



Hybrid Chassis Overview

October 7, 2010

AASHO
THE VOICE OF TRANSPORTATION

Jim Pare'
Vocational Sales Manager- Product Integration



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Corporate Responsibility



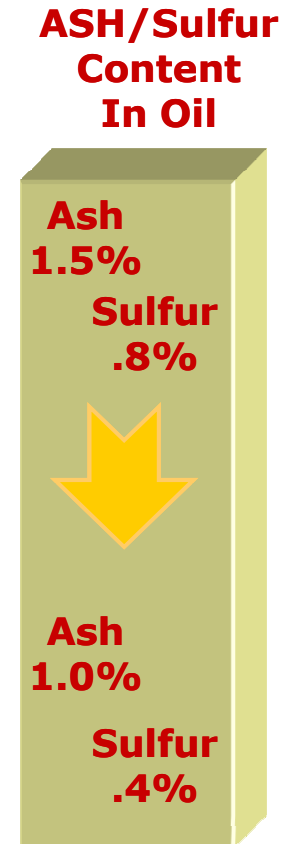
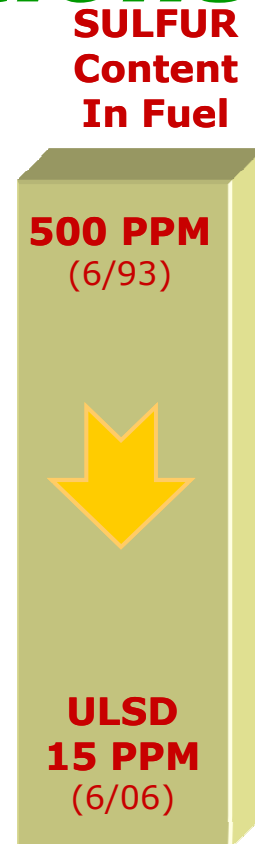
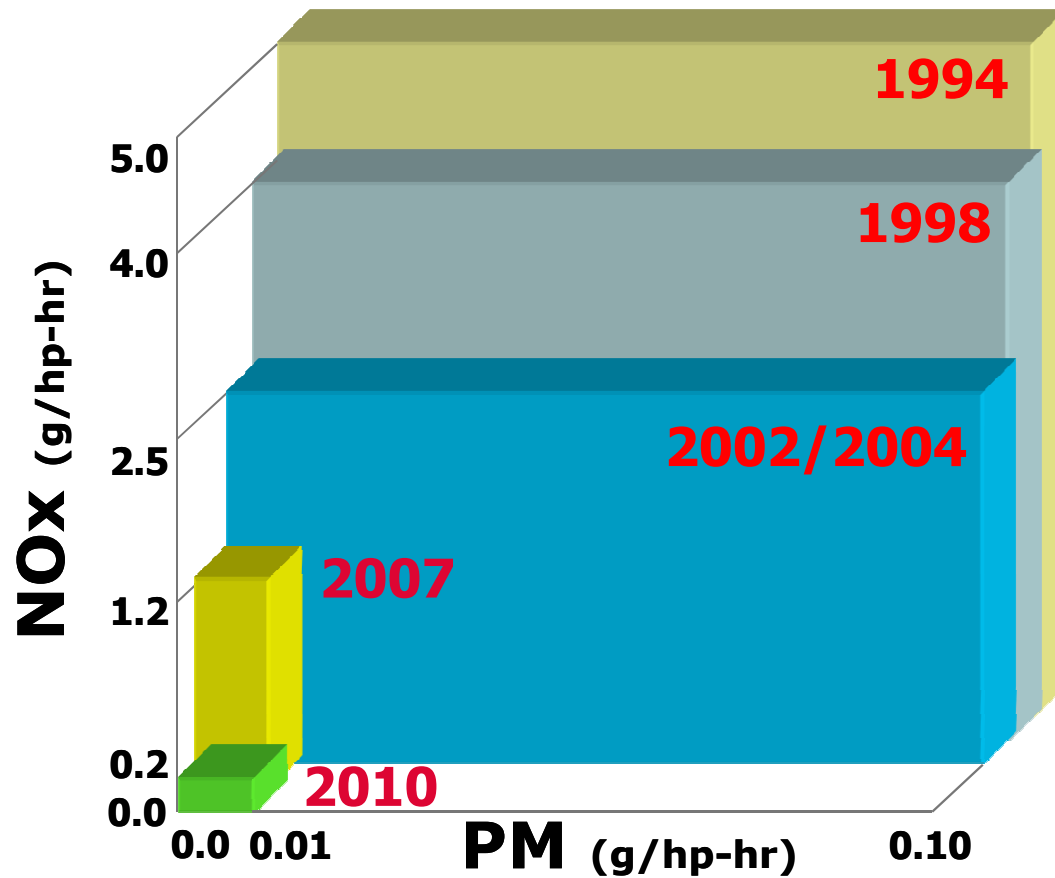
- Reduced dependence on fossil fuels
- Reduction in green house gases
 - CO2 Emissions
- Use of alternative fuels
- **International's® Green Diesel Hybrid Technology**



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Emissions Reductions



The only way to reduce CO2 emissions Green House Gases in any magnitude is to not to burn the fuel.



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Fuel Economy Improvements



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HYBRID

- Keys to improvements
 - Intercity application critical (Duty Cycle)
 - Regenerative braking
 - Idle reduction
- Expectations
 - 30 to 60% fuel economy improvement
 - Reduced emissions
 - Reduced maintenance
 - Bio-diesel approved (B-20)

The only way you can reduce greenhouse gases is to not burn the fuel!

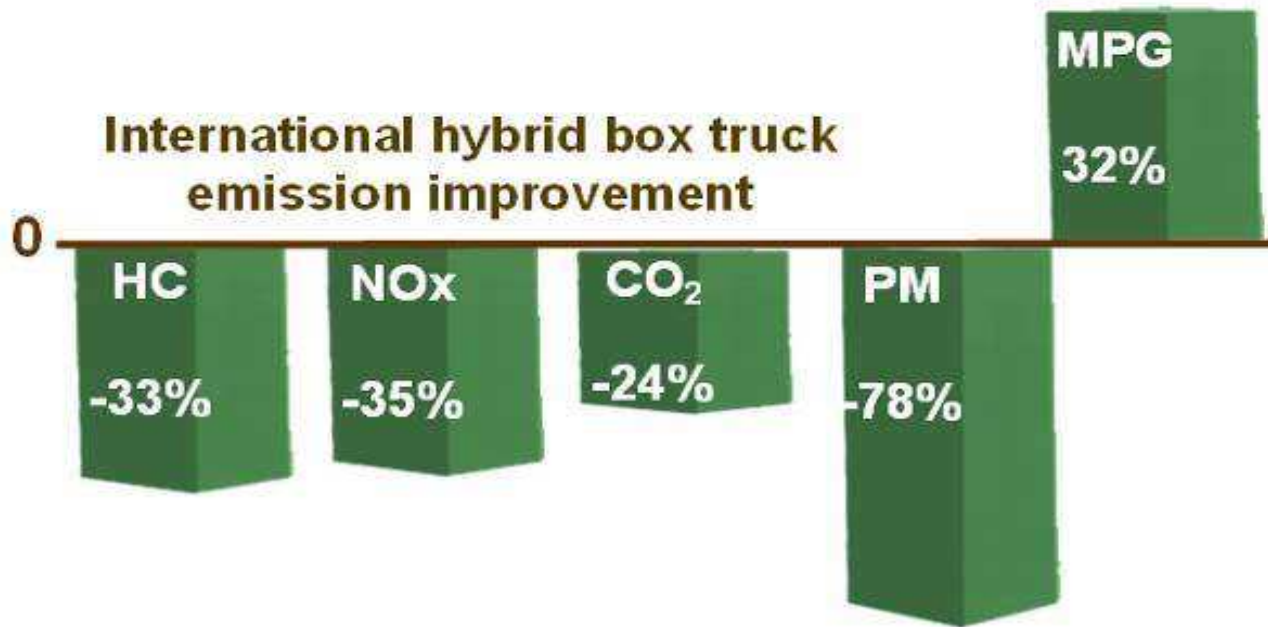


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2007 Emission test results

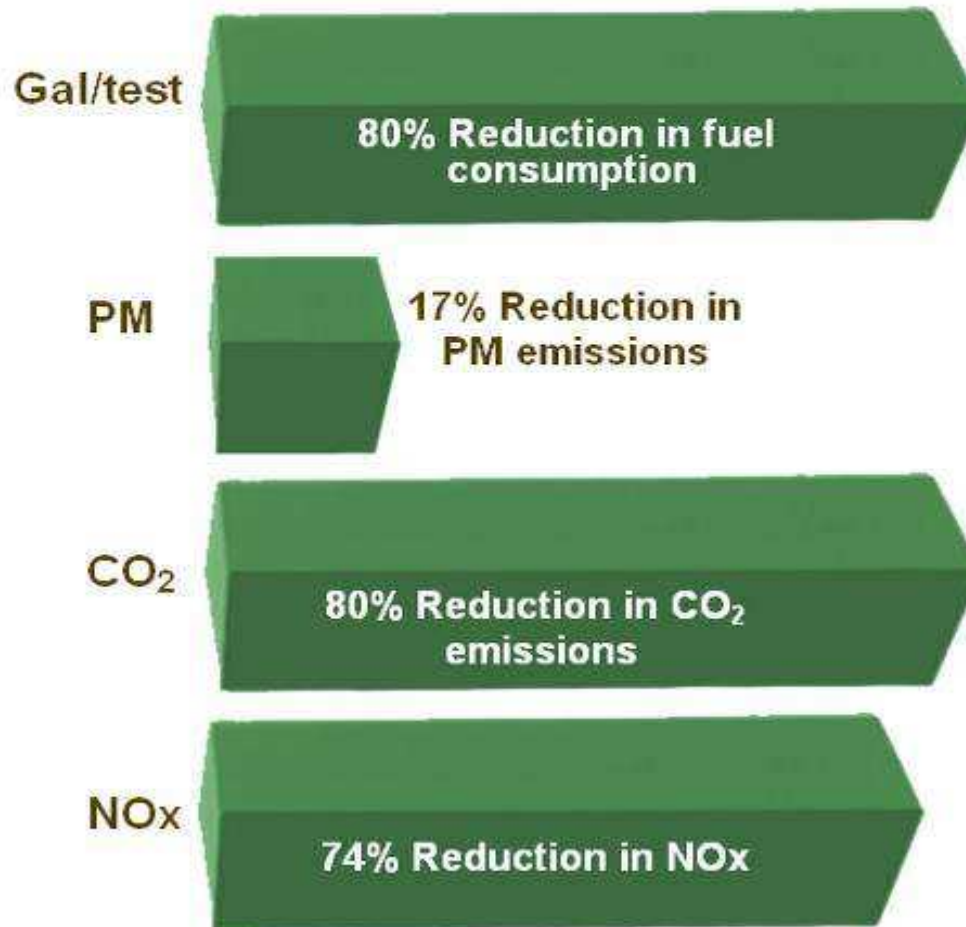
baseline and hybrid box truck

	HC g/mile	NO _x g/mile	CO ₂ g/mile	PM mg/mile	MPG
Baseline	0.154	5.53	1,247	0.30	8.2
Hybrid	0.103	3.57	947	0.07	10.8
% Difference	-33%	-35%	-24%	-78%	32%



2007 Emission test results

baseline and hybrid utility truck





Real World Customer Fuel Economy

Route Information				Hybrid Vehicle Data			Non-Hybrid Vehicle Data			Hybrid Benefit
Date	Route	Route Time (Minutes)	Average Speed (MPH)	Distance [Miles]	Fuel Consumed [USGal]	Fuel Economy [MPG]	Distance [Miles]	Fuel Consumed [USGal]	Fuel Economy [MPG]	FE % Improvement
12/8/2008	Queens	349	9.0	52.63	6.68	7.88	52.6	9.50	5.54	42.2%
12/9/2008	Manhattan	661	3.3	36.44	5.59	6.52	36.4	7.80	4.67	39.5%
12/11/2008	Brooklyn	514	3.0	25.81	4.70	5.49	25.8	6.51	3.96	38.6%
Total		1524	4.5	114.88	16.97	6.77	114.87	23.81	4.82	40%

- Three day total fuel economy improvement over the base is 40%.
- The expected fuel economy percent improvement to fall between 25% and 45% over all duty cycles on any given day.
- The overall Average FE% will be about 35%.





Primary Hybrid Components

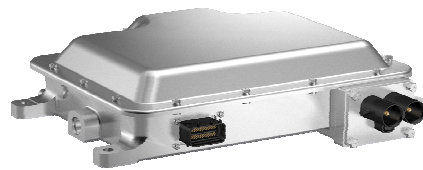
- Maximize payload weight and space
 - Additional weight of hybrid related components is ~450 lbs.
 - 300 lbs. to the front axle



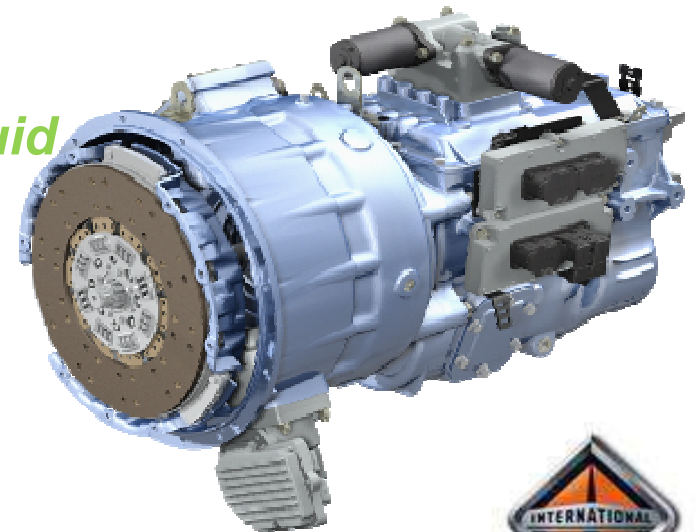
Power Electronics Carrier (Battery Box) *air cooled*



DC/DC Converter *liquid cooled*



Motor Inverter/Controller *liquid cooled*



Hybrid Drive Unit (HDU) *liquid cooled*

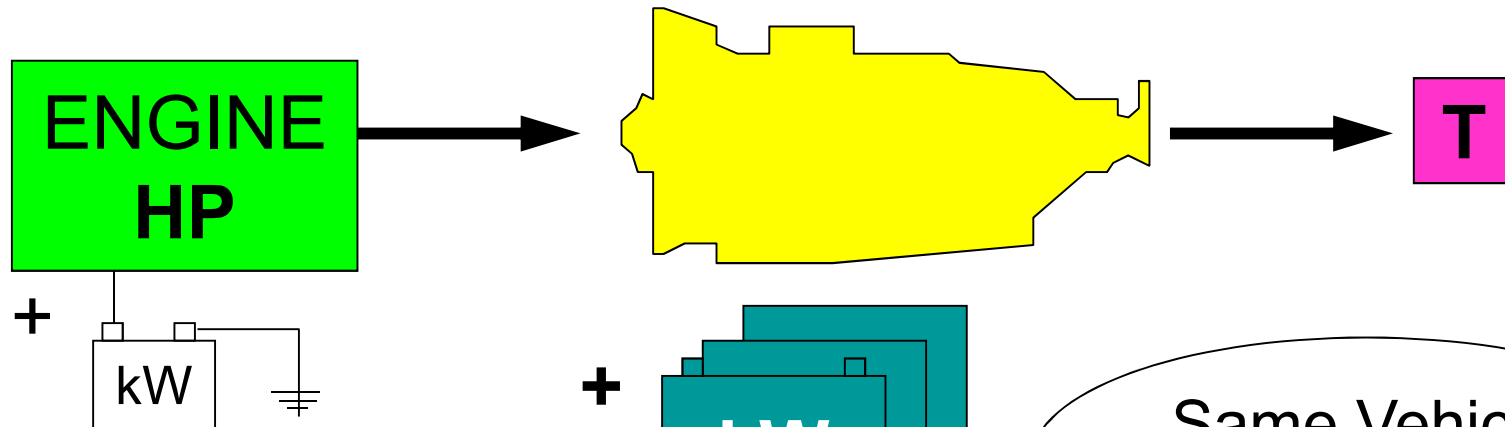


Hybrid Power Systems

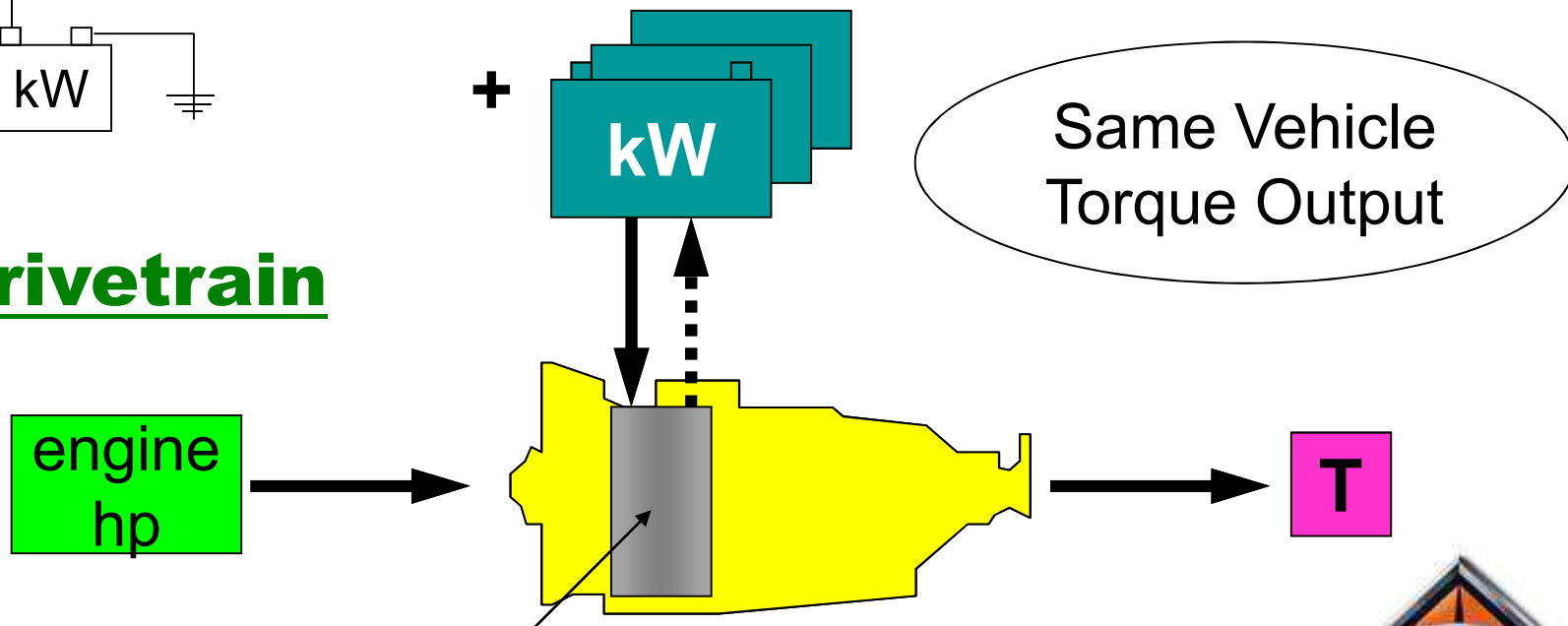


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Traditional Drivetrain



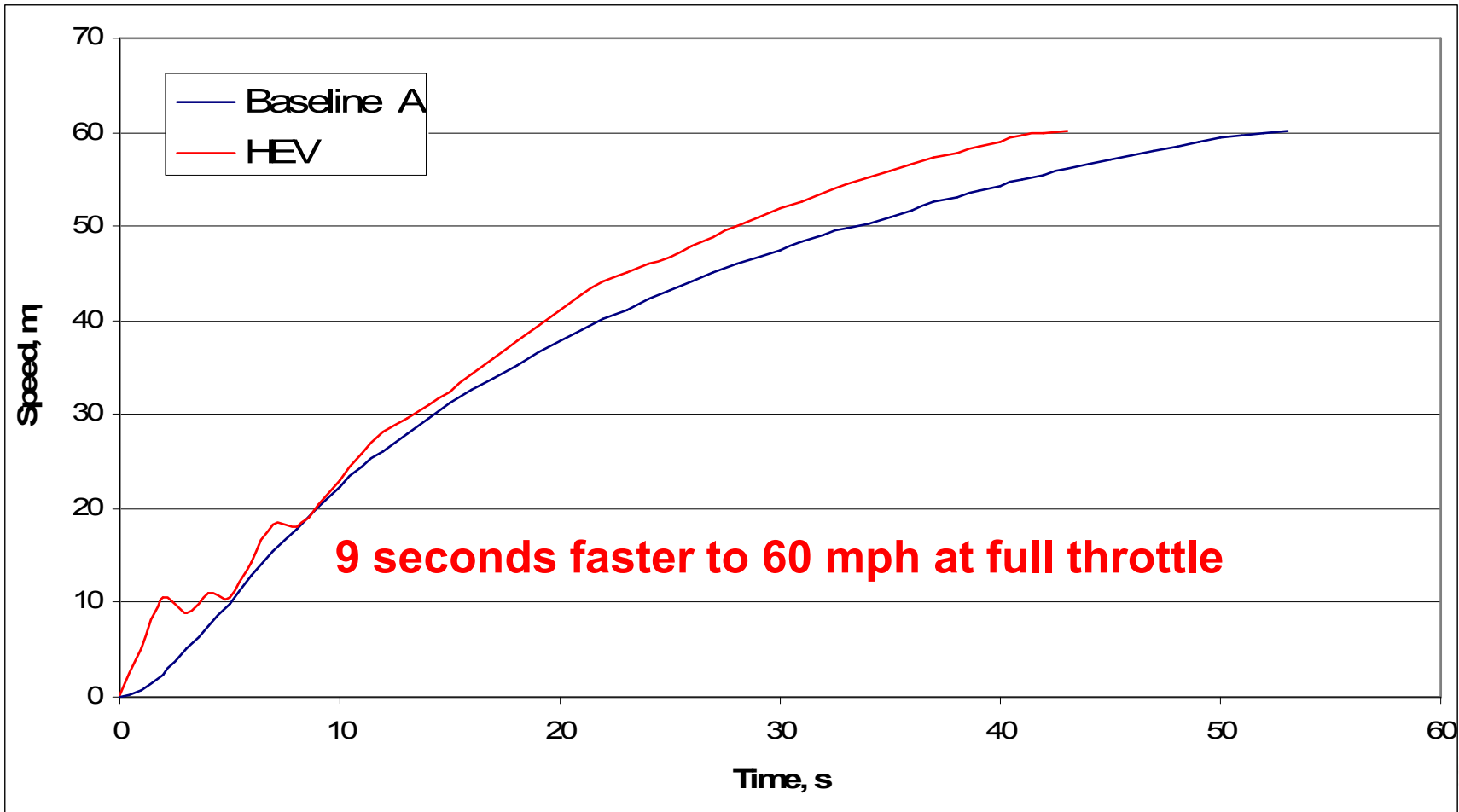
Hybrid Drivetrain



Same Vehicle Torque Output



0-60 Acceleration



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Hybrid Maintenance

- PEC requires air filter **inspection** every 4-6 months

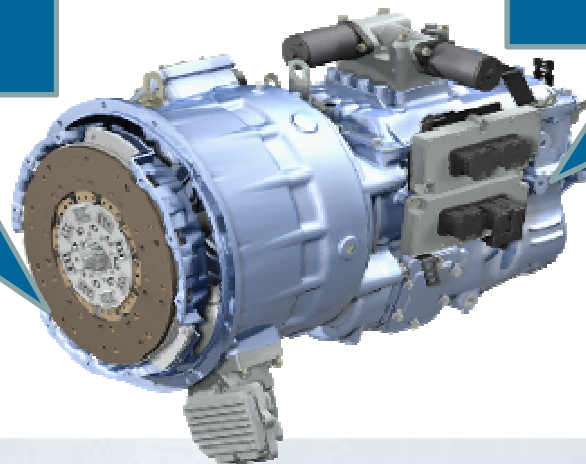


Remove the four cover bolts to inspect the Air Filter

- Transmission oil is E500 synthetic lube, 500,000 miles or five years recommended service interval

Add a couple of pumps of Grease for upper clutch cross shaft roller bearing through the Grease Zert located at the clutch inspection cover during routine maintenance inspections

Verify transmission oil level during normal maintenance inspections



Hybrid
Power Systems



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Eaton Hybrid Warranty

- Standard warranty - 3 years / 150,000 miles
 - Includes base transmission and Eaton supplied Hybrid system*
- *Cooling portion of system International Truck & Engine supplied
- Extended Warranty Coverage additional 2 years / 50,000 miles

HYBRID

Vocation	Model	Torque	Standard Warranty	Additional Coverage Years / Miles (000)			
				Option #1 w/o PEC	Price	Option #2 w/ PEC	Price
Construction (Utility)	All	All	3/150	2/50	\$3020 USD \$3500 CAD	2/50	\$3870 USD \$4490 CAD
City Delivery (Step Van, 4x2 Tractor)				2/50	\$2750 USD \$3190 CAD	2/50	\$3515 USD \$4075 CAD



Hybrid Power Systems



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Battery Life Expectancy

- Current life projection 6-8 years
- Strongly dependant upon application, duty cycle
 - Continued focus on
 - PEC serviceability
 - Component exchange program
 - Re-man program under consideration by Eaton



**Hybrid
Power Systems**



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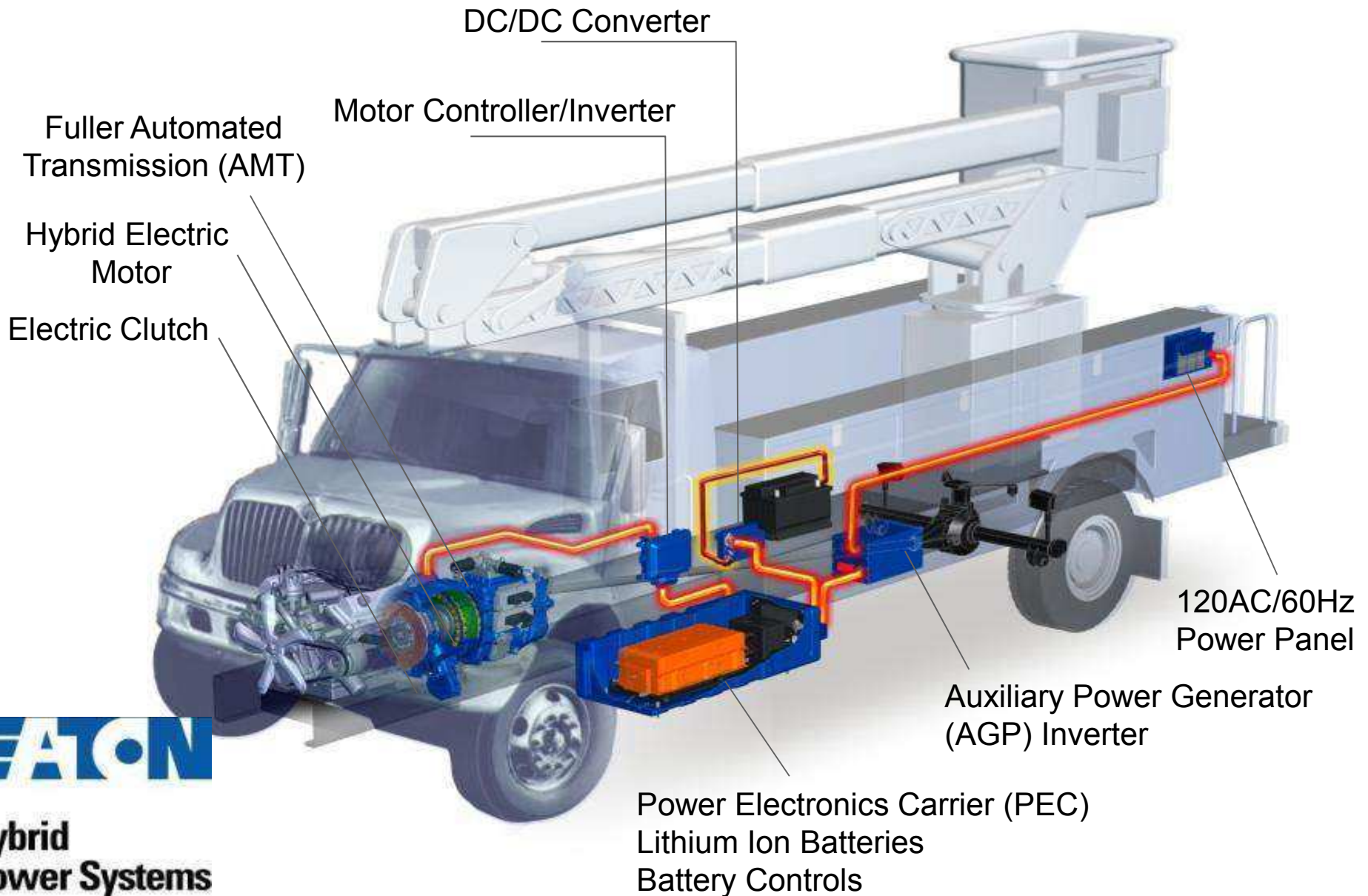


Hybrid Operating Modes



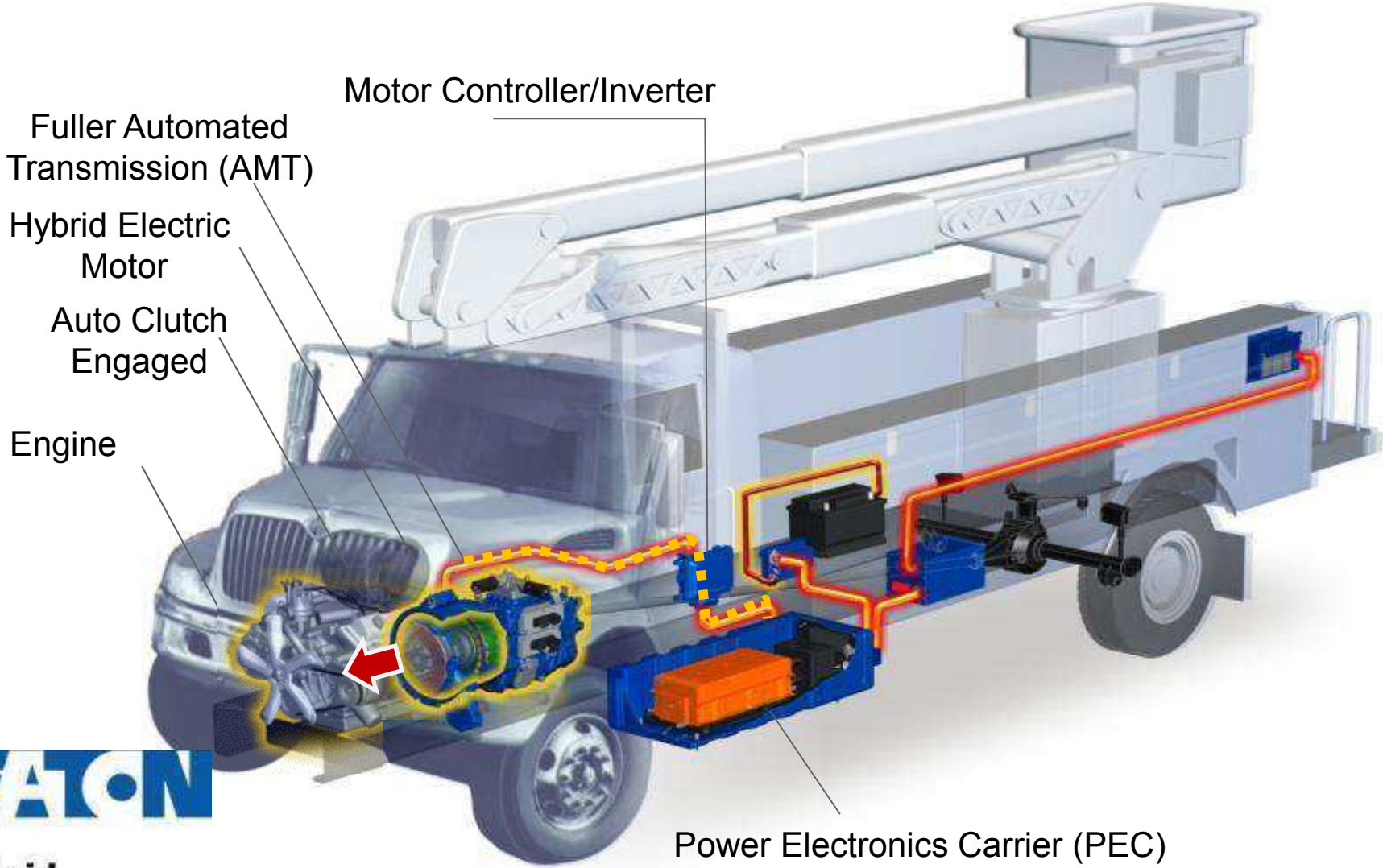
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Hybrid System Diagram



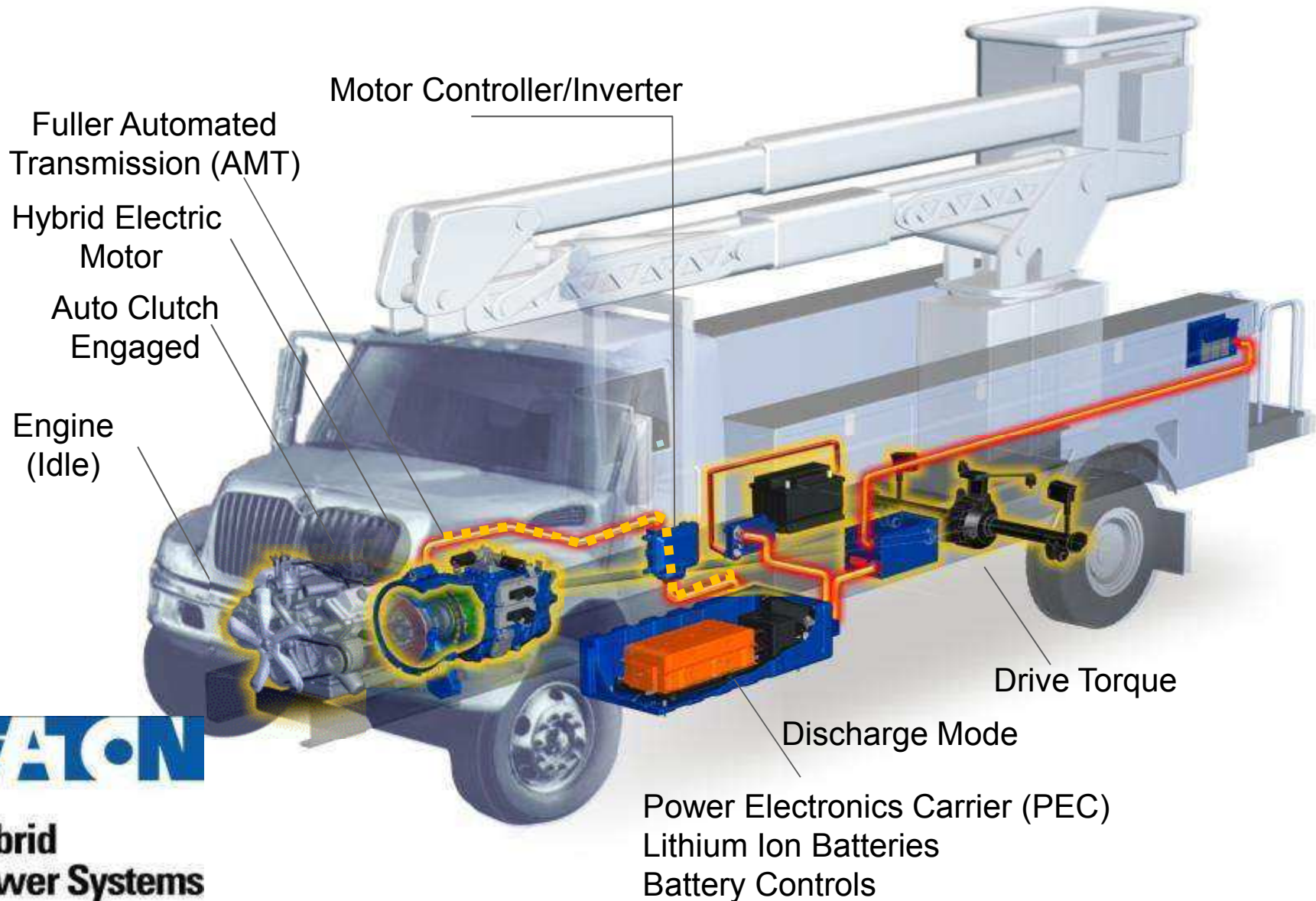
**Hybrid
Power Systems**

Direct Hybrid – Engine Starting Mode



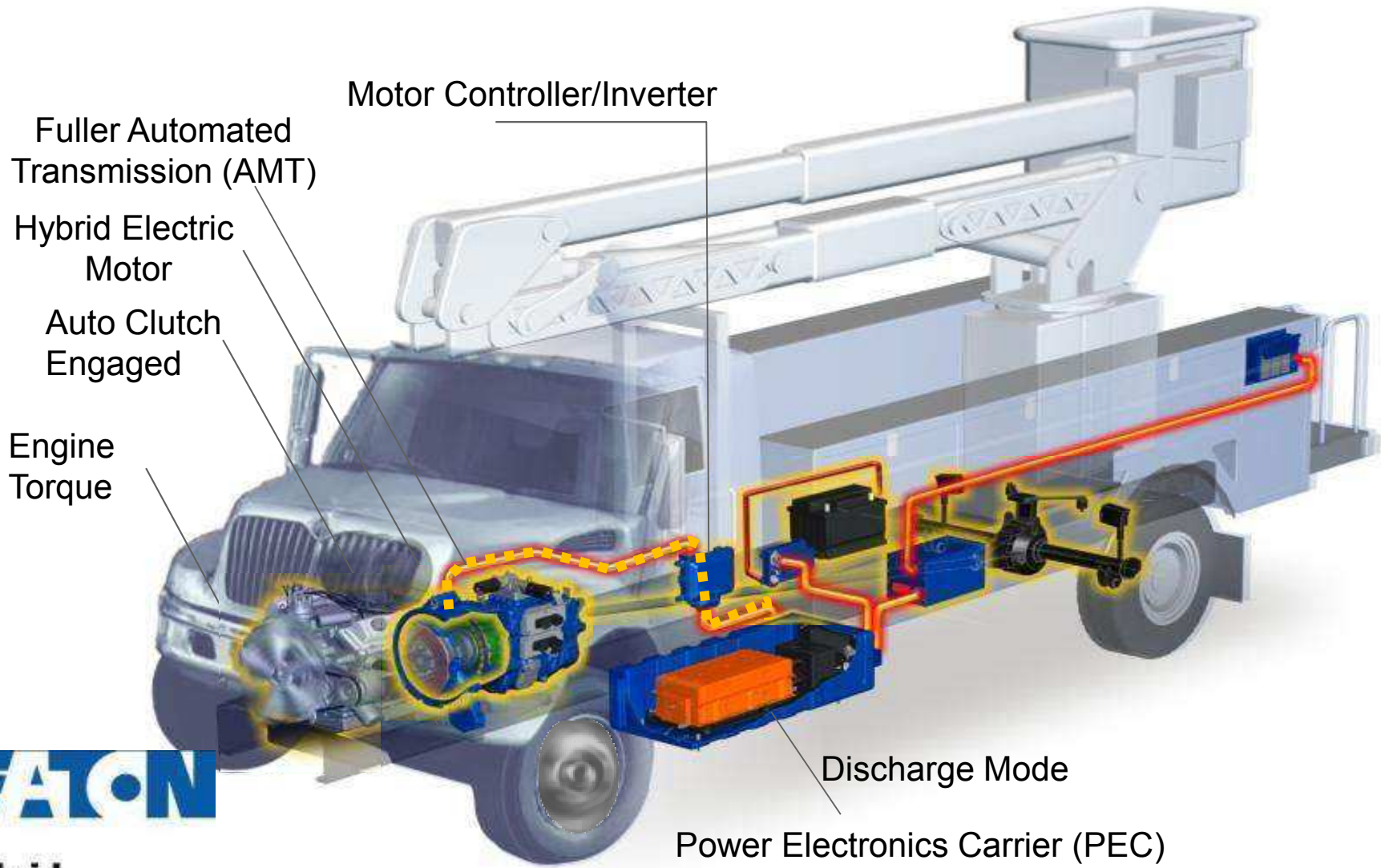
**Hybrid
Power Systems**

Direct Hybrid – Electric Only Mode



**Hybrid
Power Systems**

Direct Hybrid – Engine & Motor Drive Mode



Fuller Automated Transmission (AMT)

Hybrid Electric Motor

Auto Clutch Engaged

Engine Torque

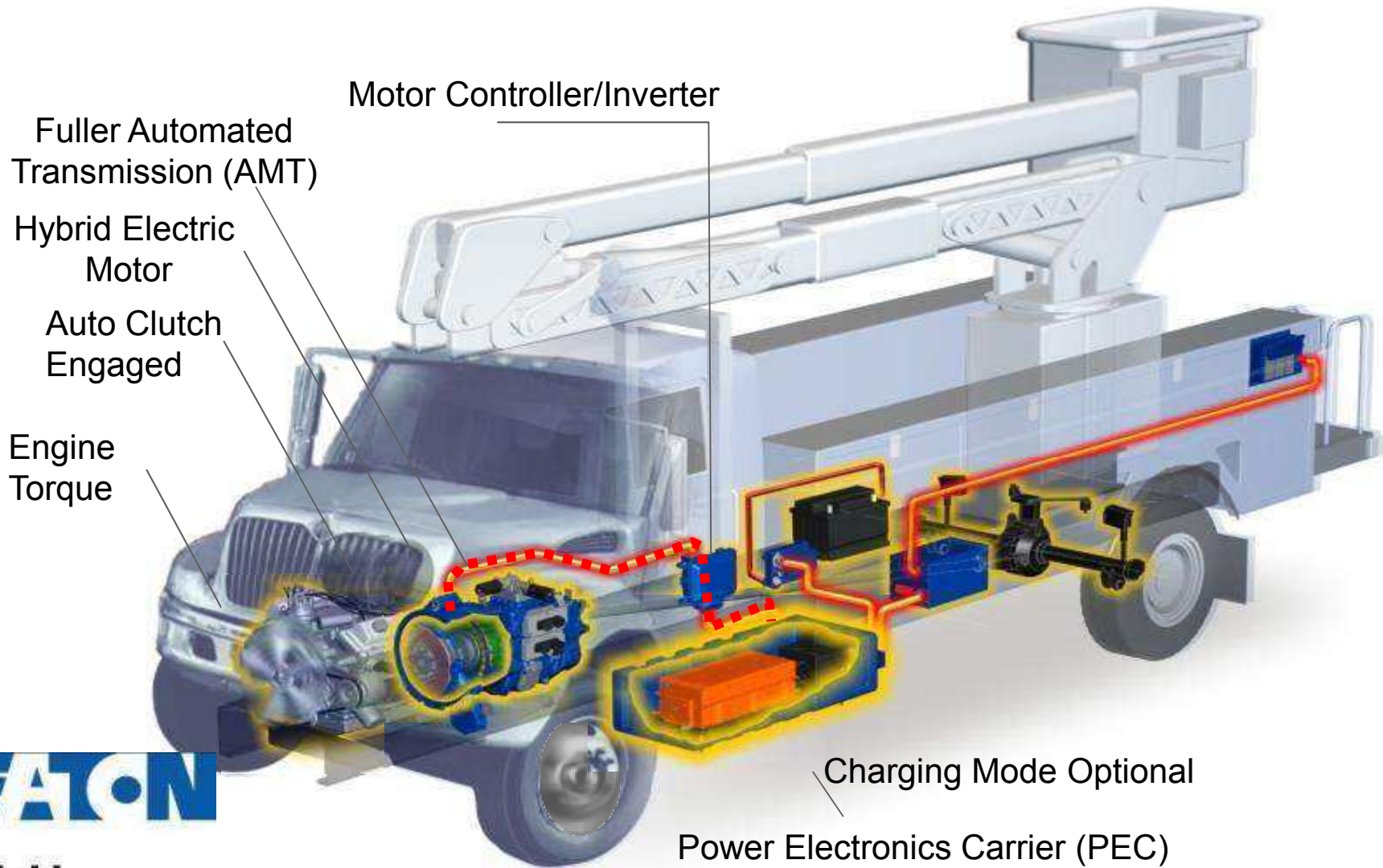
Motor Controller/Inverter

Discharge Mode

Power Electronics Carrier (PEC)
Lithium Ion Batteries
Battery Controls

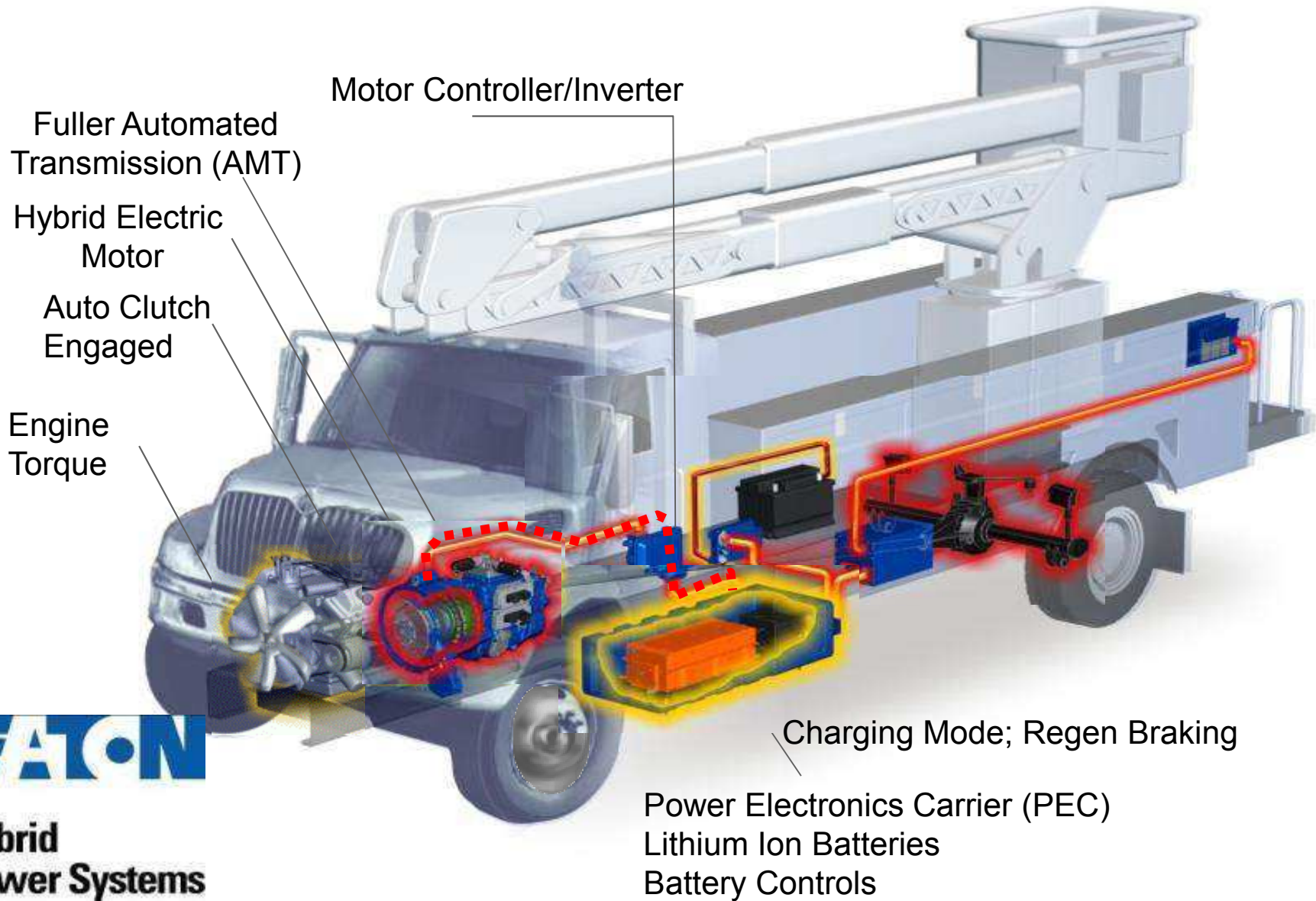


Direct Hybrid – Engine Only Mode



**Hybrid
Power Systems**

Direct Hybrid – Braking/Regeneration Mode



**Hybrid
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Optional Onboard APG

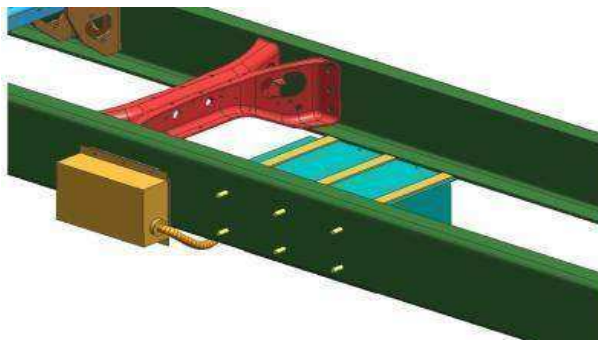
(Auxiliary Power Generation)

Drives AC loads from hybrid battery source

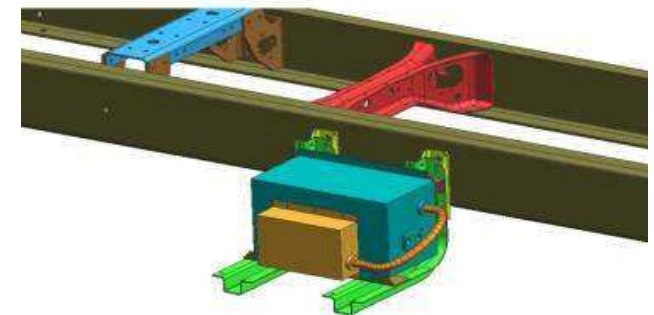


liquid cooled

Inside the Frame Rail
60AKD Inside Rail



Outside the Frame Rail
60AKE Outside Rail



Hybrid
Power Systems

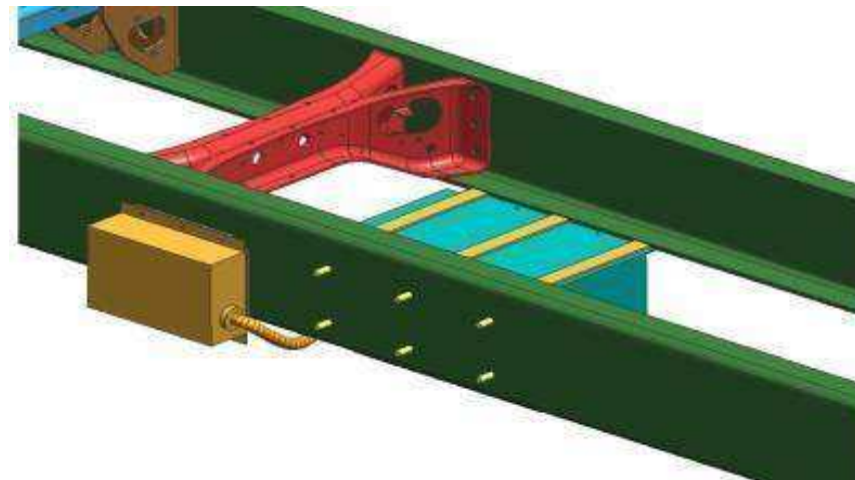




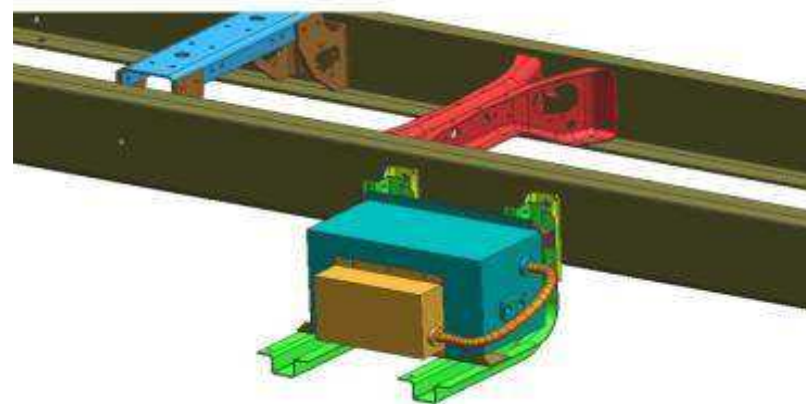
Optional Onboard A/C Power

- **60AKD Inside**

- Liquid Cooled
- With GCFI Plugs

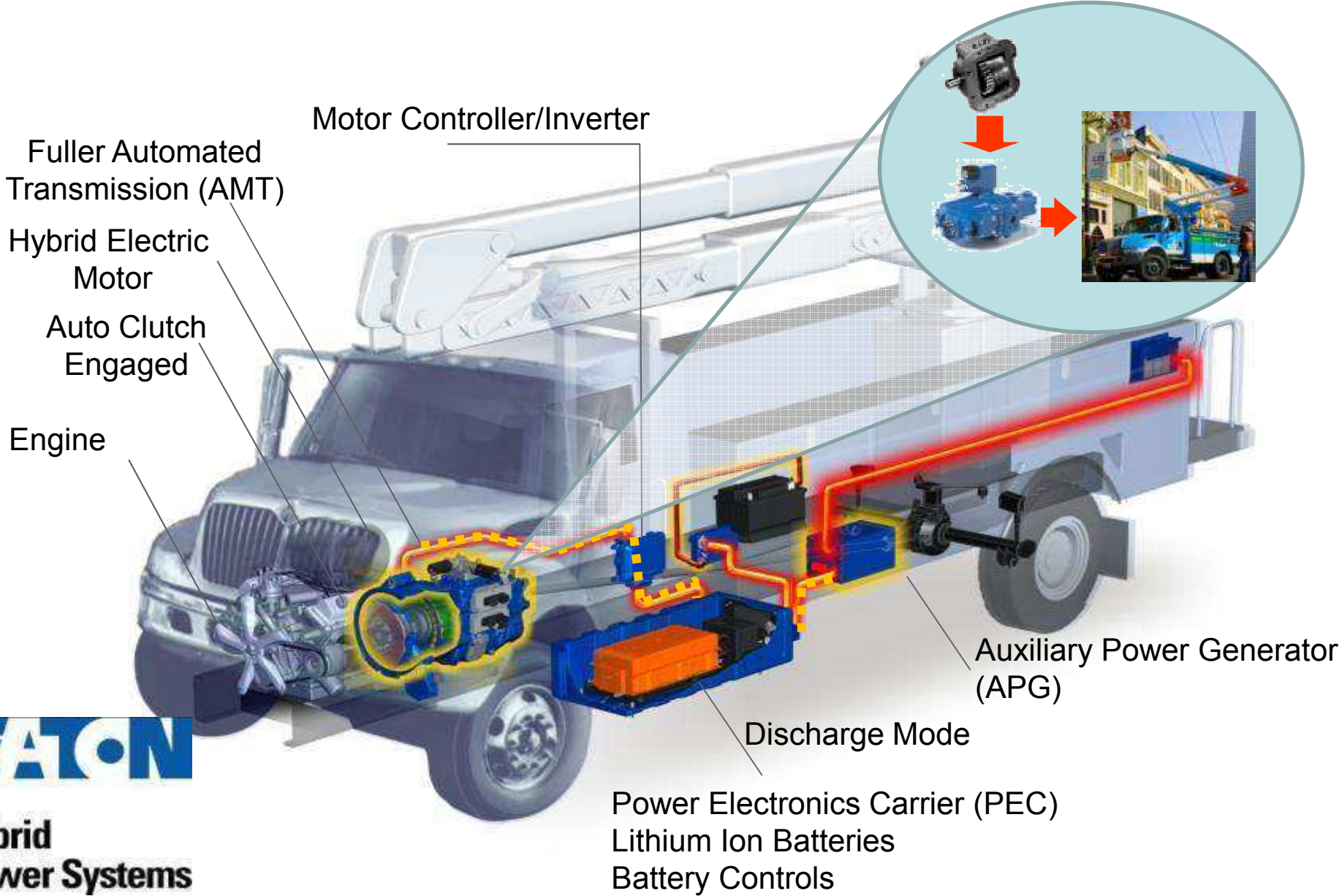


- **60AKE Outside Rail**



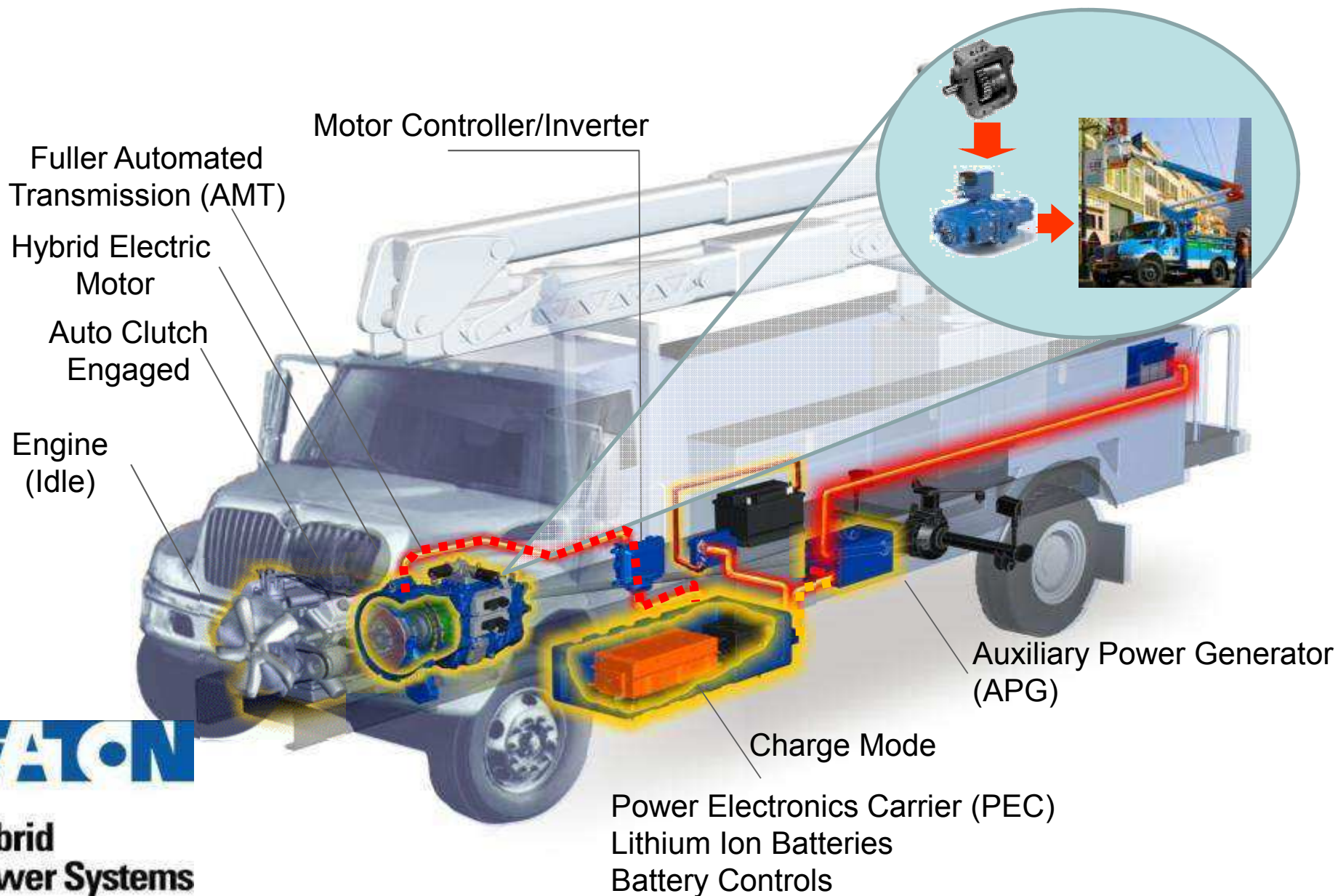
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Direct Hybrid – Engine off e-PTO & APG



Hybrid Power Systems

Direct Hybrid – Engine on e-PTO & APG



**Hybrid
Power Systems**



Production Released

Exhaust after treatment options:

- RH horz/horz,
- RH under cab horz,
- RH horz./vertical tailpipe

Cruise control availability

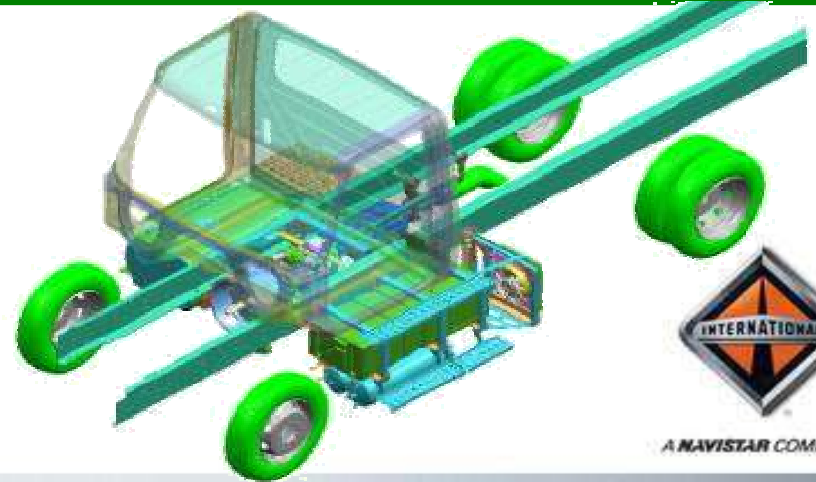
Vanity covers the PEC Hybrid Batteries

Vehicle feature requirements:

- Air brakes
- 22.5" Wheels
- On/off fan drive
- Up to 39,000 GCWR



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Application Coverage



23,500# to 39,000# GVW

- **Base System**
 - Pickup & Delivery
 - Landscape Dump
 - Shuttle Bus
 - Beverage
 - Stake Flat
 - Armored Car
 - Expediter
 - **Tractor (55,000# GCW)**
- **ePTO System**
 - Utility/Aerial Bucket
 - Tree Trimmer / Crane /Grapple
 - Recovery Vehicle
 - Road Patch Truck



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Dump – Spreader

•33,000 GVWR



Travel Crew Cab



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Wrecker Roll-Off

- Engine-Off operation with ePTO





Grapple Loader

- Waste Collection
- With ePTO



Crane Truck Application



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Expanded Chassis Options

- **Remote Mount PEC**
 - Temporary Mount
 - 10 foot Power Cable
 - Clean CA



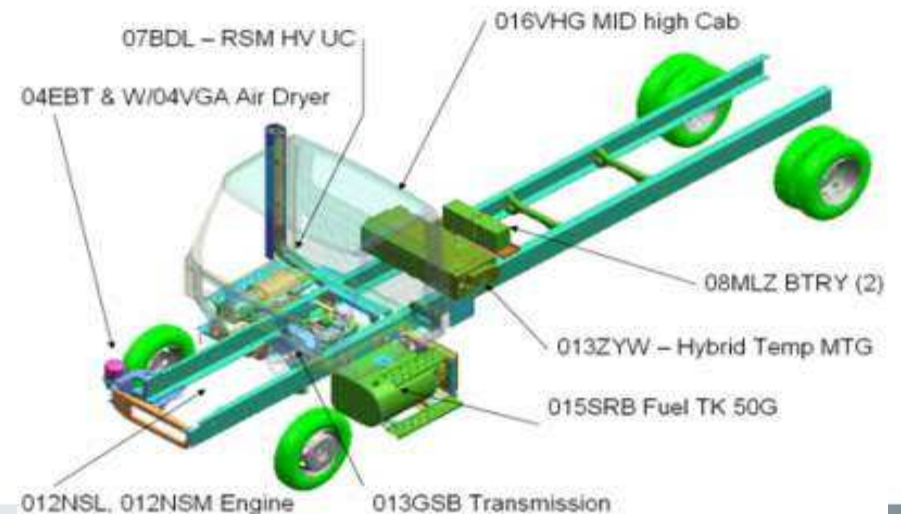
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Expanded Chassis Options

- Beverage Body
 - Drop Frame
 - Vertical Exhaust
 - Air Dryer
 - Remote Mount PEC
 - Air Ride Cab



ISO View – STD Mid High Cab – Hybrid Beverage



Expanded Chassis Options

- **Travel Crew Cab**
 - Cab Air Ride Suspension

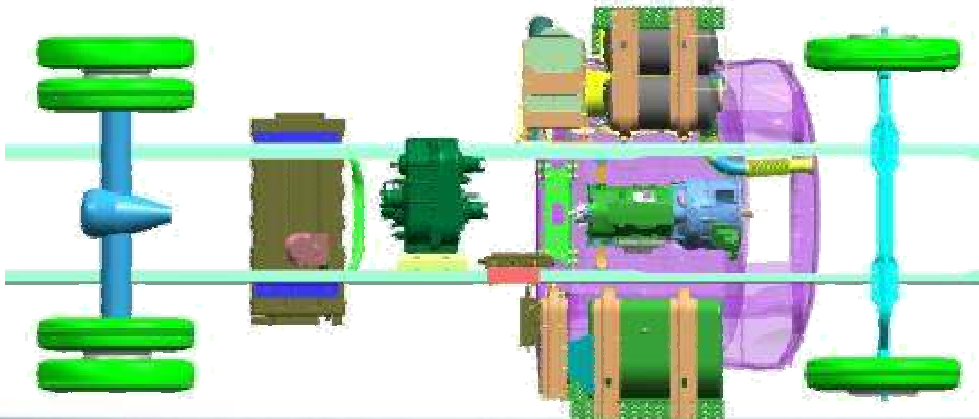


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WorkStar 4x4

- Meritor AWD System
- Limited Release
 - Utility
 - Standard Cab Only



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Expanded Chassis Options

Beverage Tractor

- Now available
- 255 HP / 660 lb. ft.
- Tractor packaging
- 395 mm clutch





Expanded Chassis Options

- **Auto Therm 60ADA**

- Engine “off” heating
 - DLB template added to hybrid chassis for a true off signal
- 70° F cab heat for 11/2 hours with 32° F outside ambient temperature with MaxxForce DT



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MAXXFORCE DT

INTERNATIONAL DIESEL POWER™

2010 Hybrid Engine Ratings

215HP/560ft-lb

230HP/620ft-lb

250HP/620ft-lb

260HP/660ft-lb



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Hybrid Product Enhancements - Update

- Driver's Display
 - Prototype software complete
 - Production targeted for late summer 2009



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Future Opportunities



- Electrification of Reefer
 - Hybrid Route Max “H” w/Johnson Truck Bodies Cold Plate
 - Thermo King
 - Carrier with the Oasis System
- Expanding Application Integration with the Hybrid
- Higher GVWR / GCWR's
- Electric HVAC Systems
- Hydraulic Brakes
- Higher Engine Horsepower





THE HYBRID SYSTEM THAT HELPS
YOU GO GREEN AND **SAVE GREEN**



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THE VOICE OF TRANSPORTATION



Thank You

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POWERING INGENUITY