The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Electric Commercial Vehicles

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Electric trucks do more than what most people think they are capable of doing. In this post, I will talk about both electric trucks and other commercial electric vehicles.

Back in July 2008, someone challenged me in Drumbeat to point out some really heavy duty electric vehicles that can move say, a fully loaded 40 foot container. I fired off a reply featuring lots of links to electric or hybrid trucks and delivery vans. Both in that comment and in this post, I rely heavily on autobloggreen.com for the research, since it is a blog almost exlusively dedicated to "green" transportation issues.

One of the trucks in the July 19, 2008 comment was a really heavy duty electric truck in use at the port of Los Angeles.

Electric truck used at Port of Los Angeles

Battery Operated Trucks

The port of Los Angeles is an interesting case. It seems to me that the electric truck and the port are a match made in heaven. The trucks used by the port basically shuttle containers around the port and to warehouses and rail yards nearby. This means that there is very little risk of a truck with a sixty mile range being unable to make the trip out of the port and back. In addition, with the port being the base of operations, charging and/or battery exchange stations can be set up right where the trucks work.

When my original Drumbeat comment was written, the port of Los Angeles electric truck were still in a trial stage. Recent news suggests that the trial referred to in my original post was a success, so much so that the port has placed an order and started taking delivery of 20-25 more units being produced at the manufacturers new production facility located in the Los Angeles metropolitan area. The manufacturer also hopes to sell additional units to other customers.

Smith Electric Truck

In the UK, Smith Electric Vehicles and Modec have been in manufacturing and selling plug in, battery electric vehicles for at least two years. Modec has a list of customers using their trucks at their web site with pictures of the trucks in company livery, as does Smith Electric Vehickes.

Fed Ex Electric Truck

Small North American manufacturers like Canadian Electric Vehicle (CEV) have also produced viable battery electric vehicles for use in and around airports. Fifty of CEV's electric trucks are on duty at airports from New York's JFK and Chicago's Dulles to Los Angeles's LAX airports. Other clients include Southwest Airlines, Shell Oil, and British Petroleum, which buys CEV vehicles for its Australian division.

Electric Truck at an airport

Series Hybrids

Series Hybrids are similar in concept to the Chevy Volt in that the internal combustion engine (ICE) is never connected to the wheels by a transmission of any kind but instead drives an electric generator providing power for the electric motors. Coupled with batteries, this allows the ICE to be run at close to its maximum efficiency at all times. Significant cost savings can be achieved by this approach. This has been the experience of London Transport, New York MTA and public transportation systems of other North American cities.

Heavy duty series hybrids are not new. They were one solution to transferring the massive amounts of power needed to move the giant earth movers used in mining operations. The technology has also been used widely in railway locomotives.

There are significant numbers of series hybrids in operation in the New York City area bus fleet. This photo is from the bus manufacturers news page

• MTA New York City Transit and the MTA Bus Company will take delivery of 850 Orion VII Next Generation diesel-electric hybrid transit buses by early 2010. This order will bring the MTA's diesel-electric hybrid bus fleet to almost 1,700 units, making it the largest diesel-electric hybrid fleet in the world. With this order, Orion brand transit buses will account for almost 50-percent of MTA New York City Transit's entire fleet.

• OC Transpo has ordered up to 202 Orion VII Next Generation hybrid diesel-electric hybrid transit buses to be delivered by 2010. This delivery will make OC Transpo the third largest hybrid bus fleet in Canada.

Similar technology exists in London where the fleet is being expanded to include double decker

series hybrid buses.

Another series hybrid that has been evaluated by the New York MTA is an intresting unit manufactured by DesignLine. This unit uses electricity generated by an onboard micro turbine manufactured by Capstone Turbine Corporation, a supplier of micro turbines for use in Combtned Heat and Power applications. This turbine boasts one moving part with air bearings. It will be interesting to see how these fare in the long term. What makes this vehicle unique is that its traction motor and auxilary power unit (turbine-generator) contain a total of three moving parts!

Parallel Hybrids

Parallel hybrids are vehicles that can have the wheels be driven by the ICE or the electric motor or both. They are easily the most mechanically complex hybrids and fall into two main camps. The two mode hybrid being implemented by GM/Allison, Daimler, BMW and Chrysler(?) typically consist of a motor/transmission unit containing:

• two AC motors;
• three planetary gear sets;
• four multiplate clutches;
• two hydraulic oil pumps.

Toyota uses a slightly less complex but similar system in their Hybrid Synergy Drive. The other main parallel hybrid type uses an electric motor sandwhiched between the ICE and the transmission with a clutch to disengage the ICE when not required leaving the electric motor to move the vehicle. Otherwise these systems are very similar to traditional ICE driven drive trains. These systems usually dispense with a starter motor and the alternator with the traction motor filling all three roles, as is the case with Volvo's ISAM amd Mitsubihi-Fuso's system.

Misubishi Fuso has been selling a parallel hybrid light truck in Japan for a couple of years now and has ten evaluation units in London. GM-Allison has sold a significant number of their two mode hybrid buses in North America and Eaton Corporation has supplied Coca-Cola Enterprises with the largest single order to date for trucks using the company's hybrid system, over 100.

Electric Advantages

Electric drive systems should be able to gain some serious traction in the commercial vehicle market since electric drive in commercial vehicles is a more viable option NOW. One reason is that a large percentage of delivery vehicles operate on fixed routes and schedules so their use and charging cycles can be planned with more certainty than an individual's personal transportation. Smaller delivery vehicles also tend to do shorter range trips, so electric drive systems are a particularly good fit. Routes can be planned so that vehicles return to base long before they run

out of juice. In addition, fleet operation bases can be equiped with high power fast charging stations or battery swap stations, if fast turnaround times are more important than the cost of spare battery packs. School buses, airport shuttles and other pasenger moving operations that frequently move people on routes that are less than 50 miles round trip also present opportunities.

For example, during a recent trip to the US, I spent some time at a car rental location and observed that there were a couple of shuttles making trips to Miami International Airport and back, a trip that I estimate takes less than half an hour to complete. Also at the location were several shuttles sitting idle. If these shuttles were electric, the idle ones could be plugged in while the shuttles were working. When the working ones need charging, they could be plugged in and one of the idle ones used to replace them.

Electric drive vehicles also tend to have lower maintenance costs. The only parts that can really wear out in an electric moter are the two motor shaft bearings. One only need look at electic motors used in industry and commerce for an indication of how much maintenace will be required. The only oil changes that are required relate to transmissions and final drives. These oil changes are less frequent than the oil changes required by an ICE.

If regenerative braking is used, the vehicles are able to go more than twice as far between brake lining replacements. In series hybrids, clutches and complex tranmissions are not required so drive train maintenance can be greatly reduced while the ICE used to generate power can be set up to operate under optimum condions extending service intervals and the useful life of the engine.

What's on the horizon?

In late 2007, Daimler introduced 16 new buses and trucks with different driving systems and "greener" fuels. These have formed the basis for many of the hybrid vehicles in use today. Research continues as they are currently testing a lithium iron powered series hybrid articulated bus. British bus builder Optare recently held a demonstration drive of its new Solo EV electric bus at the Millbrook proving ground in central England.

Volvo is supposed to be introducing a parallel hybrid to the European market this year that operates in electric mode at low speed and has regenerative braking. An article with a video of the truck in operation is here. Smith Electric Vehicles, after many false starts, finaly appears poised to begin production at a Kansas City production facility in the third quarter of 2009. They have an arrangement with Ford to electrify the Ford Transit Connect as a BEV (battery electric vehicle) light-duty van scheduled for production in 2010. Azure Dynamics, one the suppliers for the US based tests of light to medium duty delivery vans for companies like FedEx and UPS, continues to develop it's offerings and has signed new Sales & Service agreements with some Ford dealerships to work on the company's Balance Hybrid Electric commercial trucks. Electric Vehicles International and aspiring electric truck manufacturer Electrorides both offer medium duty battery electric trucks that appear to be based on the ubiquitous Isuzu NPR cab and chassis.

The main drive systems suppliers that I could identify are BAE Systems, Eaton, Enova and Azure Dynamics. The companies all appear to be in reasonable financial health and look to have sufficient orders going forward. One supplier, Odyne, was apparently insolvent and was acquired by DUECO. If the stimulus package provides an opportunity to this nascent industry, it might survive and provide a basis for a new generation of trucks and buses that will provide both a reliable and cost effective option for the transportation needs of industry and commerce as we

enter a post peak world.

According to Zerotruck's math, it would appear that electric commercial vehicles are not hard to justify in terms of the savings compared to the additional cost of going electric.

Edit

I didn't realize that this post wasn't quite finished when I posted it. (This was the second draft, not final.) These are some important paragraphs that were added to the final.

Electric Pros and Cons

Battery powered electric vehicles have restricted range. Overcoming the range restriction carries significant penalties in terms of battery pack size weight and/or cost. For commercial vehicles, the range limits are not an insurmountable problem as a large percentage of delivery vehicles operate on fixed routes and schedules so their use and charging cycles can be planned with more certainty than an individual's personal transportation. In addition, larger commercial vehicles tend to have more space that can accommodate larger battery packs without impacting the cargo or passenger areas. Smaller delivery vehicles tend to do shorter range trips so smaller battery pack sizes offering limited range are not a big issue. In any case, routes can be planned so that vehicles return to base long before they run out of juice and the fleet operation bases can be equipped with high power, fast charging stations or battery swap stations if fast turnaround times are more important than the cost of spare battery packs. In some cases the loading bays at destinations could be equipped with fast charging stations so that batteries could be topped up for the onward or return trip while the vehicle is being loaded or unloaded. School buses, airport shuttles and other passenger moving operations that frequently move people on routes that are less than 50 miles round trip also present opportunities.

Although Electric drive systems attract a higher initial capital cost of at least 30% more than a similar conventional vehicle, they should be able to gain some serious traction in the commercial vehicle market since electric drive in commercial vehicles results in significantly lower operating costs in the form of reduced fueling costs and lower maintenance costs. The only parts that can really wear out in an electric motor are the two motor shaft bearings and one only need look at electric motors used in industry and commerce for an indication of how much maintenance will be required there. For battery electric vehicles, the only oil changes required, are for transmissions and final drives which are less frequent than the oil changes required by an ICE. If regenerative braking is used, the vehicles are able to go more than twice as far between brake lining replacements. In series hybrids, clutches and complex transmissions are not required so drive train maintenance can be greatly reduced while the ICE used to generate power is usually set up to operate under optimum conditions, extending service intervals and the useful life of the engine.

What Should We Be Doing Next?

The fact is that while electric drive systems are being produced by the hundreds, internal combustion engines and their related transmissions are being produced by the hundreds of thousands. Component costs will not come down as long as these relatively minuscule number of electrically driven vehicles are being manufactured and sold. It is the classic cache 22, for prices to come down volumes must go up but, for volumes to go up, prices must come down. In this situation, something must happen tip the scales and make the new technology irresistible, like the fuel price shocks of 2008. However in this post shock recessionary climate, fuel prices have plummeted and the new, more efficient but, initially more expensive technology has lost it's luster

resulting in buyers returning to the safe haven of buying what they've always bought. It is still quite remarkable that many of the electrically driven commercial vehicles have sold in the numbers that they have and it lends credence to the thinking that the long term savings from their use are quite significant. According to Electrorides' numbers, it would appear that electric commercial vehicles are not hard to justify in terms of the savings compared to the additional cost of going electric.

If we wait for the next fuel price spike to stimulate demand for electric vehicles, several of the key players may fail and disappear in the meantime. Tax incentives, purchase rebates, increased fuel taxes are all tools governments can use to stimulate demand during hard times. If, as many readers of theoildrum believe we are perilously close to if not past the peak of world oil production, we are going to need alternatives to the almost exclusively fossil fuel powered transportation infrastructure that exists today. Hopefully the stimulus packages being devised around the world will help to provide an opportunity to this nascent industry, so that it will survive and provide a basis for a new generation of trucks and buses that will provide both a reliable and cost effective option for the transportation needs of industry and commerce as we enter a post peak world.