Opportunities for Technology and Fuel Advancement Under AB 118

Advanced Transportation Technologies

Clean Transportation Solutions SM

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AB 118 Workshop

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Mission Statement

CALSTART is dedicated to the growth of an advanced transportation technologies industry that will:

- **Create high-quality jobs;**
- **Clean the air;**
- **Increase energy efficiency; and**
- **reduce global warming.**

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CALSTART: A Strategic Broker for Advanced Transportation

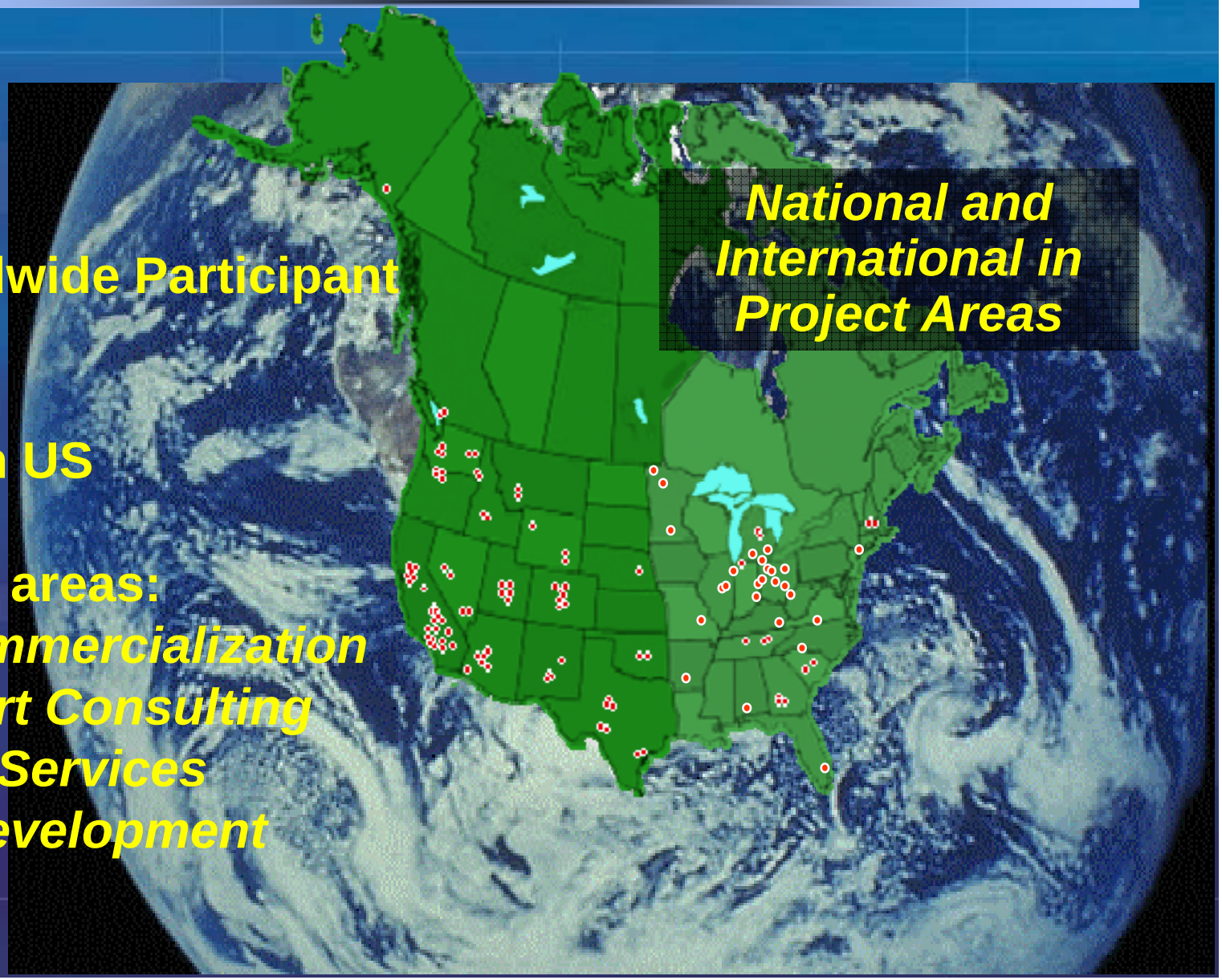
2009

130+ Worldwide Participant Network

3 Offices in US

Four focus areas:

- ***Tech Commercialization***
- ***Fleet, Port Consulting***
- ***Industry Services***
- ***Policy Development***



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There is no “Silver Bullet” – no single technical or fuel solution that exists today

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The Area for Focus in Transportation

Air Quality

Balances all three competing needs

Integrated Solutions Needed

Energy Security

Climate Change

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CALSTART's Technology Commercialization Focus Areas

Clean More-Efficient Vehicles

Hybrid Truck Users Forum (HTUF)
H2 Bus Program
NGV Cooperative
Electric Drive Strategic Plan
Hydraulic Hybrid Bus Demo
GHEV Assessment & PHEV Study
Energy Storage

Clean Lower Carbon Fuels

H2 Infrastructure
E85 Network Development
SJV Biogas Demo
Biogas Economic Assessment
Biofuels Status Whitepaper

Technology Commercialization

Identifying opportunities, building teams, securing funding, and advancing technology, vehicles, fuels, and systems

Integrated Mobility

(VMT reduction, Enhanced transit)

MyGo Pasadena
Bikestation Seattle
Mobility Industry Group
Pasadena Sustainable City

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Pace of Climate Change Faster Than Estimated

- Industrial greenhouse gases (GHGs) increasing faster than expected – some from coal in developing world
- Natural systems not able to absorb as much carbon as originally thought – ocean becoming saturated
- "Feedback" mechanisms accelerating GHG increase – permafrost melting releases CO2, methane, occurring faster than expected
  - *Christopher Field, founding director of the Carnegie Institution's Department of Global Ecology at Stanford University*

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Stimulus/Recovery Bill Targets $1.2B+ for Clean Vehicles, Fuels

- House and Senate Stimulus/Recovery Bills reconciled, soon heading to Pres. Obama's desk
- CALSTART has recommended language to encourage rapid use of funds to seed vehicle deployments
- Funding for transportation includes:
  - $300M for Diesel Emission Reduction (DERA) activities through EPA
  - $400M for Alternative Fuel Vehicles, Infrastructure through Clean Cities/DOE
  - $300M for government clean fleet purchase
  - $200M for electric drive demonstrations
  - $3.5B for Energy Efficiency projects, includes transportation
  - Additional $2.5B for advanced energy storage, including vehicles
- State funds can leverage and could focus federal funds
- CALSTART sees great opportunity for clean transportation despite economic turmoil

SUMMARY: AMERICAN RECOVERY AND REINVESTMENT

The economy is in a crisis not seen since the Great Depression.

Credit is frozen, consumer purchasing power is in decline, in the last four months the country has lost 2 million jobs and we are expected to lose another 3 to 5 million in the next year.

Conservative economist Mark Zandi was blunt: "the economy is shutting down."

In the next two weeks, the Congress will be considering the American Recovery and Reinvestment Bill of 2009. This package is the first crucial step in a concerted effort to create and save 3 to 4 million jobs, jumpstart our economy, and begin the process of transforming it for the 21st century with $275 billion in economic recovery tax cuts and $550 billion in thoughtful and carefully targeted priority investments with unprecedented accountability measures built in.

The package contains targeted efforts in:

- Clean, Efficient, American Energy
- Transforming our Economy with Science and Technology
- Modernizing Roads, Bridges, Transit and Waterways
- Education for the 21st Century
- Tax Cuts to Make Work Pay and Create Jobs
- Lowering Healthcare Costs
- Helping Workers Hurt by the Economy
- Saving Public Sector Jobs and Protect Vital Services

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AB118 Framework Observations

- Staff has done good job outlining investment framework and general intent/metrics
- Timely Implementation, Near Term Successes – must start turn around for carbon reduction, show value of state investments
- Take Balanced Approach: fund projects across near, medium and long term portfolio
  - Likely that most 2020 solutions *build bridge* to 2050
- Encourage Innovation: set goals for industry to achieve and encourage best approaches with real potential, rather than determine absolute categories
- Retain Flexibility: set targets for funding but keep ability to shift to highest benefit, innovative projects

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Hybrid Truck Users Forum (HTUF)

- **User-driven process** to commercialize medium- and heavy-duty hybrid trucks in the U.S.
- Joint WestStart-U.S. Army program (RDECOM-TARDEC-NAC)
  - Also supported by Hewlett Foundation, DOE
- HTUF focuses on commercializing hybrid trucks with dual-use benefits – pre-production
  - Speed commercialization and reduce overall costs by creating common fleet requirements, joint purchase commitments, increasing volumes

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Timeline to Commercialization: Hybrid Tech Now Entering Market

Hybrid introduction 10 years behind cars but industry is real, momentum growing; but economy may cripple or delay industry without help

Development
Test prototypes and systems

Pre-Production
Field pilot assessments (10-50 vehicles)

Production Intent
Assembly line builds up to 100+

Early Production
Initial commercial volumes – still high incremental cost

TOOLS:

R&D Support →

Purchase Incentives →

Pre-Production Deployment Support (HTUF) →

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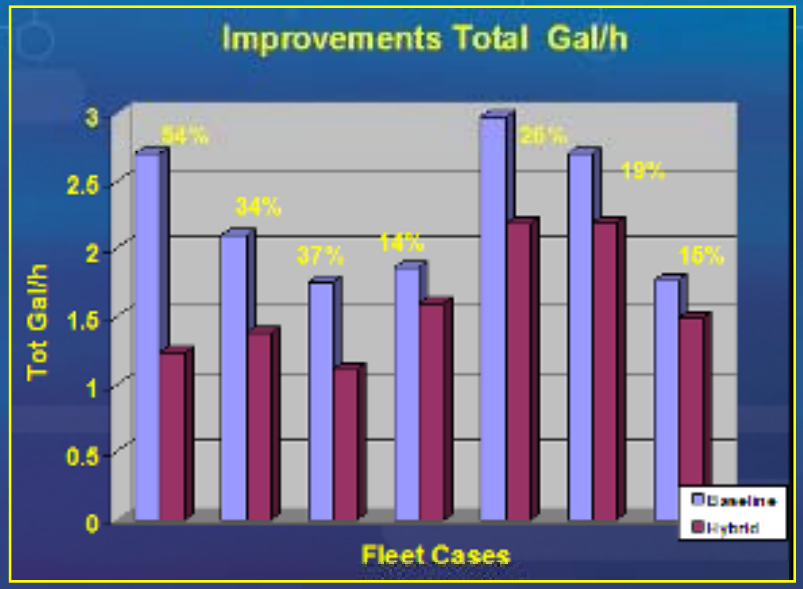
Hybrid and High Efficiency Truck Technology is Critical to CA, U.S.

- **Hybrids provide significant immediate benefits**
  - **ENERGY SECURITY: Reduced fuel consumption (30-50%)**
  - **EMISSIONS/CLIMATE: Reduced criteria (NOx) and GHG emissions (10-60%)**
    - **One of few strategies to improve on 2010 emissions reductions**
  - **ECONOMY: North American leadership in technology, manufacturing – Green Jobs of today and tomorrow**



Fuel consumption reduction from HTUF field testing data

Reductions come just from hybrid system, no additional after-treatment

CO2 reductions closely tracked fuel reduction percentages

Emissions/fuel reduction from HTUF dyno testing data performed at SwRI

TABLE 10 AND FIGURE 9. PERCENT DECREASE IN RATE OF EMISSIONS (g/hr) AND PERCENT INCREASE IN FUEL ECONOMY (mpg) OBTAINED BY USING THE HEV TRUCK COMPARED TO THE BASELINE USING FOUR EATON-SPECIFIED MISSION CYCLES

Mission Cycle ID (given in Table 8)	HC (g/mi) %	CO (g/mi) %	NOx (g/mi) %	PM (g/mi) %	Fuel (mpg) % (increase)	Miles Driven	Hours of Operation (hydraulic + electric)
A	58	50	34	25	68	70	1.5
B	73	94	34	34	80	70	4.5
C	78	73	61	37	139	48	3
D	80	74	58	32	150	38	3

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Hybrid Medium Duty Trucks Expand to Both New & Heavier Applications

- Navistar extends weight class from 23,500 to 37,000 lbs (into Class 8 range)
  - 6 engine horsepower/ torque combinations
  - Showcases hybrids for tree-trimming, wrecker, dump, crane and beverage
- Peterbilt adds dump truck variant to cargo and utility body
- Freightliner shows M2 delivery and beverage bodies, new bus and RV platforms!

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Hybrid Tractors Emerging for Regional Heavy Applications

- Kenworth unveils Class 7/8 hybrid tractor: 54,500 lbs GCVW
- Peterbilt has similar model – also continuing to test larger Class 8 heavy-duty OTR tractor
- Navistar unveils Class 7/8 hybrid tractor targeting beverage trailer applications
- Freightliner announces will pilot build a hybrid tractor Dec 08

Above: Kenworth Class 8 tractor;
Below: Navistar Class 7/8 tractor

Left: Freightliner Class 7/8 tractor pilot; right, Peterbilt Class 7/8 tractor

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Wal-Mart Class 8 Demo

- ArvinMeritor – Navistar deliver unique dual-mode hybrid design for testing
- Electric drive at lower speeds (up to 48 mph), blended mode at higher speeds
- Can greatly reduce fuel use, cut idle and give zero emission at ports, urban driving
- Wal-Mart testing this truck and several Peterbilt-Eaton trucks in line-haul and regional heavy haul applications
- Wal-Mart committed to doubling its fleet fuel efficiency by 2015

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Electric "Reefer" Units Emerging with Hybrid Systems

- Navistar, Freightliner and Azure show electric refrigeration units – "reefers" and cold plates - combined with hybrids or energy storage
- Further reduces fuel burn, eliminates additional engine, cuts criteria and carbon emissions

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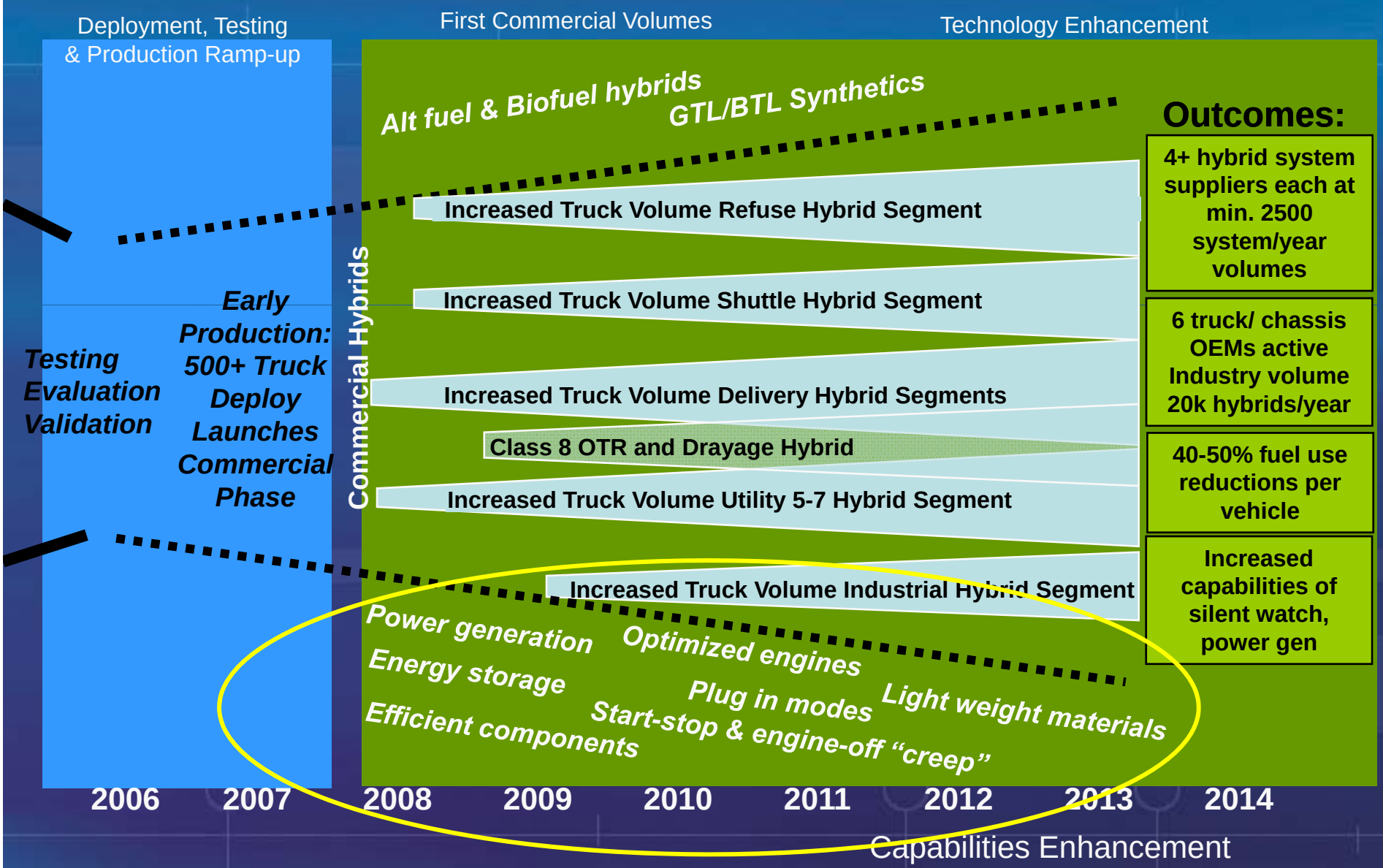
HTUF: From Hybrids to More Efficient Trucks



Transit H_2 Pathways Strategy – Harmony of Technical & Commercial Goals

System Developments

Direct Path Projects

Evolutionary Path

Component Path

40' Bus

Components Development

- Durability – 4 to 6 Years/ 20,000 to 30,000 hours
- Reliability >90% Available
- Bus Cost – <5x Comparable Size Transit Bus
- Fuel Efficiency – 2x Comparable Transit Bus
- Emissions – Exceed 2010 EPA Standards
- Enhance Public Acceptance

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CALSTART National Fuel Cell Bus Programs - H_2 Strategy at Work

Direct Path Projects
- Full Scale FC, Systems

Evolutionary Path Projects
- Small FC, ICE, Hybrids

40' Bus

Component Path Projects

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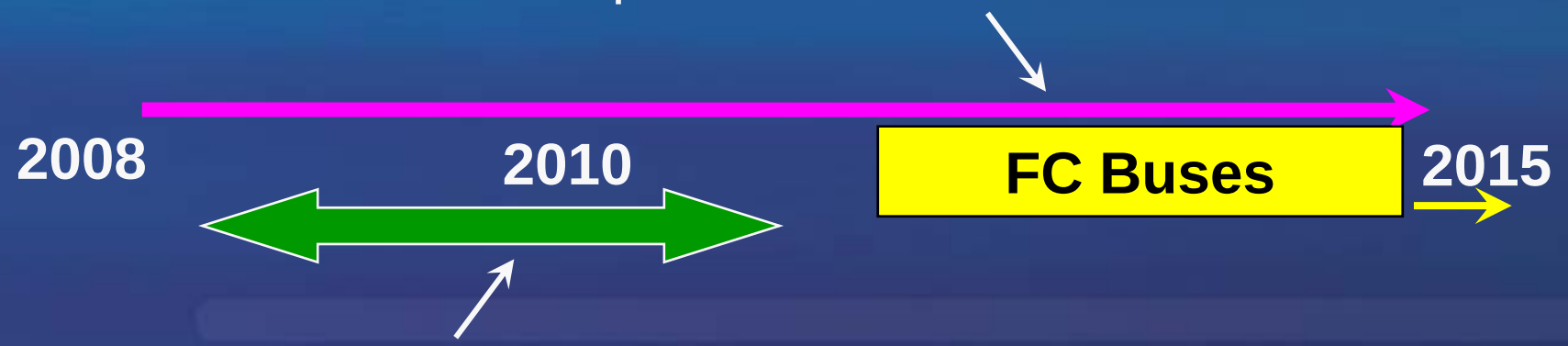
Low Carbon, Near and Zero Emission Transit

Transit Agencies using Alternative-Fuel

- Requires purchase of zero emission buses
- Fuel cell, battery or trolley buses
- 15% of all new procurements in 2012-2026



- CALSTART formed Z-TUG to assist Transit Agencies
  - Demonstrate low carbon, zero and near zero emissions tech
- User-Driven needs, requirements for compliance
- Demonstrations, in-service trials
- Seek <u>commercial solutions for the market</u>

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Bus 20-year Preliminary Performance Goals

- **Efficiency**

Current Bus	3.65 mpg diesel
Better Goal	7.3 mpg diesel-equiv (2x current)
Best Goal	11 mpg diesel-equiv (3x current)

- **Emissions**

Current Bus	Meets 2007 HD engine regs
Better Goal	50% better than 2010 HD regs
Best Goal	Zero tailpipe emissions

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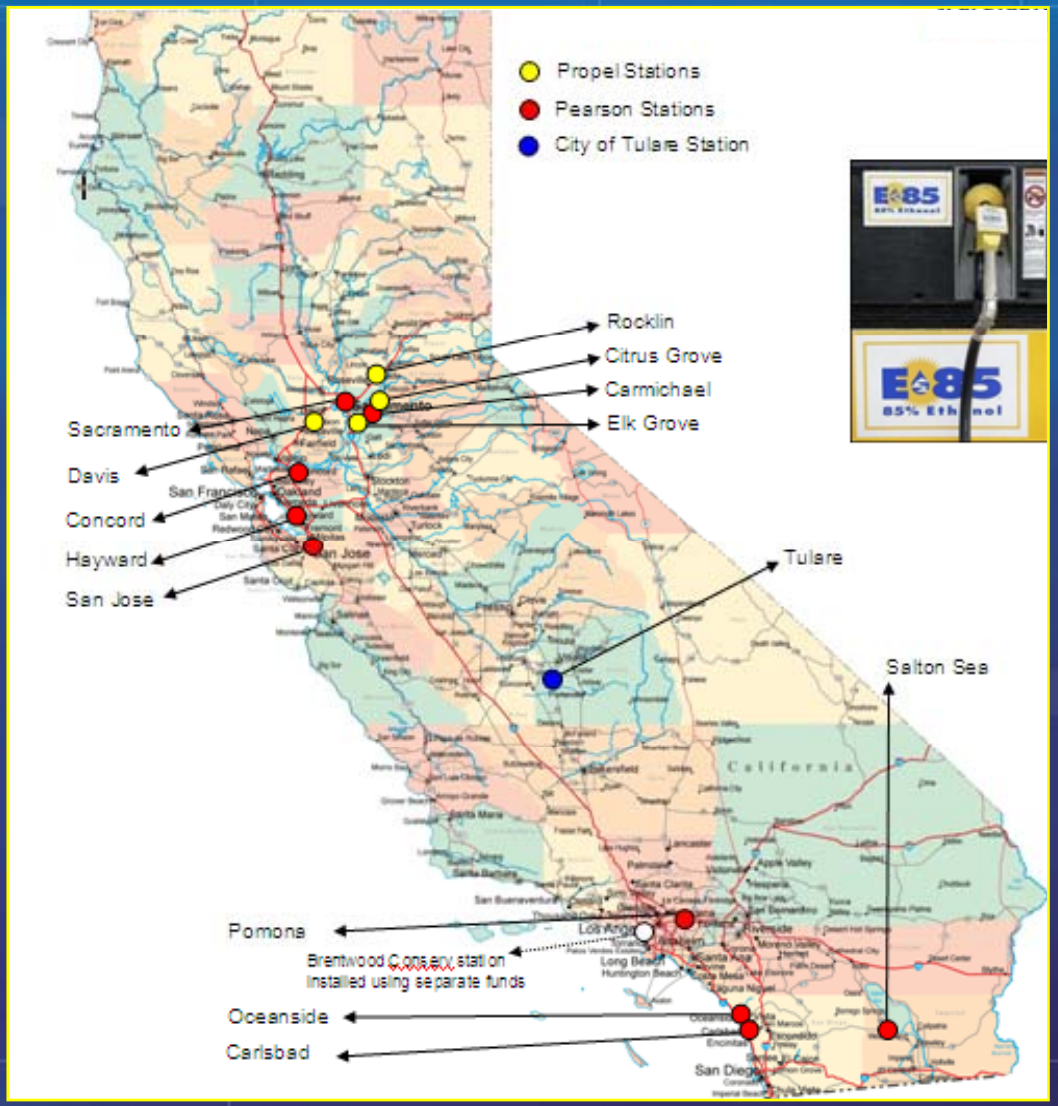
Renewable Roadway Deployment



- 14 retail ethanol E85 stations in California – first real "network" of ethanol in state
- CALSTART managing in coordination with DOE funding, several fuel partners
- Most opening Fall 2008, Spring 2009

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NGV Cooperative

- CALSTART has partnered with Sempra Utilities, SCAQMD, NGV Partnership, other NG stakeholders to create a Natural Gas Vehicle Purchase Cooperative
- Purpose :
  - To coordinate high volume purchase of light and medium duty vehicles by public and private fleets
  - Aggregate large enough numbers to incentivize dealers and manufacturers to not only participate in the Cooperative, but help them expand the market for these vehicles
  - Will assist fleets in "greening" their fleets with cleaner alternative fuel vehicles at affordable prices
  - Targets fleets, dealers within California, Arizona and Nevada, possible expansion to other states

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Possible First Year Approach to Spur Immediate Action

- Hybrid and High-efficiency trucks – speed implementation and tech development for immediate and near and medium term petroleum, carbon reductions
  - Enabling tech for 2050 path
- Zero, Near-zero emission and low carbon transit
- High efficiency natural gas vehicles
- Waste-to-fuel demonstrations, including biogas
- Low carbon retail stations (biofuel, alt fuel, H2)
- Certification/verification assistance

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