Zero Emission Truck Commercialization

Summary of the
I-710 Project Zero-Emission Truck Commercialization Study Draft Report

ITS Working Group Meeting
Rancho Dominguez, CA – November 13, 2013
AGENDA

• Why Are We Doing ZETs
• Are ZETs Possible
  – Key Performance Parameters
  – Types of ZETs that meet KPPs
• The Promise of Payback
• Challenges to Commercialization
  – Meeting the Needs
• Actions We Must Take
  – Path to Commercialization
• How Do We Get There
  – Near Term Actions

Zero-Emission Trucks (ZET) can be deployed in the Gateway Cities I-710 region if both public and private stakeholders take action now to accelerate ZE technology commercialization.
Why Are We Doing ZETs?

• Adopting trucks with zero emission technology is really an effort to **improve air quality and health outcomes** for everyone living and working in the Gateway Cities and beyond
  – Support economic growth in the future
  – Reduce petroleum dependence
  – Create a better environment for our children and grandchildren

• The Gateway Cities and Los Angeles County Metropolitan Transportation Authority (Metro) charged CALSTART with assessing the commercial viability of zero-emission drayage trucks (ZET). This Commercialization Study is one component of the *Gateway Cities Technology Plan for Goods Movement*. 
Are ZE Drayage Trucks Possible? YES!

What will it take?
What will it take to make zero emission trucks (ZETs) a viable option for drayage companies? CALSTART asked truck makers and industry leaders, and came up with these 5 critical steps:

1. Initiate a focused truck development effort to move prototype designs toward production
2. Plan, develop and roll-out infrastructure for recharging and refueling the trucks
3. Work with Federal, State, and Local agencies to develop guidelines for ZETs
4. Define the business case, ownership models and incentives to make ZET solutions cost-effective and
5. Build supporting markets for zero-emission technologies for vehicles other than drayage trucks
Some Key Performance Parameters

<table>
<thead>
<tr>
<th>Key Performance Parameter</th>
<th>Baseline Values</th>
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</thead>
<tbody>
<tr>
<td>Daily Range</td>
<td>Up to 200 miles.</td>
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<tr>
<td>Distance per trip</td>
<td>40 miles, for example from the ports to the Inland Empire.</td>
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<tr>
<td>Number of turns per day</td>
<td>3 is typical, 4-5 on a good day</td>
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<tr>
<td>Refueling interval</td>
<td>Baseline 2-4 days for diesel, daily for LNG. Varies greatly on number of turns daily and the container destinations.</td>
</tr>
<tr>
<td>Fuel economy</td>
<td>4.5-5.5 MPG is typical; some new trucks up to 8 MPG.</td>
</tr>
<tr>
<td>Range per tank of diesel</td>
<td>400 miles typical for diesel trucks</td>
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<tr>
<td>Availability of refueling infrastructure</td>
<td>On-site refueling is best, either through depot fueling infrastructure or a contractor traveling to the yard to fill up the trucks. Otherwise centralized infrastructure is important.</td>
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</tbody>
</table>

- Capability to do any delivery task like a current diesel truck
- Pulling power to do any task (approx. 350-400hp, 1200+ ft-lbs)
- 50 miles Zero Emission Range; Total range 100+ (pref. 200+) miles
Technology Option 1
Range Extended Electric Vehicle (REEV)

The “Chevy Volt of Trucks”

- Electric drive with engine backup – Natural Gas, Diesel, Turbine
- ZE much of the time; very low emissions otherwise
- CA funded demo projects
Technology Option 2
Battery EV (BEV)

The “Nissan Leaf of Trucks”

- Zero Emissions all the time
  - Only battery power; no engine
  - ~100 mile range per charge
- Some Smaller BEV Trucks are Available Right Now
Technology Option 3
Fuel Cell Range Extended EV (REEV)

The “Honda Clarity of Trucks”

- Zero Emissions all the time – hydrogen fuel with batteries
- Produces only water
PROMISE of Payback

- Our initial analysis shows the promise of acceptable ROI, but needs more study – verify assumptions and estimates
- CNG REEV, then FC REEV, then BEV esp. for short routes

### Summary of Business Case Analysis Results

Source: CALSTART

<table>
<thead>
<tr>
<th></th>
<th>Total Range (ZE Range)</th>
<th>Daily Driving</th>
<th>Simple Payback Period (years)</th>
<th>Incentive for 5-year Payback Period</th>
<th>10-yr. O&amp;M savings</th>
<th>2020 Truck Incremental Cost ($ per truck)</th>
<th>Infrastructure Cost ($ per truck)</th>
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<tbody>
<tr>
<td>#1 BEV</td>
<td>100 (100)</td>
<td>100</td>
<td>17</td>
<td>$87,708</td>
<td>$67,798</td>
<td>$100,000</td>
<td>$25,000</td>
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<td>#2L CNG REEV</td>
<td>200 (50)</td>
<td>100</td>
<td>13</td>
<td>$42,983</td>
<td>$43,051</td>
<td>$60,000</td>
<td>$8,400</td>
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<td>Low Utilization</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>#2H CNG REEV</td>
<td>200 (50)</td>
<td>200</td>
<td>7</td>
<td>$20,692</td>
<td>$74,507</td>
<td>$60,000</td>
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<tr>
<td>#3L Fuel Cell REEV</td>
<td>200 (200)</td>
<td>100</td>
<td>16</td>
<td>$23,808</td>
<td>$14,907</td>
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What are the Challenges to Commercialization

Zero-Emission Trucks (ZET) can be deployed in the Gateway Cities I-710 region if both public and private stakeholders take action now to accelerate ZE technology commercialization.

BUT HERE’S WHAT WE KNOW HAS TO BE ADDRESSED

• Truck owner/operators need “all-purpose” drayage trucks able to do anything a conventional diesel truck can do.
• Truck OEMs need to see the business case for building zero-emission trucks
• Infrastructure has to be planned and built in parallel
Meeting the Needs & Challenges

The main driver for the accelerating development of clean truck technology is proving the value for all three major stakeholders:

• The **drayage operators**: Focused on operating costs and fuel savings;

• The **truck OEMs**: Potential sales and profits from building zero-emissions trucks

• **The Gateway Cities sub-region**: Reducing the negative health impacts from dirty air and enjoy economic growth in the future
Actions We Must Take

• The commercialization process will require an aggressive and collective effort by both the private and public sector.

• 5 critical steps:
  1) Initiate a focused truck development effort to move prototype designs toward production
  2) Plan, develop and roll-out infrastructure for recharging and refueling the trucks
  3) Work with Federal, State, and Local agencies to develop guidelines for ZETs
  4) Define the business case, ownership models and incentives to make ZET solutions cost-effective
  5) Build supporting markets for zero-emission technologies for vehicles other than drayage trucks
710 Zero Emission Drayage Truck Commercialization

**Users**
- User Reqs for Vehicles
- Assess and Validate Demo Vehicles
- Assess and Validate Pre-Pro Vehicles
- Assess and Validate Prod Intent
- Phased-in Purchase and Operation

**Technology Info Sharing**
- Fleet & Maintenance Training

**Truck OEM Advisory Council**

**Infrastructure**
- Infrastructure Assessment/Planning
- Pilot Stage Infrastructure Deployment - Evaluation
- Full Scale Infrastructure Installation

**Tech/Vehicles**
- Targeted Demonstration of Zero-Emission Pathway Trucks/Tech
- Pre-Production Vehicles
- Production Intent Vehicles
- Early Production Deployment
- Production Ramp-up / Phase-In

**Backstop Regulations - Funding Mechanisms (Demonstration; Incentives; Leasing)**

**Assess Alternate Funding/Owner Models; Business Case for ZE Drayage**

**Develop Reqs and Business Case**

**Build out early ZE uses, infrastructure and “Nodes”**

**Saturate region with ZE vocational; launch deployment of ZE yard hostlers**

**Incentives for purchase, use of low NOx and ZE drayage**

**Funding to support ZE Drayage production, phase in**

I-710 Zero-Emission Drayage Truck Commercialization & Phase-In Process

**Stage 1**
- Develop Infrastructure Plan
- Targeted ZE Drayage Demos
- Enabling tech
- Business Case Refinement
- Support Additional ZE Markets
- OEM Council
- ZE Yard hostlers

**Stage 2**
- Pre-Production ZE Drayage Trucks; Deploy Infrastructure; Expand Supporting Markets
- Assess Pre Production ZET; Expand Infrastructure
- Install pilot infrastructure
- Expand ZE vocational deployments
- Regulations or Requirements Established

**Stage 3**
- Assess Pre Production ZE
- ZET Pre-Production
- ZET Pre-Production
- User Incentives
- Assess

**Stage 4**
- ZE Drayage Truck Production & Ramp-Up
- Stage 4
- Stage 3
- Stage 2
- Stage 1
- Early Production Wave 1
- Final infrastructure deployment
- ZE Truck Incentives, Operational Requirements Phase in

- Fleet, maintenance training
- Production Ramp-up – Phase-In

How Do We Get There? What Will It Take?
Near Term Actions

• Expand Technology
  – ZET Demonstration Projects
  – Supporting Technologies Demonstrations
  – Advanced Infrastructure Demonstrations
  – ZE Yard Hostler Demonstrations

• Plan and Develop Infrastructure
  – Fuel Infrastructure Availability & Impact Study
  – Infrastructure Deployment Plan
How Do We Get There? What Will It Take?  
Near Term Actions

• Business Case and Operational Model
  – Analysis of ZET Operation and Maintenance Costs
  – Assessment Report of Secondary Use Markets and Residual Value of ZET
  – Refine Specific ZET Operational Cycle from Origin-Destination Data
  – Detailed Business Case Development for ZET
  – Assessment of Ownership Models Supporting ZET Use
  – Organize and operate a Truck OEM Advisory Council
  – Organize and Stage Regular Fleet Workshops on ZET Tech and Operations
How Do We Get There? What Will It Take?

Near Term Actions

• Build Supporting Markets
  – Accelerate early deployment of existing ZE trucks in Gateway Cities and Ports region
  – Coordinate targeted incentive funding from regional, state and federal partners for early deployment
  – Research, Determine and Evaluate Markets for Wider ZET Use and Deployment
  – Collaborate with regional and state regulators to guide and establish policy for use of ZET
Conclusion

Zero-Emission Trucks (ZET) can be deployed in the Gateway Cities I-710 region if both public and private stakeholders take action now to accelerate ZE technology commercialization.

We Look Forward to Working With You Making This Future a Reality
CALSTART
Clean Transportation Technologies and Solutions