SmartWay Transport Partnership
U.S. Environmental Protection Agency

A Glance at Clean Freight Strategies
Hybrid Powertrain Technology

Hybrid vehicles can provide roughly $2,000 in fuel savings and cut greenhouse gas emissions by up to 12 metric tons per year, when used in stop-and-go freight applications like parcel delivery.

What is the challenge?

Energy losses during deceleration and braking can be significant, especially in vehicles that frequently stop or slow down, like trucks operating in urban areas. In addition, many freight trucks operate under conditions that require a wide range of engine performance. Engines designed to perform across a wide range of operating conditions tend to be less efficient and larger than engines designed to work within a less demanding range. Engine size generally affects the size and weight of other vehicle components, such as the radiator. Taken together, the energy losses due to braking, and the extra fuel consumed by less-efficient engines and heavier vehicle components can account for 30 percent or more of a vehicle's total fuel use.

What is the solution?

Hybrid powertrain technology makes it possible to optimize engine size and efficiency, and capture and harness the energy lost during braking. Hybrid vehicles have two propulsion power sources. The main power source is usually a conventional internal combustion engine. Energy recaptured from braking is converted and stored until it can be reused by the second power source. The second power source generates extra power to supply "boost" to the vehicle when needed - for example, to climb a hill or accelerate to pass. Because the main engine no longer has to handle the full range of power demands, it can be optimized to operate within its most efficient performance range. Engine optimization generally allows the engine and related components to be downsized as well.

There are a variety of hybrid powertrain designs. In one design, the second power source is an electric motor/generator, and the recaptured energy is stored in a battery. However, batteries are generally heavy and slow to charge. A variant of this design stores the energy in ultracapacitors, which are lighter and charge quickly, but are costly. A third design stores energy as hydraulic pressure. Hydraulic fluid inside a sealed cylinder pushes against a "bladder" of inert nitrogen gas, which is compressed and thus stores energy. Hydraulic systems can charge and discharge energy quickly, and may use a pump motor/generator as the second power source. Other hybrid designs use flywheels to store energy.

Although the first commercial applications of hybrid powertrain technology have been in passenger vehicles, it is more efficient to put hybrid technology on heavier vehicles like trucks. This is because a vehicle with greater mass requires more power to stop it, which represents more potential energy that can be recaptured during braking or deceleration. Larger vehicles tend to have more available space for packaging the hybrid powertrain components. Heavy-duty trucks typically cost more than passenger vehicles, so the additional cost for the technology is a smaller percent of total vehicle cost.

The results are in . . .

In pick-up and delivery service, truck fuel economy can be improved from 30 to 50 percent using hybrid powertrain technology, depending upon the type of technology and the amount of energy that can be captured from braking and deceleration and then reused. A typical step van could save as much as $1,200 in fuel costs and reduce greenhouse emissions by more than 7 metric tons per year. Benefits for a typical enclosed delivery van truck would be greater – at least $1,900 in fuel savings and 12 metric tons of greenhouse emissions per year.

Next steps

Fleets that operate primarily in urban areas or in stop-and-go applications should consider using hybrid vehicles. Transit bus, garbage truck, parcel delivery truck, airport parking shuttle van, and utility truck fleets could all potentially save fuel by using hybrid technology. Companies interested in learning more about hybrid technology and its potential to improve the fuel economy of their fleets may visit the Internet sites of the Environmental Protection Agency (www.epa.gov/otaq/technology.htm) and the Department of Energy (www.ott.doe.gov). Numerous other web sites provide information about various public and private organizations that promote and develop hybrid truck technology. Trucking companies can also learn from the experience of others in the freight industry. For example, at least two major parcel delivery companies are exploring the use of hybrid technology for step vans in commercial fleets. In May 2003, FedEx Express publicly announced it would test twenty hybrid electric trucks for potential use in its pick up and delivery fleet.