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.
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
The Area for Focus in Transportation

- **Balances all three competing needs**
- **Integrated Solutions Needed**
- **Air Quality**
- **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
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
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
• 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
Hybrid introduction 10 years behind cars but industry is real, momentum growing; but economy may cripple or delay industry without help.
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

CO2 reductions closely tracked fuel reduction percentages
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!
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

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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
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

**Deployment, Testing & Production Ramp-up**

- **First Commercial Volumes**
  - 4+ hybrid system suppliers each at min. 2500 system/year volumes

**Outcomes:**

- **Increased Truck Volume**
  - Refuse Hybrid Segment
  - Shuttle Hybrid Segment
  - Delivery Hybrid Segments
  - Industrial Hybrid Segment

- **40-50% fuel use reductions per vehicle**

**Technology Enhancement**

- 6 truck/chassis OEMs active Industry volume 20k hybrids/year

**Increased capabilities of silent watch, power gen**

**Capabilities Enhancement**

- Power generation
- Energy storage
- Efficient components
- Optimized engines
- Plug in modes
- Start-stop & engine-off “creep”
- Light weight materials
Transit H$_2$ Pathways Strategy – Harmony of Technical & Commercial Goals

- 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
CALSTART National Fuel Cell Bus Programs - H₂ Strategy at Work

Direct Path Projects
- Full Scale FC, Systems

Evolutionary Path Projects
- Small FC, ICE, Hybrids

Component Path Projects

40’ Bus

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IAM
BDC
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 commercial solutions for the market
# 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
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
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.
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
Clean Transportation Solutions™

Advanced Transportation Technologies™

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