



Automotive World MAGAZINE

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Inside Aptiv's Las Vegas Tech Center

How to spot a start-up, with **Toyota AI Ventures** | Can **LNG** help truck industry meet emissions targets? |
GM wants to take the hassle out of EV charging | Which cities are tomorrow's **mobility leaders**? |
Arrival discusses ambitious launch plans | **Uber** on the challenge of going electric |

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Editor's note

Everyone knows the saying: What happens in Vegas, stays in Vegas.

Unless, that is, you're using Sin City as a technical hub for autonomous ride-hailing operations, in which case you monitor, record, analyse and report in intricate detail on everything that happens.

Automotive World was granted access to Aptiv's Las Vegas Technical Center, guided by Karl Iagnemma, President of Aptiv Autonomous Mobility. The Tech Center is Aptiv's fourth; it's also home to the company's Global Command Center, and to its largest fleet of autonomous vehicles, including the robo-taxis which it operates on public roads in partnership with Lyft.

Next on Aptiv's to-do list is to roll out electric robo-taxis; it is also developing autonomous vehicles with Hyundai. The companies have an equal joint venture, and aim to make a production-ready autonomous driving platform available for robo-taxi use in 2022. The JV will be led by Iagnemma and headquartered in Boston. Maybe not everything stays in Vegas.

Martin Kahl

Editor-in-Chief, Automotive World

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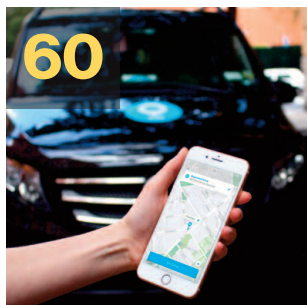
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Self-driving central: an inside look at Aptiv's Las Vegas Technical Center

Karl Iagnemma, President of Aptiv Autonomous Mobility, gives Megan Lampinen a tour of the autonomous ride-hailing hub and R&D centre

Aptiv is working towards a vision of driverless on-demand mobility, and has steadily been building up competencies. A big step forward came in 2017 when the supplier, then operating as Delphi, acquired Boston-based nuTonomy, which had developed a proprietary autonomous driving software solution for Mobility as a Service (MaaS) applications. The two operations have since combined their autonomous vehicle (AV) pilots in key markets around the world and Karl Iagnemma, one of nuTonomy's founders, serves as President of Aptiv Autonomous Mobility.

In December 2018, Aptiv opened its fourth technical centre for AV development. This 130,000 sq-ft facility, located in Las Vegas, joins similar centres in Boston, Singapore and Pittsburgh. The focus here is on research and development and data

management, but the facility is also home to Aptiv's fleet of AVs and serves as the technical hub for its autonomous ride-hail operations with Lyft. Aptiv's Vegas fleet is its largest, consisting of around 75 BMW 5 Series sedans, 30 of which are used for ride-hailing. "This centre is all about the learnings that come out of doing," explains Iagnemma.

Automotive World recently had the chance to see firsthand the sort of developments taking place at the facility during a tour with Iagnemma.

Revenue-generating AVs

Aptiv is taking a very hands-on approach to perfecting its technology in real world applications. At CES 2018, it launched a pilot robo-taxi

service with Lyft. That week-long pilot provided more than 400 self-driving rides and encouraged Aptiv and Lyft to take it further. By May that year, they had opened the service up to members of the public, and anyone using the Lyft app in Las Vegas can opt-in to the self-driving option.

The regions in which the AVs operate are restricted, but in general the fleet supports more than 1,600 destinations across Clark County and the City of Las Vegas, including the Las Vegas Convention Center and City Hall. These are paying customers, unlike many other AV pilots, but there is still a safety driver behind the wheel. So far, the service has racked up nearly 100,000 rides and covered 2 million miles. With an average customer rating of 4.97 stars out of 5, users appear to be happy with the experience.



The Las Vegas Technical Center is Aptiv's fourth; it's also home to the company's Global Command Center, and to its largest fleet of autonomous vehicles



Aptiv monitors its fleet of AVs while they are on the road

Pivotaly, the insights from this pilot are helping Aptiv to refine its automated driving technology. Data is extracted from the fleet of BMW 5 Series vehicles, all of which have been fitted with Aptiv's self-driving system. After each shift, the safety driver removes the hard drive via the access panel and hands it over for processing. These drivers are pivotal players in Aptiv's mission. There is no global standard for training safety drivers of AVs, but those at Aptiv undergo six weeks of instruction before they ever get behind the wheel of an AV, and then face recertification later down the line. They are also rotated from Lyft driving to other functions. "This helps keep things fresh," says Iagnemma.

Industry studies suggest that it is harder for humans to actively monitor a self-driving system than to simply drive by themselves. And shifts are long, running about ten hours a day at

Aptiv. Failure to remain alert can have dire consequences, as seen with the fatal Uber crash in Tempe, Arizona. At Aptiv, drivers are penalised for sloppy or dangerous behaviour on a point system. Turnover is relatively high, but that's by design. "The stakes are high," Iagnemma adds.

Fleet oversight and maintenance

The Vegas facility contains the Global Command Center, which monitors Aptiv's self-driving cars around the world. "From this one location we can monitor vehicles remotely," explains Iagnemma. Operators can access the status of any AV, tapping into their sensors for a real-time stream of information. For the Lyft fleet, a central board shows when ride requests come in, when the vehicle completes a job, the customer rating for a journey, etc. If any technical issues arise, such as a low oil warning, the

command centre will know about it. The fleet runs 20 hours a day, seven days a week.

Centre operators can also communicate directly with safety drivers and issue instructions if needed. "The people in this office can get a big picture view of the situation that drivers can't," he notes. While today they are helping safety drivers, in the future they may be dealing with completely automated machines. Even in a fully autonomous future, AVs may require human support and input. At that time, this centre will be used to send remote, on-demand assistance to AVs in tricky situations, instructing a vehicle how to proceed. "Teleoperation would be the next evolution," predicts Iagnemma. "This is how we are building towards a driverless future."

Another important aspect to the Las Vegas Technical Center is its garage. This space can hold up to 130 cars, though there are only 75 in residence today. This is where they park when not in use, and where maintenance and repairs take place. It also includes a full sensor calibration lab: vehicles are positioned on a turntable while their numerous sensors are calibrated to ensure everything is seeing what it should be. That takes place every six to eight weeks, or after any damage incurred on the road. This sort of kit does not come cheap, but as



The garage at Aptiv's Las Vegas Technical Center has room for 130 vehicles

Iagnemma comments: “That’s just part of the cost of learning.”

It is also helping to increase fleet uptime, which today stands at more than 90%. “It’s about keeping cars on the road and maximising usage on the network. That’s how we will make money,” he says. “It’s one of the biggest benefits of this facility. We need to offer a compelling service.”

That will entail a low-emission service as well in the future, and a row of electric vehicle (EV) chargers awaits the next generation of Aptiv AVs. These will be based on the Chrysler Pacifica hybrid, the same model that Waymo is using to explore autonomous capability. Pacifica models will undergo testing this year, though there is no plan yet to launch them as part of the Lyft service.


Aptiv will also soon begin working on another future model in collaboration with Hyundai. The two announced plans for an autonomous driving joint venture in September 2019, and the deal is expected to close in early Q2 2020. This joint venture, to be headquartered in Boston and led by Iagnemma, aims to produce a production-ready Level 4 autonomous driving platform by 2022. When finalised, the joint venture will assume control of Aptiv’s current operations in Las Vegas, including a new pilot programme with the city’s McCarran International Airport.

Up next

Vegas has long struggled to effectively manage the flow of visitors from the airport to the

city centre. Demand for ride-hailing and taxis is high, and it’s not unusual to wait an hour or more for a taxi into town. Once there, the drop off can be complicated due to the massive size and numerous entrances of the hotels and casinos. Aptiv is taking on the challenge with an autonomous pick-up and drop-off service.

Separate from its project with Lyft, this service is an exclusive private pilot with McCarran Airport and will only be open to a select group of passengers, mostly VIPs and Aptiv visitors. It will operate from designated pick-up spots from Terminals 1 and 3. While the scale is small to start with, this represents an important extension of its regional coverage. “If we can serve airports, we can unlock massive demand,” states Iagnemma.



How is GM tackling the EV charging challenge?

GM's Manager of Electric Vehicle Charging & Infrastructure wants to make sure nobody sees charging as an obstacle to EV ownership, writes Megan Lampinen



General Motors has committed itself to an all-electric future—a bold move from a company that built its global reputation on internal combustion engine excellence. But it's indicative of the larger industry transformation towards Vision Zero: zero crashes, zero emissions and zero congestion.

One of the manufacturer's biggest contributions to this cleaner future is its offering of low-emission models. The Chevrolet Volt plug-in hybrid broke new ground with its range capabilities, and the Bolt set the benchmark for pure battery electric motoring. Moving forward, the automaker will introduce at least 20 new electric vehicles (EVs) to the market over the next several years, but there's more to EV penetration than just model offering.

Charging infrastructure could make or break the segment, and that's where Kelly Helfrich and her team come in. Helfrich is GM's Manager of Electric Vehicle Charging & Infrastructure, tasked with ensuring that nobody sees charging infrastructure as a reason to not purchase an EV.

What are the biggest barriers to EV uptake for consumers?

We know from customer research that the three biggest barriers to greater EV adoption are affordability, range and charging infrastructure. GM has world-class engineering teams working on the first two areas, driving down vehicle costs and

building different types of EVs that fit a variety of lifestyles. We are laser-focused on making sure our vehicles are cost competitive but also have the range people expect. Our team was created to focus on the third barrier—charging infrastructure.

Home, work or public charging: what's most important?

Based on data from our Volt and Bolt users, we see that most charging is and can be done at home or at work. For those that don't have home charging, the workplace becomes key. It's extremely convenient, as the vehicle is parked there for a prolonged time anyhow.

What has been your own experience with charging?

I drive 40 miles per day with my Bolt EV. I frequently only charge at work, and not every day. I use public fast charging when needed for longer trips, and use the Energy Assist feature in the myChevrolet app to plan my route. Ensuring customers feel confident that an EV can fit into their life and that charging will not be an issue will require additional educational efforts, but once most people get into an EV they realise how seamless it is, and that charging isn't a barrier.

What role do you see for public charging stations?

Public fast charging stations are vital to ensure the continued adoption of EVs. People without consistent access to home or

Buyers want to know that there is plenty of public charging available, should they need it



workplace charging will utilise public fast charging, and it is a necessity for road trips that extend beyond the range of the vehicle. Stations should be located in areas that are easily accessible, and with amenities nearby. For this sort of use case, we will collaborate with engineering company Bechtel to build out public EV fast charging infrastructure in the US to support growing adoption of EVs. Our team has initiatives and strategies under way to address every type of charging—whether home, work, or public—to ensure that charging infrastructure is not a reason for someone to not purchase an EV.

Which comes first: the charging infrastructure or the EVs?

It is a balance. For public fast charging infrastructure, utilisation is key. We also know

that you need charging in locations where people can see it and start to picture how an EV can work for them. From a workplace charging standpoint, the Department of Energy conducted a study on the availability of workplace charging and how it changes people's mindset about EVs. The study found that chargers at work could make an employee six times more likely to consider an EV.

Other than the fast charging work with Bechtel, how is GM addressing charging concerns?

We want to make sure customers are educated on how easy it can be to equip their home for a charging station. Chevrolet has a partnership with supply chain specialist Qmerit on this front, which went live in July 2019. Customers can visit the Chevrolet charging website, enter their

address and fill out a survey about their home, which includes sending a picture of their electric panel and where they want the charger to be installed. These details are sent to qualified electricians in the area, who then issue quotes for equipping the home with a charging station. That partnership lets customers know they are getting a competitive cost estimate, as they can compare quotes online. The process is quick and easy, and has been very successful since our launch.

You mentioned educating consumers about EV charging. Can dealers play a role here?

They play a huge role. The dealership base has to be educated on both gasoline and electric vehicles to adequately answer customer questions. Customers trust their dealer.

They want to be able to walk in and get information firsthand from a salesperson. I would say they are one of the most important parts of this equation, due to that close relationship with the customer.

How do you see the future of EV charging evolving?

In the future there will be adequate public charging so the majority of people know that they can take their EV

be used for the greater good. It is absolutely a necessary piece of the puzzle.

What can we expect next from GM on the electrification front?

GM wants to make it easy for owners to install charging infrastructure at home



There has been a revived interest in battery swap technology among some EV players recently. Is there any place for this in GM's future?

I'm not bullish on the idea. It requires more engineering resources on vehicles to allow for the battery to be removed quickly. Then, you still have to establish the battery swap stations and equip them with spare batteries. I don't think it's the right mass market solution. That's not to say there aren't certain fleet applications for which this could work, but the focus for public charging should be on DC fast charging.

anywhere. Workplaces will have the right amount of charging infrastructure to accommodate their employees, which will enable greater adoption. We still expect home charging to dominate, and that customers will find it easy to install charging infrastructure. They will also be empowered to use their EV as a grid resource with utilities.

Is GM directly involved with vehicle-to-grid projects at the moment?

We have done programmes in this area, and will continue to do so. Many automakers are working to ensure their EVs can

We have been very public about our plans to become zero emissions, and we are making a serious commitment to bringing different types of EVs to market. Not everyone wants a sedan or a hatchback. We just introduced our first plant fully dedicated to EVs, along with our first all-electric pick-up, the GMC Hummer EV. Producing different types of EVs leads more people to consider them as a vehicle that can fit their lifestyle. It's an exciting time to be at GM as we are shifting to an all-electric focus, and will be releasing several vehicles and initiatives to secure a leadership position in the all-electric market.

EVs need better economics for ride-hailing fleets to electrify, says Uber

What is the world's most well-known ride-hailing enterprise doing to prepare for a zero-emission future, and just how difficult could that be? By Xavier Boucherat



Uber has faced numerous challenges in recent years as city regulators have clamped down on services. New York City is a prime example, having capped the number of drivers and extended a moratorium on new vehicle licenses until August 2020. This is already affecting the way Uber operates, with the company locking out drivers from its app at times of low demand. Currently there are approximately 80,000 Uber drivers in the city.

Meanwhile, difficulties continue in London, with Transport for London's decision not to renew the company's license in November 2019, the second time in two years, following concerns over safety and fraudulent driver ID. In addition, as in New York, the company was affected by congestion measures: the launch of the Ultra-Low Emission Zone (ULEZ) meant that fares within the centre of the English capital now have a surcharge, with an appeal by drivers turned down by the courts in July 2019.

With cities around the world continuing to grow, and bringing with them further congestion and emissions, it seems likely that these challenges for the ride-hailing sector and its drivers will only grow over time. But one way passenger car fleets like Uber's could make life easier going forward could be to begin full-scale electrification. Zero-emissions vehicles can avoid

charges, whilst putting companies in a better position for all important licenses. But how do these companies, many of which do not own their fleets, drive change?

Adam Gromis is Uber's Head of Sustainable Mobility Policy. The company's strategy, he explains, is multipronged. "Uber seeks to build a more sustainable future of mobility by enabling multi-

full battery electric vehicles (EVs) are another. However, adds Gromis, Uber is under no illusions: the task ahead of them and the sector is considerable.

"Whilst Uber is optimistic about the long-term potential for EVs in ride-sharing, we are clear-eyed about the present challenges in large-scale deployment," he says. Critically, the use of cleaner vehicles must make economic



For car-based, on-demand services, the company aims to move more people with fewer, fuller and more efficient vehicles and trips

modal, shared and active mobility at the push of a button," he says. "For car-based, on-demand services, the company aims to move more people with fewer, fuller and more efficient vehicles and trips." Pooling services and ride-sharing could therefore take greater precedence as time moves on, reducing the single-occupancy journeys which have contributed to greater congestion and emissions.

But a role for next-generation powertrain technologies is also clear. High-efficiency plug-in hybrids are one option, whilst

sense for drivers using the Uber platform. As the company has repeatedly stressed, its drivers are considered independent contractors who use their own personal vehicle.

For drivers, the current price premiums and fare-time lost due to charging, particularly for earlier models with lesser range, may offset the benefits they reap. These include traditional advantages, such as less maintenance and a reduction in cost per mile in countries with cheap electricity, as well as job-specific advantages such as evading low-emissions charges.

Opportunity cost

“The economics of using an EV on a ride-sharing network are not just determined by a driver’s vehicle and other costs, but by their earning potential,” affirms Gromis. The ‘opportunity cost’ is significant for EVs for several reasons. Along with range, the distribution of charging options remains inadequate in most cases. Inner-city charging infrastructure remains lacking, with many commercial plugs located outside of urban centres.

retail outlets such as Whole Foods and IKEA. Other common options, such as parking garages, require the driver to take on extra cost of entry.

Addressing these issues, improving the economics of EV ownership and removing the barriers for drivers will require support through policy, says the company. “In terms of infrastructure policies, the focus needs to consider the rideshare driver as a potential user and increasing fast-charger

availability in areas as close as possible to high mobility service demand,” says Gromis.

Incentives for fast-charging infrastructure in urban centres and airports, for example, should be incentivised. To date, fast-charging has largely been viewed by the industry as a means of enabling long-distance travel for EVs, and as

such, corridor strategies have been pursued, with fast-charges located at key points between cities and borders. Inner-city strategies are required to meet the needs of ride-sharing vehicles. Increasing fast-charge rates mean that recharge times are dropping ever closer to times required to refuel internal combustion engine vehicles.

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Other possible policies might include increasing incentives for charging placement at lower income, multi-family dwellings, and nascent market support via discounted fast charging rate schedules for shared vehicle drivers

“In London, many drivers reported needing to drive to the outskirts of London to find charging, particularly for fast-charging options,” says Gromis. Distances effectively amounting to downtime can be significant. Further driver anecdotes mention competition with the consumers and commuters also vying for chargers, particularly those in



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Almost half of Londoners surveyed believe Uber has had a negative impact on the environment, with only one in eight believing it has made a positive impact

Home-charging incentives must also be researched, says Gromis, along with policies which can take account of the socio-economic circumstances in which the drivers live. “Other possible policies might include increasing incentives for charging placement at lower income, multi-family dwellings, and nascent market support via discounted fast charging rate schedules for shared vehicle drivers, as well as priority access to charging stations,” adds Gromis.

Personal initiatives

For its part, Uber is running in-house programmes to get its drivers into EVs. A recent deal with Nissan will offer 2,000 new-

generation Leafs to UK drivers, in a bid to make all trips in London emissions-free by 2025. Surcharges collected on trips within the M25–London’s circular motorway—are also contributed to a fund which experienced drivers can use to fund an EV purchase.

Meanwhile in Paris, the company runs UberGREEN, a variant on its normal service in which riders can opt for hybrid and EV trips only. This secures more trips for drivers in qualifying vehicles. A recent survey by YouGov concluded this could prove a canny move: more than half of taxi and Uber customers across seven European nations said they were willing to pay an extra €0.15 to €0.20 (US\$0.16 to US\$0.22) per km for a zero-

emission ride. Young people in particular supported the idea, with 60% of those between 18 and 24 agreeing that a clean ride was worth it.

Further conclusions from the report might put the demand for action on climate change into perspective: almost half of Londoners surveyed believe Uber has had a negative impact on the environment, with only one in eight believing it has made a positive impact. The pressure is on for the ride-hailing giant, particularly with competition in the sector swelling, including interest from automakers: companies which, while perhaps lacking the software expertise, certainly have access to new powertrain technologies.



Which cities are tomorrow's mobility leaders?

A new framework makes it easier to assess the future mobility readiness of the world's leading cities. Megan Lampinen investigates

The global mobility industry is growing rapidly but vast regional differences are emerging. Many cities have been keen to boast of their efficiency improvements, congestion reductions or connected technology investments, but making any sort of objective, consistent assessment has proven tricky—until now. The Oliver Wyman Forum recently set about building a framework to help assess the quality of the business positioning of cities to take advantage of mobility trends.

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Singapore has a good positioning on all dimensions and a very strong political vision on mobility, as well as strong research and innovation capabilities

Research was conducted with the Institute of Transportation Studies (ITS) at the University of California, Berkeley, and the end product is the Urban Mobility Readiness Index. This index analyses 30 of the world's cities, looking specifically at the existing public and private mobility networks, regulations, policy, infrastructure, and capacity to absorb future technology. It then ranks the cities by outlook.

Inside the rankings

Within this ranking, Singapore emerged as the clear leader. “Singapore has a good positioning on all dimensions and a very strong political vision on mobility, as well as strong research and innovation capabilities,” explained Guillaume Thibault, an Oliver Wyman partner and one of the creators of the new index. “The way it manages the mobility system is very efficient.”

The crowded, wealthy city-state has grabbed headlines with its truck platooning and autonomous car-sharing experiments. It is frequently flagged by various industry watchers as a leader in terms of smart city developments. “Singapore has done a great job in terms of setting and realising a smart city vision,” Jesse Berst, the founder and Chairman of the Smart Cities

Council, told *Automotive World*. Notably, it was the first big city to introduce congestion charging back in the 1970s, followed by electronic road pricing (ERP) 20 years later. Developments continue at a rapid pace.

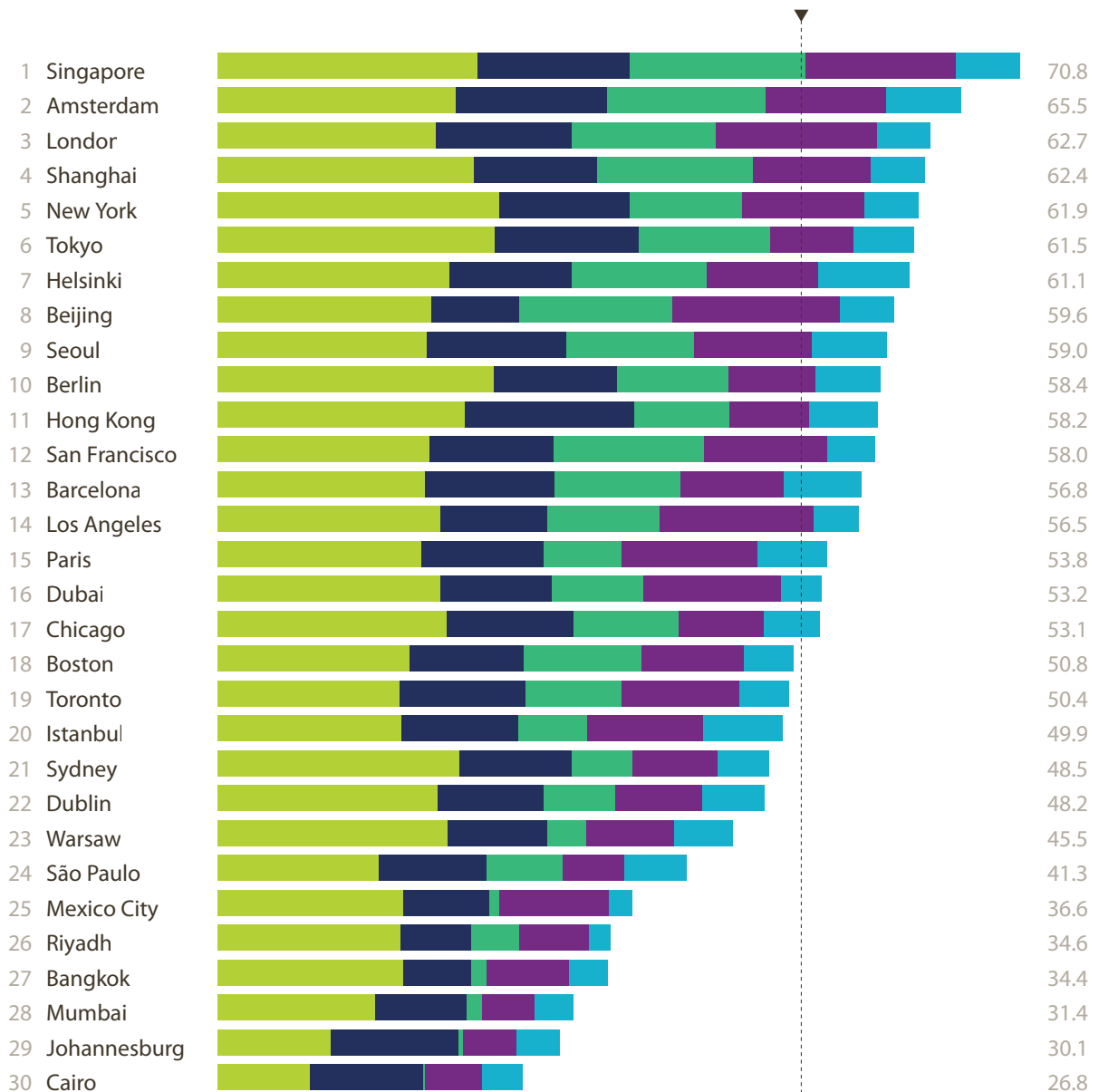
Ana Nicholls, Director of Industry Operations at the Economist Intelligence Unit, suggests that “new technologies offer new opportunities, particularly given

Overall Rankings Of Cities

1

Cities are ranked on a scale of 1 to 100, based on how well they meet five core criteria

System Efficiency Social Impact Innovation Market Attractiveness Infrastructure



Source: Oliver Wyman Forum analysis

GLOBAL AVERAGE | 51.0 ●

Self-driving cars first appeared in Singapore in 2016, as part of nuTonomy's ride-hailing fleet. The company was acquired by Delphi in 2017, and then became part of Aptiv

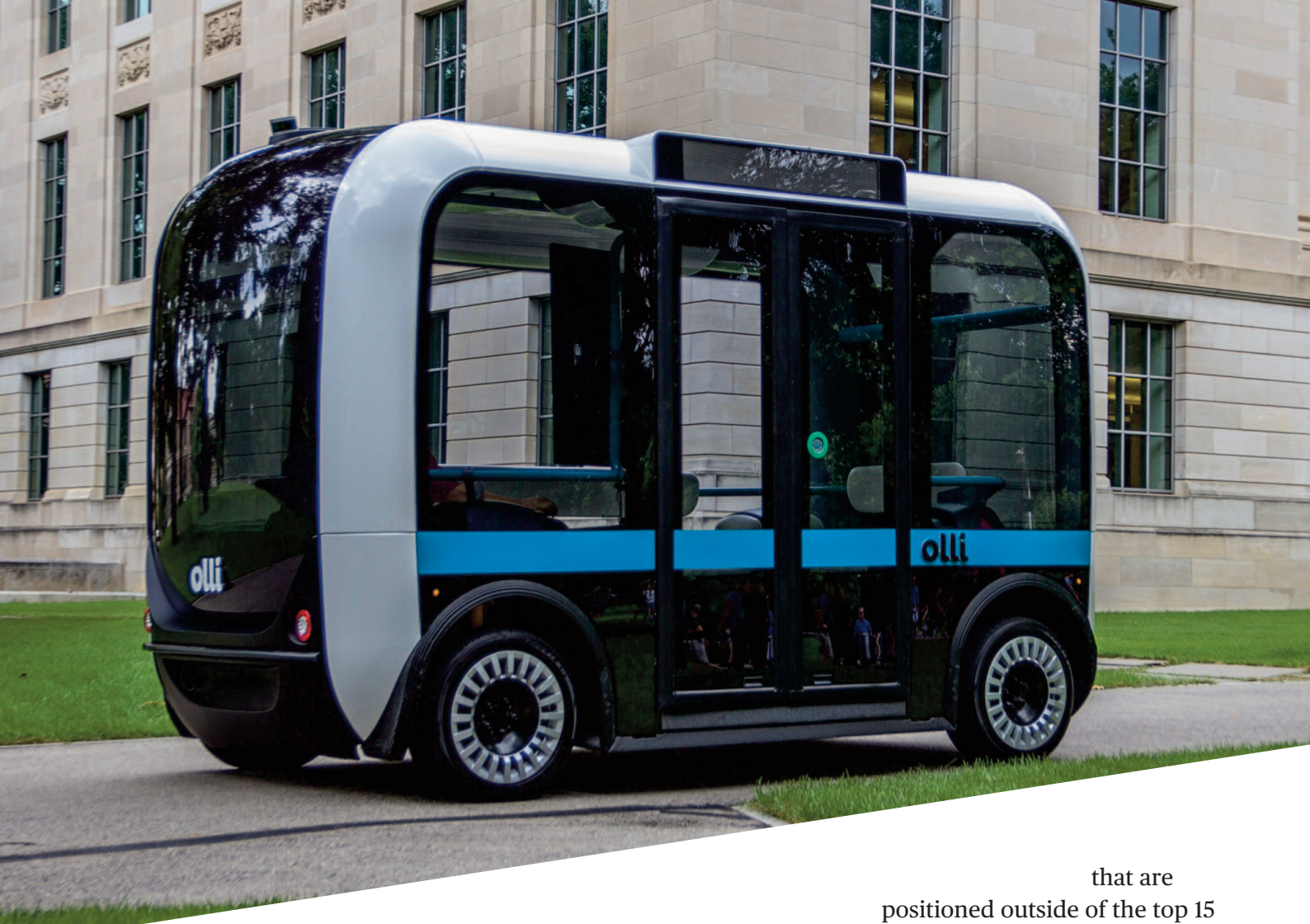


Singapore's sophisticated digital infrastructure. Using a combination of satellites and improvements to the ERP, from 2020 onwards, the government promises it will have full real-time data on all road traffic in the city, making traffic planning easier, both in the short term and the long term."

Aside from Singapore, other cities had more heterogeneous results, which have led to mitigated positioning. London, for example, came in at number three. At first glance, this may come as a surprise. "Many people from London frequently complain how awful the traffic is, but at the same time, what we showed here was that London is very well positioned in terms of market power in mobility," noted Thibault. For example, numerous Forbes 2000 mobility companies have their headquarters in London, and the research ecosystem is quite strong. The governance is also efficient. Transport for London has

considerably greater powers than many of its peers in other cities, and this authority is taking a very energetic approach to managing traffic and to organising mobility in the city. "At the end of the day, you can complain about London traffic, but this is a city which has built up capabilities to position it very well for future mobility," he emphasises.

Asian cities dominated the top ten. In addition to Singapore, this list includes Shanghai (4th), Tokyo (6th), Beijing (8th) and Seoul (9th). The top five also included Amsterdam (2nd) and New York (5th). While New York is one of the most complex urban environments in the US, the city regularly makes it into the top ten lists of innovative cities to watch. It took the number five spot in ABI Research's latest Smart City Ranking and the number nine spot in WSP's Top 10 Cities in Future Mobility Technology. Notably, New York has the highest percentage of car-free



households in the US. Los Angeles, which came in at 14 in the rankings, is at the opposite end of the spectrum. Here, 90% of transport takes place with cars, and as a result, it has attracted a global reputation for terrible traffic congestion. “When you think about mobility in Los Angeles, you could think of it as a city where you just sit in traffic, but at the same time, it has a very strong capacity to develop and implement digital tools, especially to manage traffic,” says Thibault.

What's at stake

The Urban Mobility Readiness Index is not just about city rankings. The creators also want

to emphasise the necessity for cities to create capabilities to take advantage of the potential market of future mobility. “Municipal governments see the need to become increasingly proactive and agile in the evolving mobility landscape,” observes Professor Alexandre Bayen, Director of the Institute of Transportation Studies at the University of California, Berkeley. “Cities see the benefits of re-focusing on the basics of public transportation and infrastructure development in order to lead in the next generation of mobility. Cities who embrace technology and have proactive regulation will become leaders in the mobility revolution.”

Those that do not could find themselves out of the race entirely. “At some point, cities

that are positioned outside of the top 15 or top 20 will lose opportunities in terms of investments and R&D,” cautions Thibault. “The more investments and the more R&D put in a single place, the more efficient they are. Scale effects are important. If cities completely escape the competition for talent, investments and R&D, they might be completely lost. In that case, the only topic will be about developing a nice transportation system for your residents. That’s good in itself, but it will not ensure that jobs are created.”

Mobility is a strong catalyst for job growth and corporate investment in general. “This segment is probably one of the few places where all the critical technology of our time—electrification, connectivity,

digitalisation, artificial intelligence—is combined,” he adds. “All of these are direct use cases in mobility. Cities that do not act early will lose out on employment, GDP growth, and attractiveness for investors and visitors.”

The mobility leaders of tomorrow

When it comes to addressing smart mobility in cities, there is no one-size-fits-all approach. “It’s difficult to have one common template for the simple reason that all cities are not made equal,” notes Thibault.

challenges. “We like to think there are several common problems across many cities,” says Jon Scott, Project Lead at City Data Solutions for the Ford Smart Mobility team. Ford is working to develop a set of tools that can be applied to pretty much any city. “These tools have to be relatively standard across different cities because we cannot keep recreating all of these applications,” he adds.

For the Oliver Wyman team, the key for all cities moving forward will be to work on developing a holistic mobility framework. The end game is a seamless, multi-

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Electrification, connectivity, digitalisation, artificial intelligence...All of these are direct use cases in mobility. Cities that do not act early will lose out

“Today, there is little in common between Los Angeles, which relies so heavily on the car, and Hong Kong, where public transportation handles 90% of all journeys, or Amsterdam, where cycling or walking account for 60% of journeys. Why? Because there is a cultural dimension as well as topographic constraints.”

However, despite the differences, cities are generally tackling the same sort of big picture urban

modal transport network, incorporating advanced technologies and accessible to everyone. To achieve this, they need to concentrate on forming close ties with academia and private sector mobility players to explore the latest technologies and applications. “Cities destined to become tomorrow’s mobility leaders are forward-thinking and user-centric,” adds Thibault. “They take a data-driven approach and work with the private sector to find solutions.”

INTERVIEW

Patrick Bion, Chief of Product, Arrival

Arrival is another new entrant into the electric commercial vehicle space. Freddie Holmes learns more about the ambitious UK start-up





With dedicated routes and low driving speeds, urban commercial vehicles (CVs) have become a low-hanging fruit for electrification. It is not only the established names looking to deploy their own electric delivery vehicles—new entrants have also been attracted into the space.

One of the biggest headlines has come from UK-based electric CV manufacturer Arrival, which has developed a scalable ‘skateboard’ architecture that can be shared across a range of vehicles. The company has secured a landmark deal to sell 10,000 specially designed delivery vans to UPS

between 2020 and 2024. That order can be expanded to add a further 10,000 in 2023 if all goes to plan. The company also sports investment from global automakers: a €100m (US\$110m) cash injection from the Hyundai-Kia Automotive Group comes as part of a ‘strategic partnership’ to produce electric CVs on a global scale.

Arrival recently signed a 15-year lease for a 120,000 square-foot warehouse in Bicester, UK, with a reported annual rent of £980,000 (US\$1.26m), but also has locations near London, and soon, New Jersey in the US. It may be headquartered in the UK, but the company aims to utilise ‘micro

factories’ around the world to correspond with demand.

Patrick Bion is Chief Product Officer at Arrival. Previously a member of Tesla’s design team, Bion has worked on the Model X, Model 3 and Model Y. When he joined Arrival—or Charge, as it was formerly known—he saw similar engineering principles behind the company’s efforts to commercialise electric vehicles. “We challenge ourselves to disprove why something cannot be done,” he explained. Speaking to *Automotive World*, he gave a deeper insight into Arrival’s wider ambitions in e-mobility, and why it intends to break the mould.



Arrival has developed a ‘skateboard’ architecture that can be scaled across a range of vehicles

How would you describe Arrival as a company?

Arrival is a technology company, and we say that with good reason. We've developed our own in-house software components, manufacturing methods and materials. Whereas traditional automakers would get that from suppliers, we're creating most of our stuff in-house. Then there is the software in our vehicles and the robotics that produce those vehicles, and even the tools in our development process. That's why we're more a technology company than a vehicle producer.

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It's about bringing ourselves back to our number one objective as a company: to bring cost parity between electric and diesel commercial vehicles

What is the impetus to differentiate Arrival from the established automakers in this way?

A lot of our technologies will be used by other teams around the world, not just automotive teams, so it's about bringing ourselves back to our number one objective as a company: to bring cost parity between electric and diesel commercial vehicles.

How will Arrival produce affordable battery electric powertrains?

Because price is so important for commercial customers, we've designed the vehicles to have a fairly high level of customisation; if the customer only wants 100km of range a day, they don't have to go and buy a big battery pack.

We have a strong relationship with LG Chem, so we use the same cylindrical cells that Tesla uses. We then assemble the battery modules ourselves, which are designed and engineered entirely by Arrival. In a similar concept to the micro factories, we'll also be assembling battery modules locally to where they are needed, rather than assembling giant battery packs in one area and shipping them across the world at great expense.

What kind of performance figures have you seen through initial testing, in both laden and unladen vehicles?

There are three different battery pack sizes: 74kWh, 111kWh and 148kWh. Driving range varies between 220 kilometres (136 miles) up to 405 kilometres, depending on customer needs.



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We've developed our own in-house software components, manufacturing methods and materials...we're more a technology company than a vehicle producer

To make sure we're standardised with the rest of the industry, our three battery pack options run on the WLTP cycle.

The WLTP cycle is run at a varying level of payload, but we also perform drive cycles with all of our key customers. We measure their drive cycles across a range of vehicles and run our own vehicle analysis to predict what vehicle specification they need. This is performed both laden and unladen to ensure the required range is as accurate as possible for the customer.

How important is it to replicate your customers' daily routes as they make the switch to electric?

The WLTP is useful but customers have such differing needs and different drive cycles. Customers driving in San

Francisco, Norway or England will all have very different needs, but they want the confidence to know what they're going to get. And because we get guaranteed cell performance from LG Chem, we also have very good models to project battery degradation over time. That goes down to the detail of understanding what capabilities will that battery have in ten or 15 years' time based on the drive cycles they run.

Has Arrival made any steps to support the development of charging infrastructure for these vehicles?

Yes, we are developing our own charging hardware. Consumers have barriers to overcome when moving to electric vehicles, and helping them with charging infrastructure is one way to do that. We believe, similar to how we can create drivetrains or



inverters at a reduced cost to what is on the market already, we can do the same with charging infrastructure. It is still in its infancy, but we have discussions with customers that will be charging in depots overnight to advise how we can help them with charging infrastructure.

What are the obvious benefits of transitioning a fleet of diesel vehicles to fully electric powertrains?

There are many good reasons, but the biggest barrier has always been price. The cost of

Total cost of ownership (TCO) is essential for commercial vehicle fleets, and Arrival recognises that the price of electric vehicles is the biggest barrier to EV adoption



other manufacturers' electric vans today come in at about €60,000 (US\$65,000) to €70,000 versus their diesel equivalents at about €30,000. The business case doesn't stack up for all consumers. But as soon as we offer the vehicles at the same price points, the other benefits become very attractive.

Then there is reduced cost of ownership. In a city such as London, with emission zones and the congestion charge, when you bake that in with maintenance and diesel costs, customers would see a 50% total cost of ownership

reduction. And that is immediate, because the price is no longer offsetting against that. From year one, you're seeing a 50% total cost of ownership reduction. It's huge.

Making the switch with commercial vehicles is far easier than with passenger vehicles. Customers have known drive cycles and routes, they know how much weight they put in their vehicles and for how long, and can easily charge overnight. As soon as that reduced cost of ownership becomes known, we will see many fleets trying to find electric vehicles very quickly.

Arrival's current timeline is to have the first electric vans on the road in Q4 2021. How is that looking?

It's a hard timeline to meet, we'll be honest with that, but such is the desire for us to get products into customers' hands and taking diesel vehicles off the road that we always want to be pushing ourselves. Of course, there will be challenges to overcome with setting up a new supply chain and new assembly processes, but at this stage we're still on track for that. It is an aggressive timeline, but definitely feasible.

Isuzu targets scale and expertise through tie-ups

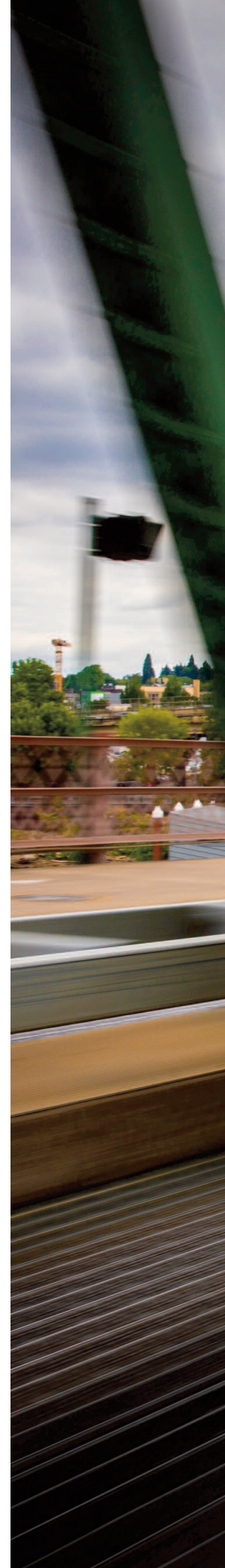
The Japanese manufacturer's recent tie-ups with Honda and Volvo Group's UD Trucks show a modern truck maker preparing for industry transformation.
By Xavier Boucherat

December 2019 saw Isuzu announce a strategic partnership with Volvo Trucks, which it hopes will “create a stronger, combined heavy-duty trucks business in Japan and across international markets,” according to a statement from Volvo. Isuzu will acquire the Swedish manufacturer's Japanese brand UD Trucks for ¥250bn (US\$2.2bn). In addition, the pair will form a technology partnership, leveraging complementary areas of expertise. Isuzu hopes to create a larger volume base to support costly future technology investments.

January 2020 saw a second technical partnership announcement from Isuzu, this time with Honda. Together the pair

will participate in joint research on hydrogen-powered heavy-duty trucks, combining Isuzu's truck-manufacturing expertise with Honda's fuel cell powertrain knowledge. Details on the two-year agreement are minimal, but both stress that co-operation is necessary to address the hurdles that remain in the way of a hydrogen society.

Jonathan Storey, author of *Automotive World* report ‘[The World's Truck Manufacturers](#)’, said the Volvo tie-up is a reasonable move for Isuzu, given the company's longer term challenges around scale. The company occupies a somewhat quirky position in the industry, says Storey, being neither a dedicated truck manufacturer, nor a full-line car manufacturer for personal transportation.







In December 2019, Volvo Group and Isuzu Motors signed a non-binding Memorandum of Understanding (MoU) to explore the formation of a commercial vehicles strategic alliance that includes transferring complete ownership of UD Trucks to Isuzu Motors

“The biggest challenge for the future is whether it will have the scale to compete in both sectors against larger players,” he writes. To date, Isuzu has shown a flexibility and responsiveness that has allowed it to carve out a reasonably profitable niche for itself. Continued flexibility and responsiveness will go a long way, but with a partnership with Toyota now dissolved, there is also the question of how to spread

the cost of new powertrain technologies, advanced driver assistance systems (ADAS) and autonomy.

“The end of year announcement of an alliance with Volvo Trucks conforms to expectations,” says Storey. Isuzu is by no means struggling: in Japan, the company took a 31.8% share of the heavy-duty/medium-duty truck market for the fiscal year ending 2019,

down from 34.2% in 2017/18. Light-duty share increased over the same, from 38.5% to 40.6%. However, like all automakers, it must now consider the upcoming period of transformational change in the industry.

“The company is in fairly good shape, but rightly concerned about the strategic challenges it faces,” affirms Storey. “The Volvo alliance should go a long way to addressing those challenges, and the takeover of UD will enable it to better take on Hino and Fuso in Japan and Southeast Asian markets.”

Many ways to electrify a truck

The Volvo partnership will seek broadly to design and build the next generation of trucks, with electrification and self-driving technologies key areas of focus. Truck electrification has already started in Japan: Daimler’s Fuso brand began deliveries of the eCanter light-duty electric truck in 2017. Toyota’s Hino has deployed a number of heavy-duty diesel-electric hybrids with on-board artificial intelligence which can mitigate inefficient driving behaviours and save fuel.

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There is now the question of how to spread the cost of new powertrain technologies, advanced driver assistance systems and autonomy

But whilst Japan is embracing batteries, it is also still positioning itself as a future hydrogen society. The country is home to two of just three automakers which have brought a fuel cell vehicle to production, and roughly 109 hydrogen stations. The Fukushima Hydrogen Energy Research Field is due to open this year, and will

has tested a fuel cell powertrain using two stacks taken from the Mirai, and has deployed concept vehicles for drayage work in the twin ports of Los Angeles and Long Beach. In 2019, it unveiled a second generation fuel cell truck developed in partnership with Kenworth.

There is growing agreement that hydrogen, if produced sustainably using renewables, could create a zero emissions solution for the road freight sector. With the pressure to decarbonise transport growing ever greater in developed markets, the industry is paying more attention to the idea, and entrants such as Nikola Motors are gearing up for launches. Isuzu and Honda's tie up will help the pair to keep pace with competitors. Fuso unveiled a 'Vision F-Cell' prototype at the 2019 Tokyo Motor Show, and Daimler says it has plans to have hydrogen-powered vehicles in series production by the end of the decade.

"I see the Isuzu-Honda tie up as Honda looking to widen its range of fuel cell technology applications, along with its customer base," agrees Storey. "Isuzu will look to benefit from the extensive work already carried out by Honda by taking the fuel cell technology and adapting it for the heavy commercial vehicle sector, where Honda has no presence." The costs of next-generation technology are sizeable: scale and expertise will be essential for any success. Isuzu's partnerships will aim to ensure it has access to both.

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Isuzu will look to benefit from the extensive work already carried out by Honda by taking the fuel cell technology and adapting it for the heavy commercial vehicle sector, where Honda has no presence

be one the world's largest electrolysis plants: a 10,000kW facility, powered by solar.

Honda's Clarity joins Toyota's Mirai and Hyundai's Nexo for sale in limited markets, specifically Japan, California and South Korea. But Honda is yet to investigate potential applications for fuel cells in the commercial vehicle sector. This is in contrast to Toyota: since 2017, the group

What do the 2020s hold for HMI and the user experience?



Megan Lampinen explores some of the more influential technologies reshaping the in-car experience over the coming decade

A number of powerful trends are reshaping the way in which drivers and occupants interact with the vehicle. Everything from advances in digital technology to shared mobility and the rise of autonomous driving impact the wider in-vehicle experience. With most of these changes, the aim is greater convenience, safer experiences or less stressful journeys, and there are plenty of different ways to go about it.

Personalised, shared mobility

“Knowing about emerging trends and culture are key to understanding how mobility will develop,” observed Brian Kushnir, Managing Director at data insight and consulting company Kantar. “An increased degree of personalisation and a continued shift towards a sharing economy are especially relevant in this respect.”

A personalised experience in a shared vehicle may sound tricky, but it is one that consumers want. Car-share and ride-hailing are attracting more users every year, and volumes are only expected to grow. ABI Research expects several cities to ban all privately-owned vehicles over the coming decade, instead promoting alternatives like subscription services. The challenge is then to take communally used vehicles and make them personal.



“The car is something like a second home for many drivers,” stated Rolf Bittner, automotive expert at in-vehicle software framework provider Qt Company. “People even store personal belongings in it. That will become a little different, as a mobility service provides access to a car every day in some form or another but it will not be the same car.” The key is to make the car behave and feel the same as a privately-owned vehicle. As a result, there will be a big need for user profiles that can move along with the individual.

“Whenever you enter a car, you want to have the same set-up,” explained Bittner. This touches on everything from the sort of infotainment and media that’s

consumed, to the style of driving preference—sporty, comfort, eco, etc. Users may also expect the car to anticipate their destinations and be familiar with their routes, including where they may want to stop for coffee or to refuel.

User profiles can carry all of this information, but they are often tied in to a key. In a future of shared mobility, there may need to be an alternative form of identification that allows the car to recognise a user and load their preferred setting. Notably, this must be able to work across different vehicle models in any fleet. “These are all big challenges for the human-machine interface (HMI),” added

Bittner. “There is tremendous activity around this space, as all the vendors are differentiating these days with the user interface. In essence, that’s the only thing left that differentiates one vendor from another.”

A button-free interior

Regardless of whether a vehicle is privately-owned or not, occupants could soon find themselves accessing controls in a variety of new ways, including voice recognition, gaze detection and gesture. “We believe that the



Gesture could play an important role in HMI in the future

best in-car experience is one that makes interacting with your car as close to interacting with another human as possible: a multi-sensory, conversational experience in which voice, eye movements, and gestures are all part of the interaction,” comments Cerence Chief Executive Sanjay Dhawan.

The technology that was on display at Cerence’s CES 2020 booth targets just that. A Mercedes-Benz V-Class fitted out with an updated Cerence Drive platform showcased how voice recognition combined with head tracking and gaze detection can be used to create button-free interaction. For instance, a user could look out the window at a building and ask the system, ‘What time does that place open?’ Through gaze detection it would know precisely which building was being looked at, and provide

the information. Or one could simply look at the passenger front window and instruct the vehicle to ‘open that window’.

The platform also allows for gesture-based interaction with a windshield user interface. Here, drivers use gestures to move, select and interact with widgets projected on the windshield. It’s not far off the sort of futuristic technology frequently depicted in science fiction films. “In fact, *Minority Report* inspired us,” Nils Lenke, Senior Director of Innovation Management, told *Automotive World*. In this application, the system is used to control such features as navigation or music selection. The driver has to employ a grab-and-drop motion with the projected widgets, which could take some practice, but nobody in the movies seems to have any trouble with this.

Biometrics

The coming decade will also see increasing use of biometrics within the vehicle to detect the physical and emotional state of the driver. Top priority is to pick up on distraction or fatigue, which have a direct correlation with safety. Harman, for instance, has been working on a digital assistant system that measures an individual’s pupils and looks at facial expressions to determine their mood. Should the system deduce high stress levels, it could then reduce the degree to which the digital assistant interacts with the driver, delaying non-urgent messages, etc.

Numerous others are following similar paths. Cerence is working with Affectiva, a specialist in artificial emotional intelligence (Emotion AI), to gauge the driver’s emotional state. At Valeo, this work takes the form

Technology like Valeo's Smart Cocoon is tuning in to emotions in order to better interact with occupants



of its Smart Cocoon 4.0 system, which aims to provide personalised comfort bubbles adapted to each occupant. These will vary based on an occupant's age, gender, heart rate and emotional state. No special input is required of the passenger—the system can deduce this information using artificial intelligence and input from infrared cameras and radar. It can then tweak the temperature, lighting, fragrance and sounds in response.

The ability to adjust the cabin environment to suit each person's needs can have a big impact on energy efficiency, with Valeo boasting savings of up to 30%. But it's not just about comfort. The system can also pick up on potentially lethal vital signs. "The heart never lies," states Georges de Pelsemaeker, Valeo's Health and Well Being Director.

Augmented and virtual reality

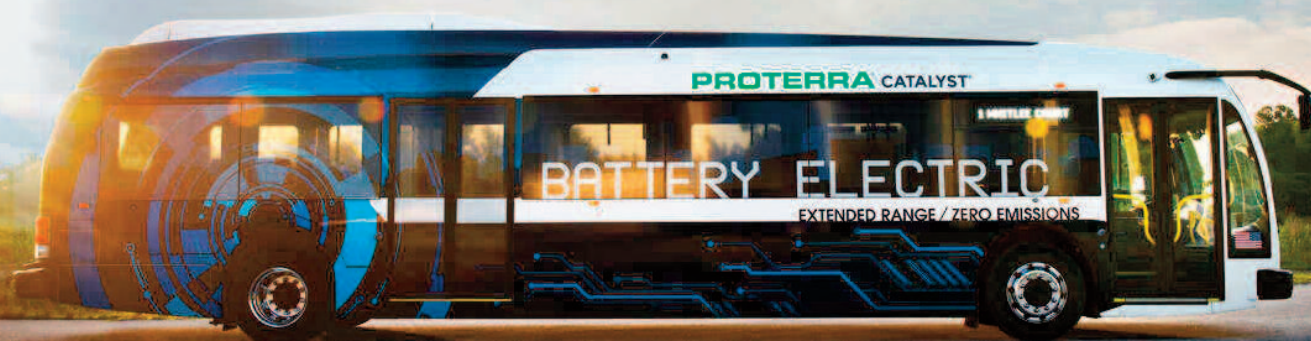
The automotive industry has been investing heavily in augmented and virtual reality (VR) for a range of applications, including driver safety training, vehicle design and retail strategies. This technology will also increasingly make its way into the cockpit. VR headsets can track orientation and position to determine exactly where an occupant is looking and where they are. A growing number of brands are tapping this to enrich the user experience. Last year, Audi partnered with Disney to create VR in-car entertainment designed to immerse passengers into a video game. Hyundai has been developing a gesture-based system that enables occupants to interact with a virtual screen projected onto the windscreen.

This year's CES saw Valeo unveil an interesting twist to this approach with its immersive communication systems VoyageXR and CallXR. They allow the driver to 'bring on board' virtually anyone outside the vehicle, such as a family member at home or a work colleague at the office.

Putting on the VR headset and operating the accompanying joystick, the user feels as if they have been teleported into the back of the vehicle. They can then interact with the driver. With VoyageXR, the virtual passenger is visible to the moving driver in the form of an avatar displayed in the rear-view mirror. This form of teleportation is made possible by the combined use of Valeo perception systems located outside and inside the vehicle, plus connectivity.

The Valeo CallXR system draws on ultrasonic sensors, cameras and machine learning algorithms to provide similar functionality. It is designed specifically so that someone outside the car can hold a video conference with the driver or passengers, using a tablet or a smartphone, and see what's happening inside and outside the vehicle.

This sort of capability, along with that offered by the other innovations explored above, have applications in today's new vehicles as well as the highly automated ones further down the line. And despite the different approaches and technologies deployed, they all seek to augment the way in which users experience travel.



The electric mass transit expert that's building more than just buses

Jack Hunsley speaks to Proterra about how North America is tackling commercial vehicle electrification



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Most of the world knows Proterra best for electric transit buses. We are the North American leader in the deployment of those vehicles, but we have taken the industry-leading technology we developed for the transit industry and now provide that to other vehicle manufacturers and categories

*Matt Horton
Proterra*

Sooner rather than later, the electric bus could become a staple of urban mobility. The relatively short, consistent routes make predicting energy usage and working out where charging stations need to go quite simple. The improved lifespan of these buses could also yield significant long term monetary savings. Put simply, the electric bus is a highly attractive solution for any city wanting to cut congestion and pollution.

Electric buses may not generate the same level of excitement as hydrogen fuel cell trucking or highly automated personal electric vehicles (EVs), but mastering the electric bus could open the floodgates for substantial electric uptake. It is a truth that US-based Proterra is keen to take advantage of.

“Most of the world knows Proterra best for electric transit buses. We are the North American leader in the deployment of those vehicles, but what most people do not know as is that we have taken the industry-leading technology we developed for the transit industry and now provide that to other vehicle manufacturers and categories,” explained Matt Horton, Chief Commercial Officer at Proterra. “Things like over the road coaches, school buses, medium-duty trucks—those are the types of vehicles we’re working with other partners to also electrify.”

Responsibility for these endeavours falls under the ‘Proterra Powered’ marque, a separate business unit in the company launched in August 2019, with the unit having already partnered with

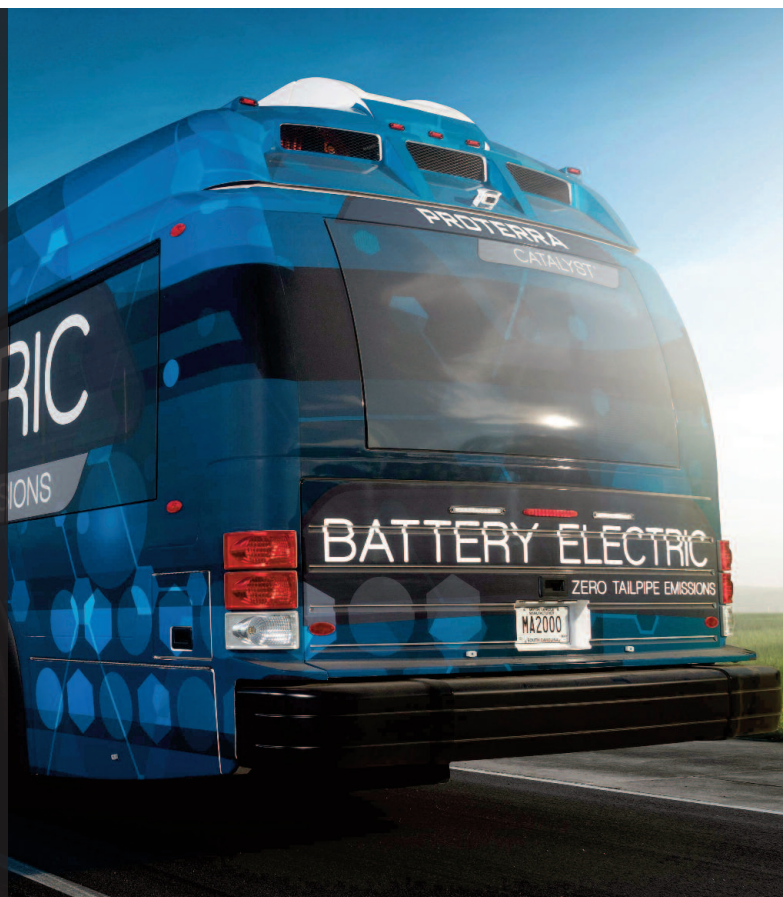
Alexander Dennis, Van Hool and Daimler to produce clean, quiet transportation. This includes a high-performance electric school bus—the Saf-T-Liner C2 Jouley—developed in conjunction with Thomas Built Buses, while Van Hool chose Proterra to help produce its first all-electric motor coach for the North American market. However, Proterra’s work expands beyond that of just building the vehicles.

“It really surprises people that we not only build what is widely considered the best electric powertrain for heavy duty vehicles, but that we build the full bus, all of the charging systems and we also cover the infrastructure installation for our customers too,” added Horton. “To do all of that well, we have developed advanced route modelling capabilities and we can guide our customers on

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We not only build what is widely considered the best electric powertrain for heavy duty vehicles, but we build the full bus, all of the charging systems and we also cover the infrastructure installation for our customers too

*Matt Horton
Proterra*



where the vehicles can go and where they can completely transition their fleet to electric. There's a huge amount that goes into being a successful automaker in the bus transit market."

Lesson learned

It is the 'whole package' service that is of particular interest. As markets across the world grapple with the challenge of kickstarting widescale electric uptake, a key limitation to adoption is the lack of infrastructure. In lieu of waiting for governments to roll out the necessary regulation and installation of public charging stations, more companies like Proterra are beginning to take matters into their own hands.

Nikola, for instance, has already laid out its European and North American infrastructure roadmaps for the 2020s. Alongside the release of its Nikola Tre model, the start-up is also planning on opening charging and refuelling stations to support not just its customers, but also other all-electric and hydrogen heavy duty vehicles out in the field.

In an attempt to conquer the 'chicken and egg problem' in Europe, H2 Mobility has committed to building 100 hydrogen fuelling stations in Germany, regardless of demand. As its Chief Executive, Nikolas Iwan, detailed to *Automotive World* in October 2019, the hope is that this effort will lay the foundations for widespread hydrogen adoption. "With these

100 locations we have a reach of six million drivers," he said. "They are quite strategically positioned. The capacity is enough for about 40,000 cars."

Approaching this challenge from such angles might make sense, but, for Proterra at least, it is a realisation that has come from continued customer interactions.

"I wish I could tell you that it was a grand strategy from the beginning, but we learned plenty from engaging with customers about what they're comfortable with and what is challenging for them," said Horton. "What we learned was that in bringing an EV into a fleet, there's more to it than just delivering a new vehicle. With an electric bus, you have an entire energy ecosystem that comes along with it."

For Proterra, ensuring it understands and is active in all parts of this ecosystem is a vital part of the manufacturer's strategy. It could prove to be a profitable one, too, given the significant lack of heavy duty vehicle charging infrastructure currently in the market. "We expected that there would be many more options in the market for charging hardware and other solutions that we could turn to, but we found that there were just no solutions that were suitable for heavy duty fleet users," said Horton. "We had to innovate in a number of areas."

North American outlook

Its multi-faceted portfolio aside, Proterra is also keeping a keen eye on the development of North America's mass transit electric market. In terms of sales figures, it may be dwarfed by that of China, but Horton is convinced that this next decade will see North America begin to truly embrace electrification. Unsurprisingly, much of this enthusiasm stems from California. While many of the transit agencies in the US have already made zero-emissions pledges, it is California's legislative approach that is leading the way.

"You cannot start this conversation without talking about California," said Horton. "California has decided once again to lead vehicle electrification with bus transit, and they have made a strong statement that the state will be

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We learned that in bringing an EV into a fleet, there's more to it than just delivering a new vehicle. With an electric bus, you have an entire energy ecosystem that comes along with it

fossil fuel free. Other states have taken notice and are now beginning to follow suit."

A key example here is that of New York state, home to New York City Transit Authority (MTA)—the largest transit operator in North America. On the state level, New York has recently implemented what Horton describes as a "very strong" incentive program. In the Big Apple itself, the goal is to bring in approximately 500 electric buses as part of its 2020-2024 Capital Plan. The move is part of a US\$1bn investment program that will also prohibit MTA from purchasing anything but electric buses in this space from 2029.

"We expect that New York will come on very quickly as another early adopter," added Horton. "We're also seeing great interest in states like Washington, Florida, Texas and Illinois as well which have been leaders also in the adoption of vehicles in their states. We're within a

decade of the last fossil fuel buses being sold in many parts of the country."

As for what future technology will power other electric commercial vehicles in North America, the general consensus is that most applications, bar long haul heavy duty trucking, are set for a battery future. The broad range of suitable applications for batteries could, for players such as Proterra, allow companies to broaden their horizons, looking past the markets in which they have made the majority of their money to date. But, with a timeline of just over a decade to get this transition truly under way, now is the time to move.

"Certainly within this decade, we'll see a transition where the vast majority of new vehicles sold will be EVs," said Horton. "We have seen research that shows that the North American market will hit 50% penetration on new sales of EVs by the middle of the decade, and we certainly believe that that is possible."



The timeline to commercial vehicle electrification: hard stop 2050?

**Can the commercial vehicle industry plan for full electrification
by 2050? By Martin Kahl**



Despite impressive improvements in passenger vehicle emissions over the last two decades in particular, the International Energy Agency (IEA) puts the annual rate of increase in truck and bus emissions since 2000 at 2.2%. With ever-more stringent regulations being introduced in the major trucking markets, however, changes in the way commercial vehicles (CVs) are powered could be more rapid over the next decades than in the light vehicle sector.

Like the vehicles themselves, regulations on CV emissions and fuel economy are region-specific, further complicating their already highly application-specific nature. Truck makers, suppliers and fleets understandably struggle to see a clear timeline from

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In Europe, new trucks will be required to achieve a 15% CO₂ reduction by 2025, and a 30% reduction by 2030

now, with diesel dominating across the CV spectrum, to what looks like near-fleetwide electrification by mid-century.

It's business time

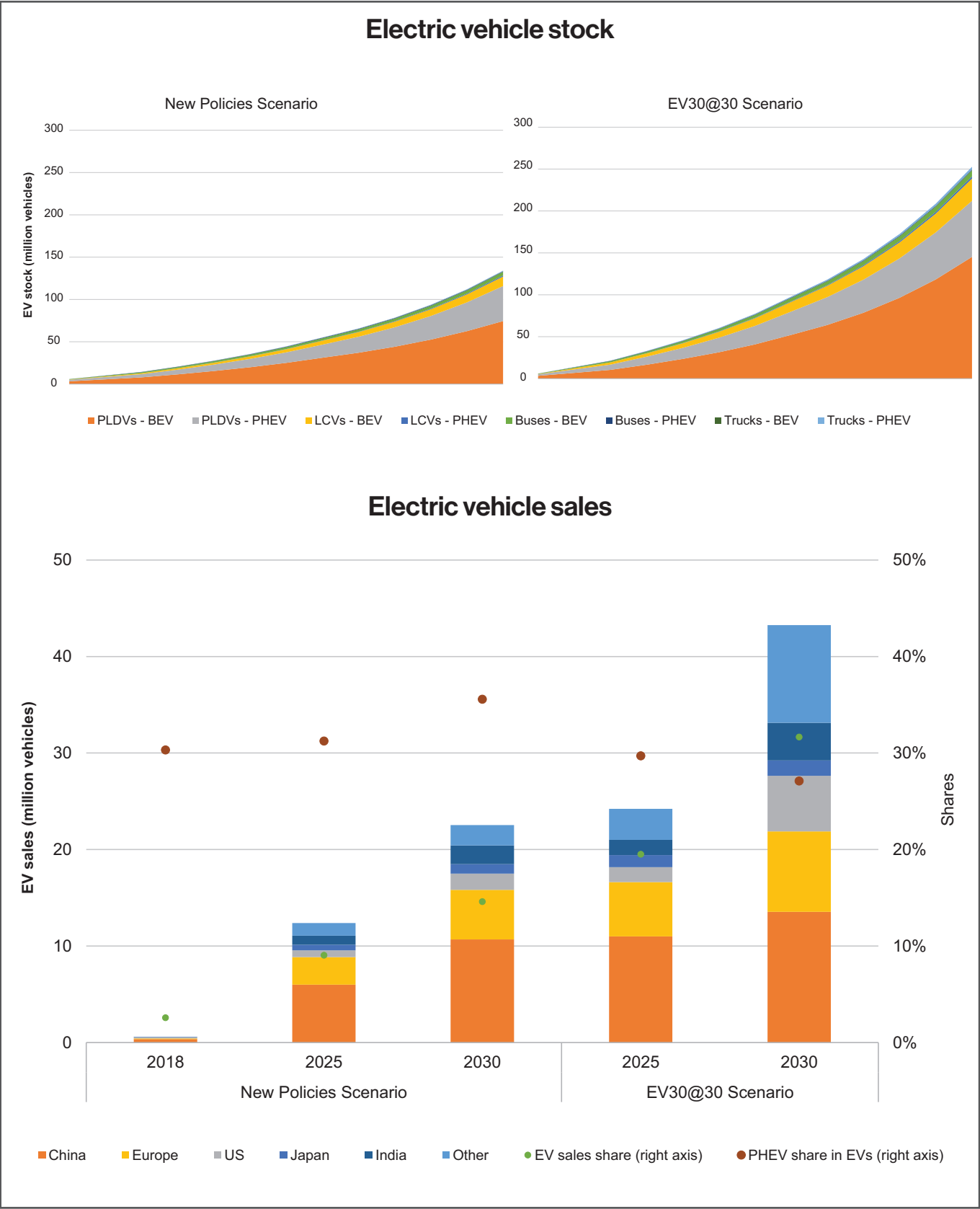
According to the European Automobile Manufacturers' Association (ACEA), “98.3% of all heavy and medium

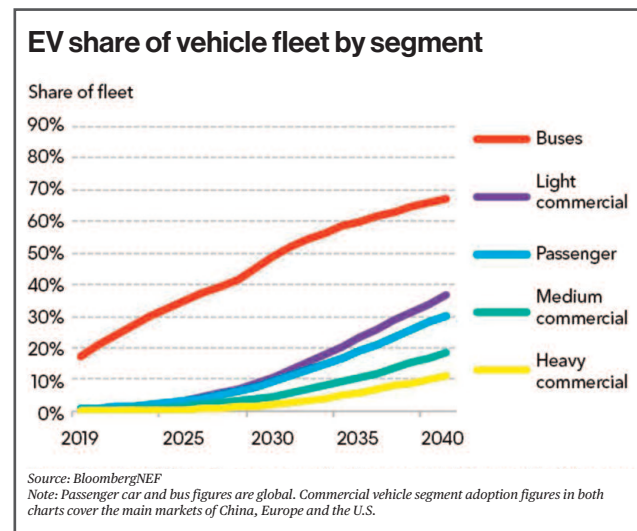
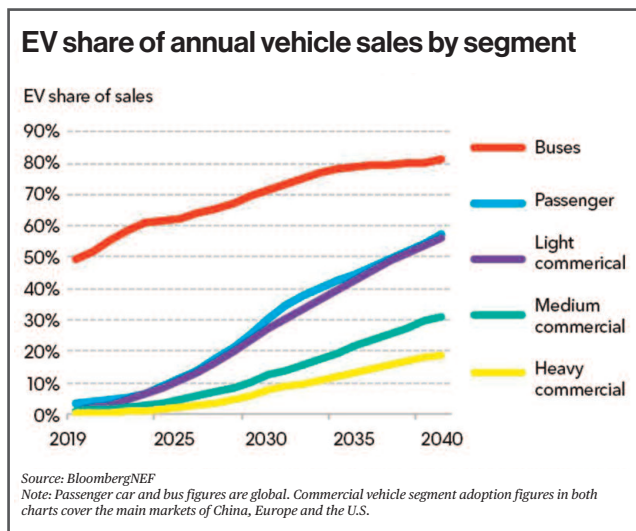
trucks (above 3.5 tonnes) on Europe's roads today run on diesel. Electrically-chargeable vehicles account for a negligible share of all trucks in circulation (0.01%, or one out of every 10,000 vehicles), and around 0.4% of all trucks in the EU run on natural gas.”



Overhead power lines, or eHighways, are one solution for long-haul truck electrification

Global EV stock and sales by scenario, 2018-30





In freight transport, the IEA notes, “electric vehicles (EVs) were mostly deployed as light-commercial vehicles (LCVs), which reached 250,000 units in 2018, up 80,000 from 2017.” Medium truck sales were in the range of 1,000 to 2,000 units in 2018, the majority sold in China. In its ‘Global EV Outlook 2019’, the IEA identifies China as the leading electric light commercial vehicle (LCV) market worldwide, at 138,000 vehicles in 2018 accounting for 57% of the global fleet. Europe is second, a 92,000 strong fleet in 2018 making up 38%. The US electric CV market makes up a tiny percentage of the global electric CV market, with eCVs currently accounting for less than 1% of the country’s CV market. Clearly, electric CV adoption rates will look impressive, thanks to a very low base.

Many ways to electrify

Discussion of CV electrification requires a recognition of the application-specific nature of this

broad sector. Add to this the fact that, despite intensive efforts to develop solutions for electrification, truck and engine manufacturers also believe they can still further improve combustion engine technology, and it is easy to see why the transition to battery electric vehicles (BEVs) appears so slow.

The light end of the CV market offers the greatest potential for battery electric vans, with viability stretching into medium duty trucking in certain use cases, namely for refuse collection and package delivery. Furthermore, 99% of electric LCVs registered to date are BEVs, the IEA notes. The Washington, DC-headquartered International Council on Clean Transportation (ICCT) puts the number of electric CVs in Europe and North America at around 70,000 and 100,000 respectively, with most of those vehicles being electric LCVs.

Urban buses, too, offer considerable scope for battery electric propulsion, with the fixed-route nature of their use making an easy business case.

As will be seen, it is at the heavy end of trucking where electrification becomes a much more complex and highly cost sensitive issue, and where alternative fuel and alternative propulsion technologies still win many viability arguments.

The clock is ticking

According to a report by ResearchAndMarkets, the global electric CV market is set to reach almost 261,000 units this year, and then grow more than sevenfold over the next seven years. “The electric commercial vehicle market, by volume, is projected to be 260,777 units in 2020. It is projected to grow at a CAGR of 32.7% from 2020 to 2027, to reach a volume of 1,890,430 units by 2027.” The report also identifies the electric van segment as the fastest growing electric CV sector, the market “driven by high demand from the logistics sector, especially in Europe.”

Not surprisingly, the largest eCV market by 2027 will be Asia Pacific, notes the report, thanks



By 2040, we expect 56% of light commercial vehicle sales and 31% of medium commercial vehicles in China, the US, and Europe to be electric

primarily to the dominance of China's electric bus market, as well as "favourable regulations for electric commercial vehicles, and a rapidly growing logistics sector". The fastest regional growth in eCVs will be seen in Europe, thanks to demand for electric vans and the focus on electrification in public transportation.

Bloomberg's research service Bloomberg NEF (BNEF) agrees with the rapid increase in electric van sales in particular. In its 'Electric Vehicle Outlook 2019', BNEF writes: "By 2040, we expect 56% of light commercial vehicle sales and 31% of medium commercial vehicles in China, the US, and Europe to be electric."

BNEF forecasts 508 million passenger EVs on the road globally by 2040, interestingly a

more conservative forecast than the 559 million units it forecast a year earlier. A total electric fleet of 550 million units in 2040 will include 41 million electric commercial vehicles.

However, BNEF also notes that "heavy trucks will prove the hardest segment for electrics to crack, with the latter's sales limited to 19% in 2040".

Other forms of propulsion?

What happens in the heavy and long-haul part of the trucking industry will make for fascinating viewing over the next decade. Fixed route, fixed payload haulage over shorter distances may enable some BEV use at the heavy end of the sector, but it is difficult to imagine a 40t truck making its

way over a mountain pass on battery power. BNEF agrees: "Long haul, heavy duty trucks will be harder to electrify; there, natural gas and hydrogen fuel cells will also play a role."

According to Bernd Heid, McKinsey's head of commercial vehicle activities, "In long haul applications, fuel cell electric trucks are better than both battery electric trucks and diesel trucks in terms of total cost of ownership. It is ultimately the best solution."

Heid suggests that for HD trucking applications, battery electric propulsion is being deployed as an interim to fuel cell technology. The absence of the necessary scale for fuel cell electric trucks is "why a lot of the truck OEMs start with electrification—this is a step they need to make either way—and



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Heavy trucks will prove the hardest segment for electrics to crack, with the latter's sales limited to 19% in 2040

Bloomberg NEF

then later on when fuel cell electric trucks become TCO competitive, they can more or less switch from battery electric to fuel cell electric. It will be a gradual transition from one solution to the other.”

On the buses

There is considerable momentum in the electrification of buses, where silent, vibration- and emission-free travel appeals to passengers and municipal rulemakers alike. The regular duty cycles and fixed back-to-base routes facilitate charging planning, and vehicle design conveniently accommodates

batteries. Furthermore, operating in low and zero emission zones necessitates electric drivetrains. Predicting a sharp increase in electric buses is to some extent forecasting what's already happened—according to BNEF, 400,000 electric buses are already in service globally.

Municipal bus fleets present an easy opportunity for authorities to mandate electric vehicles, and as one leading electric bus manufacturer points out, within a decade it will be difficult to imagine any bus fleet purchasing manager still considering diesel. Factor in the average bus lifetime of 7.5 years, according to the

International Association of Public transport (UITP), and the propulsion strategy of a fleet by any given date needs to be in place several years earlier.

Planning for the long-term...and for the near-term

The truck manufacturers find themselves stretched, developing combustion engine-based propulsion technology for the next few years and various forms of electrification for the longer term. In Europe, new trucks will be required to achieve a 15% CO₂ reduction by

2025, and a 30% reduction by 2030. Traton, which includes Scania and MAN, has said the 2025 target can be met “largely with conventional engine technology”, but the group believes the 2030 target “will require significant sales of alternative drivetrains, mainly battery electric”.

Some major orders have been placed, with start-ups in particular securing significant media coverage: UPS has ordered at least 10,000 electric vans from Arrival; Amazon has ordered 100,000 electric vans from Rivian; Tesla has secured hundreds of orders for its electric Semi; and Nikola has secured upwards of 14,000 orders for its battery electric and fuel cell electric trucks, which it claims will be out on the road from 2021, with all existing orders in service by 2028.

Once the realm of the start-up, however, electric trucking is becoming an accepted part of mainstream manufacturers’ future portfolios, a fact borne out by a number of recent launches by the major players, from electric LCVs to electric refuse trucks. Indeed, in 2019, Daimler Trucks North America’s Chief Executive Roger Nielsen said, “The road to

emissions-free driving will be driven by battery electric vehicles.”

A timeline with a hard stop: 2050?

30 years to go electric—that’s the view of the ICCT, which believes electrification is inevitable: “Long-term planning scenarios indicate that the global vehicle fleet will have to be almost entirely made up of electric vehicles, powered mostly by renewable sources, by 2050 if the world is to avoid worst-case global climate-change scenarios.”

share we will see being fuel cell electric.”

Setting a timeline may seem ambitious right now, but by the mid-2030s, battery electric and fuel cell electric trucks will count for a significant proportion of new truck sales, and fleets will need to be ramping up their e-truck acquisitions in the years from 2040 if, as the ICCT suggests, they are to electrify their fleets by 2050.

A timeline to 2050 provides some clarity for fleets, truck makers and suppliers, and gives them the ability to plan. However, as we’ve seen from

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The global vehicle fleet will have to be almost entirely made up of electric vehicles, powered mostly by renewable sources, by 2050 if the world is to avoid worst-case global climate-change scenarios

Fleets cannot afford to be without electric trucks to meet CO2 emissions reductions, says McKinsey’s Heid, adding, “This is why most manufacturers are starting with the electrification of the various different truck segments, from distribution to long-haul tractors. But the heavier the truck, the greater the

failed attempts in countries such as India and the UK to mandate electrification deadlines, or to bring them forward, there’s nothing like a hastily conceived government policy to derail a plan. And as the boxer Mike Tyson once pointed out, everyone has a plan until they get punched in the mouth.

How will passengers interact with autonomous shuttles?

Megan Lampinen explores the HMI on the self-driving e.GO Mover

Self-driving, electric shuttles are poised to play a key role in the future of urban mobility.

With zero emissions, silent operation and multiple occupancy, they certainly address many of the challenges facing cities today. But just how user friendly are these vehicles? Without a driver on board, they require a whole new approach to HMI. This year at CES, Cerence offered its take on how riders may interact with autonomous public transport.

The e.GO Moove joint venture between ZF and e.GO Mobile has been developing an electric autonomous shuttle called the e.GO Mover. This is specifically designed to plug the last-mile gap, enhancing existing public transport in cities. Cerence's job is to help develop the user experience, and for that it draws on its expertise in speech recognition and natural language understanding and output, along with speech signal enhancement.

"At the start, we had to figure out exactly what the problem was that we wanted to solve," explains Nils Lenke, Senior Director of Innovation Management at Cerence. "That centred around what we do when the bus driver disappears." With no driver, passengers must interact with the vehicle itself. Destinations, arrival times and connections could prove common questions. *Automotive World* recently had the chance to put the system through its paces during a simulated ride.

How will users interact with autonomous shuttles like the e.Go Mover?



Hey, Mover

Interaction with the Mover begins even before a traveller enters the shuttle. Someone may want to know whether it stops at a particular location or what time it might arrive somewhere. That means they need a way of asking from outside the vehicle. To ask a question, you first need to use a wake-up word so the system knows it is being addressed. In English, that's 'Hey, Mover' though the interface can recognise up to 40 different languages. "This is one of our differentiators," Lenke tells *Automotive World*. An operator may decide to offer only the most common languages in its region, but the technology is there if required.

After that, users can pretty much ask a question in the regular manner, i.e. 'Can we stop at the Bellagio?' The question is picked up by a microphone above the wheel and appears in written form on an exterior screen. The vehicle's response is also provided simultaneously on the screen and audibly. Noise reduction technology helps cancel out background sounds.

Once someone decides to board the vehicle, it's a similar interaction inside. Here, engineers faced a big technical hurdle in picking up speech. The vehicle can seat several passengers, and the microphones need to be able to accurately detect questions posed from all around the cabin. "In a passenger car, you know where the driver is sitting and so it's easier to direct the microphone," says Lenke. "It doesn't work like that in a shuttle." The solution is a microphone array on the centre of the roof and Speech Signal Enhancement (SSE). This allows for the system to remove noise from microphone inputs and enable distinct speaking zones so speech from only one speaker is picked up.

The same sort of questions can be posed, always using 'Hey, Mover' at the start. When the wake-up word is omitted, there's no response at all. Questions posed inside are more likely to revolve around connections: Will I make the route 88 bus connection? Can I make it in time to catch the 92 bus? Conversational language should work, but it's not yet perfect. For instance, during the demo

someone instructed, ‘Hey, Mover. Hold the door’—the sort of instruction a passenger might give if they saw someone running to catch the shuttle. The system didn’t like that wording and failed to respond, though it did understand and respond correctly to the expression ‘wait a minute.’

Thanks to emotional text-to-speech (TTS), the system allows for a change in speaking style based on content and circumstances. For instance, important alerts for passengers can be communicated with a more urgent tone, and delays can be announced in an apologetic voice.

Not all passengers may want the other shuttle occupants to hear their questions. “You may not care to have everyone else know where you are heading, and for that there’s the Private Zone,” says Lenke. This ‘zone’ is at the front of the shuttle, where there is a separate microphone into which one can speak in a quiet voice and receive a private response.

The user experience also leverages innovative transparent screen technology from Saint-Gobain Sekurit. Inside, this could include a rider assistant avatar in the space where the driver would traditionally sit. Elsewhere in the shuttle the screens could convey key route information. Notably, the screens allow an uncompromised outside view through any projected images.



Travellers can ask the vehicle questions before they board



A microphone array can pick up spoken questions from passengers where they are seated

Up next

Cerence began working on the Mover's interface in May last year and will continue to refine the technology based on user feedback. In theory, interfaces will vary by vehicle design but the basic principles could be duplicated in other modes of shared mobility or public transport. "It would be feasible to expand this approach to a larger vehicle," says Lenke. "We would need some adjustments, though, like multiple microphone arrays."

Cerence eGo screen

Importantly, the sort of interactive capabilities showcased in the shuttle address many key concerns about how travellers will navigate through the smart cities of tomorrow. In some instances, the automated interface offers an improvement on human drivers—after all, how many bus drivers today can claim to speak 40 languages? The heavy reliance on voice technology should also go far in addressing trust issues around autonomous vehicles (AVs). "Psychologists

have found that speech helps establish trust in AVs," Lenke points out.

That's because when a device speaks, humans automatically transfer some human characteristics to it. This was a key finding from the study 'The mind in the machine: Anthropomorphism increases trust in an autonomous vehicle', published in *The Journal of Experimental Social Psychology*. Researchers studied the reactions of volunteers who were put into a vehicle that was given a name, a voice and a gender, compared to those put into a vehicle that had no such human traits. The individuals in the car with the human characteristics had significantly higher trust in its driving capabilities.

Working to this theory, voice interaction could play a key role in any autonomous vehicle HMI, but Lenke stresses that it is still early days: "This is all new, novel technology. We still want to see the reactions of users. Nobody really knows how this will play out in the end."





Future mobility start-ups must target 'pain points' says VC firm

If mobility start-ups do not address genuine problems in the industry, they are unlikely to gain valuable venture capital support. By Freddie Holmes

Many of today's biggest names in tech emerged from humble beginnings, and may have never achieved such success without the support of specialist venture capital (VC) firms. But finding the next unicorn requires more than just deep pockets. With so many players pitching similar ideas, it takes the keen eye of a seasoned VC firm to sort the wheat from the chaff.

development, strategy, PR and recruiting. They are ever-present partners helping to bring on board the right talent, promote the entrepreneur's story and ultimately carve out a path to profitability.

"The question we need to ask is whether we are uniquely qualified as a firm to help these entrepreneurs. If our mission is to support their success, we better make sure we are a good

fit for them," explained Quin Garcia, founder and Managing Director of Silicon Valley-based Autotech Ventures. A seasoned investor, he has overseen the development of companies like Lyft from

their inception. "Lyft was founded out of my house years ago, and we have invested many times since," he added.

Autotech Ventures' business model is a little different to that of a traditional venture capital firm, he says, by acting as a bridge between big corporations and start-ups. "Corporations are great at scaling, but they tend to be slower to innovate. Start-ups are the inverse of that; they are phenomenal at innovating, but they tend not to have as much experience scaling," he said.

"Our role is to bridge between those two parties to scale up innovations and try to solve challenges."

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The e-scooter space has a really simplistic value chain: you buy scooters from China, throw them on a sidewalk, deploy an app and bam, you're in business

The mobility space in particular has become one of the most hotly contested areas for new entrants vying to push their offering into the market. In fact, many have come with the same business model and often with the same product—think about the numerous names in ride-sharing, electric vehicles, autonomous driving software or increasingly, shared e-scooter platforms.

The role of a VC

Successful VCs do not just administer a cash injection and walk away; they also assist with core elements such as business development, corporate

But with so many players latching on to the term ‘mobility’ today, it is not immediately clear exactly what a ‘mobility’ company does. Autotech Ventures’ strategy is refreshingly simple: it invests in start-ups that focus on the movement of people and goods across the surface of the earth.

The CASE for investments

Of course, any private VC firm is financially motivated, and Autotech Ventures is no different. Its job is to make risk-adjusted returns for its investors, and it must consider the risk-return profile of any start-up. This varies depending on the domain in which a start-up plays, be it connected, autonomous, shared or electric (CASE). For Autotech Ventures, some areas are more attractive than others.

“The e-scooter space has a really simplistic value chain: you buy scooters from China, throw them on a sidewalk, deploy an app and bam, you’re in business,” he said. However, these start-ups require a huge amount of capital and consumer-facing marketing, and with such a simple value chain there is no real need for Autotech Ventures to lend its expertise.

LiDAR has also been avoided for similar reasons: it is highly capital-intensive and with no clear return on investment. “It takes a lot of money to develop

LiDAR, and many years before you generate any meaningful revenue,” explained Garcia. “We don’t want to fund an early-stage company that will need hundreds of millions of dollars before we can learn whether it will successfully generate revenue.”

Autonomous vehicle stacks also fall into that category. By Garcia’s reckoning, commercialised Level 5 solutions are at least a decade away, a long time to wait for money to start coming in. “How do you fund that business for the ten years before it starts generating revenue?” he mused.

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It takes a lot of money to develop LiDAR, and many years before you generate any meaningful revenue

This may be a different story for the corporate VC arm of a major supplier or automaker, where the technology will ultimately slot into its portfolio and assist existing operations. An eventual sale—or exit—is never really the priority. “You can get seed-stage companies looking for a billion-dollar valuation. That doesn’t present a sufficiently attractive risk-return profile for a financially motivated investor like us,” said Garcia, “but a corporate VC might bite on that opportunity.”

What VCs want

Autotech Ventures typically makes an initial investment of between US\$500,000 and US\$8m. The decision to hand over a significant amount of cash is not made lightly, and potential start-ups are vetted fairly heavily in advance. There are a number of core indicators as to whether a start-up is a safe bet.

The first things to look at are ‘team’ and ‘market’. Both are vital considerations, and different firms rank one above the other depending on their investment strategy. “If the market

opportunity is extremely attractive but the team is average, it can still be a sufficiently attractive investment opportunity,” explained Garcia. “In the same way, a team might be phenomenal but the market opportunity they are pursuing is a little mediocre—it can still work.” Clearly, the ideal situation is to have the best of both where investing becomes a “no-brainer.”

Reputation goes a long way at this stage. Consider a mobility start-up that counts names from

established Tier 1 suppliers and automakers in its ranks. That calibre of management can be a differentiating factor between the many players touting a similar investment opportunity. “You’re looking for a team that is uniquely qualified to execute on its vision,” said Garcia. “If this company needs to produce an autonomous driving technology, you’re looking for people with experience on both the technical and commercial side.”

Oftentimes, a mix of experienced heads and agile start-up nomads makes a strong combination.

From there, Autotech Ventures takes a closer look at the start-up’s wider goals. “It has to be pursuing something that is really painful,” explained Garcia. “If there are no massive pain points involved, there is relatively little reason for a start-up to exist.”

For example, autonomous driving is intended to solve the pain of car crashes; electric vehicles will solve the pain of overpaying for fuel and polluting the environment; and the sharing economy aims to solve the pain of owning an expensive vehicle that is only used 10% of the time. Corporations have their own pain points too, such as paying staff to conduct internal operations. A lack of connectivity has created pain points across the traffic network, thus connecting infrastructure and vehicles could ease congestion and prevent collisions.

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If a company needs to produce an autonomous driving technology, you’re looking for people with experience on both the technical and commercial side

Together, all these trends form the CASE acronym, but Autotech Ventures believes there is an additional element to consider: the digitisation of enterprise. This describes the use of IT to streamline the operations of large corporations. “We call it CASED,” said Garcia.

Get in early

Autotech Ventures typically invests from seed-stage through to mid-stage Series-C funding rounds. Established companies present less risk, but this is not necessarily a good thing.

As start-ups mature, the scale of their business tends to grow while the level of risk tends to diminish. Conversely, early stage start-ups carry very high risk, but also very high potential returns. The risk-return profile of a mid-stage start-up is somewhere in the middle. By focusing on early- and mid-stage start-ups, Autotech Ventures has what it perceives as a balanced risk-

return strategy, but also ample opportunity to play an active role in a company’s development.

Its current portfolio of investments includes start-ups like DeepScale, which focuses on sensor fusion for autonomous driving. The company was recently acquired by Tesla. Other investments include truck insurance company HDVI; advertising-sponsored ‘free’ EV charging service Volta; and Xnor.ai, which specialises in low-memory, low-power AI algorithms. It was acquired by Apple in January for a reported sum of US\$200m.

Autotech Ventures has also received investment itself from seating and electronics supplier Lear, and in December gained backing from Volvo Group’s corporate VC arm. Both of those industry stakeholders have eyed the opportunity to leverage the firm’s expertise in finding the next big thing in the mobility space.

LNG could help trucks hit EU 2030 target, but long-term future uncertain

Some truckmakers and infrastructure giants are convinced LNG can make a difference, but its long-term viability is as insecure as any other fossil fuel. By Xavier Boucherat



There is a date approaching for the European trucking sector which, although having no immediate impact, is of significance nonetheless. In Europe, 30 June 2020 will mark the end of the 'reference period' for fleet-wide average CO₂ emissions, which began on 1 July 2019. Against this figure, new trucks will need to achieve a 15% reduction by 2025, and a 30% reduction by 2030.

Whilst the commission acknowledges that improvements have been made in previous years, the increasing amount of road freight traffic—driven by continuing urbanisation and e-commerce—has prompted the bloc to enforce commercial vehicle



CO2 regulation for the first time. It estimates that heavy-duty vehicles, including trucks, buses and coaches, are responsible for a quarter of EU road transport emissions, and 6% of total emissions.

15% target is available today, and one avenue being explored is increased uptake of liquefied natural gas (LNG), long advocated as a cleaner-burning alternative to traditional fuels.

It's already out there

Compressed natural gas (CNG) applications have been on the road in Europe for many years, such as buses in cities like Stockholm and Barcelona. But

in December 2019, Scania delivered what it claims are the continent's first LNG buses, which match the environmental benefits of CNG but with increased range thanks to improved density in liquid form.

Scania, Volvo and Iveco have all brought LNG trucks to market. Volvo's FH420 was introduced in 2018, whilst Iveco's S-Way

Natural Power heavy duty truck was unveiled in 2019, promising a 1,600km range and lower total costs of ownership. Meanwhile, in April 2019, Scania supplied German logistics firm KP Logistik with 100 R410 LNG units, for use in supermarket deliveries in the east of the country.

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We can only accelerate the adoption of greener powertrain technologies if we are equipped with sufficient infrastructure to support them

Yet progress on truck electrification remains slow, and as a mainstream solution faces difficulties like high upfront costs, a lack of infrastructure and technical limitations which rule out options for the long-haul sector. But the EU insists that the technology needed to meet the

Enthusiasm from oil giant Shell should prompt optimism for intermediate steps between diesel and zero-emission haulage. This is particularly the case when fuel cell technology is increasingly believed to represent a viable option, but hydrogen-fuelling infrastructure remains so lacking.



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For now, natural gas forms a part of the EU's strategy, with several gas projects eligible for funding. This has attracted criticism, and in response, the bloc has said that all new LNG facilities will need to demonstrate decarbonisation credentials

The fact that in some markets, LNG infrastructure is already in place has made it an attractive prospect for some fleets, particularly those running mid-distance operations. “We invested in gas trucks in the Paris area, mainly for less-than-truckload operations as LNG is currently more adapted to mid-distance trips,” said Dan Myers, Managing Director, Transport, XPO Logistics. “This has been possible because there is already a network of infrastructure in the area.”

Incoming infrastructure

Now Shell wants to flesh out that infrastructure, confident that truck manufacturers and fleets will be keen to take advantage of a more cost-effective and greener alternative to CNG. That's according to Wolfgang

Warnecke, Shell's Chief Mobility Scientist, who has pointed out that LNG engines are particularly efficient at delivering power to the wheels of a truck.

He also points to complications: LNG has to be kept at extremely cold temperatures—161 degrees Celsius below zero—creating challenges for storage, refuelling and tank solutions for vehicles. The latter must be double-walled, insulated and meet a number of EU safety standards. This adds cost which outstrips the relative affordability of retooling vehicles for CNG, and creates safety and training requirements for drivers.

Nevertheless, Shell sees an immediate future for LNG. “Heavy-duty fleets will diversify across a range of technologies, and this is likely to include natural gas in the first instance,”

a spokesperson for Shell Rimula told *Automotive World*. “We can only accelerate the adoption of greener powertrain technologies if we are equipped with sufficient infrastructure to support them. LNG is clean burning, has low sulphur and NOx emissions.”

Shell estimates there are already 5,000 LNG trucks operating in Europe, and over 200 public sites: “However, this number will need to significantly increase to meet the demands of 2040.” By then, Shell believes that over 400,000 LNG trucks will be on the road globally.

To that end, Shell has partnered with Scania and Iveco, as well as the LNG distributor Grupo Disa on a project to build and open 39 LNG stations along major European corridors by 2023. The BioLNG EuroNet initiative hopes to help the transport

sector do its part to help the EU meet its 2050 target of 60% reduction in CO2 emissions, compared with 1990 levels. BioLNG is collected from organic waste, lending it better sustainability, and companies such as Nordsol are already spearheading production, but questions remain over whether it can be produced at scale.

both Scania and Iveco that PM emissions would be virtually eliminated in gas vehicles.

The organisation has warned against government policymakers granting fossil fuel companies

Association (ACEA) announced it was “concerned about the highly ambitious CO2 reduction targets,” which it said were “highly demanding,” particularly given the lack of infrastructure for alternative fuels and charging

Conflicting figures?

That said, there remains some dispute over LNG’s green credentials. A 2019 report from the Netherlands Organisation for Applied Scientific Research (TNO) concluded that the latest generation of LNG trucks emit significantly less greenhouse gasses than their diesel counterparts, in the order of 19%. On that occasion, the Volvo FH420 was the truck tested.

Not everyone is convinced. The European Federation for Transport and Environment also cites 2019 tests by TNO, commissioned by the Dutch Government, which it claims disprove several truck manufacturer claims. It reports that three trucks tested—models from Volvo, Scania and Iveco—released comparable amounts of particulate matter (PM), and more nitrogen oxides (NOx)—up to five times more when compared with the diesel model’s best results. If true, this contradicts earlier claims from

further tax breaks and making any further investments in infrastructure, dubbing LNG another fossil fuel that requires phasing out. In addition to PM and NOx emissions, it also claims LNG trucks fail to deliver on decarbonisation promises: when transport of gas and methane leakage is factored in, spark-ignited LNG trucks are worse for the environment than diesels, it writes.

Truckmakers have been clear on the issue of incoming CO2 emissions targets: in a 2019 statement, the European Automobile Manufacturers’

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We invested in gas trucks in the Paris area, mainly for less-than-truckload operations as LNG is currently more adapted to mid-distance trips. This has been possible because there is already a network of infrastructure in the area

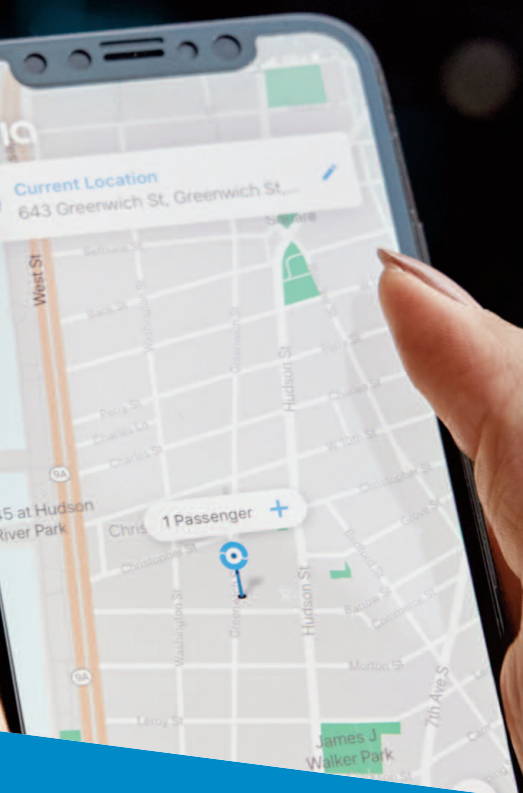
points. LNG coverage in particular, it noted, remained low and patchy.

Were tax breaks and incentives for LNG removed, it would be a blow which could make the task all the more difficult. For now, natural gas forms a part of the EU’s strategy, with several gas projects eligible for funding. This has attracted criticism, and in response, the bloc has said that all new LNG facilities will need to demonstrate decarbonisation credentials: LNG may hold promise, but Europe insists it is not locked in to the technology.



We need electric vans, say mobility service providers

Ride-hailing and ride-sharing fleets will need to electrify as cities seek to outlaw fossil fuel vehicles. They could be among the earliest wide scale adopters. By Xavier Boucherat



More and more cities are laying out their vision for the future of mobility.

For many, the goal is to reduce, if not remove, low-occupancy cars from their streets, reducing pollution and making streets safer. San Francisco is among the latest to join the ranks of urban centres that are prohibiting access for cars: parts of Market Street, one of the city's busiest roads, will be shut to private drivers. This followed New York's closure of 14th street in October 2019.

But taking cars off the road is going to prove a long-term project, not least because proposed changes are likely to face opposition and litigation. In the mean time, authorities and governments will continue to pursue other strategies for pollution and congestion reduction. It was originally hoped that ride-hailing may provide relief, but it is clear at this stage that the opposite has happened. The growth of services has been staggering, with user numbers in the US doubling in

2015, 2016 and 2017. 2019 research from McKinsey suggests that in the US, half of ride-hailing trips are 'new passenger vehicle miles', meaning they would not have happened were it not for ride-hailing.

As a result, many cities which host the services have imposed quotas on drivers, and introduced tough licensing requirements and demand rights for workers. But as the climate crisis deepens, could

these fleets also be required to go zero-emission in order to stay in operation?

Chris Snyder is Chief Executive of ViaVan, a joint venture between Via and Mercedes-Benz Vans now active in Berlin, Amsterdam, London and most recently Milton Keynes, UK. The latter, he explains, demonstrates well which direction the company, and the industry at large, hopes to move in: the fleet is nearly all-electric, using Daimler's Vito eTourer vans.

"I certainly believe we are moving towards fully electrified fleets," he says. "I also believe that commercial mobility fleets like ViaVan will be among the earliest adopters." It's the responsible thing to do, he says, but regulatory forces are a driving force which will make this a reality sooner rather than later. Cities, he explains, are currently highly motivated to counter local emissions and the wider issue of climate change: "Commercial mobility providers are the easiest to regulate."

Meeting specifications

In some sense, he notes, this is an ironic turn of events: EV marketing and hype has been largely directed at the private vehicle passenger market. There is a big difference between requirements for a commuter EV and commercial use-

cases performed by people-carrier vans, which may be on the road up to 20 hours at a time should drivers share fleet-owned vehicles.

"Batteries need to be able to last for significant periods of time, and need to be able to be recharged quickly," he says. "Right now, there are not many vehicles that fit that specification." The timeline for rollout may therefore depend on how quickly manufacturers can turn their attention to these segments.





Volkswagen has dipped its toes with an increased battery capacity e-Crafter van, a minibus version of which it has rolled out for the Moia on-demand ride-sharing service in Hamburg. LDV, owned by China's largest vehicle manufacturer SAIC, has also unveiled the EV80

(Didi), Lyft and Uber, the world's three biggest which cumulatively arrange in excess of fifty million rides a day worldwide. A partnership with Didi, for example, uses cloud technology to monitor battery and environmental conditions, adjust charging cycles and provide advice to prolong battery lifetime.

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Batteries need to be able to last for significant periods of time, and need to be able to be recharged quickly. Right now, there's not many vehicles that fit that specification

minibus, which can reach 80% of its 120 mile range in 90 minutes.

Suppliers also have a role to play, not just in producing components for these vehicles, but also through connected and intelligent services. “Bosch is deliberately entering into business with new market players that may also be antennae for disruptive trends,” a spokesperson for the Tier 1 told *Automotive World*. The company already works with Didi Chuxing

Accelerated timeline

When could fully electrified mobility services arrive? in some sense, the answer is now, with zero-emission services already in effect. “In terms of wide scale adoption, I don't think it's far out,” says Snyder. “If you look to the history of solar cells, there was a time not so long ago when, more than anything else, they were statements of good will. This has changed relatively quickly, and now the payback period for

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ViaVan's goal is essentially to provide an on-demand bus service, and that bus will ideally be full at all times. If you need to return to base to charge, the vehicle must first be emptied of people, then returned, then charged, then sent out and filled up again



fast. Today, depending on battery range, our experience would suggest that operating costs are already in favour of electrification.”

But certain questions still loom large, one being infrastructure. Scaling this up in dense, urban environments will prove a challenge on several fronts, including the technical challenge of grid demand and the legal challenge of land ownership. Snyder places a particular stress on fast-charging capabilities. Whilst return-to-base charging may present options for inner-city

delivery fleets, Snyder sees limitations for mobility fleets.

“ViaVan's goal is essentially to provide an on-demand bus service,” he says, “and that bus will ideally be full at all times. If you need to return to base to charge, the vehicle must first be emptied of people, then returned, then charged, then sent out and filled up again. That takes time, and that time is wasteful and expensive.” On-street fast charging will serve fleets better, and looking even further forward, he adds, there could be a case for wireless charging.

The issue of upfront cost also looms large, and is complicated by the ownership models seen in the ride-hailing and ride-sharing industries. Uber drivers, for example, use their own cars, and the company has become notorious for insisting on their status as independent contractors and not employees. Yet service providers are still moving to get their drivers into EVs.

If nothing else, this will enable their continued utilisation in major cities, which remain the most profitable areas. Last year in London, for example, the Ultra Low Emission Zone came



into force, affecting private hire vehicles not meeting Euro 6 standards for diesel cars and Euro 4 for gasoline cars. The zone is set to be extended in 2021 to include all of the Inner London area, whilst the standard Low Emission Zone will be rolled out London-wide later in 2020.

As such, in January 2020, Uber announced a deal with Nissan that will make 2,000 Leafs available at a discount. Prior to this, in January 2019, it launched its 'Clean Air Fee'. This adds 15p for every mile driven to a journey's recommended fare, which is then deposited in a fund from which qualified drivers can withdraw to assist in upgrading to an EV.

The company has stressed lower running and maintenance costs, and believes its drivers will work to a quicker EV timescale than the private vehicle sector. Jamie Haywood, Regional General Manager for the UK, told the *Financial Times*, "Uber drivers will be the early adopters of electric vehicles."

Rival Lyft has followed suit. In November 2019, it announced the launch of 200 EVs in Denver, Colorado, available via its 'Express Drive' rental program. Cost is the largest barrier to EV ownership, said the company, and with ride-share rentals it aims to help drivers over this. The company has ambitions to

go fully electric, but says that service providers need more support from authorities as incentive programmes were often drafted before the rise of ride-hailing and ride-sharing. Drivers often will not qualify, and the high upfront costs of EVs put them out of reach for many.

Snyder agrees. "The proper incentives must be put in place, particularly when drivers are bringing their own vehicles," he concludes. With falling battery costs, government and service provider support and harder inner-city regulation, it seems the mobility service evolution will move hand in hand with electrification.

INTERVIEW

Jim Adler, Founding Managing Director, Toyota AI Ventures

**Jack Hunsley speaks to Toyota AI Venture's Jim Adler
about how start-ups will make the difference in the
future of mobility**

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We put a premium on the team when deciding which companies to invest in: their resiliency, their optimism and their pragmatism are all important qualities for navigating that trajectory

Jim Adler, Toyota AI Ventures Founding Managing Director



For decades, the automotive industry was closed off to newcomers, dominated by manufacturing giants with vast supply networks. However, with the advent of connected, autonomous, shared and electric (CASE) development, the last decade has seen an influx of disruptors begin to rub shoulders with the big guns. The most impressive factor, however, is not just how successful some of these smaller start-ups have become, but the degree to which they have rocked the establishment to its core. The rise of the likes of Tesla and Nikola, for instance, goes to show how quickly the automotive hierarchy can change.

It's why so many automakers have now set up vast corporate venture capital (VC) arms, bestowed with the responsibility of sniffing out the latest and greatest in start-up innovation before their rivals can get their hands on potentially industry-changing technology. However, of the automaker VCs, not all are following the same path.

One such firm is Toyota AI Ventures. While it bears the automaker's name, and it has persuaded Toyota to double down on some of the companies in which it has already invested, the firm operates largely independently from Toyota. It is also focused on far more than just cars, also scouting start-ups working in

areas such as artificial intelligence (AI), data, the cloud and robotics, to name a few. To learn more about how Toyota AI Ventures is treading a course of its own in the mobility space, *Automotive World* sat down with its founding managing director, Jim Adler, to talk start-ups, CASE and what it takes to make it in today's industry.

When it comes to investing in start-ups, where can things go wrong?

Running a start-up is notoriously difficult and unpredictable, and all kinds of things can go wrong. Being too early for the market is one problem—maybe the technology is there, but the customers aren't yet. The

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Toyota AI Ventures operates largely independently from Toyota Motor Company, but "It's a huge benefit for Toyota to understand where the innovation is coming from" - Jim Adler

company needs to pivot to find the right market for its product.

Then, you have the other side, where the company is growing and has found that product-market fit, and then you have to manage growth problems. You have to deal with inevitable turnover, satisfying customers and making sure the company is well capitalised. It takes an emotional toll on the management team, first and foremost. Many, many things can go wrong, and that's why we put a premium on the team when deciding which companies to invest in: their resiliency, their optimism and their pragmatism are all important qualities for navigating that trajectory.

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Start-ups are small, but they're fast, and they can quickly bring these innovations to market

How much does your own background as an entrepreneur help in that?

We try to be a strong supporter of the company through all of its machinations. We like to help them think through certainly the intellectual

problems that face any business, but also the emotional challenges that they face, which shouldn't be underestimated. In many cases, how much passion a company can continue to have in the face of adversity separates the winners from the losers.

Toyota AI Ventures was an early backer of May Mobility, which received a US\$50m investment led by Toyota Motor Corp in December 2019



Which areas in this mobility start-up space do you feel will be particularly profitable over the coming years?

I certainly see change within automotive and mobility now we're talking about CASE; that spans some of the space, but not all of it. We're seeing tremendous amounts of technology coming into the market and you're going to see overlapping hype cycles.

For example, we're just coming off an autonomy hype cycle. People thought self-driving cars were just around the corner. We at Toyota have been saying that it's going to be tougher than everyone thinks, and that's turning out to be the case. Where we saw several autonomy start-ups say, a year or so ago, now we're seeing fewer. We're seeing more deals around connected vehicles, electrification, but also just general AI technologies moving into the market.

How significant a role will start-ups have in building the future of mobility?

I'm a huge believer in the power of innovation and the passion that start-ups bring to a market. In high tech, innovation has traditionally come from start-ups. Why? Because start-ups are free to experiment in the marketplace, without the fear of failure.

VC is set up to expect a large number of failures and, in exchange for that, the reward is to make up for all the failures that happen. It's incumbent on larger corporations to more closely value the experiments that start-ups are conducting in the marketplace.

Where does Toyota, and Toyota AI Ventures, fit into this equation?

We have some ideas of what might be next, but it is the start-ups which are in the marketplace figuring it out. It's a huge benefit for Toyota to get a front-row seat to that experimentation and to understand where the innovation is coming from, not only on the technology side but, I believe more importantly, also on the business model side. What business models are working? What do customers want to see in the marketplace from both services and products? Start-ups are small, but they're fast, and they can quickly bring these innovations to market.

We, of course, want to be there to help them and the long-term strategic value that Toyota gets out of it is to watch them innovate, and help them create some value in the market. Start-ups have a unique role to play in this, as they have traditionally, for at least the last 60 years.