

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

Principle Investigator: Matt Miyasato, Ph.D.

Presenter: Joseph Impullitti

South Coast Air Quality Management District

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Department of Energy
Project ID:arravt083



Overview

Timeline

- Start- November 2009
- Finish- July 2015
- 95% Complete

Barriers

- Fleet resistance to placing new technology in mission critical applications
- Fleet resistance since economic benefits not demonstrated

Budget

Project Funding:

- DOE: \$45,443,325
- CEC: \$5,000,000
- Contractor: \$45,443,325
- Total: \$95,886,650

Partners

- SCAQMD
- CEC
- EPRI
- Odyne Systems, Inc.
- VIA Motors, Inc.
- Pathway Technologies, Inc.

Program Objectives

- Nationwide demonstration and evaluation of approximately 280 medium duty PHEVs
- Develop a production-ready, commercializable PHEV system for Class 2 to Class 8 trucks
- Develop production –ready “smart charging” capability for the trucks
- Build customer familiarity
- Use project results for system development to optimize performance and reduce costs
- Quantify performance attributes and environmental impact

All Program Objectives were met

Project Approach

- **Design, Develop, and Validate Three PHEV Drive Systems**
 - Class 2 Pick-up and Vans
 - Class 6 to 8 Work Trucks
- **Fleet Selection, Vehicle Build, and Deployment**
- **Performance Assessment**
 - In-use Data
 - User Survey
 - Laboratory Testing

Odyne Class 6-8 Trucks

•Vehicle Design

- Odyne hybrid system with Allison automatic transmission
- Diesel engine
- High energy lithium-ion batteries- JCI 28.4 kWh
- Blended regenerative braking
- Launch assist
- On-board charger (3.3 kW)
- Charging-Level 1 (120 VAC) and Level 2 (240 VAC)
- Export power (up to 12 kW, 120/240 VAC, 60 Hz)
- Redundant system that can be returned to conventional driving
- Vehicle can drive without being charged

•Expected Performance Specifications:

- ePTO operation (>3 Hours with Engine-Off)
- Up to 7 miles equivalent all-electric range
- Up to 300 miles range between refills
- Charge time less than 7 hours with Level 2
- FMVSS compliant
- Limited 3 years/ 36,000 mile warranty



VIA Class 2 PHEV Pickup Truck

- **Vehicle Design**

- Series hybrid system with automatic transmission
- 4.3L gasoline V6 engine
- 4x4
- High energy lithium-ion battery – A123 23 kWh
- Blended regenerative braking
- On-board charger (14.5 kW)
- Charging-Level 1 (120 VAC) and Level 2 (240 VAC)
- Reduces payload by about 850 lbs
- Vehicle can drive without being charged
- Extended Cab
- Export power (14.5 kW, 120/240 VAC, 60 Hz)

- **Expected Performance Specifications:**

- Up to 40 miles all-electric range
- Up to 400 miles range between refills
- Charge time less than 6 hours with Level 2
- FMVSS compliant
- Limited 8 years/150,000 mile warranty



VIA Class 2 PHEV Van

- **Vehicle Design**

- Series hybrid system with automatic transmission
- 4.8L gasoline V8 engine
- RWD 135" Wheelbase
- High energy lithium-ion battery – A123 23 kWh
- Blended regenerative braking
- On-board charger (14.5 kW)
- Charging-Level 1 (120 VAC) and Level 2 (240 VAC)
- Reduces payload by about 600 lbs
- Vehicle can drive without being charged
- Cargo Van or 12 seat arrangement
- Export power (14.5 kW, 120/240 VAC, 60 Hz)

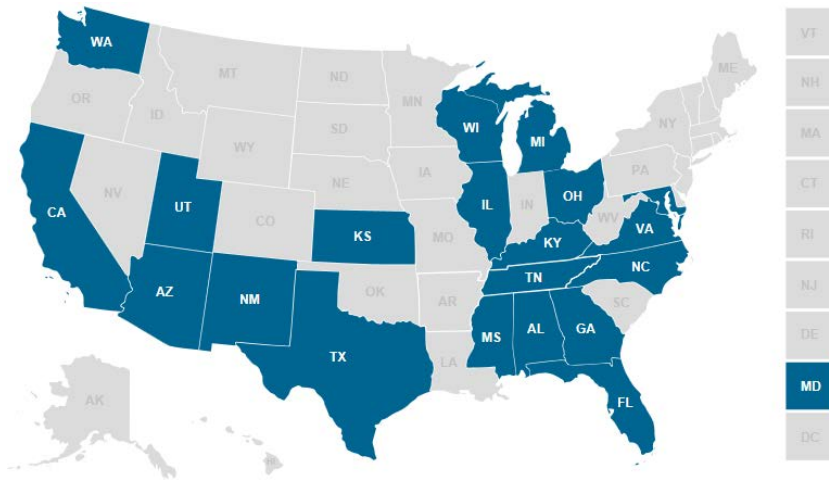
- **Expected Performance Specifications:**

- Up to 30 miles all-electric range
- Up to 400 miles range between refills
- Charge time less than 6 hours with Level 2
- FMVSS compliant
- Limited 8 year/150,000 mile warranty

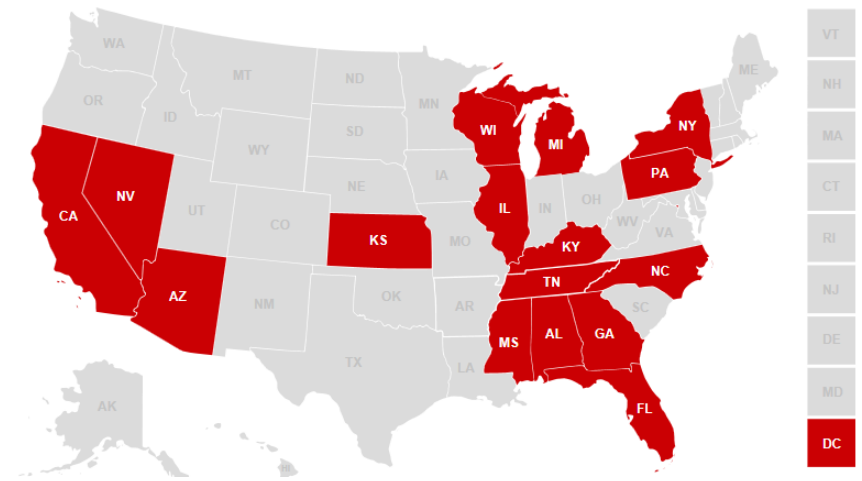


Fleet Deployment

64 different fleets in 23 States plus DC



20 VIA States



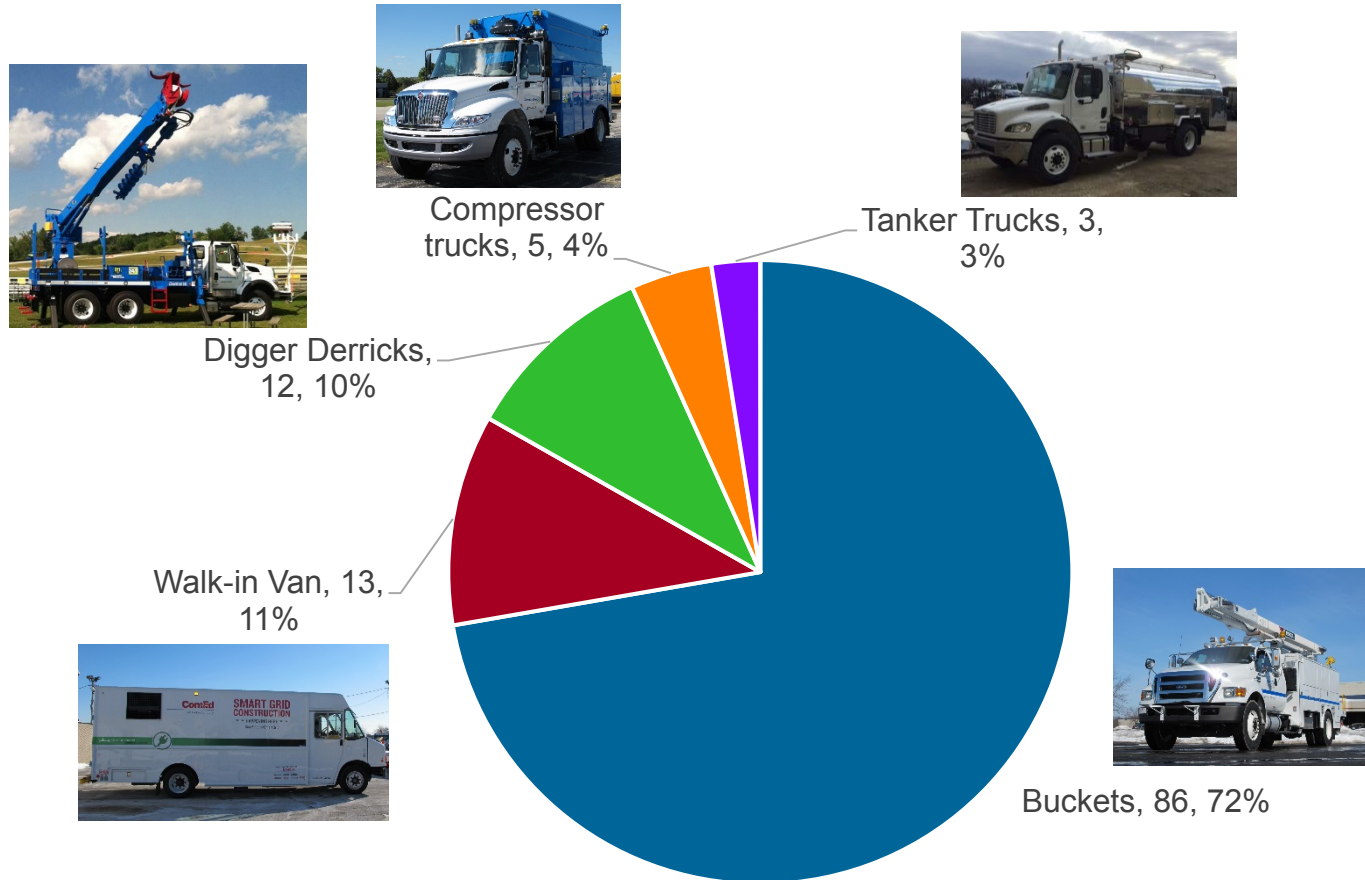
16 Odyne States + DC

Total of 296 trucks and vans

119 Odyne trucks with 35 different fleets

177 VIA pickup trucks and vans with 47 different fleets

Odyne Deployment to the Fleets



Chassis Manufacturers

- Freightliner
- International
- Ford
- Kenworth

Final Stage Manufacturers

- Altec
- DUECO
- Terex
- Amthor
- Vanair
- Utilimaster

Bucket trucks was the largest category of truck

Odyne Fuel Consumption Comparison

Traction Fuel Consumption

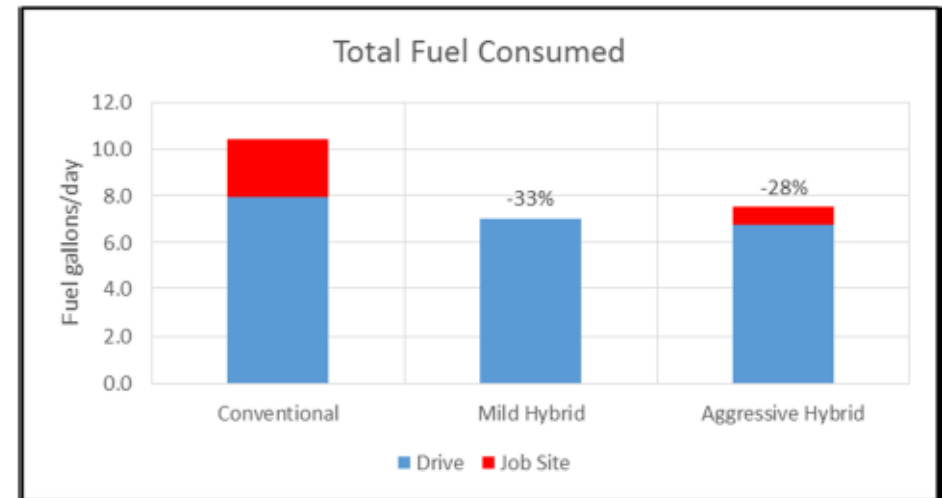
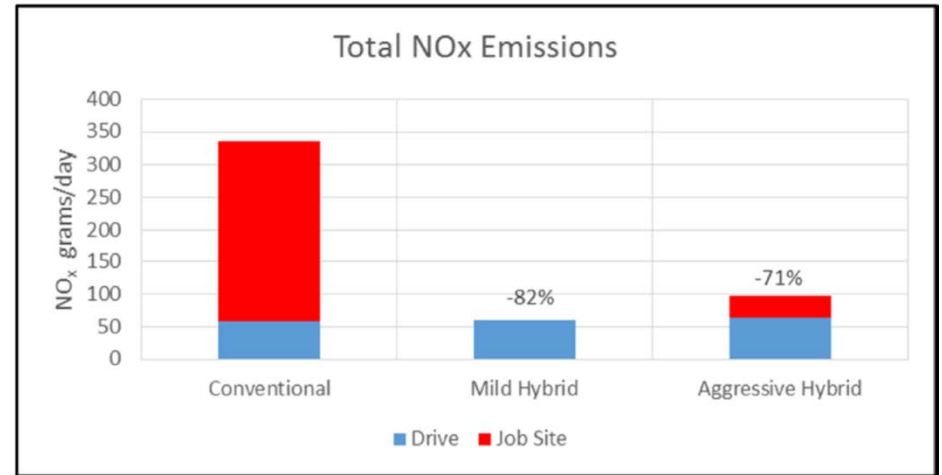
		Conventional Vehicle Fuel Used (gal)	Odyne PHEV Fuel Used (gal)	Reduction	Annual Savings (gal)	Annual Distance (miles)
Strong Calibration	Driving (50 miles per day)	7.8	5.4	32%	896	18000
	Driving (32 miles per day)	5.0	2.7	47%	840	11520
	Driving (20 miles per day)	3.1	0.9	71%	803	7200
Mild Calibration	Driving (32 miles per day)	5.3	4.9	7%	133	11520

CILCC cycle used

PHEVs contribute to significant reductions in fuel consumption

Odyne Emissions

- During driving conditions NOx results are showing higher for Hybrid vs Conventional
 - The amount is dependent on operating conditions
 - Hybrid impacts exhaust temperatures, mostly at startup
 - SCR systems are more sensitive, potentially due to dosing
- Green House Gases are reduced in all cases
- For our vocation / applications the driving impact is very small compared to the full work day benefit
 - Reduces Green House Gases by up to 50% or greater
 - Reduces NOx by up to 80% or greater



VIA Deployment to the Fleets

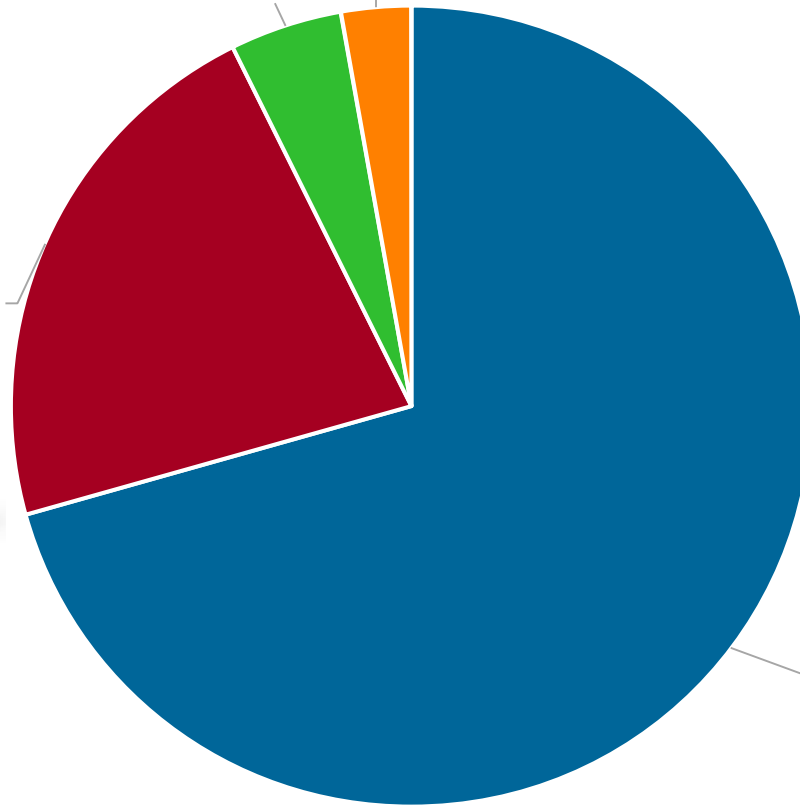
Number of VIA Trucks by Type

Passenger Vans, 8, 4%

Accessible Vans, 5, 3%

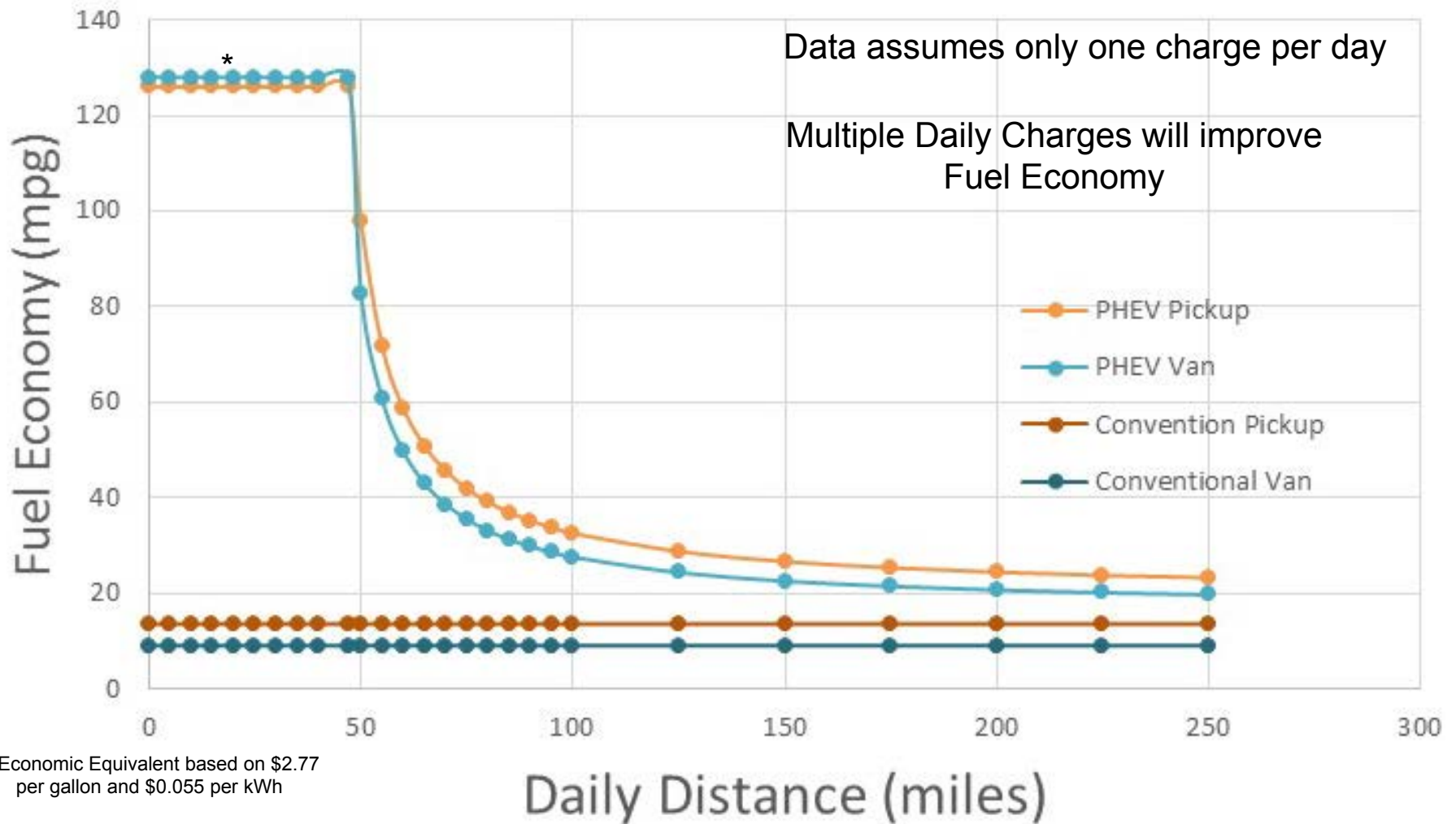
Cargo Vans, 39, 22%

Pick-ups, 125, 71%



Pickup trucks are the most popular VIA truck

VIA Fuel Economy



PHEVs contribute to significant reductions in fuel consumption

Performance Evaluation

In-Use Data Collection

- One Second Data is being collected on all trucks and vans
- Data is being captured on all modes of operation including: traction, charging, operating (hydraulics and bucket control), export power
- Data are sent to the Labs monthly
 - Idaho National Lab (INL)
 - National Renewable Energy Lab (NREL)

Laboratory Testing

- Laboratory Testing has occurred
 - Southern California Edison has tested the trucks
 - Trucks have been emissions tested for EPA and CARB certification

Survey Results Overview

- Fielded May, 2015
- 42 completed responses by March 31, 2015
- 32 Odyne (Classes 6-8)
- 10 VIA (Van only)
- Preliminary results are being tabulated

Collaborations/ Partnerships

- SCAQMD- Prime Recipient
- California Energy Commission- Funding Partner
- EPRI- Program Management and Fleet Coordination
- Odyne Systems, Inc.- Hybrid System Developer and Producer
- VIA Motors, Inc.- Hybrid System developer and Producer
- Pathway Technologies- Smart Charging Developer and Producer



Project Summary

The project has:

- Designed, developed, validated, certified, and produced three different plug-in hybrid vehicles
 - VIA pickup-up trucks and vans
 - Odyne Class 6 to 8 trucks
- Deployed 296 trucks
 - 52 VIA Vans
 - 125 VIA Pick-ups
 - 119 Odyne Class 6 to 8 trucks
- Collected Data from trucks for analysis and is providing data to the National Labs (NREL and INL)
- Developed and produced a Smart Charging System
- Completed laboratory testing by Southern California and emissions testing

Project Summary

The project will:

- Quantify the attributes of performance for each platform in terms of:
 - Criteria pollutant emissions and greenhouse gas reductions
 - Provide opportunity to further optimize the efficiency of the systems
- Evaluate System Architecture for cost reductions and performance improvements
- Complete Survey
- Complete Data Analysis
- Write a final report providing insight to the project

Responses to Previous Year's Review Comments

Comment: CARB was shown as a barrier, but for this type deployment DOE should assist in obtaining waivers to help mature the technology.

Answer: The vehicles in this program are production units and are required to have the proper certification by either CARB or EPA. This was a required barrier. Both EPA and CARB were excellent to work with, however, both architectures required new procedures which caused delays in the process. These certifications also allowed these agencies to understand the technologies.

Comment: It would be good to have a list of locations where the trucks will be used

Answer: See location list provided

Locations of the Program Trucks

58 locations

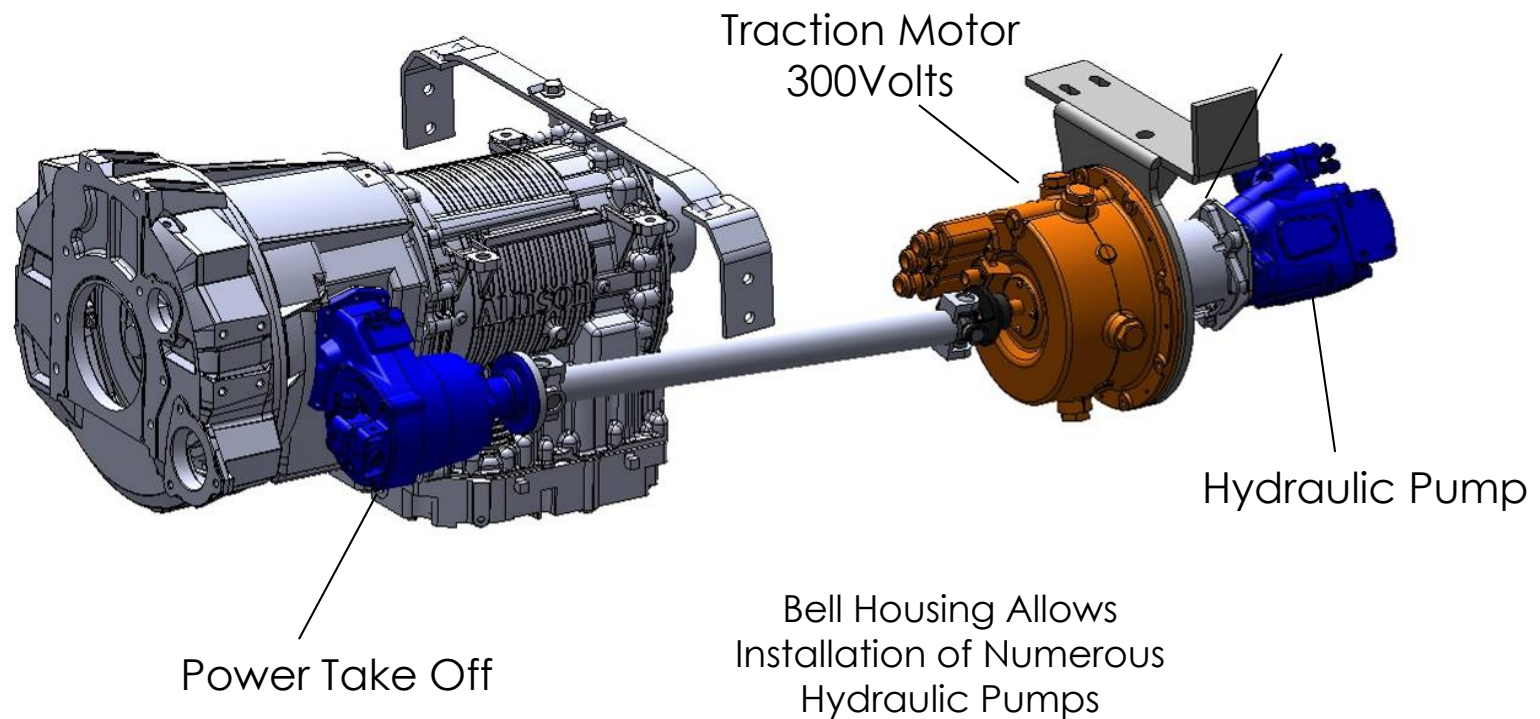
Arlington County, VA	Ft. Myers, FL	McMinnville, TN	Rochester, MI
Atlanta, GA	Golden, CO	Memphis, TN	Salt Lake City, UT
Berwyn, PA	Grand Haven, MI	Milwaukee, WI	San Antonio, TX
Birmingham, AL	Green Bay, WI	Murfreesboro, TN	San Diego, CA
Bristol, TN	Houston, TX	Nashville, TN	Santa Fe, NM
Charlotte, NC	Huntsville, AL	New Albany, TN	Savannah, TN
Chattanooga, TN	Independence, OH	Oak Ridge, TN	Seattle, WA
Chicago, IL	Jackson, MI	Oxford, MS	St. Paul, MN
Clarksville, TN	Knoxville, TN	Palo Alto, CA	Stevenson, AL
Cleveland, TN	Las Vegas, NV	Phoenix, AZ	Tempe, AZ
Columbus, OH	Lawrence, KS	Pomona, CA	Topeka, KS
Diamond Bar, CA	Los Angeles, CA	Poughkeepsie, NY	Vancouver, BC
Elizabethtown, KY	Marquette, MI	Princeton, IL	Walterboro, SC
Etowah, TN	Marshfield, WI	Reno, NV	Washington, DC
	Maryfield, KY		Winnipeg, Manitoba

Request from the last Annual Review

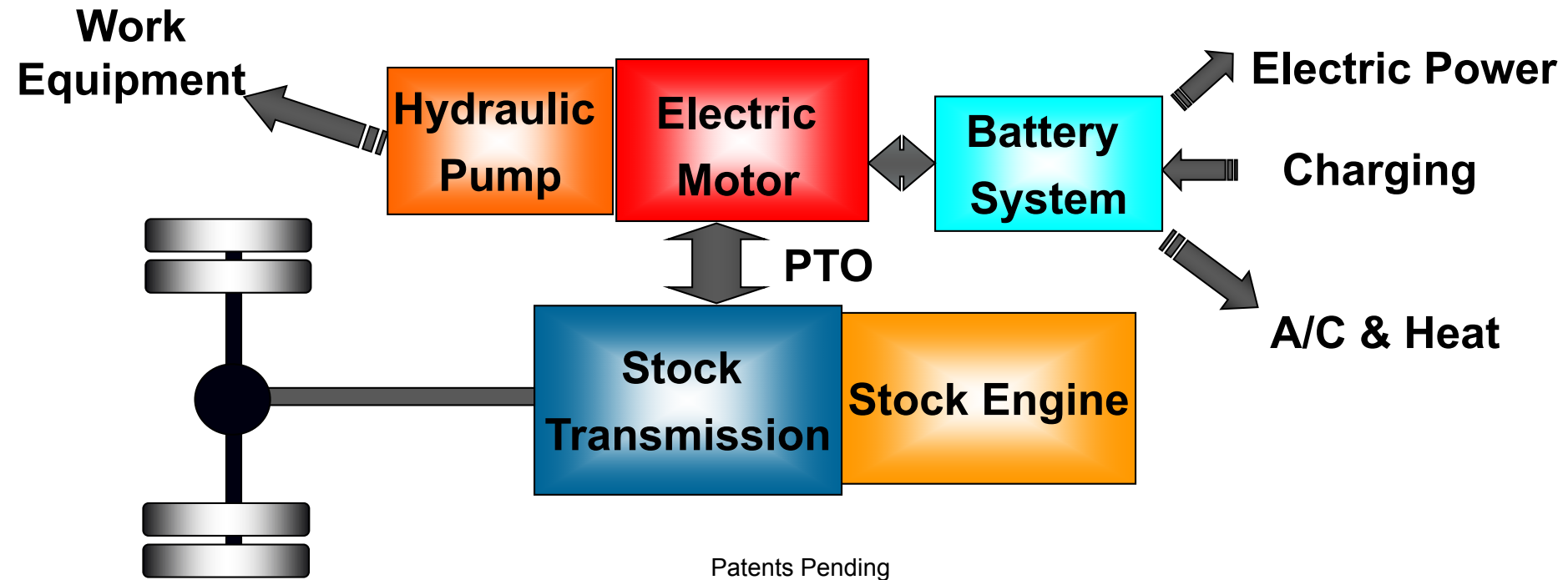
Thank You for your Attention

Technical Backup Slides

Minimally Intrusive Design



Odyne Hybrid Architecture



Parallel Hybrid Solution

- ▶ Provides redundant system to operator to minimize downtime
- ▶ Low validation and capital equipment costs
- ▶ Ability to retrofit to existing vehicles

OEM Compatible

- ▶ No modifications required to drivetrain
- ▶ Simplified integration through power take-off (PTO)
- ▶ EPA & CARB compliant

Van Configuration

