



Medium-Duty Vehicle Projects



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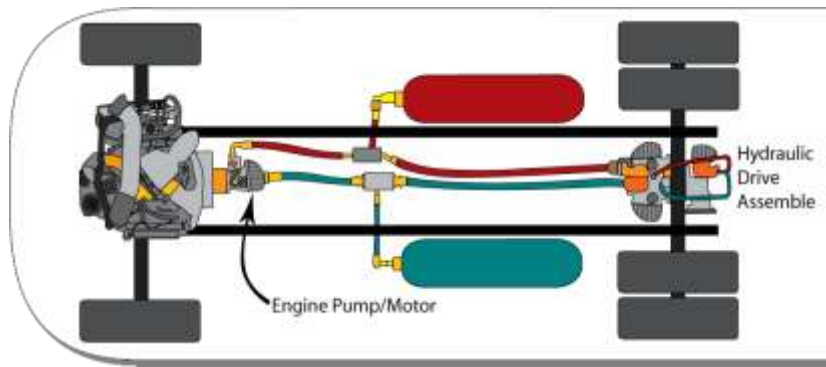
Medium-Duty Vehicle Projects

- EPA - Series Hydraulic Hybrid
- Calstart - Parallel Hydraulic Hybrid
- EPRI - 378 Vehicle Fleet of PHEV's

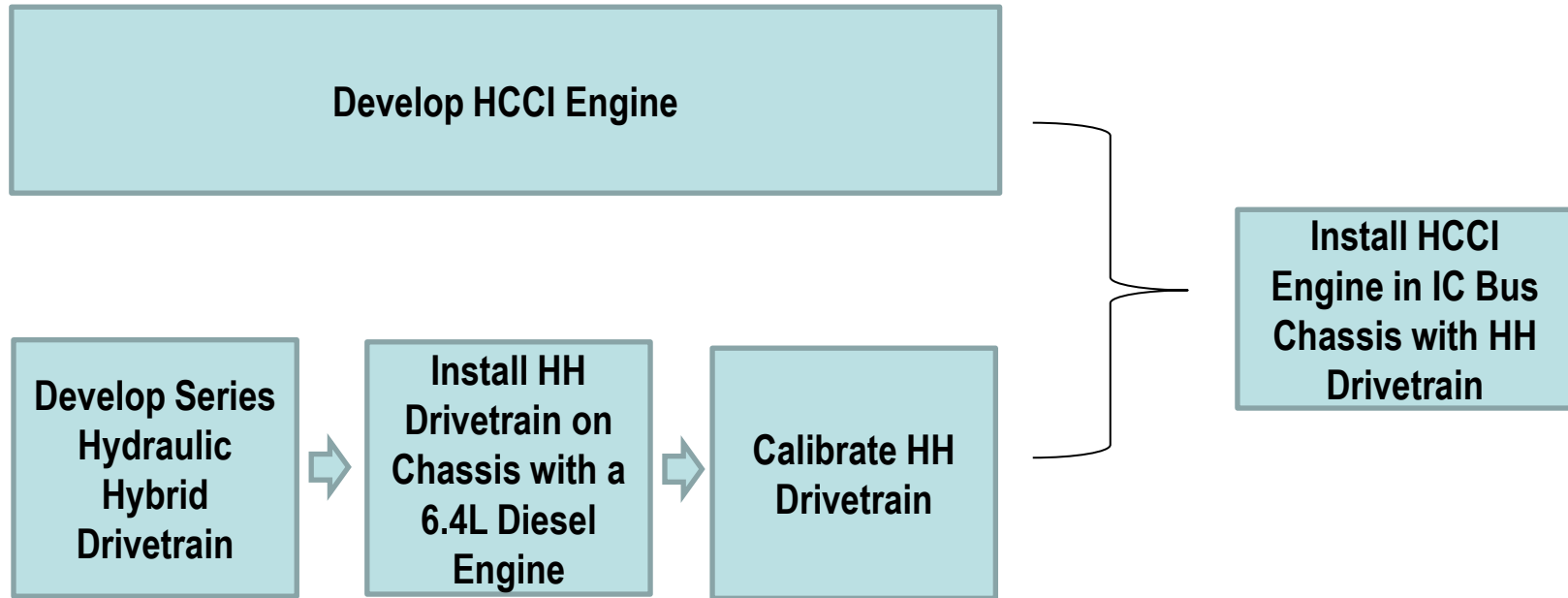


EPA Series Hydraulic Hybrid Shuttle bus

- Vehicle Technology
 - EPA Series Hydraulic Drivetrain
 - HCCI Engine
 - Navistar IC Bus Chassis
 - Demonstrate in a Shuttle Bus Application



Shuttle Bus Project Development Path



Series Hydraulic Hybrid Initial Evaluation



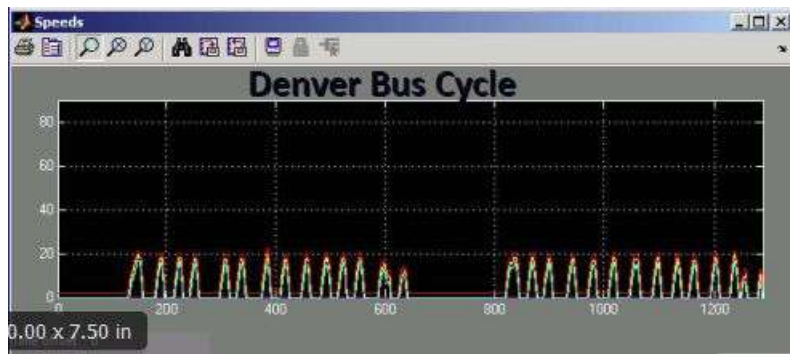
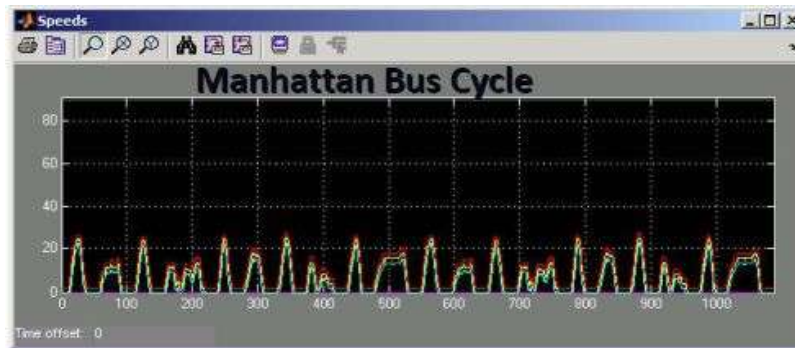
Drive Cycle Characteristics

EPA City Cycle Bag 1 Connector urban traffic, high speed highway link, average speed = 25.6 mph, 5 stops

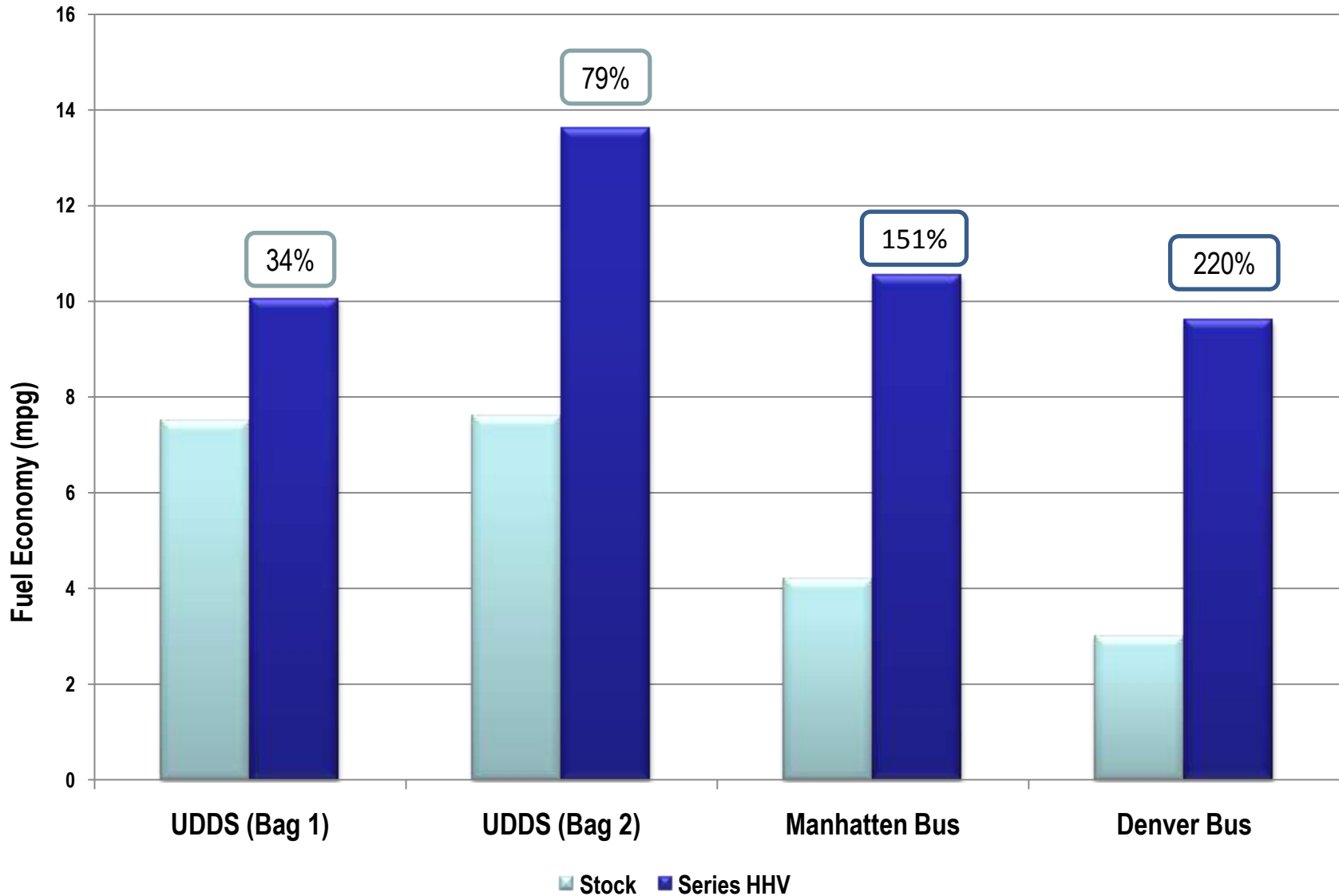
EPA City Cycle Bag 2 Business district/residential urban traffic, average speed = 15.3 mph, 13 stops

Manhattan Bus Cycle Congested urban bus route, average speed = 6.8 mph, 24 stops

Denver Bus Cycle Congested urban shuttle route, average speed = 4.5 mph, 28 stops



Series HHV Initial Evaluation

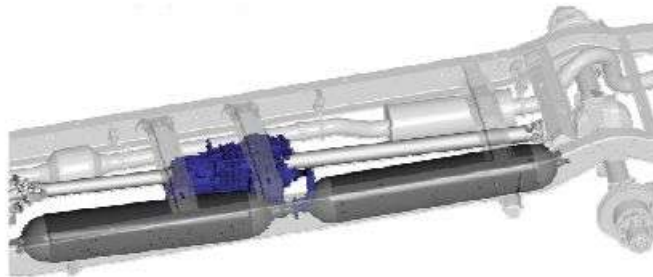


Series Hydraulic Hybrid Steady State Fuel Economy



Eaton/ Calstart Parallel Hydraulic Hybrid

- Vehicle Technology
 - Eaton Parallel Hybrid Hydraulic Drive System
 - Ford 5.4L Gasoline Engine
 - Ford E450 Chassis
 - Demonstrated in a Shuttle Bus Application

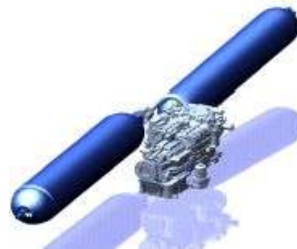
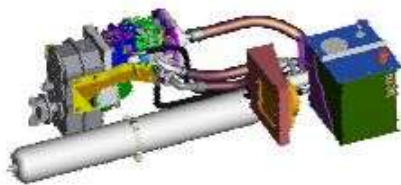


Parallel Hydraulic Hybrid Development Pathway

Develop Parallel
System for
Refuse
Application

Develop Parallel
System for
Shuttle Bus
Applications

Integrate
Parallel System
into an E450
Shuttle Bus



Comparative Test Results

Parallel Hydraulic Hybrid



Peterbilt 28.5 Ton GVW
315 hp engine
5-speed automatic transmission
30 meters between stops
1000 stops per day

Vehicle Weight	HC	PM	NOx	CO	Fuel Economy (mpg)
64,000 lbs	3%	8%	12%	35%	20%

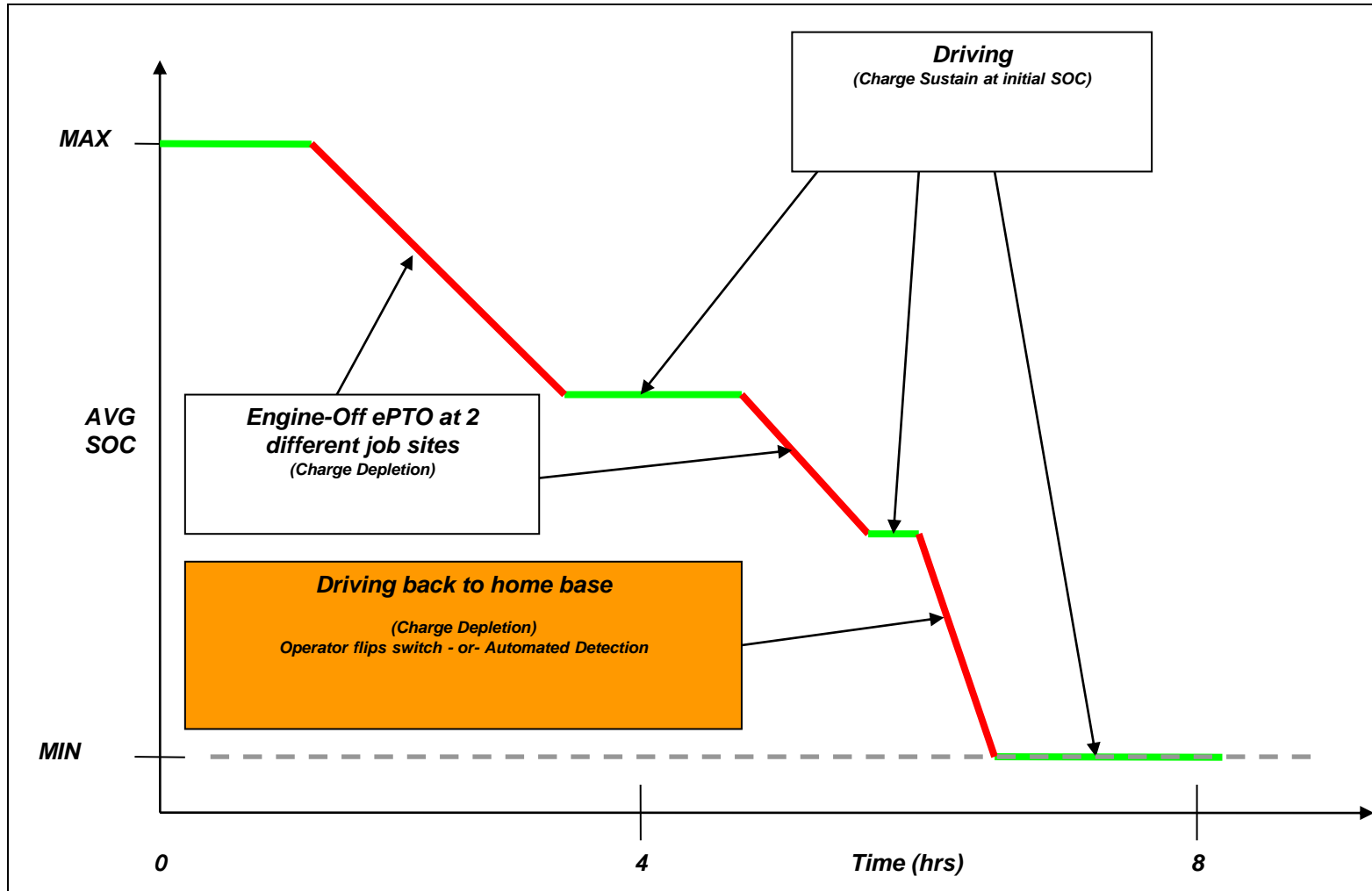
DOE Sponsored PHEV Fleet Demonstration and Evaluation

Vehicle Description

- F550 & E450 Chassis Options
- Ford 6.7L diesel and 5.4L gasoline engine options
- 13 – 15 kWh Li-Ion battery pack
- Regenerative braking
- Engine-off at zero speed
- All-electric operation at low speeds
- All-electric jobsite operation



PHEV Utility Truck Operation



PHEV Project Objectives

- Demonstration and evaluation of 378 medium-duty PHEVs
- Develop a production ready PHEV system for class 4 – 5 vehicles
- Develop production ready “smart charging” capability for vehicle
- Build customer familiarity
- Use project results for further system refinement

Project Schedule

