Engine[15]

Hydrocarbons	28% reduction
Carbon Monoxide	98% reduction
Carbon Dioxide	33% reduction
Nitrogen Oxides	44% reduction
Particulate Matter	99% reduction
Fuel Economy	16% increase

New York City Transit tested a total of 10 hybrid-electric buses from 1998 to 2002 and will receive 125 more during the fall of 2003. By 2006, a total of 335 buses will be in operation by the fleet. Dana Lowell, assistant chief maintenance officer of MTA New York City Transit, describes their experience with hybrid vehicles as "very positive – for a brand new technology, [hybrid buses] have exceeded expectations". These vehicles have achieved a 16 percent improvement in fuel economy over standard diesel buses, while requiring little to no investment in training or infrastructure.[16]

HYDROGEN FUEL CELLS

Hydrogen fuel cells combine on-board hydrogen with oxygen in the air to generate electricity and water vapor. Fuel cells are about 40 to 60 percent efficient in converting energy, compared to about 20 percent efficiency for internal combustion engines. Fuel cells produce no harmful emissions, potentially eliminating vehicles as sources of air pollution.

Fuel cell technology for transit buses has been in the research, development, and demonstration stage for several years. In 1994, Georgetown University began one of the first fuel cell bus demonstrations using methanol. Since the late 1990s, the number of demonstrations increased dramatically. Today, practically every bus manufacturer in North America and Europe is involved in some form of fuel cell bus demonstration activity. The European Fuel Cell Bus Project will operate 30 fuel cell buses in ten cities to demonstrate and test the technology beginning in 2003. The California Fuel Cell Partnership in 2002 already began operation of the world's first fuel cell bus in revenue service in Thousand Palms, CA.

Despite its benefits, there are serious concerns that fuel cells may continue demand for polluting sources of energy. While the fuel cell itself may be clean, hydrogen pollution can become a major new pollution source. Though hydrogen is the most abundant element in the universe, it is not easily found in its pure form. Rather, it is bound up in combination with other molecules and must be separated from them. The water molecule provides one of the most abundant and accessible sources of hydrogen. However, the process of electrolysis, the separation of water into hydrogen and oxygen, requires electricity. The source of this electricity can come from any energy source, including nuclear, coal and others that pollute the air and water. Hydrogen is also abundantly found in hydrocarbon fuels, including natural gas and other petroleum products. However, the process of generating hydrogen from these products also produces unwanted emissions. The only known way to keep hydrogen fuel cells as truly renewable, non-polluting sources of energy is to ensure that hydrogen is generated through renewable means using solar, wind, geothermal, biomass and hydroelectric energy to drive electrolysis, or through controlled biological processes using enzymes and algae, for example.

Emissions of Hydrogen Fuel Cell Compared to Petroleum Diesel[17]

Hydrocarbons	100% reduction
Carbon Monoxide	100% reduction
Carbon Dioxide	100% reduction
Nitrogen Oxides	100% reduction
Particulate Matter	100% reduction

The federal research initiative proposed by President George W. Bush in his 2003 State of the Union speech may speed up the timeframe to fuel cell commercialization. Among the hurdles still to be resolved are the construction of a cheap and reliable hydrogen distribution system as well as a reduction in the weight and cost of current prototype fuel cells.

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[15] Chandler, K., Walkowicz, K., and Eudy, L., *New York City Transit Diesel Hybrid-Electric Buses: Final Results.* DOE/NREL Transit Bus Evaluation Project. P24. Emissions data for the Manhattan cycle are given. These are closest to the actual operation evaluated in revenue service of transit buses. (p23).

[16] Environmental and Energy Study Institute, *Commercializing Alternative Fuels and Advanced Vehicle Technologies: the Government's Role*. Briefing Summary, May 2002

[17] These reflect emissions reductions from the tailpipe of the vehicle. They do not reflect well-to-wheel emissions, which can vary according to the hydrogen source.

SunLine Transit Agency of Thousand Oaks, CA in October 2002 began the first operation ever of a fuel cell bus in revenue service; while in Europe, Daimler Chrysler has planned a two-year demonstration of 30 Citaro fuel cell buses in ten cities. Explaining Daimler Chrysler's plan, Dr. Eckhard Cordes, head of commercial vehicle busines stated, "Urban bus transport is the ideal field for practically testing the fuel cell as a vehicle propulsion system." Buses are part of a "niche" market where technical and other resources are centralized, making fueling, maintenance and problem-solving easier.

Policy Options

The federal transportation bills – the Intermodal Surface Transportation and Efficiency Act of 1991 (ISTEA) and the Transportation Equity Act for the 21st Century (TEA-21) – provided an excellent foundation for the conversion to cleaner vehicles. The reauthorization of TEA-21 presents an important opportunity to build on this promise and deliver a full range of modern, safe and cost-effective transportation options that meet the expectations and needs of U.S. citizens. Upcoming TEA-21 reauthorization provides two important opportunities. The Congestion Mitigation and Air Quality Improvement Program (CMAQ) is potentially the largest federal source of funding for purchase of vehicles powered by alternative fuels and technologies and related infrastructure. The Clean Fuels Formula Grant Program established by TEA-21 can also provide the greatest federal assistance directed specifically to the deployment of clean buses and support mechanisms. In addition to these, other policy options have become available. The Energy Policy Act of 2003 currently being considered in Congress, is another opportunity for supporting the use of energy-efficient, advanced vehicle technologies, while incentives such as those proposed by the Clean Efficient Automobiles Resulting from Advanced Car Technologies (CLEAR) Act of 2003 would provide tax credits for the purchase of light and heavy duty vehicles, the construction of alternative fueling infrastructure, and the purchase of alternative fuels. These and other legislative opportunities represent important policies through which the federal government can take action to support the deployment of cleaner buses.

Clean Bus Program

Federal funding for the Clean Fuels Formula "Clean Bus" Grant Program to assist local clean bus efforts was authorized in the Transportation Equity Act of the 21st Century (TEA-21), but this program was never implemented as intended. TEA-21 authorized a minimum of $100 million per year beginning in fiscal year 1999 and ending in fiscal year 2003 for the purchase of clean fuel buses, construction, modification and/or leasing of associated facilities, and repowering or retrofitting of existing buses. However, this source of funding was never appropriated in accordance with TEA-21 authorizing legislation; instead these funds were largely earmarked for specific projects. Additionally, the Department of Transportation delayed several years in writing regulations for the program. These are necessary to explain application procedures to applicants seeking clean bus funding and make clear other information not already provided in public law. Final rules for the Clean Bus Program were finally published in the Federal Register June 11, 2002, a delay which unfortunately prevented the use of guaranteed funds for fiscal years 1999 through 2002. Again in fiscal year 2003, congressional appropriators diverted clean bus funding from its intended purpose, despite the newly published program rules.

The Clean Bus Program could be reinvigorated to encourage greater deployment of clean buses to assist local areas in meeting air quality standards, reduce dependence on imported oil and help pave the way for wide scale commercialization of advanced vehicle technologies. Buses serve as excellent test vehicles for deployment of new technologies because they are centrally fueled and maintained by professionals. For example, a revamped Clean Bus Program could cover the differential cost of cleaner buses over that of comparable conventional buses, and provide funding, at an 80 percent cost- match, of clean fuels infrastructure to support this deployment. Rebate programs would also help local communities to absorb clean bus costs that provide national benefits.

Congestion, Mitigation and Air Quality Improvement (CMAQ) Program

The U.S. Department of Transportation's Congestion Mitigation and Air Quality (CMAQ) Improvement Program, an important component of TEA-21, has provided a substantial amount of money for transit but extremely little for alternative fuels and advanced vehicle technologies. At a May 2002 EESI briefing, Ken House, Democratic Staff Director of the House Transportation and Infrastructure Committee,

described this as a serious shortcoming in the original intent of the program, intended not only to improve air quality but also to "support the emerging technologies."

Expansion of CMAQ funds to include all pollutants regulated under the Clean Air Act (including PM 2.5), as well as greenhouse has emissions and increases of CMAQ funds proportional to the population of all newly designated non-attainment areas (once new air quality rules are implemented) is an important issue to be considered. A greater allocation of funds to local and regional levels could provide creativity and responsiveness in meeting local transportation and air quality improvement needs. Allocating funds based on established goals and performance standards and implementing an evaluation program to assess performance could also help ensure positive results. In general, air quality improvement and public health protection need to be central to the distribution of such funds.

Research

The reauthorization and implementation of the Advanced Vehicle Program, an existing program within the Department of Transportation, to coordinate the research and demonstration of fuels cell, advanced batteries, and other advanced vehicle technologies and infrastructure, is critical to the wide scale market penetration of cleaner vehicles.

Future Outlook

Fuel cell technologies have demonstrated the greatest potential for eliminating the health risk of bus transit emissions and dependence on foreign petroleum supplies, but these technologies are not yet ready for commercial production, nor does the requisite fueling infrastructure exist. During the ten to fifteen years projected as necessary for fuel cell technologies to reach maturity, short and medium term technologies are available at realistic prices with proven benefits. Of these, hybrid technologies, after-treatment devices and natural gas technologies significantly reduce emissions of air toxins and criteria pollutants. Natural gas engines are proven in the field and have already been widely adopted, while hybrid engines though still in the demonstration stage, have shown great promise. Low sulfur diesel and after-treatment devices through government regulation will become standard in 2007. Biodiesel presents important opportunities for immediate adoption of a domestically produced, renewable fuel without the need for high capital investment in new engines. It can also be used in conjunction with hybrid engines, low-sulfur diesel and after-treatment devices to further reduce emissions. Each of the above technologies satisfies different demands and will be adopted in the future by customers capable of absorbing their associated costs.

Clean buses are an important part of our transportation future as consumer demand and government support for buses, cleaner fuels and advanced vehicle technologies grows. Technologies are available today to resolve the problems of petroleum diesel, but their integration into this nation's transportation sector has yet to receive the full government and public support it needs to grow. This will ultimately determine the future of clean bus transit.

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