Hybrids and Advanced Trucks: Creating and Supporting Market Demand

Clean Transportation Technologies and Solutions SM

Bill Van Amburg
Senior Vice President

National Academies Battery Conf
July 26, 2010

Agenda

- CALSTART Background
- New Urgency for High-Efficiency Trucks
- Status of Hybrids and High Efficiency Trucks
- HTUF Process for Market Creation-Commercialization
- Implications for Energy Storage
- Drivers Needed to Succeed

CALSTART

CALSTART is a unique California-based national, non-profit, member-supported organization.

Founded in 1992 as a public-private partnership to help launch and grow a clean transportation industry.

Mission: via programs and services, supporting and expanding the growth of a clean transportation technologies industry that will:

- **Create high-quality jobs;**
- **Clean the air;**
- **Reduce dependence on foreign oil; and**
- **Reduce global warming emissions**

CALSTART Has Broad Industry/Public Sector Support (*partial list*)

Every truck here is:
Hybrid Electric,
Hybrid Hydraulic,
Plug-in Hybrid
or all-Electric – and 70%
Are in *early* production

HTUF 2009

New Carbon and Fuel Rules for Trucks

- May 21 President signs memorandum to set new, first-ever fuel efficiency and carbon rules for trucks
- Joint rule development by EPA and NHTSA – following process set for LD cars and trucks
- Fuel economy rules likely to go into effect by 2016
- However, rules could start as early as 2014 – possibly voluntary

the WHITE HOUSE PRESIDENT BARACK OBAMA

BLOG PHOTOS & VIDEO BRIEFING ROOM ISSUES the ADMINISTRATION

Home • Briefing Room • Presidential Actions • Presidential Memoranda

The White House

Office of the Press Secretary

For Immediate Release May 21, 2010

Presidential Memorandum Regarding Fuel Efficiency Standards

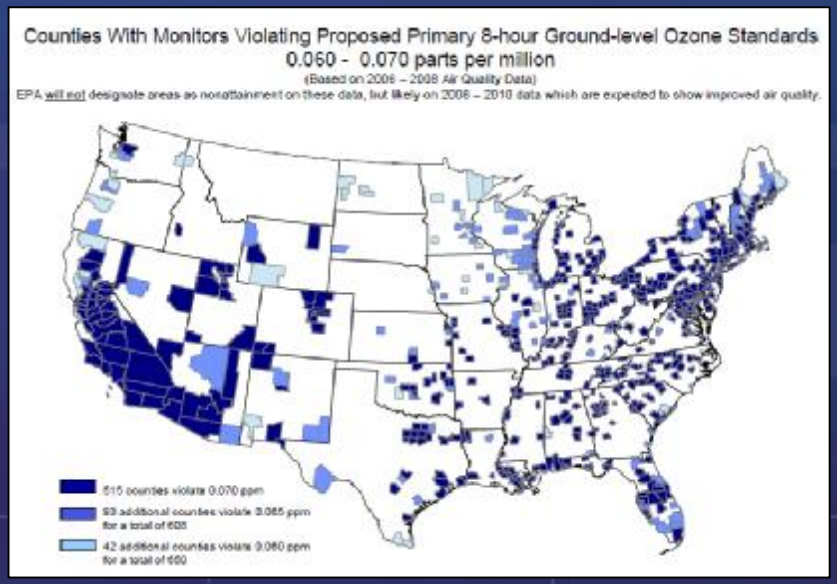
MEMORANDUM FOR THE SECRETARY OF TRANSPORTATION
THE SECRETARY OF ENERGY
THE ADMINISTRATOR OF THE ENVIRONMENTAL PROTECTION AGENCY
THE ADMINISTRATOR OF THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

SUBJECT: Improving Energy Security, American Competitiveness and Job Creation, and Environmental Protection through a Transformation of our Nation's Fleet of Cars and Trucks

America has the opportunity to lead the world in the development of a new generation of clean cars and trucks through innovative technologies and manufacturing that will spur economic growth and create high-quality domestic jobs, enhance our energy security, and improve our environment. We already have made significant strides toward reducing greenhouse gas pollution and enhancing fuel efficiency from motor vehicles with the

Criteria Emissions – New Ozone Rules Coming

- EPA announces it will strengthen ozone rules to meet health standards
- Would replace standards from Bush Admin which were not as protective of health as science advisors had recommended
- New rules would drop ozone limits to no more than 0.060 – 0.070 ppm ozone over 8 hours, phased in over up to 20 years
  - Current limit 0.075 ppm
- Hundreds of additional counties will fall into non-compliance (from 322 today up to as many as 650 out of 675 monitored)
- EPA finalizing rule – will issue final standards by Aug 31, 2010 – states would need to outline plans to meet standards by 2013 which go into effect in 2014
- Most-impacted regions receive to 2031 to comply

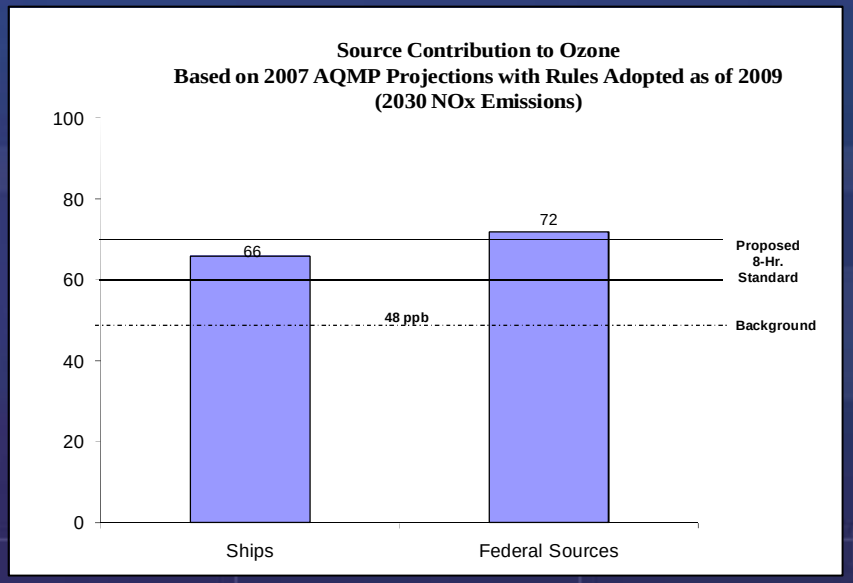


Regional Impact of Ozone Rules Example: Southern California

- LA region still has worst air quality in nation
- SCAQMD supports the new ozone levels, but estimates to achieve them will require reducing NOx in region by additional 88-91%!
- Could mean transition away from fossil fuel combustion
- District believes it cannot achieve standards if federal emission sources (ships, trains, planes) do not significantly reduce their impacts

We calculate that to demonstrate attainment of the proposed standard range would require 88 to 91% reductions in NOx emissions. This preliminary analysis means that we need to essentially transition out of fossil fuel combustion and move toward zero-emission technologies.

- Dr. Barry Wallerstein, SCAQMD Executive Officer, in comments to EPA on proposed rule



710 Zero Emission Freight Corridor

Moving Freight with Zero Emissions

Metro has engaged CALSTART to examine the commercial viability of zero-emission freight movement – *and to launch a process to commercialize zero-emission freight movement vehicles and infrastructure*

The structure: a multi-year public-private program involving partners and stakeholders serving, using and living along the I-710 corridor

Goal: develop, validate and commercialize market-sustainable, zero-emission goods movement vehicles - and supporting infrastructure – to service the I-710 freight corridor (and additional uses)

DoD Cites Climate Change as Threat

- Department of Defense's *Quadrennial Defense Review* (QDR) cites climate change for the first time as a global threat
- Global warming impacts and disasters will accelerate political, economic, and social instability/conflict
- Military installations and forces will have to adapt to rising sea levels, extreme weather events
- DoD cutting emissions, energy use from its non-combat facilities by 34% by 2020
- Air Force, dependent on billions on gallons of imported oil, is investing extensively in all forms of renewable energy, running biofuel tests in jets

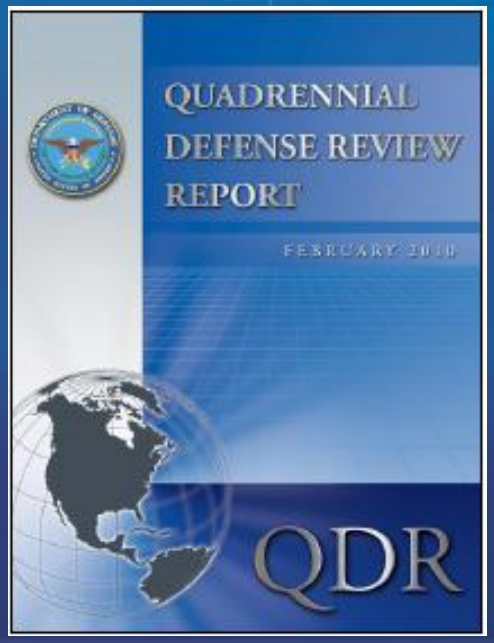


Photo source: thewonkroom.com

Army Energy Security Goals

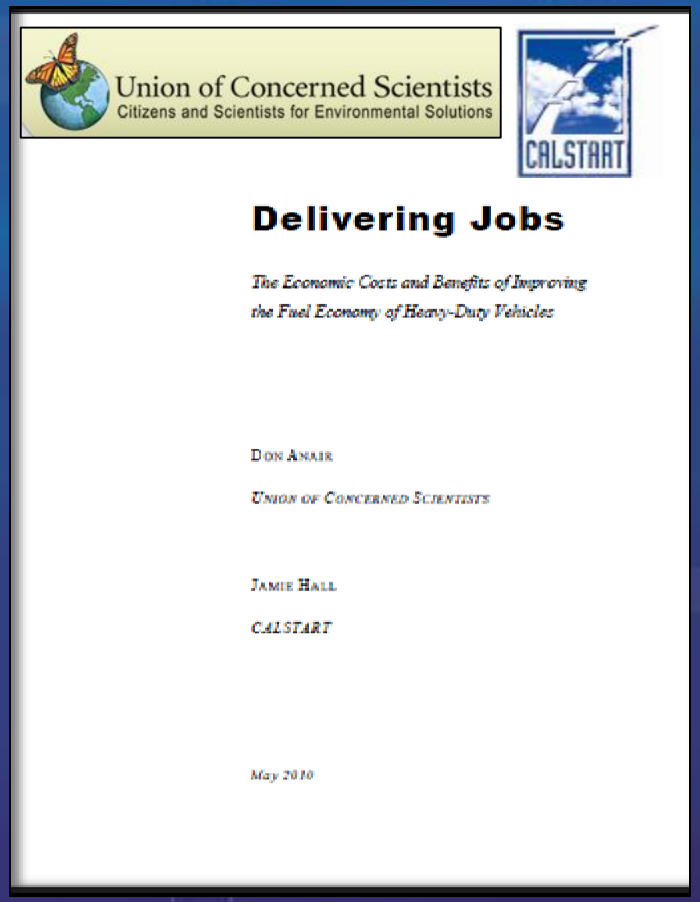
Army has calculated every 1% of fuel savings means 6,444 fewer soldier trips in convoys, protection

Mandates and Targets

Directive Topic	Energy Performance Target [Source]
Installations energy use	Reduce by 30% by 2015 from 2003 baseline [EO 13423 / EISA 2007]
Non-tactical vehicle (NTV) fuel consumption	Reduce 2% per year through 2015, 20% by 2015 [EO 13423]
Electricity from renewable sources	A "Sense of Congress" goal - 25% by 2025 [EISA 2007 / NDAA 2007]
Fossil fuel use in new/renovated buildings	Reduce 55% by 2010; 100% by 2030 [EISA 2007]
Hot water in new/renovated buildings from solar power	30% by 2015 if life cycle cost-effective [EISA 2007]
Non-petroleum fueled vehicles use (ethanol, natural gas)	Increase by 10% annually [EO 13423]
Energy metering for improved energy management	Meter electricity by Oct 2012 [EPAct 2005] Meter natural gas and steam by Oct 2016 [EISA 2007]

From 4/12 presentation by Dr. Kevin T. Geiss, Program Dir., Energy Security Office of the Asst. Secretary of the Army, Installations and Environment

High Efficiency Trucks Create US Jobs


Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

Delivering Jobs

The Economic Costs and Benefits of Improving the Fuel Economy of Heavy-Duty Vehicles

Don Anair

Union of Concerned Scientists

Jamie Hall

CALSTART

May 2010

- New report from Union of Concerned Scientists and CALSTART shows **124,000 economy-wide jobs** and **$24B in economic savings** can be created if policies support high-efficiency trucks
- All states show gains
- Fleets benefit and have substantial savings from reduced fuel over vehicle life

High Efficiency Truck Industry Touches Most States

Hybrid Medium Duty Trucks Expand to Both New & Heavier Applications

- All hybrid truck makers have Class 8a tractors and straight trucks
- Wide variety of truck body – chassis combinations and more added each year
- Much of this activity was driven by core first work of the HTUF Utility Working Group actions
- Of 14 original fleets in this group which deployed 24 trucks – all 24 still in service, those fleets now have 180 hybrids

Regional Heavy and Line Haul Advanced Trucks

- Kenworth, Peterbilt, Navistar and Freightliner all have Class 8 regional haul hybrid tractors
  - All developing next generation advanced Class 8 – including electric and hybrid configurations
- Mack showcased advanced hybrid line haul Class 8 (full 80,000 lb GVWR); next stages add more electrification; Peterbilt has several in demonstration

Advanced Class 8 Demo Vehicles

- ArvinMeritor – Navistar testing unique dual-mode hybrid design
- Electric drive at lower speeds (up to 48 mph), blended mode at higher speeds
- Can greatly reduce fuel use, cut idle emissions, provide partial zero emissions
- Vision Industries demonstrating a fuel cell – hybrid electric drayage truck
- Zero emission operation potential in regional applications
- Hydrogen fueling

All Electric Drive Trucks Emerging

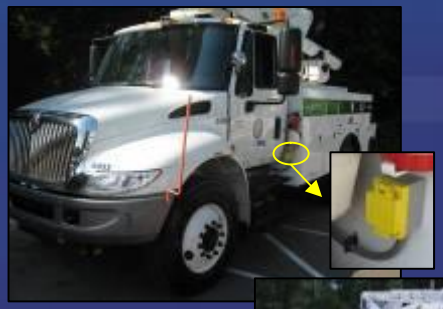
- Oshkosh HEMMT military heavy transport and support truck
  - Series hybrid electric drive system with ultracap energy buffer
- Capacity “PHETT”
  - Plug-in, series hybrid design
- Balqon all-electric port trucks
  - Up to 40-60 miles range
- Freightliner Custom Chassis and Enova electric parcel truck (in testing)
- Smith “Newton” electric truck (in early production)
- Navistar/Modec electric truck (in early production Q1 2010)

Electric Truck Gets High Profile Roll-outs

- All-electric FedEx parcel delivery vans now on Los Angeles routes
- Two from Navistar-Modec – may add more
- Took US Route 66 Tour in Spring, ended in LA
- First wave of early production electric trucks

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

Possible New Plug-in Options

- Quantum showing a Ford F-150 plug-in conversion kit
- Possible 35 miles all-electric range
- Combined driving 475 miles (gas and electric)
- Top speed 95 mph
- 22 kwh lithium-ion battery
- Recharge 110 or 220 V
- Working on Escape version as well

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

Hydraulic Hybrids Coming of Age

- Several pre-production and near production models shown: Eaton, Bosch Rexroth, Parker
- Parallel and Series architecture
- FCCC – Parker series parcel strip chassis showed impressive integration, potential fuel savings

How do we Transition to Advanced Trucks?

We need a coordinated set of standards, incentives, and investments throughout the commercialization process

Commercialization "Continuum" – the Steps to Commercialization

Development	Demonstration	Pre-Production	Production Intent	Early Production
Test prototypes and systems	Proof of concept evaluations	Field pilot assessments	Assembly line builds up to 100+	Initial commercial volumes – still high incremental cost

TOOLS:

R&D Support →

Purchase Incentives →

Pre-Production Deployment Support →

HTUF – 10 Years of Work Paying Off

- **Hybrid Truck Users Forum: User-driven process** to commercialize med- and heavy-duty hybrid trucks
- Joint **CALSTART-U.S. Army** program (RDECOM-TARDEC-NAC)
  - With support from DOE, DOT
- HTUF focuses on commercializing hybrid trucks with **dual-use** benefits
  - Speed commercialization and cut costs by creating common fleet requirements, joint purchase commitments, increasing volumes

All Major Truck Makers and System Suppliers involved
(partial list)

HTUF Working Groups

- ***Active Working Groups expand:***
  - **Class 8** – *Hybrid Class 8b Regional Delivery & Drayage*
  - NEW! **Telecommunications trucks** – *Hybrid Class 3/4 work trucks & vans (self-supported group)*
  - **Utility trucks** – *Hybrid Electric Class 7/8 International/Eaton Bucket Trucks (completed); Class 4/5 Bucket Trucks*
  - **Parcel Delivery trucks** – *Hydraulic Hybrid Class 6 Package Delivery*
  - **Refuse Truck** – *Hydraulic and Electric Hybrid Class 8 Crane Carrier Rear Loader Refuse Trucks (deployed in NYC Dept. of Sanitation)*
  - **Incentives Working Group** – *bringing common industry issues to the attention of legislators and regulators (self-supported group)*
  - NEW! **Military Hybrid Non-Tactical Vehicle** – *production hybrid trucks to be deployed on military installations*

DEPARTMENT OF SANITATION NEW YORK CITY

Military Hybrid Non-Tactical Vehicle Working Group

- Military utilizes many of the same trucks that are now commercially available in hybrid form
  - Huge opportunity to expand NTV hybrids and place in military hands
- Aim is to increase deployment of current commercial hybrids throughout the services
- Main obstacle is overcoming high incremental costs

HTUF Actions Lead Hybrid Industry Progress

	2002	2003	2004	2005	2006	2007	2008	2009
Industry Status	**No major truck makers involved in commercial hybrids –** OEMs skeptical	Hybrid transit buses grow in market	OEM interest growing – first FedEx trucks delivered	Hydraulic hybrid development expands	**Peterbilt and Freightliner unveil pre-production hybrids**	First plug in utility truck	**Peterbilt, Kenworth, Freightliner and Azure enter low-volume commercial hybrid production**	**1,500+ coml. hybrid trucks ordered or delivered – all truck makers active**
		FedEx hybrids testing	Utility WG issues and awards 24 hybrid truck RFP	FTTS underway	First Class 8 hybrid data	100 utility hybrids in delivery – **International begins commercial production**	6 working groups active	**Calif. approves hybrid incentives**
HTUF Activities	Military hybrid demos: HMMWV and FMTV	Parcel & beverage working groups launch	Utility hybrid "validation" truck delivered	EPA test protocol started	Oshkosh prototype refuse truck	Refuse & parcel groups select suppliers pre-production	**Construction Equip Forum launches**	Hybrid on Hill event
	First HTUF Working Group launches (utility)	**Utility WG agrees to common KPPs**	**Eaton and International host HTUF Forum 4**	Validation testing of utility hybrid shows significant fuel savings	24 utility hybrids deployed with fleets **Positive results leads to orders for 100 more**	Class 8 and incentives working groups	Bosch Rexroth hosts HTUF Forum 8	Refuse WG testing HEV and HHV
	First HTUF Forums: Allison hosts 1; Enova/EVS 2	SwRI and Stewart & Stevenson host HTUF Forum 3		Refuse , bus working groups launch	ISE & Siemens host HTUF Forum 6 – **all truck makers attend**	**Paccar (Kenworth/ Peterbilt) host HTUF Forum 7**		Bus WG selects supplier
				Dana hosts HTUF Forum 5				**Southern Company (user) hosts HTUF Forum 9**
	Indianapolis Forum 1	*Chattanooga Forum 2* / *San Antonio Forum 3*	*Kalamazoo Forum 4*	*Toledo Forum 5*	*San Diego Forum 6*	*Seattle Forum 7*	*So. Bend Forum 8*	*Atlanta Forum 9*
	80/120 attendee 3/5 hybrid ride & drive	172 attendees 7 hybrid ride & drive	250 attendees 14 hybrid ride & drive	275 attendees 13 hybrid ride & drive	330 attendees 14 hybrid ride & drive	430 attendees 19 hybrid ride & drive	550 attendees 36 hybrid ride & drive	550 attendees 30 vehicles











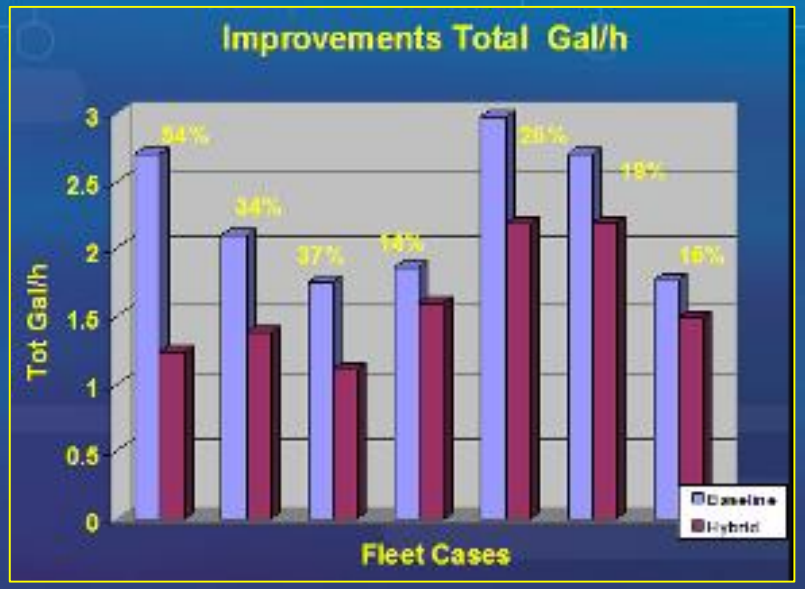



HTUF Forums & WGs: A Market Development & Transformation Process

- HTUF Forums are North America's primary hybrid and high efficiency truck industry meetings
- The HTUF process has sped market introduction by 2-5 years (5 years according to fleets)
- The Forums uniquely bring together the full range of key stakeholders in one place:
  - fleet vehicle users (commercial and military)
  - vehicle manufacturers
  - suppliers and technology developers
  - regulators
  - researchers
  - NGOs
- The Forums provide the clearest window on industry status and reality; technology developments; field-test data and real-world performance evaluations; hands-on experience via ride-and-drives; and developing the action agenda for the industry.

HTUF Helped Prove Reality of Technology and its Benefits

- **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

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

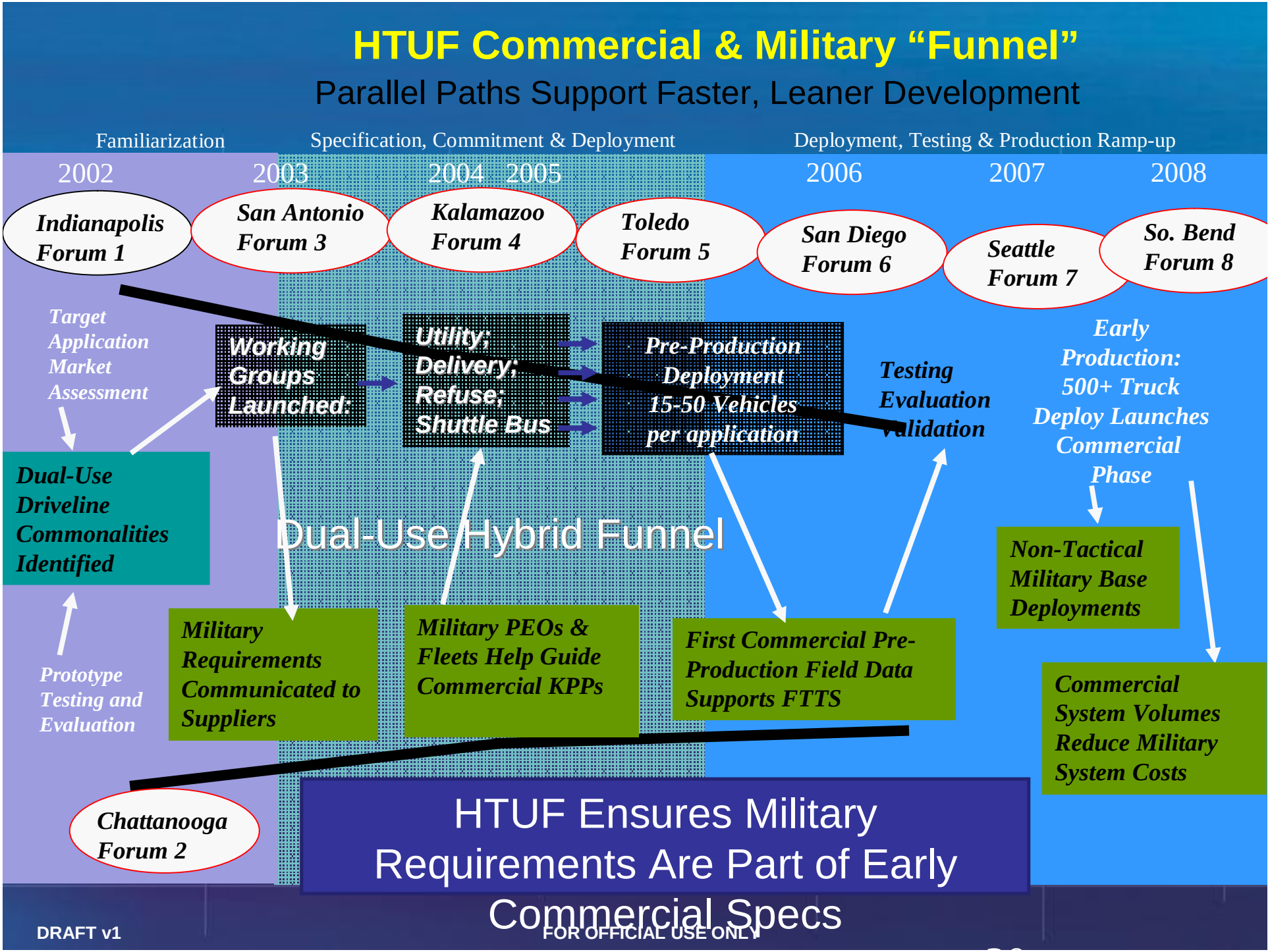
Mission Cycle ID (given in Table 8)	HC (g/mi) %	CO (g/mi) %	NOx (g/mi) %	PM (g/mi) %	Fuel (mpg) % (increase)	Miles Driven	Hours of Operation (hydraulic + electric)
A	58	50	34	25	68	70	1.5
B	73	94	34	34	80	70	4.5
C	78	73	61	37	139	48	3
D	80	74	58	32	150	38	3

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

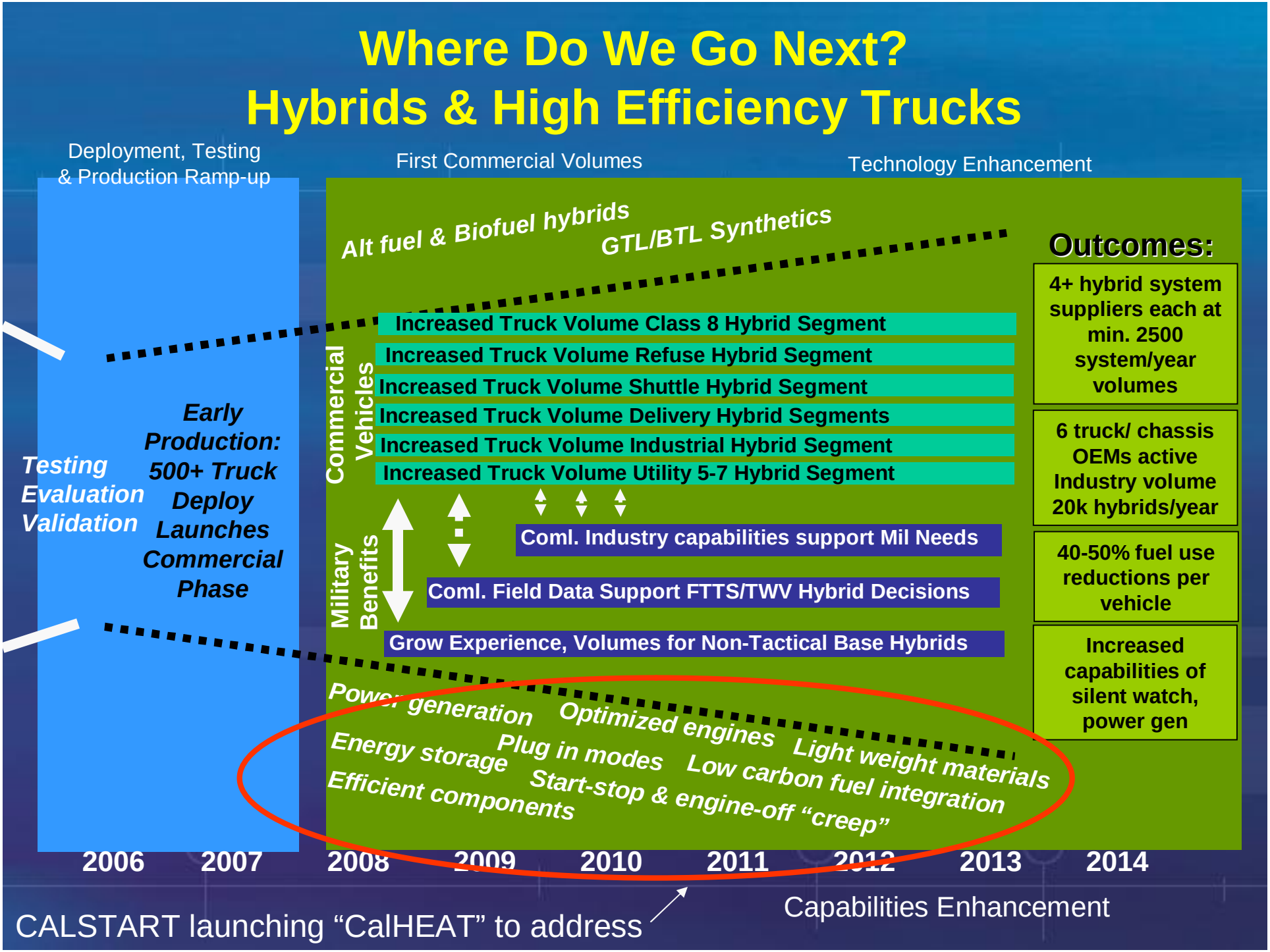
CO2 reductions closely tracked fuel reduction percentages

HTUF Commercial & Military "Funnel"

Parallel Paths Support Faster, Leaner Development

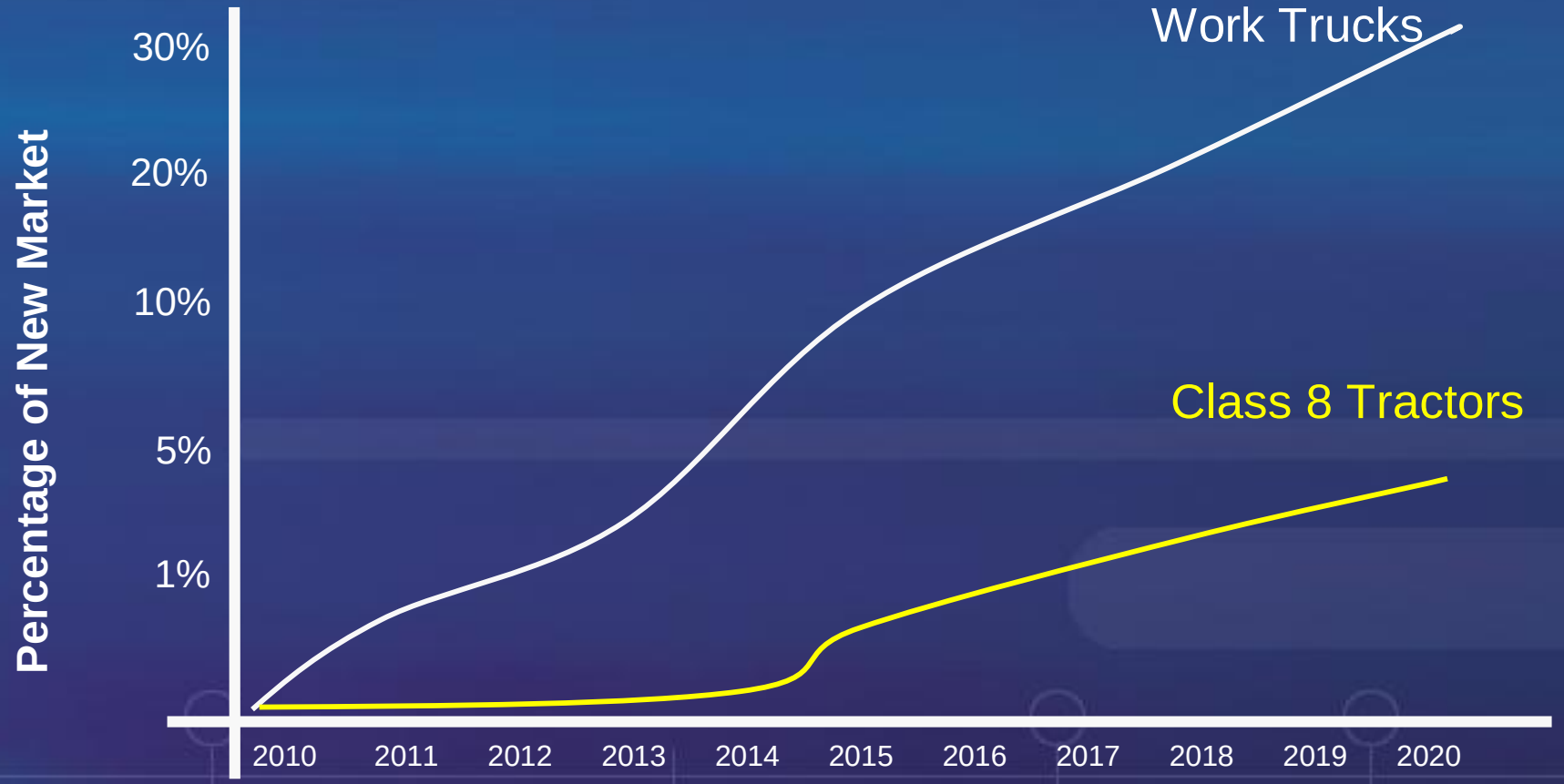


Where Do We Go Next?
Hybrids & High Efficiency Trucks



Introduction/Impact Framework

21,000+/year hybrids nationally 2015
70,000+/year hybrids nationally 2020



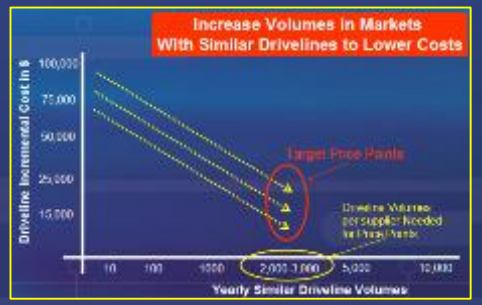
Initial HTUF Estimates

Energy Storage Implications of Advanced M/HD Vehicles

- 2015 Potential Energy Storage Demand
  - 213,000 kwh
    - 20,000 Hybrid trucks: 48,000 kwh (80%@2 kwh; 20%@4 kwh)
    - 2,000 Electric trucks: 100,000 kwh (@50 kwh)
    - 2,000 Plug-in trucks: 45,000 kwh (@22.5 kwh)
    - 10,500 Idle Reduction: 21,000 kwh (@2 kwh)
- 2020 Potential Energy Storage Demand
  - 935,000 kwh
    - 70,000 hybrid trucks: 168,000 kwh
    - 10,000 electric trucks: 500,000 kwh
    - 10,000 plug in trucks: 225,000 kwh
    - 21,000 Idle reduction: 42,000 kwh

Hybrid Trucks: at "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 big fuel/maintenance savings
- **However: modest volumes can move prices to within business cases needs: Need 3,000 - 5,000 unit sales/year**
  - ***Incentives can provide big kick-start to this number by helping drive volume up in targeted effort***
    - **Federal, state level**
- Need **correct incentives** to bridge gap between today's price and prices at higher volumes
  - Federal tax credits well-intentioned but not best tool for commercial fleets: too low, doesn't help most fleets



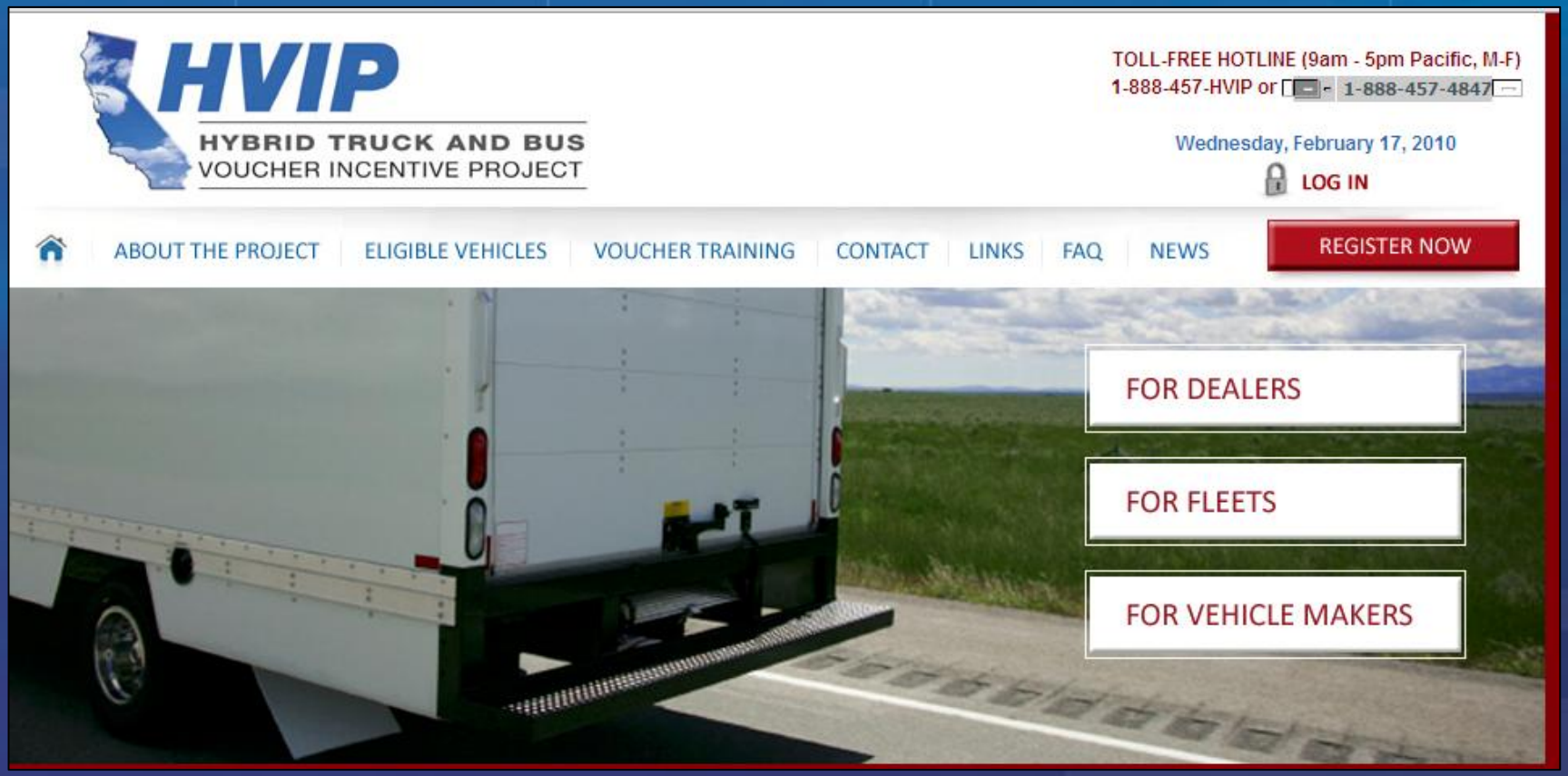








Incentives to Move the Market



- www.californiahvip.org

What You Can Do Now: Hybrid Truck & Bus Voucher Incentive Program (HVIP)

- www.californiahvip.org

Vehicle Weight	Base Vehicle Incentive[1]
10,001 – 14,000 lbs.	$10,000
14,001 – 26,000 lbs.	$20,000
26,001 – 33,000 lbs.	$25,000
> 33,000 lbs.	$35,000

- Program recommended by CALSTART/HTUF – based on what needed to change fleet purchase decision, speed market
- CARB staff crafted extremely simple program – incentives target half the incremental cost of today's hybrids
- $19.4M invested for year 1 – over 95% of vouchers already requested in just 6 months of operation!
  - $919,000 still available
- CARB planning $25M for 2011 and will add electric trucks to program; and is offering program design, software to other states and regions

Proposed Hybrid Truck Tax Credits
Levin Bill (HR 3367)

Extends Credit for Five Years and Doubles Credit Amounts

Vehicle Weight	Demonstrated Fuel Economy Gain			
	Max Credit for a Fuel Efficiency Increase of:			
	20%	30%	40%	50%
8,500 - 14,000 lb	n/a	$3,000	$4,500	$6,000
14,001 - 26,000 lb	n/a	$6,000	$9,000	$12,000
26,000 - 33,000 lb	n/a	$12,000	$18,000	$24,000
>33,000 lb	$10,000	$20,000	$24,000	$24,000

*Maximum allowable qualified incremental cost [Sec. 30B(d)(2)(B)(iii) as modified]:

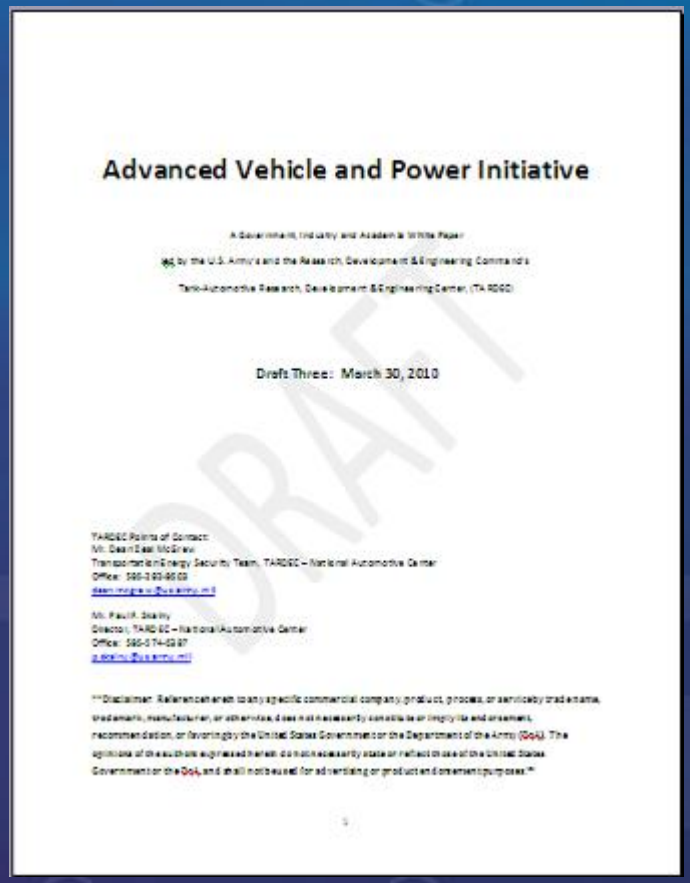
8,501 – 14,000 lb	$15,000
14,001 – 26,000 lb	$30,000
26,001 – 33,000 lb	$60,000
33,001 lb and above	$100,000

*Credit amounts allowed for efficiency increases [Sec. 30B(d)(2)(B)(ii) as modified]:

A 20% fuel economy increase can apply for 10% of qualified incremental cost (>33K lb only)
A 30% fuel economy increase can apply for 20% of qualified incremental cost
A 40% fuel economy increase can apply for 30% of qualified incremental cost
A 50% fuel economy increase can apply for 40% of qualified incremental cost

Army Advanced Vehicle and Power Initiative (AVPI)

- Initiative represents an emerging concept for rapidly reducing Army domestic vehicle fuel use and cutting energy use on domestic facilities
- Direct response to Quadrennial Review
  - Goal is to support 2% yearly fuel use reduction in vehicles; 30% reduction in base energy by 2015
- Draft industry-government-academia white paper proposes multi-year procurement and rapid demonstration efforts:
  - Replace 8%/year of Army's 72,000 non-tactical domestic vehicles with advanced vehicles (hybrid and electric in light, medium and heavy duty classes)
  - Conduct five year demonstration of next gen PHEVs and FCEVs together with renewable power generation and V2G (vehicle-to-grid) applications on selected bases
  - Successful demonstrations lead to procurement of next gen vehicles



Advanced Vehicle and Power Initiative

Draft Three: March 30, 2010

Point of Contact:
Transportation Energy Security Team,
TARDEC – National Automotive Center

Non-tactical Vehicle Inventory

Organization[1]	Total Vehicles[1]	Auto[1]	Trucks[1]	Other[1]
Government	651,000	240,000	402,000	9500
DOD	195,000	86,000	102,000	6600
Army	83,000	44,000	36,000	2900
CONUS Army Bases	72,000	38,000	32,000	2444

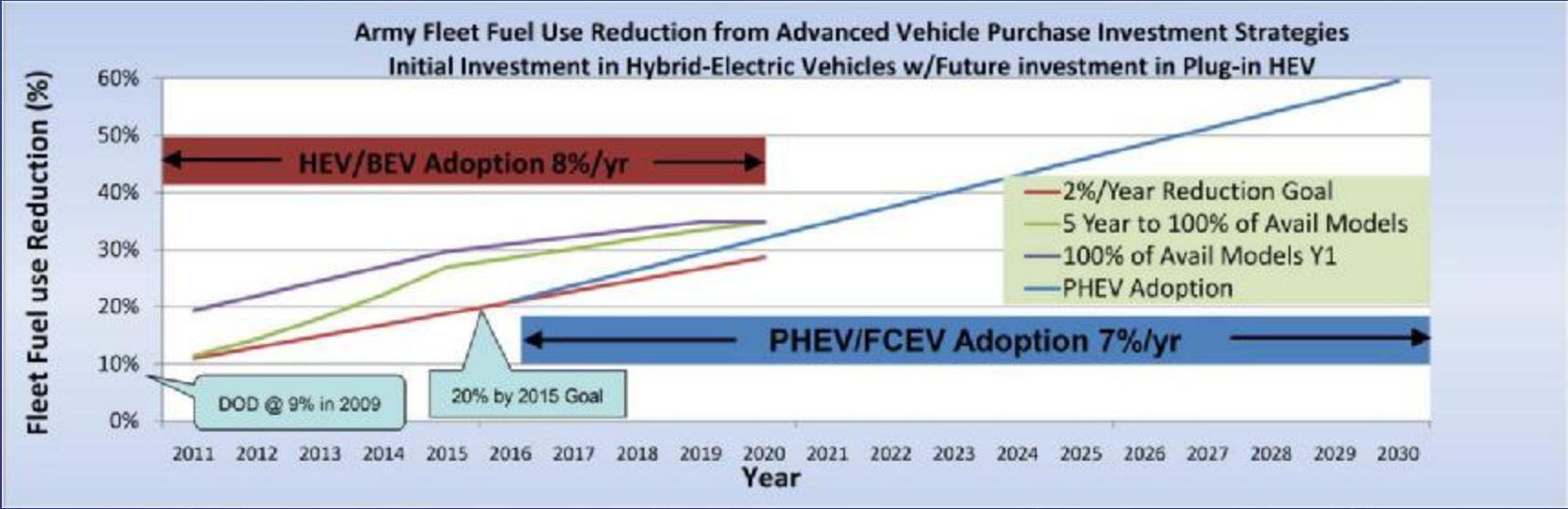
Phased Replacement Strategy

Phase 1
HEVs & BEVs
2011-2020

- Many models available
- Reduce petroleum consumption ~33%[1]
- Excellent customer acceptance
- Provide petroleum independence path

Phase 2
PHEVs & FCEVs
2016-2030

- Three to five base demonstration:
  - Validate petroleum use reduction expected >60%[2]
  - Facility Export/Import power – vehicle-to-grid; grid-to-vehicle
- Convert Fleet after demonstrated/validated/defined path



1 – Composite fuel economy improvement – See backup
2 – Includes fossil fuel power generation

What Will Drive Advanced Technology Trucks – and Therefore Energy Storage?

- Multi-year, coordinated plan; aligned investments, requirements, incentives and policies
- Need coordinated approach for commercialization
  - Support R&D consistently
  - Deploy, assess and validate pre-production vehicles and share info
  - Incentivize the business case in the early years
- Market “pull” critical – CREATE DEMAND!
  - Focus on leading-edge User Needs – build support to pull product through

Save THE DATE

September 28-30, 2010

DEARBORN, MICHIGAN

HTUF™ hybrid truck users forum

National Conference 10th YEAR ANNIVERSARY

Be a part of the 10th year anniversary and join us for the largest hybrid and high efficiency truck event in North America! This year's conference promises to be the best yet focusing on medium and heavy-duty hybrid vehicles and supporting technologies:

- Sessions on market opportunities, OEM products, plug-ins, updates on incentives, future funding opportunities,latest field results, military hybrid and advanced vehicle needs
- World's largest medium and heavy-duty Ride and Drive
- HTUF Working Group Meetings
- HTUF Commercial Construction Equipment Users Forum
- An expanded agenda; high efficiency vehicle technical sessions – hybrid, plug-in, battery electric and alternative fuel hybrids
- Attendance by major end-users and suppliers, networking events and more.....

The 10th Annual HTUF National Conference promises to be the biggest and most ambitious to date, reflecting the growth in hybrid technology, products, and the expanding focus of truck makers on efficiency

HTUF (Hybrid Truck Users Forum) is a program operated by CALSTART in partnership with the US Army National Automotive Center (NAC) - TARDEC

HTUF 2009 Ride & Drive

CALSTART

NAC

JOIN OUR MAILING LIST. To receive updates on the agenda, sponsorship and early registration discounts contact Debby DuBose, Event Manager at ddubose@calstart.org

For more information and to register, visit www.htuf.org or call 626-744-5600

Clean Transportation Technologies and Solutions [SM]

www.calstart.org

For info contact:

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

Job Creation Potential – CALSTART/UCS Research

TODAY

- Over **100k jobs in truck manufacturing**.
- **15k jobs in advanced tech**, with **US companies leading**

TOMORROW, if we have the right policies in place…

- **25k+ new advanced truck jobs** over next 10-20 years
- **Tens of thousands of jobs retained** through US leadership

California Hybrid, Efficient and Advanced Truck (CalHEAT) Research Center

CalHEAT Goals

- Help drive medium- and heavy-duty technology products to market that meet and exceed California climate and petroleum reduction goals
- Assist the nation meet needs for more efficient, reduced carbon medium and heavy-duty transport
- Help create economic activity through focused technology development and market initiatives
- Help improve the efficiency and reduce the impacts of goods movement in Southern California, and by extension California and North America