Heavy-Duty Plug In Vehicles
Lessons from the E-Truck Task Force

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KEY TOPICS

HD Plug in Vehicles Here Now

But Market in Shake Out

Must Address Cost, Reliability, Infrastructure, Placement

WCC Meeting, San Francisco

September 4, 2014

Today: Electric Trucks – Current Models MD

Smith

Balqon

EVI

AMP

Motiv

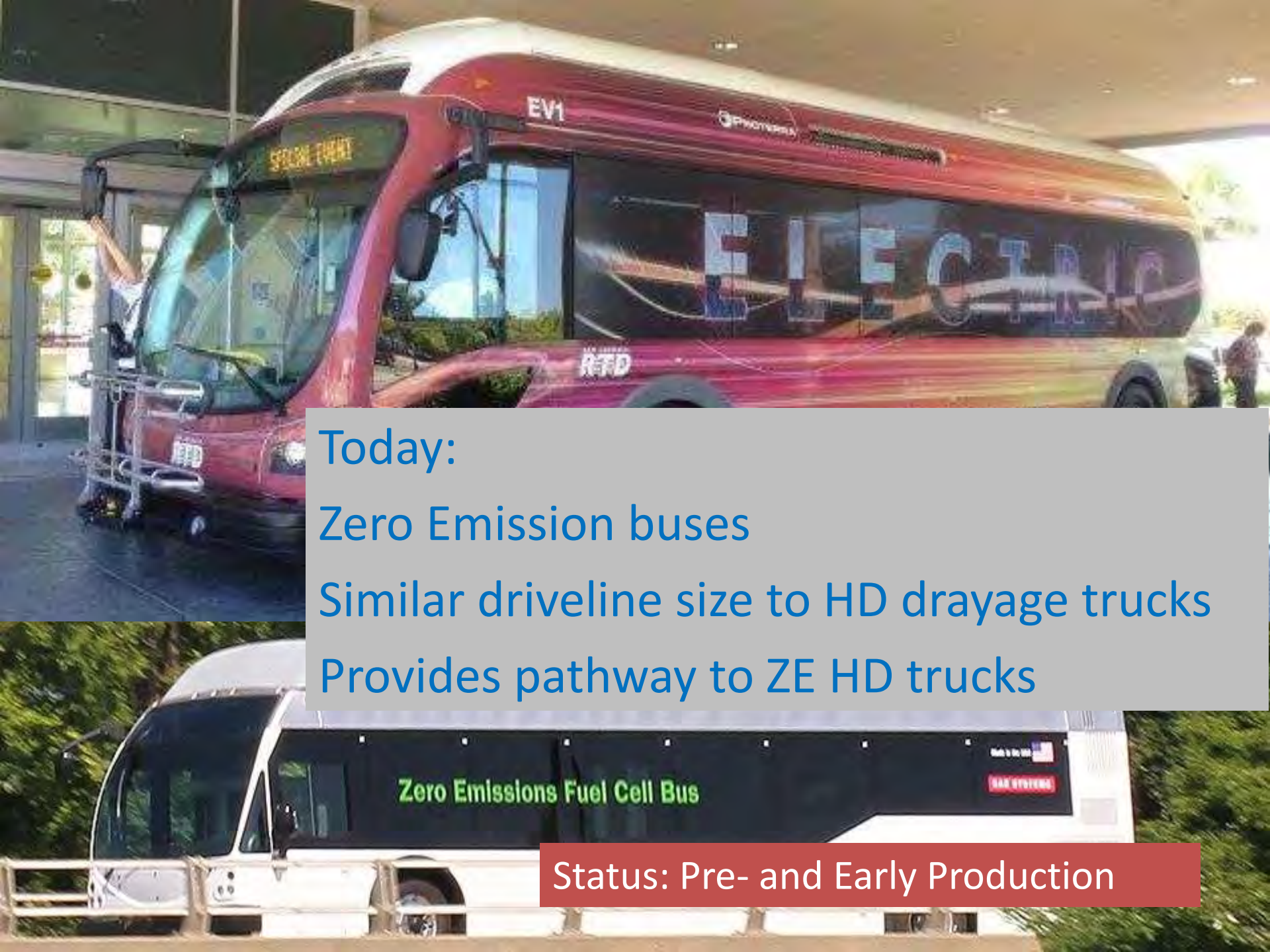
Transpower

Zero Truck

Boulder

Status: Pre- and Early Production

Supply Chain Shaking Out



Today:

Zero Emission buses

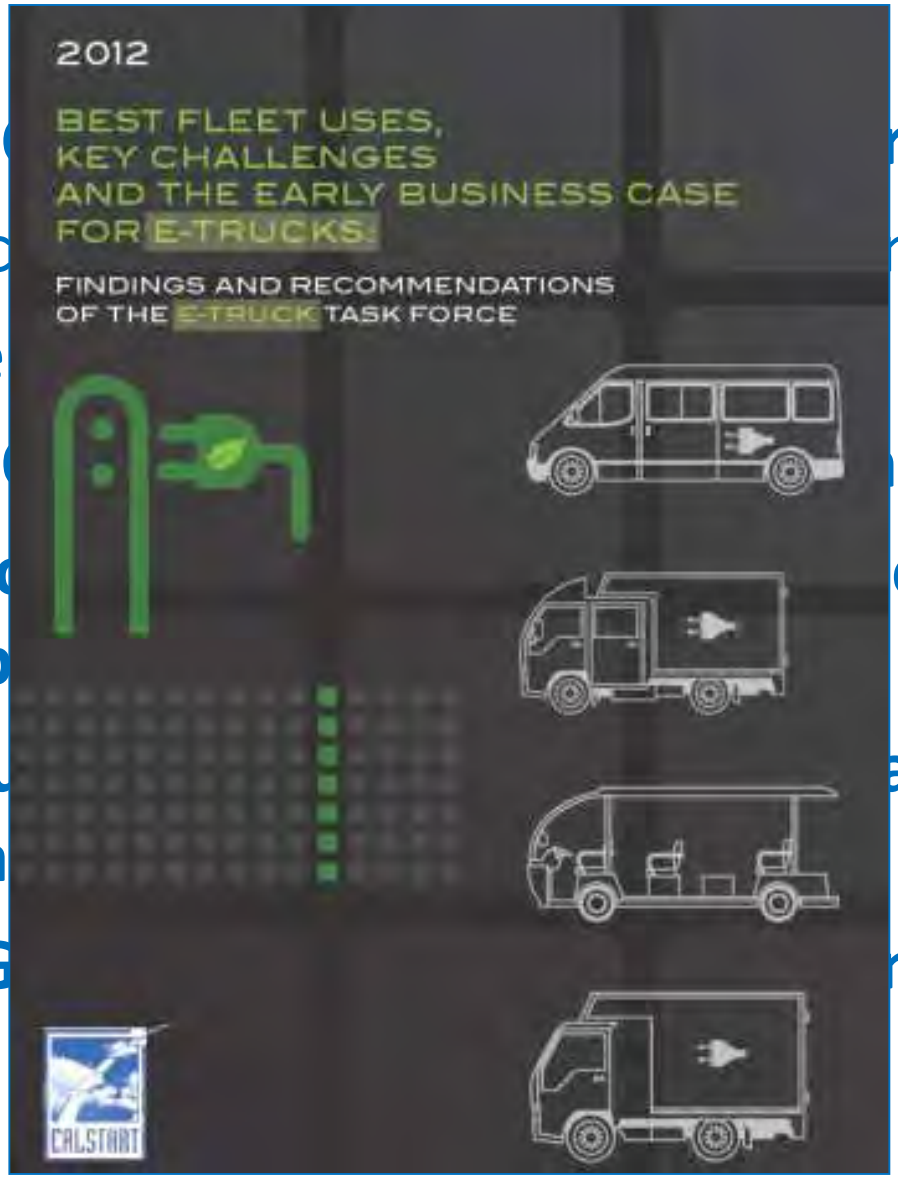
Similar driveline size to HD drayage trucks

Provides pathway to ZE HD trucks

Status: Pre- and Early Production

E-Truck Task Force: Key Findings

- ✓ **Vehicle C** **rriers**
  - Produc **ncentives**
  - Greate **needed**
- ✓ **Vehicle C** **prove**
- ✓ **Validatio** **ess Case are Key Gap**
- ✓ **Infrastru** **and Importa**
- ✓ **Better G** **nt, Use Needed**



Expanding Tools: California HVIP Zero-Emission Voucher Amounts

New increased HVIP voucher amounts for electric trucks and buses
August 1, 2014: You can now receive vouchers **up to $110,000** toward the purchase of any zero-emission truck or bus in the HVIP! The California Air Resources has recently increased the voucher levels for **electric trucks**. Please see the table below (Table 2 on page 12 of the HVIP Implementation Manual).

GVWR (lbs)	Base Vehicle Incentive		
	1 to 100 vehicles[1]		101 to 200 vehicles
	Outside DC[2]	Within DC[2]	
5,001 – 8,500	$20,000	$25,000	$10,000
8,501 – 10,000	$25,000	$30,000	$12,000
10,001 – 14,000[3]	$50,000	$55,000	$20,000
14,001 – 19,500	$80,000	$90,000	$25,000
19,501 – 26,000	$90,000	$100,000	$30,000
> 26,000	$95,000	$110,000	$35,000

1 - The first three vouchers received by a fleet, inclusive of previous funding years, are eligible for the following additional funding amount: $2,000/vehicle if below 8,501 lbs; $5,000/vehicle if 8,501 to 10,000 lbs; and $10,000/vehicle if over 10,000 lbs.
2 – 'DC' refers to a disadvantaged community.
3 - This weight range is not intended for vehicles utilizing a pick-up truck chassis/platform typically found in vehicles below 10,001 lbs GVWR. Vehicles at the lower end of the 10,001 to 14,000 lbs weight range will be evaluated on a case-by-case basis to determine eligibility for the full Base Vehicle Incentive.

Findings: Best Use / Duty Cycles

General

1. Fixed route applications - **70%**
   - Stop and go
   - Localized, dedicated routes
   - Short haul
   - Limited range
   - ‘Spoke and hub’
   - Urban Delivery, Refuse, Mail trucks, Transit Buses

2. Facility vehicles – **19%**
   - Airports, seaports, railyards, military bases, parks, resorts
   - Warehouse support and maintenance
   - Cargo handling

3. High idle, work site applications – **11%**
   - Aerial devices
   - PTO
   - Utility vehicles

Findings: Best E-Truck Business Case

- To get sufficient payback, need to drive maximum miles possible (or maximum use of energy)
- Dedicated, return-to-base routes with known daily mileage highly valuable
- High Utilization/Daily miles (5-7 days a week) important
- 60-80 miles/day seems like an initial “sweet spot” for fuel savings payback (sufficient miles to generate fuel savings needed)

e-Truck Business Case Calculator
Version 1.3

Calculate

Print

Conventional Diesel Vehicle Information		
Vehicle Life	10	years
Vehicle Daily Range	80	miles/day
Fuel Economy	8.00	mpg
Vehicle Capital Cost	$ (61,000.00)	-
Maintenance Cost	$ 0.22	/miles
Diesel Fuel Price	$ 4.062	/gallon
Fuel Escalation Rate	7%	-

Electric Vehicle Information		
Electricity Consumption Rate	0.70	kWh/mile
Maximum Charging Power	6.60	kW
Maintenance	$ 0.14	/mile
Electricity Costs	$ 0.10	/kWh
☐ Include Demand Charges	$ 10.56	/kW
Electricity Escalation Rate	5%	-
Electric Vehicle Capital Cost	$ (150,000.00)	
Infrastructure Installation Costs	($3,000.00)	
Smart Meters	$ -	for 1 vehicle
EVSE	$ *(3,000.00)*	for 1 vehicle
Electrical Service Upgrade Costs	$ -	/kW over 33 kW
Panel Upgrade	$ -	/33 kW
New Conduits	$ -	/33 kW
Trenching	$ -	/33 kW
Load Management Software Costs	$ -	per fleet
Contingency Costs	$ -	/ vehicle over 10 vehicles

Financial Information	
Cost of Capital	7%
State EV Incentive (HVIP)	$ 20,000.00
Federal EV Incentive	$ -
EV Infrastructure Incentive	$ -

EV Battery Information	
Battery Cost ($/kWh)	$ 350.00
Minimum Battery Size (kWh)	67.2
Total Battery Costs	$ (23,520.00)
Battery Replacement Interval	10
End of Life Costs	$ -

Fleet Information	
Fleet Size (Number of vehicles)	1

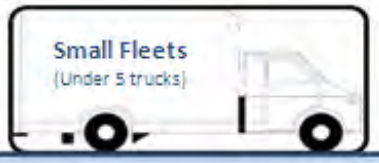
Results	
e-Truck Incremental Cost	($92,000.00)
Simple Payback Period without incentives	8.04
Simple Payback Period with incentives	6.30
Return On Investment	15.88%
Net Present Value	$ 32,158.00
Internal Rate of Return	7.41%
Modified Internal Rate of Return	7.20%

http://www.calstart.org/Projects/htuf/E-Truck-Project/Resources.aspx

Findings: Infrastructure

- Average EVSE simple, single install $3300 (usually at a building); fleets say often higher
- Installing conduit to take power to truck locations can cost $8-10,000 or more
- Demand charge is key issue – time of charge can push facility over its core demand load and cost much more money
- No existing EV charge rate for commercial sites (though Time of Use – TOU – rates exist)
- Fleets may need new costly electrical service expansion to accommodate demand from 3-5 more vehicles

E-TTF Infrastructure Planning Guidelines for E-Truck Fleets



Your Facility Consultation

- ✓ Level of service, power available at your site (each E-truck using level 2 EVSE can add up to 19.2 kw of load (average closer to 12 kw for a 240V 50 A EVSE circuit)
- ✓ Time of peak facility demand (want to charge trucks during low facility demand – likely overnight, but not always – find out!)

• Infrastructure *Installation* Costs

EVSE Supplier Consultation

- ✓ Level 1 or Level 2 Charging (2 is most common – average install cost $3,000)
- ✓ Number of EVSE required
- ✓ Placement of EVSE
- ✓ Permitting requirements
- ✓ Building Code requirements
- ✓ Local Zoning requirements
- ✓ Signage
- ✓ Cost of Electrical and EVSE Contractor

Utility Consultation

- ✓ Additional Metering requirements (may be an added cost from utility)
- ✓ Consider Time of use (TOU) meter
- ✓ Service Panel Upgrade (usually not needed at commercial site for small number of vehicles)

• *Additional* Infrastructure Installation Costs

EVSE Supplier Consultation

- ✓ Proximity to power supply
- ✓ Safety and Accessibility Issues
- ✓ Concrete Cutting / Trenching (anticipate future EVSE installs now)
- ✓ Paving

Utility Consultation

- ✓ Panel Upgrade
- ✓ New circuitry/ conduit requirements – (can be up to $10,000 with new EVSE - forecast future fleet needs now)

• Further Concerns

- ✓ To avoid significant demand charges, consider charging EV's when a large portion of the refueling can be done off-peak and below your normal operating load.
- ✓ If EV load is incremental (in addition to existing operating load), the cost will also include a price per kilowatt. This can be over $60/ new kilowatt.
- ✓ Consider purchasing demand response charging system
- ✓ Consider purchasing a Load Management System that eliminates the costly process of managing electric vehicle charging by automatically sequencing and optimizing multiple chargers.

• Ongoing *Operational* Costs

Utility Consultation

- ✓ Determine current electrical rate structure
- ✓ Determine time-of-use charges
- ✓ Analysis of expected charge times – AM/PM – peak/off-peak

Management Consultation

- ✓ Analysis of common duty cycle and on-road time required for trucks

• *Additional* Ongoing Operational Costs

Utility Consultation

- ✓ Determine kW threshold at which demand charges are triggered (over 20kW) – how much $ will be added to electricity bill?

Management Consultation

- ✓ Forecast current and future EV needs
- ✓ Determine charging schedule for each fleet vehicle

http://www.calstart.org/Projects/htuf/E-Truck-Project/Resources.aspx

NEXT STEPS:

- Phase 2 of E-Truck Task Force now underway – *want to take part*? tbrotherton@calstart.org
- Continued technology improvement (CEC, other funding)
- Continued market development
- Stronger network of regional incentives – US VIP initiative to create voucher programs – *want to take part*? bvanamburg@calstart.org