State & Local Action to Build Clean Transportation Tech Industry

CALSTART Headquarters
What I want to talk about today

- The urgency of why we are here
- Wayne Gretsky and the jobs topic
- Reasons for optimism
- Specific suggestions for joint action
CALSTART Investor Council (CIC)

Prelude Ventures

Capricorn Investment Group

Wells Fargo

Global Environment Fund

Linse Capital
### CALSTART Overarching Goal:
*Clean air for all; prevent climate change; clean transportation tech industry dominates*
*Speed commercialization of clean transportation technologies*

#### These are our focus areas:

#### This is the work we do:

<table>
<thead>
<tr>
<th>Activities Areas</th>
<th>CARS</th>
<th>BUSES</th>
<th>TRUCKS &amp; Non-Road</th>
<th>FUELS</th>
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<tbody>
<tr>
<td>Tech. Development &amp; Demonstration</td>
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<td>Tech. Assessment &amp; Validation</td>
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<td>Policy Development &amp; Support</td>
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<td>Industry Services</td>
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The Greenhouse Effect

Some sunlight that hits the earth is reflected. Some becomes heat.

CO₂ and other gases in the atmosphere trap heat, keeping the earth warm.
USA – What % of World’s Population and What % of Daily GHG Generation?
Now in time of dynamic change: 30+ Years of Continuous Improvement Needed.
If It Was Only About Jobs What Would We Do?

• Wayne Gretzky: I skate not to where the puck is but where it will be – high efficiency, low carbon transportation is where puck will be Be global technology leaders in vehicle technology, low carbon fuels, and new mobility systems

• Use renewable domestic fuels – keep our transportation energy $’s at home
Suppliers Continue to Back 2025 Federal Standard – No Change Needed

According to a recent survey, 84% of auto suppliers agree that the 2025 standards encourage job growth at their companies.

Source: CALSTART commissioned survey by Ricardo Energy & Environment
According to a recent survey, 95% of auto suppliers agree that more ambitious MPG standards encourage more innovation & investment in the U.S.

www.CALSTART.org
Source: CALSTART commissioned survey by Ricardo Energy & Environment
According to a recent survey by CALSTART, 82% of auto suppliers agree that companies that are leaders in vehicle efficiency technologies will be more successful over the next 10–15 years.

Source: CALSTART commissioned survey by Ricardo Energy & Environment
Leadership at State and City Level Extremely Important Right Now

• Indianapolis has the nation’s largest fleet of electric buses
• Stark Area Regional Transit Authority (NE Ohio) is developing a fleet of fuel cell buses to provide service
• Texas is the nation’s leading producer of wind power
Global Climate Action Summit –
September 12-14, 2018
San Francisco
CALSTART Global Beachhead Workshop
Battery Costs Below 2020 Expectations

- Old forecast: $300/kwh by 2020
- 2014 findings: Industry $410/kwh; leaders at $300/kwh
- New data: leaders <$200/kwh

Nature Climate Change report: http://www.carbonbrief.org(blog/2015/03/electric-vehicle-batteries-already-cheaper-than-2020-projections/
Moore’s Law for Batteries – 30-40% Cost Reduction Every 5 Years?

• Source: Bloomberg New Energy Finance, 10/31/16
Chevy Bolt EV has a real world range of 240 miles on a charge (2017) vs. 50 miles for Gen1 Nissan Leaf in 2011
Electric dreams

Manufacturing capacity forecasts
Gigawatt-hours per year

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<tr>
<th>Company</th>
<th>2017</th>
<th>2020</th>
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<tr>
<td>Panasonic (Japan)</td>
<td>10</td>
<td>50</td>
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<tr>
<td>CATL (China)</td>
<td>20</td>
<td>40</td>
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<tr>
<td>BYD (China)</td>
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<td>30</td>
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<tr>
<td>LG Chem (South Korea)</td>
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<td>20</td>
</tr>
<tr>
<td>Samsung SDI (South Korea)</td>
<td>5</td>
<td>20</td>
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Source: Cairn ERA

*Includes Tesla gigafactory

Major Growth in Global Battery Production Capacity
CALSTART Launches Nation’s First Pilot Training Program Using ZE aircraft
In 2017 – EV 2.0 - 200 Mile Range for $30,000 (USD)/240SK
EV 2.0: Tesla Model 3
Tesla Model 3 – Winning Its Category

Mid sized premium sedans - US market share

- Tesla Model 3
- BMW 3-series
- Audi A4
- Mercedes C class
- Lexus IS
EV’s Compete Well When They Compete

- BoltEV best selling sub-compact in CA
- Tesla Model 3 2nd best selling luxury/high-end sports cars
- OEM’s still not providing full suite of EV’s in all states
- Lack of EV options in most segments
  - Dearth of EV options in SUV/Mini-Van/Pick-up truck segments
States Can Give Awards to Top 5 Employers Who Provide EV Charging for Employees
Natural Gas Engine 90% Fewer NOx Emissions – Trucks and Buses with “Near Zero Emissions” (NZE)

Get Closer to Zero
Dairy Methane Emissions = Big Climate Change Contributor = Opportunity

Goal: Closed Loop System – Ag Trucks Running on Renewable Methane
CA Company – Using Dairy Waste as Feedstock – Will Begin Producing Renewable Natural Gas Next Year – 70 cents/diesel gallon equivalent

Biorem Energy has created a cooperative to

Reduce Fuel costs to less than 10% of operating costs

Increase company profits by an estimated 25%
Low Carbon Fuel Standard

» State level policy
» Sets target for carbon intensity of all fuels sold
» Refiners point of regulation
» Carbon values established for each fuel allows for efficient market trading and outcomes
» Complimentary to federal Renewable Fuel Standard
» Opportunity for Midwest States with major agricultural sectors – new revenue stream for farmers
Strategic Transformation
“Beach Head” Framework

» Identify and leverage key early markets where technology can be successful; use as launching point to then support additional applications

» Success comes from growth of core supply chain, transferring similar powertrain and components

» Beachheads help establish first success cases
  » As technologies mature, they can expand in application and get more affordable

» Each succeeding market builds greater volume
M-HDV Zero Emission Beachhead, Pathways

**BEACHHEAD**
- BEV Transit Bus
- BEV & FC Forklifts
- EV GSE
- Electrification at Terminals, Facilities

**BEV**
- BEV Delivery
- BEV Shuttle, School Bus
- FCEV Transit Bus
- BEV Hostlers

**FCEV**
- Series Drive Engine and FC Range Extender Tech Demos

**BEV & BEV XR**
- M/HD Delivery

**EV, PHEV & EV XR**
- Regional HD

**Electrification at Terminals, Facilities**

**XR** = Extended Range with FC or engine

**XO** = Extended Operations with FC or engine

2017 Steadily Expanding Climate ‘Wedges’ of Increasing Volume, Impact
More Than Twenty Three ZEB Products Across Ten Bus Makers
The Midwest Office is also responsible for supporting the Ohio Fuel Cell activities in conjunction with Ohio State University and GTI; testing, evaluating and demonstrating fuel cell buses.

» OSU is leading a new FTA Low or No Emissions Component Testing Center; testing components, systems and vehicles

» The team brings together world class experts in power electronics, gaseous fuel systems and the largest test track in the nation

» CALSTART is identifying potential technologies and leading ‘Voice of Customer’ activities to keep focus on the needs of the end-users
Federal LoNo Funding Available Now

» Federal Transit Administration is accepting applications now for its Low & No Emission (aka LoNo) bus program

» Approximately $85 million available

» Incentives for deploying in buses in rural areas

» Contact CALSTART’s Fred Silver – fsilver@calstart.org or (626) 744-5687
Volvo Group Announces 2 Electric Truck Products This Year
Cummins Electrified Powertrain

- Class 6-8 delivery, transit bus
- All-electric, downsized engines PHEV and range-extender architecture
Meritor Electric Axle

- Multiple components built around electric drive integrated into axles – no drive shaft
- Range of size and application designs including low floor bus and line haul
- Also electric suspensions, new air brakes
- $26 million investment in TransPower – etruck start-up
- CEO Jay Craig: “You’re seeing part of the Renaissance of Meritor”
• Electric Delivery & Shuttle, Class 4 – more to come
• Ryder to provide service network
Toyota Fuel Cell Truck Demo
What Can States Do To Support ZE Truck and Bus Markets?
VW Settlement Funds Can Play Key Role in Supporting Beachhead Markets

• States should invest funds so they get 3:1 benefits – reductions in smog forming and greenhouse gas emissions and reduced dependence on oil

• Voucher Incentive most efficient way to distribute funds
  – Applications can be completed in 15 minutes
  – Avoid lengthy proposal development/review processes
  – Market driven
CALSTART is Managing Clean Vehicle Purchase Incentive Programs in 3 States
Infrastructure Challenge & Opportunity

Challenges:
• Fleets need help addressing high costs
• More EV charging needed

Solution:
• Utilities need to be in the game
• Use ratepayer funds to under-write % of cost of infrastructure
• Favorable rates

*Regulatory proceedings underway in several states*
CALSTART Utility Change Model

• Pre-application to utility regulatory body – important to bring key stakeholders together
  – National trucks fleets, truck and bus OEM’s, transit fleets, EVSP’s and utilities
  – Identify real world issues and solutions
  – Seek consensus prior to application & organize support for proposal
  – Reach consensus on rates and investments needed

– Contact: Ryan Schuchard rschuchard@calstart.org
CALSTART at ESNA
November 7-8, 2018 at the Pasadena Convention Center

• Co-locate with Energy Storage North America 2018
• Clean Technology Exhibit Vehicle Showcase and Expo Hall
• CALSTART will lead development of mobility track
• 2,000+ Attendees from Around the Globe

www.esnaexp.com
Please join us at ESNA 2018

ESNA 2018 Keynote Speakers

Penny McLean-Conner
Chief Customer Officer, SVP
Evensource Energy

Mary Powell
President & CEO
Green Mountain Power

Maria Rigiati
EVP & CEO
Edison International
What Does a Win Look Like in 2030 or 2050?

- US companies and manufacturing sector strong and healthy because of global technological leadership in vehicle efficiency
- Economy benefitting from elimination of imported oil – all transportation energy produced and used in US
- Clean and health air; emissions related respiratory issues virtually eliminated
- Climate threat has subsided and rest of world appreciates our leadership and role – much like WWII and Marshall Plan
Summary

• Technology is improving and becoming commercially viable
• We are in a race against time
• Policy is an essential driver
• Leadership from US states and cities is critical
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