
Courtesy of Eaton

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Plug-In Hybrid Medium-Duty Fleet Demonstration and Evaluation Program

FOA-28 Award #EE0002549

Face to Face Meeting

Williamsburg, Virginia

June 24, 2010


Courtesy of Eaton

Agenda

Introductions	All
Overview	Jeff Cox- SCAQMD
Data Acquisition System	Tim Taylor- Telogis
Technical Overview F550	Hélène L Cornils- Eaton
Manufacturing F550	Chad Sarver- Altec
Ride and Drive Phase 2	Hélène L Cornils- Eaton
Technical Overview E450	Mark Kosowski- EPRI
LUNCH	
Smart Charging	Andy Suri- Pathways
Charge Stations	Mark Kosowski- EPRI
Fleet Agreements Discussion	Mark Kosowski- EPRI
General Issues	All
Q and A	All
Adjourn 2:00 pm	

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Program Overview

Jeff Cox- AQMD

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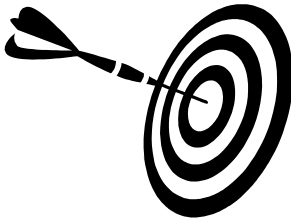
Vehicle Description

- F550 & E450 Chassis Options
- Ford 6.7L diesel and 5.4L gasoline engine options
- 23kWh Li-Ion battery pack
- Regenerative braking
- Engine-off at zero speed
- All-electric operation at low speeds
- All-electric jobsite operation


Courtesy of Eaton

Project Objectives

- Demonstration and evaluation of 378 PHEV medium-duty trucks
- 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
- Conduct studies to develop a path for successful commercialization



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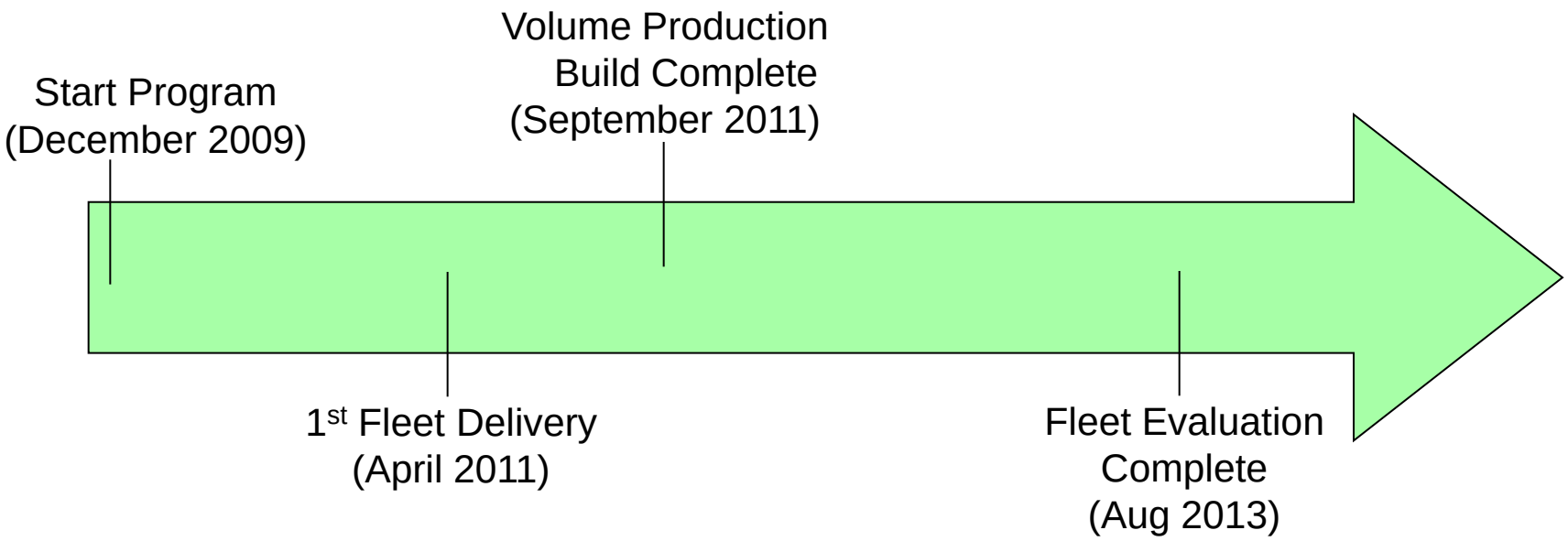
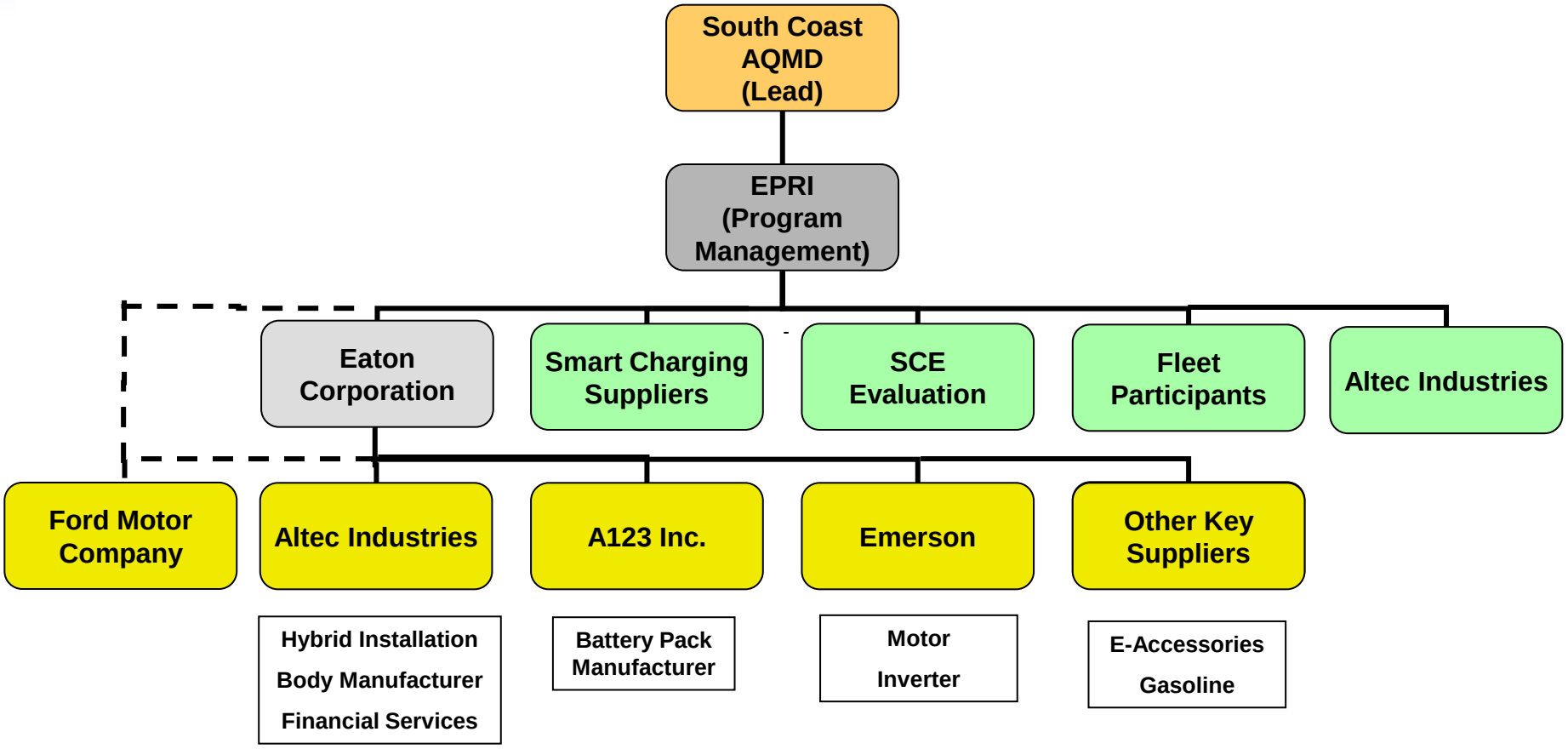
Program Milestones



Project Funding Breakdown

Source	Funding Amount	Percent of Total
DOE	$45.4M	50%
CEC	$5M	5%
EPRI	$3.1M	3.4%
Eaton	$2.38M	2.6%
Fleet Participants	$35M	39%

Key Partners with the DOE




Courtesy of Eaton

Demonstration and Evaluation

Mark Kosowski- EPRI

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Demonstration and Evaluation

- All vehicles will be up-fitted with a Data Acquisition System
- While the vehicles are used in the field, the system will accumulate data during vehicle-on events
- The data will be periodically sent to a main-frame computer for storage and reporting
- The Events will be either:
  - Key-On Events, Charge Events, or Aerial Events
- Data and reports will be available to analyze usage, loads, and consumption trends
- The demonstration phase will last about 2 years

Data Acquisition System

- All vehicles will be up-fitted with a Data Acquisition System
- Telogis is our Partner. (Tim Taylor)
- Monthly telemetry costs will be covered by the program
- The system includes a fleet management system that is localized to the fleets but can also aggregate multiple fleets
- The system will be used to upload daily data stored on the vehicle for analysis
- Parameters for the system are now being analyzed

Technical Overview

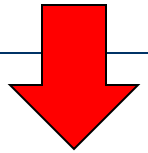
PHEV F550 Medium Duty Trucks

Hélène L Cornils- Eaton

EATON
Powering Business Worldwide

Program Scope

- EPRI PHEV program
  - F550 PHEV trouble truck proof of concept
  - 6 prototype builds



- DOE PHEV program
  - Develop and deploy production intent F550 PHEV demonstration fleet
  - 343 near-production vehicles
  - Path to production / commercialization

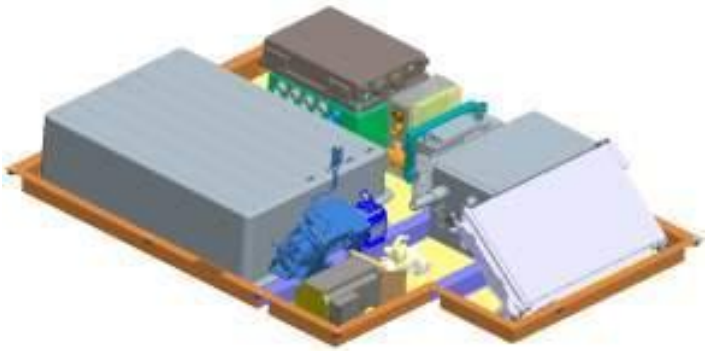
PHEV System – Quick Comparison

	EPRI PHEV Phase 1		DOE PHEV	
	Description	**Supplier**	**Description**	**Supplier**
Motor	44kW/420Nm Peak	Hitachi	65kW/600Nm peak	Emerson
batteries	16kWh - Air Cooled	GAIA	22.8kWh - Liquid Cooled	A123 Systems
Charger	3.3kW - Liquid Cooled	Brusa	7kW (J1772) - Liquid Cooled	EDN
Charging receptacle	Marine grade		J1772	EDN
Receptacle location	Driver side		Driver or passenger side	
Parking Brake	Brake Lock (optional)	Mico	ParkPawl	Eaton
Engine	No-reflash	Navistar	Reflash OK	Ford
PS/PB	Mechanical (engine driven)	Ford	Mechanical and Electrical	Ford and Danotek
HVAC	Engine driven	Ford	HVDC electrical	Mitsubishi (Ford)
Component location	Truck bed and body		Single enclosure mounted below truck bed	
PTO engagement	Mechanical + ePTO switch		Single switch	
Body Configuration	Limited options		Customize to order	
CAN Bus	Some components		All components	

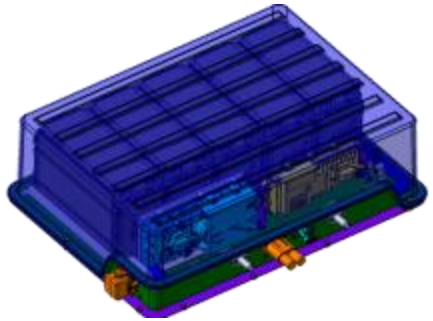
Major System Components

F550 Diesel Utility PHEV

Hybrid Drive Unit (HDU)



PEC (Power Electronics Carrier)



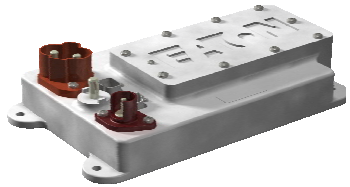
Battery (mounted in PEC)

Traction Inverter (in PEC)

Auxiliary Power Generator (APG)

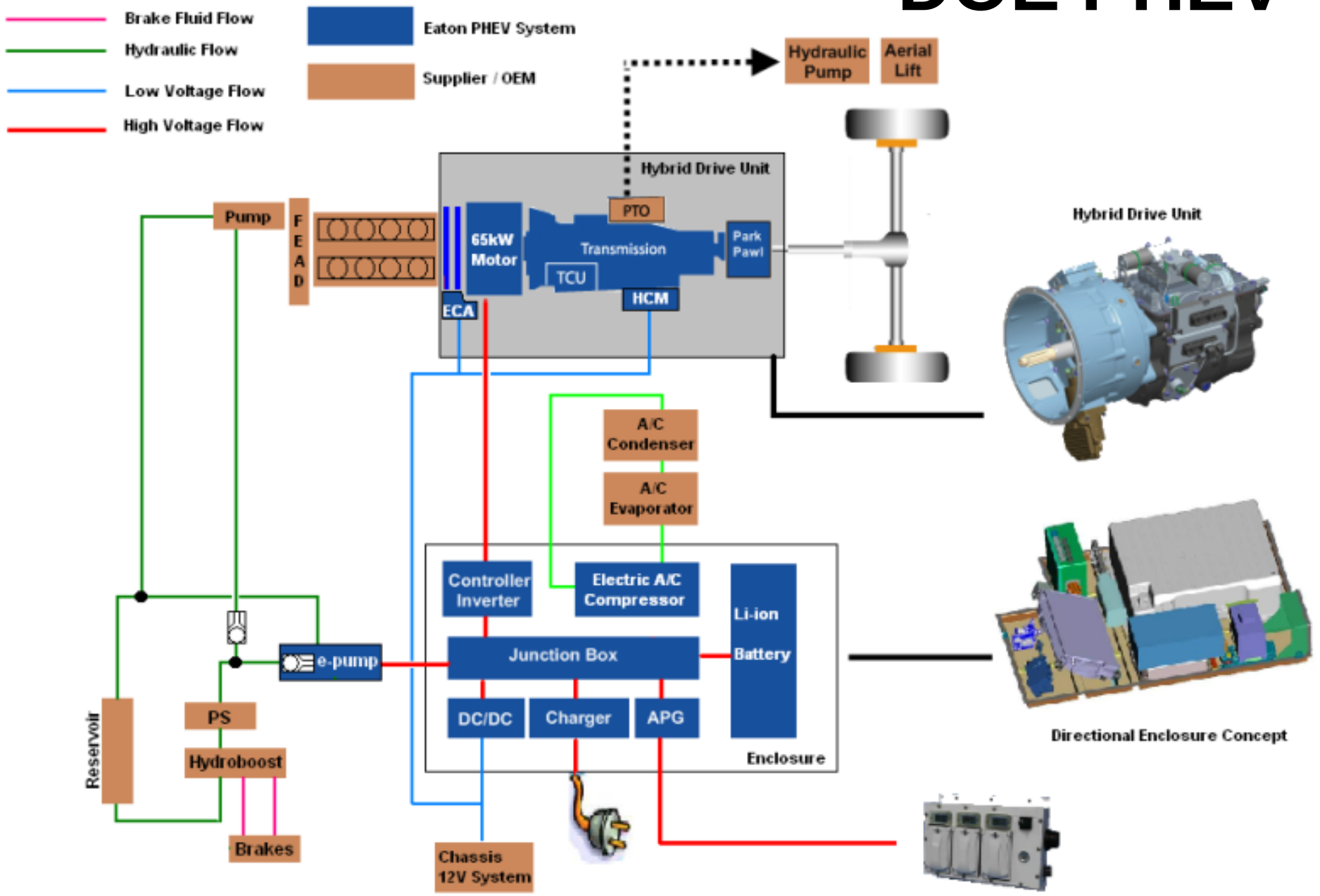
E-pump for PS/PB

Plug-in charger



DC-DC Converter (in PEC)

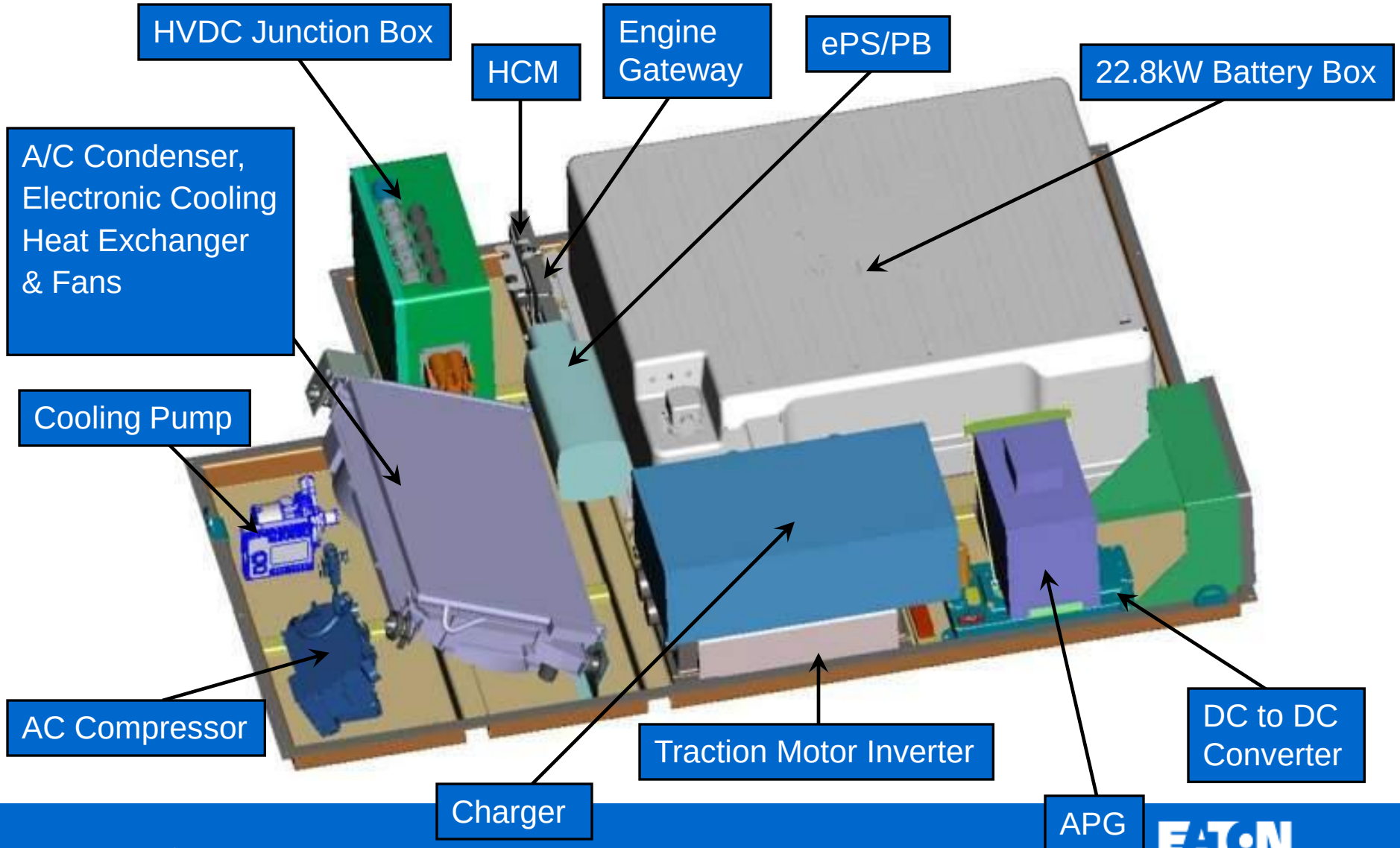
DOE PHEV


Brake Fluid Flow
Hydraulic Flow
Low Voltage Flow
High Voltage Flow
Eaton PHEV System
Supplier / OEM
Hydraulic Pump
Aerial Lift
Hybrid Drive Unit
PTO
Pump
F E A D
65kW Motor
Transmission
Park Pawl
TCU
HCM
ECA
Hybrid Drive Unit
A/C Condenser
A/C Evaporator
Controller Inverter
Electric A/C Compressor
Li-ion Battery
Junction Box
e-pump
DC/DC
Charger
APG
Enclosure
Directional Enclosure Concept
Reservoir
PS
Hydroboost
Brakes
Chassis 12V System

DOE PHEV Program Status

- Significant progress made
  - Staffing, new hires, training
  - System and sub-system definition
  - Transmission upfit studies
  - Battery system design and build,
  - PEC enclosure design and build,
  - Motor / inverter design and build,
  - Engine control changes, system trade-off studies
  - Engine off functionality testing
  - Performance testing on Base vehicle
  - Ford relationship and support
  - Contract and sub-contracts waiting for roll-down
  - Vehicle mock-up at Altec
  - Motor and inverter lab testing

Fully integrated Power Electronics Carrier (PEC) simplifies complexity of interfaces to vehicle



DOE PEC Program Status

Auxiliaries Operating Modes

Mode	Engine State	PS/PB	A/C Compressor	Heat	12 V Supply
Engine On	Running	Engine driven pump	Driven electrically	Supplied by engine coolant	Engine driven alternator
Engine Off	Not Running	Electric pump		Supplied electrically	DCDC converter
Stationary	Not Running	Off		Engine waste heat and / or electric	DCDC converter

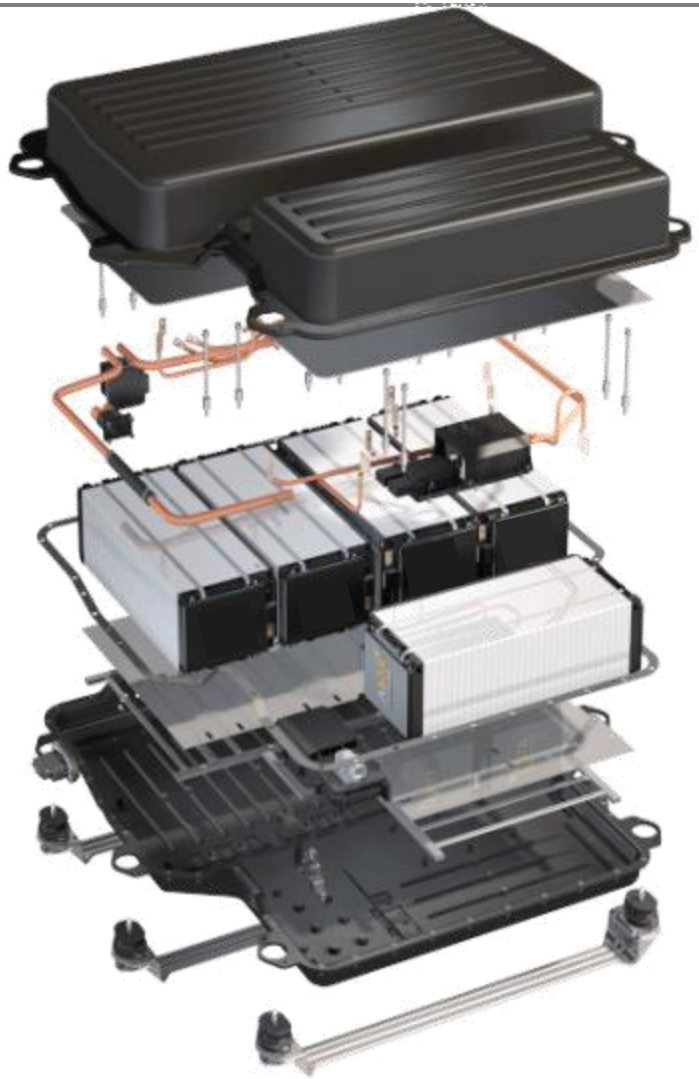
The Power Steering / Power brake can be driven by either engine driven pump or electric pump.

- When the engine is running ➔ engine driven Pump
- When the engine is off and the vehicle is moving ➔ electric pump
- When the vehicle is off and the vehicle is stopped ➔ neither (not needed)

The A/C compressor will always be driven electrically.

Energy Storage: Li-Ion Battery pack supplied by A123

Pack Total Cells	357
Pack Cell Configuration	119S3P
Pack Vmax	428 volts
Pack Vnom	381 volts
Pack Vmin	298 volts
Min Pack Capacity	60 A-Hr
Min Pack Energy	22.8 kW-Hr



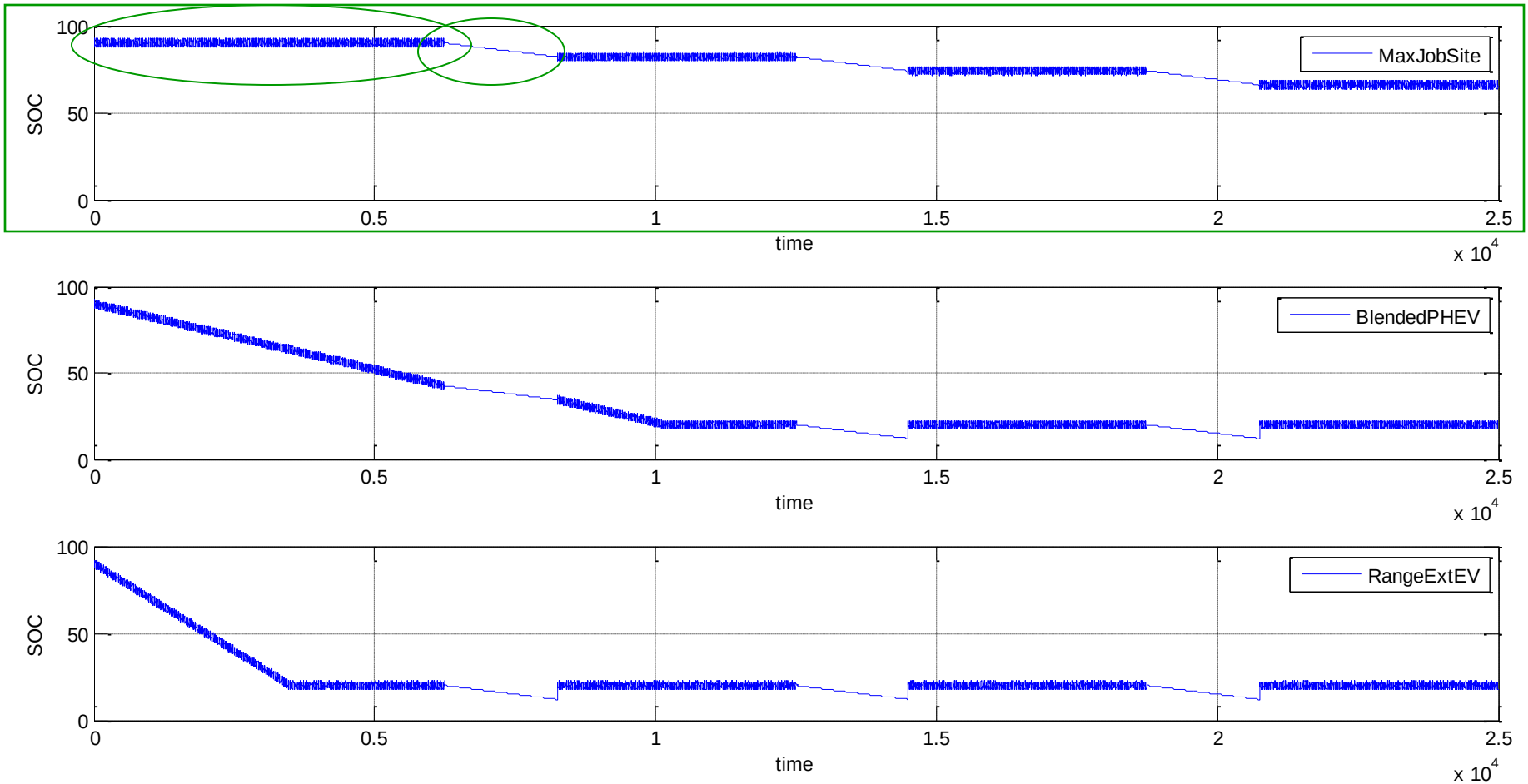
- Liquid cooled solution
- Serviceable at the module and subsystem level (BMS, contactor control)

PHEV Control Strategy

- Three basic strategies to manage the battery energy:
  - Maximize Engine Off Job Site Operation (MaxJobSite)
  - Maximize Driving Performance (BlendedPHEV)
  - Allow Pure Electric Vehicle Driving (RangeExtEV)

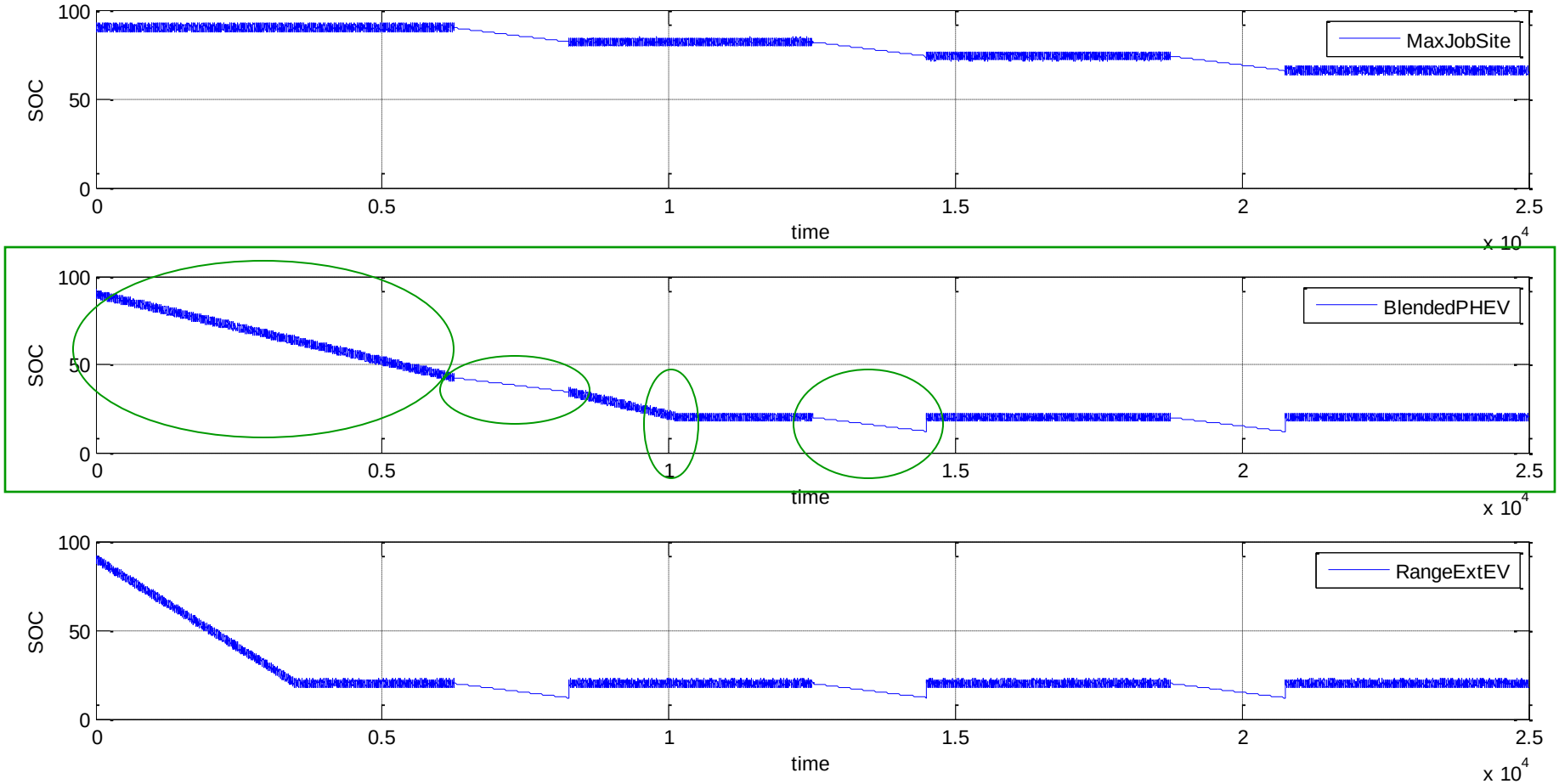
- Control strategy will be configurable by fleet operators through the Eaton diagnostics and service tool ServiceRanger.

Strategy: MaxJobSite



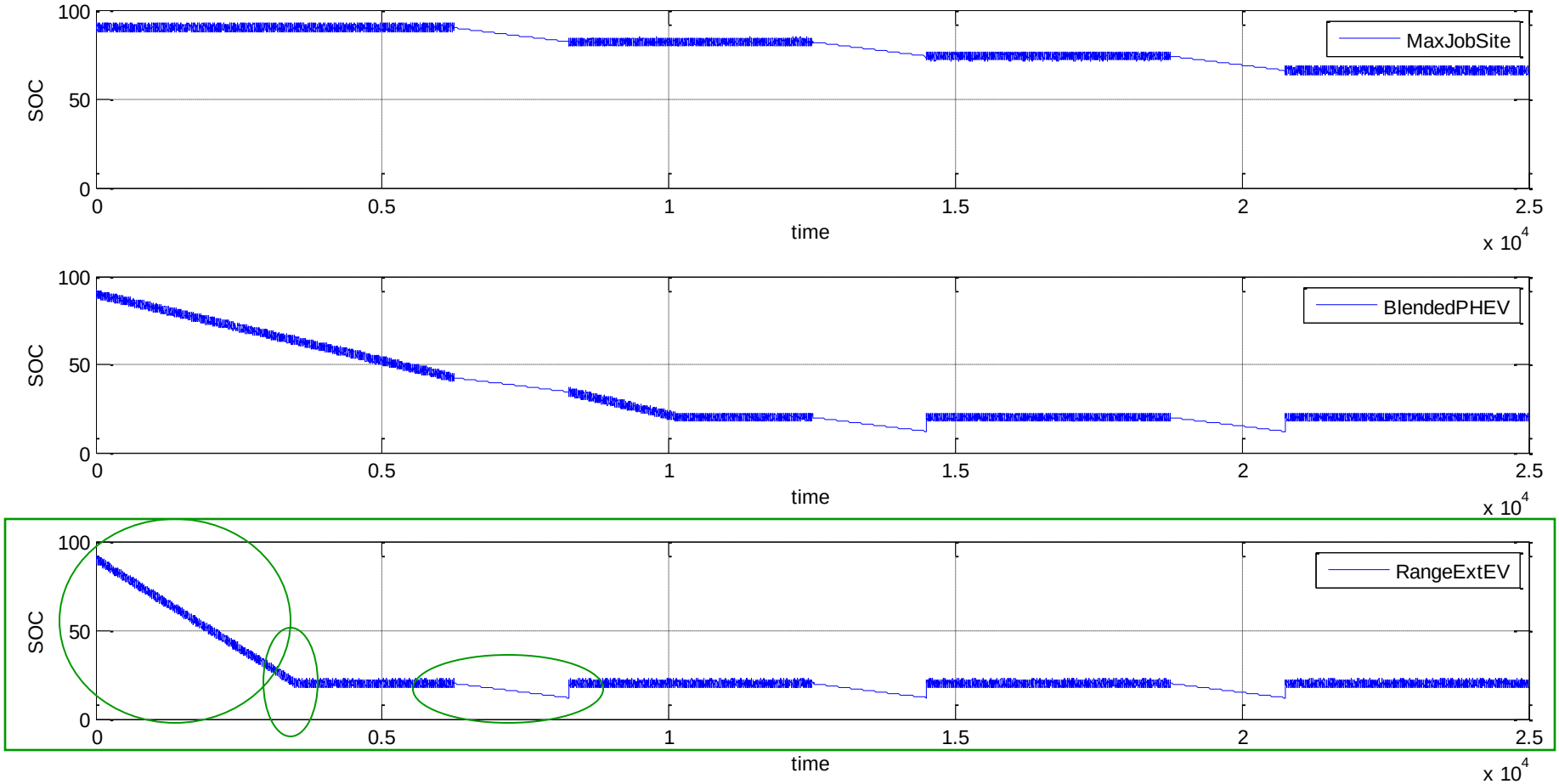
- Operates in charge sustaining mode while driving to conserve battery energy and maximize engine off job site operation. This is the approach that was used in the prototype truck.

Strategy: BlendedPHEV



- Initially operates in charge depletion mode blending the engine and electric motor during high power driving demands. After the battery becomes depleted it operates as a standard HEV in charge sustaining mode.
- While in charge sustaining mode stationary ePTO operation is similar to a standard HEV.

Strategy: RangeExtEV



- Initially operates as a pure electric vehicle until battery becomes depleted, then as a standard HEV in charge sustaining mode.
- While in charge sustaining mode the stationary ePTO operation is similar to a standard HEV.

Side-by-side Comparison

Design Criteria \ Control Strategy	MaxJobSite	BlendedPHEV	RangeExtEV
Amount of EV Driving	Good	Almost Best	Best
Engine Off at Job Site	Best	Good	Good
Fuel Economy	Good	Better	Best
Driving Performance	Best	Best	Poor

- Summary:
  - BlendedPHEV: Maximizes performance and is the best overall strategy as it provides practical driving performance and “better” fuel economy.
  - RangeExtEV: Allows for pure EV mode driving, but may not be practical for most fleets.
  - MaxJobSite: Maximizes engine off time at job site, but fuel economy is dependant on the amount of job site operation.

Discussion Questions

- Driving Distance:
  - What is the typical daily driving distance for this vehicle use? Maximum?
  - What is the service area? Is home base located near the center?
  - How many stops per day are typically made?
- Platform
  - What platform/vehicle type would best suit the Underground Service Vehicle?
  - What applications are best suited for the PHEV?

Eaton Standard Service Support

- Standard Service support relies on OEM and their dealerships
  - The vehicle is brought to the local OEM dealership
  - The vehicle is diagnosed using Service Ranger.
  - The Call Center is notified and repair authorization is given to allow for payment if within warranty period.
  - If parts are required, they are sent over night when possible or at least the fastest possible.
  - The repair then takes place and any defective material requiring inspection is sent back to Eaton.
  - The Call Center also acts as an additional resource if initial diagnosis is not understood.
  - The Real-time Warranty System (RWS) is updated by the Call Center at each step to show repair process.

Industry-Leading Support

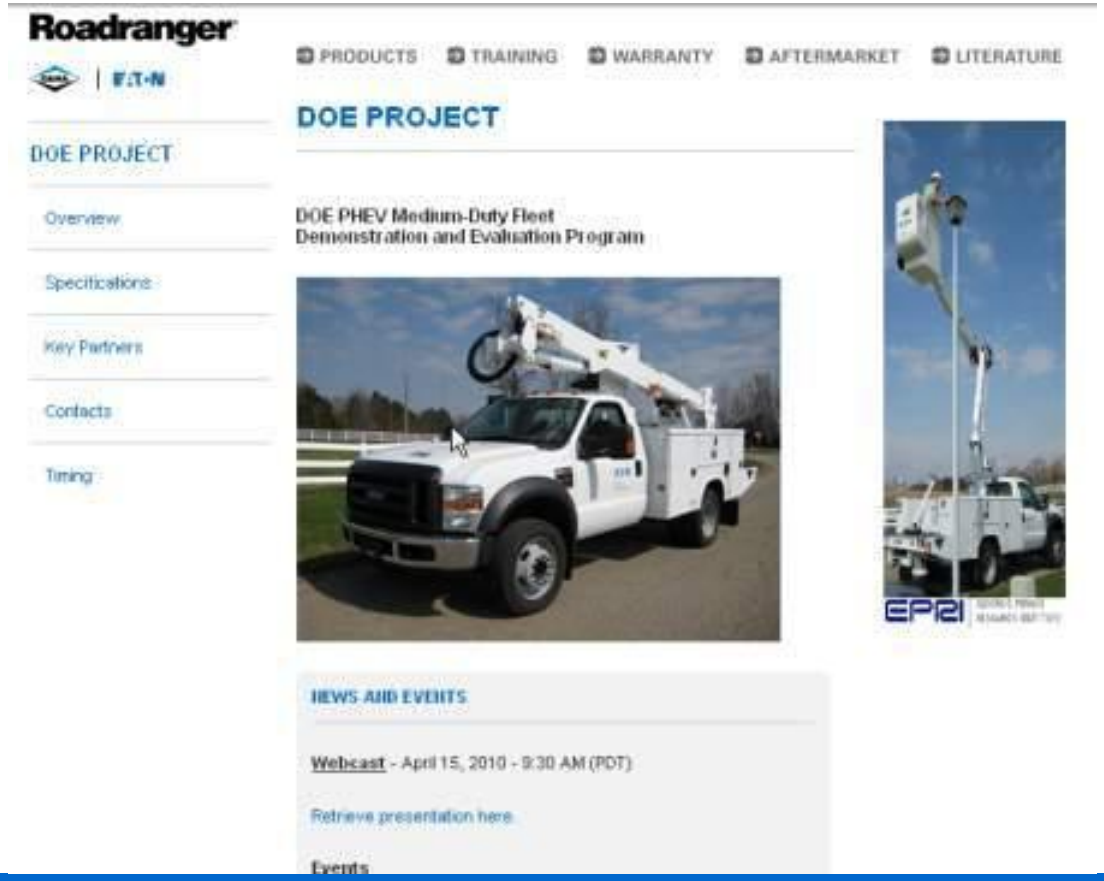
- Available at 2,000+ OEM truck dealers, with more than 6,000 Roadranger-certified technicians
- More than 150 Roadrangers throughout North America
- online support @ roadranger.com
- telephone support at **1-800-826-HELP**

DOE F550 PHEV Support Plan

- Similarly to our Standard Support, Eaton is working with Ford to leverage their extensive dealership network
- Selected dealerships will be trained by Eaton on PHEV system and troubleshooting
- Additionally, all vehicles will include a diagnostic display to inform operator or maintenance technician on fault codes
- All vehicles will include telematic capabilities to remotely diagnose issues
- Eaton has hired a PHEV specific Service manager and 3 additional Product Specialists.

DOE RoadRanger Web site

http://www.roadranger.com/Roadranger/DOEProject/index.htm

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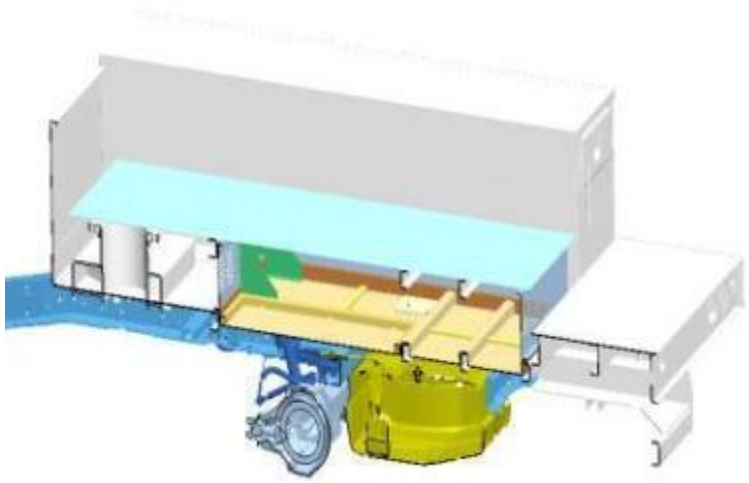
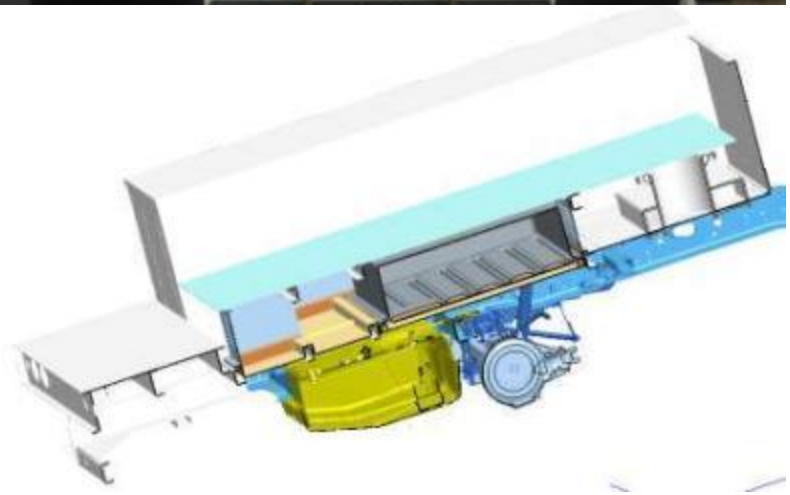
Manufacturing

Chad Sarver- Altec

PHEV Enclosure Integration (PEC)





Required Chassis Specifications

Each fleet participant will now be able to use their standard specifications for ordering the chassis for the program. Below are the only required selections when configuring the vehicle

REQUIRED CHASSIS OPTIONS:

- **2011 Ford F550 XL Décor Regular Cab**
- **6.7 L Diesel Engine**
- **7,000 FAWR**
- **19,500 GVWR**
- **60" or 84" CA**
- **Bucket Seats (40/Mini/40)**
- **Limited Slip w/4.88 Axle Ratio**
- **40 ga Aft Axle Fuel Tank**
- **Engine Block Heater**
- **DEF Tank Relocation Between Frame Rails**

Helping Crews Work Safer & Smarter

As part of the PHEV vehicle package, we will mark the appropriate high voltage area with orange tinted non-skid coating.

There will be a 7” step from the tailshelf to the cargo area on each vehicle.

It is imperative that each operator have a safe working environment and understand their environment.

Ordering Logistics

Step 1…. All fleet specifications should be reviewed by Chad Sarver. This will be a high level fit/form/function review for integration with the PHEV system.

Step 2…. Fleet participants will need to obtain a quotation, from Altec Industries, for their PHEV package. The quotations can be obtained through the standard quotation process.

Step 3…. Fleet participants will be required to sign a fleet agreement, with EPRI, prior to placing orders with Altec.

Step 4…. After the fleet agreements are signed, a purchase order will need to be provided to Altec for the purchase amount of the PHEV vehicle.

Step 5…. All orders will be subjected to a Total Quality build program which will be initiated by Altec with each fleet participant. This may include Post Award Meetings, Pre-Build Meetings, Pre-Paint Meetings, etc…

TO DATE:

There are 50 fleets represented in the program

36 of the 50 fleets have sent in their specifications for review

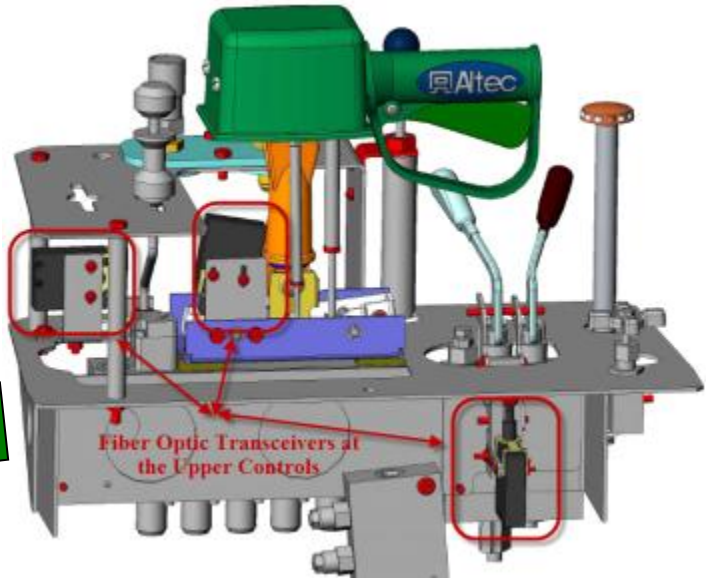
11 of the 50 fleets have received quotations

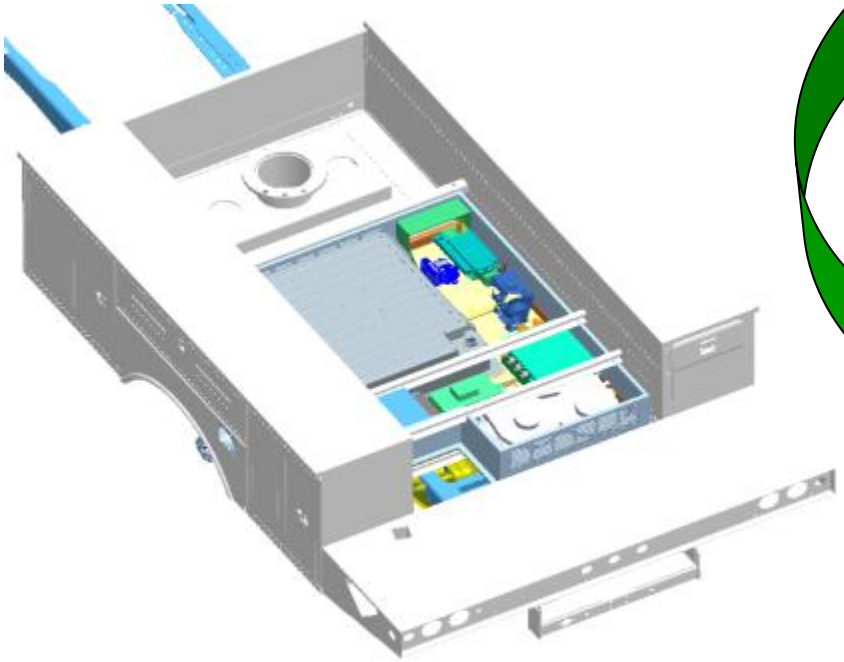
0 of the 50 fleets have signed a fleet agreement

PHEV Incremental Cost Increase

In addition to the standard cost for each aerial device package, there will be an incremental cost increase for the inclusion of fiber optics into the aerial device controls system. This will allow the insulated aerial device to communicate with the ePTO system to accomplish the "on demand" system requirement.

Also, there will be an incremental cost increase to the body package for the inclusion of the PEC sub-floor design.





Courtesy of Eaton

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Technical Overview PHEV E450 Shuttle

Mark Kosowski- EPRI

AZD AZURE DYNAMICS

PHEV E450 Program Scope and Specifications

Scope:

- Azure Hybrid System
- Ford 5.4L Gasoline Engine
- High Energy Lithium-Ion Battery (13 to 15 kWh)
- Blended Regenerative Braking
- Engine Off at Zero Speed
- On-board Charger (3.3 kW)
- Charging-Level 1 (120 Vac) and Level 2 (240 Vac)
- Electrified Accessories (Steering, Brakes, and HVAC)

Performance Specifications:

- Up to 10 miles equivalent electric range (~25 mph average)
- Up to 300 miles range between refills
- Charge time less than 6 hours with Level 2
- FMVSS compliant

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E450 Gasoline Plug-in Hybrid

AZURE is developing a plug-in version of the AZURE Balance Hybrid on E450 gasoline Shuttle bus

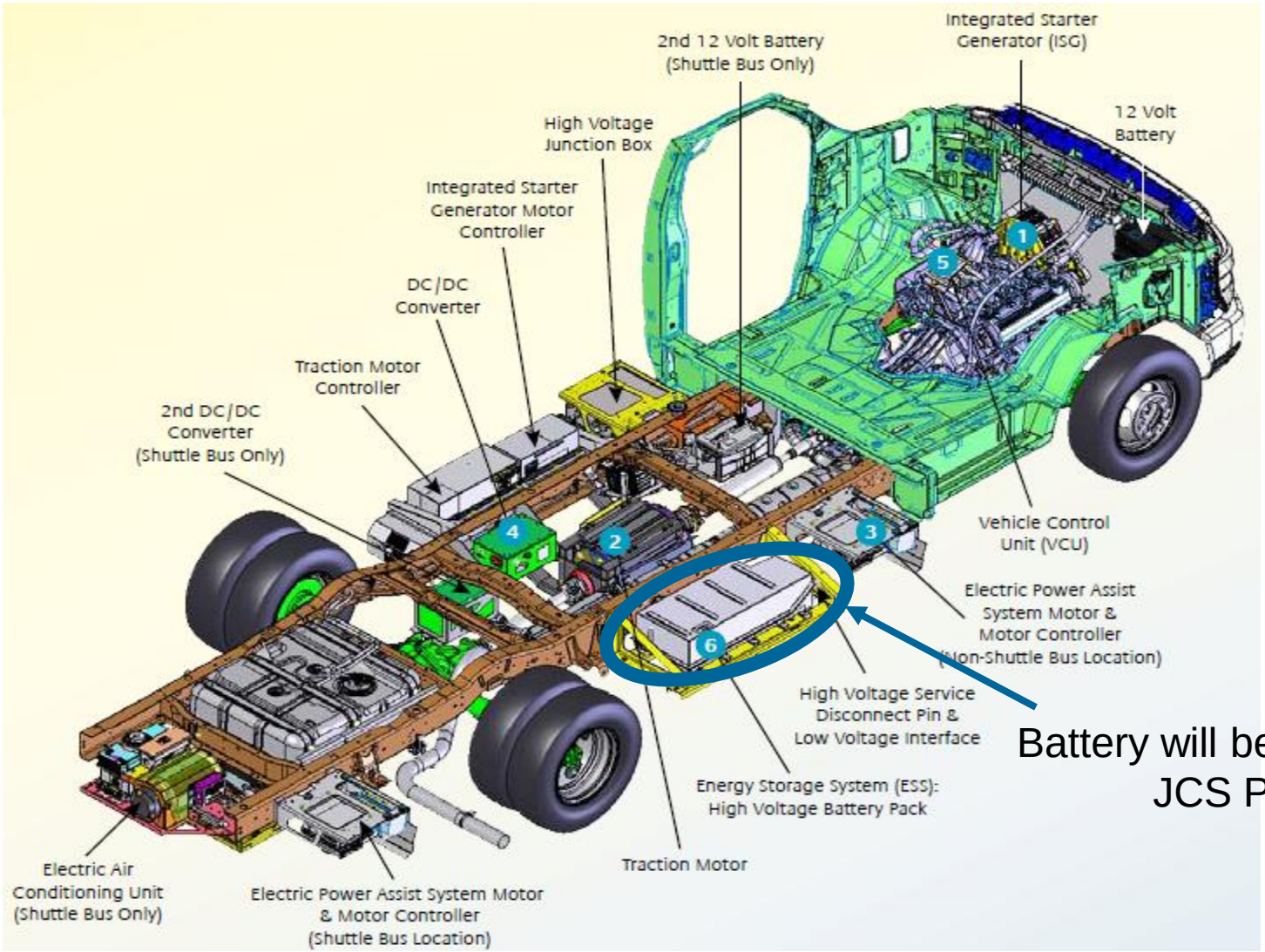
Benefits:

- AZURE system is already developed and certified by Ford on the E450 5.4L gasoline shuttle bus application (including e-accessories)
- The Plug-in system will include the JCS battery pack
- AZURE is Ford QVM certified
- Limited R&D required ("fast" development and deployment)

Estimated Timing:

- 35 vehicles will be made
- Start of production: July and August 2011

E450 Gasoline Plug-in Hybrid



Battery will be a 14 kWH JCS Pack

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PHEV to Smart Grid Interface Technology Status

06/24/2010

Sunil Chhaya, PhD,
EPRI – Electric Transportation

Andy Suri, PhD,
CEO, Pathway Technologies

Outline

- Introduction to Pathway Technologies
- Status on PHEV to Smart Grid Interface Technology Development

Pathway Vision

Motivation:

In the smart grid infrastructure the automobile is just another plug and play device

"What makes this possible is intelligent embedded electronics"

Pathway Vision:

Pathway's intelligent embedded electronic solutions – the real power behind energy and mobility

Pathway Mission

Motivation:

As smart energy begins to dictate the way we live, every other automobile will be a plug-in hybrid, buildings will be a solar power plants, and neighborhoods will be wind farms

"Embedded electronics will play a key role in infrastructure development for Smart Grid"

Pathway Mission:

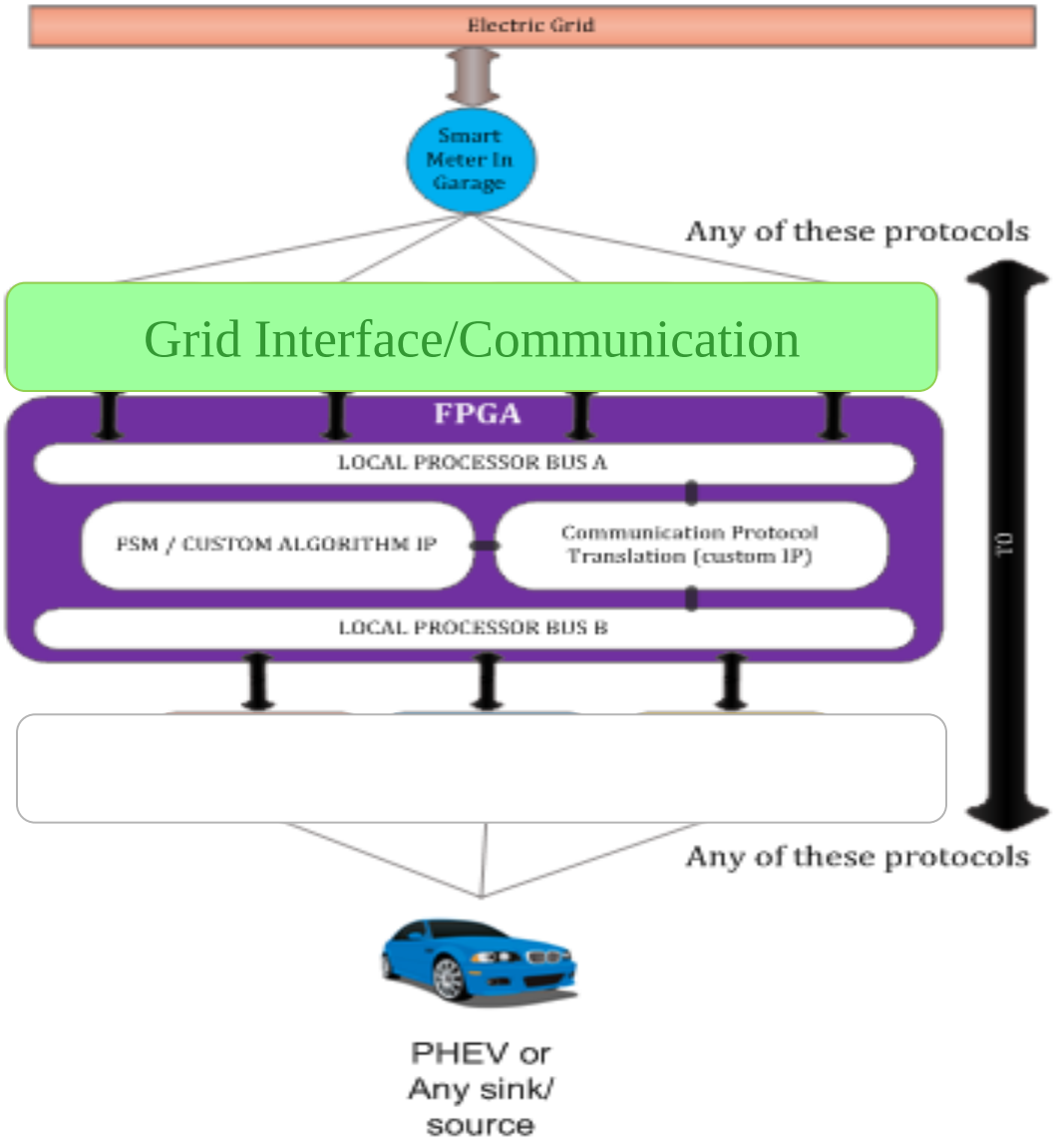
In this new Smart Energy driven technology development, intelligent embedded electronics will play a significant role.

Pathway's technology expertise and customer base offer us an unique advantage to deploy products and services for "Command, Communication, Control, and Intelligence" that are transparent across industry segments.

Smart Energy

Smart Energy devices in general need development expertise in embedded systems, custom electronics design, and high level software development extending all the way from a 8-bit microcontroller in a vehicle to web based interfaces. The platforms could be different PDA devices, cell phones with browser capabilities, or fixed devices.

Given the breadth of the expertise required to bring smart energy applications to market, Pathway is uniquely positioned to offer its expertise in various fields to help with your Vehicle to Grid application development and deployment.



Pathway Solutions

- Smart Automotive/Energy sub-systems and electronics
- Smart/efficient power system solutions
- New Generation Building Automation Framework
- Embedded electronics for Command, Communication, and control in Smart Grid Infrastructure
- Electronic hardware and software products
- Streamlined software development processes
- Distributed automated code generation that significantly reduces time and cost
- Tools and technologies to reduce time-to-market and cost

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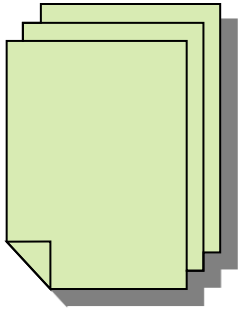
Pathway Products

Model Based Design & Autocode Generation

Requirements and Specs | **Design** | **Implementation** | **Test and Verification**



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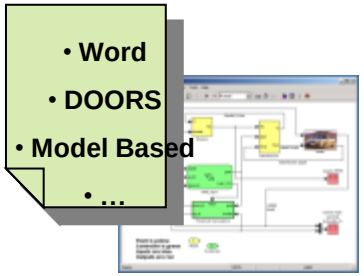
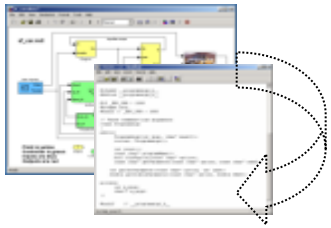


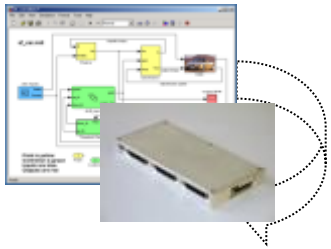
Executable Specification

Design, Simulation & Analysis



Autocode Generation

- No manual coding errors
- Repeatability
- Bridges the gap between domain knowledge, software and hardware knowledge



Test & Verification

- Reduce physical prototypes
- Detect errors early

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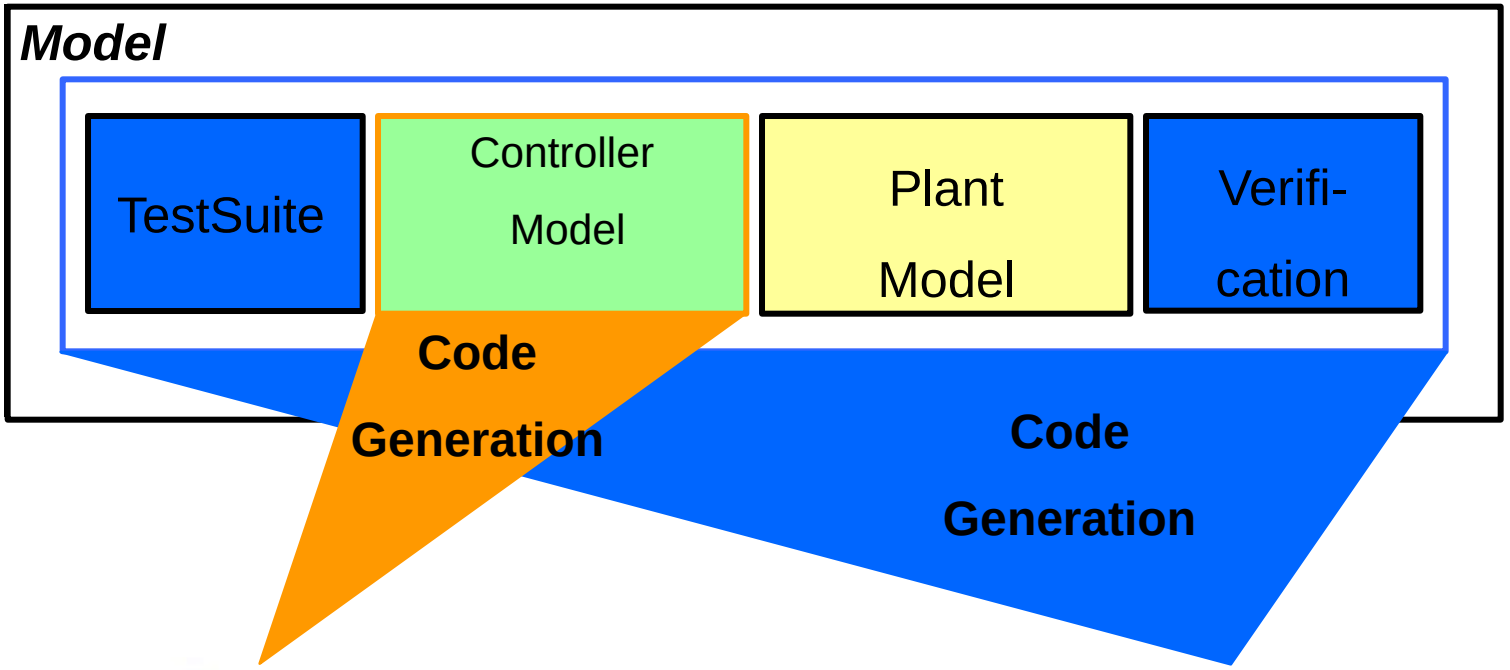
Pathway Products

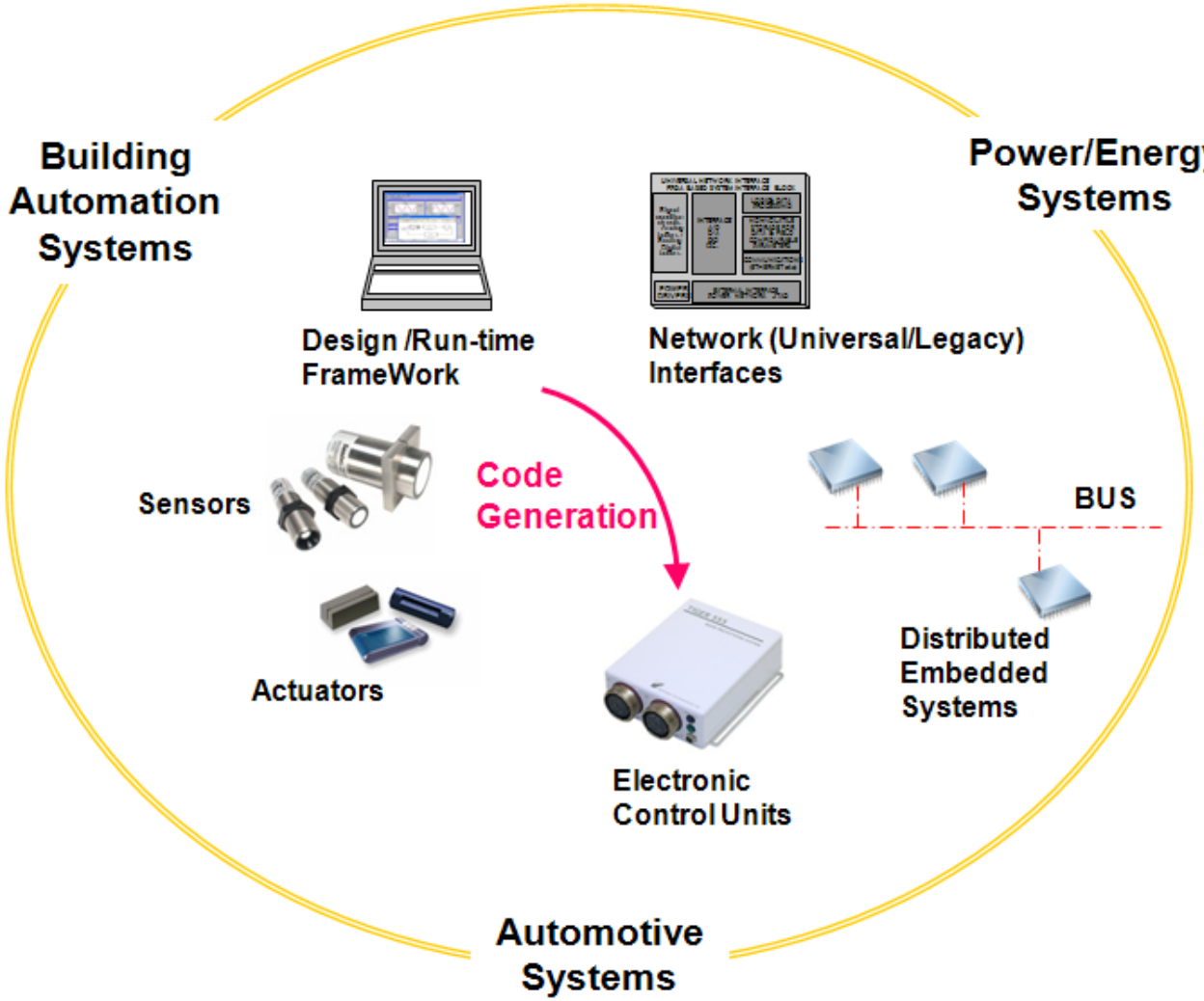


Pathway - Electronic Control Unit

Harness

Pathway - Real-time System (SIMULATOR)

Solutions for Multiple Industry Segments



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Pathway - Core Value to Customers

Automotive Solutions

- Power Train Control
- Vehicle Modeling
- HIL Systems
- Systems Engineering
- Electronic Control Modules

Energy Solutions

- Battery Tech
- Vehicle to Grid
- Net Zero
- Energy Routers
- Advanced Controls

Aerospace/Industrial

- Renewable Energy Solutions
- Energy Mgmt
- Security & Safety
- Sustainability
- Network Integration
- Building Automation
- HVAC
- Rapid Prototyping

- ***Stand-alone/Distributed Embedded Systems are driving the innovation in the next generation of engineered products – Cars, Aircraft, Power Plants, Buildings, etc***
- ***Embedded Systems (Electronics, Controls, and Software) is our core customer value across all industry segments***

Products & Solutions Summary

- For the last 10 years, clients from automotive, aerospace, energy, and commercial vehicle sectors have successfully used our electronics and software solutions for designing their next generation products
- Tradition of Innovation – 9 patents/patent pending technologies in last 6 years
- Our long term vision is to expand our successful field tested technology solutions in the following key areas
  - ***Energy – Connectivity, Management, and Control***
  - ***Mobility – Hybrid, Plug-in Hybrid, Hydrogen Fuel Cell***
  - ***Low Volume Manufacturing of ECMs for Communication and Control in Mobility & Energy applications***

Key Personnel

Andy Suri, PhD

Experience	Ph.D. in Mechanical Engineering, 20 years of industrial experience
Patents	12 US Patents (7 approved, 5 pending), 3 foreign patents (1 approved, 2 pending)
Publications	25 publications in prestigious peer reviewed journals, conferences and magazines
Awards/Honors	ASME Best Paper Award, AIAA Conference Best Technical Paper Award, Phi Kappa Phi Honor Society, Elected member Tau Beta Pi Honor Society
Committees/Invited Lectures/University	Joint research with Upenn, University of Michigan, University of Delaware, IEEE Controls Applications, ASME CIE Conference Committee, US Center for Automotive Research, Invited Lectures at NASA, NIST, University of Delaware
Industry/Government Projects	NASA, NIST, USDOE, Boeing, Booz-Allen-Hamilton, Johnson Controls, Eaton, Caterpillar, EPRI, Borg-Warner Automotive

Key Personnel

Viswanath Ananth, PhD

Experience	**Ph.D. in Physics, 15 years of industrial experience**
Patents	**5 US Patents**
Publications	**10 publications in prestigious peer reviewed journals, conferences and magazines**
Awards/Honors	**ASME Best Technical Paper award**
Industry/Government Projects	**NIST, Johnson Controls, USDOE, EPRI**
OpenSim	**Chief Product Architect for Pathway Software tools**

General competencies

Software

- Embedded software development
- Enterprisewide embedded system design framework development
- Device drivers
- Object Oriented technologies
- Systems integration
- …

Hardware

- Analog and Digital systems
- FPGA based systems
- Power electronics
- Wireless
- Sensors and transducers
- Custom board design & fabrication

Services

- Mathematical modeling & simulation
- Control system design
- Machine design, Mechanisms, Structures, Hydraulics, Electromagnetics
- MEMS/NEMS based system design
- Flexible/Hard automation
- Instrument design
- …

Products

- Lossless data monitoring
- Distributed embedded system prototyping and deployment
- Industrial PCs for prototyping
- Prototyping Electronic Control Units (ECU)
- Power electronics, signal conditioning
- Touch panel systems

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Industry Segments and Customers

Automotive Solutions

- Eaton
- Borg Warner
- Cooper Standard
- Johnson controls
- USUI
- DURA
- Caterpillar
- KDS Controls

Energy Solutions

- EPRI
- GM
- Johnson controls
- OptiSolar
- Eaton

Aerospace/Industrial

- USCAR
- Boeing
- Sikorsky
- NIST
- MathWorks
- CGN
- Volvo

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SMART GRID INTERFACE STATUS UPDATE

Why a Smart Grid Interface?

- Enable PHEV to perform demand response, load control and off-peak charging functions
  - Demand response: Interrupt charging during a summer peak emergency
  - Load control: Control charging power to a specific value based on premise circuit loading criteria
  - Off-peak charging: Either **time** or **price-based** signal that shifts charging interval during off-peak hours
- Provide means for utility to communicate bidirectionally with the PHEV using standardized interface
  - Hardware: Various transport layers
  - Software: Standard set by SAE (SAE J2236/J2247)

Typical Mode of Operation for Smart Charging Medium Duty PHEV

- All PHEV- AMI communications in silent mode – no operator intervention required
  - Operator override provision possible for quick charge
  - The truck driver just plugs in the vehicle for recharging

- PHEV to AMI / HAN (Home Area Network) communications over wired (Ethernet / PLC) or wireless (ZigBee/WiFi) media, with standard messages per SAE J2836, J2847

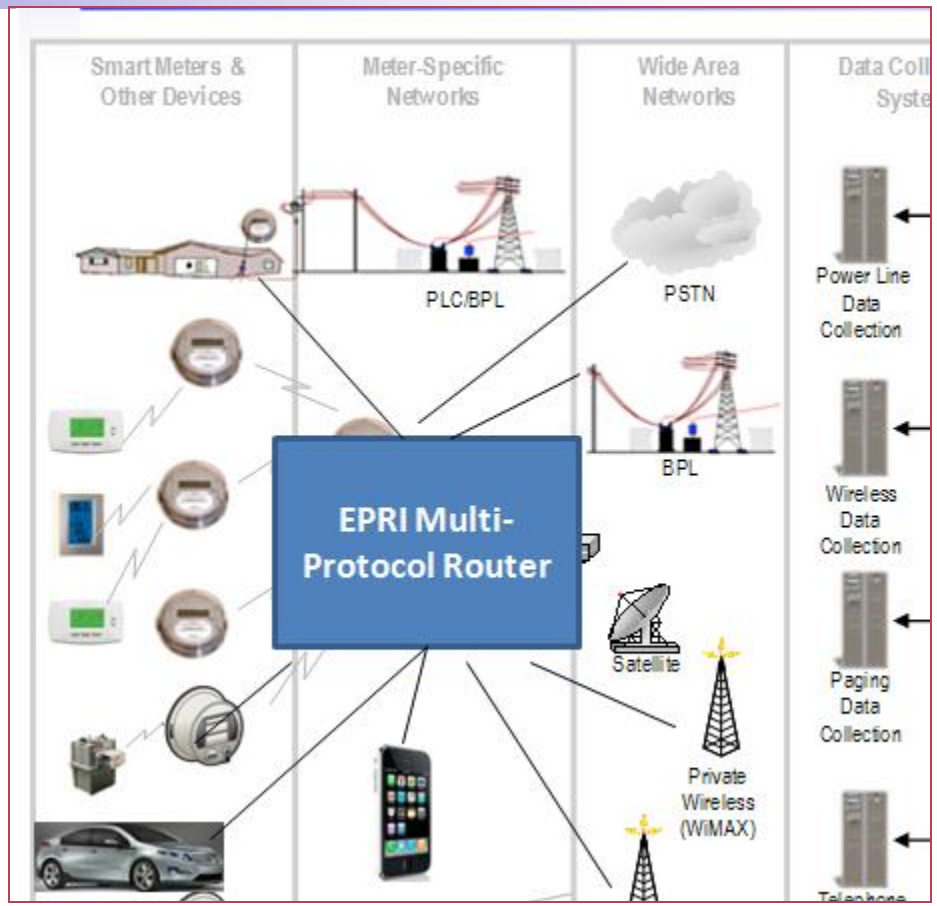
- Vehicle responds to utility pricing, demand response or load control commands to modify charging for the battery, while completing charging by scheduled time

- Vehicle defaults to ‘dumb’ charging in the absence of a smart node

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Medium Duty PHEV to Smart Grid Interface Reference Design – Multi-Protocol Router (MPR)

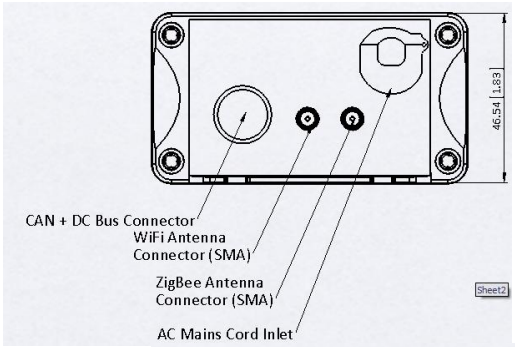
- **Connects** a PEV with AMI or HAN
- **Open and extensible** architecture based on off-the-shelf components
- **Ruggedized enclosure** for on-vehicle implementation per SAE J1445
- **Data messages**: Standardized SE2.0 application layer
- **Physical Connection**:
  - Vehicle side: J1939 (CAN), RS232, USB
  - Meter side: ZigBee, WiFi, Ethernet, HomePlug
- **Programmability:** Web server interface for protocol conversion setup, flash-capable through diagnostics CAN (ALDL)
- Technology currently in its 3rd generation of development, MD PHEV will be **4th generation**



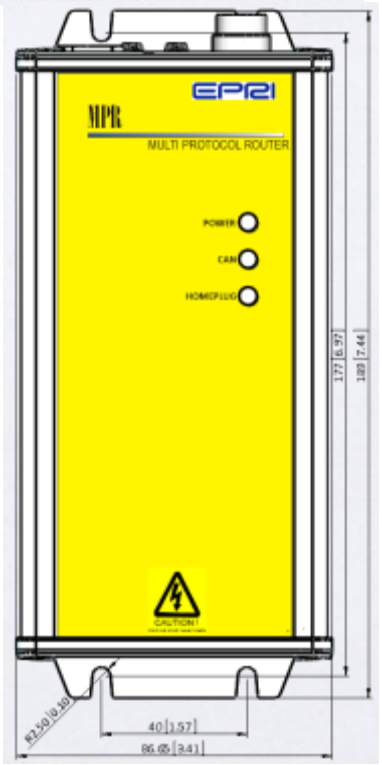
MD PHEV to Smart Grid Interface

Multi-Protocol Router – Physical Characteristics

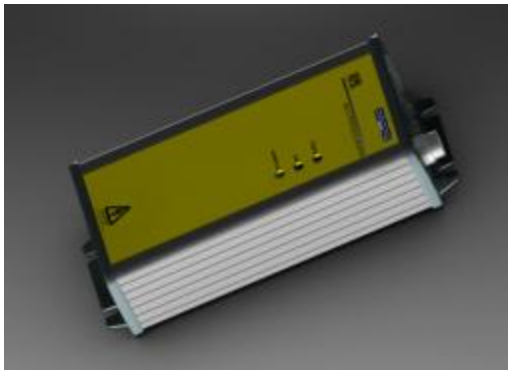
End View



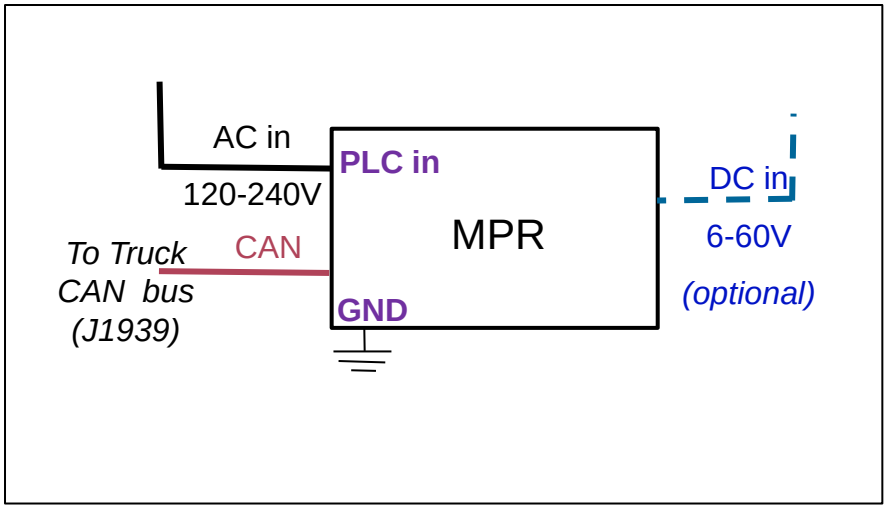
Plan View



Perspective



7.4” x 3.4” x 1.8”



Electrical Interface Diagram

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Multi-Protocol Router Plan of Execution

- Project underway since August 2009
- First design samples for EPRI testing: mid-2010
  - First samples for automotive on-board application delivered in May 2010 for another project
- First ruggedized samples for truck integration: 4Q2010
  - On track
- EPRI will lead to help Eaton integrate hardware and software functionality of MPR for seamless operation

MPR hardware and firmware delivered for on-board implementation for one automotive OEM on 5/8/10

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Stage-Gate process envisioned to introduce MPR on-board to reduce program risk

- MPR considered to be a ‘new’ technology requiring off-vehicle verification and integration before on-vehicle application
- Plan therefore will have a fully functional bench setup with MPR, smart meter, charger and battery pack / simulator
- State-Gate process to be used to ensure functionality is verified and validated off-vehicle before on-vehicle integration
- Stage-gate process consistent with integrating all other new technology on-board the vehicle


Courtesy of Eaton

Charging Station Information

Mark Kosowski- EPRI

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Charging Station Information

Plug-In Hybrid Medium-Duty Fleet Demonstration and Evaluation Program

FOA-28 Award #EE0002549

June 24, 2010

EPRI ELECTRIC POWER RESEARCH INSTITUTE


Courtesy of Eaton

Program Overview

Mark Kosowski- EPRI

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Fleet Infrastructure Options

- EVSE will be either from:
  - ClipperCreek, Inc. or
  - Coulomb Technologies, Inc. or
  - Leviton Manufacturing Co., Inc.
- All charging facilities will be ready prior to vehicle delivery
- EPRI will provide Infrastructure Support to the fleets as needed

ClipperCreek, Inc.

Clipper Creek Manual

Clipper Creek EVSE

Terms and Conditions

Clipper Customer Set-up

Clipper Credit Application

Coulomb Technologies, Inc.

Coulomb Product Selection

Coulomb Installation Manual

CT-500 Mounting

Leviton Manufacturing Co., Inc.

Leviton EVSE

Leviton Cord Set

Charge Station Costs

ClipperCreek, Inc.

Model	Level	Power	Mounting Options	Warranty	Cost
CS-40	2	32 A	Wall or Post	1 year	$1,900
Warranty				3 year	$300
Post					$525

Coulomb Technologies, Inc

Model	Level	Power	Mounting Options	Warranty	Cost
CT-500 CDMA	2	32 A	Wall	1 year	$1,900
Warranty				5 year	$658
CT-2000 CDMA	2	32 A	Floor	1 year	$2,425
Warranty				5 year	$1,455

Leviton Manufacturing Co., Inc.

Model	Level	Power	Mounting Options	Warranty	Cost
EVB-65	2	32 A	Wall or Post	10 year	$695


Courtesy of Eaton

Fleet Agreement Discussion

Mark Kosowski- EPRI

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Questions and Answers

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