

1.1.3 ALTERNATIVE-FUELED VEHICLES

Technology Description



A school bus in New Jersey runs on biodiesel (right). United Parcel Service maintains a natural gas compressor station and CNG fueling island at several facilities in Connecticut (left).

Alternative fuels that will be important during the transition to hydrogen include electricity, ethanol, biodiesel, liquefied petroleum gas, and compressed natural gas. These fuels offer near-term carbon reductions of 19%-44% for a variety of vehicles.

System Concepts

- Alternative fuel vehicles (AFVs) are similar to today's vehicles, except for certain fuel- and emission-related systems.
- Vehicles operating on gaseous fuels like natural gas or liquefied petroleum gas require specific fuel system components including fuel regulators, an air and fuel-mixing apparatus, and modified fuel injectors. Modifications to the fuel tank and fuel supply and infrastructure are also required.

Representative Technologies

- Compressed natural gas buses are widely used by transit fleets nationwide.
- Automakers offer several models of compressed natural gas, and liquefied petroleum gas, and ethanol flexible-fuel vehicles.
- Heavy-duty alternative fuel engines are offered as options to the commercial market for trucks and buses.

Technology Status/Applications

- Light-duty AFVs have shown good in-service emissions performance and similar levels of fuel economy in Federal fleet demonstrations. AFV purchase costs vary; natural gas vehicles have significant incremental costs over conventional vehicles.
- Heavy-duty AFVs have shown reductions in particulate emissions. Maintenance costs are higher but are likely to decrease with experience. Natural gas is the alternative fuel of choice in these classes of vehicles when considering 100% replacement of fuel.

Current Research, Development, and Demonstration

RD&D Goals

- Develop light- and heavy-duty engine and fuel technologies that utilize transitional alternative fuels and have as good or better performance than conventional engine technologies to meet future emissions standards.
- By 2004, develop two heavy-vehicle engines that use natural gas and achieve emission compliances while being fully competitive with their diesel counterparts.

RD&D Challenges

- AFVs must be developed to meet cost, performance, and future environmental and energy efficiency goals over the lifetimes of the vehicles. Specific areas of concern include cost, range, refueling convenience, cold-start performance, and engine efficiency.
- Some alternative fuels have lower energy content, which can reduce the range of the vehicle – particularly if a gaseous fuel is used.
- Challenges to accelerating the integration of AFV technologies into the marketplace must be addressed by working with industry to eliminate near-term technical barriers and to increase availability, acceptance, and awareness of AFV technology and equipment:
 - Assist with the development of additional vehicle platforms that utilize AFV technologies previously developed in partnership with DOE in order to ensure ongoing viable product availability.
 - Maintain efforts to increase efficiency, reduce costs, and improve emissions performance of AFV engines, technologies, and equipment.
 - Enhance AFV infrastructure and vehicle development by addressing near-term technical problems as they are identified and ensure that appropriate solutions are rapidly communicated and adopted in the marketplace.

RD&D Activities

- DOE, in collaboration with engine and truck manufacturers and fuel suppliers, is conducting the Next-Generation Natural Gas Vehicle project to develop advanced medium- and heavy-duty natural gas vehicles.
- With DOE cofunding, heavy-duty engine manufacturers have major alternative-fuel engine R&D efforts.
- The Environmental Protection Agency is developing unique engine designs utilizing renewable fuels and achieving diesel-cycle efficiency levels while meeting Tier 2 emission standards for light vehicles.
- Component manufacturers, national laboratories and research institutions, universities, and state and local governments have sizable alternative-fuel R&D activities.
- Biomass and hydrogen fuels are discussed in other Technology Profiles; see the Table of Contents.

Recent Progress

- Work on the first-generation, ultra-safe, and ultra-low-emission school bus powered by compressed natural gas has been completed, and the bus is now commercially available. More than 100 have been sold in California, and work on the second generation is underway to improve engine efficiency that reduces carbon emissions. Natural gas transit buses comprise 25% of new bus orders.
- Honda has obtained ultra-low-emission vehicle certification for a dedicated compressed natural gas automobile.
- With DOE assistance, Cummins Engine, John Deere Company, and Mack Trucks have introduced heavy-duty natural gas engines with high efficiency, power ratings, and torque that maintain very low emissions.
- Light-duty alternative-fuel vehicles are currently available from all major automotive manufacturers.

Commercialization and Deployment Activities

- Domestic automobile manufacturers have been producing AFVs since 1991. Currently, 29 light-duty and 20 medium- and heavy-duty vehicle models are available, powered by a number of alternative fuels. The configurations used include flexible-fuel, dual-fuel, and dedicated fuel. Prices for gasoline-ethanol, flexible-fuel vehicles have decreased to those of their conventional counterparts.
- The Federal government has more than 50,000 AFVs on the road and is expected to lead the deployment of new alternative-fuel vehicles under the direction of DOE, the General Services Administration, and interagency coordinating committees.
- Since its inception in 1991, the DOE-sponsored alternative-fuel, heavy-duty truck demonstration program has assisted in placing more than 600 heavy-duty data collection AFVs. Data collection continues to provide valuable feedback to manufacturers and fleets.
- The DOE Clean Cities Program actively enables deployment of AFVs through its locally based government/industry partnership, with a goal of 1 million light- and heavy-duty vehicles by the end of 2010 in the United States.

Market Context

- The prices of all these fuels need to be made more attractive to vehicle users.