A program of CALSTART

HTUF hybrid truck users forum

HTUF DiaLog

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Growth of Clean Truck Industry Highlighted at HTUF National Meeting

HTUF Update: World's Largest Ride & Drive Shows Market Expansion

CALSTART's 2008 HTUF National Conference in South Bend, Indiana – hosted by Bosch Rexroth – should set records in all categories, including featuring the world's biggest ever hybrid truck ride-and-drive with more than 35 medium- and heavy-duty hybrids on site.

This year's forum takes on increased importance with national diesel prices extremely high and the economy struggling, since hybrid systems can cut fuel use from 20 to more than 50 percent in some truck and bus applications.

Most hybrid truck technology leaders are also mostly North American firms and could provide new economic opportunities as they are poised to start entering the market in

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International-Eaton HEV tree trimmer and Bosch Rexroth parallel HRB HHV are two of more than 35 hybrids at HTUF 2008

Plug-In Hybrid Trucks May Beat Cars to Market

At least five plug-in hybrid electric truck (PHET) and bus models from four different supplier teams are being developed or assessed this year and just-passed federal legislation may provide a further boost to these early efforts. The prototype designs are mostly focused on urban work trucks with high work-site idling operations, particularly in the electric utility application, although there is also one model for the school bus market. What is intriguing is that while the high cost of batteries is a barrier to plug-in designs, as fuel prices rise the value they can provide in key commercial applications may drive them to make sense in trucks before they do in cars.

Unit costs remain high because of the price of energy storage – batteries – for plug-in units. However, the trade-off that is being explored is the value of shutting off the truck engine for long periods of time while still performing work, such as in the case of electric utility trouble, material handling and "digger-derrick" trucks. In these cases, more batteries

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Incentive Update: Kick-Starting the Hybrid Truck Market

Medium- and heavy-duty hybrid vehicles have demonstrated significant fuel-saving and emission reduction value, and are now

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Hybrids Recognized as a Solution in CARB's AB 32 Scoping Plan

Transportation technologies and systems that are more efficient and use lower-carbon fuels will be increasingly important in California, and medium- and heavy-duty hybrids are recognized as one of the many strategies needed.

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Also Inside this Issue

CALSTART Provides Testimony on Hybrids and High-Efficiency Trucks

CALSTART recently was invited to participate as an industry expert in a Congressional hearing on hybrid technologies in the truck world before the U.S. House Committee on Science and Technology's Energy and Environment Subcommittee. Senior Program Manager Richard Parish represented CALSTART and the HTUF program, providing comments on challenges and the state of the industry:

- Future vehicles need to reduce urban pollution while also cutting fuel use. Few technologies can do both: hybrids can. American OEMs and suppliers are leaders in medium- and heavy-duty hybrids, which can position the domestic industry to lead a global market.
- HTUF's process has removed one to two years from the product development cycle, and helped speed product improvement.
- Funding and support from a number of government agencies, critical in progress-to-date, has or will be ending.
- Truck and system makers need public sector support and partnerships to bring important technologies forward as quickly as the nation needs them.

Parish urged that a multi-year strategy targeting a sustainable hybrid and high efficiency truck market was needed, supporting an array of new technologies including optimized engines, improved energy storage, light-weight material use, more efficient components, better aerodynamics in long haul applications, plug-in hybrid modes, and other strategies.

The CALSTART proposal stressed that a government-industry partnership is needed to help move hybrid and high efficiency trucks along the three stages to market: research and development of new technologies; demonstration and assessment of pre-production vehicles; and purchase incentives during early production years to spur the market. This outline could serve as a framework for the effort needed to ensure U.S. manufacturing technology leadership and the nation meeting its energy security and greenhouse gas emissions goals.

Richard Parish's testimony in full can be accessed at:
http://www.calstart.org/info/OP_ED/CALSTART_Science_Comm_Testimony_June_2008.pdf

Hybrids Recognized As Climate Change Strategy, cont'd from page 1

Those are some of the results of the state's first work to identify how to meet the requirements of its Global Warming Solutions Act of 2006 (AB 32) which requires reducing statewide emissions related to climate change to 1990 levels by 2020.

The California Air Resources Board (CARB) has recently completed a draft Scoping Plan for AB 32 to achieve significant GHG reductions in California. It contains the main strategies California will use. Because transportation accounts for more than 40 percent of the state's GHG emissions it is a key sector for reduction. CARB has identified more than 60 million metric tons of GHG reductions needed from the transportation sector. CARB has also specifically recognized medium- and heavy-duty hybrid technology as one of its strategies to cut carbon.

The AB 32 Scoping Plan includes a range of transportation GHG reduction strategies, including:

➢ Low carbon fuels; ➢ Passenger car carbon tailpipe standards; ➢ Increased vehicle efficiency; ➢ More efficient goods movement; ➢ Heavy-duty vehicle efficiency, including aerodynamics, hybrids and engine improvements, and ➢ High speed rail.

The CARB AB 32 Scoping Plan will go to the Board for adoption in November or December of 2008. CALSTART has been actively monitoring and providing input on the implementation of AB 32 and other complementary State measures, including AB 118, and briefing CALSTART members.

To learn more: An ***Executive Summary*** is available at: http://www.arb.ca.gov/cc/scopingplan/document/sp_executivesummary_draft.pdf

The full draft ***Scoping Plan*** can be accessed at: http://www.arb.ca.gov/cc/scopingplan/document/draftscopingplan.pdf

Plug-in Hybrids, *cont'd from Page 1*

mean the truck can operate aerial devices and work tools without idling the engine, which can reduce fuel use significantly in some cases. One of the prototypes provides the ability to drive short distances without starting the engine, allowing quiet operation in neighborhoods.

Dueco, a major utility truck final assembly and leasing company, has a partnership with technology-provider Odyne and have built two PHET models: a material handler and a digger derrick. The trucks use a large lead-acid battery pack to allow nearly all day engine-off operation. The batteries mostly power the aerial device and tools: it provides very little assistance to the truck while driving. Several of the trucks have been sold and are in fleet testing.

Terex, one of the industry's biggest aerial device makers, has developed a Low Carbon Footprint (LCF) prototype truck that is not so much a hybrid as it is an energy-storage body: none of its energy is used in the driveline. However, the design does allow long periods of engine-off operations. A unit is in testing with Pacific Gas & Electric and may enter production next year.

Eaton has enhanced one of its production Class 6/7 hybrid utility trucks to create a plug-in variant that it is assessing. In this case, the truck remains a fully functional hybrid but adds additional energy storage modules to extend work site operations by 1-2 hours. If depleted, the modules can be recharged at night off the grid. In a separate prototype development project, Eaton is modifying a Class 5 truck for plug-in operations, including adding electrified steering and braking so the truck can drive short distances without its engine. IC Corp., Navistar's bus division, has previously developed a plug-in school bus using an Enova driveline.

What is the future of the plug-in truck? Testing will showcase the value of reduced fuel use the units can provide, together with other benefits such as quiet, no-emission field operations. As fuel prices rise and battery costs drop, there may soon be a cross over point for the commercial user that balances the cost and size of the bigger battery pack with the fuel savings of shutting down the engine.

Port Hybrid Hostler Project Chooses Drive Team Member

US Hybrid has been chosen as the drive system supplier for the hybrid yard hostler demonstration project at Port of Long Beach (POLB). The project, managed by CALSTART, is being funded by POLB, Port of Los Angeles, and the U.S. Environmental Protection Agency.

Three hybrid systems from Torrance, CA-based US Hybrid will be integrated with Kalmar Ottawa 4x2 chassis and tested at Long Beach Container Terminal (LBCT). The heavy-duty off-road vehicles are popular at ports, railroad yards, and distribution centers. Their duty cycles lend themselves to hybridization, due to their frequent idling and stop-and-start operations. The integration process will commence this fall and the first prototype target delivery date is mid-2009.

The hybrid yard hostlers will be placed in regular service at LBCT for evaluations of performance, fuel economy, and emissions compared with traditional diesel models. The project's final report will include an analysis of the business case for hybrid yard hostlers in marine applications.

The hybrid yard hostler project is just one component of the two ports' Clean Air Action Plan that aims to significantly reduce emissions from maritime and dockside operations.

Hybrid Incentives Progress, *cont'd from Page 1*

increasingly recognized as an area of technology leadership for the U.S., important to economic growth. Now, how to move this vital product to market faster? Fleets and industry involved in HTUF's Incentives Working Group have now developed a clear structure of smart, short-term incentives that can kick-start the market for this fuel-saving technology.

The Incentives Working Group (IWG), a partnership of CALSTART and Environmental Defense Fund, is made up of more than sixty fleets, manufacturers and suppliers. Its central finding in 2008 was a consensus agreement on what level of near-term, limited assistance can move the market and kick-start faster fleet purchase. This is a key need: while the first production medium- and heavy-duty hybrid vehicles are now entering the market, they are still at low, early-production volumes. That means the incremental cost – the cost above a standard truck – is still high. While hybrids have demonstrated significant fuel saving benefits, as long as production volumes are low the benefits do not quite out-weigh the added costs, at least not in simple three year payback. HTUF research has identified that unit prices will drop as volume goes up: the gap between the incremental cost and the benefits pay-back will disappear once a minimum volume is reached: roughly two-to-three thousand units per year (per similar driveline type) will help reach this initial "tipping point."

These are not huge volumes. By comparison, nearly one thousand medium- and heavy-duty hybrids have already been delivered or ordered, most this past year. So how do we reach the next level? The IWG has identified that incentives equal to half today's incremental cost will allow fleets to justify purchase. A rebate starting at roughly half the increment cost and dropping each year for five years – when it would end – would be the most powerful tool to kick-start fleet adoption and manufacturer production. The intent is such a program would lead to a sustainable and growing market for hybrid and high-efficiency trucks. The following chart outlines the findings of the IWG:

Table 1. Rebates to Purchasers of Qualifying Hybrid Trucks (first year of program)

Vehicle Weight	**Demonstrated Fuel Efficiency Gain**			
	20%	**30%**	**40%**	**50%**
8,500 – 10,000 lb	$5,000	$10,000	$15,000	$20,000
10,001 – 14,000 lb	$10,000	$15,000	$20,000	$25,000
14,001 – 33,000 lb	$15,000	$20,000	$25,000	$30,000
	10%	**20%**	**30%**	**40%**
>33,000 lb truck	$20,000	$27,500	$32,500	$40,000

Notes: The rebate amounts would drop each year of the program. Hybrid trucks would qualify by demonstrating fuel efficiency gains through existing IRS or EPA guideline.

This rebate structure is a powerful tool. The Incentives Working Group has shared it and the industry rationale behind it with federal and state policy makers as part of on-going discussions on how to move more fuel-efficient trucks into the market. Earlier this year, this discussion led to language proposing substantial rebate and support assistance for hybrid and high-efficiency trucks in the federal Lieberman-Warner climate change legislation. While that bill did not pass in 2008, successor bills in 2009 may build on its structure, and there is now an understanding that hybrids are an important American-made technology that can save fuel and cut global warming emissions.
Indeed, CALSTART and other industry experts testified before the House Subcommittee on Science and Technology on the issue. There is growing interest in hybrids and advanced truck technology.

The Incentives Working Group has made progress on other fronts, as well. There is a federal tax credit for hybrid trucks available under the Energy Policy Act of 2005 (EPAct 2005) that HTUF and

its partners helped secure. While well-intentioned, most commercial fleets have difficulty making use of a tax credit and public fleets are essentially shut out. However, in the absence of the rebate program, an enhanced tax credit that can include public fleets can still help. The Incentives Working Group supports the extension of the tax credit – and its enhancement – past 2009, when it is slated to end, to at least 2012.

On the state level, New York has been a leader in programs to support hybrids, including a limited program that actually provides up to 80 percent of the incremental cost. California has a very aggressive $200 million/year program in formation, known as AB118 (based on Assembly Bill 118), that could provide some of its funds to kick-start hybrid trucks. The Incentives Working Group has been sharing data with policy makers in several states, including California, New York, Texas and Florida and has been encouraging adoption of the rebate structure outlined above as the best basis of an effective incentive program.

Team members have also worked to help pull together fleet purchase teams and funding proposals around regional EPA funds from the Diesel Emissions Reduction Act (DERA) funds. DERA this year offered funds through the EPA regions for projects that reduced diesel vehicle emissions; hybrids were one strategy. Several of the proposals may be funded. For the 2009 solicitations, the Working Group wants to develop a database of fleets in each EPA region willing to purchase and desiring funding assistance. Similarly, CALSTART and the Working Group will establish a database of California based- or operating fleets who might be able to make use of AB 118 funds when those become available.

The HTUF Incentives Working Group will continue to work to secure assistance funds for hybrid purchase in 2009 at the federal, state and regional levels. Want to get involved? Please take part: contact Bill Van Amburg or Jamie Hall at CALSTART (bvanamburg@calstart.org or jhall@calstart.org) or Rachel Beckhardt at EDF (rbeckhardt@edf.org).

Clean Construction Equipment Forum Launched

As announced in the last edition of Hybrid Dialog, HTUF's newest venture, the Commercial Construction Equipment Users Forum (CCEUF) is now underway. This forum brings together manufacturers, suppliers, and end-users of heavy-duty construction equipment to investigate ways to increase their efficiency. It is anticipated that popular equipment types such as wheel loaders and excavators will be the first ones to undergo analysis.

The first activity of the CCEUF will be a stakeholders meeting that will be held on October 14, 2008 as part of the HTUF National Conference. It is anticipated that attendees at this meeting will provide guidance on the Forum's overall direction and serve as advisors during the process.

Future milestones will include a full-scale information-sharing forum that will be held at the Clean Heavy Duty Vehicle Conference next March and a follow-up forum to be held at the 2009 HTUF National Conference. The end result of the CCEUF will be full-scale plans for technology demonstrations in the 2010-2011 timeframe.

Refuse Working Group: Electric, Hydraulic Systems Assessed

The HTUF Refuse Truck WG has selected Crane Carrier Company as the provider for both electric and hydraulic hybrid refuse vehicles to be supplied to the City of New York Department of Sanitation, City of Houston Solid Waste and City of Chicago. CALSTART and Crane are completing an agreement for validation testing of the vehicles and longer-term data acquisition in fleet operation. The hybrid trucks are expected to yield 30 percent to 50 percent reduction in fuel use with an accompanying reduction in emissions. This will be demonstrated in the chassis dynamometer and field testing in 2009.

Crane Carrier Company and ISE Corporation will develop a series hybrid electric vehicle (HEV) version using a self-contained hybrid drive assembly that can be easily mounted between the frame rails in most chassis, replacing the conventional manual or automatic transmission. The proposed HEV system uses components that have already been developed for the transit market in heavy 60-ft. articulated bus applications. The HEV will use nickel-metal hydride (NiMH) batteries or ultra-capacitor packs to store energy recovered from the numerous braking cycles experienced by these types of vehicles during normal operation.

Crane Carrier and Bosch Rexroth Corporation will use Rexroth's Hydrostatic Regenerative Brake (HRB) parallel hydraulic hybrid system to power their new Condor 830L chassis. The HRB system will be integrated with the Heil refuse body hydraulic system for weight savings and more efficient packaging. The HRB system uses a hydraulic pump/motor, connected to the driveline, to capture kinetic energy during vehicle braking. When braking, the pump/motor absorbs energy from the driveline, slowing the drive wheels and using the absorbed energy to pump hydraulic fluid into a nitrogen-pressurized accumulator. During acceleration the pressurized gas pushes fluid out of the accumulator and through the pump/motor, assisting the engine and reducing the fuel required to launch the vehicle.

For more information or to participate in user Working Groups, contact:
-Parcel Delivery, Refuse, and Class 8 Working Groups: Richard Parish – rparish@calstart.org.
- Incentive Working Group: Bill Van Amburg – bvanamburg@calstart.org.
-Utility/Telecom Working Group and Plug-in Hybrid Truck Task Force: Jasna Tomić – JTomic@calstart.org.
-Bus Working Group: Susan Romeo – sromeo@calstart.org.
-Commercial Construction Equip Users Forum: Steve Sokolsky – ssokolsky@calstart.org.

Hybrid Parcel Delivery Group: Vendor Moves Ahead on System

The Hybrid Parcel Delivery Truck Working Group has selected Hybra-Drive Systems LLC to build three large Class 6 trucks for road testing that incorporate the firm's hydraulic hybrid technology.

Using Department of Energy funding, Hybra-Drive will build and deliver three hydraulic hybrid trucks over the next 12 months. UPS, FedEx Ground and Purolator will conduct a 6 - 9 month evaluation. Hybra-Drive hopes to demonstrate up to a 60 percent cut in fuel use along with emissions reductions. Fuel economy is increased in three ways: vehicle braking energy is recovered; the engine is operated more efficiently; and the engine can be shut off when stopped or decelerating.

Hybra-Drive Systems is working with Gates Corporation, Detroit Custom Chassis (a subsidiary of Spectra LMP, LLC) and Morgan Olson LLC, on a series hydraulic hybrid vehicle (HHV) based on a Ford Motor Co. chassis for the project. A gasoline, alt fuel or diesel engine can be used to operate a hydraulic pump that pressurizes stored energy to propel the vehicle. The system is designed to add no extra curb weight compared to the standard vehicle and includes unique, cost effective designs for the variable displacement gear pump and fluid power accumulator system.

Class 8 Working Group: Picking the Application

The HTUF Class 8 Working Group has been monitoring the status of progress in the development of hybrid technology for this vehicle class. The working group plans to determine which application, Over-the-Road, Regional Pickup and Delivery, or Drayage, would benefit the most from hybridization. The working group will then pursue that application for pre-production assessment to help stimulate interested OEMs and suppliers to target investment in the production and deployment of these vehicles. CALSTART and the U.S. Army National Automotive Center, plan to target support funding to help demonstrate this technology in Class 8 trucks this year.

Small Hybrid Bus Working Group: RFP On the Street

After 18 months of hard work by working group members, led by chairman Tony Bryant of TriMet, the Small Hybrid Bus Working Group has put its RFP out for proposals. The RFP is a performance based RFP looking for a 25'-27', 19,500 GVWR size bus to be used in a variety of applications from paratransit to shuttle bus services. The RFP does not request a specific hybrid drive system – either hybrid electric or hybrid hydraulic - and seeks responses from all teams who believe they can meet the performance parameters and bus characteristics in the RFP. Ten public and private fleets nationwide are part of this RFP requesting 16 - 25 buses.

Assisting the working group with the RFP and acting as the lead agency is Missouri Department of Transportation (MoDOT) with working group member Steve Billings guiding the effort. A pre-proposal conference call was held on September 9th during which potential bidders had an opportunity to ask questions about the RFP. It is anticipated the award will be made by the end of the year. **Deadline to submit proposals is October 22, 2008 at 2:00 p.m. central time.** All interested vendors are encouraged to participate and submit proposals. The RFP and responses to questions are posted both on the CALSTART web site at:

http://www.calstart.org/programs/htuf/smhybridbus_rfppage.php

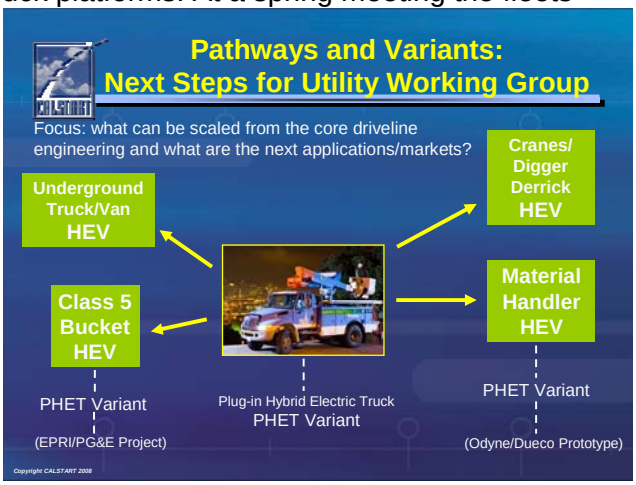
or the MoDOT web site at

http://www.modot.mo.gov/business/surplus/Fleet%20Buyers%20Web%20Page/HybridBus.htm.

Utility WG & Plug-in Hybrid Truck (PHET) Update: Next Steps

The **Utility / Telecom Working Group** is actively developing market commitments to signal potential purchase volumes for next phase new hybrid truck platforms. At a spring meeting the fleets identified the following four categories of vehicles they would like to see hybridized:

- Heavy service trucks (33,000 pound GVWR and above),
- Crew and work step vans,
- Class 5 trouble trucks, and
- Light panel vans.



These platforms were defined as next steps that are logical extensions of driveline capabilities already in the market or moving to the market. The group is collecting data to update and flesh out chassis and application sizes in these areas of interest, the yearly volume potential of these platforms, and potential purchase volumes at different cost points. The goal is to identify key platforms where this group can focus industry interest in production, purchase and deployment.

This may be in the form of a RFI/RFQ or some other process to push the industry in our areas of focus and lead to procurement. The group will discuss the results of the data collection at the Working Group meeting during the HTUF 2008 national meeting. The group is also continually expanding and welcoming additional fleets, including cable, telecom, tree-trimmer and other urban work truck types.

PHET Task Force - Plug-in variants of these trucks are also being considered and fleets are asked to indicate their preference for a plug-in hybrid in the above platforms. Plug-in hybrid trucks (or PHETs) are hybrids that have larger batteries and can partly or fully recharge from the grid. The benefit of a PHET is that it can provide longer idle reduction and power the electrical load on the trucks. The business case of PHETs is critical and challenging. Additional benefits other than fuel savings that need to be captured may be health benefits, quiet operations, CO_2 reduction, and providing export power.

HTUF 2008 Highlights New Industry, *cont'd from page 1*

significant numbers in a variety of classes and service types.

For fleets, the conference provides outstanding access to information on hybrid performance, cost and availability. The major truck makers will outline their current lineup of high-efficiency vehicles and plans for future offerings in briefings and at the ride-and-drive, including:

- Kenworth, with four hybrids including a Class 8 Hybrid Tractor.
- Freightliner, with three hybrids in two weight classes.
- Peterbilt, with a trio of hybrids, including Dump Trucks.
- Dueco-Odyne, with two plug-in hybrid utility industry trucks.
- Azure Dynamics, with three Gas-Electric Hybrids and LEEP Freeze refrigerated truck.
- Host Bosch Rexroth, with two hybrid hydraulic refuse trucks platform based on the Parallel HRB System.
- E-One and its hybrid-electric Command Center
- Hino Trucks, with a cab-over style Class 4 city-box hybrid truck.
- Arvin Meritor Commercial Vehicle Systems, showing its Unicell Quicksider Electric Vehicle.
- Navistar, featuring nine hybrids including its 55-ft Beverage Tracker.
- Eaton Corp., with three hybrids featuring several truck makers.

Presentation sessions will also target key areas of interest, such as:

- ***More Efficient Trucks***: where trucks are headed for higher efficiency;
- ***Military/Commercial Technology Panel***: outlining the Army's needs for advanced vehicles and developments coming next to benefit commercial and military users;
- ***Commercial Construction Equipment***: experts will share insights and projections on technologies for the off-road sector;
- ***New Hybrid Capabilities***: what's on the horizon for evolving hybrid technology.

The HTUF National Conference is recognized as the premier event for fleets, truck makers and suppliers to come together around hybrid truck and bus technology and products. This year's expanded three-day conference grows the meeting to the next step.

HTUF and the National Automotive Center (NAC) thank our 2008 host:

Rexroth Bosch Group

HTUF hybrid truck users forum

*The **Hybrid Truck Users Forum (HTUF)** is a North American program to speed the commercialization of heavy-duty hybrid technologies. It is a project operated by CALSTART to assist fleet truck users to identify hybrid requirements and organize joint purchases of early production vehicles. The U.S. Army National Automotive Center (NAC) is CALSTART's partner in HTUF, and the Hewlett Foundation provides support funding, with project support from the Department of Energy (DOE). HTUF focuses on developing the commercial industry through increasing user-driven volumes, ultimately to provide the dual-use hybrid benefits of reduced fuel use, lowered emissions and increased performance. HTUF program information, contact:*
Richard Parish – HTUF Program Manager, Refuse, Parcel & Class 8 WG, rparish@calstart.org;
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