FUTURE OF TRANSPORT

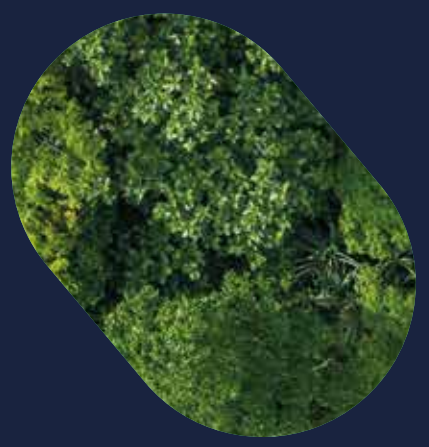
Masternaut customers save 230,000 tonnes of CO_2 every year.

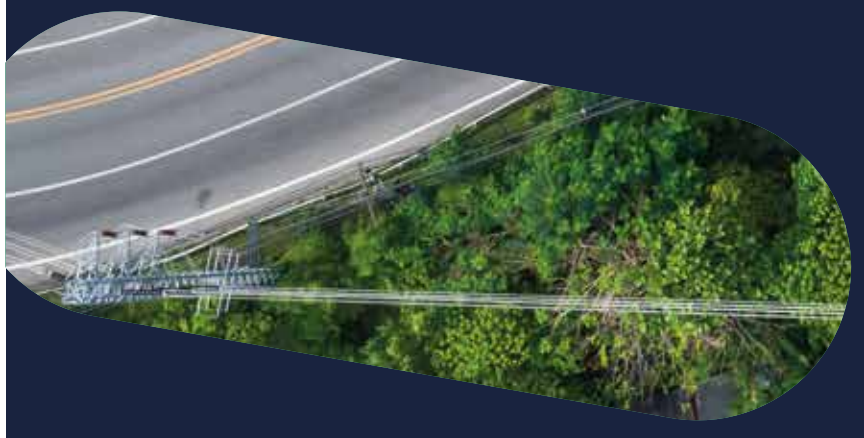
That's the same as planting trees on over 350 football pitches each day.

Our Fleet Certification Programme reviewed by The Energy Saving Trust* recognises fleets that are considerably reducing their CO_2 emissions year-on-year or are performing better than their competitors. **Congratulations to all our bronze, silver and gold customers contributing to a greener future.**

More information at
www.masternaut.com/CO2

*The Energy Saving Trust has conducted a limited assurance verification of Masternaut's Fleet CO2 Certification methodology and can give assurance on its accuracy as a measurement of CO_2 improvement.





masternaut

FUTURE OF TRANSPORT

Distributed in THE TIMES

SUSTAINABILITY

Driving towards zero emissions

In an era of ever-rising ecommerce, consumers and delivery firms increasingly demand cleaner logistics, but who is driving change?

OLIVIA GAGAN

If you were to add up the miles all the food, clothes and furniture in your home travelled to get there, it would most likely number in the thousands. We live in a world where we take access to global goods and produce as a given; and this presents both an opportunity and a challenge for the delivery and logistics industry.

It's an opportunity because as international commerce increases, so too does demand for these companies. It's a challenge because making more deliveries means producing more carbon and the customers of logistics firms are more environmentally aware than ever. They are also deeply time conscious.

Jagjit Singh Srai of the Centre for International Manufacturing at the University of Cambridge says: "We live in on-demand societies that want and expect shorter and shorter delivery times. I live in an area where I can get an item delivered in two hours, for instance. Rarely as consumers do we look at the efficiency of that kind of activity."

Whether for business-to-consumer or business-to-business clients, working out how to make fast, global delivery as low carbon as possible is now key to the logistics industry's success.

Failure to invest time and capital into resolving this issue could be fatal to these companies, says René Schmidpeter, who leads international business ethics research at Cologne Business School. "It is not a question of willingness anymore," he argues. "Corporates that are not in-vesting in new sustainable business models will be out of business soon."

This isn't purely academic opinion. Delivery firms say their sustainability efforts are already influencing whether they win or lose lucrative contracts. Royal Mail Group operates one of the largest delivery fleets in the UK. A spokesperson for its courier and logistics arm, Parcelforce, says the firm's ability to prove its green credentials is "an increasingly important factor in tenders".

So how to future-proof and make a logistics business more sustainable? Decarbonising the delivery industry requires an arsenal of digital and technological advances, as well as some old-fashioned changes in behaviour. Physical asset management also needs to improve. At the top of the wish list for delivery companies is access to a better range of low-carbon vehicles and the government backing to support their growth.

Andreas Rentz/Getty Images

Christof Ehrhart, executive vice president of corporate communications at Berlin-based logistics firm DHL, says first and foremost delivery firms need the green vehicle industry to grow. "One of the major challenges to decarbonising is the non-availability of low or zero-emission heavy-duty vehicles or aircraft," he says. "At the moment, progress on the development of alternative technologies is slow, and the legislative environment in Europe and internationally remains heterogeneous."

Parcelforce's representative agrees, saying: "The greatest challenges include the availability of infrastructure to support alternative-fuel vehicles, coupled with the availability and choice of suitable vehicles that can support the increase in parcel volumes."

Dr Srai says increased consumer pressure and government regulation will be needed to encourage corporates to invest in low-carbon vehicles and for new technology to emerge. "Emission standards, congestion charging, having green zones in cities – these all help drive the sustainability agenda and are crucial to improving industry performance," he says.

As carbon-reduction regulations vary from country to country, and with few commercially viable, low-carbon ocean, air and road freight carriers on the market, the global logistics industry is driving decarbonisation efforts itself.

Parcelforce says it is working with vehicle manufacturers to develop, trial and use low-carbon vehicle and fuel technologies. DHL's target is to produce zero carbon emissions by 2050 and the amount of activities the firm is undertaking to achieve this is extensive. It has commissioned its own fleet of electric vehicles, is switching to delivering some products in urban areas by bicycle and training staff in greener behaviour. Mr Ehrhart says the firm plans to start planting a million trees a year.

Beyond company-specific measures, Dr Srai says wider development of better digital infrastructure will be key to decarbonising the logistics industry. He points to a bugbear of many online shoppers – missed deliveries – as an area where carbon emissions are at present too high.

"First-time deliveries to homes are not as high as one imagines," he says. "If you look at some of the major costs and carbon outputs for logistics firms, a lot can be around the last few miles of the delivery journey and repeat deliveries."

Developing systems that increase the odds of delivering at the first attempt would not only lower carbon output, but could also drive profit by preventing customers drifting to other delivery methods. Dr Srai says he has already noticed a trend is emerging that involves moving away from expensive, unreliable home delivery, particularly in ecommerce. "Consumers are increasingly picking deliveries up on their way home from work or as part of another shopping experience," he says.

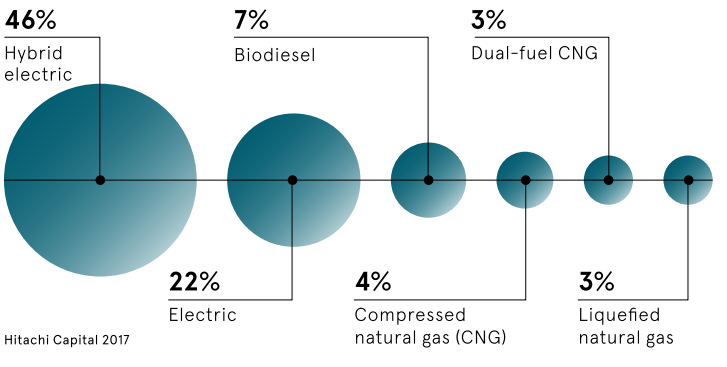
Maximising the performance of physical assets is another way to cut emissions, curb costs and limit the amount of delivery vehicles piling on to clogged roads. "Businesses need to ask themselves, to what extent are our assets being fully utilised?" Dr Srai says. The practice of "backhauling" could increase, he suggests. "If a truck delivers from A to B, on the return back to A, there is empty space. Backhauling is where you fill that empty truck with a different customer requirement."

Embracing the concept could effectively double the capacity of logistics firms, but it will require competitors to collaborate.

Dr Schmidpeter points to research that suggests risk-adjusted returns are up to 6 per cent higher for corporates that are integrating sustainability in their value chains. DHL's Mr Ehrhart says, for his company, it's simply a matter of playing the long game. Most of their carbon-cutting and sustainability measures, while having a high initial investment and longer payback period, show a positive return on investment. ◆

Current state of sustainable logistics

Usage of alternative fuels by fleet companies



Hitachi Capital 2017

AS A SERVICE

Accelerating into a new era of motoring

With car-sharing gaining traction, carmakers are moving towards a different business model, while also developing a brand of electric vehicles


IDEO

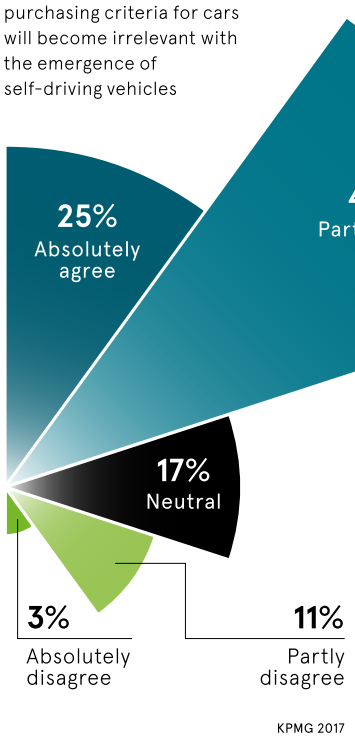
OLIVER PICKUP

It is September 2035. You have to travel from your London home-pod to a 9.30am summit in St Andrews, the home of golf, 30 miles northeast of Edinburgh. You command your smart alarm clock, which has woken you up at 7am, to have a driverless Mercedes-Benz F105 ready to zoom you to St Pancras International at 7.30am.

After catching the 8am Virgin Hyperloop One to Edinburgh – the 414-mile journey takes just 50 minutes – another driverless car, an IDEO WOW Pod, ordered on your smart watch, is waiting to speed you and three other people, who happen to be sharing the ride, to the meeting. You make use of the mixed reality visor and dial into a briefing conference. The car even has some golf clubs in the front boot, as requested, in case you have time to hit The Old Course.

Changing purchasing criteria

Auto executives were asked whether the traditional purchasing criteria for cars will become irrelevant with the emergence of self-driving vehicles



KPMG 2017

This may seem far fetched, but as soon as fully autonomous cars are given the green light to drive on our roads – Jensen Huang, chief executive of California-headquartered chipmaker NVIDIA, recently predicted this will happen by 2022 – then it will take no time to accelerate beyond that reality.

The promise of productive, cheap, stress and accident-free journeys is hugely appealing. Industry experts forecast that by 2060 around three quarters of the vehicles on our roads will be fully autonomous.

Forward-thinking car manufacturers are revving up for a huge pivot, realising that as-a-service (aaS) models will render their existing business redundant.

Fiona Falcone, UK head of automotive at Accenture, warns: "The values that traditional car brands once held dear are becoming less relevant.

Certain car brands were sought after as a status symbol, because it represented freedom, wealth and success.

"With ownership declining, these types of brand values are less important to consumers. Today, these are more likely to be represented by a smartphone or bitcoin. Younger brands have swooped in and are speaking to the new generation of drivers."

Duncan Baizley, senior editor at trends forecaster WGSN Insight, points out that a 2017 study by the Trades Union Congress revealed the average worker in London currently loses more than 30 days a year commuting. "The biggest potential impact for automotive aaS models will be on our everyday commute," he says.

Mr Baizley believes that automotive brands have to speed towards sustainable workplace solutions to gain traction. Also other big players are entering the race; indeed, Google's Waymo driverless-car project is leading the charge.

"Concepts like IDEO's WOW Pod and Mercedes-Benz's F105 are driverless, connected workspaces," he says. "And although Tesla dominates the electric vehicle (EV) space, I expect Apple to start making serious moves in the next few years."

In August the tech giant rehired Doug Field, recently Tesla's senior vice president of engineering for its EV project, Titan. "This suggests that it is still very serious about creating autonomous hardware, as well as software," says Mr Baizley. He can see Apple adopting a similar strategy to Daimler's Car2Go and BMW's DriveNow car-sharing services, especially from a data perspective.

"There is an enormous potential market for responsive travel information and services, particularly in congested urban areas, and Apple has both the product design and data management expertise to challenge, and stand out, in this increasingly competitive space," he says.

"I can also see an Apple autonomous vehicle being very much a brand experience, one that sells you its goods and services as you enjoy a stress-free ride in its highly desirable, fully connected cabin."

Pressing the peddle to the floor, Tom Rivers, vice president of global marketing at connected car technology organisation Harman, goes as far as to say: "Connectivity will have a more dramatic effect on cars than any other automotive technology in the last century. Car brands will therefore have to develop their brand positioning to encompass this new autonomous experience and have the chance to be more relevant.

"Today a car manufacturer might promote its car through its driving attributes: handling and steering feel. With autonomy, that in-car experience will be much broader and automotive marketers will shift their messaging to promote the wider 'riding' experience.

"We spend so much time in the car and do so much in there – for example, we know it's the preferred place to listen to music – it's not surprising that brands such as Apple and Google want to be part of this space."

Concepts such as the WOW (Work on Wheels) pod by IDEO, where commuters travel in hired workspaces, could disrupt the traditional auto market

"If car brands don't speak to the driver of the future and evolve their role to fit with the new world of mobility, they run the risk of being blank carriers of other people's success

Last year, Intel calculated that $200 billion of revenue could be generated from rising consumer use of new innovative applications and services that will emerge with autonomous cars. It also claimed that autonomy could free more than 250 million hours a year of commuting time in the world's most congested cities.

To take advantage, high-profile collaborations will become the norm between carmakers and service brands, Mr Rivers believes. In January, for example, Toyota unveiled a self-driving vehicle involving partners such as Amazon, Uber and Pizza Hut. "It's clear that the world is changing very rapidly and it is too broad for any one organisation to monopolise," he says. "That's why there are many more partnerships and acquisitions in the industry."

Offering a final tip, Accenture's Ms Falcone says: "Vehicle brands need to be careful not to let hubris lead them into the same trap that the large telcos have found themselves in; once the cool kids of connectivity, they were soon challenged by the manufacturers and software developers taking their audience's attention. They became invisible plumbing.

"Car brands are in the same danger, if they don't speak to the driver of the future and evolve their role to fit with the new world of mobility, they run the risk of being blank carriers of other people's success." ◆

in hyperloop one

The future of transport is closer than you think

As changing passenger demands and complex commercial pressures frustrate incumbents, emerging technologies offer a new response to today's transport challenges. Industry leaders must redress the balance between competition and collaboration to succeed

Transport has long been pivotal to how we live and work, and how our society grows. Today, we face the limitations of heritage transport systems. We endure outdated infrastructure, capacity crunches and disjointed hubs in inconvenient locations. We have become accustomed to unplanned maintenance, and escalating disquiet around environmental, safety and security issues.

We know existing networks are reaching capacity and that we risk a gridlocked future. But transport is so essential to our way of life that we compromise because we need transport to sustain the world we live in.

Chris Lynch
Global transport, travel and logistics lead, PA Consulting

PA Consulting believes in a future where we can progress further, faster. A future with seamless, integrated transport systems that enable us to move around the world with fewer interruptions.

Ultimately, a future that's better connected, with easy access to new markets and existing hubs; one that makes travel easier between our home and workplace, friends and family. A future when transport providers are better equipped to meet individual demands and passengers no longer face those difficult compromises of cost versus comfort, speed versus convenience, reliability versus disruption.

Indeed, PA's recent, in-depth research with senior transport leaders across the UK and Europe shows that two-thirds believe the future of transport must be built on customer-centric business models.

The study reveals significant challenges, but also big opportunities, in this rapidly evolving sector. When asked what they believed would be the key characteristics of the future of transport in the next five years, increased route connectivity (51 per cent), new modes of transport (48 per cent), improved capacity (43 per cent) and autonomous vehicles (37 per cent) came out on top.

So, what does this mean? The majority of respondents believe it means greater opportunities. Technology innovations will enable us to be more customer centric; flexible ticketing systems are addressing this today. Upgrades to physical and digital transport infrastructure can create smoother, safer journeys and improve capacity; consider new airport terminals, smart ports or digital railways. We can develop new routes, on-demand transportation services and smarter connections between the places we need to get to. All the while becoming cleaner and more accessible.

In short, the vision for the future is positive and achievable; in fact, it's already happening.

But what about something totally unexpected and unprecedented? A new transport system. One that changes how we think about how people and goods move around the world.

This is fast becoming reality. Hyperloop, the first new mode of transport in 100 years is set to revolutionise transport as we know it. "Hyperloop will deliver the speed of an airplane, the cost of a train ticket and the ease of a metro for fast, effortless travel," says Ryan Kelly, head of marketing and communications at Virgin Hyperloop One, the company working to deliver the first hyperloop to market.

"There are too many people today who are caught in soul-crushing traffic, forced to make hard choices on where to live and work, and who are limited in their access to experiences and opportunities. It's our mission to build a system that will give back some of that time and deliver the travel experience of the future."

Virgin Hyperloop One's transport system will run on magnetic levitation, in a partial vacuum, to reach speeds of up to 670 miles per hour – on land. That means shaving three hours off the travel time between London and Edinburgh to a mere 41 minutes. Paris to London would take less than half an hour.

PA Consulting has worked hand in hand with Virgin Hyperloop One to devise the technology blueprint on which the transport system operates. When considering the impact of the partnership, Chris Lynch, global transport lead at PA,w highlights the human factor. "The technology and speed are incredible," he says. "But it's hyperloop's effect on everyday people that is unprecedented in our lifetime. It's projects like this that epitomise PA's vision for the future of transport – bold, bright and changing the world we live in for the better."

As members of Virgin Hyperloop One's Partner Advisory Board, PA continues to support the company's latest initiatives to bring the new transport mode to life. Commercial deployments are slated by the mid-2020s, initially linking key freight routes and then capacity-challenged city pairs. In India, Virgin Hyperloop One, with PA's support, are on track to connect Pune and Mumbai, two major economic centres, creating a competitive mega-region with a combined population of 26 million inhabitants.

> **Hyperloop will deliver the speed of an airplane, the cost of a train ticket, and the ease of a metro for fast, effortless travel**

Jim Morgan, PA's technology and transport expert, says: "In India, capacity is the issue. You have an antiquated rail infrastructure and constrained flight network that are stretched. Mumbai's population is already over 18 million, so cannot sustain growth without a forward-looking transportation solution. Hyperloop serves a critical purpose by adding capacity and accelerated throughput with high-velocity, dynamic transport."

So, hyperloop is a response to today's congestion and capacity challenges. By expanding the catchment areas of airports, augmenting the linkage of key business city-pairs or boosting the reach and responsiveness of freight and logistics centres, hyperloop can deliver improved passenger experience, better connections and more seamless transport options.

This is what Mr Lynch says makes hyperloop most ingenious. "All this talk of transforming transport may make hyperloop appear as a threat to the status quo, but it's actually an integrator," he says.

Yet traditional commercial competition dies hard. PA Consulting's study shows that the fifth feature of the future identified by more than 200 transport leaders is increased competition between modes of transport. So, the perception that innovators or even old adversaries are competition to be beaten must be challenged, before any of the significant opportunities can be leveraged.

The reality is hyperloop is developing fast, along with a host of new autonomous transport modes, intelligent infrastructure developments and radical new business models. When combined with the progress industry incumbents are already making, we are closer than ever to delivering a better future in transport; a vision that all actors so clearly share.

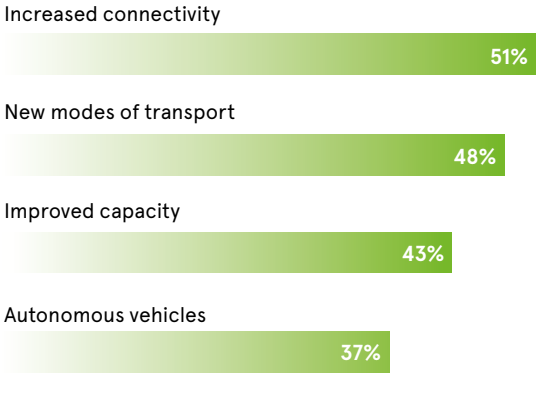
What's required now is a shift to collaboration, pairing disruptive future thinking with the wealth of existing experience in the sector. With 70 per cent of transport leaders citing collaboration as critical to success, perhaps we're closer than we think.

For more information please visit www.paconsulting.com/transport

#FutureofTransport

Four key features of the future of transport

Industry leaders believe the next five years of transport will be characterised by



Commercial feature

International, industrywide standards are needed for autonomous vehicle liability

The automotive and technology industries are rapidly developing self-driving cars. But while these vehicles are expected on UK roads within three years the legal frameworks for liability and data privacy remain far from ready, says leading global insurance law firm **Kennedys**

Niall Edwards
Partner
Kennedys

Deborah Newberry
Head of corporate and public affairs
Kennedys

Car insurance may have operated essentially the same way for many years, but it faces a new complication in the form of self-driving cars. In an accident, questions abound whether it was the fault of the autonomous system or the driver, how it can be determined whether the car was manually driven or automated at that moment and if the system had been tampered with or hacked.

As the industry grapples with how to cover such vehicles and how to educate consumers on the new world, different versions of a potential legal framework and normal practice are emerging across nations. Governments and the whole industry, including automotive executives, trade bodies and the entire supply chain, must co-operate to develop a proper, singular legal framework that reflects the globalised sector. That framework must also be able to adapt to the constant evolution of smart technology.

"Developing global standards is absolutely critical. There must be clear terms around safety, liability and data privacy," says Niall Edwards, partner and automotive litigation expert at Kennedys . "This is achievable but it needs everybody, from manufacturers, the supply chain and insurers to governments around the world, to discuss the issue and create common terms and standards."

A variety of discussions are already taking place around the world, and many in the vehicle industry want to see a clear coverage and liability system, global to national, for what will happen if an autonomous vehicle is involved in an accident. But there are already some significant differences between the approach adopted on liability and insurance coverage in different countries.

> **We risk the impending arrival of autonomous vehicles on some countries' roads without common standards**

In the European Union, particularly in Germany, there is a move towards a more strict liability system, founded on a putative ethical base, with proposals that the driver has responsibility for any actions of the autonomous car. The UK plans to have driverless cars commercially available in 2021, creating a £28-billion industry, but the review of the legal framework is still at an early stage and there is the risk that Brexit leads to a separate approach.

In the United States, some of the most advanced vehicle testing is taking place with autonomous vehicles on the roads in California and Arizona, and many states' legislation has jumped to the finish line, covering vehicles without any human input. Earlier this year, the US earmarked $100 million for a highly automated vehicle research and development programme. Meanwhile, in Singapore and Dubai respectively, automated taxis and drones are being tested, and related regulatory frameworks are being developed.

The complexity created by these potentially conflicting laws creates a dangerous situation in which there could be serious confusion, even gaps, in how liability, safety and privacy are handled in different nations. The automotive industry, insurers and government regulators must urgently tackle the problem.

"We do still see some naivety in attitudes. In some markets the thinking remains to legislate when self-driving cars are a more obvious reality for the roads," says Mr Edwards. "But communication between interested parties needs to be promoted by government now. Otherwise we risk the impending arrival of autonomous vehicles on some countries' roads without common standards."

The automotive industry can learn from work in the aviation and marine sectors. He explains: "In aviation, there has been steady creation of harmonised drone regulations by the Joint Authorities for Rulemaking on Unmanned Systems, a body of experts. Within this process there is an emerging consensus on the categorisation of drone operations based on risk levels, licensing, registration and designation of airspace drones can be flown into."

Meanwhile, in the marine industry, existing conventions and regulations presume that a vessel is crewed and discussions are examining potential legal liability frameworks that include autonomous ships.

Another aspect complicating liability is access to proprietary in-car telematics data that reveals how and where vehicles are driven. A standard format of data is needed so that following any accident, insurers and local authorities can check what happened. "The key is translating manufacturers' own proprietary data formats into a standard that can be accessed by others to assess how an accident happened and who is liable," says Mr Edwards.

Consumer concerns remain around how such data will be used, and manufacturers and insurers must be upfront about this. By being open, there will be a better appreciation of autonomous vehicles by consumers and therefore more take-up. In addition, manufacturers will reduce tension with key-partner insurers that provide white-label insurance services.

There must also be a focus on communication with citizens, with Kennedys' research showing more than half of drivers are concerned about driverless cars and 49 per cent fear a rise in their insurance premiums.

"Any campaign could be like those we have seen in health, for example, around exercise and tackling obesity. It needs to be significant because autonomous vehicles are going to change the world we live in," says Deborah Newberry, the law firm's head of corporate and public affairs. "The government's ambition is clear and this represents a chance for the UK to be a truly worldwide leader in the field of autonomous technology."

International, industrywide standards are needed around liability, safety and data privacy for those driving autonomous vehicles. These are achievable with full international co-operation across manufacturers, insurers and governments, and clear communication with citizens. Kennedys, an expert in this area, works with insurers and car manufacturers to advise on liability and data privacy, and is lobbying governments to create an effective international framework that protects drivers and all parts of the industry.

Only...

44%

of UK adults favour the use of driverless cars on UK roads

20%

of the public would feel comfortable with the use of driverless technology to allow HGVs and other commercial road vehicles to operate in platoons

20%

would feel comfortable with the idea of using a driverless taxi

To be part of the changing liability, safety and data privacy frameworks for autonomous vehicles please visit kennedyslaw.com or call 020 7667 9667

Kennedys

RAIL

Callum Chapman/Unsplash

Time for proaction on UK railways

Two fifths of London's commuters use apps powered by Transport for London data

Shifting to a proactive, rather than reactive, model of investment and maintenance is vital to deliver the high level of reliability, punctuality and overall experience rail passengers expect

FELICIA JACKSON

Proactive spending on predictive maintenance techniques helps determine the condition of equipment so network operators can plan the best time to carry out maintenance work.

Nick Hughes, director of Hitachi Rail UK, explains: "Our digital systems use over 40,000 sensors on the trains to deliver real-time updates to the depot, so gone are the days where a train fault could only be investigated at the end of the day. Once a sensor picks up an issue, it is immediately relayed to the depot so they can prepare work."

Only replacing parts as needed can save up to 15 per cent on the cost of materials, while the time taken and wastage is cut because maintenance teams know exactly which parts they need to service and when. Train operators can provide more capacity using fewer trains because rolling stock is available for longer as it is spending less time in the depot.

Such an approach seems obviously more efficient, so why isn't it used across the UK rail network?

The biggest challenge for UK railways is keeping up with demand. Since privatisation in the 1990s, rail use has doubled and it's expected to do so again in the next ten years. There are currently more than 1.7 billion rail journeys every year in the UK.

Euan McLeod, head of infrastructure for HSBC UK Commercial Banking, says: "Rail operators and rolling stock financing vehicles are successfully supporting the modernisation of the system, including investment in stations, trains and better services. More of this should be encouraged, and even extended into tracks and signalling where investment is needed. There is real appetite from private finance to support rail investment in the UK and at record low interest rates too." The question is whether resources are being deployed in the most effective way.

One area where the UK seems to be staying ahead of the curve is with rolling stock. Companies such as Eversholt are backed by banks and own much of the rolling stock leased by operators. With more than 6,500 carriages estimated to be coming on to the market in the next decade, it seems likely that peak demand can be met.

> **You only have to look at the rail experience delivered in countries such as Spain and China, which have proactively invested in high-speed rail and digiti-sation, to see the benefits of this approach versus maintain and fix**

The infrastructure surrounding rail has also received a boost through projects such as Thameslink and High Speed 2. As Mr McLeod points out: "Rail investment is often characterised as a raw cost when in fact this is outweighed by the long-term economic benefits to users and wider society in terms of improved connectivity, mobility, journey times and congestion."

From King's Cross in London to the remodelling of Leeds Station, gateway hubs developed around rail networks can boost regional connectivity and provide an economic boon for the region.

Paul Hirst, head of transport at Addleshaw Goddard, says: "Transport improvements can transform the cultural and socio-economic status of the urban environments they inhabit, not least through job creation. It is the combination of wider economic and social benefits that makes such a compelling case for investment in transport hubs."

In Europe, high-speed rail has penetrated rapidly, connecting regions and boosting the popularity and performance of the rail sector, unlike in the UK where high-speed network developments seem frequently delayed or cut despite potential benefits. In May, rail think tank Greengauge 21 proposed a UK network of high-speed rail by 2050 to boost productivity compared with France, Germany and Spain.

At the same time, the UK has been falling behind in the digitalisation and management of its rail network. Predictive maintenance may be gaining traction, but the UK still lacks significant investment in other digital technologies.

In Japan, for example, traffic management systems were deployed in the 1960s to help facilitate the bullet train. This has a direct impact on user experience. As traveller numbers rise, there is a growing need for more lines and better rail traffic management.

In the new Thameslink project, intended to improve passenger flow in and out of central London, Hitachi Rail's traffic management system will enable the network to run 24 trains an hour, nearly as many as the London Underground. It will do this through providing cab signalling and computerised train control on part of the main line network.

Lack of digital in-cab signalling also slows the network and impacts user experience. Across Europe rail traffic is managed by such a system, known as the European Train Controls System. This enables trains to run closer together because it continually calculates the safe maximum speed for trains and can take control depending on whether permissible speeds are exceeded.

Systems which can track wind speed, fallen obstacles and other elements on the network only improve network management.

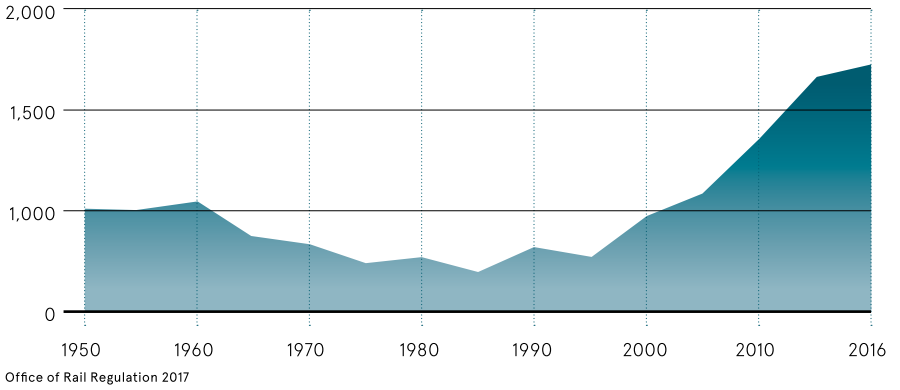
Mike Hughes, UK and Ireland zone president at Schneider Electric, points out: "You only have to look at the rail experience delivered in countries such as Spain and China, which have proactively invested in high-speed rail and digitisation, to see the benefits of this approach versus maintain and fix.

"New technologies have delivered a level of reliability we can only dream of in the UK. The Spanish high-speed network achieves 98.5 per cent punctuality and a five-minute delay is considered significant."

Rail continues to grow in importance as a key part of a sustainable transport network and a lever for regeneration. To manage the scale of technology innovation and improvement, isn't it time policymakers rethink their current approach to infrastructure spending in the UK? ◆

Passenger journeys in the UK, 1950 to 2016

In millions



Office of Rail Regulation 2017

ELECTRIFYING AUTOS

Four of every five cars sold worldwide will be battery-electric vehicles battery-electric vehicles by 2050, according to analysts Morgan Stanley, with the production of traditional combustion engines soon set to peak. So how is the industry changing, and what are governments and carmakers doing to prepare? This infographic explores eight key ways the auto manufacturing industry is being transformed by electric vehicles

Beijing

15-25%

of commercial buildings and all new residential buildings to be fitted with wire conduits

San Francisco

10%

of parking spaces in new builds must have level-2 chargers

Shanghai

28k

public charging points planned by 2020, taking the total of public and private points to 210,000

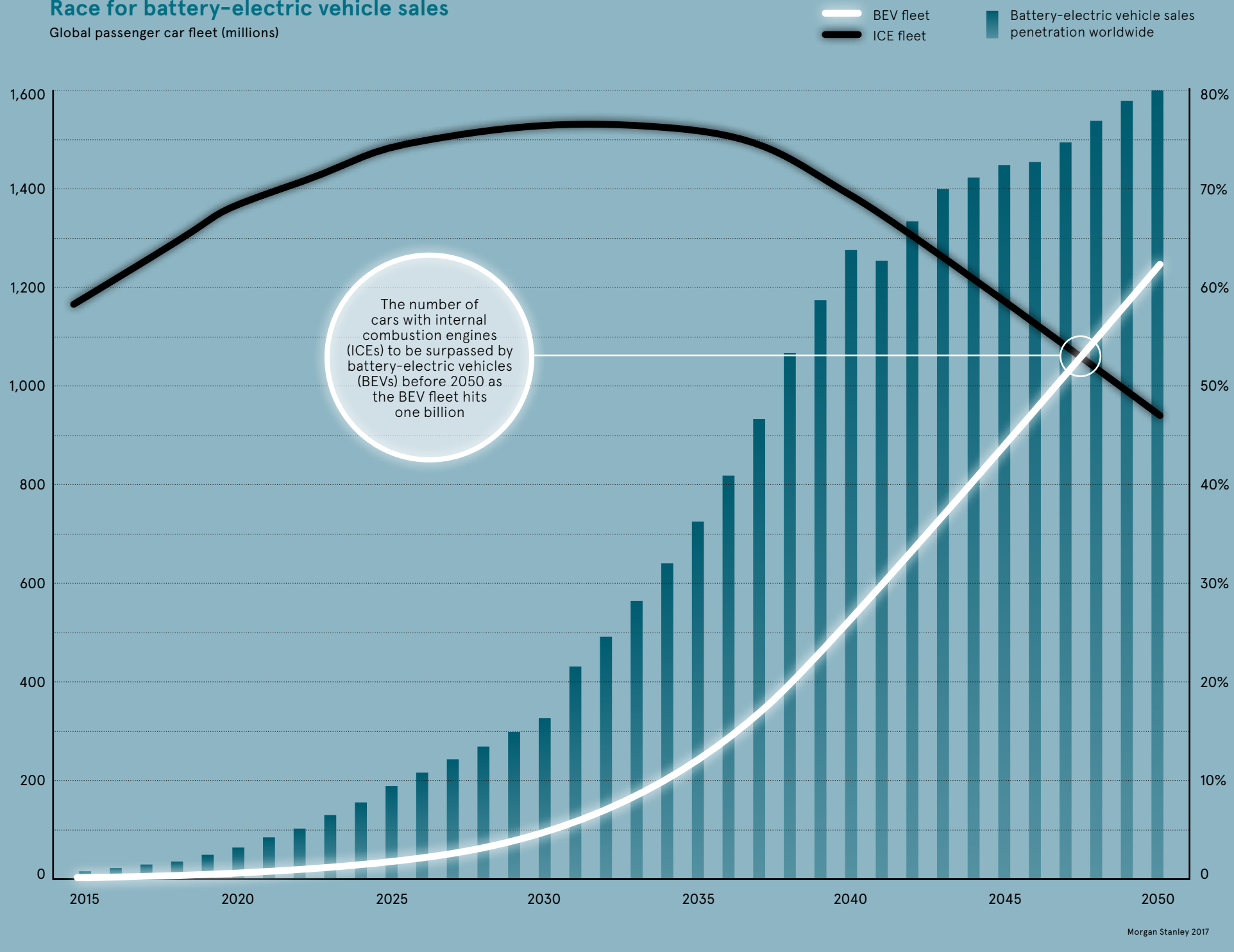
Oslo

>60%

of charging point installation cost covered by grants

Race for battery-electric vehicle sales

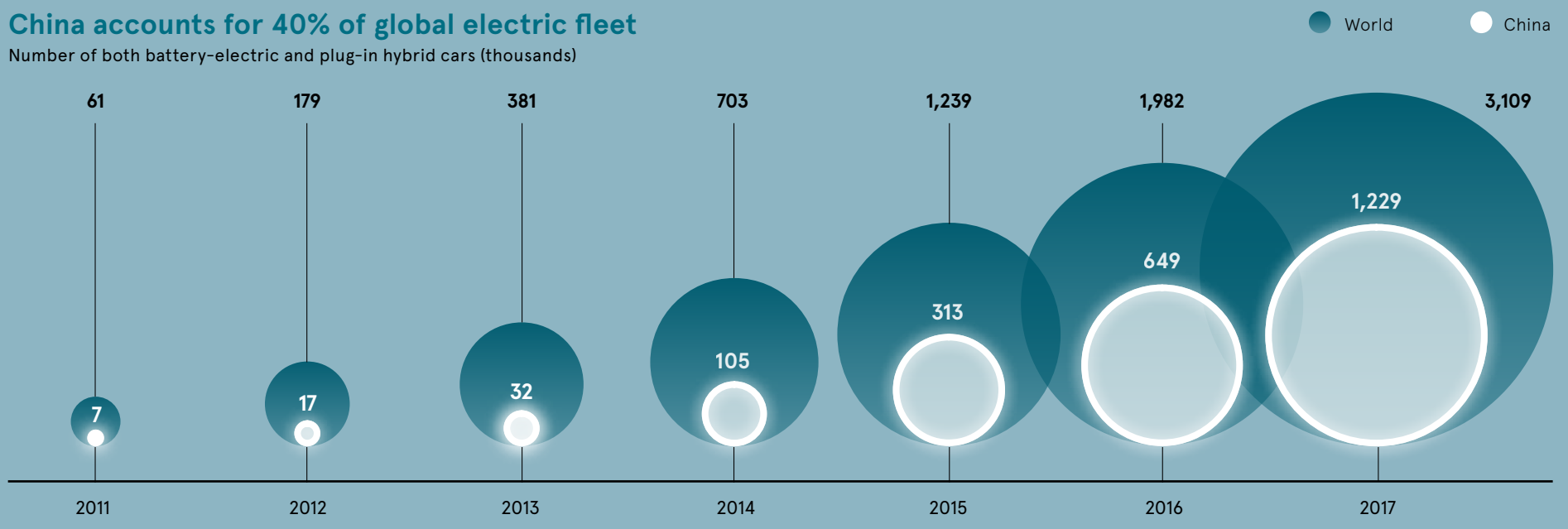
Global passenger car fleet (millions)



Morgan Stanley 2017

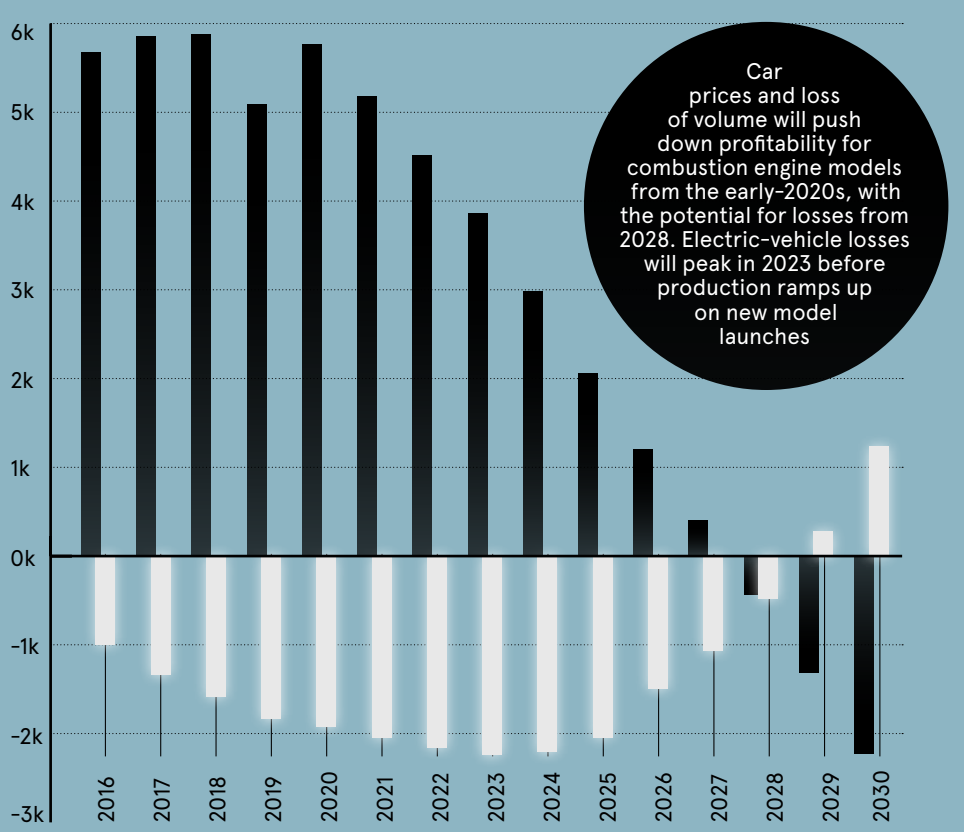
China accounts for 40% of global electric fleet

Number of both battery-electric and plug-in hybrid cars (thousands)



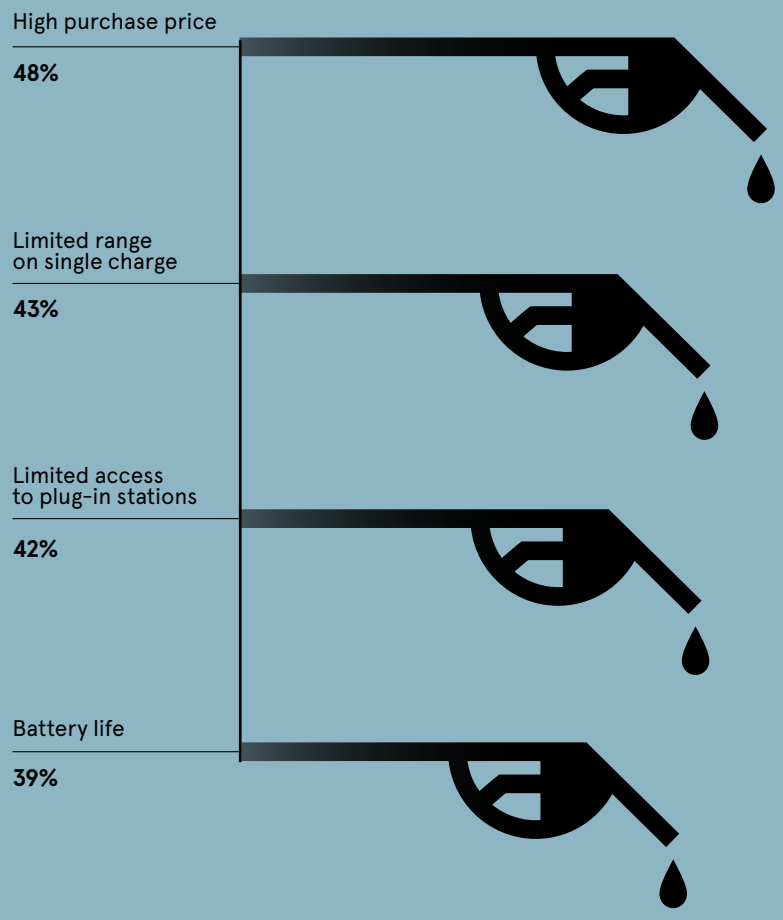
Transition to electric will be a gamechanger for traditional carmakers

Morgan Stanley estimates of profit and loss of electric and traditional vehicles (€ millions)



Factors holding back electric vehicle adoption

Top consumer concerns about battery-electric vehicles



Carmakers are curbing or halting production of diesel engines

Announced measures taken by major manufacturers

FCA (FIAT CHRYSLER AUTOMOBILES)
Phase out diesel models by 2020

HONDA
Discontinue production and sale of flagship diesel-powered vehicles in Europe

PORSCHE
No diesel units for major models; focus shifting to optimised petrol engines, battery-electric vehicles and hybrids

SUBARU
Withdraw diesel car production and sales by 2020

TOYOTA
Stop selling diesel cars in Europe by the end of 2018

VOLVO
Stop developing diesel engines

ELECTRIFICATION

Going electric will spark the UK economy

Electrifying the UK's transport network holds the key to major benefits, though significant investment in infrastructure is still needed at a time of national austerity

Samuele Errico Piccarini/Unsplash

BEN ROSSI

Electric vehicles currently make up just 4.3 per cent of new vehicle registrations nationally. But the UK is seen as a European centre for electric vehicles because of government incentives for carmakers to invest in production capacity. However, a lack of costly infrastructure has held back development.

According to the National Infrastructure Commission, battery power could save the UK £8 billion a year by 2030 as electrification is estimated to reduce energy usage by around 50 per cent, making everything much cheaper to run.

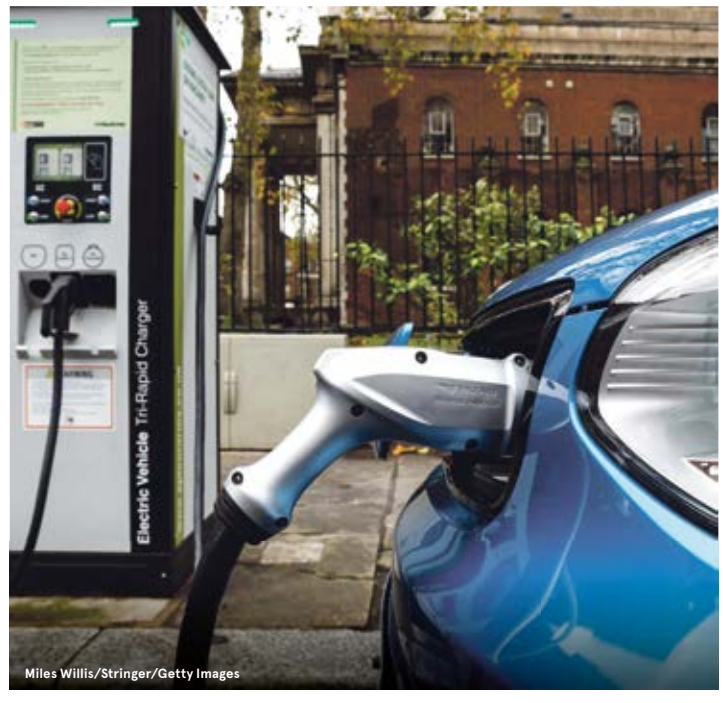
As well as economic benefits, going electric on the roads improves UK energy security through the reduction in reliance on oil and dependence on oil-producing nations.

While reductions in operational costs and pollution are the obvious benefits of electrification, electric transport is also set to underpin the autonomy revolution as the UK seeks a lead in the fourth industrial revolution and, in particular, self-driving vehicles.

"When compounded with autonomy, electrification promises to reduce congestion, dramatically cut road traffic accidents and bring mobility to the immobile," says Robert Harwood, global industry director at engineering simulation firm ANSYS.

Exciting though this may sound, environmental factors are primarily driving the government's policy decisions in this area. Diesel buses are around four times more polluting than private cars. With the clean air zones being introduced in a number of UK cities, and motorists deterred by congestion and parking costs, the need for an efficient and clean bus service is greater than ever.

"Air pollution is the greatest health problem after obesity in the UK," says Matthew Pencharz, a former deputy major of London and now non-executive director for Off Grid Energy. Indeed, poor air quality results in around 40,000 deaths every year, 9,000 of which are in London. "Electrifying transport reduces harmful tailpipe emissions and carbon emissions," Mr Pencharz adds. "The UK already has a low and decreasing grid carbon intensity, and there is broad support across government."



Miles Willis/Stringer/Getty Images

Growth in electricity consumption is increasing rapidly and will double by 2050, according to DNV GL's Energy Transition Outlook. This is driven by significant electrification of energy demand in all regions and sectors, particularly electric vehicles.

Road transport dominates transportation energy use and DNV GL predicts that by 2027 all new cars sold in Europe will be electric. Recent advances in heavy vehicle electrification are leading to swift uptake of

Factfile

Electric vehicles overtaking UK infrastructure

A study by Emu Analytics has shown that there will be more than one million electric vehicles (EVs) registered in the UK by 2020, up from 150,000 in May 2018. However, due to the slow rollout of infrastructure, there will be an 83 per cent shortfall in the required number of charging points

Number of EVs to every rapid charging connection

UK average
43

Best
1.45
(Newcastle)

Worst
485
(Peterborough)

Electrification promises to reduce congestion, dramatically cut road traffic accidents and bring mobility to the immobile

battery power for public buses too and is expected to reach 80 per cent just after 2030 in Europe.

The UK has the most electric buses in Europe. Hybrid electric buses currently run in numerous British cities, representing 18 per cent of Europe's entire fleet, though the adoption is dwarfed by China which operates more than 98 per cent of the global total.

"The electrification of UK road transport is still in its infancy, though political will and falling costs are starting to drive a transition," says Laurence Chittock, senior transport modeller at Mott MacDonald. "The cost of an electric bus, which traditionally is much higher than a diesel equivalent, is falling rapidly.

"Thorough planning is required to identify suitable services and integrate a charging regime. Transport for London is currently embarking on a transition to electric buses by identifying where this can be implemented, such as on the European Union-funded ELIPTIC project."

Electrification of the UK's railways, however, lags behind most of Europe. Only 42 per cent of the UK's rail network has been electrified, compared with 76 per cent in the Netherlands, 71 per cent in Italy and 61 per cent in Spain, according to the Institution of Mechanical Engineers.

While several major electrification schemes were initiated, including Cardiff to Swansea, Kettering to Sheffield and Windermere to Oxenholme, they were cancelled by the government last year due to growing infrastructure costs.

"Rail electrification will continue, but remains a small sub-sector," says Ditlev Engel, chief executive of DNV GL Energy. Meanwhile, the electrification of the air travel will still be in its infancy by 2050, he adds.

Electrifying UK transport services en masse means more electrical energy will be required from the National Grid, on top of the anticipated demand from domestic vehicles leading to a huge change in capacity and load profile demands.

Although the grid has the capacity to meet the predicted demands, higher uptake of electric vehicles in certain regions, combined with a lack of infrastructure investment, has the potential to cause significant local challenges, including possible reductions in voltage.

"To minimise the need for reinforcement of our ageing electricity infrastructure, we need to see fully flexible charging and smart systems that communicate with the wider energy system in real time, to help us gain a wider understanding of the optimal time to charge and minimise new peak demands," says Chris Evans, deputy managing director at engineering consultancy Rolton Group. "This has been stated as the route by government."

In the coming years, the government's strong policy stance on the electrification of road-based transport will significantly accelerate public transport services in this area. However, the large investments required in the rail network, to ensure the UK keeps up with electrification in other parts of the world, for now appear unlikely.◆

Consumers, carmakers and insurers waking up to benefits of telematics

Drivers are seeing their vehicles become increasingly internet connected and vast swathes of data are being generated – consumers, carmakers and insurers are all beginning to see the benefits of properly harnessing this information

The car industry is changing dramatically as a result of emerging technologies and the interconnectedness of consumers, their smartphone devices and third-party service providers.

Data is being generated at a rapid pace, but consumers often have instinctive concerns about what their in-car information might reveal. Nonetheless, there are now very clear value propositions and business models emerging that show great promise as methods of helping drivers save money and enjoy enhanced user experiences in return for their data.

"People don't necessarily think about it in different parts of their lives, but with services like Facebook, essentially what they have done is give away quite a lot of their personal data in return for a free service that they really like," says Andrew Lee, head of market intelligence and analysis at Octo Telematics. "In the car industry, manufacturers and insurers are realising that they're creating lots of data without yet being sure how to monetise it as effectively."

This is where companies such as Octo Telematics are stepping in to provide much-needed clarity. Its solutions offer a platform for collecting and analysing a vast amount of data, generating a wealth of contextual information on driving styles.

For carmakers, this opens up huge potential in predictive maintenance, as well as being able to sell warranty and service packages specific to driving styles and environments. "Manufacturers now think of not only how to sell a car, but how to provide ongoing services to the customer, keeping them coming back," says Mr Lee. "By understanding how each person drives, they can better price ongoing servicing, tailor leasing arrangements and even vastly improve their choice of next car to offer to the customer."

5.6m
connected users

207bn
miles of data

447,000
car accidents analysed

In the car industry, manufacturers and insurers are realising that they're creating lots of data without yet being sure how to monetise it as effectively

Meanwhile, for insurers, there is the opportunity to provide much more personalised services to customers. "They can reposition themselves as a service that looks after drivers, instead of something drivers have to have," he explains. "Insurance can be much better priced for safer motorists. A lot of people assume they're worse drivers than they actually are and think telematics will demonstrate that, but in reality they're often paying a premium without it because their insurer has so little data on them."

There are further benefits in terms of safety, he notes. "If a connected car is in a road accident, then an insurer can automatically call for assistance as well as understanding more about the accident, making the driver safer and also reducing the administrative paperwork," says Mr Lee.

Working with some of the world's largest car manufacturers and insurers, Octo Telematics is aiming to make the use of vehicle and driver-related data a much more widely understood and appreciated process. Among them it has a partnership with the finance arm of Renault, enabling the manufacturer to offer customers personalised services and rewards for safe driving, while helping fleet managers with dashboards of drivers' safety.

Octo Telematics' datasets are the largest in the world, and already incorporate 207 billion miles of data, detailed analysis of 447,000 car accidents and some 5.6 million connected users. Its proposition to industry partners is that the more data end-users are willing to share, the more benefits they will see, helping firms develop real brand loyalty.

Carmakers and insurers are increasingly simplifying their data-based services, bundling them as part of the total cost or only charging on the basis that drivers see clear benefits. Ultimately, the aim is to encourage greater engagement with connected car services as the journey accelerates towards driverless vehicles and radically expanded internet of things integration.

To find out how to use telematics data to improve and deepen the services you offer to drivers please visit octotelematics.com

OCTO

Commercial feature

An end to the rush hour crush? How data is liberating road and rail

An urban mobility data and analytics company with 200 million users is providing city planners with astonishing levels of insight into human movement, helping them optimise infrastructure

What is your idea of heaven?" asked author Stephen Fry. His own dream: "The Saturday afternoon of an Ashes match at Lord's. And his idea of hell? "The M25 on a Tuesday in February."

It's a relatable gripe. Traffic jams are the bane of modern urban life. And rail offers no respite. Many commuters live their own version of perfect misery every day at rush hour.

City planners have struggled to ease congestion on road and rail. The current set of solutions are largely based around building more infrastructure, which takes years and costs tens of billions of pounds. But now a new approach offers real hope, based on using data to optimise transport services and get more out of the existing infrastructure. The results have been dramatic.

Here's an example. Like many cities, Boston, Massachusetts, wants to encourage commuters to switch from cars to trains. But commuters resist taking the train at peak hours. In fact, at 8am, as the car numbers soar, train usage plummets.

Moovit analysed the problem. Moovit's smartphone app helps users find the best public transit and shared mobility routes for their journey. The app is used by more than 200 million users in 2,500 cities, giving it unprecedented reach. The data from each user journey, anonymised to protect users' privacy, is collected and stored by Moovit.

Data from Moovit made it possible to see the actual commuting patterns from homes to offices across Boston. Researchers concentrated on the data along the 40-mile Worcester to Boston train line, in a radius of five miles.

The data revealed two critical insights. First, the reason train usage declines at peak hours is a lack of parking spots at the stations. The car parks are full by 7.45am. Commuters have no choice but to make their journey to Boston by car.

Second, there is no option to get to the railway station without using a car; so-called first-mile public services are poor to non-existent in the suburbs. Moovit knows this because it operates the world's largest database of public and private transportation, and it became clear that most commuters need a car to get to the station.

This forensic travel data informed the options for city planners. They can build more car parking spaces, which is expensive – if there is vacant land. They can introduce road tolls, viewed as merely containing rather than solving the problem. Buses to transport commuters to the station might be an answer, but the data suggests few productive routes.

Or the government can introduce a subsidy for first-mile services, such as Uber and Lyft, or other options that take commuters to the station. Subsidies are commonplace in public transport, currently amounting to a trillion dollars globally, and in this case would boost rail usage even when car parks are full, and free up road space. For the first time, city planners are able to consider all options with all the data at their fingertips.

> **Moovit's information offers transport policymakers an unprecedented insight into the preferences and routes of the population**

"The best analogy is with air traffic control," says Mr Erez. "Airports use real-time data to manage flights as they take off and land. The flight pattern is optimised to allow for tight schedules. Can you imagine an airport without an air traffic control system? The flights would be a tenth as frequent. Passengers would be in misery. Chaos would reign.

"City planners are only just realising the role data plays in improving services," says Moovit co-founder and chief executive Nir Erez. "What shocks them is the scale and granularity of Moovit's data." Moovit currently gathers four billion anonymised datapoints a day from the userbase. It tracks subjects the minute they leave the house, which routes they take and when they arrive. Moovit's information offers transport policymakers an unprecedented insight into the preferences and routes of the population.

"We find some cities are still employing students with clipboards to run surveys on commuters," says Mr Erez. "It means they run surveys only annually or every few years. With Moovit, you learn immediately by analysing the data from tens or hundreds of thousands of individuals."

Bus routes are being redrawn using consumer data. The buses can reflect where users actually want to go. And for cities with minimal technology budgets, Moovit's TimePro product puts a GPS device right on buses for authorities and riders alike to access on their smartphones to know exactly where buses are. No more standing at the bus stop with no clue when the bus will arrive.

In Italy, football club AS Roma is working with Moovit to help fans get to and from the stadium more efficiently. The app integrates Rome's transport system – roads, trams, rail and metro – and guides fans to the exact gate as well as communicating real-time transit changes. This improves journey times with fans no longer getting lost or encountering rivals.

"It is the same with cities. They need to know the demand for mobility from all their citizens and the supply of all forms of mobility, supplied with real-time data. When they do that, like airports, they can increase transport efficiency without increasing infrastructure."

The need to use data to optimise city transport will only intensify as new mobility services go mainstream. Autonomous cars, scooters, cycle schemes and ride-sharing, will need to be factored into city plans. It won't be easy.

City planners keen to adopt a data-led approach will discover simplicity and depth from Moovit's cloud-based products. Within minutes of logging on, city planners can begin to explore the movement of citizens and start reshaping services.

"The challenge for cities is profound," Mr Erez concludes. "As demand grows, roads will get more clogged. Simply building more infrastructure is hugely expensive. A single road or train line can cost billions. The solution is to use data to maximise existing infrastructure. Data can help you keep roads clear, help you improve bus and rail schedules and routes, and make decisions based on fact, not intuition. The cities of the future will all run on data. We are only just exploring the potential."

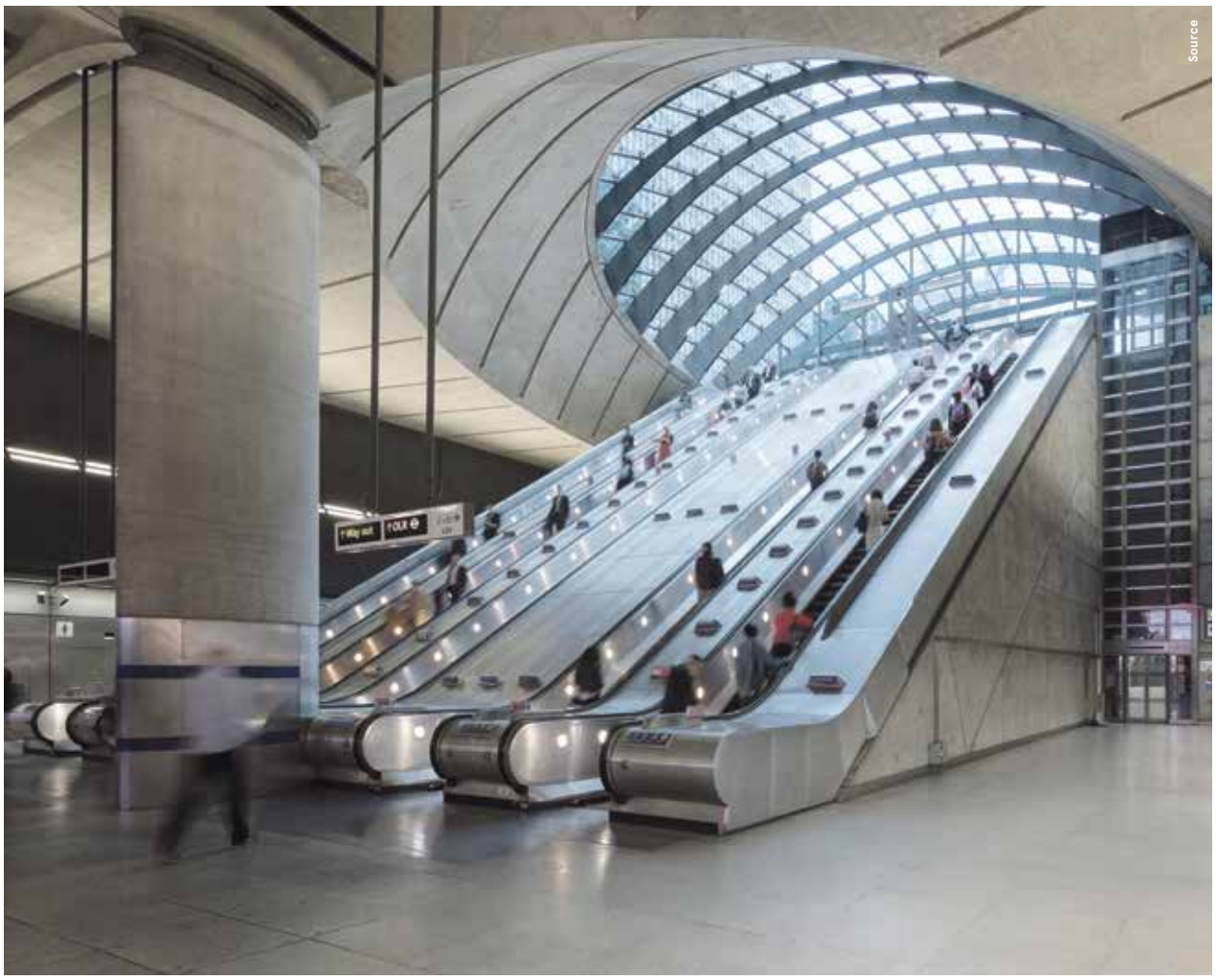
To find out more please visit Moovit.com

moovit

SMART CITIES

Data is the oil for city transport systems

Cities around the world suffering gridlock must smarten up by introducing integrated data-driven systems to unblock clogged commuter arteries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OLIVER PICKUP

We are drowning in data, according to Nell Watson, a leading futurist and member of California-based Singularity University's artificial intelligence and robotics faculty. "That is a very good thing," she says, emphatically, "because it gives us so much capability to train machines." Ms Watson posits that in the 10,000 years to 2000, humanity amassed five exabytes of data, a colossal amount, but which is now doubled less than every 60 seconds.

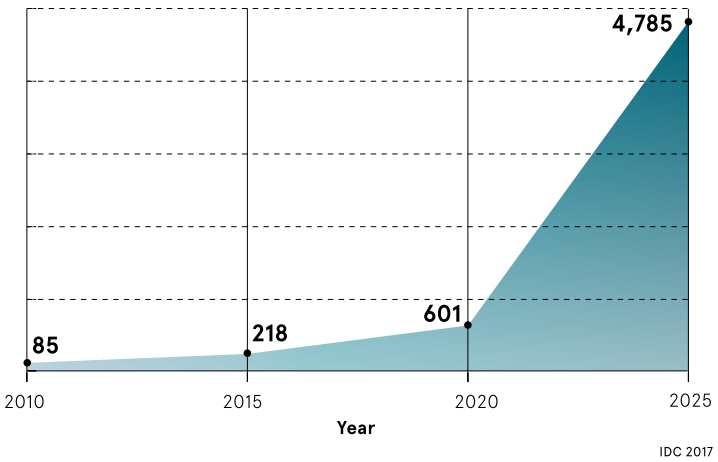
By 2025 the average connected person, anywhere in the world, will interact with connected devices nearly 4,800 times a day, or once every 18 seconds, analyst firm IDC predicts in its recent *Data Age 2025* white paper. "The potential benefits of this vast quantity of data for city dwellers is enormous – improved air quality, reduced traffic and safer streets among them," says Glenn Rogers, senior directer, Europe, Middle East and Africa, at Seagate Technology, the organisation that commissioned the research.

Indeed, the torrents of data – the primary driver of machine intelligence – are beginning to oil the transportation infrastructure of smart cities, where citizens now expect to flow to and between urban locations, using multiple modes of transport. In theory, the data harvested from an increasing number of sensors and other datapoints, blended with GPS technology, can provide real-time mapping to aid smoother inner-city travel.

Developments in data analysis may flash the green light for innovators and entrepreneurs, however complexities around legacy infrastructure and a long list of stakeholders competing for funding means the brakes of progress are being applied. In practice, then, the majority of cities are playing catch-up and failing to maximise the potency of emerging, data-hungry technologies.

Number of times people interact with connected devices

Estimated daily interactions for the average connected person globally



IDC 2017

"There is a huge opportunity in this area," enthuses Miranda Sharp, head of Ordnance Survey's innovation and outreach department. "The amount of data available is exploding; data from mobile phones, smart tickets, CCTV cameras, engine-performance systems and from social media can be used by control systems in traffic lights, emergency services, and for making long-term decisions about routes and demand."

As Londoners will attest, a seamless travel experience in the capital is some distance away, with overground and underground train delays, and standing traffic a near-daily frustration. Although it has rapidly improved in the last handful of years ever since the pioneering decision by Transport for London (TfL) to open, and make public, its data.

Now, according to Deloitte, some 42 per cent of London's commuters use at least one of the 600-plus data-powered applications spawned from TfL's data. These include the popular Citymapper and Waze, plus other journey planners, mapping, booking and scheduling tools, and analytics engines.

Deloitte's study, published last year, found that there are more than 80 TfL data feeds being used by over 13,000 registered developers, ranging from individuals to multinational tech organisations. Furthermore, the total value of open data to the organisation, customers and others is estimated to be £130 million a year.

Two fifths of London's commuters use apps powered by Transport for London data

At present more than 31 million journeys are made in London every day, and each one serves to improve the wider transport network, with data-fuelled artificial intelligence learning to spot patterns and predict trends. TfL recently analysed data from the free wifi provided in 97 per cent of its tube stations and in only four weeks had managed to reconstruct 42 million journeys through the network from five million distinct devices.

Ms Sharp holds up TfL as a "great example of how the data from an integrated transport system being made available gives rise to a number of consumer services that optimises routes and use of the network". New ways of utilising data are being explored.

She continues: "Moovit, an Israeli company available in more than 2,500 cities across 82 countries around the world, takes a different approach, using data from mobile phones to create data feeds about transport to assist both consumers and the mix of public and private authorities that manage the transport to optimise the experience. And in Manchester and Dublin we are seeing the first examples of cycling infrastructure being built on the back of data produced by cyclists."

> **Data harvested from an increasing number of sensors and other datapoints, blended with GPS technology, can provide real-time mapping to aid smoother inner-city travel**

Elsewhere, countless other data-driven smart city transport schemes are taking flight. They have, for instance, already uprooted Copenhagen's public transport system – 40 per cent of commuters use bikes – and doubled the average speed of Singapore's inner-city traffic. And in Helmond, a southern city in the Netherlands, Sweco UK's cloud-based Smart Traffic system, which collects data from existing loop sensors and overlays it with GPS location data, has cut congestion by 40 per cent.

"In the future this will allow city authorities to give greater priority to public transport by introducing new initiatives such as 'green-light phases' at intersections during busy, rush-hour periods," says Stephen Russell, Sweco UK's director for transportation. "This technology will also form a key part of the infrastructure required to prepare for the advent of driverless cars. In a future where traffic signals are no longer needed, vehicles will use a cloud-based central traffic management system they can talk to that will provide every car, bus and tram with permission to cross a junction."

Dr Nick Reed, head of mobility research and development at electronics giant Bosch, agrees. "Vehicle data is already informing mobility solutions of the future, as automated driving functions rely heavily on data collected through vehicle sensors for decision-making," he says. His organisation has developed a community-based parking service that utilises data-sharing to guide drivers to available, out-of-sight spaces, saving around £500 in wasted time a year, while simultaneously reducing emissions and stress levels.

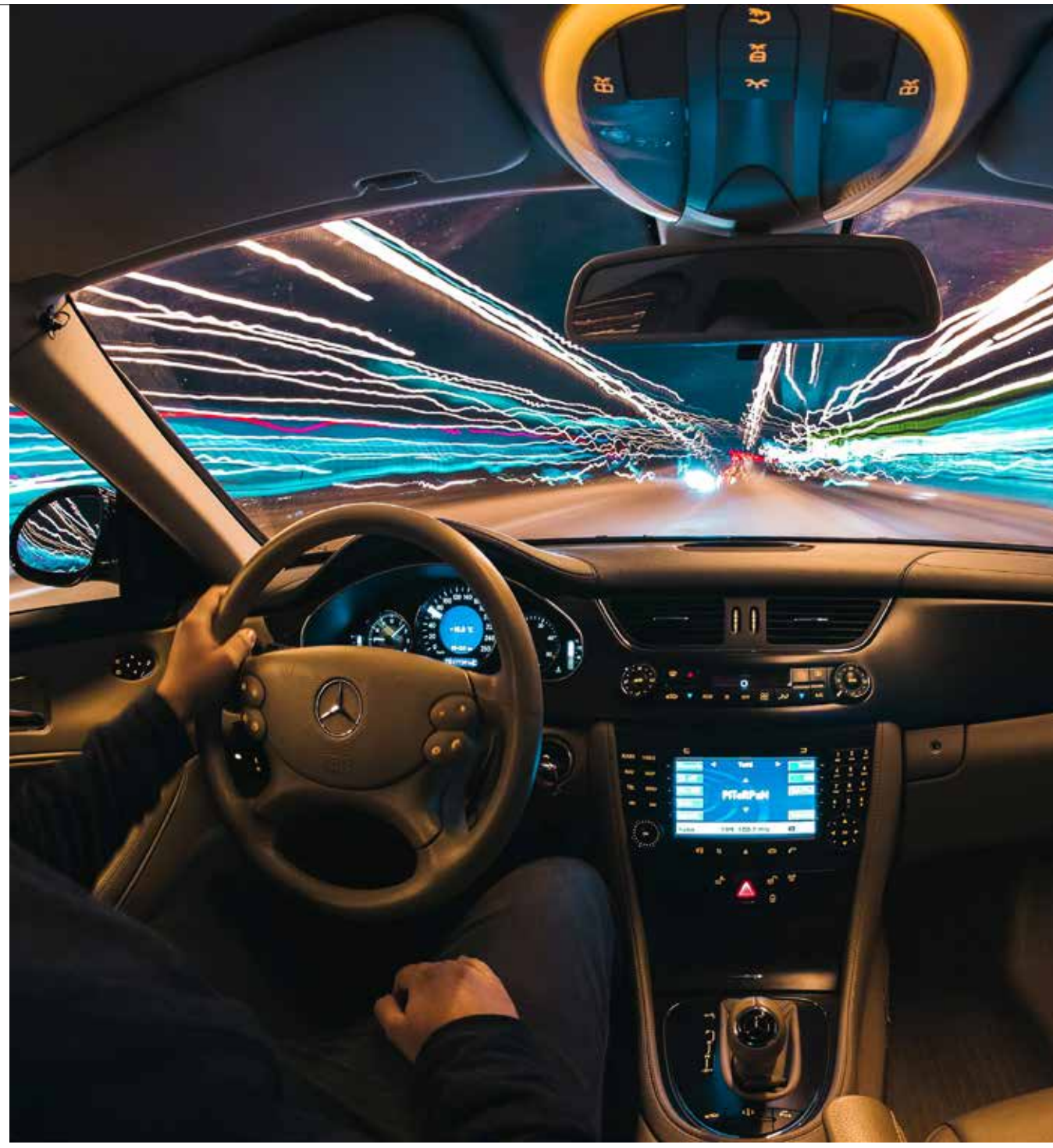
Jacqui Taylor, chief executive and co-founder of FlyingBinary, and a strategic adviser to the UK government on smart cities, warns: "By 2050, the global population is forecast to exceed nine billion, 80 per cent of which will inhabit cities." While transport systems will be at the beating heart of tomorrow's urban centres, she stresses that multi-stakeholder collaboration is imperative.

"Transportation networks in smart cities operate a multi-agency model that requires data and information technology services to be shared across many organisations," Dr Taylor concludes. "These services form a part of the city-critical infrastructure that must support the expected significant increases in population. Hence the need now to use shared, not just open, data principles for transport infrastructure."◆

AUTO

Streamlined data signals way ahead

Closed-loop manufacturing, which enables continuous data flows shared seamlessly throughout departments, creates a virtuous cycle, resulting in faster product improvements



HEIDI VELLA

Henry Ford famously said: "Any customer can have a car painted any colour that he wants, so long as it is black." The founder of the Ford Motor Company thought simplicity and functionality should be a car manufacturer's only priority.

But today, over a century later, things couldn't be more different. The internet of things (IoT), social media and increased car connectivity, mean carmakers now have access to more information than ever about what their customers want and how their cars operate on the road.

Using this data to improve the customer experience could add significant value to the industry, particularly in the context of increased mobility services, carpooling and self-driving vehicles.

According to a McKinsey & Company report this March, as a global value pool, data and connectivity may reach between $450 billion and $750 billion worldwide by 2030.

But this depends, the report says: "On the ability of market players to use the data generated by cars, drivers and mobility systems to develop products that create revenue, reduce costs, and enhance safety and security."

Xavier Mosquet, senior partner at Boston Consulting Group's automotive sector, says: "User data has significantly increased for the design and evolution of a car, and now directly informs the specification of the next versions, such as what has customer value and what doesn't."

Mr Mosquet says carmakers are mining social media and online information, as well as taking data from the car itself.

General Motors, for example, equips all its vehicles with connectivity, which it then uses to collect data for the important first six months of on-road operation, so it can analyse the car's quality and parameters, he says. From this information, the company can determine what works well in the model and what doesn't.

Similarly, Harman, a leader in connected car and IoT solutions, is working with nearly every car manufacturer on the planet, according to the company, using its Ignite platform to monitor vehicles.

"Historically, OEMs [original equipment manufacturers] have not had detailed data on who uses what features on vehicles, so when they were making decisions about dropping CD players, for example, they were doing it based on survey and other research data, not precise data," says Stephen L. Surhigh, vice president of automotive cloud services for Harman, which is a Siemens company.

Now, for example, carmakers can quickly identify functionality or usage issues with in-car software and quickly fix them with over-the-air updates.

Furthermore, companies are increasingly keen on monitoring specific vehicle components and the environment in which cars are used, such as weather and location. By combining these different data sets, carmakers can uncover issues before they cause a problem, which can be costly if occurring during the warranty period.

Mr Surhigh provides an example. A manufacturer of a specialty vehicle used in parades that is typically driven at low speeds discovered a vibration that caused certain parts to fail. The carmaker later re-engineered the part to avoid failure. This would have been impossible without knowing how the vehicle was used.

The increasing prevalence of cars for specific uses, such as e-mobility, more autonomous driving and car-sharing, mean it is beneficial for manufacturers to know how to design and monitor vehicles for special uses.

> **There is no doubt well-organised and highly analysed data creates great opportunities for carmakers**

"Understanding how those vehicles wear out and therefore being able to optimise their design will be of very high value," says Mr Mosquet.

Monitoring them on the road, with customer consent, will also enable manufacturers to offer additional services, such as providing predictive maintenance.

Consultancy and technology firm BearingPoint has been working with Jaguar Land Rover since 2014 to provide telematics signals and data from their vehicles.

According to BearingPoint, analysing this data helped the company cut the product life cycle of a vehicle from approximately four years from inception to coming off the production line to two-and-a-half years.

"It's about identifying patterns and profiles, and feeding that back into designer specifications and recall programmes quickly to improve the end-customer experience," says Professor Alan Braithwaite, *senior adviser* at the company.

Yet for carmakers, managing huge amounts of data is still extremely challenging and it is currently being done by separate departments rather than shared seamlessly throughout an organisation.

"It's a big evolution and no company is fully organised, to be frank," says Mr Mosquet. "I don't think anyone has an automated process to extract information, and analyse it, and then loop it directly to making hardware changes."

To do this, Siemens and Hewlett Packard Enterprise (HPE) are helping their customers adopt a closed-loop manufacturing approach to managing data.

This is essentially a structured process of continuous data flows that are seamlessly shared throughout different departments to create a virtuous cycle, which can result in product improvements being implemented faster.

"If you recognise a product flaw, it can take anything from nine to twenty four months for a remedy to be put in place, but that cycle can be accelerated by connecting different departments, such as R&D, manufacturing, sales and back again," says Volkhard Bregulla, vice president of global manufacturing, automotive and IoT at HPE. "That is what industry 4.0 is starting to do, to horizontally integrate data."

Using technologies such as HPE's Edgeline Converged Edge Systems, for example, companies can leverage advanced analytics, artificial intelligence and IoT to capture and analyse data directly at the place where it is created for actionable insights available across the manufacturing value chain.

Although Mr Bregulla declines to name them, he says many companies HPE works with are beginning to build a digital image, a sort of digital twin, of their entire manufacturing process, starting from the supply chain and including customers, looping all the way back, to make adjustments in the design. However, many are so far struggling with full integration, he says.

Samuele Errico Piccarini/Unsplash

Yet, in the future, if data is shared more seamlessly and improvements to components created more quickly, will manufacturers scale back production into smaller batches, making tweaks each time?

"Absolutely," says Mr Bregulla. "Where is the cost in manufacturing? It is the retooling of the manufacturing equipment; however, 40 per cent of this machinery will be replaced because it is not connected and can't be retooled fast enough.

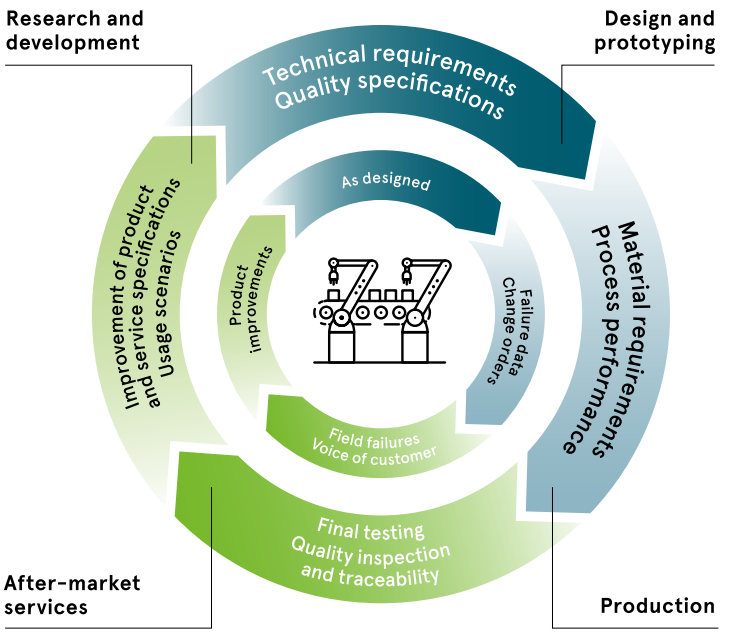
"Reducing production is really hard. Unless there is a major issue, most likely OEMs will continue producing because otherwise they have to stop selling."

There is no doubt well-organised and highly analysed data creates great opportunities for carmakers. From fixing engineering glitches faster, to offering regular over-the-air updates to in-car software applications and speeding up improvements in the production line, data has many uses, some not yet realised.

Beyond product improvements, experts agree connectivity and data will help carmakers build a closer relationship with their customers to unearth new revenue streams. These could include predictive maintenance models, and selling data insights and analytics to mobility companies or even becoming a mobility business itself. Data software company Hortonworks, for example, is currently working with Ford to help the company transition to a car and mobility company.

Although there are many challenges ahead, such as improving data management and discovering how to monetise data beyond internal processes, it's clear that, unlike in Henry Ford's day, the better understanding carmakers have of their customers and their cars, the more opportunities there will be to remain agile and responsive in a rapidly evolving industry. ◆

Closed-loop manufacturing model



Hewlett Packard Enterprise 2018