US Automakers

Expert Call: Many Challenges Remain For EVs (Includes Conference Call Transcript)

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UBS hosted a call and meetings with EV battery expert, Jon Bereisa

Last week, we hosted a conference call and group meetings with Jon Bereisa, the President and CEO of Auto Lectrification. He worked for over 35 years at GM and served as a Chief Engineer for the EV1 and Senior Architect of the Chevy Volt. His experience gives him unique insights into battery costs. Overall, the meetings were slightly cautious for TSLA as his 2020 battery cost targets implies that EVs costs would still be at least ~$7k more than a comparable gas vehicle, limiting the mass-market potential. He also highlighted significant EV adoption in the US would result in the need to upgrade local utility infrastructure; globally, EV demand also could be constrained by more limited dedicated parking (most charging done at home). That said, he sees large inefficiencies in the dealer network (too many, too much inventory cost, etc.), which could help reduce the manufacturing cost gap vs EVs.

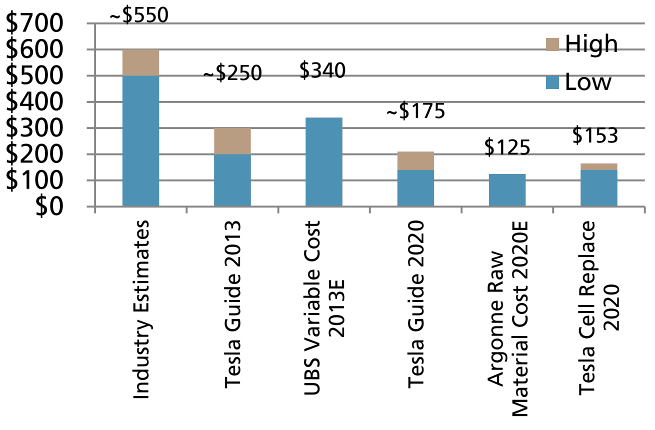
Sees potential to reduce battery cost ~50% today…

Interestingly, manufacturing scale is not the biggest driver of reducing battery costs. Rather, about half the cost savings are achieved through reducing the cost of 'finished' materials (similar to how automakers reduced costs in the catalytic converter). Other key drivers through 2020 include engineering the pack more efficiently and leveraging overhead. Beyond 2020, cost reductions will be dependent on improving cell density.

… but is that enough for EVs to be competitive?

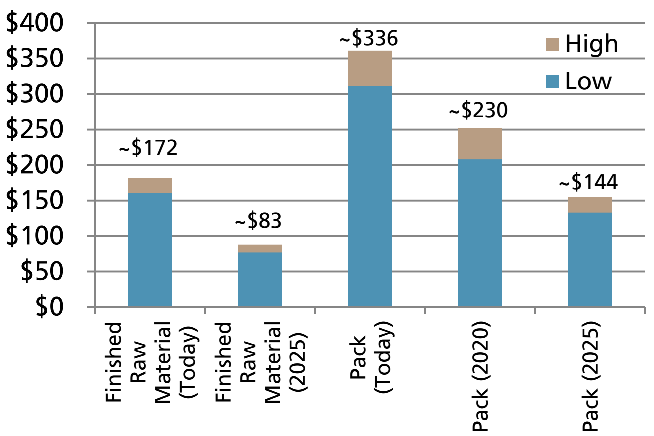
Bereisa's *bull* case 2025 target makes the optimistic assumption that cell density doubles via scientific progress. Even in this case, it implies the factory manufacturing cost of an EV would be ~$26k, well above the average mass market vehicle's ~$19k cost today. Adjusted for the ~$3k in cost likely added to meet fuel economy standards, the reduced ~$3k gap becomes more reasonable given the fuel savings. Without a density improvement, the economics would likely fall short for mass market adoption, which is likely why TSLA is the only OEM moving forward with scale EV facilities.

Figure 1: Battery Cost Estimates



Source: BCG, Company reports, Argonne lab, UBS

Figure 2: Battery Expert Cost Estimates



Source: Auto Lectrification

Summary

Last week, we hosted a conference call and group meetings with Jon Bereisa, the President and CEO of Auto Lectrification. Mr. Bereisa worked for over 35 years at GM and served as a Chief Engineer for the EV1 and was the Senior Architect of the Chevy Volt. His experience gives him unique insights into battery costs and critical EV issues.

Battery Cost Analysis

Mr. Bereisa estimates EV battery pack costs are $311-$361/kWh today ($211-$236/kWh cell) with the potential to reduce costs ~30-33% with scale (Gigafactory). With improved cell density, by 2025 costs could fall ~51-52% (see Figure 2). Reducing supplier margins associated with processing raw materials is key to cutting cost. This is similar to how OEMs have reduced catalytic converter costs historically. Automakers have gone as far as acquiring platinum mines to reduce costs, and they have also used large contracts as a 'big stick' to get better margins on suppliers that process the platinum and other raw materials.

Gigafactory helps reduce battery costs 30-33%, largely by squeezing raw material supplier margins. Further savings are possible with advances in cell density.

Bereisa's *bull* case 2025 target makes the optimistic assumption that the science doubles the cell density. Even in this case, it implies the factory manufacturing cost of an EV would be ~$26k, well above the average mass market vehicle's ~$19k cost today. Adjusted for the ~$3k in cost likely added to meet fuel economy standards, the reduced ~$3k gap becomes more reasonable given the fuel savings. Without a density improvement, the economics would likely fall short for mass market adoption, which is likely why TSLA is the only OEM moving forward with scale EV facilities

Even under the 2025 *bull* case, an EV will still be more expensive than a comparable gas vehicle.

Positively, he sees significant inefficiency in the dealer network (too many, too much inventory cost, etc.) which could help reduce the manufacturing cost gap.

Avoiding expensive franchise system could help reduce manufacturing cost gap.

3 Points of Caution

- **Battery technology evolves slowly.** While battery chemistry technology changes, he cautioned that unlike other technology, battery technology evolves slowly (15-20 years). He also warned investors to be careful of technology 'hype' since often getting one part of the cell to perform well on one characteristic often comes at the cost of other important characteristics. Investors should focus on improvement around the cathode (vs. anode) as this is the more limiting factor to battery performance today.

Battery technology evolved over 15-20 years.

- **Parking availability is a global issue.** Jon highlighted that the availability of dedicated parking may be a challenge outside of the US. Most EV charging is done at home. In the US about 47% of people have dedicated parking; however in Europe likely less than 30% of the population has dedicated parking, and in the wealthy urban cities in China, dedicated parking is rare.

Limited dedicated parking could be a limitation of EV adoption globally.

- **Transformers likely need upgrades.** Bereisa highlighted that there is enough power in the grid to support about 120m EVs in the US, or about 45% of the parc, which is a meaningful amount. However, higher EV penetration could pressure the grid locally as local transformers would need to be upgraded. Transformers can handle a total of 50kW; this supports the needs for about 10 homes. If you add 5-7 Volts or 1-2 Model S 10V chargers, these local transformers will need to be upgraded. These upgrade costs will drive up

Significant EV adoption would require local transformers to be upgraded.

overall utility prices for consumers. If more supercharging stations were also added, this would put even more pressure on the local grid.

TSLA Competitive Advantage

Mr. Bereisa does not believe that the cell chemistry or even scale will be a long-term competitive advantage for Tesla. However, the expertise that would give TSLA a competitive advantage is facility management. Superior management will result in lower scrappage, higher throughput, and therefore better overall cost. Moreover, battery production is more similar to manufacturing semiconductors vs. vehicles, and therefore requires a different expertise.

Fuel Cell Logic

Fuel cell interest driven by fast refuelling and ample hydrogen supply; however this is a long-term opportunity (2030 or later).

Toyota and Honda are continuing to invest in fuel cell technology. However, he believes this technology will not be significant until 2030 or later. He thinks that Toyota is looking longer term and does not see the grid supporting EVs at full scale. Moreover, it would only cost $11bn to install a hydrogen infrastructure in the US ($1m per station and 11,000 stations need to address the 27 largest metro areas). This is small relative to overall oil spend. These stations would be capable of refuelling cars within 3 minutes. He also highlighted that hydrogen can be easily created and is in ample supply. Currently, significant amounts of hydrogen are burnt off or vented each year by manufacturing facilities. That said, the biggest challenge is making storage economical (need high-cost carbon-fiber tanks to handle higher pressure).

Investment Conclusion

The meetings support our cautious view of the mass market launch in 2017.

We remain Neutral on Tesla. We see upside to sales and earnings as the Model S ramps production globally; however we remain cautious about the ability to both lower the battery and non-battery costs in the Model 3 mass market vehicle, which launches in 2017.

Battery Cost Analysis

In Figure 3 below, we recap Jon's battery cost reduction analysis. The key drivers are reducing the processed raw material costs and boosting cell density. Jon highlighted that there is likely more limited ability to reduce battery cost beyond 2025 with just advancements in lithium technology.

Figure 3 below walks through the opportunity to lower battery costs. Key drivers include lowering the raw material finishing costs and reducing pack costs.

(1) **Going vertical:** The materials in a battery require a lot of processing before being incorporated into the cell. The suppliers that refine these raw materials have very good margins of 40-60%. Automakers need to reduce these costs by both moving up the value chain (ex. owning mines) as well as leveraging very high volumes to pressure margins ("big stick"). This is how automakers addressed platinum and palladium costs in catalytic converters. In this 2025 outlook, these margins are squeezed to just 10%.

(2) **Boost density:** Jon sees Argonne's dual-layer cathode as having the most long term potential. *This technology needs significant refinement*, but has the *potential* to offer twice the density relative to current technology. The material would be slightly more costly so it would be slightly more than one half of the current unfinished raw material cost.

(3) **Reducing battery pack costs:** There is also the opportunity to reduce battery pack costs though learning over time. When vehicles are originally designed, there tends to be over-contenting for safety and durability concerns. As automakers learn, they can reduce the excess costs without compromising the vehicle.

Figure 3: Analysis of Battery Costs

	Today		Scale (2020)		Density (2025)	
	Low	High	Low	High	Low	High
Raw Material (Unfinished)	$115	$130	$115	$130	$70	$80
Mark Up to Process	40%	40%	15%	15%	10%	10%
Raw Material (Finished)	$161	$182	$132	$150	$77	$88
Manufacturing Cost	$15	$15	$10	$10	$10	$10
Factory Cost	$176	$197	$142	$160	$87	$98
Overhead %	15%	15%	8%	8%	5%	5%
Overhead	$26	$30	$11	$13	$4	$5
Profit %	5%	5%	3%	3%	2%	2%
Profit	$9	$10	$4	$5	$2	$2
Total Cell	**$211**	**$236**	**$158**	**$177**	**$93**	**$105**
Add Pack Costs	$100	$125	$50	$75	$40	$50
Total Pack Cost	**$311**	**$361**	**$208**	**$252**	**$133**	**$155**

Source: Auto Lectrification, UBS

In Figure 4 we summarize the total implied cost of the vehicle. Jon's analysis highlighted that an EV vehicle would cost about $10k more than a gas vehicle with the Gigafactory and about $6k more under his best case 2025 outlook. This gap would be about $3k smaller given the need to add costs to gas vehicle to meet fuel economy regulations. The larger the cost disadvantage, the more challenging it will be for Tesla to convince consumers that the economics of EVs makes sense. Cost paybacks typically need to be in the 3-year range for fuel saving technology.

Figure 4: Analysis of Total Vehicle Cost

	Today	Scale (2020)	Density (2025)	Mass Market Gas
Factory Cost	$34,726	$29,417	$25,625	$19,402
Battery Pack Cost	$15,674	$10,365	$6,573	

Source: Auto Lectrification, UBS

Grid Impact

Focus is on the last one-hundred feet

Concentration problem rather than a volume problem.

Electric vehicles will most certainly bring additional electric load but with the charging of vehicles likely focused on the off-peak hours when there is excess generation, the generation side of the equation is not likely to be impacted significantly, at least in the short/intermediate-term. The high voltage transmission infrastructure is seeing significant investment due to FERC policies that incentivize spending and should be adequate to handle higher electric vehicle penetration but the same may not be true for the local distribution systems. Concentration of electric vehicles relying on aging transformers could force upgrades to distribution assets, particularly if consumers opt for fast charging systems. Jon said that just a handful of Volts (5-7) or Leafs (6-8) on a transformer could cause overheating issues with as few as one or two Tesla's straining the distribution system depending on the charging options.

What is the alternative? Centralized turbo charging

Centralized charging systems could prevent utility distribution capex.

Rather than having utilities *significantly* invest in upgrading local distribution system, a centralized charging system could make more financial sense. We have seen companies such as NRG be pioneers in the centralized electric vehicle charging arena and view this 'refuelling station' focus as key for the adoption of EVs. High voltage quick-charge stations that can charge in 10-15 minutes will go a long way to alleviate consumer concerns about running out of fuel on longer-trips, one of the negatives frequently cited. Obviously this is not an 'either/or' question but a matter of degree as there will be consumer demand for in-home fast charging.

Transcript

Colin: Good Morning, this is Colin Langan from UBS…Jon is the president and CEO of Auto Lectrification. I'll briefly go through his resume. He's worked as the senior architect on the Chevy volt and Chief Engineer of GM's EV 1. Jon will start with a general overview with his thoughts, focusing around battery costs and how overtime we can get them down and then we will open it up to Q&A from there. With that I'll pass it over to Jon…

Bereisa: Hopefully everybody can hear me. With batteries, there are lies, damn lies, and battery engineers which is often said. The battery dates back over ~150 years. You might argue that you might find some in Arab antiquities in the Middle East that looks like battery cells. The difficulty with batteries is that they come few and far between.

In the last I'd say 150 years, I'd say we had Lead-Acid, Nickel-Zinc, Nickel-Metal Hydride, Nickel Cadmium, Lithium Ion. There are not that many and they typically run in 15-20 year increments. As they get better and get more improved, they tend to take longer to improve, simply because we are packing more and more energy into a smaller and smaller space and its harder to contain it. It's harder to prevent itself from eating itself up, destroying itself just by sitting here. And it also has to be safe, it can't just spontaneously go off, & short-circuit or, and some thermal runaway. So it's not like the semi-conductor industry, it's not like smartphones. An android time constant today for an android phone is more like 6-8 months before you get a new one, but in batteries its 15-20 years maybe more.

Battery development time is typically 15-20 years.

The other thing that has to be remembered and to take into account is that batteries need balance. You have to balance in terms of energy, in terms of power, in terms of safety, in terms of cycle life, how many times you can cycle them. They also have to balance in terms of cost.

Requires balancing energy, power, safety, life, cycle times, and costs.

…

The fact is I hear a lot of hyperbole and a lot hype about the latest and greatest battery. The fact is all the parameters I mentioned have to be balanced. They have to exist simultaneously. You can't just have a lot of energy and have a safety problem. You can't have a lot of power performance and not many cycles. You can't have all the above happen without a very high cost. Again that just violates the usability of the product.

So again, you will hear a lot of, like I said hyperbole out there, and be careful of that. Always ask are we talking an entire battery or we just talking about an anode. Are we talking about an electrolyte, are we talking about a component or piece of the battery. So again be cautious about the informed person in that regard.

The other thing is that with batteries you can't make them any cheaper than the raw materials that go into them. I don't care about what the volume of manufacturing rate is. Doesn't matter how much hamburger you make, if the same amount of cuts of meat go into it. That is what you are paying for and so several things have to happen in this battery game. You have to find ways to get more energy into the battery with the same materials or you have to lower the cost of the materials and of course you need a high volume manufacturing process and preferably all three of those have to come into play as opposed to any just one of those as being the magic silver bullet.

And then you also have to be careful in this game of battery discussion, when people give you cost. Costs at the cell level, in other words individual cells, and if you're thinking cell, almost 6-7k , high 7k for a TSLA, 300 or so for a volt, you are talking a lot of small cells and that's the price per cell. That is not something that does the work of a battery pack. So you have to put the cells together, two you have to wire them, you have to put sensors on them you have to put thermal conditioning around them to heat them and cool them, you have to computerize the controls for them, you have to have the right controls and controls for the charging, and when you're done you have a battery pack. And that's a different cost that's a much higher added cost. Again you can get confused as to what is a cell and a battery pack. And maybe if I could just talk about a few quick numbers here we can open it up to a battery discussion.

Today's estimates cell cost is $211-$236/kWh and $311-$361/kWh with the pack.

If we look at today, at least at a 1 gigawatt hour plant, the raw incoming materials are somewhere, as unfinished materials, at $115 - $130 per kilowatt hour. There is about a 40% margin to get them into finished goods in other words into a lithium salt in terms of pure electrolyte. That takes us to $161-$182 for finished materials. That is what goes into the plant making batteries. $161-$182. Can't sell it for less than that. Manufacturing cost add about another $15 dollars per kWh because it's a very rapid manufacturing process. It's very little hand labour; it's highly automated, it's like making semi-conductor wafer processing and chips. And that gets us to a factor variable cost of like $176 - $197 per kWh. These plants again, there are maybe 100 people that can run a plant and you'll be surprised how few people, employees there can be in real world plants. So that's only an overhead of maybe ~15% and if you own the plant you got to refresh the equipment so that's only going to put a thin margin on the order of 5% on it. So at the cell level you are going to be somewhere around $211-$236 depending on the lithium ion chemistry. I think our friends at TSLA can just buy a shade under $200 these days from Panasonic but you got to put it into a pack. That adds about $100-$125 per kWh so you wind up at the pack level something to put in a car and drive away at the cost level of $311 -$361. You know that's today economics on roughly 1 gigawatt hour per year plant. And if you have like a 85kWh hour, like a model S motor, multiply those numbers I just cited of the pack level of $311-$361 by 85. Or if you are thinking like you know a generation 3, maybe 50-60 kWh, to get a decent range you have a gen 3 vehicle if you were using today's economics. And of course later on if you like we can talk about what a Gigafactory would do in that cost run down and what could possibly the best lithium ion be by 2025.

So with that Colin maybe if you could open it up for some questions.

Colin: Yeah why don't you just cut right to the…

Bereisa: Chase? Alright assuming that somebody is writing these numbers. Let's just run a Gigafactory because that's probably the most fun.

Scale with Gigafactory helps drive down margins on processing raw materials into finished product.

The raw material is still raw materials. What the Gigafactory allows you to do is attack the vertical supply chain. In other words because you are such a big consumer, you have a very big stick, kind of like what the autos do today with platinum and rhodium. They go right to the mine and buy 5-7 year contracts and they'll buy and then contract people or companies to make the finished materials and then they separately contract other people or companies to make the catalytic converters. So you dominate the whole chain and so the 40% becomes 15% with a bit of purchasing power which gives us finished materials now at an improved margin of $132 -$149. You are going to be running a very large plant here.

You're talking 30-35gWh site so you are going to be extremely efficient. You will be like making semi-conductors chips and a wafer. So your manufacturing cost is going to drop way down maybe $10 or so per kWh, again extremely automated. That rolls down to a factory variable of $142-$159. We are also going to improve on our efficiency & our margins. So we are not getting a lot of overhead in this plant. We can probably drop that down to almost in half to 8%. Now we are going to have to keep refreshing the equipment and paint the building and mowing the lawn, we are going to have to throw some cash at the business. So probably 3% margin reapplied even though we own the factory which gives us, when we take those percentages and roll it up a $158 - $177 cell cost at the cell level. And we are going to have to do much more improvement with integration and design simplification of the battery pack. There are too many parts in those packs today. So we are going to take that down literally in half which I think personally very doable to a $50-$75 per kWh for simplification design and that all rolls up the pack level to $208-$252.

With scale costs fall to $158-$177/kWh for the cells and $208-$252/kWh with the pack.

Much more interestingly, you know by my math, and I've been inside quite a few battery plants. The 30%- 33% reduction from where we are to 2014 levels and let's say we really get lucky and for instance the Argonne National Labs technology of dual-layered cathodes and high voltage technology pans out, quite a few companies are chasing it. You know success is still quite far away, that we can improve energy density from a factor of about 2 but the materials get more expensive. When you combine the two the best we could be and this is Jon's personal opinion in 2025 is starting with raw materials at $70-$80. Purchasing power margin on the supply chain reduces down to 10% or finished materials coming into the battery plant, and into the Gigaplant, at $77-88 per kWh. Still keeping the same $10 manufacturing cost. That's extremely lean; you're not going to get much better because it's already good by 2020. This is 2025. So we wind up with a factor variable cost of a cell at $85 - $97. We will probably improve on the overhead and keeping the factor running and our margins on the overhead are at least going to drop to at least 5% and 2% to reinvest into the factory which gives us an output cost of $91-$104 per cell. We are going to make some more improvement on design integration giving us $50 we have to add which would then roll us up to $131 -$154 per kWh at the pack level which is about a 51-52% reduction vs. today. Again depending on the range per vehicle and the total hours you need multiply that and that should get you the cost.

Improving density could drive down cell costs by 51-52% by 2025.

Colin: *Do you want to give a quick overview of your resume?* You know I gave a very brief overview and your background is actually quite impressive. I think we should have led off with that.

Bereisa: Well as Colin mentioned, Chief Engineer of the EV1 and you learn by doing and learned a lot back in the 90s on what constitutes a good electric car, what constitutes a compelling value proposition, how legacy thinking can pervade in OEM to make just appliances for transportation. How to mismanage consumers who dearly want to keep the product and avoid nasty movies of who killed the electric car. But I also learned a lot about the technology. I was a founding member and chairman of the United States Association Battery Consortium and that's a multi-billion dollar effort between the auto OEMs, US, and the Department of Energy, which still exists today. Developing advanced battery technology specifically for transportation and my personal focus while at the USABC was in the early lithium. In fact, funded the first lithium development during the mid and late 1990s. And then I went on to be program director for General Motors fuel cell vehicle program because a lot of autos including GM held a belief that the end

game maybe 2030-2050 sustainable end game was still electric vehicles but hydrogen powered via fuel cells. And did put several hundred of these out in consumer hands across the country and even China and Europe with real people driving them and again understand the product and understanding the market. I worked with Shell Hydrogen on developing the hydrogen infrastructure, the costs associated with stations and you know what it would take for deployment here across the US. You got experiences and numbers there. And then basically I took the fuel cell architecture which has a battery in it basically as supercharger to accelerate the car where the fuel cell just keeps it running at constant speed and resized the battery, upped it, changed out the fuel cell to a small engine and generator and that became the Chevy Volt. I was system architect, so I was basically laying out much like an architect for a house what that car had to look like, structured, and how the components had to be arranged inside. After that, 35 years I retired from GM, and now I have my own consulting company called Auto Lectrification.

Colin: Okay very good background. *The main thing from your walk getting into the next gen is the raw material piece, going from the raw material to producing the finished goods. From that 40% margin to that 10%. Can you please talk about getting that number down?*

Process for lowering raw material cost is similar to how OEMs addressed the costs with the catalytic converter.

Bereisa: Well volume and long term contracts. The best example I can give you in the auto industry is the so called non-ferrous metal purchasing group which you will find in just every major OEM. When catalytic converters became a requirement for emissions control in the 70s, the autos were faced with this thing called platinum. And if you wanted a 3 way catalytic converter, rhodium and ruthenium. And how do you possibly make that affordable. You can't just put jewellery in the exhaust pipe of the car. And there were a lot of predictions that that would not happen even though it worked technically, you would never get the cost down. Well today we have it down to 3-4 grams per catalytic converter in a modern automobile in a mid-size to premium size automobile, almost an unbelievable achievement. But that was done two ways. It was done with a lot of science and physics to find a way to make very fine platinum particles and deposit these on a substrate, ceramic substrate or sometimes you got a metal mesh substrate. The other was a business move. The business move was to go all the way to the mine before the non-ferrous metal people come in (Iron and Steel) very long–term contracts, very large- multi- billion dollar contracts to buy up capacity at the raw materials level. Really at the mine head and sometimes in some cases causing mines to be created and opened. And also contracting long-term material finishers, where companies take the raw mined product and make it into a finished material, refine it down to the platinum and then equally competing with Tier 1 suppliers, the guy that makes parts, you know, kind of like the people who used to make mufflers but now make catalytic converters and they can't, and competing these tier 1s against each other very viciously and notice the word viciously. So that you are basically dominating with your volume over long periods of time all the way from the mine head to the components.

And in some cases in the early years, some of the autos would own the companies, GM & F have now divested those in the last 20 years or so. Toyota still has invested in sister companies that produce these parts for them which enable them to have again very tight control over the whole process and it's really vertical. The auto industry started that way. Henry Ford achieved all of that by starting with rubber plantations and iron mines and had his own iron ore freighters from the Great Lakes, had his own rail roads, he made his own tires, before he hooked up

with Firestone. The wood bodies or even the stringers that the frames that made the body were wood. The wood scraps were turned into charcoals which are today known as Kingsford Charcoal actually a Ford by-product.

Today there is a 60-70% mark-up from manufacturing costs attributed to the dealer sales process.

Henry Ford owned everything all the way out to the stores and he even invested methanol production because he believed that the wealth should be shared within the auto industry and the rural farmers should be able make rain crops and make methanol for the fuel. He had a big fight with the GM leadership for many years, gasoline on one side, and methanol on the other. So even then, you can see that the way Henry Ford got the price down and made it affordable for the mass market was a complete dominance all the way through the process all the way out to the selling and the store. This dominance changed more recently here because everybody started buying commodity parts and making the same parts. Cars haven't been too innovative lately. They look good and perform well but there is not a lot of technology innovation until we get to Electric, fuel cells, and hydrogen. The autos have basically slept off intra catalytic converters and by the way they are dominant, they are doing the same vertical chain for fuel cells dominating and owning all the cells now and even in development but the rest of the commodity stuff is commodity. Since 1934, the autos basically shed the model of owning their own factories and dealers, and the dealers today are very powerful, very controlled go-to market process. It forces high margins, mark-ups to get it to MSRP, paying a lot of people, covering a lot of brick and mortar, a lot of employees, a lot of margins. Your own warranties, your own overheads, your own advertising, dealer holdbacks, policies. You can have like a 60-70% margin you have to tack on before you get to the sticker price vs. the factor variable cost. Take a $10,000 car coming out of the factory, it's really a $16 -17k sticker price. We have to be cognizant that the business model could use a revamping.

Colin: Feel free to chime in if you have any questions. I guess I'll throw one out. You mentioned fuel cells, ***what are your thoughts on fuel cells going forward, the challenges, pros and cons?***

Bereisa: Well, I'll answer it the Toyota way and the reason I'll answer it the Toyota way, is periodically, governments, including our own, allows major companies to collaborate. It's called pre-competitive R&D. And so I've been fortunate to have pre-competitive programs with Toyota, in battery electrics and hybrids, and fuel cells and even government regulations of all things.

Fast charging puts stress on grid.

If we take a look at Toyota, their belief is that battery electric vehicle or you can achieve the performance, you might even get down to the cost curve, it's a big might, but it's not sustainable in high volume. It's not sustainable because it basically puts extraordinary demand on the electric grid. The larger the range, the bigger the battery, the more energy. Either the longer it takes to charge it or if you want to charge it in a fast period of time you can't it takes an enormous amount of power to charge it. So if you want to charge a large battery and if you want to charge it in 5 minutes, you have to charge it at 6x its capacity rate. So if I had a 100 kWh battery for instance I would have to charge it at 600 kWh. In other words we are basically talking about megawatt type charges and that basically creates a huge problem for the utility distribution.

Distribution is a challenge as EVs put stress on local capacity.

There is plenty of generation, plenty of transmission; the distribution is like the big substations you see around town. And it created even a bigger problem for the feeder. The feeder is what goes into a business or residence. 5 or 6 V starts to challenge a typical residential feeder line at the 25KW and with 100% overcapacity KW capability. Each house is like 2-3KW, about 10 houses. Every time I throw a

Volt on-line it's like another house on-line. And if we throw a Ford battery electric focus that's a 6KW charger, all of a sudden, 3 or 4 of those make a big problem. We toss on a Model S at a 10KW base charger it's already a problem. If you toss on a 20KW optional charger on a Model S, all of a sudden your utility feeder has gotten a problem. All of a sudden it's an unexpected un-agreeable transformer on some lines. Maybe if you were in a newer subdivision, where the houses run 5000 square feet or better, you can delay that but that's not Americana. That's not your 1800-2200 square foot home with a hundred amp panel.

Grid can handle about 40-45% of cars in the US.

So the whole issue then is even though we can support about 115 say 120m EVs in terms of transmission, we got that much night time capacity today in generating. We could basically cover 40-45% of all the cars and the US could be all electric that's a big number. We wouldn't have any big transmission problems. We probably would if we wanted to get renewables there because you know where the sun shine and the wind blows, there is not a lot of transmission lines and that is one of the biggest problems we are facing in this country and anywhere else with renewables you got to build transmission lines because it would be great to run these cars off renewable energy. Though when you get to distribution and fast charging, unless you provide battery backup and again that's where the Gigafactory could play a role, we can put a lot of batteries that can suck up the charge, during the night time slowly and then avoid a great big jolt through the distribution grid from charging cars during the day. And likewise at home, if you got at least ~750-1000 sq-ft of roof, you can have a very nice nearly off-grid capability for your home including charging your EV. But then you would also need batteries, when the wind blows, sun shines and so forth so you need some amount of battery capacity for the home.

Hydrogen can be refuelled quickly and be made very economically.

Now, if you're Toyota, you view the cost associated with distribution and all the lines that run to businesses and residences as an enormous cost, basically because it takes a hundred years to put in place. So their belief is that with hydrogen, two things: 1) you can refuel in three minutes and – you know, I built cars and stations, and we put stations that do just that at 10,000 pounds per square inch and then got another 300 miles, or even 400 – and the fact that hydrogen can be very economically made from bio-waste, from pod bacteria, from electrolyzing renewable or nuclear energy – otherwise breaking water down at hydrogen and oxygen – you can even make it from coal. Basically, hydrogen is very fungible – you can make it virtually from anything. And you can make it quite cost effectively. The equivalent today – if you're trying to run a hydrogen fuel cell car – you'd be talking like $1.25 gasoline. So that and the faster refuelling and the fact that displaying hydrogen, the chloride industry, the chemicals industry produces a lot of waste hydrogen, by-product hydrogen. Some of that is routed to refineries in big pipelines. In Los Angeles, there's a 42-inch pipeline that runs along the Interstate 5 there, about 40-50 miles of it, from chemical plants to refineries. That provides hydrogen and you can't refine gasoline, you can't refine petroleum without hydrogen. You can't really get a good quality gasoline and get the sulphur out without the hydrogen. And if we take a look at the Niagara Falls, where you have a lot of chloride, and then chemical plants because of [the bund of] hydro, cheap electricity, especially at night, that aggregate net area, those plants about 2.5m tons of hydrogen either get burned or vented into the atmosphere, because they have nothing to do with it. So, there's no lack for hydrogen, you can make it in a variety of different ways, the cost of electric motors, the cost of power electronics, that's it. It's very affordable today. Remember of fuel cells electric, the fuel cell stack, the same thing we learned with converters. That's why it's a vertical, dominant chain.

All the automakers have internalized the fuel cell development. They do it all, literally from the mine to the product. And that's all of them, all majors including Hyundai, believe it or not. And the fact that you can refuel, and the study that I did, which shows that it's about a million dollars, including land costs, for a modern hydrogen refuelling station. You can maybe get it as low as $850,000, but a million is a good number. And about 11,000 of these would cover the 27 largest population densities here in the continental US. With 50 miles to every freeway would then be connected. And that $11bn costs is not an unreasonable number.

Hydrogen infrastructure costs about $11bn.

Again the question is entrepreneurship and a matter of government willingness. Who's got either the guts or the will to do it? So that's why you find Toyota skipping over the battery electrics. They love batteries, they love hybrids, they even love lithium-ion, but not as a battery electric. They're going all the way for fuel cell electrics and it's an expensive proposition. Publicly, when I left GM, we were narrow to $2bn on our R&D program and that was 2009. So that's why you find GM teamed with Honda. You find BMW teamed with Toyota. You find Daimler (a.k.a Mercedes) teamed with Renault-Nissan and Ford. And that's why Hyundai is really teamed with the Korean government as they typically are. It's a big stake's game, but it's a 2030-2050 game. In the meantime, we are going to see hybrids, we are going to see more of those, and we are going to see battery electrics. The big challenge is, will we get the cost, both of the product and of the business model of delivering the battery electric, down into the mass market range. Get into that $25,000-35,000 range. And personally, I submit that you can't get there with massive battery plants if you won't do science for batteries, unless you tackle the question of how you sell. You got to start thinking like Dell started thinking with PCs as opposed to IBM in terms of how you go to customer, how you go to market.

Fuel cells are a big stakes game but it's a 2030-50 timeframe.

Colin: Great, and back to your question about fuel cells costs, are *EVs getting the price down?*

Bereisa: Well, I think the fuel cells, since it's the only dependent now, but it's a big one. It's not the fuel cell, not the platinum catalysts, that's pretty well under control cost wise. In the phase I did before I retired, it was very doable. We need some value, we need to be in norms of 100,000 to 200,000 annually to get there. But it's very doable. Their performance is exceptional too. The cars are extremely fast, they're extremely quiet, they're powerful, they go on for 300-400 miles and they refuel fast. The problem is the storage medium. That doesn't sound like batteries, it is the hydrogen tanks. Remember we're storing gas, as opposed to liquid hydrogen, because liquid evaporates and we lose fuel and you got to keep it cold in an isolated tank. So it's not as good. It's ok for a space shuttle, makes a great rocket fuel, but not for a car. So we have to go gas. We have to go very high pressures. Thing of what I said – 10,000 pounds per square inch. Your compressed natural gas is like 500. So it's four times what we do for CNG. And that requires very high-strength carbon fiber, the fibers themselves. And it requires rather clever, inventive, almost secretive lining patterns to make these tanks – computer-driven patterns. It takes special resonance to bind these fibers, to put them together. They get to be about two inches or more thick. Valves and regulators go into the tank, so all hour pressure regulation and everything is inside the high pressure zone. Only low pressure comes out. And when you set and done, it's very expensive. It's the most expensive element in there. The storage can be somewhere (you'd be hoping for $3,000) but today it's more of a 6,000. And then you got to put everything else inside. You have to put all the electric drives and you still got a smaller battery, electric heat pumps, heating and air conditioning, electric parts,

The biggest challenge in fuel cell cost is the cost of the carbon fiber fuel tank.

electric brakes. All of that stuff hasn't gone away. So the challenge right now is in the carbon fiber. That's why you'll find, for two reasons, making light-weight vehicles and getting the energy storage. Every major OEM has got some vested financial interest or teaming arrangement with a carbon fiber manufacturer. BMW started with SGL and they set up a special plant in Vancouver, in British Columbia, Canada, because making carbon fiber takes a lot of energy. You want to carbonize lots of electricity, so you want hydro, you want cheap electricity. Either it was Japanese, Chinese or European firms, all the major OEMs are also teamed up on carbon fiber. Again, lighter and stronger cars, less fuel to go a mile and at the same, to get the economies of scale, look for different precursor materials. Right now we use petroleum, but we will use lithium or something like that, or bio derived from trees. Some different precursor to reduce the cost of carbon fiber. Right now, we're competing with golf clubs, tennis rockets and the Dreamliner. The 787 is basically a carbon fiber airplane. And the prices are there accordingly. So the challenge is in the storage. Oddly enough, again it's the energy storage. Just of a different form.

Colin: And on the pure EV side. *What kind of time until you get to that 40% penetration in the grid*?

Bereisa: Actually, the grid will stop bearing it very quickly. It's a matter not of a quantity. Let me stress that. We can support an enormous amount of EVs by generation and transmission. In other words, whether it's hydro or nuclear, coal, natural gas or combined cycle plants, we have plenty of generation. We're basically sized for the afternoon peak at the national level – 2:1. So at night time, we got this enormous reserve and it's very hard to turn down all the generators. They're big, huge machines. Once you get it up and running, you just don't trim it. It takes hours and days to trim it. So you just run. And the electricity being produced at night is not used and it's not being monetized. And utilities would love to sell it. So that's not a problem. The problem occurs as a matter of concentration. How many cars per square mile? Now remember we talked of two ways of concentration. One is in residential neighbourhoods, where you have a transformer feeding 10-15 homes. And all of a sudden, each car looks like a house or more. And that now means the utilities got to come out and beef up new transformer. And that's just money, but it's money. Somebody's got to pay for it. It's got to be rolled in some of the tariffs. And chances are pretty good that they're going to string either new iron on the poles or bury new underground. And maybe, if you got a 10kW or 20 kW charger, like for a Tesla, then maybe they'll even bring new wires to your home. Not just down the alley or down the street. So that's at the feeder level. The other concentration problem occurs in a city. You'd love to have some fast charger. For Los Angeles, about 45 stations on a 5-mile grid would just satisfy everybody. But now, each one of those, when I pull up and I want to charge in a 200-mile car, requires 0.5-1.0mW. We're talking about one of these gigantic transformers distribution yards. The cost of that is ginormous. In some places there's even not enough capacity. So to do fast charging, you're going to have companionate costs putting in batteries to store off-peak and then charge the cars of the batteries and not directly of the grid. And by the way, if you're planning a Gigafactory, how are you going to get the volume of batteries up to get their price down before you can sell enough cars. Start selling batteries and grid applications, home solar applications, home off-grid applications, fast charger applications and start using the batteries yourself to run your own plant. So I think there's a method to this madness of a large battery plant. But not just for cars, use it everywhere. And I think if you look at Tesla, there's some good method to having a Solar City

there. And I applaud them very much for getting into fast charging right out of the box.

Colin: Are there any questions on-line out there, anyone? I'll throw out one more. You've mentioned a couple of times about the dealers and the dealer network as about 60-70% over the factory cost as opposed to what it's sold for to the customer. Tesla is fighting very hard to avoid the franchise system. ***What kind of cost savings, what kind of market they can get it down to and what are the key drivers?***

Bereisa: I kind of backed into the other light. I ask myself on my own cost model. What would it cost me to make a gen-3 car? From my knowledge base and what I even know of Tesla. And what would that factory's variable cost be? Under the scenario when I had to do it today in terms of a Gigafactory. Maybe let's fill up Gigafactory in 2020 and maybe let's do the best it could be with the best lithium before we go to a new technology in 2025. What I did is that I ran my model and I came up with a factory variable cost before margins, markups or anything. If we did it today, a 200-mile car built using the same construction technic and everything like any OEM or even Tesla would do it, by the time I added the batteries, I'd be sitting in a $34,700 variable cost, of which the battery pack is $15,675. If we go the whole far to the Gigaplant, the factory variable would get down to $29,417, with my model, of which $10,365 is the battery. And that's not just for a stripper car. This is something we compete in that timeframe with the acceleration, range, performance.

2025 estimate implies costs can get down to $25,600.

In other words, a no-excuses electric vehicle. It's a substitute product, so it's got to have a compelling value proposition. It just can't be a more expensive car that does less. That's why all the pricing turns out is the factory variable. Now, if we assume the best we could be, let's roll on to 2025. I can see it getting down to $25,600 with a massive plant and massive control of the vertical structure, as well as now- the $6,573 battery pack. Before we transition to whatever the next battery is going to be. Now if I want to sell this car for $25,000-35,000, I'm sure I'm not going to do it for $25,000. I'm going to sell it for the $35,000. And if we assume that the headwind, which is CO2 regulation and that the car engines in that timeframe are going to get $3,000 more expensive. So we've got that to play with. Let's say we make it $25,000 vs. $38,000 with that ratio and that's the best it could be. With a Gigaplant it would probably be more like $22,000 increment, so it would be $37,000 vs. $29,300, so we.ve got a $7,700 margin. A lot of the margin is very much wasted today. There's a lot of legacy. It's not unusual for big OEMs to spend $2-3bn on national advertising, and do just the lousy, terrible deal of it, because of a lot of incumbency and a lot of traditional advertising. Big money, but TV ain't it anymore. And print, what is print anymore? You got to rethink the whole advertising and how you get the word out there. So the whole process is right away, plus you got all the brick and mortar. We started on the EV1 to challenge the brick and mortar. We did not stock every dealer with an EV1. We had a central yard in greater Los Angeles Area or Phoenix Area, or Sacramento and we stocked a variety of cars there of different compositions of accessories, colors and so forth. And we would ship to a dealer order from that location. We also didn't put in repair and remanufacturing localizations in case you had an accident or something happened to the car are there was a problem. We had one central location. You'd still bring your car back to a dealer or you could even call and we would pick it up and give you a loaner, but we had one central site. We did all the repair work with one set of brick and mortar, one set of tools and one set of really good technicians, basically engineers. So again I tell you, you have to rethink it.

Otherwise, to replicate thousands and thousands of dealers. And if you go along all the national models, in the US there's probably 28,000-30,000 dealerships. That's a lot of legacy cost. And it will be a challenge as the dealers do provide a very valuable function that can't be overlooked. Today, you don't worry much when you buy a Tesla, if you got to trade it. If you buy a Chevy Volt, who's going to take your Honda? You also have to find a way to handle finance, insurance, taking trade-ins and disposing of the trade-ins. The customers are not going to want to go to ten different places. When they go and buy a Dell computer, the want it configured with all the software and everything in it ready to go. And if they have a problem, they want you to take care of it. So in my opinion, that business model is not baked yet. The Gigafactory is necessary, but is not sufficient. New battery chemistry may or may not come along. But if you got a Gigafactory and you tackle the business model, there's definitely a possibility for you to upside, but you have a different customer you're dealing with. It's not a technology adaptor. It's not fuel-sensitive like today. A Model S buyer is not your appliance buyer. The mass market customer is different. They buy by what they can afford in a monthly payment. And they buy by how reliable and durable the product is, how long it will last. Dollars per mile is what they really wind up doing. And they're not willing to pay a big premium for fuel. When hybrids get more or less $2,000, the interest starts to vanish. At $3,000 it's almost gone. You'll find cars that are hybrid vs. non-hybrid that when they get to about $3,000 difference, some like Lexus go to $5,000, you're lucky to sell 20-50 a month in the US. So the customers are a very different customer you're appealing to. And you got perfectly good cars, get some to what they want to do today. So the competing cars are substitute products, so you got to be even more compelling. And if you package it, if you maybe can refuel it at home, repackage it with your own solar and your own refuelling capability and reduce your electricity cost at home at the same time. You got to rethink what is the value proposition. Is it a car, or is it really a transportation system? Or is it something that tackles your energy cost? It's the whole issue of home energy and what you pay for energy throughout what you do. Honda is a car company that thinks very much along the energy line, for instance. If you take other car companies, they're still in the appliance domain. They're still selling a transportation appliance.

Historically hybrids need to be <$3,000 of the gas equivalent to attract customers.

Colin: Are there any questions out there?

Call Participant 1: *What was the technology that you were referring to that Argonne National Labs is working on?*

Bereisa: It's referred to as dual-layered-cathode, it's a cathode of lithium-ion, that is basically structured with two layers. And by using two layers, physical intertwined layers, you can discharge more lithium-ions. The anode is where you store it, when you charge a battery. But how many of those ions you can move from the anode and put into the cathode limits how much electricity it will flow. So if the cathode fills up quickly, that's it, you're done. You may have extra charge sitting on the anode, but it's useless. So this structure creates more sites, for a given amount or mass of material to store those ions. But it comes with all sorts of difficulties. By the way, this Argonne is licensed to all kind of smaller companies like Envia Systems, who had some successes, but are still having some difficulties. BASF and several other very large and smaller companies have taken out the Argonne license. The problem is that this dual layer can fall apart after a certain number of cycles, all of a sudden you can't store twice the energy, and it decays very rapidly after that. So it's kind of like an ordinary battery that quickly decays. So you've got to balance out all the attributes. You need thousands of cycles, you

Dual-layered cathode offers the most promising opportunity to lower raw material costs.

need years of life, you need double the energy density, and you need half the cost. We have so much energy that it can explode on you. So it's still work-in-progress, but it's the one that have shown so far being the closest to the pathway, the closest to the promise. But it's far from a baked-in-the-can solution. But there are others. There's magnesium-ion. Magnesium gives you two electrons. Toyota's R&D is particularly looking at that, even though they don't favour battery electric. They favour hybrids and fuel cells with batteries. So there's a lot of development out there. But again, it's a 15-20-year type of proposition. These things don't happen overnight. Consider the fact that lithium-ion become practical in 1986. And we didn't start using it in our PCs and our cell phones until late 1990s. And we didn't give it the scalability to get it into a car, to mid-2000s. It's a long journey each time to do a battery. Basically, it's a Noble-Prize-winning science. It's not like the semiconductor industry or software industry. It's a very long development process, because you're basically dealing with physics and chemistry. And these days it's at the quantum level. But we're really moving ions around now. We're more like the semiconductor than a chemical battery with lithium-ion. We've already left the old battery days.

Colin: Any additional questions out there, before we wrap up the call?

Call Participant 2: I have one quick question on the supply of batteries. *Is there enough provided?* I understand you're argument about the transmission issues, but is the demand for this big enough from the consumers? Is there enough supply out there from the battery providers to meet any significant demand?

There are no material costs problems with EV batteries.

Bereisa: We're not in the materials problem. The shameless forecasts for catalytic converters, platinum, rhodium and ruthenium turned out not to be true. The bigger issue today is C-H-I-N-A, China, and it's with electric motors. And Tesla was smart enough and I admire them, because that's the direction I prefer to go with – AC induction motors. And then are permanent magnet motors, which require neodymium, which is largely controlled by China now. They've been putting everybody else outside of the business, since five years or so when the quadrupled, and then tripled the prices. But also to make it last, to make it work in any temperature, you need dysprosium, which is a heavy rare. And they basically got the dysprosium connection. There are not a lot of mines other than in China now. We shut down the few that we had here in the US and Canada. Then China drove up the price. So there's the bigger question with motors, when you consider having a permanent magnet motors for electric and fuel cell vehicles. There's much scramble with getting the magnets. But personally I prefer losing 2-3% efficiency and going with the AC induction motor, which doesn't require anything other than steel, copper and aluminium. And we got plenty of that. And those are very ragged motors. Look at Tesla. Lots of power, lots of capability, it's durable and nothing happens to it. I never lost a motor in EV1, never.

Colin: Any last questions?

Call Participant 3: I was hoping you could just quickly describe *if you have any high-level thoughts on how the broader adaption of batteries, that goes with the utility scale and with autos, will impact utilities and the generation mix.*

Bereisa: Two things are happening. One is that we're putting more and more on the grid and the grid operators are having problems maintaining frequency and voltage. By frequency, I mean 60 cycles a second. You know, your clock runs on it, the timer on your vault in your bank runs on it. It's got to be 60. And what's

happening, is that to regulate that, since the power is fluctuating going up and down, they have a hard time regulating the speed of the generation, the frequency. So the light to be able to switch very fast loads. They've been using resistive waste loads up till now. But they're starting to use batteries that can take charge rather fast and give it back equally fast. So maybe at anywhere from 1-2 cycles per second, maybe even a fraction of a cycle per second, being able to regulate the frequency. That's called frequency regulation. And the utilities will pay you for that, because that helps them balance and maintain their grid without adding new capex themselves. The other thing is a voltage loop, when everything powers up in the afternoons. In if you're Californian, every peaks at about 6pm. Everybody gets home, they all turn on everything, they turn on their stoves and everything else. And when that peak comes up, all of a sudden you've got losses in the lines, you've got the limits of generation, the ones you've been buying. So you need to peak-shave, you need to store off energy the night time hours and peak-shave during the day. You can peak shave for business, for portion of the grid. The utility can of an peak-shaving big battery bank or a company could. And then another thing happens. When you get to 15-20% of renewables, and Germany is a classy example at 18% or so, your grid becomes dependent on renewables, which don't run all the time. The sun doesn't shine and the wind doesn't blow all the time. What you have to do then is not have the starvation of the grid, so you'll need energy storage. Massive energy storage, when you get to a big renewable fraction. And we see that coming. In the US, some utilities are projecting up to 30% of renewables by 2030. If that happens, oh my god, there will be lots of energy storage required. But there will be different batteries too. You'll have to get that down to $150, or maybe $100 per kWh and you'll need something like 4,000-10,000 cycles. So it won't all be lithium-ion. You'll find these flow batteries. Companies like Aqueon popping up, Zync. They're big, they're huge, they're heavy and they're cheap. And if you got acres to put them on, it's not a problem. It's not putting it in a car or airplane. We'll see lithium going into that too. Lithium is probably better suited for the peak-shaving, because lithium can charge and discharge fast and some of the others are rather slow, not good for power, but good for lowering energy. There's a big market coming and you're even going to find tugboats and ferries that are electric powered, some having 2-3mWh of lithium-ion battery on board. They literally have a plant roof of battery capacity on these big ferries. And you find them in the Baltic, Norway, Latvia Lithuania, Estonia, Sweden.

Colin: Great. At this time, we'd like to end the call. We'd like to thank Jon for his time, coming on the call and sharing his thoughts with us. If anyone has any follow-up questions, feel free to send me an email.

Statement of Risk

The global auto industry is highly cyclical, vulnerable to sudden shifts in consumer sentiment, employment, interest rates, and general economic activity. Auto companies have high fixed costs, and therefore earnings and cash flows can dramatically change with sudden shifts in vehicle demand. A significant and sudden decline in demand would negatively impact automaker liquidity and increase the financial distress on the supply base. OEMs also faces risks associated with the impact of discount rates and asset values on legacy obligations. In addition, the auto industry is highly competitive, and therefore automakers may face pricing pressure from competitors looking to gain market share. Moreover, Detroit 3 North American operations have historically been dependent on light truck sales, and therefore the continued shifts toward cars will remain a headwind. Parts suppliers are further exposed to customer pricing pressure, shifts in OEM market share, volatile production schedules, and unforeseen changes in technology. Through its building efficiency segment, JCI is also exposed to non-residential and residential construction. JCI is also exposed to lead, steel, resin, foam chemicals, copper, and fuel costs. BWA is heavily dependent on the European market, and in particular diesel engines. In addition, BWA's drivetrain segment supplies transfer cases for SUVs in the US market. Consequently, the continued shift toward cars from light trucks and SUVs will negatively impact this segment. BWA also is exposed to steel and nickel pricing. LEA is exposed to fluctuations in the price of steel, polypropylene, and copper. Both Visteon and Dana mitigated a number of their former risks in bankruptcy and have emerged as much healthier and more streamlined businesses. Given the companies have corrected a large portion of their former operational and liquidity issues, we view the biggest near-term risks to be similar to those of their publicly traded supplier peers - including commodity exposure, OEM pricing pressures, and production schedule shifts. In addition to these end market risks as a supplier Meritor is also exposed to customer pricing pressures, commodity price risks (primarily steel), shifting OEM share and volatile OEM production schedules. Auto dealers are also exposed to shifts in OEM market share, changes in OEM marketing incentives, and changes to OEM warranty coverage. AutoNation's and Sonic's results may be worse than the industry average due to differences in brand performance and geographic mix. In addition, failure to meet CSI standards and franchise contract market share limitations may impede their ability to acquire new franchises. ESL Investment, an investment firm controlled by Edward Lampert, owns over 25% of the outstanding shares, and the sale of a significant portion of this position could raise investor concern. Dealer earnings are also dependant on LIBOR interest rates. For Sonic, voting control for the shares rests with O. Bruton Smith and family, leaving public shareholders with only minority rights.

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12-Month Rating	Definition	Coverage[1]	IB Services[2]
Buy	FSR is > 6% above the MRA.	47%	34%
Neutral	FSR is between -6% and 6% of the MRA.	42%	28%
Sell	FSR is > 6% below the MRA.	11%	21%
Short-Term Rating	**Definition**	**Coverage[3]**	**IB Services[4]**
Buy	Stock price expected to rise within three months from the time the rating was assigned because of a specific catalyst or event.	less than 1%	less than 1%
Sell	Stock price expected to fall within three months from the time the rating was assigned because of a specific catalyst or event.	less than 1%	less than 1%

Source: UBS. Rating allocations are as of 30 September 2014.
1:Percentage of companies under coverage globally within the 12-month rating category. 2:Percentage of companies within the 12-month rating category for which investment banking (IB) services were provided within the past 12 months.
3:Percentage of companies under coverage globally within the Short-Term rating category. 4:Percentage of companies within the Short-Term rating category for which investment banking (IB) services were provided within the past 12 months.

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Company Disclosures

Company Name	Reuters	12-month rating	Short-term rating	Price	Price date
Tesla Motors[13, 16]	TSLA.O	Neutral	N/A	US$207.00	12 Dec 2014

Source: UBS. All prices as of local market close.
Ratings in this table are the most current published ratings prior to this report. They may be more recent than the stock pricing date

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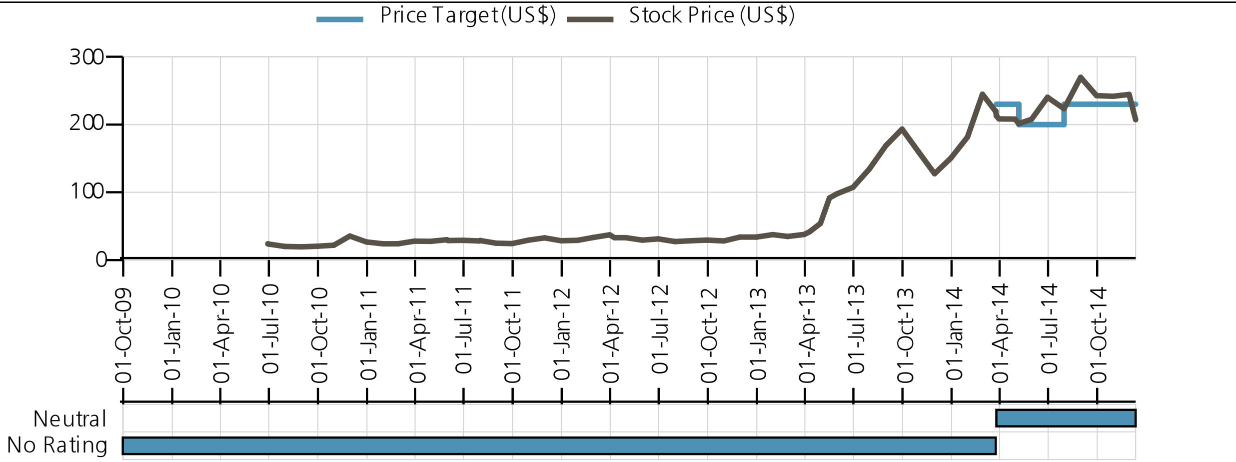
Tesla Motors (US$)



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