

HEAVY DUTY GREEN TRUCKS

TCCC 9-17-2009

DAVE NAVEY
CHARLOTTE TRUCK CENTER

POINTS OF INTEREST

- ELECTRIC HYBRIDS
- HYDRAULIC LAUNCH ASSIST (HLA)
HYBRIDS
- NATURAL GAS TRUCKS
- NG FUELING SYSTEMS

ELECTRIC HYBRID

Fleets

- Reduce operating (fuel) cost
- Green image
- Improve operating environment (i.e. quieter, lower emissions)
- Reduce carbon footprint (if mandated)

Government

- Improve air quality
- Reduce GHG emissions (Global Warming)
- Reduce dependence on foreign oil

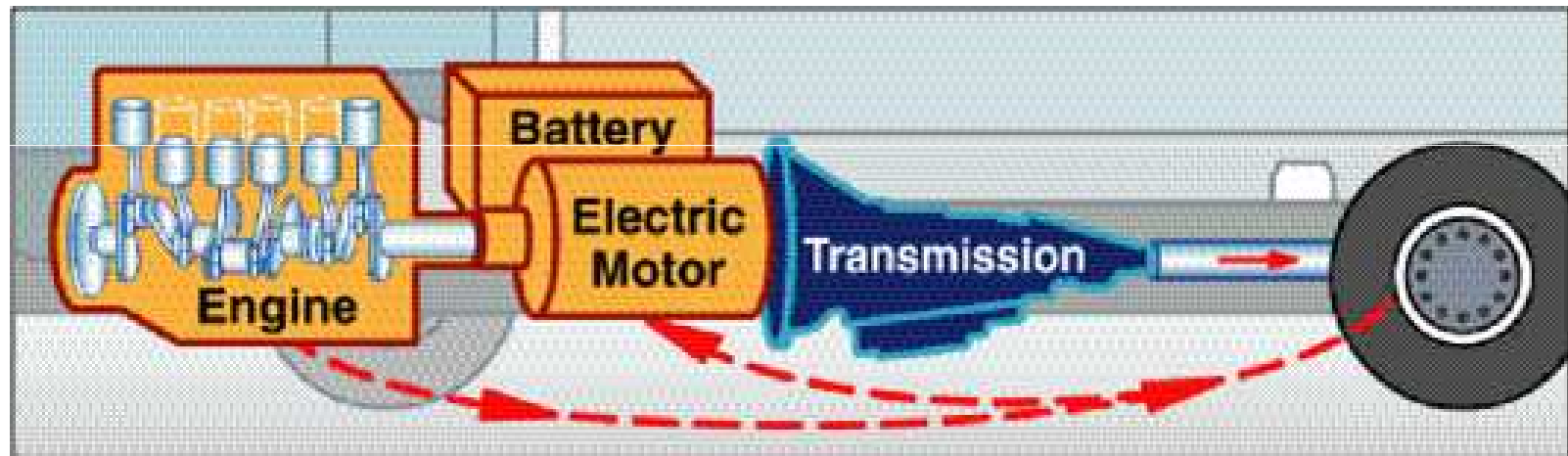
Manufacturer

- Competitive product offering to maintain and grow market share
- Environmental stewardship and industry leadership

HYBRID APPLICATIONS



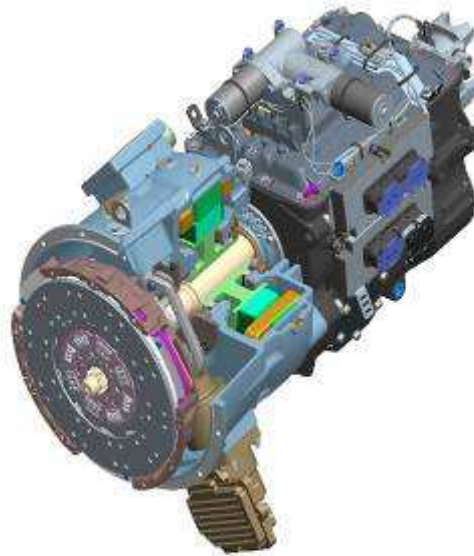
CONCEPT



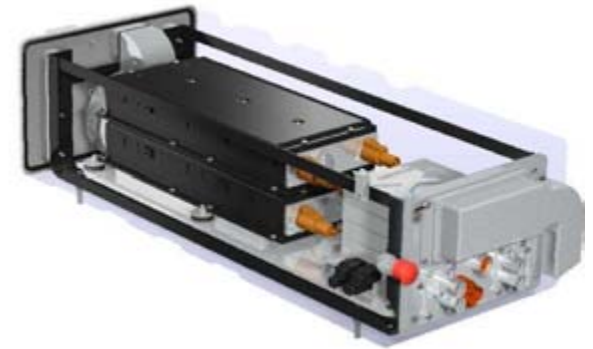
MAJOR COMPONENTS



DIESEL ENGINE



HYBRID DRIVE UNIT



**POWER ELECTRONICS
CARRIER (PEC)**



AC/DC INVERTER



**HYBRID COOLING
SYSTEM**

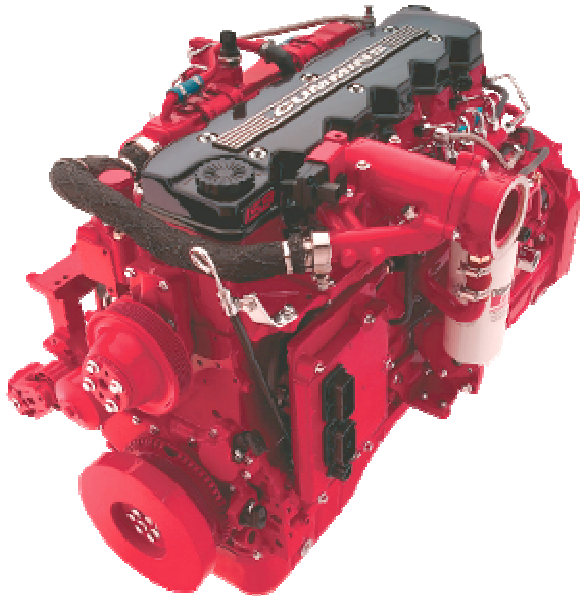


**DC/DC CONVERTER
ePTO ONLY**



5 kW APG (OPTIONAL)

EPA 07 Cummins ISB Engine



Power

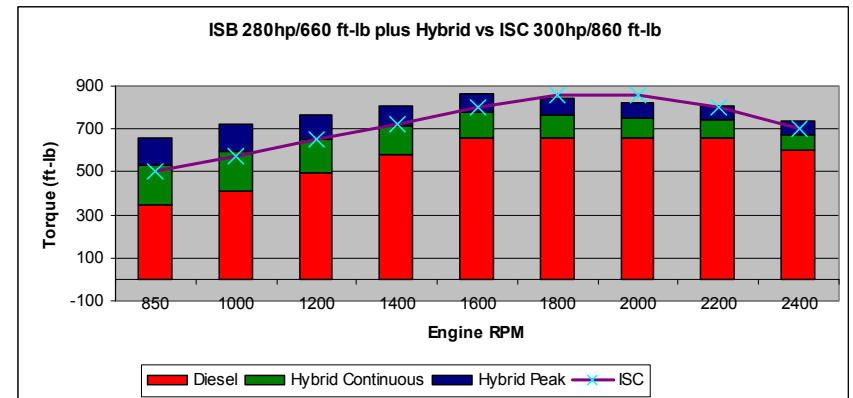
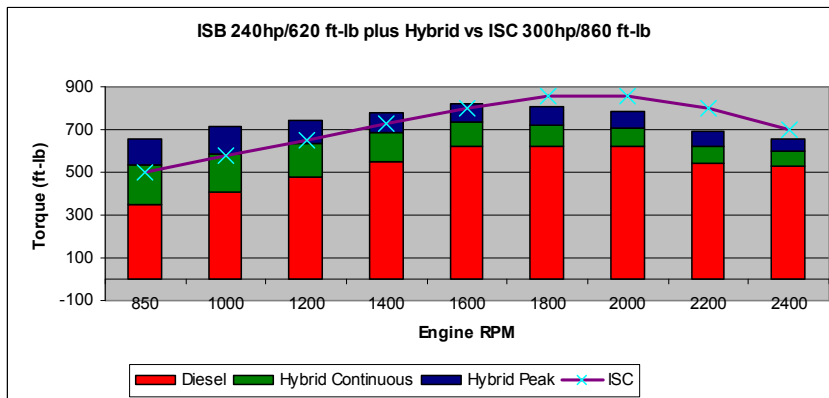
200 to 300 hp + 60 hp hybrid peak
vs 260 to 330 hp for ISC

Torque

520 to 660 ft-lb + 310 ft-lb hybrid peak
vs 660/800/860/1000 for ISC

Weight

500 lbs lighter, offsets hybrid weight
Biodiesel compatible up to 20%



HYBRID DRIVE UNIT (HDU)



- Includes electric generator/motor and Ultra-shift transmission
- Rated for 35 continuous hp, 60hp and 310ft-lb peak
- Liquid cooled on separate circuit
- Supplies regenerative power (under braking) to PEC
- Provides power for vehicle launch/driving
- Primary engine starter
- Provides ePTO power with engine off (for ePTO option)
- Factory installation similar to normal powertrain



MOTOR / GENERATOR
TRANSMISSION MOUNTING LOCATION



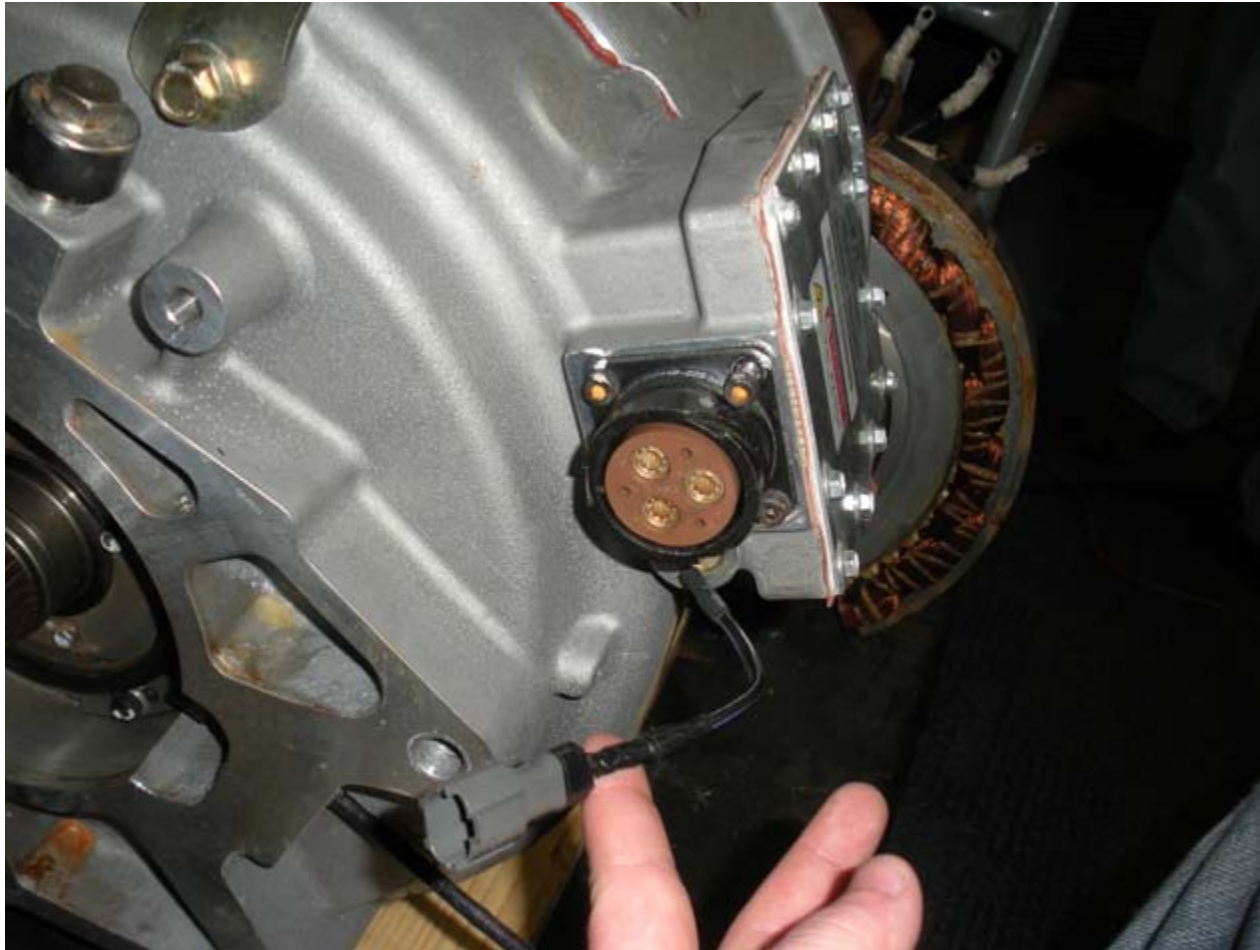
HOUSING WITH MOTOR REMOVED



STATOR / ROTOR ASEM
3 PHASE A/C MOTOR GENERATOR



A/C POWER CABLE CONNECTION
DATA BUS CONNECTION



Power Electronics Carrier (PEC)

The PEC is a two-piece plastic shell, with reinforced steel frame.

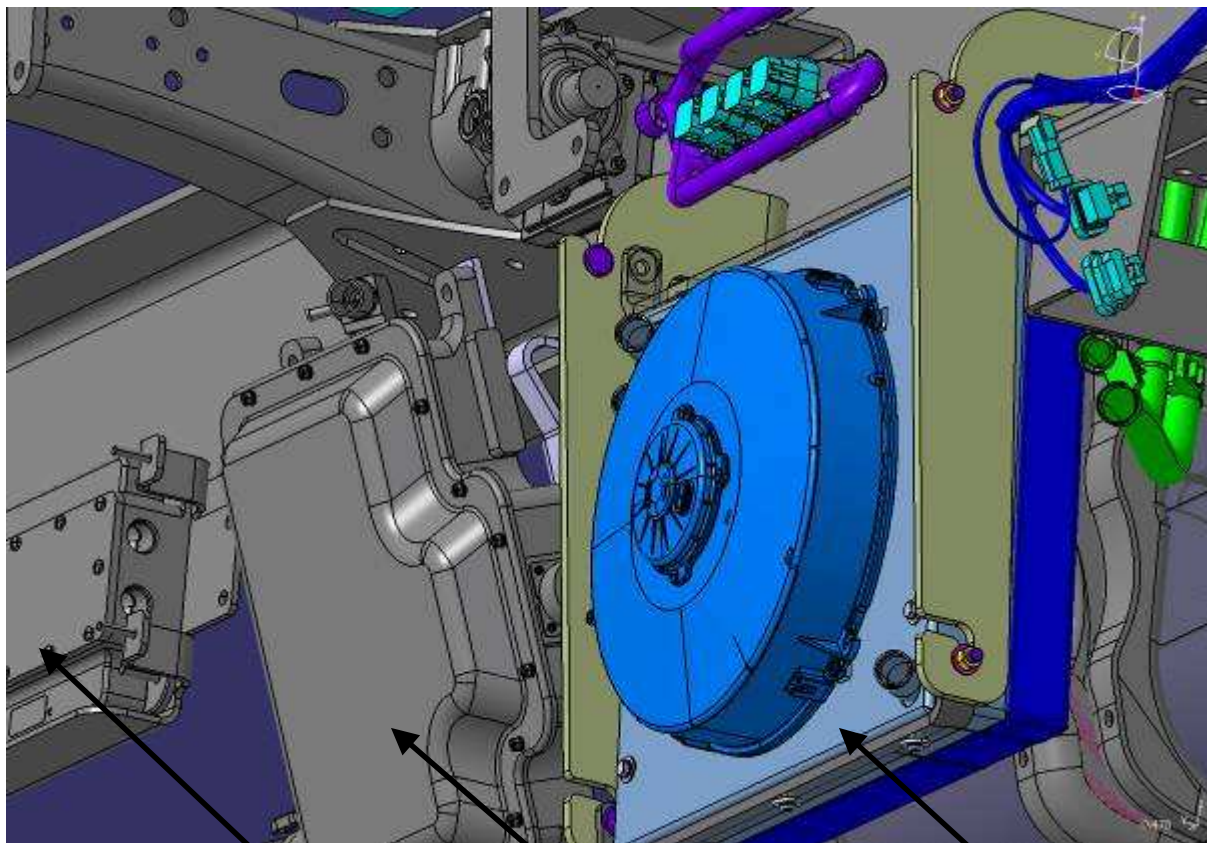
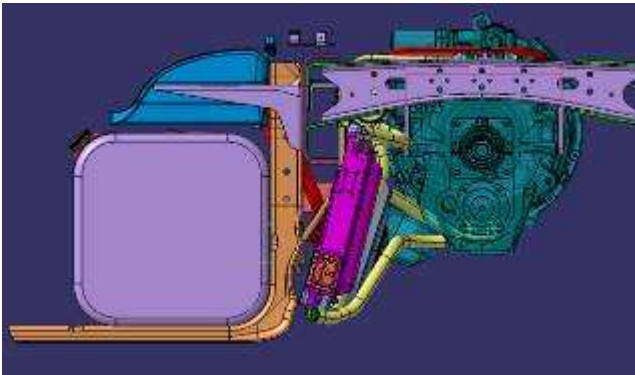
Air-cooled unit with replaceable air filter.

Contains two 170-volt lithium ion batteries connected in series, operating at 340-volts DC
PEC weight is approximately 220lbs.

Mounting location can vary depending on application and body builder.



M2e Hybrid - Cooler/Inverter



DC/DC
Converter

Inverter

Cooler

Hybrid system uses separate liquid cooling system for the high power electronics

Inverter controls the entire high-voltage system and converts 340V power between AC (motor) and DC (battery)

Location Under cab
Inside frame rail LH side

Benefits

- Clear back of cab
- No wheelbase impact
- Supports dual fuel tank options
- Day, Extended, and Crew Cab
- Works with 2010 engines
- RH PTO open



DC/DC Converter

Utility truck applications only.

Converts Hybrid DC high-voltage to maintain vehicle 12-volt system in ePTO mode
DC converter function is controlled by Hybrid Control Module.

Unit is liquid cooled.



GEAR SELECTOR

Gear displays are located in the dash of the vehicle and are supplied by Freightliner.

“Check Hybrid” and “Stop Hybrid” warning lights are also supplied by Freightliner and notify the driver of problems with the Hybrid system.

The Push Button Shift Control unit is supplied by Eaton and is available in two different configurations: City Delivery and Utility (pictured).





M2-106 straight truck
GVW – up to 40K

Cummins ISB – 200 to 300hp / 520 to 660
ft-lb

Eaton Parallel Electric Hybrid Drive –
60hp/310 lb-ft peak
6 speed Ultrashift transmission

Air Brakes

Performance (dependent on stationary
PTO usage)

- Fuel Economy Improved 40% - 60%
- Idle Time Reduced 4 to 5 Hours per Day
- CO2 Output Reduced 13 to 17 Tons/Year

Financial

Federal Tax Credit

Class 6 = \$6K

Class 7 = \$12K

Annual savings \$4,500 to \$6,000

Electric Refrigerated Van



Freightliner
M2e Hybrid



Eaton Hybrid
5kW APG



Aura Systems
Oasis Electric



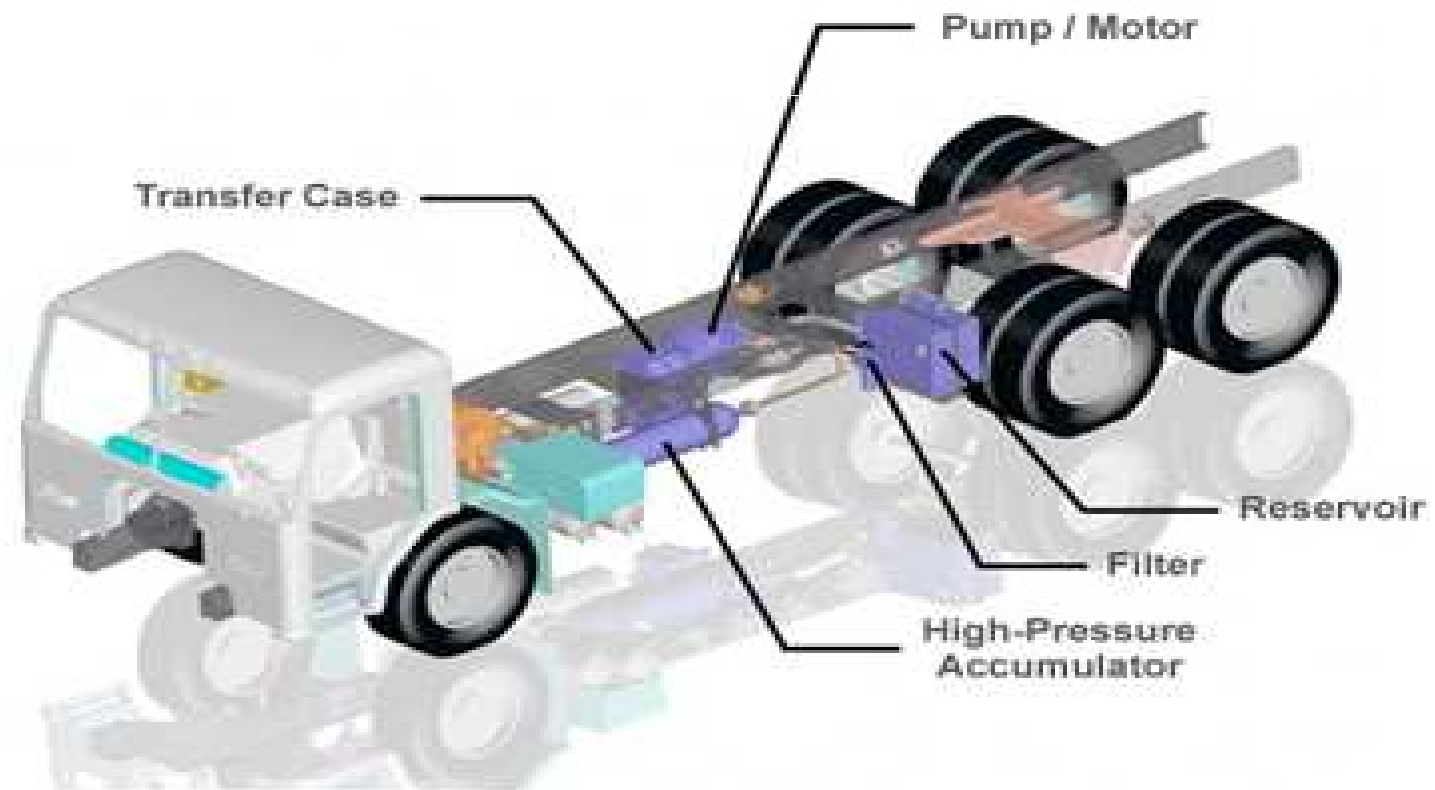
- Reduce
- Fuel Consumption
 - Maintenance
 - Noise
 - Weight
 - Emissions

Hydraulic Hybrid (HLA)



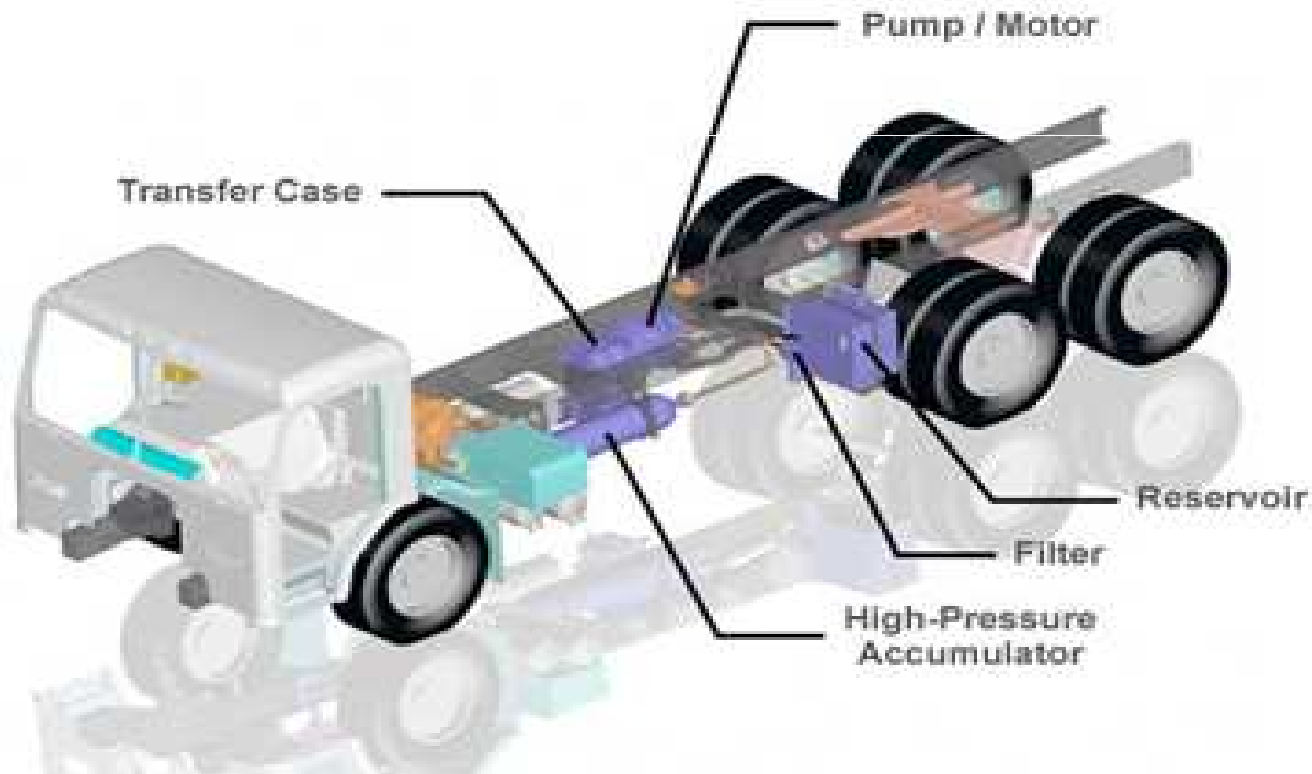
Braking

During braking, the trucks energy drives the pump/motor as a pump, transferring hydraulic fluid from the low-pressure reservoir to a high-pressure accumulator.



Pressurization

The hydraulic fluid compresses nitrogen gas in the accumulator and pressurizes the system. The regenerative braking captures about 70% of the kinetic energy produced during braking.



Reduced Brake Wear

Capturing 70% of the braking energy with the hydraulic fluid can reduce brake wear by more than 50%. The HLA system prevents service brake application till just before a complete stop.

Heavy refuse trucks may need 2 or more brake jobs per year. This system could stretch the life of one brake job to well over 1 year.

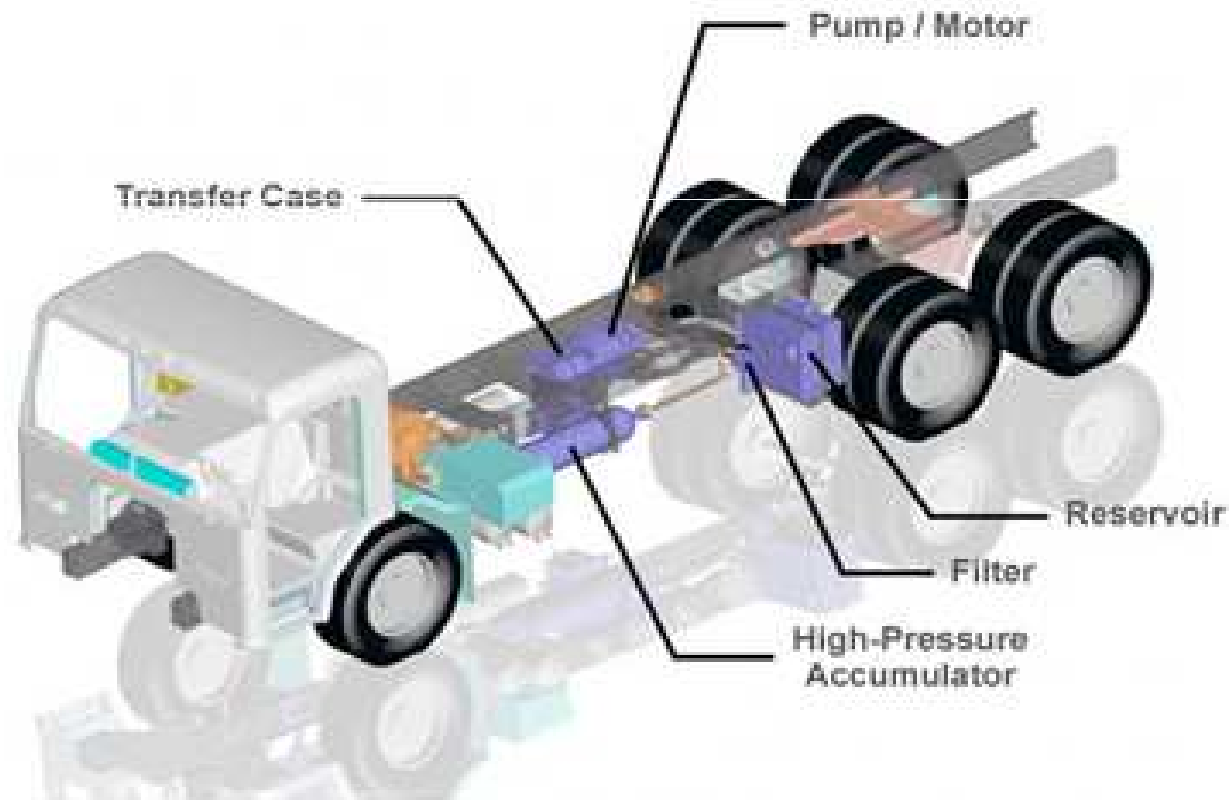
An average brake job may cost \$3500.00 x twice per year X 8 years service life = \$56,000.00

One brake job every year x 8 years service life = \$28,000.00

\$28,000.00 savings through reduced brake wear over 8 years

Launch Assist

During acceleration, fluid in the high-pressure accumulator is metered out to drive the pump/motor as a motor. The system propels the vehicle by transmitting torque to the driveshaft.



Economy Mode

When the Hydraulic Launch Assist System is operating in Economy Mode, the energy stored in the accumulator during braking is used alone to initially accelerate the vehicle. Once the accumulator has emptied, the engine will begin to perform the acceleration. This process results in increased fuel economy.

Economy Mode Savings

Increased fuel economy of 30%
Increased acceleration of 2%

Economy mode allows for maximum fuel savings &
Maximum exhaust emission reductions

Performance Mode

In Performance Mode, acceleration is created by both the energy stored in the accumulator and the engine. Once the accumulator has emptied, the engine is completely responsible for acceleration. While fuel economy improvements are seen in Performance Mode, the greatest benefit is increased productivity

Performance Mode Savings

Increased fuel economy of 17%
Increased acceleration of 26%

Performance mode allows for faster cycle times,
More stops per day, & greater productivity

Specifications

- Mass of HLA System 1250 lb
- Max Pressure 5000 psi
- Total System Oil Volume 21 gallons
- Torque 2550 ft-lb
- Active Speed Range Up to 25 mph
- Minimum Wheelbase 191" (single) 215" (tandem)

Summary

- Works best with high stop & go duty cycle applications
- Parallel system allows normal vehicle function when HLA is offline
- 15-30% better fuel economy
- Reduces emissions of NOx, particulates, & CO2
- Provides more torque for quicker acceleration & shorter cycle times
- Greatly increases brake life
- Extends service intervals for engine & transmission.

NATURAL GAS

