Partners

EPA
United States
Environmental Protection
Agency

The technical organizations that contributed to the development of the hydraulic hybrid yard hostler are: U.S. EPA, APM Terminals, Parker-Hannifin, Kalmar Industries, FEV, Inc., R. H. Sheppard Co., Inc., and Webasto.

APM TERMINALS

Parker

FEV

SHEPPARD

Kalmar

Webasto

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THE PORT AUTHORITY OF NY & NJ

DEPARTMENT OF ENVIRONMENTAL PROTECTION NEW JERSEY

EPA does not endorse any specific company or enterprise.

CLEAN AUTOMOTIVE TECHNOLOGY

INNOVATION THAT WORKS

An EPA Program

EPA's Clean Automotive Technology Program conducts this innovative research primarily to:

- Achieve ultra-low pollution emissions
- Reduce greenhouse gases
- Increase fuel efficiency

By developing cost-effective technologies, the Clean Automotive Technology program also encourages manufacturers to produce cleaner and more fuel-efficient vehicles. Fleets owners benefit by being able to recoup the initial hybrid system costs through lower operating costs within a few years.

United States Environmental Protection Agency

National Vehicle and Fuel Emissions Laboratory (NVFEL)

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www.epa.gov/otaq/technology

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HHV

HYDRAULIC HYBRID VEHICLES

THE WORLD'S MOST EFFICIENT, LOWEST COST HYBRIDS

Series Hydraulic Hybrid
"Yard Hostler"

HHV-HYDRAULIC HYBRID VEHICLES

HIGHEST EFFICIENCY - LOWEST COST

Using innovative series hydraulic hybrid technology, EPA and its industry partners have created a highly efficient and cost-effective hybrid. This system is projected to improve the stop-and-go fuel efficiency of off-road container tractors known as yard hostlers by 50-60 percent and reduce climate change CO_2 greenhouse gas emissions by over 30 percent. The unique energy recovery technology used to stop a hydraulic hybrid vehicle also reduces brake wear by up to 75 percent, increasing the net operating savings substantially.

Each high efficiency yard hostler could save a terminal operator over 1,000 gallons of fuel per year.

Even more remarkable, when manufactured in high volume there is the potential to recoup the hybridization costs from fuel and maintenance savings in three to five years.

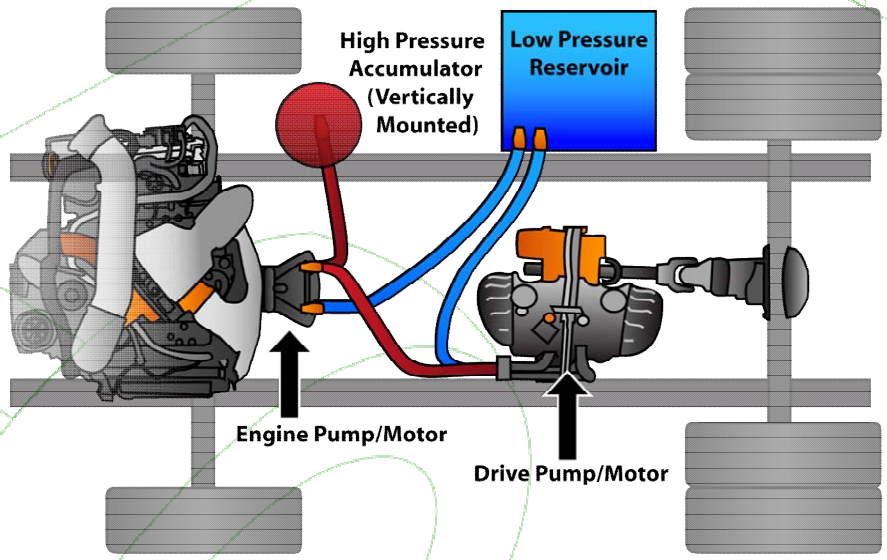
The lifetime fuel savings for this vehicle's typical 12 year lifespan could be over $35,000 (assuming fuel costs of $3/gallon).

Hydraulic hybrid vehicles rely on proven technology which is being evaluated in package delivery vehicles, shuttle buses, and refuse trucks.

HOW IT WORKS

This innovative technology is simple. The main components in a full series hydraulic hybrid vehicle are:

- **High pressure accumulator** — stores energy by using hydraulic fluid to compress nitrogen gas much as a battery is used to store energy in a hybrid electric vehicle.
- **Rear drive pump/motor** *(acting as a motor)* — converts pressurized hydraulic fluid into rotating power for the wheels .
- **Low pressure reservoir** — holds the spent fluid after it has been used by the rear drive pump/motor.
- **Rear drive pump/motor** *(acting as a pump)* — captures braking energy by pumping hydraulic fluid back into the high pressure accumulator.
- **Engine pump/motor** *(acting as a pump)* — creates additional high pressure fluid needed to drive the vehicle, storing any excess in the high pressure accumulator.
- **Hybrid controller** — monitors the driver's acceleration and braking, and sends operating commands to the various hybrid system components.



A typical yard hostler vehicle used to move containers at a sea port terminal.

The three key design features that contribute to improving the fuel efficiency of hydraulic hybrid vehicles are:

1. **Regenerative Braking** — To slow or stop the vehicle, the rotating energy of the wheels is used to pump fluid from the low pressure reservoir into the high pressure accumulator. This stored energy is then used to accelerate the vehicle. Up to 70 percent of the energy normally wasted during braking is recovered and reused.
2. **Engine Shutoff** *(idle reduction)* — Over 40 percent of a yard hostler's working hours are spent waiting at the port with the engine idling. The vehicle's engine-off power steering and heating systems allow the engine to be shut off during these waiting periods. The unique series hybrid design also enables the engine to be automatically turned off when it is not needed, such as during braking. These features reduce vehicle emissions, as well as operating and maintenance costs.
3. **Optimum Engine Control** — In the full series hybrid design, there is no conventional transmission and driveshaft to connect the engine dirctly to the wheels. This frees the engine to be operated at its best efficiency "sweet" spot, achieving optimum vehicle fuel economy.