# AB 118 Recommendations to Kick-Start Hybrid & High Efficiency Electric Drive Trucks




*Advanced Transportation Technologies*

*Clean Transportation Solutions* SM

**Bill Van Amburg**
**Senior Vice President**

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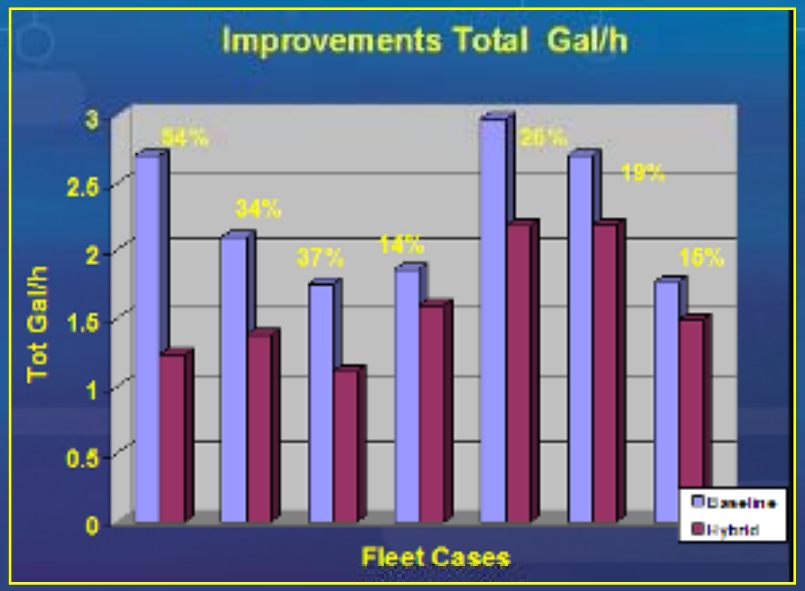
# HTUF National Conference 2008

- **World's biggest hybrid truck and bus ride and drive**
- **Vehicles from Navistar, Freightliner, FCCC, Kenworth, Peterbilt, Azure Dynamics, Bosch Rexroth, Eaton, Dueco-Odyne, Hino, E-One, Arvin Meritor, Crane Carrier,  NABI, JAMMA vehicle**

# Hybrid Truck Technology is Critical to California and U.S.

- **Hybridization provides 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**




*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 |

# Timeline to Commercialization: Hybrid Trucks Now Entering Market

*Hybrid introduction 10 years behind cars but industry is real, momentum growing*

## 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)***

# Hybrid Trucks – Front Edge of Electric Drive Transition in Trucks, Buses

## At First "Tipping Point" but Need Help to Speed Early Market

- Hybrid truck production volumes are still too low in early market to realize price reductions
  - Current payback period too long even with fuel/maint savings
  - *Need continued investment in technology improvement – federal funds left "gaps" – particularly in California, hybrid*
- Plug in electric and plug in hybrid face similar constraints
- **However: modest volumes can move prices to within business case needs: Need min 3,000 - 5,000 unit sales/year**
  - ***California can provide a big kick-start by helping:***
    - ***Drive first purchase volumes up with voucher/incentives***
      - **Fleets and industry believe 4-5 year grant-rebate best**
    - ***Expand pre-production deployment, validation programs***
    - ***Expand development efforts on next phase technology***











*Hybrid nd high efficiency trucks moving from development to production*

# What's Needed Specifically? A Kick-Start

- Kick-start program for med/heavy hybrid and high efficiency trucks and buses
- **Meaningful funding: minimum $400 Million Nationally over 3-5 years**
  - **Up to 75%+ of funds directly for purchase rebates to fleets**
  - Up to 25% of funds for demonstration, assessment, development
- California's share? State is ahead of nation: its investment would speed state implementation AND help seed national market
  - **Minimum $100M from California over 3-5 years for both deployment (3-5k trucks) and demonstration, development support for emerging platforms (refuse, Class 8, plug in, optimized hybrids)**
  - **Strong support for rebate and R&D concept with fleets and industry – developed via HTUF collaborative process**

# Unified Hybrid Industry in DC

- CALSTART, HTUF and 9 major companies – including all truck makers - outline status, benefits and needs of hybrid trucks
- Joint call for federal assistance for:
  - Purchase incentives
  - Broader fleet demonstrations and
  - Long term R&D investment

# Hybrid Truck & Bus Voucher Incentive Program (HVIP)

**Table IV-1: Staff Recommended Hybrid Vehicle Incentive Amounts**

| Vehicle Weight | Base Vehicle Incentive[1] | Additional Incentive for ARB Vehicle Certification |
|---|---|---|
| 10,001 – 14,000 lbs. | $10,000 | $5,000 |
| 14,001 – 26,000 lbs. | $20,000 | |
| 26,001 – 33,000 lbs. | $25,000 | |
| > 33,000 lbs. | $35,000 | |

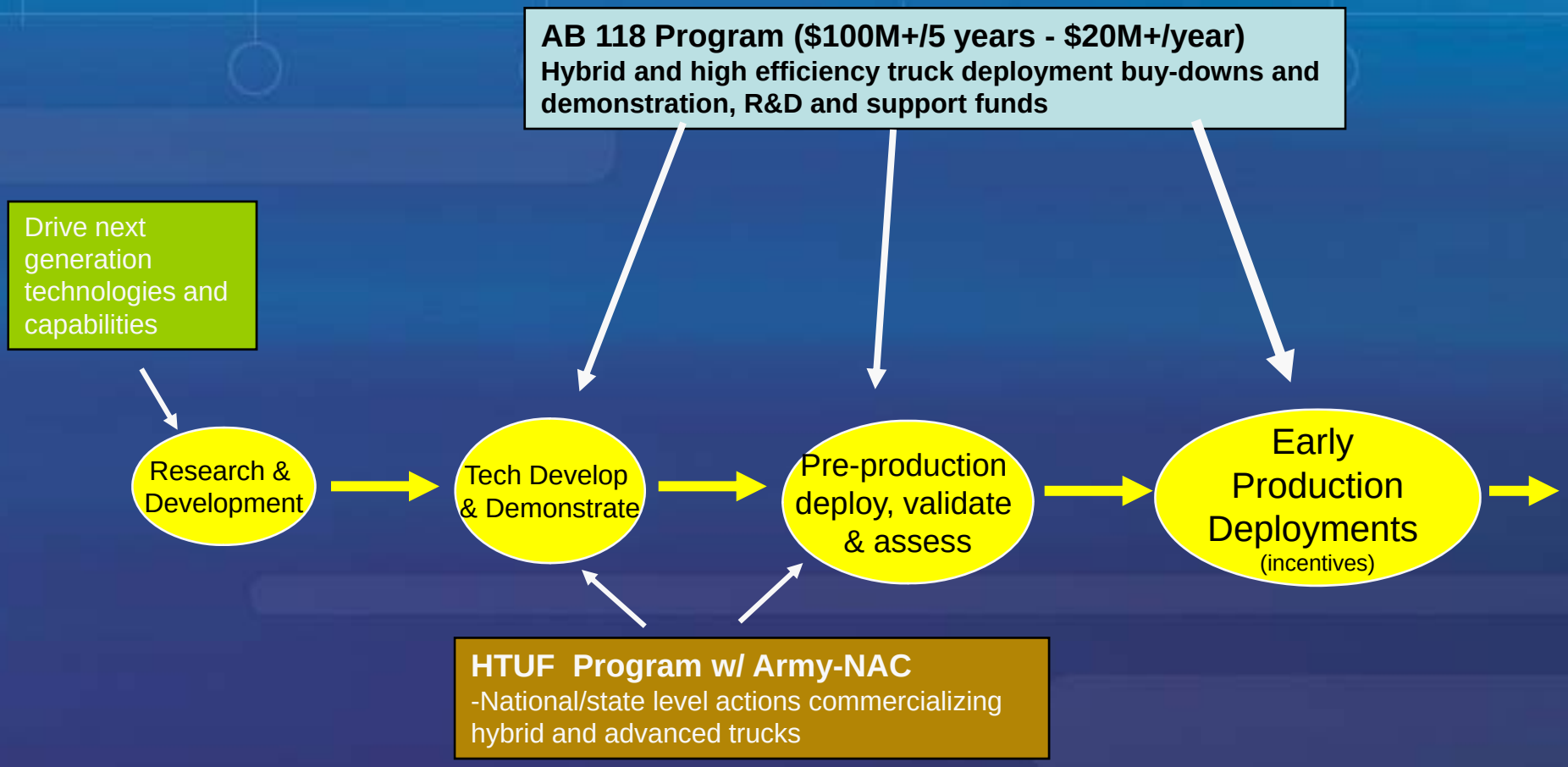
[1]The first HVIP-eligible hybrid truck or bus purchased by any fleet would be eligible for an additional $5,000 voucher.

- CARB staff worked to craft extremely simple program – incentive targets half the incremental cost of today's hybrids
- If successful, plans are for multi-year program but incentive may drop in future years
- CARB Board approved April 24; current level $20.4M

# Kick Starting Hybrid & High Efficiency Trucks

- In Addition: Establish Hybrid & High Efficiency Truck Development Program
  - Support pre-production demonstration and assessment projects
  - Support MD/HD hybrid test and certification standards
  - Support R&D of next generation enabling technologies for hybrids and high efficiency trucks
    - Electrically driven accessories
    - Plug-in capability
    - Optimized engines
    - Advanced energy storage
    - Export power
  - Utilize balance of funds (25% of recommended California funds = at least $25M)

# Coordinated Approach, High Leverage, Strong Success Case



# 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*

# Class 8 Hybrids – New Possibility

- Peterbilt is now testing this hybrid prototype of its heavy-duty Model 386 tractor
- Example of the new capabilities and markets emerging for hybrid technology
- Port yard hostler hybrids to be developed in WestStart project with Ports of Long Beach and LA
- Vehicles common at port, rail and distribution centers

THE PORT OF LONG BEACH

# 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



# Plug in Hybrid Trucks Emerge: Several Utility Industry Variants

**Dueco-Odyne plug-in "material handler" (above), "digger-derrick" (middle), compressor truck (bottom).**

**Eaton PHEV utility trucks**

*Plug-in port*

- Commercial work trucks show potential for PHEV functionality *before cars*
- Extra energy storage boosts idle reduction/work site engine-off ops
- Diesel fuel costs cause rapid review of potential business case
  - Energy Storage costs still high
- Dueco-Odyne first into market
  - Plug-in hybrid utility bucket trucks
  - PHEV "digger-derrick" version 6/08, a higher power-demand work truck
  - Trucks carry 35 kwh of energy storage (lead-acid, 3000 pounds) for long work site ops
  - PHEV underground compressor truck
- Eaton has two prototypes
  - Class 6/7 variant based on production truck, system
  - Class 5 "Superduty" prototype with EPRI

# Plug-in Energy Storage Bodies

- New variant of an older idea – uses stored energy to operate lift, tools at work site
- Separate from and does not change conventional driveline
- Fuel savings and idle reduction benefits

# Bright Plug-in Van Prototype Shown

- "IDEA" prototype from Bright Automotive brings together light-weight body/chassis with hybrid driveline, plug in battery pack
- 30 miles possible all-electric; blended mode can see 100 mpg in urban delivery duty
- Front conventional engine, rear electric drive axle; 10 kwh Li-ion batteries in proof of concept unit

# Electric Delivery Vans Deployed by FedEx in UK

- Electric propulsion systems can work in selected niches in truck market
- Cost of batteries remains a challenge

# Smith to Build More Electric Vans, Trucks in US

- Smith Electric Vehicles launches new production facility in US in Kansas City region
- Smith also unveils the US version of the Newton, which has a top speed of 50, range of over 100 miles and a payload capacity of up to 16,280 lbs and is available in US truck Classes 5 through 7
- Unveils first all-electric utility bucket truck based on Newton at EUFMC 2009 in partnership with Altec, testing with PG&E
- Will also build electric Ford Transit Connect vehicle in Kansas City



# E-Trucks at Port of LA

- Delivery of heavy-duty all-electric trucks begins at Los Angeles port
- Partnership with the Port of Los Angeles, South Coast Air Quality Management District and a small manufacturer, Balqon Corp.

Photo: Los Angeles Times

- Nautilus E30 all-battery electric vehicle for work within the port, and for short hauls outside
  - Range of 40-60 miles per charge, depending on load
  - Charging time of three hours on 230v/480v chargers
- Unique partnership involved R&D funding from the port, and future royalty arrangement paid to port



02/25/09 Los Angeles Times, http://www.latimes.com/business/la-fi-electric-truck25-2009feb25,0,6411132.story

# Freightliner CC, Parker Hannifin Show Hydraulic Hybrid

- Team of Freightliner and Parker Hannifin introduce a new hydraulic hybrid platform
- Features Cummins ISB 2007 engine, a Parker hydraulic-propulsion system, no transmission needed
- Available in limited volume for now
- Power recovery is critical
  - Hydraulic hybrid recovers and reuses up to 70% of energy during the braking process

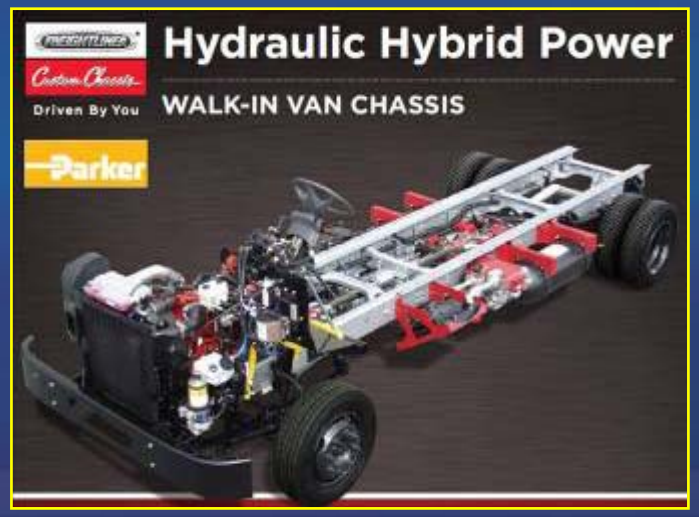
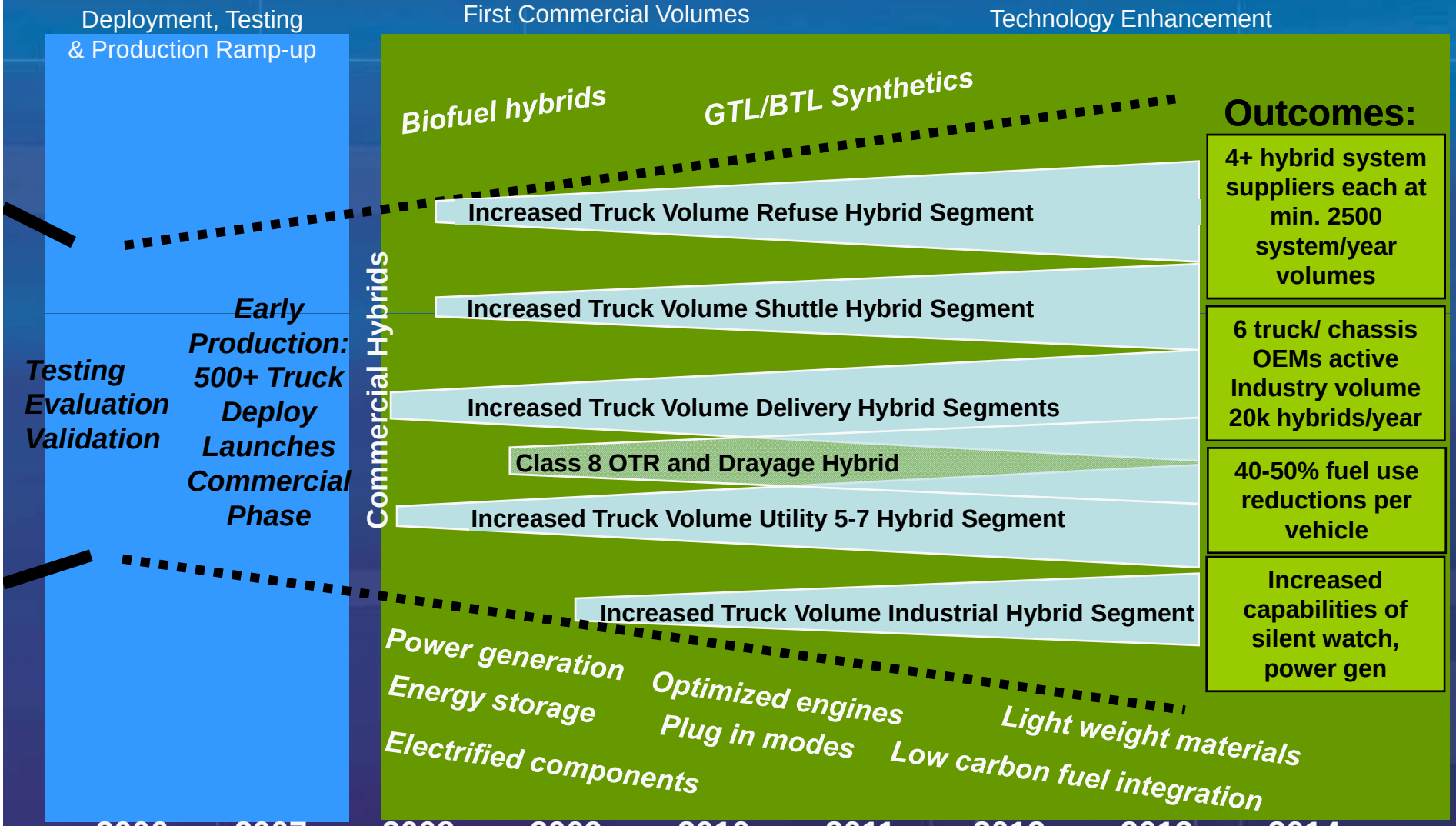



Photo: Freightliner Custom Chassis



For more information, visit www.freightlinerchassis.com

# HTUF: "Expanding the Funnel"
# Hybrids & High Efficiency Trucks



# Recommended Multi-year Allocation

Up to 75% of Funding

25% or more of Funding

**Buy Down**

**Rebates or vouchers**

**Pre-Production Deployment/Assessments**
HTUF Working Groups

**Technology Development & Demonstration**

**Testing/Certification Support**

**Education/Outreach to Fleets**

- Collect data/report on deployed production trucks to validate success
- Deploy and assess next pre-production ready trucks from working groups
- Technology development projects for hybrids and high efficiency trucks
- **Promising categories - demo**
  - **Class 8 tractors/drayage/regional**
  - **Refuse**
  - **Shuttle bus**
  - **Class 4/5 and 2b work trucks**
  - **Plug-in work trucks, including parcel**
  - **Optimized and downsized engines**
  - **Efficient truck/low carbon fuel integration**
  - **Non-road/construction**
- Assist and help manufacturers with testing/validation
- Education and assistance to fleets to understand value, business case and best uses of hybrids and high-efficiency trucks and buses

# Summary: California Hybrid and High Efficiency Kick-Start

- **AB 118 Block: 5 year, minimum $100M Kick-Start**
- Kick-start med/heavy hybrids and high efficiency in California and ramp up capability in time for AB 32 needs
  - **Up to 75%+ of funds for purchase rebates to fleets**
  - Up to 25% of funds for tech demonstration, assessment, development ($10M+/year)
- California ahead of nation: this investment would speed state implementation/reductions AND help seed national market – federal funds have missed California need
  - $100M over 3-5 years for both deployment (3-5k trucks) and demonstration, development support for emerging platforms
  - Kick starts capacity to reach 0.5MMT+ GHG reductions from HD hybrids by 2020
  - *Strong support for this rebate and R&D concept from fleets and industry*

# HTUF National Conference 2009

## The Nation's Major Hybrid & Efficient Truck Event

## Oct. 27 through 29 in Atlanta, GA

- Three full days of information, networking, and hybrid truck-driving kicked-off by a hybrid truck convoy to the meeting site


- Working Group Meetings; OEM briefings; Market status and growth briefings; incentive briefings; Construction Equipment Workshop; Energy Storage Workshop; Technical Briefings; military hybrid and advanced vehicle briefings; hydraulic and plug-in tech status reports;
- Networking receptions to develop those valuable contacts

2009 Primary Host: SOUTHERN COMPANY

National Sponsor: IBM

***World's biggest hybrid & plug-in truck and bus ride and drive:*** **You can't afford to miss it!**

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**www.calstart.org**


**For info contact:**

**Bill Van Amburg**
**(626) 744-5600**
**bvanamburg@calstart.org**

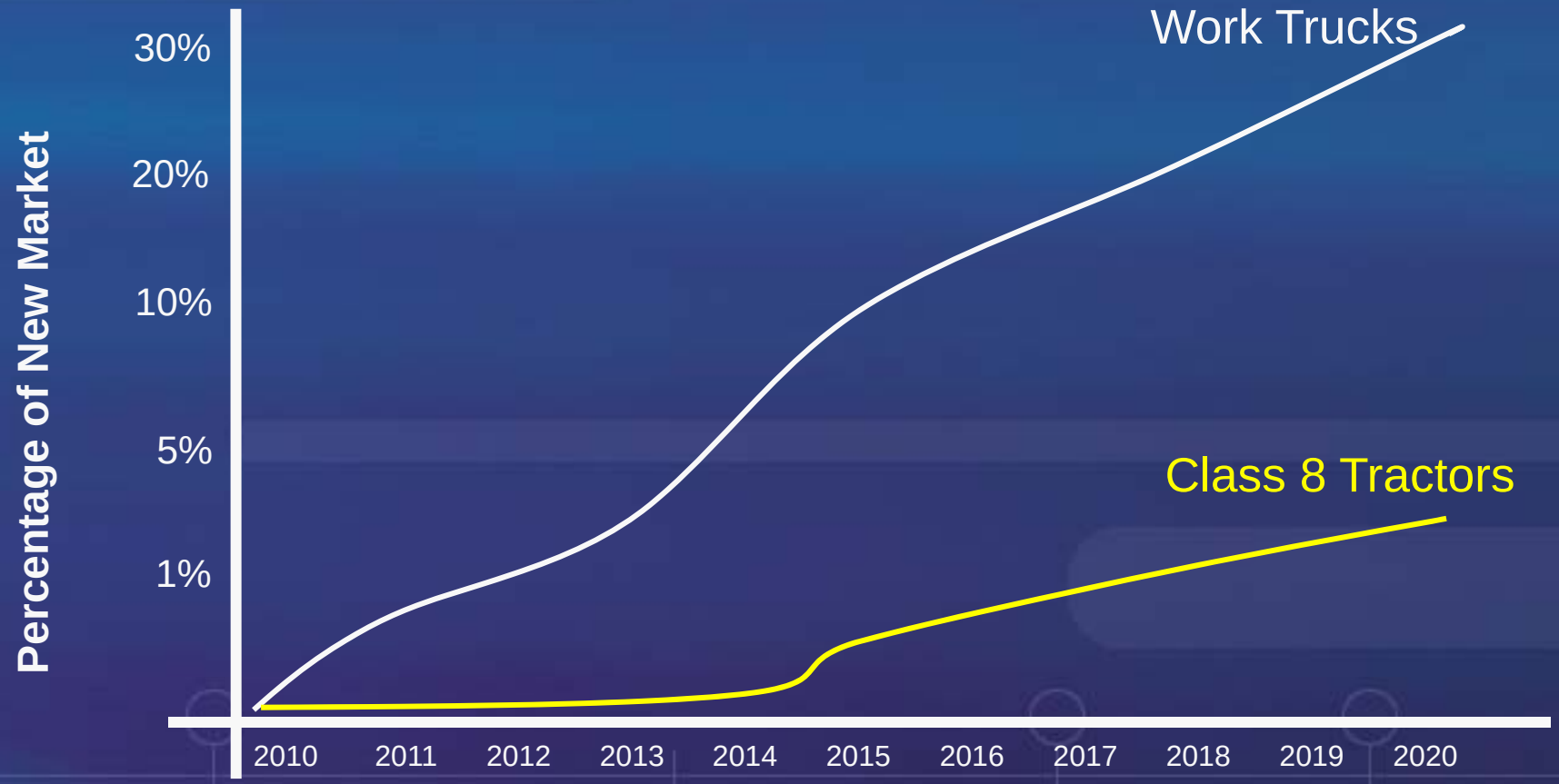
**www.htuf.org**

# What's Target for Volumes, Price?

**Increase Volumes in Markets With Similar Drivelines to Lower Costs**

# Introduction/Impact Framework

21,000/year hybrids nationally 2015 (2100+/year CA)
64,000/year hybrids nationally 2020 (6400+/year CA)




*Initial HTUF Estimates*

# How to Speed High Efficiency Med and Heavy Vehicle Commercialization

- Trucks are different than passenger cars
  - Tech concept similar to light duty; business case, volumes, components and technology availability different
  - Big “bang for the buck” benefits per truck
- Industry and fleets could benefit from:
  - support for ongoing needed R&D;
  - funding to field pre-production fleets;
  - enhanced purchase incentives
- A significant commitment to a long term, consistent program across these core areas would pay huge dividends
- Purchase incentives need to last longer, provide assistance to broader range of fuel economy benefits
  - First-mover fleets ideally need *up-front purchase cost reduced to spur purchases and increase volumes*

# Duke Study Finds "Strategic US Opportunity" in Hybrid Tech

- Hybrid technology represents a competitive advantage to the US
- Other countries have worked on the technology – the pace of change and momentum is currently highest in US
- The hybrid truck supply chain now represents a growing national industry – touching jobs in more than 30 states
- Duke study shows there are regional "hot spots" for technology manufacturers and their suppliers – can benefit regions hurt by economy
- Industry shows great promise for creating green energy jobs
- Further commercialization requires government support, partnership to assist truck purchase and develop next technologies