



THE PRINCE OF WALES'S  
CORPORATE LEADERS GROUP



Business  
conversation

# Electric avenue:

The future of road  
transport in Europe

## The Prince of Wales's Corporate Leaders Group

The Prince of Wales's Corporate Leaders Group (CLG) brings together executives from a cross-section of European industry to accelerate progress towards a low carbon, sustainable economy. Through cross-fertilisation of ideas and influential conversations with policymakers and peers, the CLG advocates forward-looking solutions that build a resilient and prosperous future. The CLG is convened by the University of Cambridge Institute for Sustainability Leadership (CISL).

The CLG is a founding member of the We Mean Business coalition.

## The University of Cambridge Institute for Sustainability Leadership

For 800 years, the University of Cambridge has fostered leadership, ideas and innovations that have benefited and transformed societies. The University now has a critical role to play to help the world respond to a singular challenge: how to provide for as many as nine billion people by 2050 within a finite envelope of land, water and natural resources, whilst adapting to a warmer, less predictable climate.

CISL empowers business and policy leaders to make the necessary adjustments to their organisations, industries and economic systems in light of this challenge. By bringing together multidisciplinary researchers with influential business and policy practitioners across the globe, we foster an exchange of ideas across traditional boundaries to generate new solutions-oriented thinking.

## Rewiring the Economy

*Rewiring the Economy* is our ten-year plan to lay the foundations for a sustainable economy. The plan is built on ten interdependent tasks, delivered by business, government, and finance leaders co-operatively over the next decade to create an economy that encourages sustainable business practices and delivers positive outcomes for people and societies.

### Author and acknowledgements

This business briefing was authored by Nicholas Walton with editorial input from The Prince of Wales's Corporate Leaders Group (CLG) Secretariat and Amy Barry of di:ga Communications. CLG is a member of the We Mean Business coalition, which has provided financial support for the production of this report.

## Corporate Leaders Group members

# Executive summary

**Radical changes are occurring in the road transport sector with wide-reaching implications for European businesses, policymakers and consumers. Innovations such as electric vehicles and self-driving cars are no longer confined to research departments but are finding their way onto residential driveways and into company fleets. Transport is also evolving towards a service model, rather than one based primarily on car ownership. The changes are being enabled by new technology and incentivised by the need to cut greenhouse gas emissions and localised air pollution.**

The trends in road transport should – if the right policies and choices are made – result in better air quality, safer roads and reduced congestion; and contribute towards CO<sub>2</sub> reduction targets. They will also open up many new business opportunities for companies in Europe and beyond. But they also carry risks for those that fail to respond. Businesses need to understand how transport is changing and react accordingly; and policymakers must support them to make investment decisions that have positive social and environmental outcomes and allow them to remain competitive.

This report from **The Prince of Wales's Corporate Leaders Group** (CLG) maps the trends in the road transport sector and assesses the implications and opportunities for European businesses, as well as providing recommendations for policymakers. Below is a summary of the main findings and recommendations:

**The rise of electric vehicles and automation is inevitable:**

Europe's legacy car makers urgently need to catch up with, and respond to, these changes or risk being made irrelevant by competition from the US, China and beyond.

**New transport ecosystems are appearing:** The infrastructure and services needed to support and enable new transport technologies, such as electric and automated vehicles, offer new business opportunities, for example in the sharing economy. In some areas, such as battery manufacturing, Europe is lagging behind.

**Transport is becoming more about services and less about products:** Future road transport will be as much about selling data-enabled mobility services, and extracting the value from data produced by vehicles, as about manufacturing and selling cars. New ownership models and consumption patterns are being adopted, which is accelerated by new technology.

**The opportunities – and the competition – are global:** There are millions of new consumers in places like China and India, ready to consume the new forms of transport; these markets will also give birth to capable new companies that challenge the incumbents.

**Policymakers need to act fast to help European business catch up:** European policymakers should pass legislation and invest in infrastructure that encourages innovation and new business models supporting the jobs of the future, rather than seek to protect jobs based on out-dated business models.



We would like to thank the following CLG member companies for their time and contributions to this report:

<b>3M</b>	Natasa Sbrizaj, Manager, Public Policy & Government Affairs, Europe
<b>Acciona</b>	Juan Ramón Silva Ferrada, Chief Sustainability Officer Rocío Fernández Flores, Sustainability Engineer
<b>Anglian Water</b>	Stewart Lightbody, Head of Fleet Services
<b>Iberdrola</b>	Francisco Laverón, Head of Energy Prospective, Energy Policies and Climate Change Directorate, Chairman's Area
<b>Jaguar Land Rover</b>	Ian Ellison, Sustainability Manager
<b>Lex Autolease</b> (part of Lloyds Banking Group)	John Webb, Principal Consultant
<b>Tesco</b>	Kené Umeasiegbu, Head of Climate Change and Sustainable Sourcing

And the following organisations and people for their time and contributions:

<b>C40 Cities Climate Leadership Group</b>	Caroline Watson, Network Manager, Low Emission Vehicles
<b>EV100, The Climate Group</b>	Sandra Rowling, Head of EV100
<b>European Climate Foundation</b>	Pete Harrison
<b>European Commission, DG MOVE</b>	Peter Vis, Special Advisor to the Commissioner
<b>Regional Centre for Energy Policy Research, Hungary</b>	Balazs Felsmann, Senior Research Associate
<b>WRI India</b>	Chhavi Dhingra, Manager – Capacity Building

# Contents

<b>Introduction</b>	<b>4</b>
<b>The diesel misstep</b>	<b>5</b>
<b>Scope</b>	<b>5</b>
<b>Powering up</b>	<b>6</b>
<b>It's all about batteries</b>	<b>7</b>
<b>Supporting infrastructure</b>	<b>8</b>
<b>Always cleaner?</b>	<b>8</b>
<b>Think about the future</b>	<b>9</b>
<b>Sharing economy and mobility as a service</b>	<b>9</b>
<b>Road freight: look at the data</b>	<b>11</b>
<b>Automation, computerisation and smart infrastructure</b>	<b>12</b>
<b>International opportunities – focus on India</b>	<b>13</b>
<b>Conclusion: which side of history are you on?</b>	<b>14</b>

# Introduction

On 9 September, China's Vice Minister of Industry, Xin Guobin, told an automotive conference in Tianjin that a long-term plan was being drawn up to phase out both the production and the sale of petrol and diesel cars in his country.<sup>1</sup> Mr Xin offered no firm date for this to happen, but China has said it wants 20 per cent of new car sales to be electric vehicles (EVs) by 2025.<sup>2</sup> This matters: China already manufactures one third of the world's cars – 28 million a year – and is the second largest oil consumer after the US.<sup>3</sup>

China's putative plans are evidence that long-promised changes to road transport are gaining traction. "Towards the end of the current planning horizon you'll see a lot of new things featuring as normal," says Ian Ellison, who works in product development for **Jaguar Land Rover**, a member of The Prince of Wales's Corporate Leaders Group (CLG).

“

It may take ten or twenty years to be properly transformative, but there'll be significant change in the next decade.

*Ian Ellison, Jaguar Land Rover*

”

The road transport sector is clearly on the verge of radical change, and businesses both old and new need to recognise and respond to the challenges and opportunities this represents. They will need support from policymakers to do this. The changes are happening in three broad areas:

- **A shift to electric:** Although there is substantial research into technologies such as hydrogen fuel cells and liquid natural gas, the dominant trend for powering private road transport is a switch to EVs.<sup>4</sup> This includes both pure-electric plug-ins and hybrid vehicles, where the electric motor operates alongside a small internal combustion engine (ICE).
- **Mobility as a service:** From ride-sharing apps like Uber and Lyft, through to car clubs and leasing, there are a number of emerging business models, supported by data and the trend towards automation, that are disrupting the standard model of buying and owning a car.
- **Automation and computerisation:** This is not simply about much-heralded driverless cars, but also about a range of ways in which the practice of driving can be assisted. Sensors can make both roads and vehicles 'smart', allowing them to communicate, and providing large quantities of data that can be analysed and acted upon.

With transport accounting for around



**25% of global energy-related carbon emissions,**

the sector is an obvious target for new regulation and green innovation.<sup>5</sup>

The factors influencing these shifts include the increasing availability and affordability of technology, concerns about air quality and congestion, the need to decarbonise the economy in the face of climate change, and consumers' demand for increased convenience and lower prices.

With transport accounting for around 25 per cent of global energy-related carbon emissions,<sup>5</sup> the sector is an obvious target for new regulation and green innovation. Manufacturers are anticipating this and making rapid progress in developing less carbon-intensive vehicles. Tesla in the US, Nissan in Japan, and BYD in China are leading the way on EV development.

But Europe is lagging behind, and in all three of the areas above, policymakers and companies will have to race to catch up with more progressive regions.

### The diesel misstep

Until recently, Europe was heavily backing investment in diesel engines, which burn less fuel than petrol engines and therefore were considered a pragmatic response to the climate challenge. This assumption has been proven to be a misstep, with diesel engines now known to exacerbate localised air pollution through the emission of higher levels of nitrogen oxides than petrol engines, as well as dangerous particulates leading to health concerns.

European governments explicitly encouraged the investment in diesel through tax breaks and de facto subsidies. The new evidence against diesel engines, coupled with the revelations that companies including Volkswagen were using software to cheat emissions-testing regimes, has fundamentally shifted political and customer sentiment against them.

The European Commission is currently extending its standards for CO<sub>2</sub> emissions for both light and heavy vehicles beyond 2020, and member states are revising their policies regarding diesel and petrol-powered cars. Diesel vehicles are now being targeted by legislation and low-emissions zones, especially in urban areas.

However, clarification, tightening and enforcement of regulations will be required in the EU to catalyse a genuine push into EV technology, and to help position car makers to make the most of other opportunities. Europe needs to give its car makers a clearer signal that it is serious about EVs, and encourage them to invest in factories here, rather than import cars from the US or Asia.

It is crucial for the health of the European economy that businesses and policymakers understand the changes that are happening and take action to meet the challenges ahead. The European automobile industry alone employs more than 5 per cent of the continent's workforce.<sup>7</sup> The industry is important beyond traditionally large producers such as Italy and Germany. It is the biggest exporter in Hungary, for example.<sup>8</sup>

Failure to act could result in the irreversible decline of the European car industry, with wide-reaching and dramatic consequences for employment and competitiveness across the continent.

### Scope

This report from **The Prince of Wales's Corporate Leaders Group** draws together insights from businesses and industry experts to map the trends toward electrification and automation in the road transport sector. It seeks to make a high-level assessment of the implications and opportunities for European businesses, as well as what policymakers need to do to respond to these trends. The impacts of electrification on public transport are not covered.

Shares of global sales of passenger vehicles (2017 estimate<sup>6</sup>):



# Powering up

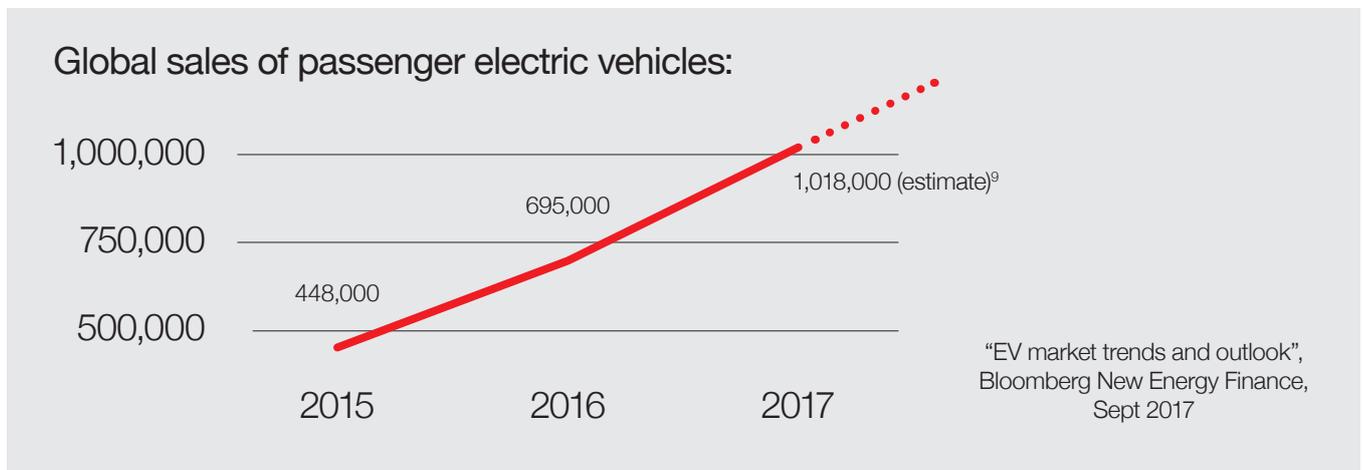
**In 2015, there were 448,000 electric vehicles (EVs) sold worldwide. Last year, that figure had risen to 695,000, and predicted sales in 2017 are over a million.<sup>6</sup> This rapid upward trend is one of the biggest in the road transport sector, and shows no signs of slowing.**

Around the world, governments are recognising that commitments on CO<sub>2</sub> emissions will only be met by a dramatic shift to EVs or vehicles powered by technologies such as hydrogen cells, and are introducing new regulations designed to achieve these reductions and curb pollution.

China and India are moving aggressively towards an EV future,<sup>9</sup> and more recently France and Great Britain have announced plans to ban ICEs, a commitment which has also featured in the coalition agreement of the new government of the Netherlands. Preferential taxation and subsidies for EVs, along with publicly

funded infrastructure such as recharging stations, are designed to nudge consumers and companies in this direction.

The private sector is responding. Several car companies used the Consumer Electronics Show in Las Vegas in January 2017 to announce significant plans for EVs; tyre manufacturer Continental believes that Germany's car makers will essentially end their development of ICEs by 2025; and Volvo says that all of its new cars will be an EV of some sort from 2019 (Volvo's Chinese owner, Geely, wants to sell one million EVs a year by 2025).<sup>10</sup>



Battery prices per kWh<sup>6</sup>:



2010	\$1000
2016	\$273

Meanwhile, high-profile companies such as Unilever, Heathrow, Deutsche Post DHL and IKEA have joined the Climate Group's **EV100** initiative, making public commitments to the widespread use of EVs by 2030.<sup>11</sup>

Some companies are realising significant savings through switching fleets away from ICEs. John Webb of **Lex Autolease** says that BAE Systems wanted a small number of EVs for their naval base in Portsmouth. Lex Autolease mapped journeys at the site for two months, and telemetric data showed that BAE would save £360,000 a year by switching 48 vans to electric, and installing 26 charging points. The savings came from lower maintenance costs (EVs have fewer moving parts than ICEs) as well as fuel.



**BAE initially thought they'd switch just a few vans, but we were able to demonstrate that they could move almost half their van fleet to electric.**

*John Webb, Lex Autolease*



Such moves are significant. Europe's businesses buy around half of new vehicles so policymakers can make disproportionate progress with decarbonisation targets and charging infrastructure if they target the fleet industry. Policies that support a stable second-hand market for EVs could also have an impact in allaying fears from businesses about poor residual values.

Consumer sentiment towards EVs is also changing. In Asia, millions of new consumers are looking to buy their first car, unburdened by an attachment to legacy manufacturers or the ICE.<sup>12</sup> In Europe, concerns about up-front costs are being met with tax breaks, subsidies, new car financing models and falling battery prices. In fact, many studies show that the total cost of owning and operating an EV for the first owner will reach parity with that of a combustion car around 2025.<sup>13</sup> At the same time, 'range anxiety' among consumers is increasingly being addressed by improved recharging infrastructure and longer ranges of EVs.

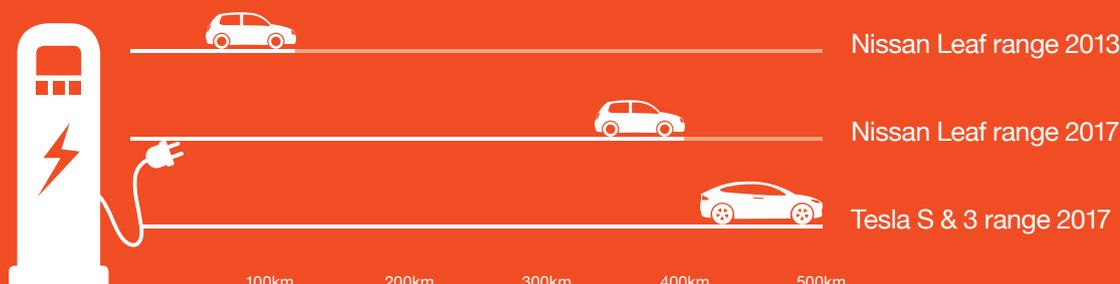
### It's all about batteries

The ramping-up of EV production is coming on the back of an ongoing massive expansion in battery manufacturing, including Tesla's commitment to building a \$5 billion 'Gigafactory'. Battery prices have fallen dramatically, as their capability has increased.<sup>14</sup>

This is important, as the price of electric cars has been a major barrier to mass-market adoption, as have concerns about how far an EV can be driven between recharging points. Greater battery capacity is contributing to increasing mass-market penetration by EVs, as they become practical options for a range of different motoring needs.

The location of much of the investment in battery manufacturing has sobering implications for European businesses: only five per cent of manufacturing is based in Europe. A target of eight million EV sales by 2030 would require the equivalent of seven of Tesla's Gigafactories, each with a lead-in time of five to seven years.<sup>15</sup> Batteries are heavy, and it can be hazardous to ship them. Given the rapid growth in EV production, European car makers could face problems in the future simply securing enough batteries to fit into their cars.

In 2013, the world's best-selling EV, the Nissan Leaf, had a **range of 120km**; the latest version has a **400km** range, while the Tesla Models S and 3 can go for **500km**.<sup>15</sup>



Developing more battery-manufacturing capacity in Europe would help with R&D and collaboration, as well as propagate a strategically vital new industry. There are also business opportunities in developing uses for depleted batteries, for instance in local electricity storage or smart grids, where they can be used to regulate flows of electricity in response to demand.<sup>16</sup> This would lower the lifetime carbon footprint for the batteries. One such example is given by CLG member **Anglian Water**, who is trialling the use of second-life Renault electric vehicle batteries to provide a smarter, affordable and more flexible approach to its grid load management by storing excess energy for when it is needed most.<sup>17</sup>

The European Commission Vice-President in charge of energy, Maroš Šefčovič, has spoken of forming a consortium of European companies to develop battery technology at scale, supported by up to €2.2 billion funding from the EU.<sup>18</sup> This is something that deserves support.

## Supporting infrastructure

EVs and other technologies bring a ‘chicken and egg’ challenge, where customers are reluctant to buy vehicles without supporting infrastructure such as recharging points, but companies and governments are reluctant to invest in this without evidence that people are buying the cars.

This includes charging points at people’s houses (where houses do not have off-street parking), in car parks and motorway service stations, as well as at workplaces.



Even if you have a very competitive electric vehicle, if you don’t have charging stations then nobody will buy them.

*Francisco Laverón, Iberdrola*



The European Commission is seeking to address the ‘chicken and egg’ problem through investing in rechargers, but also through requiring EU Member States to put together plans for alternative fuels infrastructure in time for the delivery of the new vehicles. In the Netherlands, buyers of EVs can request a charging point to be built near them if none is available.<sup>19</sup> The Commission is also proposing to use legislation around the energy performance of buildings to encourage charging infrastructure.<sup>20</sup>

Governments need to understand cabling requirements on motorways, so that fast-charging points can be installed there, while slower points can be used where cars are left for longer periods. They also need to address the fact that some older power grids may lack the capacity and flexibility to deal with the extra demands of recharging EVs.

Car makers and other businesses can help; for example Tesla has begun to install its own network of fast-charging points to satisfy unmet customer demand. And companies that run fleets of EVs can also contribute to charging infrastructure. As EVs become more popular, retailers will have to install charging points because customers will expect them.

Kené Umeasiegbu, Head of Environment at the supermarket giant **Tesco**, also a CLG member, says the company sees charging points just as it sees petrol and diesel sales: as an amenity that creates a better environment for its customers.

However, governments will need to regulate the market, to avoid duplication and standardise design. Policymakers should also enable private sector innovation in areas that may be left behind. For example, New Motion is building an international network of charging points, with membership and finance subscriptions;<sup>21</sup> while a German company, Plugsurfing, allows users to access recharging networks across Europe via their smartphones.<sup>22</sup> Just as the European Union has done with mobile phone contracts, there is an opportunity to support mobility by requiring standardisation and ‘roaming’ to be offered.

## Always cleaner?

There is ongoing debate about whether a simple switch to EVs will always contribute to decarbonisation, when factors such as manufacturing inputs and electricity generation are considered.<sup>23</sup> If countries like Poland and China continue to generate much of their electricity by burning coal, the gains from EVs could be smaller than expected, although there is analysis to show that even then EVs are a clean option.<sup>24</sup>

Policymakers who wish to decarbonise obviously need to pay attention to wider questions about energy generation, but this is no reason to delay progress on the rollout of EVs.

# Think about the future

## Sharing economy and mobility as a service

Up to now, the predominant model for individual transport in Europe has been ownership of a private vehicle, combined with public transport and the occasional use of car hire services or taxis. This is changing. Taxi-hailing apps like Uber and Lyft have made getting a ride more convenient and affordable, while pay-per-hour car sharing services such as Budapest's GreenGo, Zipcar in the UK, or Greenwheels in the Netherlands, are now widespread in Europe's cities.

The controversial rise of Uber illustrates just how dramatic and disruptive the sharing economy can be. Across the world it is attracting protests from taxi drivers, and – as was recently the case in London – worrying regulators that it is adding to traffic disruption and congestion. But it provides customers with a replacement service that is on-demand, convenient and competitively priced.

The sharing economy is also influencing public parking, allowing people to rent out their electric vehicle (EV) charging points to strangers.<sup>25</sup> Urban planners in some cities may be able to start preparing for a future with far fewer cars on the roads and in parking places.

These forces have started a slow shift of perceptions towards thinking of mobility as a service, rather than a matter of ownership. If you can have access to mobility when you want it, in the form of a shared car or taxi app, why go through the tribulations of car ownership such as parking, insurance, taxes, depreciation, breakdowns, servicing and washing?

Car makers are already starting to respond to this. "There's lots of work going into how cars will be owned in the future," says Ian Ellison of **Jaguar Land Rover**, including what he calls "disassociating car ownership from the driving experience."

Volvo has just launched a new car that comes complete with a full-service ownership model, bundling together things such as vehicle rental and insurance with a 'concierge service'. They plan to extend this to services such as cleaning and allowing couriers to deliver packages direct to your car's boot.<sup>26</sup> If rapid technological change means that car users will want their vehicles changing more frequently, car makers will need to provide customers with similar service-based contracts.



I-PACE: Jaguar's first all-electric car

Another way the sharing economy might affect transport is by making cars more multi-purpose. Tesla has suggested that the self-driving capabilities of their cars mean they could be used as autonomous taxis when not being driven by their owners.<sup>27</sup> Were this to happen, manufacturers would have to make their designs more flexible, for instance by allowing reconfigurations of passengers and luggage, or by adapting seats for occasional use by children.<sup>28</sup> This would open up opportunities for businesses able to work with, manufacture, or design in, dynamic new materials or technologies.

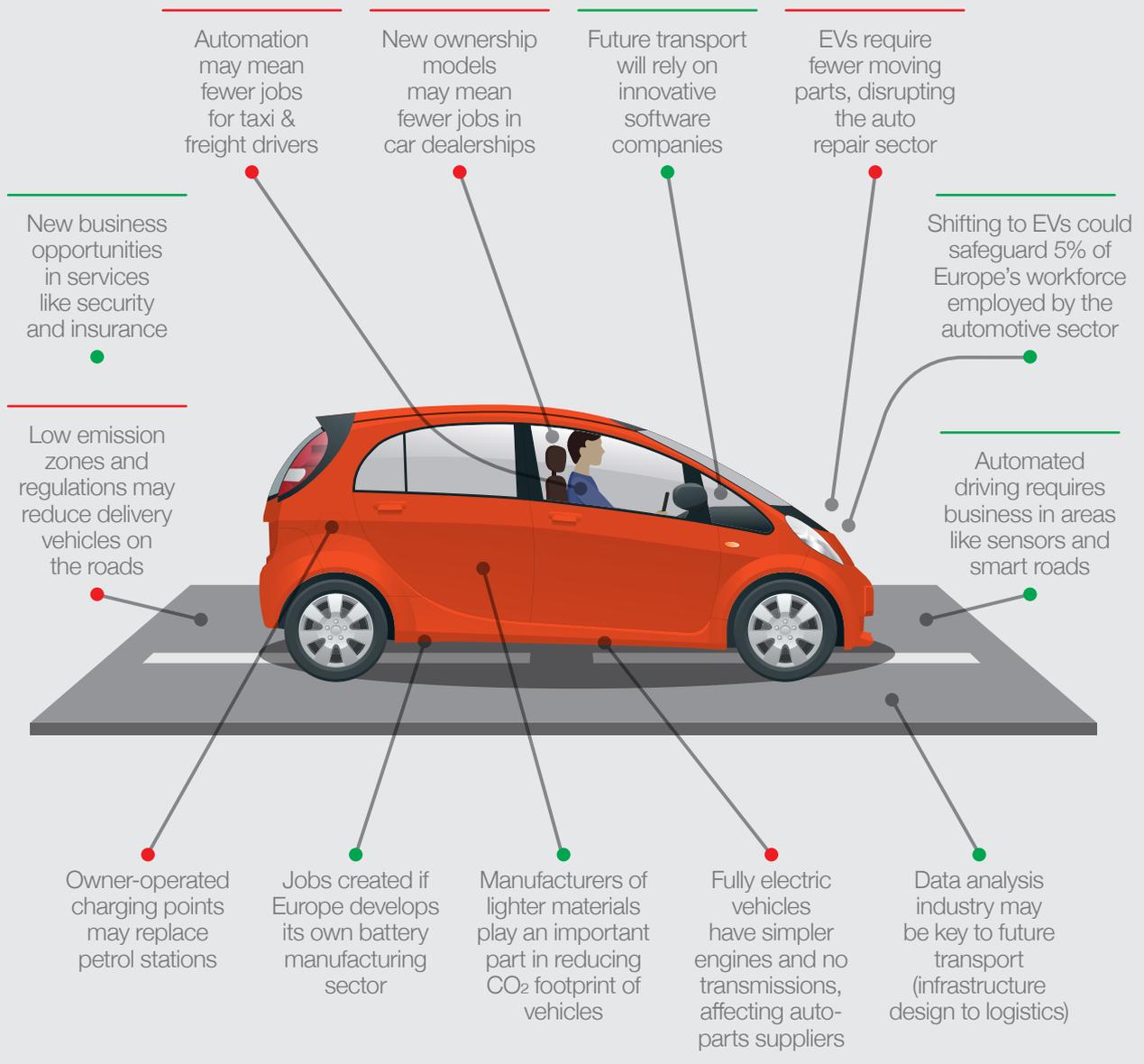
Moving towards mobility as a service also opens up the transport space to new types of business, including existing financial services companies and software start-ups. This will require a change in mind-set, so that companies can recognise

opportunities and innovate to realise them. It also requires thinking about value in a different way, where ownership counts less than the provision of a service, unlocked by data and clever software.

Finally, the rise of car sharing and taxi apps means that consumers are now increasingly exposed to the true marginal cost of their transport use. Some analysts, who blame inappropriate over-use of cars on owners not being aware of the true cost of their transport, say this knowledge can help policymakers nudge them into more optimal conduct.<sup>29</sup>

Policymakers will need to understand these shifts, and create an enabling environment informed by public discussion of the costs (for instance to existing categories of jobs) as well as the benefits.

### How could these proposed changes affect employment?



## Truck sales in US and EU as proportion of total global sales (estimate)<sup>30</sup>:



### Road freight: look at the data

Europe's road freight sector is likely to see dramatic change in the next decade. The sector is growing quickly, with the global market for trucks of 6 tonnes and over predicted to increase from €150 billion in 2015 to €240 billion in 2025.<sup>31</sup> Trucks also account for 40 per cent of the predicted growth in oil demand up to 2040, and as such are a target for governments and manufacturers who need to decarbonise.<sup>32</sup>

There are some simple ways in which the sector can reduce costs and carbon emissions, for instance through aerodynamic refits, low-rolling-resistance tyres, reduced idling and lightweight materials. Greater efficiency in engines and transmissions is also targeted, as 45 per cent of energy converted by a large conventional diesel engine is lost in the form of heat in exhaust gases or the cooling circuit.<sup>33</sup>

All these are opportunities for European businesses, as is the use of different technologies to power freight vehicles. Current electric batteries do not yet have a long enough range, although Tesla is among companies aiming to launch viable electric trucks. Some companies are also looking at rail or barge alternatives, avoiding road freight altogether. Shorter-range operations are fertile ground for EV adoption, as illustrated by La Poste in France, which is converting much of its fleet to electric power.<sup>34</sup>

Autonomous vehicle technology is of great interest to the freight industry as driver costs account for between 30 per cent and 60

per cent of costs in the EU, and motorways and main roads are a relatively predictable and stable driving environment.<sup>33</sup> Recent 'platooning' road tests in Europe and the US have tested the viability of a convoy of trucks, led by a single manned vehicle, which also saves money by reducing wind resistance.

Policymakers can support such innovation and help balance several factors including public safety, competitiveness, and incentives to develop new technologies. The difficulty of this balancing act was recently illustrated by multi-billion European Commission fines for six European truck makers who had run a cartel fixing prices and evading stricter pollution rules.<sup>35</sup>

Data-driven technologies will have a big impact on the road freight and logistics industries. For instance, telematics systems can use GPS data to optimise journeys and regulate driving behaviour, especially in the 'last mile' where loads need to be split into smaller units for delivery to different locations, often unsuitable for larger vehicles.

Technology based on the sharing economy can also help, for example using smartphone apps to employ freelancers for 'last mile' deliveries (although attitudes of policymakers towards new forms of irregular employment will impact this). App-based projects are being trialled that match companies who need freight services with spare capacity in others' vehicles.<sup>36</sup> Such projects reduce carbon emissions, as well as saving costs.

Autonomous vehicle technology is of great interest to the freight industry as

driver costs account for between



of costs in the EU, and motorways and main roads are a relatively predictable and stable driving environment.<sup>34</sup>

## Automation, computerisation and smart infrastructure

Anybody with doubts about how automation is going to change the world of transport should read about a place called ‘Castle’ in California. Castle is in effect a fake city, built by Waymo, a subsidiary of Google’s parent company, Alphabet. It was built to test Waymo’s self-driving technology in near real-world conditions, complete with actors playing unpredictable pedestrians and the occasional wayward skateboard.

In Castle, and on the real streets of California, Waymo’s cars drove 835,868 autonomous miles in 2016, compared to 424,331 the previous year. Waymo has also built simulation software called ‘Carcraft’, where it models eight million virtual miles driven by virtual cars, every single day.<sup>37</sup> Every mile and every simulation helps its systems learn the complicated skills needed to drive in the real world.

Waymo’s investment – and that of a number of other competitors both from the tech and car industries – is aimed at moving driving from being a technical skill to a human activity, assisted (and, in some cases, replaced) by artificial intelligence (AI).

This progress does not mean that the world of fully driverless cars is almost upon us. There are six levels of vehicle automation, requiring different degrees of control from humans and computers.<sup>38</sup> In the near term, most drivers are likely to experience these technologies in more mundane areas such as assistance with their parking, or automated braking on motorways when traffic slows down suddenly.

There is a debate over how quickly true self-driving vehicles are likely to hit the roads (in the form of public transport vehicles on the more predictable and confined streets of urban areas for instance). Some commentators indicate that this is unlikely to happen until the late 2020s, while others suggest it could happen more quickly.<sup>39</sup>

The automation revolution throws up a range of implications, challenges and opportunities for businesses. For car makers, it emphasises the importance of developing intermediate technologies that make life easier and safer for drivers. Just as with electric motors, this is a considerable shift away from the capabilities that have made them successful so far, putting a premium on their ability to collaborate with other companies that seize opportunities in areas such as AI, sensors and software development.

The premium that automation puts on technology is likely to affect the lifespan of cars, especially if customers demand the latest safety technology. This opens up opportunities for recycling or reusing discarded vehicles (including battery packs in EVs).

Increasing automation of cars will be accompanied by increasingly ‘smart’ roads and infrastructure, capable of communicating conditions and other data to them. Natasa Sbrizaj of **3M**, a CLG member, says that her company is working on making sure that elements of Europe’s road infrastructure, such as signposts, are able to function with different levels of automation.

“

Our vision here is to develop road signs and pavement markings that will be smart.

Natasa Sbrizaj, **3M**

”

Infrastructure is becoming more sustainable in other ways. Rocío Fernández Flores of **ACCIONA**, also a CLG member, says that innovative lightweight materials, such as composite, nanomaterials or recycled plastics, are being used to replace concrete and steel e.g. in road surfaces and bridge beams. ACCIONA is studying how to enhance the interaction between a vehicle’s tyre and the road surface to improve safety, performance and reduce carbon emissions. Tendering processes for infrastructure can also emphasise a reduction in carbon emissions. Again, insights drawn from usage data can drive these developments.

This is an area where businesses must work together with policymakers, making them aware of the infrastructure that is needed for increasing automation. An environment can be fostered where companies are able to innovate and develop solutions that enable ground-breaking automation technologies at home, while taking advantage of a rapidly developing global market.

Governments also need to look at how their regulatory frameworks affect automation. Some countries, including Singapore and

‘Disengagements’ where a human driver was forced to intervene in a Waymo self-driving car test:

2015 - once every **2,511 kilometres**



2016 - once every **10,850 kilometres**



France, have been proactive in courting self-driving technology firms, to the extent of opening up their public streets for road tests.<sup>40</sup> This needs to be balanced with concerns from the public in areas such as safety.

As Ms Sbrizaj suggests, automating transport relies heavily upon hundreds of sensors in both vehicles and infrastructure. As with the example of how telemetric data convinced BAE to convert much of its fleet to EVs, these sensors will generate very useful data. Car manufacturers can monitor the performance of their cars in real time, and update software on the go to suit driving conditions or fix emerging problems.

Policymakers will be able to use data to integrate their public transport systems and increase efficiency, anticipating overcrowding, redeploying vehicles, and communicating critical information to their users. They will also be able to track the condition of assets such as roads and bridges, and introduce dynamic pricing systems that reduce congestion (while raising money in lieu of lost fuel-taxes).

Innovative businesses can take advantage of this wealth of data, for instance by developing apps that help public transport users plan their journeys more effectively, or find a parking place. Policymakers need to be convinced that this data is a business-enabling resource, and make it public. Finland has taken steps in this direction, aiming to create the preconditions for new business models for public transport.<sup>41</sup> As Europeans tend to be protective of their personal data, especially in comparison to Asia, policymakers also need to pay attention to – and where necessary adapt – data privacy laws.

Automation and computerisation have serious implications for the service industries. They could dramatically disrupt the automotive insurance industry, which was worth US\$617 billion in 2014.<sup>42</sup> Automation could mean vastly safer cars, but also more complex questions of responsibility and the possibility of massive system-wide failures.

Computerisation is already allowing pay-as-you-drive insurance policies, where the company tracks not just where a user drives, but *how* they drive. Morgan Stanley, a bank, predicts that car makers could leverage their access to data and financial operations to enter the automotive insurance industry themselves.<sup>43</sup>

Greater interconnectedness also brings the potential for cybersecurity risks, for instance through criminals hacking into a

vehicle network or individual car.<sup>44</sup> This is another opportunity for non-transport tech companies to collaborate with the sector, and an area where policymakers must be alerted to both the risks and possible safeguards related to new technologies.

One model for policymakers to deal with these issues was recently provided by the German government, which looked at automation through an ethical lens as well as legal and technical ones. It mandated that software and AI systems must be a priority to safeguard human life.

Germany's Transport Minister, Alexander Dobrind, announced "the world's first set of guidelines for automated driving," saying that the Ministry's Ethics Commission had examined "new ethical questions in the age of digitalisation and self-learning systems."<sup>45</sup>

Innovative and successful companies are more likely to flourish in an environment created by a proactive government than one that sits and waits for technology to be proven elsewhere.

## International opportunities – focus on India

Investing in the future of transport is not just a business opportunity within Europe. There is enormous potential for European companies to create and compete in new transport markets across the world. For example, India has recently been making high-level pledges about encouraging EV use as part of its plans to tackle CO<sub>2</sub> emissions and localised pollution.

In 2016, the Power Minister, Piyush Goyal, said that "India can become the first country of its size which will run 100% on electric vehicles," and announced a business model that would allow less affluent consumers to purchase EVs without high up-front costs.<sup>46</sup> Although India is still heavily coal-dependent, the government is aggressively promoting renewables.<sup>47</sup>

The Indian car industry is already the sixth largest in the world, accounting for 22 per cent of the country's manufacturing output.<sup>48</sup> A concerted Indian push towards developing cheaper EVs opens up significant opportunities for innovative European automotive companies with relevant expertise to contribute to this shift. Equally, if Europe and its industries do not modernise, they may find that others will overtake them.

**Innovative and successful companies** are more likely to **flourish** in an environment created by a **proactive government** than one that sits and waits for technology to be proven elsewhere.

In 2016, the Power Minister, Piyush Goyal, said that "**India** can become the **first country** of its size which will **run 100% on electric vehicles**,"

# Conclusion: which side of history are you on?

**European businesses and policymakers need to realise that long-predicted dramatic and systematic changes are now definitely under way. These changes go far beyond headlines about electric vehicles (EVs) and self-driving cars. New forms of ownership, driver-supported technologies, telematics, AI-enabled data analysis, and lightweight materials will all be part of the future transport picture, and many consumers will start to understand transport in terms of a service rather than ownership.**

Technology is making transport systems more interconnected and integrated than ever before. The changes will also affect public transport, logistics and road freight, along with private vehicles such as cars and motorcycles. They have important implications for infrastructure and urban planning.

For some, meeting the challenges that this throws up will be a question of competitiveness and survival. For many others it will be a question of understanding opportunities to save money, make their operations more efficient, or realise new business opportunities that may range well beyond Europe. The market – as well as the competition – is global.

To unlock the opportunities and avoid the pitfalls, businesses will need to understand the new ecosystems associated with changes to the sector. These range from recharging stations and batteries, to smart roads and sensor-laden vehicles. Software platform developers, AI pioneers and service companies can all operate and innovate in the transport space, along with more obvious companies that may deal with vehicle manufacturing, material science and design.

These opportunities are already being seized; in many cases by new companies whose specialisms are better suited to future transport trends than the legacy car makers'. These include Tesla, and several Chinese manufacturers, who are leveraging insights into their huge domestic market. European car companies must get used to competing with companies like these, as well as their more traditional rivals.

To do this, they must work with policymakers to enable the future, rather than lean on them to protect their current business models. Businesses should be going to politicians and making the case for a clear and effective regulatory framework that is fit for purpose for a very different road transport sector. The transport systems of the future will be far more interconnected and integrated than before, and offer global opportunities that extend far beyond making batteries or EVs.

To ensure European companies remain competitive and relevant, **European policymakers should take action in the following areas:**

1. **Standardise and expand infrastructure:** Europe needs a common approach to infrastructure that avoids unnecessary duplication of charging infrastructure. Payment plans should be developed to enable seamless roaming for drivers across the EU. Similarly, mobile connectivity will need to be expanded and data standardised to enable new business models and smarter, more connected transport choices.
2. **Increase support for innovation:** Research and development needs to be scaled up in crucial industries, including the development of new battery technologies and AI. Support for innovation should be applied to new business models as well as new technologies.
3. **Use smart regulation and procurement to accelerate change that supports public goals:** Disruptive innovation in the road transport sector is more of a reason than ever to focus on important public goals like health, safety and addressing climate change. Emissions standards should be tightened, to drive carbon emission reductions and air quality improvements. Regulation should continue to be used to discourage congestion and support road safety. Public procurement should also be used to encourage investment in new approaches and technologies by supporting sustainable solutions.
4. **Think about social implications:** Disruptive change has negative as well as positive implications. Governments will need to understand the implications of technologies such as automation, and respond to public concerns while supporting innovation. The impact on jobs, both positive and negative, will be particularly important.



Electric car at Iberdrola facilities

## References

- <sup>1</sup> “Zooming ahead: China moves towards banning the internal combustion engine”, *Economist*, 14 Sept 2017, <https://www.economist.com/news/business/21728980-its-government-developing-plan-phase-out-vehicles-powered-fossil-fuels-china-moves>
- <sup>2</sup> “China targets 35 million vehicle sales by 2025, NEVs to make up one-fifth”, *Reuters*, 25 April 2017, <http://www.reuters.com/article/us-china-autos-electric/china-targets-35-million-vehicle-sales-by-2025-nevs-to-make-up-one-fifth-idUSKBN17R086>
- <sup>3</sup> “China looks at plans to ban petrol and diesel cars”, *BBC News*, 10 Sept 2017, <http://www.bbc.com/news/business-41218243>
- <sup>4</sup> “Hydrogen and fuel cells for transport”, *European Commission*, 2017, [https://ec.europa.eu/transport/themes/urban/vehicles/road/hydrogen\\_en](https://ec.europa.eu/transport/themes/urban/vehicles/road/hydrogen_en)
- <sup>5</sup> “Climate change: Implications for transport”, *Intergovernmental Panel on Climate Change*, July 2014
- <sup>6</sup> “EV market trends and outlook” - Shift up a gear - presentation by Colin McKerracher, head of Advanced Transport, *Bloomberg New Energy Finance*, Sept 2017 <https://www.transportenvironment.org/sites/te/files/EV%20market%20trends%20and%20outlook%20%28by%20Colin%20McKerracher%29.pdf>
- <sup>7</sup> “Facts about the automobile industry”, *European Automobile Manufacturers’ Association*, 2017, <http://www.acea.be/automobile-industry/facts-about-the-industry>
- <sup>8</sup> Reference from interview with Balazs Felsmann, *Regional Centre for Energy Policy Research*, Hungary, September 2017
- <sup>9</sup> “The electric vehicle future: 30 questions to ponder”, *Loren McDonald, Clean Technica*, Sept 5th 2017, <https://cleantechnica.com/2017/09/05/electric-vehicle-future-30-questions-ponder/>
- <sup>10</sup> “China looks at plans to ban petrol and diesel cars”, *BBC News*, 10 Sept 2017, <http://www.bbc.com/news/business-41218243>
- <sup>11</sup> <https://www.theclimategroup.org/project/ev100>
- <sup>12</sup> “Zooming ahead: China moves towards banning the internal combustion engine”, *The Economist*, 14 Sep 2017, <https://www.economist.com/news/business/21728980-its-government-developing-plan-phase-out-vehicles-powered-fossil-fuels-china-moves>
- <sup>13</sup> “Low carbon cars in the 2020s, Consumer impacts and EU policy implications”, *BEUC*, November 2016, [http://www.beuc.eu/publications/beuc-x-2016-122\\_low\\_carbon\\_cars\\_in\\_the\\_2020s-brochure.pdf](http://www.beuc.eu/publications/beuc-x-2016-122_low_carbon_cars_in_the_2020s-brochure.pdf)
- <sup>14</sup> “Batteries may power future of auto industry”, *Morgan Stanley*, 19 May 2017, <https://www.morganstanley.com/ideas/electric-cars-sales-growth>
- <sup>15</sup> “Speeding up European electro-mobility: How to electrify half of new car sales by 2030”, *Report for Transport and Environment by Christian Berggren and Per Kågeson*, Sept 2017, <https://www.transportenvironment.org/sites/te/files/publications/Speeding%20up%20European%20Electro-Mobility.pdf>
- <sup>16</sup> “Lithium-ion battery costs: Squeezed margins and new business models”, *Bloomberg New Energy Finance*, 10 July 2017, <https://about.bnef.com/blog/lithium-ion-battery-costs-squeezed-margins-new-business-models/>
- <sup>17</sup> <https://media.anglianwater.co.uk/driving-efficiency-for-the-future/>
- <sup>18</sup> “Brussels wants Airbus-style consortium to lead battery revolution”, *Financial Times*, 4 Oct 2017, <https://www.ft.com/content/3260d4fc-a53f-11e7-9e4f-7f5e6a7c98a2?>
- <sup>19</sup> [https://www.amsterdam.nl/publish/pages/799470/planam-03-2016\\_art2\\_2\\_1.pdf](https://www.amsterdam.nl/publish/pages/799470/planam-03-2016_art2_2_1.pdf)
- <sup>20</sup> <https://ec.europa.eu/energy/en/news/commission-proposes-new-rules-consumer-centred-clean-energy-transition>
- <sup>21</sup> <https://newmotion.com/en>
- <sup>22</sup> [www.plugsurfing.com/en/](http://www.plugsurfing.com/en/)
- <sup>23</sup> “Electric cars are not necessarily clean”, *Scientific American*, 2016, <https://www.scientificamerican.com/article/electric-cars-are-not-necessarily-clean>
- <sup>24</sup> “Turning over a new leaf: Electric vehicle carbon emissions”, *ICCT*, 2016, <http://www.theicct.org/blogs/staff/turning-over-new-leaf-electric-vehicle-carbon-emissions>
- <sup>25</sup> “Unlock the sharing economy for the parking sector”, *European Commission*, 2017, [https://ec.europa.eu/transport/themes/research/challenge/projects/unlock-sharing-economy-parking-sector\\_es](https://ec.europa.eu/transport/themes/research/challenge/projects/unlock-sharing-economy-parking-sector_es)
- <sup>26</sup> “Volvo XC40 on sale – prices, specs and pictures of the new Swedish SUV”, *Daily Telegraph*, 21 Sept 2017, <http://www.telegraph.co.uk/cars/volvo/volvo-xc40-review>
- <sup>27</sup> “Could India really become 1st fully electric car country?”, *Clean Technica*, 15 June 2017, <https://cleantechnica.com/2017/06/15/india-really-become-1st-fully-electric-car-country>

- <sup>28</sup> “Cracks in the ridesharing market – and how to fill them”, McKinsey, July 2017, <http://www.mckinsey.com/industries/automotive-and-assembly/our-insights/cracks-in-the-ridesharing-market-and-how-to-fill-them>
- <sup>29</sup> “Digital-age transportation: The future of urban mobility”, Deloitte, 2012, [https://www2.deloitte.com/content/dam/Deloitte/es/Documents/sector-publico/Deloitte\\_ES\\_Sector-Publico\\_Digital-age-transportation-The-future-of-urban-mobility.pdf](https://www2.deloitte.com/content/dam/Deloitte/es/Documents/sector-publico/Deloitte_ES_Sector-Publico_Digital-age-transportation-The-future-of-urban-mobility.pdf)
- <sup>30</sup> “The future of trucks: implications for energy and the environment”, International Energy Agency, 2017, <https://www.iea.org/publications/freepublications/publication/TheFutureofTrucksImplicationsforEnergyandtheEnvironment.pdf>
- <sup>31</sup> “Delivering change: The transformation of commercial transport by 2025”, McKinsey, Sept 2016, <http://www.mckinsey.com/industries/automotive-and-assembly/our-insights/delivering-change-the-transformation-of-commercial-transport-by-2025>
- <sup>32</sup> “The future of trucks: Implications for energy and the environment”, International Energy Agency, 2017, <https://www.iea.org/publications/freepublications/publication/TheFutureofTrucksImplicationsforEnergyandtheEnvironment.pdf>
- <sup>33</sup> “The future of trucks: implications for energy and the environment”, International Energy Agency, 2017, <https://www.iea.org/publications/freepublications/publication/TheFutureofTrucksImplicationsforEnergyandtheEnvironment.pdf>
- <sup>34</sup> “Electric vehicles in Europe: Gearing up for a new phase?”, McKinsey, Apr 2014, <https://www.mckinsey.com/netherlands/our-insights/electric-vehicles-in-europe-gearing-up-for-a-new-phase>
- <sup>35</sup> “Antitrust: Commission fines truck producers €2.93 billion for participating in a cartel”, European Commission, 2016, [http://europa.eu/rapid/press-release\\_IP-16-2582\\_en.htm](http://europa.eu/rapid/press-release_IP-16-2582_en.htm)
- <sup>36</sup> “Will we see the ‘uberisation’ of the logistics market?”, Logistics Handling, Mar 2017, <http://www.logisticshandling.com/articles/2017/03/01/will-we-see-the-uberisation-of-the-delivery-market>
- <sup>37</sup> “Inside Waymo’s secret world for training self-driving cars”, Alexis C Madrigal, The Atlantic, 23 Aug 2017, <https://www.theatlantic.com/technology/archive/2017/08/inside-waymos-secret-testing-and-simulation-facilities/537648>
- <sup>38</sup> “Automated driving: Levels of driving automation are defined in new SAE International Standard J3016”, SAE International, [https://www.sae.org/misc/pdfs/automated\\_driving.pdf](https://www.sae.org/misc/pdfs/automated_driving.pdf)
- <sup>39</sup> “The long, winding road for driverless cars”, The Economist, 2017, <https://www.economist.com/news/science-and-technology/21722628-forget-hype-about-autonomous-vehicles-being-around-cornerreal-driverless-cars-will>
- <sup>40</sup> “Will you need a driving licence in the age of self-driving cars?”, Jennifer Bradley (Aspen Institute), BBC website, 31 July 2017, <http://www.bbc.com/news/technology-40570592>
- <sup>41</sup> “Good and flexible transport services through a new act”, Finnish Ministry of Transport and Communications, 24 May 2017, <https://www.lvm.fi/en/-/good-and-flexible-transport-services-through-a-new-act-933165>
- <sup>42</sup> “Transport in the digital age: Disruptive trends for smart mobility”, Deloitte, Mar 2015, <https://www2.deloitte.com/content/dam/Deloitte/tr/Documents/public-sector/transport-digital-age.pdf>
- <sup>43</sup> “For car insurance industry, traffic and detours ahead”, Morgan Stanley, 20 Mar 2017, <https://www.morganstanley.com/ideas/jon-hocking-auto-insurance-tech-disruption>
- <sup>44</sup> “A deep flaw in your car lets hackers close down safety features”, Wired, Aug 2017, <https://www.wired.com/story/car-hack-shut-down-safety-features>
- <sup>45</sup> “Germany draws up rules of the road for driverless cars”, Reuters, 23 Aug 2017, <http://www.reuters.com/article/us-autos-autonomous-germany-idUSKCN1B31MT>
- <sup>46</sup> “India aims to become 100% e-vehicle nation by 2030: Piyush Goyal”, Economic Times, 26 Mar 2016, <http://economictimes.indiatimes.com/industry/auto/news/industry/india-aims-to-become-100-e-vehicle-nation-by-2030-piyush-goyal/articleshow/51551706.cms>
- <sup>47</sup> “To slow climate change, India joins the renewable energy revolution”, The Conversation, 9 Jun 2017, <https://theconversation.com/to-slow-climate-change-india-joins-the-renewable-energy-revolution-78321>
- <sup>48</sup> “India proposes making all vehicles electric by 2030”, Gas2, 27 Mar 2016, <http://gas2.org/2016/03/27/india-proposes-all-vehicles-electric-2030>

## Cambridge insight, policy influence, business impact

The University of Cambridge Institute for Sustainability Leadership (CISL) brings together business, government and academia to find solutions to critical sustainability challenges.

Capitalising on the world-class, multidisciplinary strengths of the University of Cambridge, CISL deepens leaders' insight and understanding through its executive programmes; builds deep, strategic engagement with leadership companies; and creates opportunities for collaborative enquiry and action through its business platforms.

Over 25 years, we have developed a leadership network with more than 7,000 alumni from leading global organisations and an expert team of Fellows, Senior Associates and staff.

HRH The Prince of Wales is the patron of CISL and has inspired and supported many of our initiatives.

## Publication details

Copyright © 2017 University of Cambridge Institute for Sustainability Leadership (CISL). Some rights reserved.

### Disclaimer

The opinions expressed here are those of the authors and do not represent an official position of CLG, CISL, the wider University of Cambridge, or clients.

### Head Office

1 Trumpington Street  
Cambridge, CB2 1QA  
United Kingdom  
T: +44 (0)1223 768850  
E: info@cisl.cam.ac.uk

### EU Office

The Periclès Building  
Rue de la Science 23  
B-1040 Brussels, Belgium  
T: +32 (0) 2 894 93 19  
E: info.eu@cisl.cam.ac.uk

### South Africa

PO Box 313  
Cape Town 8000  
South Africa  
T: +27 (0)82 829 6852  
E: info.sa@cisl.cam.ac.uk

### Reference

Please refer to this publication as University of Cambridge Institute for Sustainability Leadership (CISL). (2017). *Electric avenue: The future of road transport in Europe*, Cambridge, UK: The Prince of Wales's Corporate Leaders Group.

### Copies

This full document can be downloaded from the Corporate Leaders Group's website: [www.corporateleadersgroup.com](http://www.corporateleadersgroup.com)

### Contact

To obtain more information on the report, please contact Adele Williams:  
E: [adele.williams@cisl.cam.ac.uk](mailto:adele.williams@cisl.cam.ac.uk)  
T: +44(0)1223 768451

November 2017