INFORM

Respiratory Hazards and Diesel Buses

Do diesel school and public transit buses pose a respiratory hazard?
Diesel-powered engines emit particulate matter that can aggravate asthma and other respiratory problems. Children may be especially susceptible to these health risks, and fine particulates can penetrate children's narrow airways and lodge deep within the lungs. Children's higher respiration rates can increase their exposure per unit of body weight. One study showed that a child riding inside a diesel school bus may be exposed to up to 4 times the level of someone riding in a car ahead of it. Exposure was higher in the back of the bus and when windows were closed.[1]

What other risks does diesel exhaust pose?
Diesel exhaust contains dozens of toxic chemicals and chemical compounds that, according to the California Air Resources Board, may cause or contribute to an increase in mortality or serious illness. These include several highly persistent, bioaccumulative, and toxic (PBT) chemicals: polychlorinated dioxins, polycyclic aromatic hydrocarbons (PAHs), naphthalene, mercury, cadmium, and lead. Other toxic constituents of diesel fuel include a number of known human cancer-causing agents such as formaldehyde, acetaldehyde, benzene, and 1,3-butadiene.[2]

What alternatives are available?

- **Compressed natural gas (CNG).** The conventional natural gas bus is today's best choice. Natural gas buses emit 40% to 86% less particulate matter than diesel buses.[3]
- **Biodiesel.** Biodiesel is a cleaner-burning version of diesel fuel made from renewable sources such as vegetable oils rather than petroleum. EPA and other studies show that biodiesel blends reduce all criteria pollutants[4] except NO_2, which may increase. Further, the toxicity reductions these fuels achieve are still unclear.[5]
- **Ultra-low-sulfur diesel.** Ultra-low-sulfur diesel may provide comparable particulate reduction in the future; however, the options available today do not match the particulate reductions of natural gas. Heavy-duty natural gas vehicles continue to be cleaner for all criteria pollutants (except carbon monoxide) than vehicles powered by low-sulfur diesel and equipped with the most advanced after-market treatments.[6]

Does the use of compressed natural gas require the purchase of new buses?
New buses must be purchased or existing buses must be "repowered," or converted to use a different type of fuel. Public transit buses may be repowered, but diesel school buses are not permitted to be converted to natural gas under Federal Motor Vehicle Safety Standard 303.

Is it more expensive to purchase CNG buses than diesel buses?
Yes. Natural gas buses generally cost from $25,000 to $40,000 more than a conventional diesel bus, depending on the type of bus. However, grants are available to offset these costs.

What financial assistance and incentives are available to offset the cost of converting to or purchasing new natural gas buses?

- Congestion Mitigation and Air Quality (CMAQ) grants are available through your state air quality or transportation agency. See http://www.fhwa.dot.gov/environment/cmaqpgs/.
- The Department of Energy Clean Cities program can assist municipalities. See http://www.ccities.doe.gov/
- Various incentives may be available. See http://www.ccities.doe.gov/vbg/progs/laws.cgi.
- The Department of Energy lists funding sources at http://www.afdc.doe.gov/afv/funding.shtml.

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Is it more expensive to operate or maintain natural gas buses than diesel buses?
The Environmental and Energy Study Institute has found that the long-term costs of maintaining natural gas buses are lower than those for diesel buses.[7] Many school districts and transit lines have realized savings due to less frequent oil changes, fewer fuel system problems, and, depending on diesel prices, lower fuel costs. One school district expected a 5- to 10-year payback, but because of high diesel prices, realized a shorter payback time.[8]

What about the cost of fuel?
Whether CNG is cheaper per mile than diesel depends on local fuel prices. Because natural gas is mostly a domestic product, prices may be less dependent on international petroleum prices.

Where can CNG buses obtain fuel?
The Department of Energy lists 1171 CNG refueling stations across the US. For locations and contact information, see the Alternative Fuels Data Center at http://www.afdc.doe.gov/refuel/usmaps_new_app.html.

What if there are no refueling stations near me?
CNG bus purchasers have formed partnerships with fuel suppliers, refueling infrastructure builders, and vehicle providers to help reduce the costs of establishing refueling stations. The funding sources listed above may also provide financial assistance. Examples of successful partnerships to develop CNG refueling stations include:

- The City of Regina (Saskatchewan) and SaskEnergy (see http://www.saskenergy.com/news/newsreleases/010926.htm)
- Wright Oil and Tire, L/CNG Energy Systems, and the Idaho National Engineering and Environmental Laboratory in Idaho Falls, Idaho (see http://www.inel.gov/inews/2000/12-19-00/1219lngstation.htm)
- The New York Department of Transportation with the Central New York Regional Transportation Authority (CNYRTA), the New York State Energy Research and Development Authority, and the Niagara Mohawk Power Corporation (see http://www.state.ny.us/governor/press/year01/july5_1_01.htm)

Who else has switched to CNG buses?
Numerous success stories are profiled at http://www.ccities.doe.gov/success/transit.shtml. These include public transit buses for York County, PA, and school buses for the Lower Merion School District in Ardmore, PA, and the Jordan School District in Salt Lake City.

Where can I buy CNG buses?
Information on different bus types, specifications, and original equipment manufacturers is available from the Alternative Fuels Data Center database at http://www.afdc.doe.gov/hdveh_cgi.shtml.

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[1] Gina M. Solomon *et al.*, *No Breathing In The Aisles: Diesel Exhaust Inside School Buses*, Natural Resources Defense Council Coalition for Clean Air, January 2001, http://www.nrdc.org/air/transportation/schoolbus/sbusinx.asp.
[2] California Air Resources Board, "ARB's Study of Tailpipe-out Emissions from In-use CNG and Diesel Transit Buses," http://www.arb.ca.gov/research/cng-diesel/cng-diesel.htm.
[3] James S. Cannon and Chyi Sun, *Bus Futures: New Technologies for Cleaner Cities*, INFORM, Inc., 2000, http://www.informinc.org/busfutr.pdf.
[4] EPA uses six "criteria pollutants" as indicators of air quality and has established for each of them a maximum concentration above which adverse effects on human health may occur. These pollutants are ozone, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead (Pb).
[5] US EPA, Biodiesel Emissions Analysis Program, http://www.epa.gov/OMS/models/biodsl.htm.
[6] California Air Resources Board, "ARB's Study of Tailpipe-out Emissions from In-use CNG and Diesel Transit Buses," http://www.arb.ca.gov/research/cng-diesel/cng-diesel.htm.
[7] Environmental and Energy Study Institute, "Diesel Buses, Oil Prices and Premature Deaths from Particulate Matter," March 2000, http://www.eesi.org/publications/03.15.00cleanbus.pdf.
[8] Pennsylvania Dept. of Environmental Protection, 1997 Governor's Awards for Environmental Excellence Energy Efficiency/Renewables, Lower Merion School District.