Goods Movement Webinar: Overview of Near- & Zero-Tailpipe Emission Freight Transport Technologies

Call-in number: 1-866-299-3188; Passcode: 415-972-7418#

1. **Welcome and Introductions:** Trina Martynowicz, Trucking Sector Lead, U.S. EPA Region 9
2. **Overview of the Freight Technology Symposium:** Henry Hogo, Assistant Deputy Executive Officer, Mobile Source Division, Science and Technology Advancement, South Coast Air Quality Management District- see PowerPoint (PPT)
3. **Trucking**: Joe Calavita, CA Air Resources Board (ARB)- no PowerPoint
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5. **Ports Cargo Handling Equipment, harbor crafts, tug boats and ocean going vessels:** Renee Moilanen, Port of Long Beach and Kevin Maggay, Port of Los Angeles- no PPT; see presentations from April Symposium for more information
6. **WCC Update, including the National and Tribal DERA RFP:** Penny McDaniel, Co-Lead, WCC, U.S. EPA Region 9
7. **General Updates from You!**

Freight Technology Symposium Agenda and PPT's: *www.aqmd.gov/tao/Conferences Workshops/ZeroEmissionFreightForum/ZeroEmissionFreight_Agenda.htm*

We encourage you to provide any feedback, thoughts, and suggestions to contact the Trucking Sector Lead at Martynowicz.Trina@epa.gov

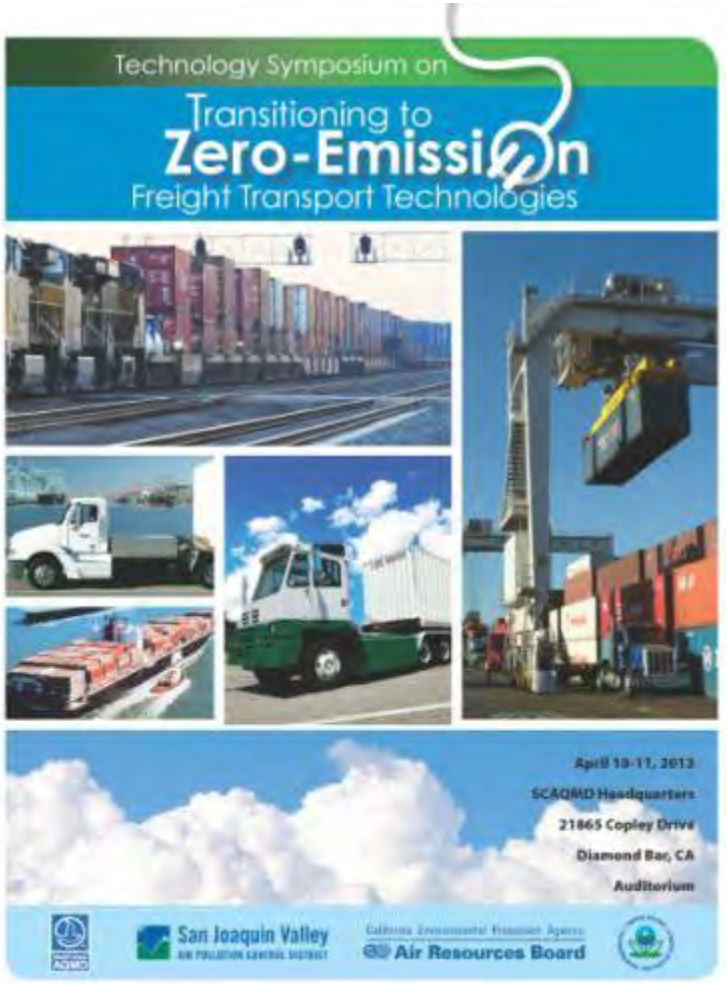
Overview of "Transitioning to Zero-Emission Freight Transport Technologies" Symposium

West Coast Collaborative Goods Movement Webinar #1

May 21, 2013

Overview

- Two-Day Symposium on Zero- and Near-Zero Emission Technology Development – April 10-11, 2013
- Jointly Hosted – South Coast AQMD, San Joaquin Valley APCD, CARB, U.S. EPA
- ~200 Attendees Over 2-Days



Overview

- Objectives
  - Discuss Status of Advanced Zero- and Near-Zero Emission Technologies for Goods Movement
  - Speakers Asked to Focus on Status, Challenges to Commercialization, and Timelines for Commercialized Products
- Technology Discussions –
  - On-Road Trucks/Yard Hostlers
  - Locomotives
  - Cargo and Other On-Port Equipment
  - Marine Vessels

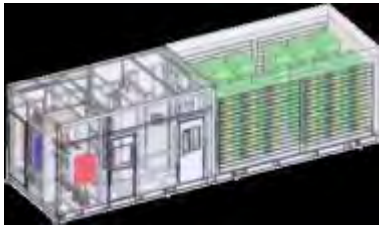
Day 1

- Host Organizations Opening Remarks
- Focus on On-Road Trucks/Yard Trucks
  - Battery Electric
  - Fuel Cell/Hybrid
  - Natural Gas/Hybrid
  - Extended Range Catenary/Wayside
  - Alternative Fuels/ Going Beyond 2010 On-Road Emission Standards

Day 2

- Locomotives
  - LNG Locomotive Development
  - Battery/Hybrid Locomotive Development
  - Electric/Overhead Catenary Experience
  - Linear Drive Technologies
  - Battery Tender Concept
  - Fuel Cell Locomotive

IORE Loco, Sweden



HXD3 China

Day 2

- Cargo Equipment, and Other On-Port Vehicles and Equipment
  - Activities at Ports of Long Beach and Los Angeles
  - Current Technology Deployment
  - Technology Advancement Program
  - Operational Efficiencies

Day 2

- Marine Vessels
  - Shorepower
  - “Hood” Technologies
  - Vessel Speed Reduction
  - Low Sulfur Marine Fuels
  - Propulsion Engines
    - Sea Water Scrubbers
    - Slide Valves
    - SCR

Roundtable Discussions

- Roundtable Discussion at End of Each Day
- 1st Day Panelist – SCAQMD, SJVAPCD, CARB, CEC, U.S. EPA, U.S. DOE
- 2nd Day Panelist – SCAQMD, SJVAPCD, CARB, CEC, U.S. EPA, Ports
- Discussions –
  - Incentive Funding Needs
  - Opportunities for Collaboration

Goods Movement Webinar: Overview of Near- & Zero-Tailpipe Emission Freight Transport Technologies

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Summary of Advanced Freight Locomotive Emission Reduction Technologies

(Freight Technology Symposium – April 10-11, 2013)

GE Battery Hybrid Locomotive

West Coast Collaborative – Conference Call

(May 21, 2013)

California Environmental Protection Agency

Air Resources Board

Brief Background

- California Locomotive Emissions
- North American Freight Rail Operations
- North American Freight Locomotives

California Locomotive Emission Inventory

(2010 - tons per day)

AIR BASIN	NOx	PM
Mojave Desert	26	1.2
South Coast	20	0.9
San Joaquin	20	0.6
Sacramento	17	0.5
Bay Area	11	0.3
Rest of the State	*22*	*1.0*
Statewide Total	**116**	**4.5**
% of Statewide Mobile Sources	**4.6%**	**2.7%**

Interstate line haul: 85 percent. Passenger: 10 percent. Switchers: 5 percent.

Current U.S. EPA Line Haul Locomotive Emission Standards (g/bhp-hr)

Standard	NOx (g/bhp-hr)	Percent Reduction	PM (g/bhp-hr)	Percent Reduction
In-use/pre-Tier 0	13.5		0.32*	
Tier 0/Tier 0+	9.5-7.4		0.60-0.22	
Tier 1-Tier 1+	7.4		0.45-0.22	
Tier 2 (2005-2011)	**5.5**		**0.2**	
Tier 3-Tier 2+ (2012-2013)	Same as Tier 2		0.1	
Tier 4 (2015)	**1.3**	**85-90%**	**0.03**	**90%**

* Note: PM standard is 0.6 g/bhp-hr, but average in-use PM emission levels are about 0.32 g/bhp-hr.

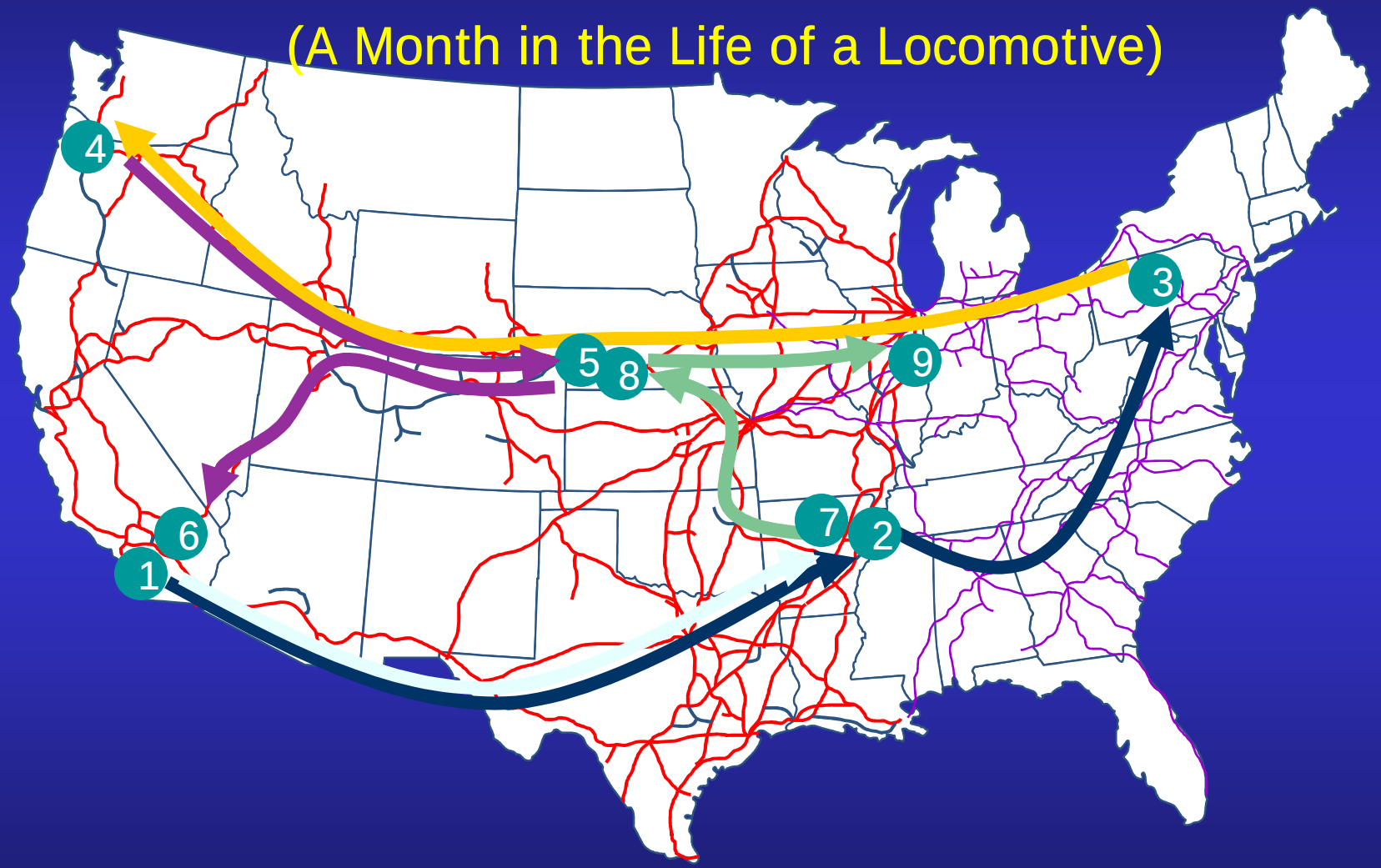
The North American Freight Rail System

Number of North American Interstate Line Haul Locomotives

- Seven Class I U.S. Freight Railroads:
  - 25,000 total locomotives
- UP and BNSF:
  - 15,000 total locomotives
  - 10,000 interstate line haul locomotives (ILHs)
    - 8,000 ILHs enter-exit California
    - 7,000 ILHs enter-exit South Coast Air Basin (2012)

The Dynamic Operations of an Interstate Line Haul Locomotive

(A Month in the Life of a Locomotive)



California's Intrastate Locomotives

(can operate up to 90% or more of the time in-state)

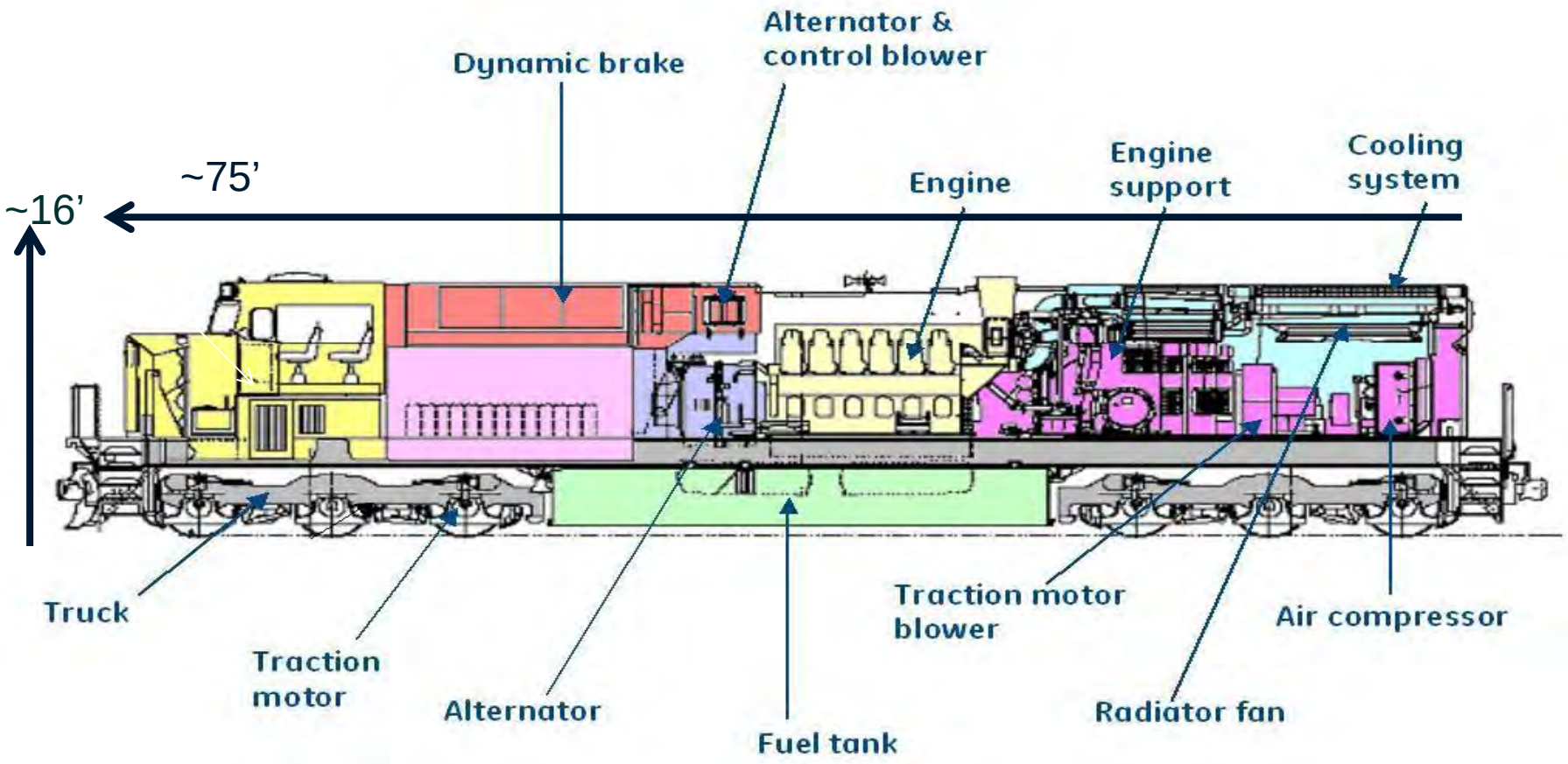
- UP and BNSF: 440
- Passenger: 130
- Shortlines: 150
- Military-Industrial: 50
- TOTAL: ~770*

* Can contribute up to 15 percent of statewide locomotive emissions.

Key Differences

U.S. and European Freight Locomotives and Trains

U.S. Diesel-Electric Freight Locomotive



Courtesy of General Electric (GE)

U.S. Diesel-Electric Freight Locomotive

- Built for pulling power – at lower speeds
  - Max. speed: 70 miles per hour
  - 4,400 horsepower - six axles
  - Starting Tractive Effort: ~190,000 lbs/force
  - Capital Costs:
  - Tier 2 = ~$2 million. Tier 4 = ~$3.3 million

U.S. Diesel Freight Trains

- Range: 5,000 to 25,000 tons. 50-150 rail cars.
- Coal: 15,000-25,000 tons.
- Manifests: 5,000-15,000 tons
- Intermodal: 5,000-12,000 tons.

Distributed Power Units (DPUs)

- By 2010, up to 75 percent of freight trains are DPUed
- Fewer and longer trains with newer and more fuel efficient locomotives
- Helper locomotives have been nearly eliminated
- Significant fuel savings

European Freight Locomotives & Trains

- Built for speed to coexist with passenger trains
  - Speeds: 90 to 150 miles per hour.
  - Train-miles: 50% electric. 50% diesel.
  - Interoperability issues between countries
  - Many rail operations intra-country, shorter distances
- Starting Tractive Effort: 70,000- 90,000 lbs. of force.
- Typical train tonnage: 1,000 to 6,000 tons

Deutsche Bahn DBAG Class 152 pulling a freight train

Brief Summary

Locomotive Session
Freight Technology Symposium
April 11, 2013

Caterpillar and Electro-Motive Diesel (EMD)

(Development of LNG Line Haul Freight Locomotive)

- Potential benefits:
  - Current price differential with diesel
  - Technically feasible
  - Potential progress on locomotive emissions
- Potential challenges:
  - 40% less energy content, and the need for tender cars
  - Operational challenges
  - Fuel infrastructure and locomotive related costs

General Electric (GE) Concept for Battery-Hybrid Locomotive

- 2007 GE prototype
- GE concept for sodium-nickel batteries in locomotives
- Potential for zero-emission miles

General Electric and Transpower Concepts for a Battery-Tender Car

- Store batteries in a “tender car”.
- Operate within a region, zero-emission miles
- Operational challenges, and large capital costs

Sweden's LKAB Iron Ore (IORE) All-Electric Freight Train

- Largest electric heavy hauler in Europe
- Paired-set: two all-electric freight locomotives
  - Combined Tractive Effort: 260,000 lbs of force
  - One U.S. Tier 2 diesel tractive effort: 190,000 lbs of force
- Total Tonnage: 9,500 tons with 68 rail cars.
- Maximum Speed: 50 mph.
- Paired-Cost: ~$18 million

Dual-Mode Passenger Locomotive

- New Jersey Transit – Bombardier – ALP-45DP
- Electric and diesel-electric power plants
  - Electric: 125 mph. Diesel-electric: 100 mph.
- Starting Tractive effort: 71,000 lbs. of force.
- Cost: $10-$12 million per unit.

Concept for a Solid Oxide Fuel Cell/Gas Turbine (SOFC/GT) Locomotive

- Could significantly reduce locomotive emissions
- Potential for high thermal efficiencies (up to 70%)
- Internal reformer allows the use of many fuels to convert to H_2.
- 1000^{o} C fuel cell operating temperature
- More effective at steady-state operations

Contact Information

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- Email: hholmes@arb.ca.gov
- ARB Railyard Website:

  http://www.arb.ca.gov/railyard/railyard.htm

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