Commercial Vehicle Electrification

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- Government
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- Others
Briefing Paper #4 - Electrification: Evolution or Revolution Part 1

Alex Woodrow, Managing Director

Tesla’s much awaited announcement of its ‘Semi’ Class 8 truck has generated a lot of commentary, so we thought it would be interesting to take a step back and consider what it actually means for the industry…

Whilst most are agreed that innovation is necessary to meet society and industry’s often conflicting requirements, we don’t believe that the electric truck is today’s near future. What it is doing is heating up the debate about the future of heavy goods transport. However, as powertrain analysts in the heavy and non-road segment we see it more as a trend that started in earnest in the late ’00s, had a long hiatus after the global economic crisis of 2008/9 and continued as low oil and fuel prices muted the interest in fuel economy technologies, but has changed up a gear in the past 12-18 months. This time however, it is not just the OEMs and Operators, with their focus on lowest TCO rather than purely fuel cost, or emission legislation driving the change. It is the additional focus on local emissions, urban air quality and Corporate Social Responsibility (CSR) in the medium term and GHG/fuel economy legislation in the longer term. As a result we see the convergence of society and operators needs over the next 5-10 years driving development.

There are many examples of recent new innovative product launches, with Tesla at one extreme, but at the same time we’ve seen massive investment in the next generation of conventional trucks. This process of investment and optimisation will continue for at least the next 10 years. By that point all-electric will have a share, hybrids, natural gas a slice, possibly fuel cell as well, but diesel is likely to still have the largest share of the pie.

So again, we aren’t totally pessimistic about Tesla’s future but the initial numbers don’t stack up. Battery prices, vehicle price, charging availability, electricity prices, based on near future economics just don’t stack up. And that’s the reason in our opinion that fleets will take low volumes, but we expect and hope to see technology innovation spill out from Tesla Semi into the into other segments including the plug-in-hybrid, offering ‘last mile’ all electric delivery and optimised mild hybrid for longer distance transport.

About the Tesla Semi...

So let’s take a brief look at the Tesla Semi. Even though the truck won’t launch until 2019 the promise of 500 miles range on one charge is a compelling proposition for a number of fleets that have announced they will put deposits down. But for many the announcement, and subsequent press releases leave too many questions unanswered:…

Specifications and Competitors

Tesla doesn’t specify the total battery size, but with a range of up to 500 miles and energy usage of around 2kWh per mile it suggest a battery of 800-1000kWh, some 10x as big as the largest Tesla S and 15 times that of the new Tesla 3. Mercedes’s electric delivery truck claims 200km (120 miles) with a battery of 212kWh. Daimler’s other new electric truck, from Fuso, has a battery from Daimler’s subsidiary, Deutsche Accumotive, with 42-84kWh capacity. Proterra’s Catalyst (E2 max) electric bus is available with a 660kWh battery. So the Semi will easily have the largest battery of any truck, but the not the largest road vehicle battery to enter production. With Tesla’s battery cost targets nearing $100 per kWh that means a $100,000 battery, at cost price.

What does 900kWH mean for payload? With the new Tesla 2170 cell that means 53,000 cells in total, packaged into around 8-10 modules according to some commentators. With an energy density of 17Wh per cell that means a weight of 5-6000kg. So a potential payload loss of around 5-10% depending on the type of truck.

And charging? With that battery size and the 30 minute fast charge promised a ‘Mega’ charger has been proposed. With the current superchargers, the Tesla Semi Truck would need around 8 to charge up to 80% of capacity in 30 minutes. The price announced at between $150,000 and $200,000 looks very optimistic, but nobody really knows what the battery cost Tesla can achieve. 800-1000kWh at $100 means the battery alone will cost half the vehicle price. Proterra’s Catalyst E2 with 330kWh battery costs a staggering $799,000.

So what does that mean for the other costs and Tesla’s margin recovery? Will the batteries last 1m miles? Will they go back into a secondary market, i.e. for Powerwalls? What is Tesla’s secret? How many service and maintenance dealers will Tesla have for the launch or will they be solely fleet based? All questions left to answer….

About EV/HEV in the CV segment

Looking at the broader global picture there is already considerable electrification in the CV segment. In
China notably the electric bus has already taken 40% plus of the market, depending on who you talk to, and which segments are being analysed. This is partly driven by subsidies but also by air quality issues and direction by the central government, as well as local governments. In other markets there is a low penetration of hybrids, but more natural gas vehicles. The issue with both electric and natural gas is that the energy density is much lower than diesel. Even with the improved energy efficiency of the electric driveline, the battery size equivalent to a 1000l diesel fuel tank with a weight of 800kg compares to 20t for a battery, using Tesla 2170 cells (assuming electric is double the efficiency of a diesel powertrain). With an engine and transmission at 2,000kg including accessories there is likely to be substantial weight penalty even if the energy density doubles as forecast over time.

The problem is that even with the considerable energy recovery achievable the average energy consumption is much more than a light vehicle:

Figure 2 Average energy consumption estimates

<table>
<thead>
<tr>
<th>Segment</th>
<th>kWh/km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium Truck</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Heavy Truck</td>
<td>1.20</td>
</tr>
<tr>
<td>Heavy Bus</td>
<td>1.30</td>
</tr>
<tr>
<td>Light Vehicle</td>
<td>&lt;0.2</td>
</tr>
</tbody>
</table>

As a result, Chinese buses on average have a battery of 300kWh on a closed route. Electric trucks with batteries around 100 kWh can achieve a low but useful all electric mileage, and are being developed by other OEMs in specific applications.

Compared to diesel averages in Europe and North America the cost savings can be significant if the up-front investment falls. With European and North American fleets looking for less than one-year payback for most new technologies there is a long way to go for the electric trucks before it competes on conventional economics. Therefore, its success will rely on fleets with long payback calculations or Corporate Social Responsibility CO₂ targets.

We also see considerable potential for CV applications to continue to improve using conventional technologies. Tesla’s technology has a very aerodynamic body and existing vehicles could adopt these without needing to go to electric.

Current technologies to meet GHG II?

A number of technologies can be adopted across both CV and Non-Road with some borrowing capability from the light vehicle segment to further reduce costs. What are the options?

- 48V coming faster than expected as technology runs from the light vehicle to the CV segment
- Mild hybridisation allowing modest downsizing of the engine with a smaller battery size, allowing conventional technologies to be adopted.
  - Advanced thermal management
  - Waste heat recovery
  - Aerodynamics

All of the above technologies will reduce CO₂ from trucks by 20% over the next decade, reducing the benefit of the electric truck and pushing out the payback for those trucks. Over 200,000 Class 8 trucks with a 5% saving in CO₂ is better than a 100% saving in just 10,000 and the cost benefit is likely to be significantly better. Getting these new trucks into the fleets and replacing older vehicles would improve air quality more quickly than a small share of all electric trucks.

So what are we saying? We think that a systems approach to powertrain selection, picking the right fuel for the truck, on a fixed route is the driver for alternative fuels. Making most of the benefits for air quality in non-attainment zones. Using low carbon fuels in industries that have limited mitigation opportunities in their other processes. Optimising the driver training, route selection, load management etc. in the short term. Adopt advanced powertrain technologies with lower emissions for conventional trucks in the mainstream. Use natural gas or LNG in locations where it is readily available and can displace diesel.

Our outlook suggests that it is these drivers other than fuel economy that are pushing right now. Even as diesel heads towards $100 it isn’t enough to really push the payback curve in the right direction, it is more important to look to secondary benefits to achieve payback at a corporate level. What is also means is a change in the Business Model for much of the transport industry and the major fleet owners if government policy dictates.

With this ‘environmental scenario’ we see the following potential penetration by 2024.

Figure 3 CV Scenario 2024

Global hybrid and Electrified CVs, plus alternative fuels are expected to reach around 1 million units in 2024, out of 4m in total above 6t GVW.

In early 2018 the full findings of our work will be published alongside a study on Non-Road Mobile Machinery Hybridisation, electrification and alternative fuels.
Meet us!

KGP will not be attending any events until after the New Year but please contact us to arrange a free consultation on Single Client, Multi-Client and Special Reports.

We can also prepare a client specific webinar to introduce our services and provide an industry overview.

Briefings

KGP’s free briefings are published twice per month covering Commercial Vehicle and Non-Road Mobile Machinery topics. Forthcoming briefings will include:

- Hybrid and Electric Commercial Vehicle Trends
- Hybrid and Electric Non-Road Mobile Machinery Trends

References

- Knibb Gormezano and Partners Q3 2017 CV Engine Market Summary Report: [Click Here]
- LMC Global Commercial Vehicle Forecast [Click Here]

KGP’s partner, LMC Automotive, provides three services in the medium and heavy commercial vehicle sector, two of which address production of, and demand for, medium and heavy commercial vehicles, while the third service is specifically devoted to the global bus sector.

Published in conjunction with ACT Research, the leading supplier of information and forecasts on the North American truck and trailer sectors, the Global Commercial Vehicle Forecast analyses the current and future state of the global medium and heavy commercial vehicle sectors at a level of detail unmatched by existing services in the field.

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