

**Testimony for the U.S. Senate
Committee on Energy and Natural Resources
May 19, 2011**



**Clean Transportation
Technologies and Solutions**

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CALSTART thanks the Senate Committee on Energy and Natural Resources, its chairman, ranking member and its members for the opportunity to testify and share our knowledge with you on policies to effectively reduce oil consumption in transportation via advanced vehicle technologies and fuels, including electric drive technologies.

The United States stands at an opportune moment with these new transportation technologies. Several of these technologies are areas of U.S. leadership with significant job growth potential if they are expanded. They also directly reduce oil use via increased energy efficiency or fuel switching, providing an avenue for reducing oil imports, cutting operational costs for users, as well as reducing air emissions and improving air quality. The adoption of advanced technologies also importantly supports U.S. manufacturers building these leading-edge products here and for export to the international market.

CALSTART via its national programs together with its industry, fleet and public partners, is working to speed the development and market adoption of high-efficiency, clean transportation technologies, such as hybrid and electric drive, and alternative and clean fuels, for the light (passenger car), medium and heavy-duty vehicle platforms – cars, trucks and buses. Via specific programs, such as our national Hybrid and Advanced Truck Users Forum (HTUF) partnership with the U.S. Army, our renewable natural gas (RNG) efforts, electric vehicle infrastructure and biofuel projects, we have identified the key benefits and also barriers to progress which we welcome the chance to explain. There is an opportunity for smart, targeted partnerships between industry and government to speed the impacts – in oil reduction and job growth – from these new capabilities.

Our testimony will follow this outline: A brief introduction to CALSTART; the **Multiple Solutions Needed to Reduce Oil Use**; a brief overview of the State of the Industry; and Gaps and Barriers. The legislation you are considering will be discussed as part of this structure.

What is CALSTART?

CALSTART is North America's leading advanced transportation technologies consortium. It is a national, fuel and technology neutral, non-profit organization with more than 150 private industry company as well as public agency members. It is dedicated to expanding and supporting a high-tech advanced transportation industry that addresses energy security through reducing imported oil use while also reducing air emissions and creating economic opportunity. We operate across all fuels and technologies, and across all vehicle platform sizes, from two-wheeled vehicles through heavy-duty trucks. We target those solutions that can achieve multiple benefits.

CALSTART serves as an unbiased, strategic broker to spur advanced transportation technologies, fuels, systems and the companies that make them. It works across four areas to expand and support this industry: operating technology development and demonstration programs with industry partners; consulting to ports, fleets and others on implementation of new fuels, vehicles and technologies; providing services to industry members to expand their capabilities; and supporting and guiding the creation of policies that increase the efficiency and reduce the emissions of U.S. transportation.

CALSTART plays a leading national role in facilitating the development of advanced propulsion systems and alternative fuels. For example, it helped create the capability

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for heavy-duty hybrid drive systems in transit buses in program partnerships with DARPA, and now leads efforts in advanced commercial vehicle hybrids, fuels cells, hydrogen and biofuels. Founded in 1992, CALSTART is headquartered in California but operates nationally in its programs.

As one example of CALSTART's work across multiple technologies and fuels, one of our major programs in efficiency and oil reduction is the Hybrid and Advanced Truck Users Forum (HTUF). HTUF is operated by CALSTART in a unique partnership with and under contract to the U.S. Army Tank-Automotive Research, Development and Engineering Center (TARDEC) – National Automotive Center (NAC)¹. Its focus is to **speed the development and deployment of dual-use (military and commercial) technologies** to increase the efficiency of commercial and military vehicles.

It initially targeted market growth in promising hybrid-electric and hybrid-hydraulic medium- and heavy-duty drivelines and then electric vehicles, and now is expanding focus on alternative fuel-hybrids. The goal is to build a competitive, sustainable medium- and heavy-duty hybrid and efficient vehicle market. By working with first-mover fleets and targeting their vehicle performance needs for efficiency with industry partners, HTUF has proven to be a highly successful program to jump-start the commercial hybrid, electric and efficient truck industry in North America. Its track record of success, and the results in terms of industry development and product launches, has benefited truck makers and suppliers as well as military planners keen on supporting a dual-use commercial manufacturing capability for advanced trucks. HTUF is credited with removing one to two years from the product development cycle, and now works with more than 80 national fleets representing more than 1-million vehicles on the road, and all major truck makers and system suppliers.

Another example is in renewable natural gas (RNG), a domestic, bio-based form of natural gas that adds additional domestic supply and can even further reduce emissions from clean natural gas. CALSTART developed first partnerships with Sweden, an early leader in the use of RNG for transportation, and has helped focus partnerships and funding on its production and use in the U.S. **Each region of the nation has unique fuel opportunities, from waste and bio sources**, that can be tapped to create transportation fuel. CALSTART has been active in working with second generation biofuel companies to assist their growth, as well.

Similarly, besides work on the vehicle development side, CALSTART since its beginnings has been very active in electric vehicle infrastructure deployment and technology and built out with partners an initial 500 site recharging network for EVs in the mid 1990s. Today the organization is active in understanding with first movers the best strategies for new recharging site deployment at home and work site, and in particular the opportunities for commercial vehicle recharging.

Multiple Solutions Needed to Reduce Oil Use

To successfully increase our national energy security and reduce our dependence on oil, particularly imported oil, requires a suite of technology and policy options and approaches. While it is tempting to fix on attractive single solutions, CALSTART strongly believes there is no "silver bullet" able to address our national energy

¹ The NAC is the Army's outreach arm to the commercial transportation industry, and is charged with both understanding the capabilities of the commercial vehicle industry and working to increase the capabilities of the industry to build advanced vehicles and technologies that can support emerging Army and military needs.



challenges, no one fuel or technology that alone can effectively reduce our petroleum use to the degree needed. **Rather, we have followed and recommend a “silver buckshot” strategy, advocating a portfolio approach to policy,** technology development and market support decisions.

However, it is also important to note that focus is critical when it comes to the long term goal of reducing our oil dependence and imports. In considering the bills before you and others that may be proposed, **this committee is rightly addressing the most important single sector when it comes to oil use: transportation.** Nearly 70 percent of the oil used in the United States goes for transportation according to the U.S. Energy Information Agency. Some assume that there is more oil used in power production or other uses. However, that is not the case. Therefore, to effectively address energy security and oil use, we must make transportation the top focus of our national efforts.

There are two main strategies to successfully reduce oil use in transportation, and both are required to be effective:

1. **Use less fuel** to do the same work – in other words, increase **efficiency**, such as with hybrid, electric drive and other technologies; and
2. **Switch to non-petroleum fuels**, such as natural gas and bio-based fuels.

Where these **strategies can be combined, as in alternative fuel hybrids or other approaches, you can further increase your effectiveness** in cutting oil use on a per vehicle basis. This is an area of high interest for technology and product development going forward and CALSTART is operating several projects around this combination strategy.

At the same time, while it is critical to support technologies and fuels furthering these strategies, it is equally important to **drive these strategies across all vehicle types**. Partly because they achieve the highest visibility, passenger cars have received the bulk of the attention in the past when it comes to research and development partnership funding and in manufacturing assistance and market introduction. However, there is both a need and a strategic opportunity for greater focus on commercial vehicles – the medium- and heavy-duty trucks and buses that move most of the goods and provide the services in our country. Medium- and heavy-duty vehicles use roughly a third of the fuel consumed in U.S. transportation, and on a single vehicle basis are easily the highest fuel use vehicles on our roads. The fuel saved by a single truck can equal the fuel savings from ten to thirty or more cars. They represent a “big bang for the buck” opportunity for oil reduction that has been insufficiently addressed. However, this is not an argument to switch efforts from cars to trucks; rather, it is a request to include trucks (medium- and heavy-duty vehicles) with cars in all your policy decisions to increase their effectiveness.

There is a strategic opportunity in this sector, as well, for **economic leadership and job growth**. The U.S. is currently the world leader in advanced efficiency technologies for trucks and buses, particularly in hybrid and electric drivelines, presenting a tremendous opportunity for job growth and even for expanded exports. A recent Duke University – Center on Globalization, Governance and Competitiveness report identifies these technologies as areas in which the United States has a strategic advantage as an early leader. The particular areas it researched were electric hybrid and hydraulic hybrid drive systems and the growing high tech component industry supply chain in the United States to produce them. Indeed, CALSTART sees a tremendous opportunity for export of such components and products, given U.S. leadership. We are currently working on a program to develop industry partnerships



for product export opportunities in these technologies to China with our U.S. industry partners. We have already seen growth in exports of such products as advanced natural gas engine systems from North America.

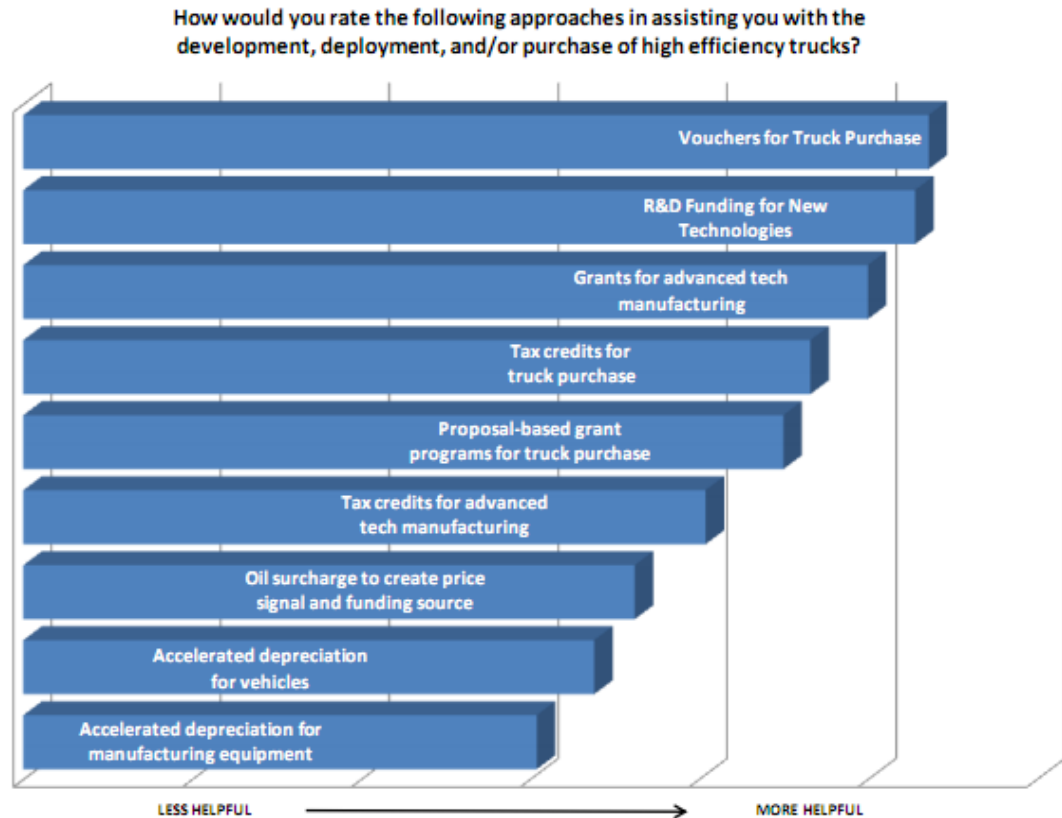
Additionally, UCS and CALSTART last year completed a report on the economic and job growth opportunities from high efficiency trucks. Called “Delivering Jobs,” it documented that 124,000 jobs can be created along with \$24 billion in economic savings over the next two decades through expansion of efficiency throughout medium- and heavy-duty vehicles.

This is of even greater importance given the emerging regulatory pressure to increase efficiency from the National Highway Transportation Safety Administration (NHTSA) and the Environmental Protection Agency (EPA). They are currently in a joint rule making process leading to the first standards for fuel efficiency in medium- and heavy-duty vehicles. The rules should be finalized this summer and go into effect as early as 2014. Policies that can support the industry’s work to develop and produce these new technologies will be extremely timely and helpful.

In view of the above observations, the Advanced Vehicle Technology Act (AVTA) you are considering can be of great assistance to industry to address both greater efficiency and the integration of non-petroleum fuels in vehicles. We applaud its inclusion of medium- and heavy-duty vehicles together with passenger cars and light trucks, as we strongly believe this properly acknowledges the contributions of both segments of transportation to oil use and its reduction. We need strategies to reduce oil use across all vehicles platforms, and the approaches will vary across vehicle sizes. **It may sound trivial, but a big rig or refuse truck is not a car!** While the high level strategies required are the same, as noted above, the state of technology and the effectiveness of different solutions will vary by size, use and type of vehicle. The AVTA could provide this segmented approach, because of its design, allowing custom strategies by vehicle type across all vehicle types.

The proposed legislation also sends an important longer term signal that is critical to manufacturers and suppliers in the light, medium- and heavy-duty vehicle industry. Research and development efforts to date have often suffered from on-going changes in focus and sometimes the selection, in our view, of single solutions rather than encouraging multiple solutions based on performance outcomes. They also have short funding horizons that do not align with the four to five year development cycle of technologies into products, or the longer cycle needed to justify investment in new technologies. A multi-year horizon for a partnership and development process better fits what industry has said would assist it to focus its investments in new efficiency and fuel technologies.

By way of example, recently CALSTART completed the report, “Speeding High Efficiency Truck Adoption: Recommended Policies, Incentives and Investments.” It was performed via research and a task force of industry stakeholders, including fleet vehicle users, manufacturers and suppliers. The findings from the report are highly instructive. **First, they identify the top measures the industry feels would speed the development, production and purchase** of more-efficient vehicles.



The top measures identified by industry were those measures to assist vehicle purchase, thus encouraging greater production and supporting industry investment, and longer term R&D efforts, to partner with industry to keep the next generation of technology in the product “pipeline” and moving to market. The AVTA would address one of the top two areas of need that industry has identified as prime barriers to its progress and therefore to achieving faster and greater oil reduction.

Secondly, it makes a strong case that R&D and other investments and partnerships need to focus on results that achieve multiple benefits, or co-benefits. For instance, while reducing oil use is critical for energy security, it would be counter-productive to reduce oil use through policies that increase emissions and therefore reduce air quality, or which export jobs from the nation. The most valuable approaches achieve these multiple benefits. Greater efficiency and targeted fuel switching can meet these goals.

Table ES-1: Summary of Selected Co-Benefit Value Estimates for Truck Efficiency Improvements

	Fuel Efficiency Gain	Corresponding Fuel Consumption Reduction	Value of NOx Emission Reductions	Value of GHG Emission Reductions	Value of Energy Security	Total Value of Selected Co-Benefits
Heavy Heavy Duty	5%	4.8%	\$2,500	\$1,800	\$1,300	\$5,700
	20%	16.7%	\$8,800	\$6,400	\$4,600	\$19,900
	50%	33.3%	\$17,600	\$12,800	\$9,200	\$39,700
Medium Heavy Duty	5%	4.8%	\$300	\$300	\$200	\$900
	20%	16.7%	\$1,000	\$1,200	\$900	\$3,000
	50%	33.3%	\$1,900	\$2,400	\$1,700	\$6,100

The report attempts to quantify and monetize these co-benefits, in the form of the public value provided – in this specific case – by greater efficiency in vehicles (in the report, trucks and buses). There are significant co-benefits that can be achieved with



efficiency in vehicles, including direct energy security savings and criteria emission reductions. In place of efficiency as a metric, oil reduction could be a metric as well, assuming emission reductions and other benefits are met. In the face of limited resources and increasing needs for reductions in oil and emissions, we likely cannot afford only single benefit outcomes. Driving multiple solutions that can achieve these multiple benefits is smart public policy and also supports industry competition and growth.

It is also worth noting in this context that the Obama Administration has just announced its plan to form a partnership with private fleets to speed their purchase of advanced technology and alternative fuel vehicles. As part of this partnership, the President also made a commitment that by 2015 the federal government will purchase only alternative fuel, hybrid or electric vehicles for replacement vehicles in its fleets. This is a dramatic proposal, and one in principal CALSTART very much supports as it has the government “walking the talk” on petroleum reduction with its own assets. If actually enacted, this will send a strong signal to industry as well as contribute useful purchase volumes to help decrease costs. In this regard, the Promoting Electric Vehicles Act certainly aligns with part of the Administration’s goals and could help to support it. It will be important to understand potential overlaps between the legislation and executive branch commitments.

This legislation also rightly encourages electric drive vehicle deployments across vehicle weight classes, taking advantage of the breakthroughs now occurring in electric trucks and buses. By also targeting deployments in those regions most interested in and supportive of the technology, it can also support regional energy solutions, which, as highlighted earlier in these comments, is an important consideration for successful U.S. energy policy.

There is certainly pragmatism and some focus to be gained from legislation and approaches encouraging important segments of this overall portfolio, which can be centered on specific driveline technologies or specific fuel types. CALSTART supports many of these specific approaches, but **strongly encourages their consideration as part of a larger policy strategy and portfolio.** Individual solutions should be supported as they combine as part of a broader strategy – for instance, a balanced policy of both increased efficiency and increased fuel switching. Longer term, CALSTART strongly supports moving to performance-based approaches to encourage this balance, with incentives and R&D driven and rewarded by their ability to achieve the multiple outcomes (oil reduction, emission reduction, job growth) desired.

State of the Industry

Advanced technologies for efficiency, and effective alternative and bio-based fuels available for switching, are at a new threshold level in America: they are ready for greatly expanded deployment, support and use. Approaches that ten years past were still in early or developmental stages are more mature and increasingly cost effective, particularly on an operational basis when capital costs for ownership can be reduced at the time of purchase. The currently high cost of fuel is an important additional inducement to consider these technologies and fuels. However, the great price volatility of fuel confuses manufacturers and users alike in terms of when to make investments in vehicles with these technologies and fuels. Both the bills the committee is reviewing attempts to address the reality of these technologies and address some of their barriers.



Higher vehicle capital costs – in the form of incremental cost beyond the conventional vehicle – are generally still relatively high because of low volume production and first or second generation designs. This is certainly the case with hybrid electric and hybrid hydraulic technology in commercial vehicles, and to a similar extent with natural gas and other dedicated alternative fuel vehicles, still in low volume early production. Hybrid technology in trucks, for instance, is roughly ten years behind its introduction in cars – they are different market segments. Additionally, there are also some barriers in terms of first-time costs for fueling infrastructure in the case of certain fuels and technology. This is true of the re-emergence of electric drive in passenger cars and its new emergence in all-electric commercial trucks. It is also one of the barriers to be addressed with natural gas and other gaseous fuels, though growing business opportunities exist for private infrastructure development.

Having observed the early market stage of these technologies and fuels, **it is important to note their potential effectiveness.** Natural gas has made a strong case for itself in high fuel-use medium- and heavy-duty bus and truck platforms, particularly in locations where there is sufficient fueling demand to support investing in fueling infrastructure. All truck makers now have natural gas models. Transit and school buses, refuse collection trucks and cargo haul tractors are examples of growing early markets for natural gas vehicles. Infrastructure installed for these uses can have multiple uses for other natural gas vehicles, including light duty cars and pickups. The business case for a user is the low cost of the fuel which is significantly under current diesel and gasoline costs. Natural gas, while currently certified to the same emission levels as diesel and gasoline, has the potential for significantly lower emissions, as well. Several current and potential R&D projects are aimed at the next generation of ultra low emission natural gas engine. Hybrid technology, now established in cars, is just now entering early production in trucks but has attracted every truck maker to the early market with several platforms. The first production units were hybrid electric designs; this year the first hybrid hydraulic systems will enter production. Best uses include and provide options to transit bus, refuse collection, as well as any type of delivery vehicle, from parcel and package through heavy food and beverage tractors. Hybrid technology is now expanding into the tractor-trailer market in heavy regional delivery applications. While it provides some value today in long haul trucks, it is not as well suited to provide reductions in that application currently as are other technologies, though that is likely to change over time. The business case is highly driven by fuel savings and some maintenance savings (such as brakes). All electric vehicles can perform exceptional roles in the light duty arena for commuting, urban delivery, and fixed route, return-to-base operations. Similarly, the medium- and heavy-duty electric truck and bus market is starting to grow by targeting similar applications. Ranges of 70-100 miles per day in delivery and shuttle operations are starting to show potentially strong business case benefits and are proving out their ability to perform the mission. The advances in energy storage during the last fifteen years has provided this base and will now continue to improve, at reduced cost, over time.

From this plateau and these initial capabilities, the focus of development efforts is now on better system integration and design engineering to reduce manufacturing costs in most of these systems. There is also increased interest in designs that can, in the future, combine alternative fuels with greater efficiency, such as with natural gas hybrids. Transit bus users are exploring this potential, and there is interest in refuse and other higher fuel use applications. Because of increasing pressure to reduce emissions under new EPA ozone rules now under review, there is also growing interest in zero-emission transportation, including zero emission freight haul, particularly in larger urban regions with large port and distribution operations. CALSTART is now working to outline a



multi-year project to commercialize zero-emission freight haul vehicles around a major corridor in Southern California which will have need of further developments in all the technologies and fuels mentioned above.

So far, unlike what befell the U.S. automotive industry until just recently, the leaders in these medium- and heavy-duty technologies are U.S.-based manufacturers. This is a significant advantage to the nation. However, that leadership is not assured. More than six truck makers and ten system makers are now developing products in first applications, but the effort has not yet achieved critical mass. To break out, these first efforts must succeed and expand.

Gaps and Barriers

Given these observations, CALSTART has identified with its industry and fleet partners the core needs for continuing momentum in technologies and fuels that reduce oil use, and they fall along the general stages of development:

- **Need for consistent, targeted funding of research and development in advanced vehicles systems and partnerships to assist manufacturers transition to new technologies**
- **Need for funding partnerships with fleets and manufacturers to speed pilot projects and validate performance and reliability**
- **Need for fleet-focused purchase assistance in the early market stage to speed introduction and rapidly increase manufacturing volume**

In terms of R&D, the core technology development needs now are for improved system integration and manufacturability, reduced energy storage costs specific to commercial vehicle designs, efficient components (to enable even greater fuel economy gains in all vehicles, and more capable hybrid and electric vehicles), optimized and downsized engines, advanced combustion schemes, power generation, light-weight materials, and advanced control systems.

The commercial vehicle segment has not been a high enough priority for funding in the past. It has also been assumed that investments made in passenger cars are sufficient to support commercial vehicle needs. The truth is, there are important differences between commercial and consumer – truck and car – vehicles in terms of duty cycles, system architectures, market needs and business cases. A portfolio of smart, targeted funding over a multi-year period and covering all the stages identified above and aimed at the needs of the commercial industry would have significant impacts.

No one approach alone will provide the full solution needed. Similarly, no one policy approach is sufficient. We strongly encourage a portfolio approach to technologies and fuels, balancing the strategy to achieve the end goal of reduced oil use via efficiency and fuel switching, or their combination.

It is important to note that assistance is needed now. The industry is at a critical stage and on the threshold of a successful launch. However, this launch can also be viewed more broadly as the first stage of a transformation of transportation technology. What is required is a commitment to a portfolio of change over a longer term to send clear policy signals to the end user and manufacturer. Ideally, the level of partnership should be commensurate with the needs and the challenge.

Again, thank you to the committee, members and staff for the opportunity to provide this testimony and share the progress to date we have seen in advanced efficient



technologies and fuels that can reduce oil use and emissions in cars, trucks and buses of all sizes. These technologies are areas of U.S. national leadership, and together with the other benefits, can be important for job creation, export opportunities and economy growth.