SmartWay
U.S. Environmental Protection Agency

Hybrid Powertrain Technology

A Glance at Clean Freight Strategies

ENERGY & FUEL SAVINGS

Long Haul Hybrid

Gallons Saved:
1,333 gallons

CO_2 Savings:
13.5 metric tons

Fuel Economy Increase:
9%

MPG (original 6 mpg):
6.52 mpg

Reduction in Fuel Consumption:
8%

Fuel Cost Savings:
$5,066

Hybrid vehicles that use two or more distinct power sources to operate can provide fuel savings in both long-haul combination trucks and stop-and-go freight applications as well as cut greenhouse gas emissions. The amount of savings is highly dependent on the drive cycle.

What is the challenge?

When a truck decelerates or brakes, the kinetic energy of the moving vehicle is typically lost. This energy loss is particularly large for trucks operating in urban areas, where vehicles make frequent starts and stops. If the kinetic energy of a braking truck can be captured and harnessed, the truck can achieve better fuel economy and lower emissions.

What is the solution?

Hybrid powertrain technology is a method to capture this energy and improve fuel economy. Hybrid technology uses two power sources to move the vehicle, a main source and a secondary source. The secondary power source provides an extra boost to the main power source (usually an internal combustion engine) when the vehicle needs extra power, such as when climbing a hill or accelerating to pass. This usually makes it possible to use a main power source that operates more efficiently and could be downsized. When the main engine is downsized, other powertrain components, such as the radiator, can be downsized as well.

One of the primary benefits of hybrid powertrain technology is the ability to reclaim a portion of the energy otherwise lost to braking or deceleration. A variety of options exist to capture and store this kinetic energy for later use. One option relies on the kinetic energy of the vehicle to generate electricity, which can be stored in a battery. Another option is to store the electricity in ultracapacitors, which charge quickly but are costly. A third option 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. Flywheels have also been used to store the extra energy.

While the first commercial applications of hybrid powertrain technology have been passenger vehicles, it is actually more efficient to place hybrid technology in heavier vehicles like trucks. Since a vehicle with greater mass requires more power to stop, more potential energy can be recaptured during braking or deceleration. Larger vehicles also tend to have more available space for packaging the hybrid power train components. Heavy-duty trucks typically cost more than passenger vehicles, so the additional cost for the technology can be a smaller percentage of total vehicle cost.

Savings and benefits

In pick-up and delivery service, it is estimated that truck fuel consumption can be reduced from 25 to 50 percent using hybrid powertrain technology. Fuel savings depend on the type of hybrid technology, the amount of regenerative braking energy, and the amount of engine efficiency improvements. A typical long-haul combination truck could save about $5,000 in fuel costs and reduce greenhouse gas emissions by over 13 metric tons per year. Benefits for a typical stop-and-go truck include fuel savings of about $1,000 and 4 metric tons of greenhouse gases each year. At least three major parcel delivery companies are exploring the use of hybrid technology for step vans. Preliminary results from some parcel delivery companies indicate hybrid trucks expect about a 40 percent improvement in fuel economy.

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Hybrid Powertrain Technology

A Glance at Clean Freight Strategies *Continued*

ENERGY & FUEL SAVINGS

Stop & Go

Gallons Saved:
394 gallons

CO_2 Savings:
4 metric tons

Fuel Economy Increase:
33%

MPG (original 6 mpg):
11.39 mpg

Reduction in Fuel Consumption:
25%

Fuel Cost Savings:
$1,497

NEXT STEPS

1. Use hybrid power train technology in a fleet setting.
2. Set up an evaluation process to assess hybrid power train technology with different fleet drive cycles.