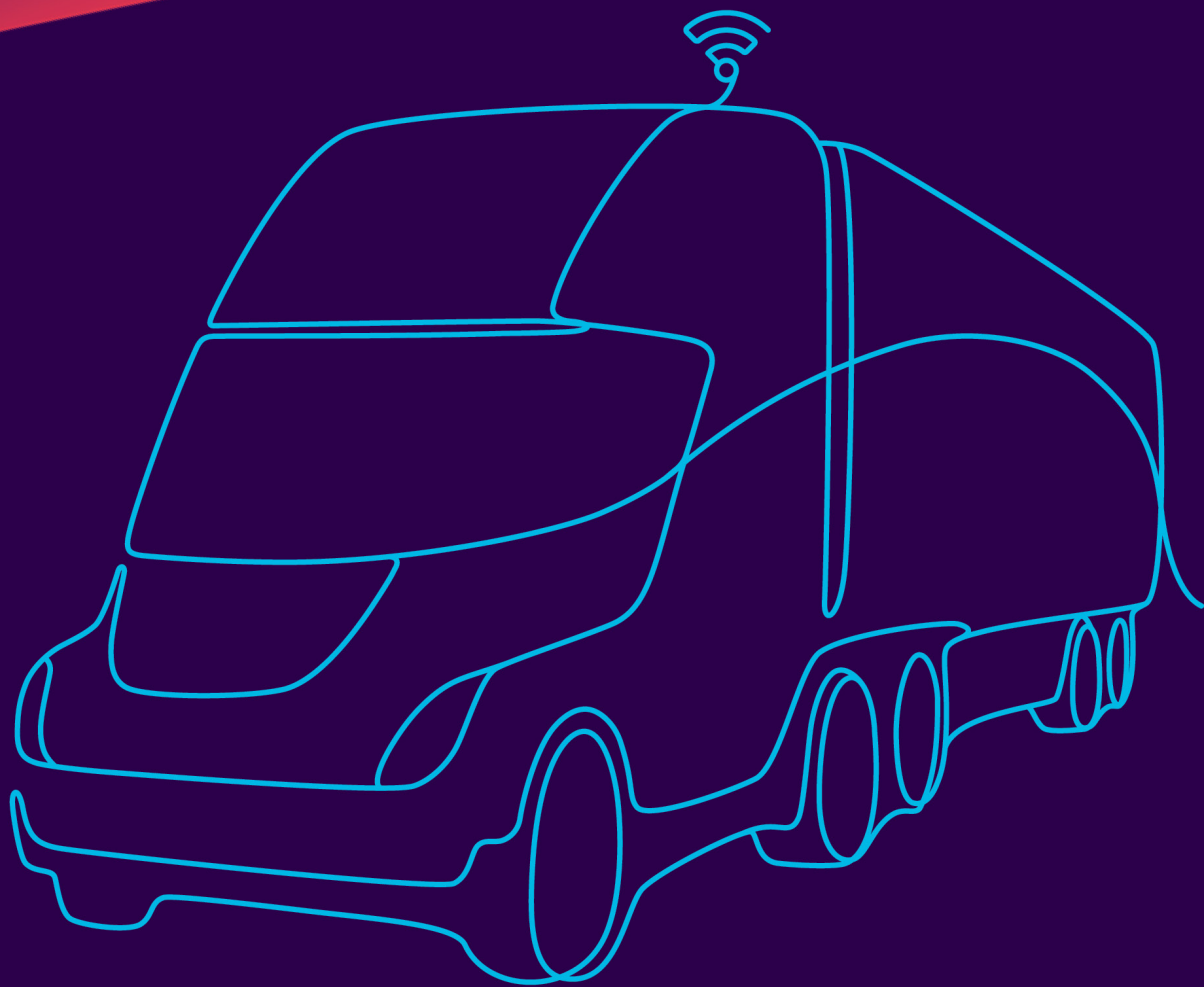


# TAKING THE LEAD WITH SUSTAINABLE TRANSPORTATION

Transforming the commercial vehicle sector



EXECUTIVE

# SUMMARY

The challenges and opportunities currently faced by commercial vehicle OEMs are significant and often exciting ones. Tighter environmental regulation will compel them to shift their portfolio toward electric vehicles, whether battery electric vehicles (BEVs) or fuel cell electric vehicles (FCEVs). Connected services will help achieve sustainability goals but also address much wider needs. Changes like these will force OEMs to look for new ways to innovate, both internally and externally. This report discusses three specific areas of focus that we believe are crucial for truck OEMs.



Photo by Frederic Lambert on Unsplash



## 1. SUSTAINABLE TRANSPORTATION:

OEMs are under pressure from governments, customers, and the public to reduce emissions from road transport. The question is which of the two candidate technologies to pursue. FCEVs look more attractive for long-haul transport and heavy loads because they can carry a larger payload and cover a longer range more sustainably. BEVs may be preferable for short-haul transport where frequent recharging is possible. Electric vehicles (EVs) will form only part of the portfolio for the next 10 years, but after that can be expected to replace ICEs.



## 2. CONNECTED SERVICES:

Connected services bring major revenue opportunities. Service provision can raise fees while generating data, provided the right services are chosen. Service integration generates commission and reduces the cost of providing premium services, but OEMs must integrate services into a seamless customer experience, as well as allocating the right services to the right providers. Data monetization, potentially the biggest revenue stream, is achieved by using data internally, e.g. to reduce costs, and by selling it to third parties.



## 3. STRENGTHENING INNOVATION:

Effective innovation is needed to deal with new technological demands, market disruption, and the move to digital that OEMs and their customers want. Internally, innovation competencies can be enhanced by, for example, setting up innovation centers or innovation companies. Missing competencies can also be sought outside the company via a variety of partnership models, including venture client and co-competition, and a wide range of partners, including universities.

Many of these observations are true for buses as well as trucks but there are a few differences – for example, in the case of buses it will probably be local operators rather than OEMs who build the ecosystems.

Truck and bus OEMs can gain an advantage in this dynamic market if they:

- **Combine the right EV technology strategy with their know-how in building commercial vehicles – know-how that gives them an advantage over new entrants.**
- **Make connected services into a win-win by providing services that customers value and in return gaining new revenue streams themselves.**
- **Strengthen innovative capabilities with the best internal and external resources and models to ensure an agile and confident response to new challenges.**

Far from being the Cinderellas left behind when passenger car OEMs go to the innovation ball, truck and bus OEMs who focus on these goals could find themselves leading the way.

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# INTRODUCTION

## RETHINKING THE COMMERCIAL VEHICLE PORTFOLIO

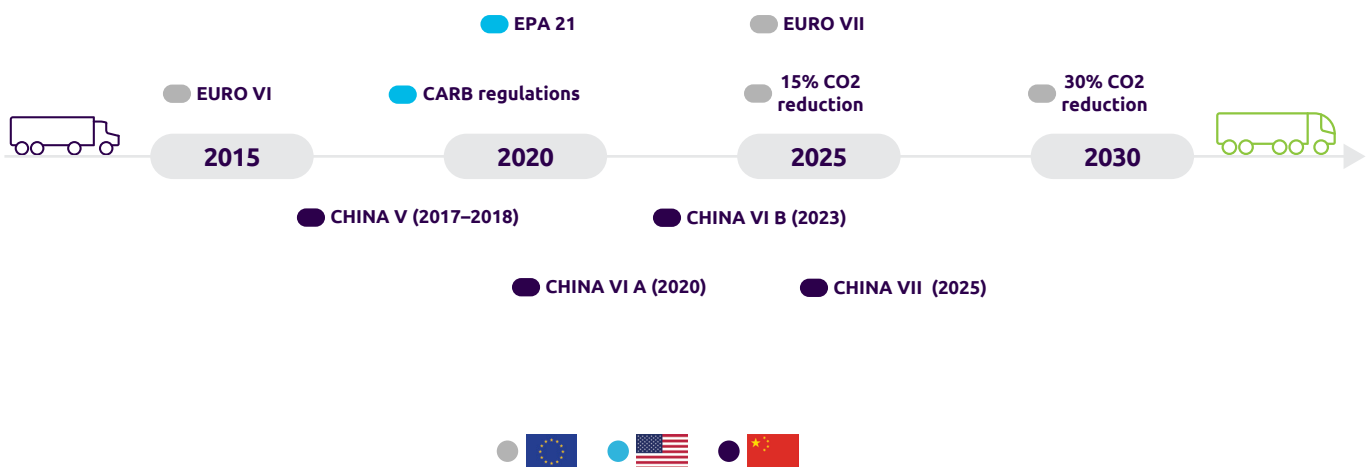
This report aims to shed light on key market and technology changes that will affect commercial vehicle OEMs over the next decade, and recommend actions they can take to tackle them and turn them to advantage.

### TIGHTENING REGULATIONS ARE PUSHING THE TRUCK INDUSTRY TO ADOPT MORE SUSTAINABLE TECHNOLOGIES

One of the biggest challenges is the requirement to reduce CO2 emissions. As shown in Figure 1, tighter emission regulations are being introduced worldwide, and these affect commercial vehicles as much as passenger vehicles – perhaps more so, since commercial vehicles account for a large and growing share of emissions.

FIGURE 1

TIMELINE OF ALL EXISTING AND UPCOMING REGULATIONS IN EUROPE, THE US, AND CHINA



These regulations are being imposed in all major markets, but are tightest in Europe, where the EU emission standard came into force as early as 2013. Europe's requirements can only be achieved by low-emission vehicles (LEVs) or zero-emission vehicles (ZEVs), and not by internal combustion engines (ICEs), however efficient.




Alongside nationwide regulations (and those at EU level in Europe), many major cities are imposing, or considering, strict regulations of their own to limit global warming and local air pollution. Some of these are summarized in Figure 2. These concerns are leading to the implementation of low-emission zones (LEZs) and, in the future, zero-emission zones (ZEZs). These initiatives will necessitate the use of LEVs or ZEVs for last-mile deliveries.

These regulatory changes at various levels create powerful pressure for truck OEMs to facilitate sustainable transportation by reducing emissions from their vehicles. To do this, they must reshape their portfolio with an increased emphasis on electric vehicles (EVs). For the foreseeable future, this means either battery electric vehicles (BEVs) or fuel cell electric vehicles (FCEVs). Truck OEMs, especially those in Europe and China, are already building experience in both areas.

The most obvious reason for OEMs to produce more sustainable vehicles is to avoid fines for breaching the new regulations. However, they should also take advantage of the opportunities that this disruption presents to improve their products and safeguard the future of their businesses.

**FIGURE 2**

OVERVIEW OF EXISTING AND UPCOMING REGULATIONS IN EUROPE, THE US, AND CHINA

	Access criteria	LEZ	Regulations	
	London	<b>Euro VI</b>	✓	ZEZ for central London will be delivered from 2025. Larger inner-city zones are planned by 2040 and a city-wide ban by 2050.
	Paris	<b>Euro V</b>	✓	Starting in 2024, diesel vehicles will be banned from Paris; from 2030, only electric and fuel cell vehicles will be permitted.
	Hamburg	<b>Euro VI*</b>	✓	Further bans are expected.
	New York	<b>EPA 16</b>	✗	Fees for vehicles with excessive emissions are currently being discussed.
	Los Angeles	<b>EPA 16</b>	✗	Zero Emission Roadmap 2.0 in place. Additional 25% greenhouse gas reduction through accelerating transportation electrification.
	Minneapolis	<b>EPA 16</b>	✗	Reduction of 30% of the city's emissions from a 2006 baseline from restructuring transportation among other things.
	Shanghai	<b>Standard IV**</b>	✗	City regions are more easily accessible for local trucks with specific plate numbers. Stricter restrictions limit the hours when trucks from other regions can enter the city.
	Beijing	<b>Standard IV**</b>	✓	Trucks' hours of entry to the city are limited for most of the day, but vary by area.
	Chengdu	<b>Standard IV**</b>	✗	Trucks are not allowed to enter the city (from the third ring inwards) between 07:30 and 20:00 on working days.

LEZ = low-emission zone    ZEZ = zero-emission zone    \*Only two streets require Euro VI    \*\* Three-year action plan to fight air pollution (2018–2020) aims to eliminate all trucks at standard III and below

## THE MOVE TOWARD CONNECTIVITY PRESENTS CHALLENGES AND OPPORTUNITIES

Connected services are an additional way to reduce the environmental impact of vehicle use, for example by optimizing charging patterns and routes. But the push toward connectivity comes from other directions as well. The demand for intelligent and connected solutions for commercial vehicles will continue to grow and will become an important selection criterion.

Offering these services requires OEMs to adopt unfamiliar ways of working. But connected services also offer attractive business opportunities. OEMs can gain new revenues, particularly, but not only, by gathering and monetizing data. More importantly still, they can give customers the seamless experience they increasingly want and so gain competitive advantage.





**MEETING TECHNOLOGICAL AND BUSINESS CHALLENGES REQUIRES NEW APPROACHES TO INNOVATION**

OEMs face a number of challenges, all requiring rapid, surefooted innovation – not just the need for sustainable transportation and connected services provision but also wider issues such as the move to autonomous driving and the general digitization of their businesses.

In tackling these challenges, they need to keep a close watch on their competitors, in particular the many new entrants who are aiming to capitalize on changes such as the shift to more sustainable transportation. These include startups such as Nikola, Hyliion, and Tesla, joint ventures between OEMs

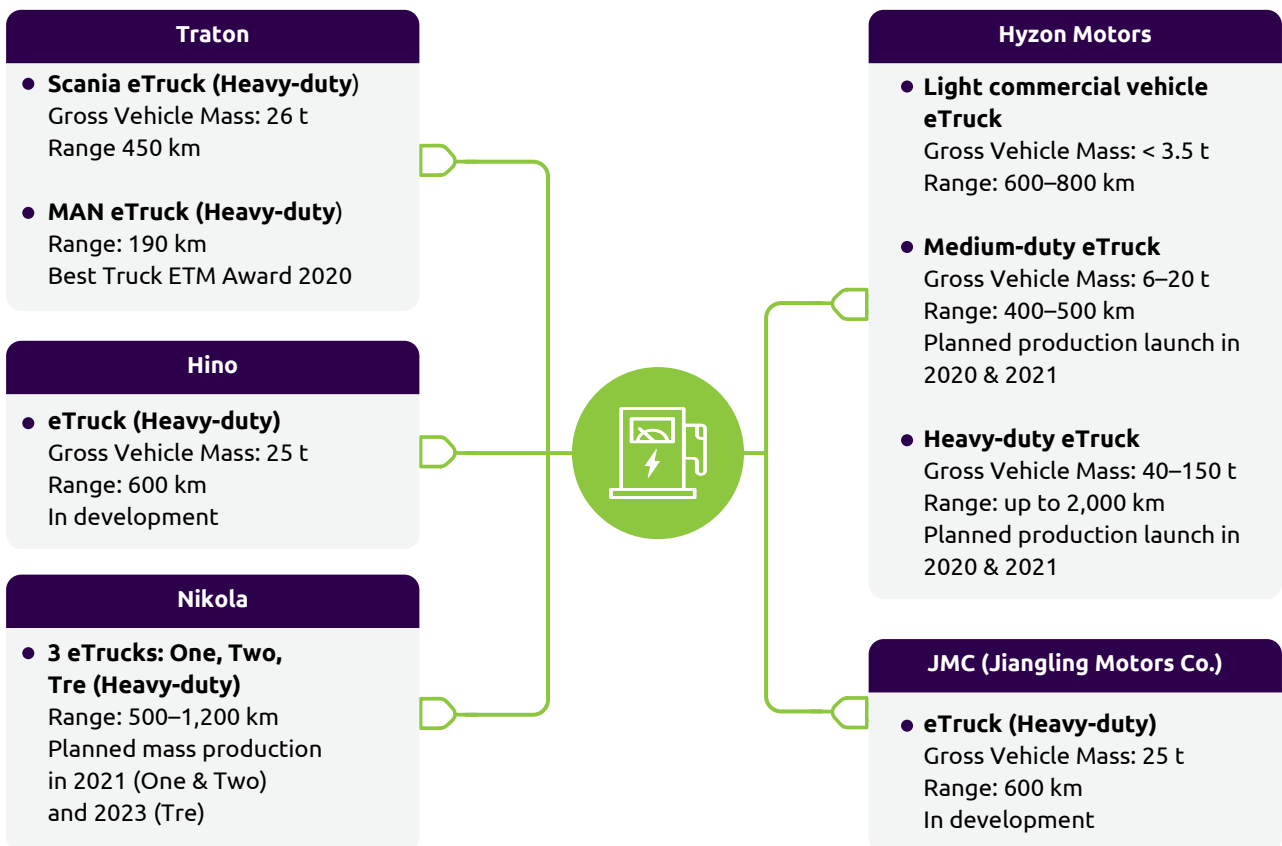
and other players, and companies from other industries such as Hyzon Motors.

Smaller companies tend to excel at innovation and some of these are launching a comprehensive attack on the OEMs’ market: As Figure 3 shows, Hyzon Motors is aiming to capture market share in several classes of commercial fuel cell electric vehicles (FCEVs).

Clearly, commercial vehicle OEMs need to find better ways to innovate, whether internally or through partnerships of various kinds.

**FIGURE 3**

NEW PLAYERS ARE ENTERING THE SUSTAINABLE TRANSPORT MARKET



## THIS REPORT

Below we outline the need for commercial vehicle OEMs to rethink their product and service portfolios in response to these challenges, focusing on three countries, the US, Germany, China, and drawing on a recent survey (see panel). We discuss three major fields of action: the development of sustainable transportation via alternative powertrains, the exploitation of the opportunities arising from connected services, and ways to strengthen innovation capabilities, both internally and through partnerships. While our focus is generally on trucks, we also present an expert interview with a key figure in the bus industry.

## RESEARCH METHOD

We recently conducted an online survey to explore the views of truck drivers, fleet managers, and dispatchers. A total of 294 participants took part in our survey, 108 of them from the United States, 85 from China, and 101 from Germany. The participants answered a 10-minute online survey, which included questions on the previously mentioned fields of action.

Our analysis focuses on the next 10 years in line with OEMs' planning timeframe. We recognize that technological advances over the next decade may change the picture in the longer term.

## NOTE ON TERMINOLOGY

**BEVs** and **FCEVs**: We use these terms throughout the report to refer to the two main types of electric commercial vehicles.

**Customers**: This term includes fleet owners, fleet managers, dispatchers, and drivers except where otherwise specified.

**OEMs**: We use this term to refer to truck OEMs except in the bus chapter.



# SUSTAINABLE TRANSPORTATION: DECIDING WHICH HORSES TO BACK

This report aims to shed light on key market and technology changes that will affect commercial vehicle OEMs over the next decade, and recommend actions they can take to tackle them and turn them to advantage.

## **BATTERIES AND FUEL CELLS LOOK LIKE ECO-FRIENDLY ALTERNATIVES TO DIESEL – BUT WHICH TECHNOLOGY SHOULD BE USED?**

Road transport today is responsible for a significant and growing share of global anthropogenic CO<sub>2</sub> emissions. Diesel is the dominant fuel for heavy trucks: 98% of trucks sold in Europe in 2019 were diesel-powered.

As discussed in the introduction, government regulations and public pressure mean that this situation needs to change to meet decarbonization, energy security, and urban air quality objectives. We believe that, for the foreseeable future, manufacturers need to consider only two solutions, both electric, in order to meet these requirements: battery electric vehicles (BEVs) and fuel cell electric vehicles (FCEVs).

## **NOTES**

We consider both BEVs and FCEVs to be electric vehicles. The only difference between the two lies in the way electricity is supplied to the motor. In BEVs, the electricity is supplied by batteries. In FCEVs, the electricity is produced through a chemical reaction of hydrogen, with water as a by-product.

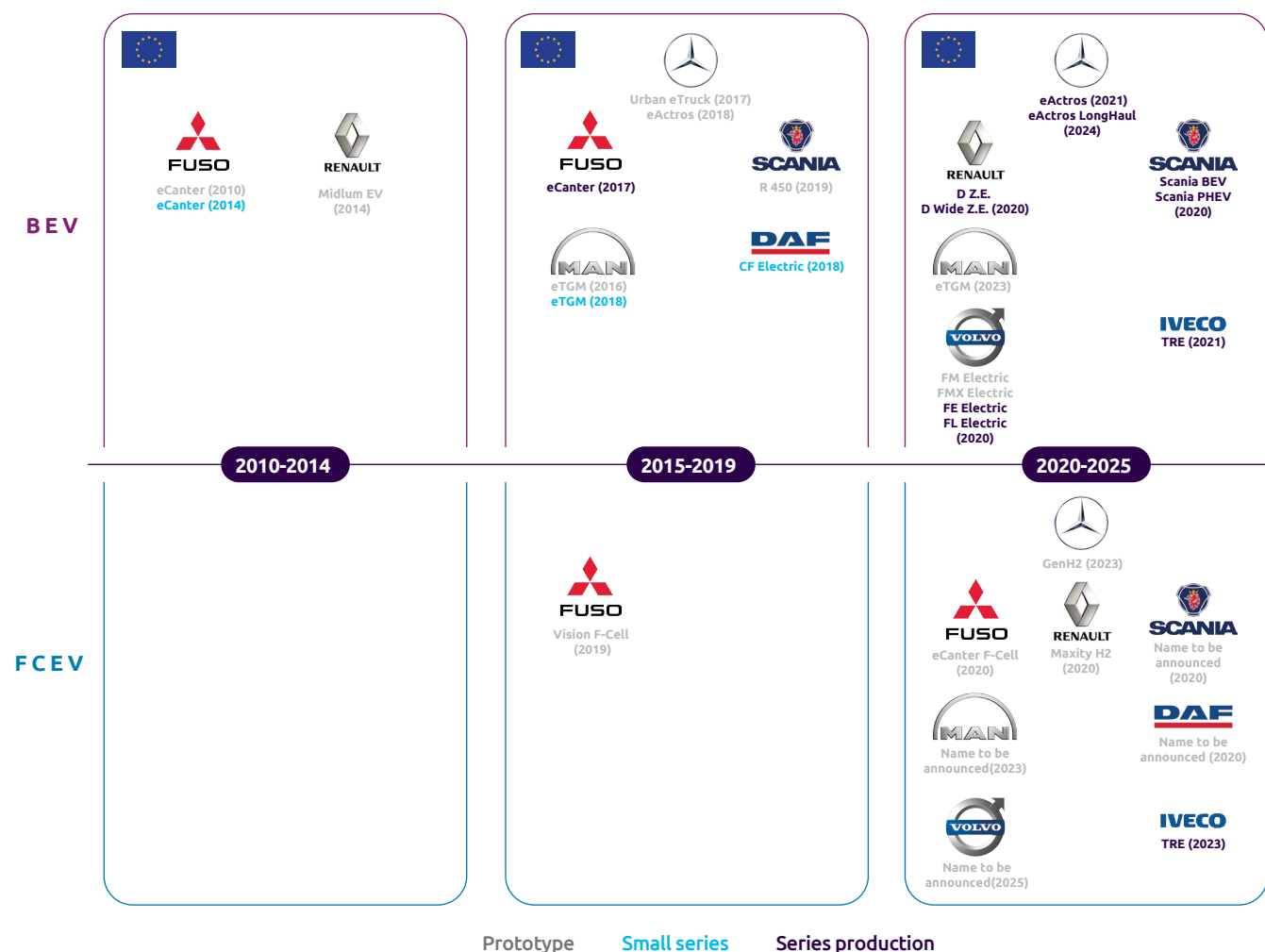
Survey data within this chapter relates to the subset of our survey participants who are either fleet managers or dispatchers.

An additional source of pressure for OEMs is the recent success of new competitors such as Tesla, Nikola, and Hyzon in the EV market (Figure 4), which is forcing established OEMs to shift the balance of their portfolio toward EVs to complement and, in the long run, completely replace their current product portfolio.

Fleet managers and dispatchers, too, are well aware of this need. Our survey shows that, like OEMs, they feel pressure from both government regulations and public discussions to replace their fleet with alternative powertrains over the next decade.

**FIGURE 4**

OVERVIEW OF BEV AND FCEV TRUCKS RELEASED BY EUROPEAN COMMERCIAL VEHICLE OEMS FOR THE EUROPEAN MARKET



**NOTE**

We considered seven of the top European truck manufacturers, including sub-brands, that produce BEV and FCEV Trucks for the European market.

Source: Capgemini desk research, October 2020.

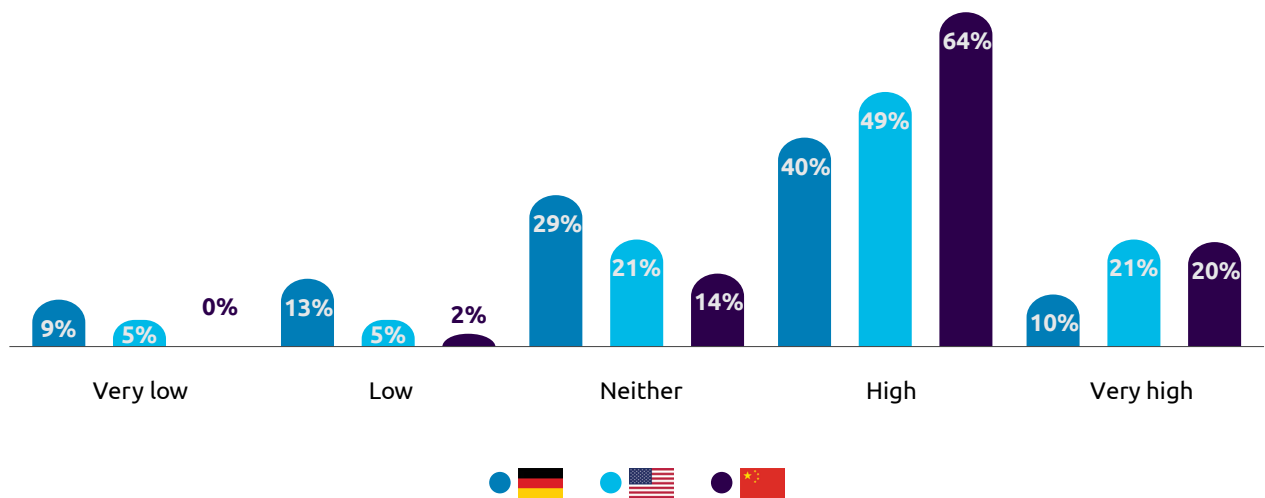
As Figure 5 shows, even in Germany, where no regulations are currently in place, more than half of our participants feel high or very high pressure to replace powertrains. In the US and China, the pressure is even higher. Accordingly, in all three geographic areas nearly all participants expect to change at least 25% of their fleet to alternative powertrains by 2030 (82% of participants in Germany; 92% in the US; 93% in China). This customer demand for alternative powertrains is an additional source of motivation for OEMs to provide more sustainable vehicles.

Therefore, the race is on to develop alternative fuels and vehicles, and the scale of investment required is considerable. One factor that could increase cost is that government regulation is inconsistent globally. CO2 emissions of heavy-duty vehicles are not yet regulated at EU level, whereas countries such as the US and China have already set CO2 emission standards for these vehicles. In the absence of international standards, truck manufacturers will need to adopt a region-specific approach to this challenge, which is likely to push up costs and decrease product effectiveness.

Especially given the scale of the investment required, it is vital for OEMs to choose the technology that will best help them meet government regulations for fleet emissions and avoid carbon-emission penalties.

**FIGURE 5**

LEVEL OF PRESSURE FELT BY FLEET MANAGERS AND DISPATCHERS TO REPLACE POWERTRAINS OVER THE NEXT DECADE



## BATTERIES AND FUEL CELLS: THE PROS AND CONS

Progress has already been made with both BEVs and FCEVs, with the percentage of alternative powertrains sold increasing year on year in all the markets we studied (see Figure 4). Nearly all global truck OEMs have announced BEV model launches. In addition, companies such as Hyzon, Hyundai, Toyota, BYD, and Nikola – as well as a Daimler-Volvo joint venture – have all heavily invested in developing a FCEV. Nonetheless, for many OEMs it is unclear where their attention should be focused.





We will now show how to compare the advantages and disadvantages of the two main alternative powertrains in terms of critical factors including total cost of ownership (TCO) which is the most important measure of profitability, infrastructure, and sustainability. Figure 6 summarizes our comparison, which looks different in 2020 and 2030 because of evolving regulation and technology. This figure excludes environmental criteria, where both BEVs and FCEVs are usually superior.

## TOTAL COST OF OWNERSHIP

While there is no 100% correct way to calculate total cost of ownership (TCO), variables such as maintenance, battery replacement, taxation policy, and private ownership of charging infrastructure clearly play a role. Moreover, there are soft costs that are hard to integrate but still important, such as brand image or customer satisfaction – either that of the driver or of the fleet owner. We have taken a simplified approach here, focusing on equipment costs, payload, range, and charging time. On this basis, FCEVs appear superior to BEVs for long-haul trucks at least, even allowing for some uncertainty about the relative prices of their inputs.

FIGURE 6

COMPARISON OF BEVs AND FCEVs WITH DIESEL TRUCKS

Topic	BEV		FCEV	
	2020	2030	2020	2030
TCO	●	●	●	●
Equipment costs 	●	●	●	●
Payload 	●	●	●	●
Range 	●	●	●	●
Charging/ refueling time 	●	●	●	●
Infrastructure	●	●	●	●

● Competitive     
 ● Less competitive     
 ● Uncompetitive

Source: Capgemini analysis

## EQUIPMENT COSTS

Our survey shows that fleet managers and dispatchers are price-sensitive when it comes to buying new trucks, implying that price parity for trucks with alternative powertrains is a prerequisite. This is especially true in China where 71% of participants mention it, but the majority of German and US participants also see it as crucial.

Price parity is currently some way off, however. Although it is difficult to find a firm price for FCEVs, Nikola estimates that its fuel cell trucks will cost around \$270,000; Tesla estimates that its battery electric trucks will cost \$150,000–180,000. A regular diesel truck's starting price of around \$120,000 makes it more attractive for potential buyers at present.

We should also note that many governments are offering or introducing subsidies to make alternative powertrains more competitive. For example, the German government gives between €8,000 and €40,000 in subsidies depending on the weight of the truck and the type of alternative powertrain. China also has a subsidy system in place for electric trucks.

## PAYLOAD

Payload is lower on a BEV than a diesel-powered truck because, with lower energy density, large battery packs are necessary. The energy density in FCEVs, taking into account both the fuel cell and the tank, is also lower than for diesel but much better than in BEVs, with the cell and tank together only weighing about a tenth as much as the battery of a fully electric truck.

Payload reduction for FCEVs is therefore much less of an issue than for BEVs at present, but it can be assumed that batteries will become much more efficient over the next few years.



## RANGE AND CHARGING TIME

In terms of range and charging time, FCEVs considerably outperform BEVs at the moment. On average, BEVs' range is about 300 km whereas, according to Nikola's website, FCEVs have a range of around 500–750 km. When it comes to charging and fueling time, it takes only a few minutes to fill a FCEV but several hours to charge a BEV.

As range and charging time are the decisive factors, FCEVs might become the better choice in the future. Our survey reinforces this point: Around 80% of German and Chinese participants say that range is crucial for EVs.




## INFRASTRUCTURE

A dense infrastructure network for trucks with alternative powertrains is a key prerequisite for widespread adoption; existing infrastructure can hardly ever be used by trucks. They need bigger parking spaces, which must have suitable access routes, and they also require more energy.

According to the European Automobile Manufacturers' Association (ACEA), a network of at least 37,000 charging points and 50 hydrogen filling stations suitable for heavy-duty vehicles will be needed as soon as 2025 (see Figure 7). ACEA has called for an Alternative Fuels Infrastructure Directive to force EU member states to commit to these goals.

FIGURE 7

ESTIMATE OF REQUIRED CHARGING AND REFUELING STATIONS IN EU BY 2025 AND 2030

Type of refueling/charging station*	2025	2030
DC <100 kW 	4,000 (+20,000**)	50,000 (+200,000**)
DC 350 kW 	11,000	20,000
DC >500 kW 	2,000	20,000
H2 stations (compressed, liquified) 	At least 50	At least 500

\*DC chargers compared to AC chargers are rapid charging stations with the converter built inside the charger itself.

\*\*depot charging (privately owned)

Source: ACEA

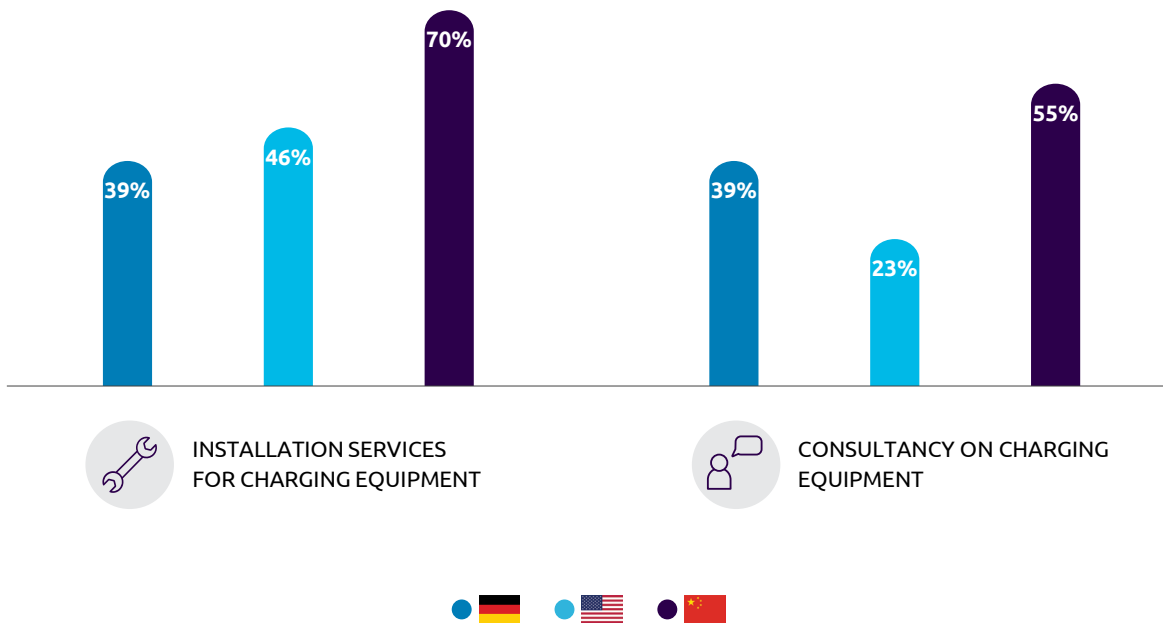
Even though infrastructure is a critical success factor for wide adoption of new powertrains, the lack of public refueling stations will be less of a barrier to adoption for trucks than for passenger cars, because fleet operators can establish their own refueling points. Nonetheless, according to our survey, the majority of German, US, and Chinese fleet managers and dispatchers see an adequate public charging infrastructure as a critical prerequisite for the change to alternative powertrains.

Infrastructure needs to be supported by installation and consulting services tailored to local needs. For example, as Figure 8 shows, our survey revealed considerable variation between regions as to the importance fleet managers and dispatchers attach to consultancy and/or installation services.



**FIGURE 8**

THE IMPORTANCE OF CONSULTANCY AND INSTALLATION SERVICES TO FLEET MANAGERS AND DISPATCHERS



**SUSTAINABILITY**

There has so far been little research comparing the sustainability of BEVs and FCEVs in the commercial vehicle segment, but some findings can be transferred from research conducted in the passenger car segment.

Comparisons of sustainability depend on two critical factors: the battery and the energy source. In the case of BEVs, the production of batteries for trucks creates far more emissions than those for cars as the batteries are much bigger; the CO2 footprint, too, is proportional to battery size.

Energy production currently looks less sustainable for FCEVs than BEVs as hydrogen production is almost exclusively based on natural gas. This situation could be improved if the hydrogen were produced using electricity from environmentally friendly sources such as wind power.

According to a study by the Fraunhofer Institute, when comparing the two alternative powertrains for passenger cars for an average mileage of 150,000 km, it can be assumed that FCEVs will be more sustainable than BEVs for the foreseeable future.

## GOVERNMENT INCENTIVES MAY SHIFT THE BALANCE

When choosing between BEVs and FCEVs, customers will naturally gravitate to BEVs as they are cheaper to buy and easier to fuel. However, government incentives may shift the balance in favor of FCEVs, especially in countries where hydrogen is produced locally. A likely candidate is the US, which accounted for more than a third of global hydrogen production in 2016. China, too, has become a major player in hydrogen production. Meanwhile, the EU has announced a new initiative called the Clean Hydrogen Alliance to ramp up European hydrogen production.

## A FAST-CHANGING PICTURE

As the above discussion suggests, despite higher initial costs compared to diesel trucks, FCEVs have a strong advantage for trucks transporting heavy loads over long distances. Industry estimates suggest FCEVs could reduce TCO by around 20% for long-haul transportation. Cargemini research reinforces this point, showing that cost parity between BEVs and FCEVs is reached at a range slightly above 100km. And FCEVs, as we have seen, can carry a higher payload.

Our research also shows that the traditional internal combustion engine (ICE) is currently by far the most attractive solution with respect to TCO. However, by 2030 the TCO of both BEVs and FCEVs is expected to have become close to that of ICEs due to increased battery life expectancy, lower energy prices for hydrogen and electricity, and increased taxes on fossil fuels.



These considerations explain the truck industry's strong interest in FCEVs. The scenario of long distances and heavy loads is already the focus for startups such as the Nikola Motor Company, which is partnering with the likes of Bosch, Mahle, and Iveco to produce FCEVs. However, BEVs come into their own for short journeys and light loads, where battery size can be small and light because frequent charging is possible.

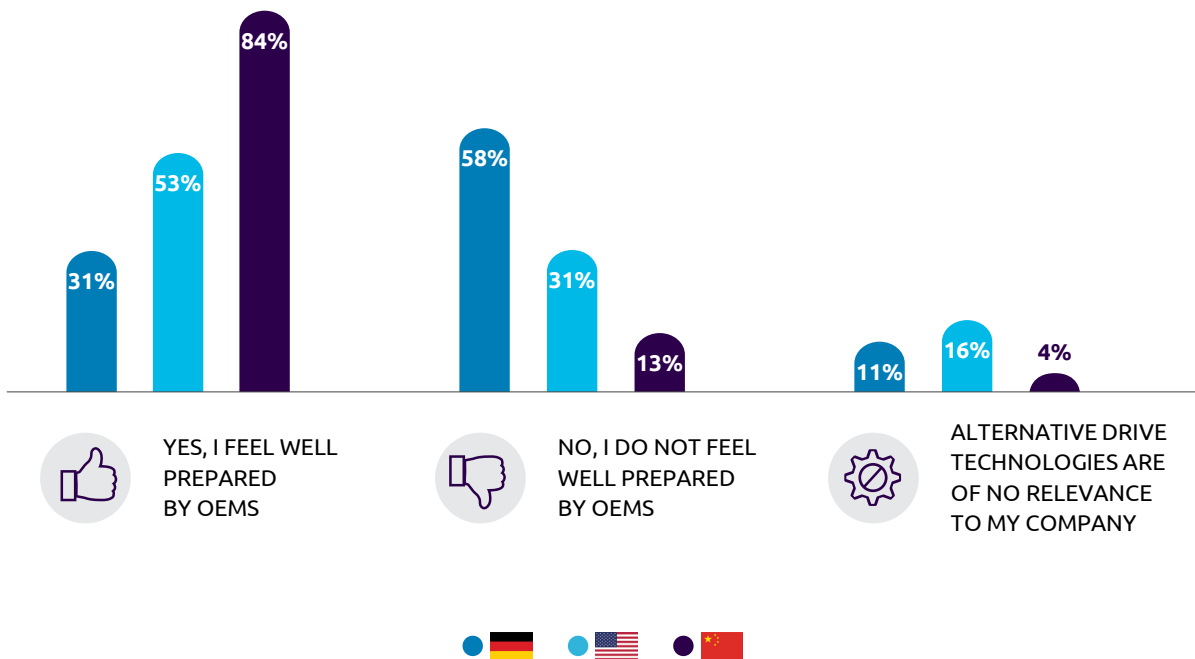
Some OEMs will choose to invest in one or other of these technologies, while some may decide to pursue both. Whatever their choice, they will need to capitalize on their advantages over new entrants. These new entrants have been in a position to create completely new trucks around alternative powertrains, whereas traditional OEMs have largely been retrofitting alternative powertrains to chassis that were designed for diesel. On the other hand, OEMs can draw on many years' experience of building trucks and can perhaps be more confident that their vehicles will stay the course, given that trucks are often expected to keep running for a million miles or more.

OEMs will also need to do more to prepare their customers. Outside China, participants in our survey feel that OEMs are not preparing them very well for the transition, as Figure 9 shows. The first OEMs to provide customers with information and guidance for the transition will gain a significant competitive advantage.

For now, alternative powertrains will represent only one part of OEMs' portfolio, albeit an increasingly important one. Short-term CO2 targets can be achieved with a combination of evolutionary improvement to the ICE and adoption of hybrid or full electric systems for short-haul or city delivery. However, OEMs' strategies for 2030 and beyond will require more radical options, including phasing out the ICE.

**FIGURE 9**

PREPAREDNESS FOR THE CHANGE TO ALTERNATIVE POWERTRAINS





# CONNECTED SERVICES:

## REALIZING THE POTENTIAL

**NEW TECHNOLOGIES ARE MAKING TRUCKS SMARTER. OEMS AND FLEET MANAGERS ALSO NEED TO BECOME SMARTER IN LEVERAGING THE DATA COLLECTED.**

Smart and connected vehicles are proliferating. It has been estimated that by 2023 there will be over 350 million connected passenger cars on the road – around 24% of all cars – and similar trends can be expected for commercial vehicles. Our customer survey shows that the majority of fleet managers, dispatchers, and truck drivers across the US and China already have connected services in their trucks, currently at 57% and 58% respectively. In Germany, 44% of trucks currently include connectivity packages, according to our survey.

To OEMs, connected services may look like an extra job they have to do, since they now have to provide their customers with much more than just a truck. These companies are having to transform themselves, and invest heavily, to achieve excellence not just at manufacturing but also at the provision of customer-centric and data-driven technologies and services.

But in fact, experience shows that connected services offer OEMs important opportunities. For example, they can support OEMs in complying with regulatory issues such as those discussed in the previous chapter. Connected services can guide both drivers and vehicles – with or without alternative powertrains – to perform in a more sustainable way by improving power use and optimizing routes, for example.

Equally important, connected services give OEMs an opportunity to offer customers the seamless experience they increasingly demand. For example, these services can automate the process of dealing with new regulations such as temporary truck restrictions in cities. They can also guide customers in becoming better at their core business – for example, by decreasing delivery times.

Connected services also provide opportunities for OEMs to leverage additional revenue streams. In particular, smart and connected vehicles provide a wealth of data that can be monetized. This chapter focuses on how to approach that task.

### THREE MAJOR REVENUE STREAMS

As discussed in Capgemini Invent's recent report on [Monetizing Vehicle Data](#), three major revenue streams can greatly increase OEMs' income beyond the one-time sale. These are:

1. **SERVICE PROVISION** 
2. **SERVICE INTEGRATION** 
3. **DATA MONETIZATION** 

These three areas are strongly interconnected. Although we expect data monetization to yield by far the greatest revenue, the other two areas have to be tackled first. This is because service provision and integration are needed to achieve the critical mass of connected service customers (and hence data) required for monetization.

Each of the three areas is discussed below.



## 1. SERVICE PROVISION

### THE NEED TO PROVIDE VALUE

By service provision, we mean the provision of connected services to business-to-business (B2B) customers and end-consumers. Services are valuable to OEMs because of the data they generate, and also because they themselves can be a source of revenue. Recent research for Capgemini Invent's [Connected Trend Radar 2](#) found that (B2B) services may be more lucrative than business-to-consumer (B2C) ones because B2B customers recognize their cost-saving potential, especially in the case of services such as predictive maintenance and fleet management.

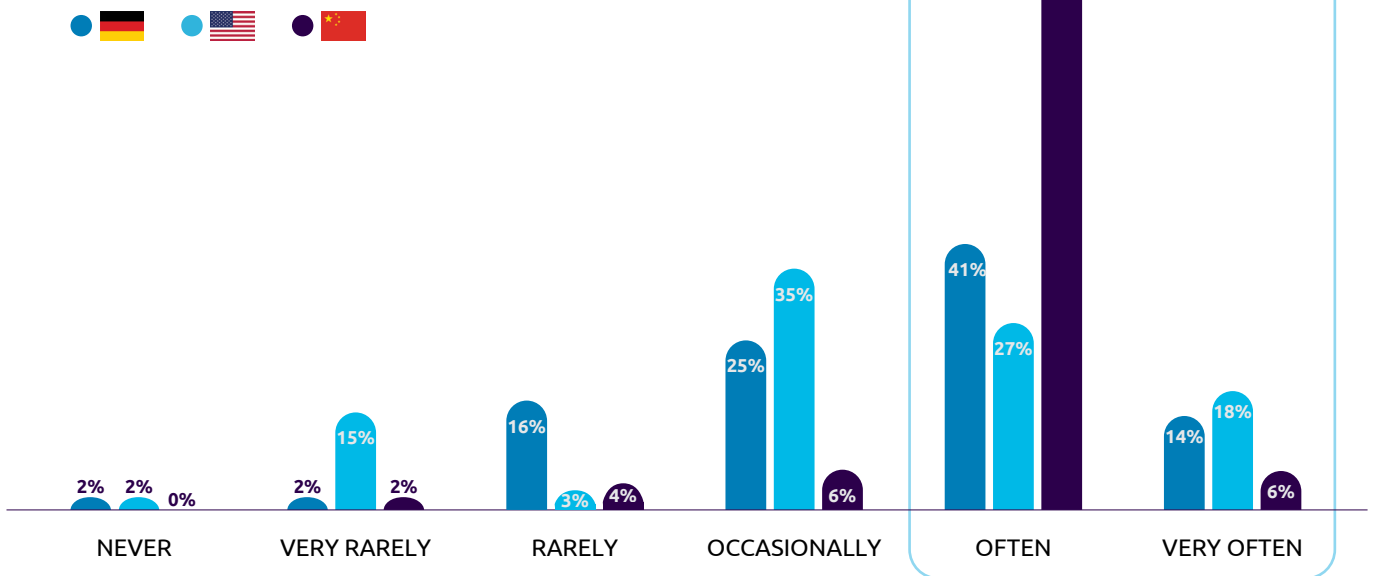
But services also have to be seen as valuable by customers, so that they are willing to pay for the services and/or share their data. With trucks, the main way to provide value to customers is to offer an exceptional customer experience to those who buy or use each vehicle. Our research shows that connected services can be used to provide that experience, and that they are also valued in themselves.

Our customer survey reveals a high level of use of connected services by fleet managers, dispatchers, and truck drivers. Over 40% of the participants say they use them often to very often. China shows the highest usage with over 80%, which could be explained by China's relatively high level of adoption of and affinity for technology.

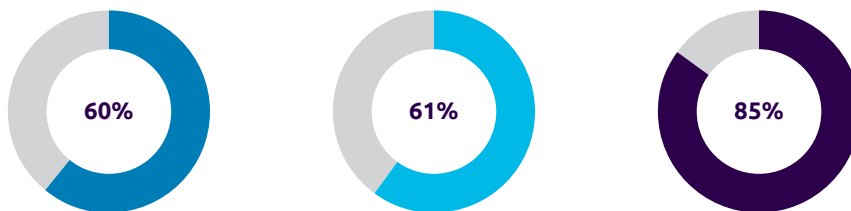
The survey also shows that connected services in general are seen to increase the value of a truck, with over 60% of participants across all three countries taking this view (see Figure 10).

FIGURE 10

CHINA USES CONNECTED SERVICES MORE FREQUENTLY THAN OTHER MARKETS



THE PERCEIVED VALUE IS GENERALLY HIGH IN ALL MARKETS, WITH THE HIGHEST IN CHINA



PERCENTAGE VALUING OR HIGHLY VALUING CONNECTED SERVICES

## UNDERSTANDING SERVICE TYPES

Even though all types of connected services appear to be valued by truck customers, OEMs need to know which ones are valued most in order to decide where to invest. It is useful to categorize services according to the type of value they create for customers.

Our recent Trend Radar identifies over 50 connected services, many of which are as applicable to trucks as to passenger cars. Here we have grouped them into four service categories that are important for truck customers.

### Efficiency

Vehicle data can be used to make working life more efficient for everyone from fleet manager to drivers and gain valuable time for the business. Examples include decreasing a fleet's downtime (during loading and so on) and also the charging time for e-trucks. Fleet management dashboards can combine personal, behavioral, and vehicle data for full transparency. Predictive maintenance uses algorithms to calculate the optimum moment for maintenance to avoid breakdowns.

### Risk mitigation

Here, the data gathered from trucks is used to decrease a fleet's risk. Usage-based insurance is one example. Another is charging station monitoring, which can provide the real-time status of chargers, KPI charge reports, remote resets of chargers, and automated incident reporting within a depot, among other benefits.

### Safety

These services increase the security of the fleet and its drivers. For example, real-time truck data can enable automated emergency calls complete with instant information that facilitates rescue services. It can also provide road hazard warnings that allow drivers to be informed and respond quickly. Relevant services include predictive collision avoidance and real-time driver assistant systems that reserve charging stations and parking spaces and help with real-time route and break planning.

### Convenience

Services in this category mostly target the truck driver's enjoyment and ease of driving. Bonus and loyalty schemes are examples; they are based on driving data and may use gamification to reward safe and efficient drivers. Another convenience service is driver onboarding and storage of preferred settings, something that becomes increasingly important for electric trucks, where drivers need to be extensively onboarded and detailed profiles stored.

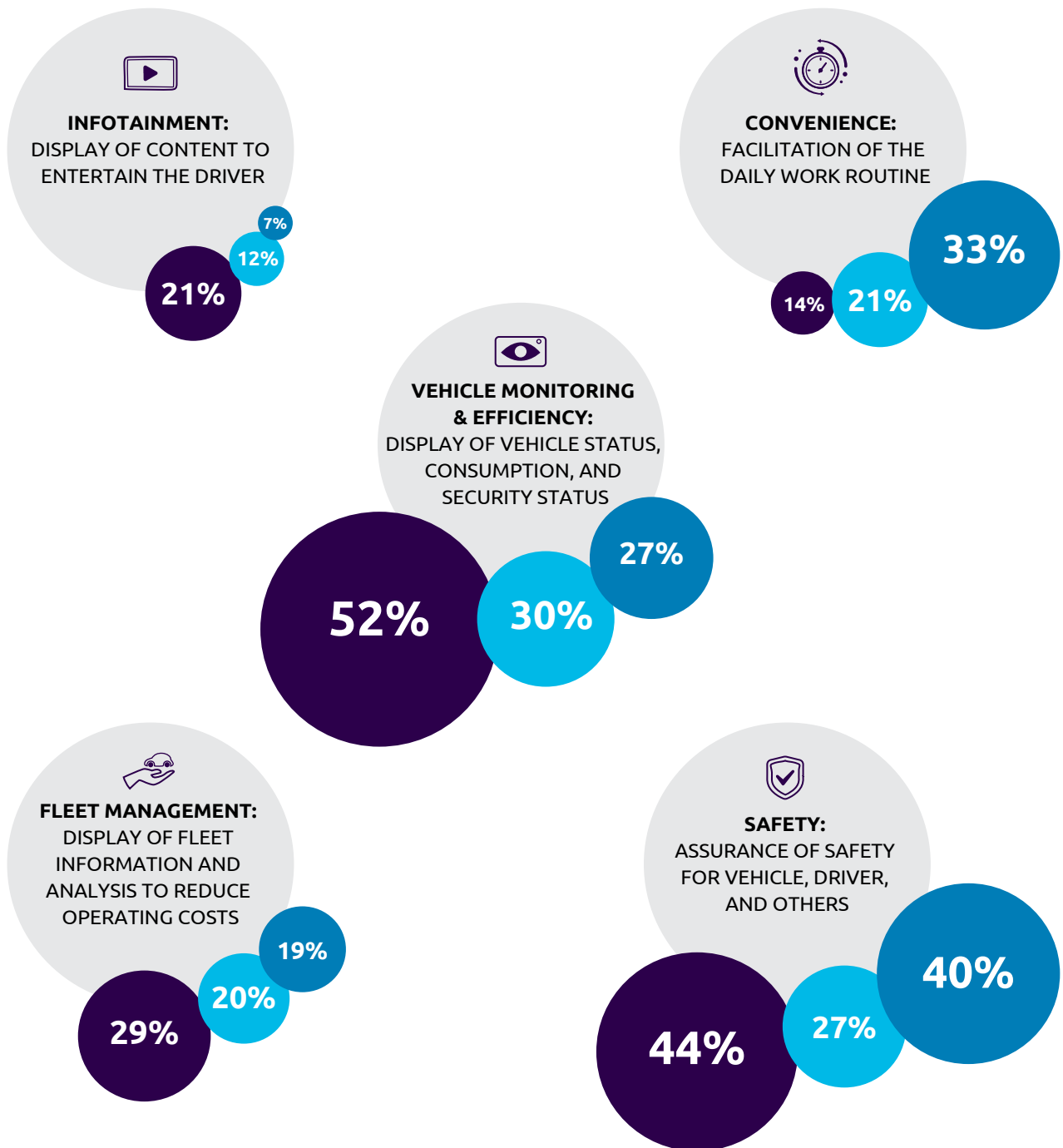
## PRIORITIZING SERVICE INVESTMENTS

To maximize the monetization potential of their service portfolio, OEMs should assess each potential new service against two factors: customers' willingness to pay for the service and the time it will take to bring it to market. This becomes even more important when e-trucks are introduced because they need additional types of connected services. It is critical that OEMs offer the services that satisfy customer expectations of a smooth, successful experience.

Figure 11 shows the service categories for which participants in each of the countries we surveyed are most willing to pay.

FIGURE 11

WILLINGNESS TO PAY FOR CONNECTED SERVICES BY CATEGORY



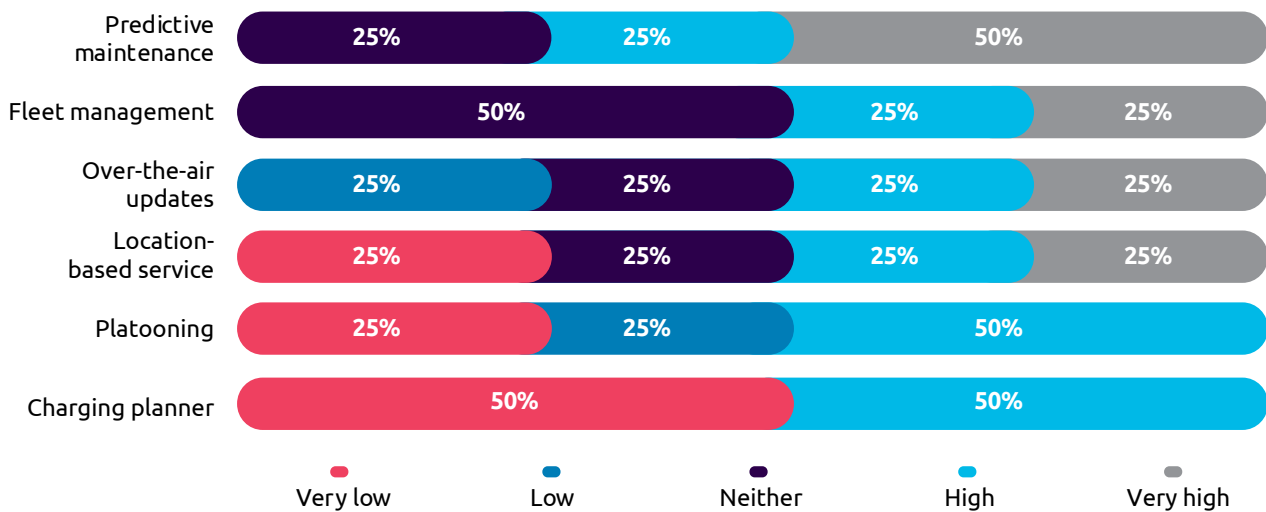
Willingness to pay varies between categories and regions. Our research shows that of all the categories, Chinese customers are most willing to pay for efficiency services (e.g. vehicle monitoring, fleet management) whereas German customers are most willing to pay for safety services. In the US, willingness to pay is not as clearly focused on one category, though willingness to pay for services relating to driver convenience (e.g. facilitating the daily work routine, driver entertainment) is higher here than in other markets.

In practice, selection of services has to be an iterative process. Each service will need to be piloted and assessed against predetermined criteria, typically customers' willingness to pay and time to market. Services that cannot meet the criteria should be discontinued after the pilot.

Figure 12 shows the services with the greatest monetization potential according to Capgemini research.

**FIGURE 12**

**B2B CONNECTED SERVICES WITH BEST MONETIZATION POTENTIAL**



**REMOTE AND TELEMATIC SERVICES** have the highest monetization potential for OEMs





## 2. SERVICE INTEGRATION

Integration of third-party apps/services into trucks provides the second of our three revenue streams. The revenue arises from the fact that integrating third-party services generates commission and enables OEMs to offer premium services at minimal cost.

Collaboration between an OEM and a service provider has advantages for both parties. The service provider gets to extend its user base and/or increase frequency of service usage, and it also gets to become part of the OEM's connected service ecosystem. Meanwhile, the OEM extends its portfolio with familiar and/or attractive service offers, so improving customer experience and satisfaction. It retains control of the customer relationship, though not of the data handled within the third-party service.

Service integration does require up-front investment since the OEM has to provide connectivity functions and APIs to enable the third-party services to be integrated into existing systems and devices.

Recruiting third-party service providers should be relatively straightforward provided that the OEM selects the right mix of connected services for its portfolio. Then the overall customer base can be expected to increase, and with it the user base for connected services. This larger user base will in turn attract more service providers.

Which services should be developed internally and which should be entrusted to third parties? In general, OEMs should focus on their core competencies, and functions that are aligned with these competencies. For example, OEMs should consider delivering connected services that are based on the main functions of a truck or that provide data for product optimizations and cost reduction.

Third parties, on the other hand, are well placed to provide services for which customers are willing to pay but which OEMs do not have the capabilities or the know-how to develop to the right standard. For example, Netflix and Spotify can provide quality media services. Map providers already offer the functions and services needed to expand navigation capabilities. The selection of ecosystem partners is discussed in our chapter on Strengthening Innovation.





### 3. DATA MONETIZATION

The third and most important revenue stream that OEMs can derive from connected trucks arises from data monetization, first through selling data to third-party providers and second through using it internally, especially – but not only – for cost reduction.

#### CONNECTED VEHICLES CAN GENERATE A WEALTH OF DATA

Today's trucks are loaded with in-vehicle technologies such as sensors, cameras, Wi-Fi, displays, and more: technologies that not only connect the customer or driver more closely to the vehicle but also connect the vehicle with its surroundings and with other vehicles ("vehicle-to-everything" or V2X).

Industry estimates indicate that these connected trucks can generate up to 25 GB of data per hour, collected via about 400 sensors and 1,200 different parameters (see Figure 12). Future trucks will undoubtedly feature increasing amounts of in-vehicle technology and connected services, and generate even more data.

An OEM that exploits all this data fully can become a leader in data-driven services and enjoy significant new value streams.

Selling raw, anonymized data to third parties, either directly or via data platforms, is a fast and effective way to obtain value from it. The type of data can be anything from information on road infrastructure to weather gathered by the sensors around the truck. The more connected services are in use, the more data is available. Before it can be legally sold, the data needs to be made anonymous, so that it cannot be traced back to the truck, its driver, or its owner.

The sale of such data not only brings value to the OEM but can also help third parties to optimize their products and services and to create insights, so that the ecosystem membership is mutually beneficial. An example is provided by map developers, who need real-time infrastructure data for continuous enhancement of street maps. OEMs can offer them anonymized data collected from trucks via their data platform in return for a fee. In a more advanced form of this transaction, real-time anonymized traffic data can be transferred automatically to the map developers within seconds.

Internally, OEMs have the opportunity to monetize data through data analytics drawing on the vast amount of personal, behavioral, and driving data provided via integrated technologies and connected services. Analyzing this data generates insights that can be used for cost reduction through product and service optimization, and marketing and sales initiatives. An example of product improvement would be using the data within research & development to lengthen vehicle life span or enable predictive maintenance and remote diagnostics. With regard to service optimization, data facilitates enhancement of connected services.

#### DATA IS ALSO THE KEY TO STRONGER CUSTOMER CONNECTIONS

We have discussed various ways to raise money from connected services, the most important being data monetization. Arguably, however, the most important role of data is its ability to help OEMs understand the needs of customers. OEMs who offer the right services and use the data to create a strong connection with customers will be the real game changers.

Monetizing data, in particular, requires access to a managed ecosystem of players who will shape the vehicle data landscape. OEMs' own role within the ecosystem includes gathering data and sharing anonymous data between parties such as service providers, governments, and regulatory authorities. This is the topic of our next chapter.

FIGURE 13

B2B CONNECTED SERVICES WITH THE BEST MONETIZATION POTENTIAL

Examples of data signals



**Driver settings**  
Driving data  
Tachograph data

- Driver identity
- Preferred settings
- Driving period
- Stress level
- Average fuel consumption



**Navigation data**

- GPS speed
- Navigation destination
- State of motion of the vehicle



**Communication data**

- Vehicle-to-vehicle communication



**Breakdown data**

- Crash location
- Crash severity



**Smartphone data** Examples

- Mobile phone pairing
- Use pattern of applications



**Warning systems data**

- ABS/ESP events
- TDC
- ADAS events
- Sensors



**Engine data**  
Service data  
Vehicle data

- Status of tire pressure
- Coolant and oil level
- Condition of lights
- Engine temperature
- Battery status
- Range of tank capacity
- Date of next service



**Assistance systems data**

- Capture of environment
- Recognize signs



**Trailer data**

- Total weight



**General data**

- Display unit of the instruments
- Outside temperature
- Truck position



# STRENGTHENING INNOVATION: BUILDING DIGITAL ECOSYSTEMS

## TECHNOLOGY CHANGE, MARKET DISRUPTION, AND THE MOVE TO DIGITAL ARE FORCING OEMS TO INNOVATE AS NEVER BEFORE, USING BOTH INTERNAL AND EXTERNAL CAPABILITIES

For several compelling reasons, truck OEMs today need to be able to innovate effectively. They have to respond to new technological needs such as those arising from tighter regulation: For example, as we have seen in earlier chapters, they must forge ahead with alternative powertrains and become suppliers not just of vehicles but also of connected services.

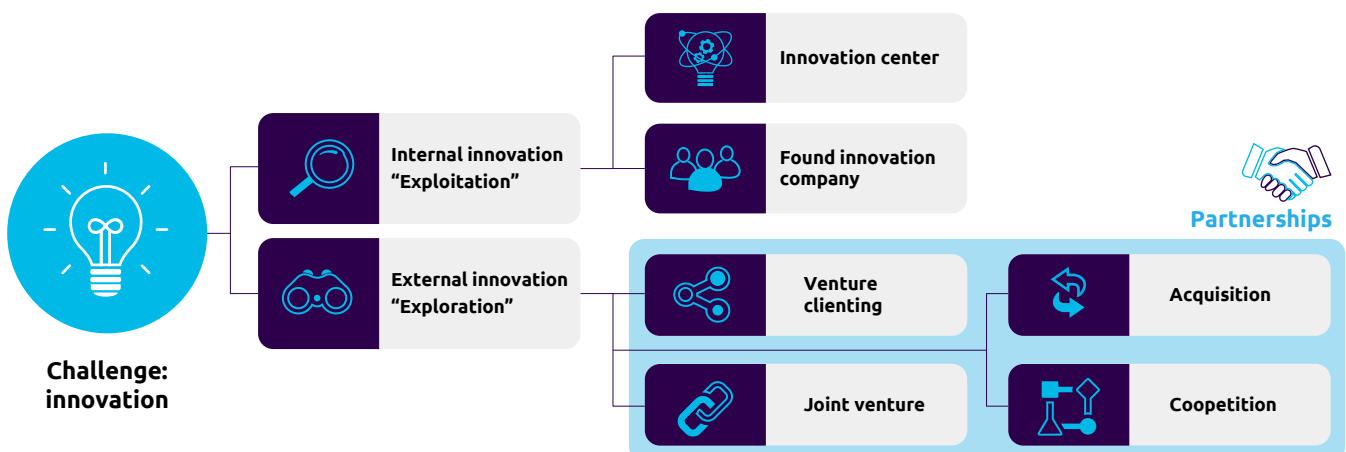
Another reason for innovation is to combat the threat from emerging competitors. As we saw in the introduction, some new competitors are aiming to capitalize on specific opportunities such as alternative powertrains and connected services, while others are launching a wholesale attack on the OEMs' market.

The third, and perhaps most compelling, reason to innovate is in order to keep pace with the industry's general move to connected services. Truck OEMs are shifting their business toward digital (including connected services) – part of a more general trend, revealed by recent Capgemini research, toward riskier, more substantial, and more transformational projects. Customers, too, are demanding a digital experience, preferably one that is seamlessly integrated with other applications that they use. To meet this demand, OEMs need to offer a broad portfolio of services connected together intelligently.

Faced with these challenges, OEMs must transform the way they innovate. Each OEM has to decide how to do this. As Figure 14 shows, their options are to leverage existing innovation capabilities internally or turn to external innovation sources such as digital ecosystems – or some combination of the two.

FIGURE 14

### OVERVIEW OF OPTIONS FOR INCREASING INNOVATION CAPABILITIES



## DIGITAL ECOSYSTEMS: OUR DEFINITION

In biology, ecosystems are “all the plants and living creatures in a particular area considered in relation to their physical environment.” In the context of digital services, an ecosystem is a network of companies, products, partners, suppliers, and customers, all connected via digital means (e.g. by exchanging information digitally).



### INTERNAL INNOVATION: EXPLOITING EXISTING CAPABILITIES



### INNOVATION CENTERS

Innovation centers such as accelerators, incubators, and labs provide an autonomous environment for innovative people, with a campus for collaboration. This type of environment creates openness to new ideas and approaches and makes it possible to innovate independently of company constraints for the duration of the initiative.

This idea has quickly entered the mainstream. The majority of large companies now have a lab or innovation space of some kind. Our research shows that in Germany, the number of innovation centers increased by 28% between 2016 and 2019. The commercial vehicles sector is also following this trend: For years, companies such as MAN (FutureLab) and Scania (Innovation Factory) have used innovation centers to identify new business models and products.

The innovation center concept has some disadvantages, however. It inspires creativity only temporarily, and the boundaries and agility of the process are ultimately determined by the group as a whole.



### NEW INNOVATION COMPANIES

One way to overcome the disadvantages of the innovation center is to found a new innovation subsidiary. Here, group-wide initiatives can take place and staff can be 100% dedicated to innovation roles.

This approach offers the best of both worlds. On the one hand, the innovation companies can profit from the vast expertise and financial power of a global parent. On the other hand, they provide an environment for creative and innovative minds with freedom to bring new ideas to life in a startup-like atmosphere beyond conservative group boundaries.

These companies are also characterized by an agile working style and a fail-fast culture that enables them to quickly launch and close down new services, thereby reducing time to market. In addition, they are staffed not only with people from the parent group but also with young talent hired for their innovation capabilities, who bring a fresh mindset and new ideas.



### FINDING INNOVATION COMPETENCIES OUTSIDE THE ORGANIZATION

The skills needed for innovation are expensive and scarce. Developing these skills inside a corporation is capital-intensive and time-consuming. Innovation companies can attract talent and skills more easily, but it still costs money. In addition, taking too long to build the skills base might threaten an OEM's market position, given that new competitors are achieving rapid time to market.

External innovation sources and partners can often provide a faster way to access the missing competencies. Figure 14 shows how companies' approaches differ, confirming that the more a company has a comparative advantage in innovating using internal resources, the less it will use external innovation sources.

Partners can provide more than just additional capabilities, of course. In some cases, OEMs may also benefit from valuable data, customer knowledge, an agile and efficient organization, or an established brand reputation.

**CHOOSING PARTNERS**

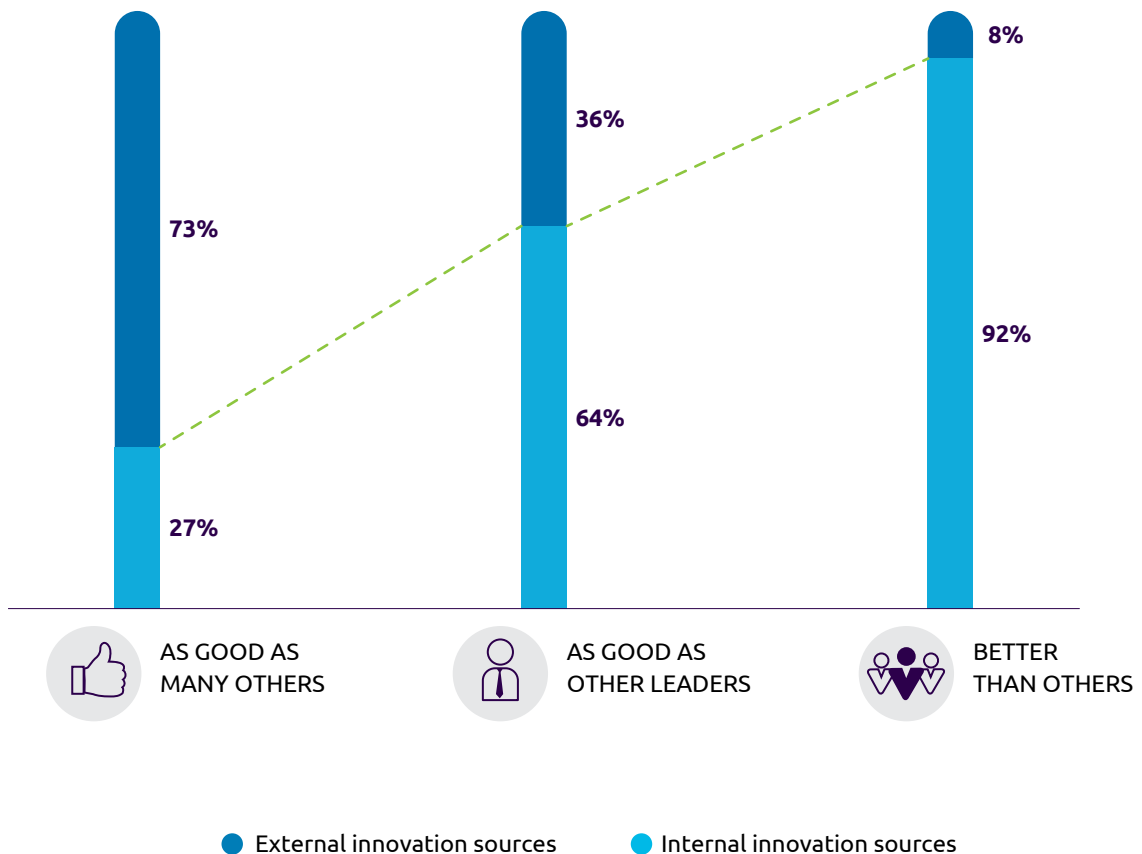
OEMs have a growing array of possible partners to choose from. Suppliers are among the most traditional sources of external innovation competencies and are still widely used.

However, we are also seeing the emergence of a wide variety of new sources, as shown in Figure 16.

This broadening of choice is happening fast, and the new innovation sources are becoming more and more important, though not to the exclusion of traditional partners. A recent Capgemini study on corporate innovation found that 30% of companies had launched partnerships with universities in the past two years, and 41% with startups (Figure 15).

**FIGURE 15**








THE GREATER A COMPANY'S COMPARATIVE ADVANTAGE IN USING INTERNAL RESOURCES, THE LESS IT WILL USE EXTERNAL SOURCES



Source: MIT-Capgemini Corporate Innovation Research

**FIGURE 16**

EXAMPLES OF EXTERNAL INNOVATION SOURCES

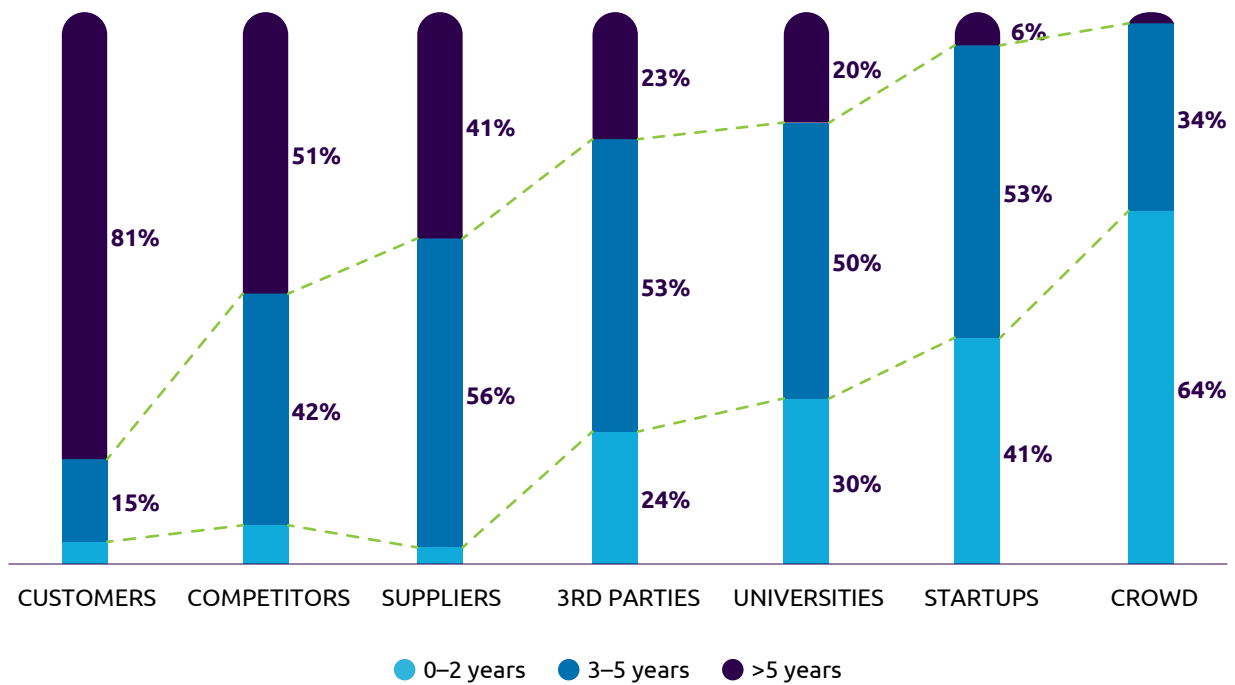
External innovation sources	Description
<b>Suppliers</b> 	Firms who are in, or could be in, the value chain of the company.
<b>Universities</b> 	Universities or independent researchers who are sponsored by the company or whose innovations are licensed or otherwise acquired.
<b>3rd-party</b> 	Independent providers of product or services, including technology vendors, consulting/design firms, independent innovators, and opinion leaders; excluding startups.
<b>Customers</b> 	Customers who provide feedback on innovation by companies, and participate in co-creation of proofs of concept.
<b>Startups</b> 	Startups who are solicited through innovation scouting, incubators, accelerators, corporate venture capital, acquisition, etc.
<b>Competitors</b> 	Innovation developed by competitors that were open source, acquired via licensing, brought in by former employees, or reverse engineered, or which arose from industry collaborations/associations.
<b>Crowd</b> 	Innovations that originate from crowd-sourcing platforms, hackathons, innovation competitions, or third-party developers.

We strongly recommend that OEMs consider the full spectrum of innovation sources, choosing appropriate solutions for each specific requirement. The choice of partner depends on which objective is being pursued (process skills, asset needs) and at what point in the innovation cycle the collaboration needs to take place. For technologies that

are already in high demand by customers and are therefore critical to competitiveness, we recommend working with startups and companies that are already specialized in the relevant field. By doing so, time to market can be significantly shortened.

**FIGURE 17**

OVERVIEW OF INNOVATION SOURCES THAT COMPANIES PARTNER UP WITH AND DURATION OF THESE PARTNERSHIPS.





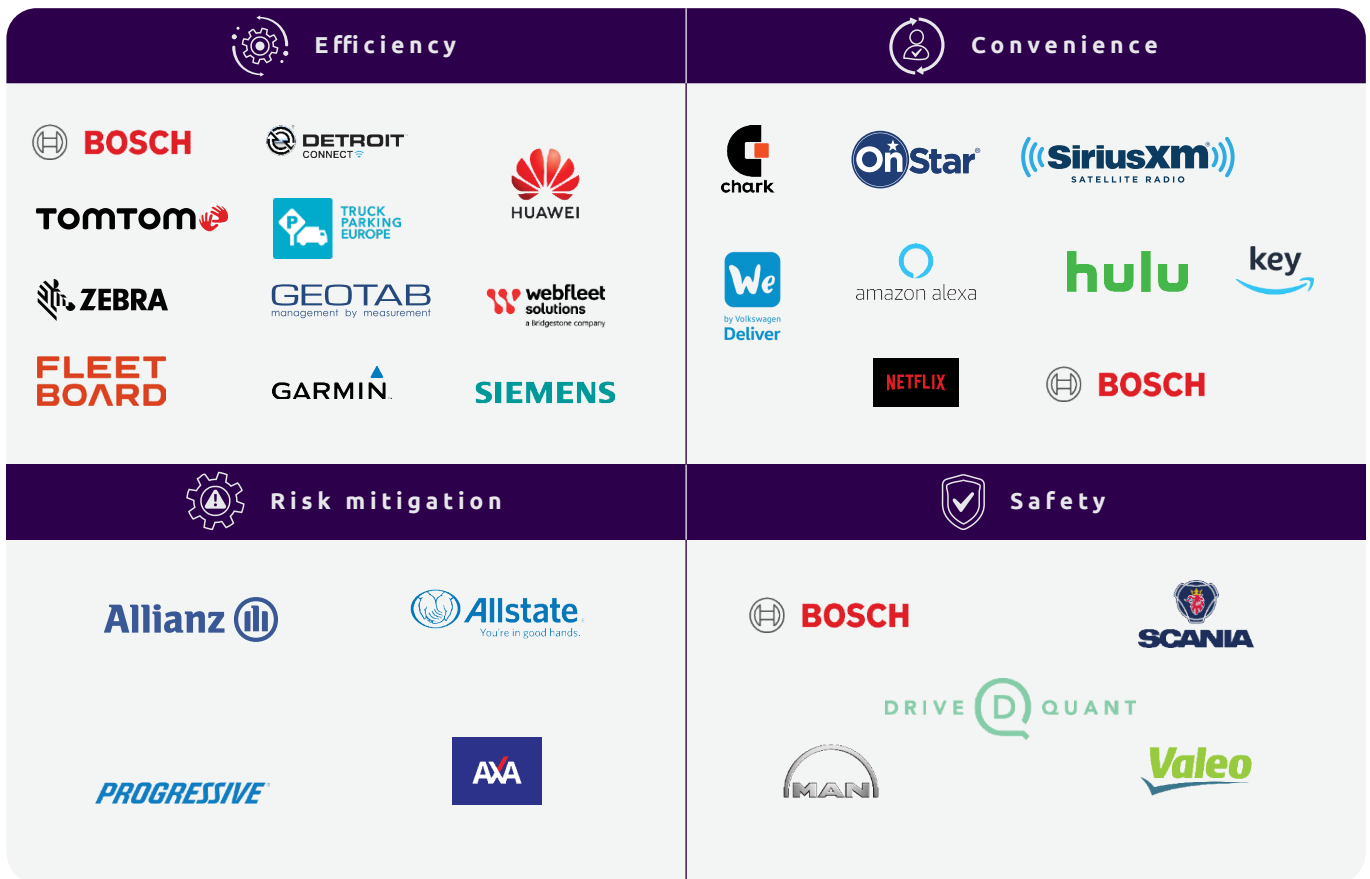
The previous chapter identified four different service categories that are key for truck OEMs: efficiency, risk mitigation, safety, and convenience. Specialists have already emerged in these categories, as shown in Figure 16, and may be candidates for partnership with OEMs.

However, this picture is changing rapidly. By watching for the rise of new players in their chosen innovation areas, OEMs can win the race for the best partnerships.

One way to get in touch with rising stars is to join an innovation network, as many truck OEMs are doing. For example, to access other Nordic industrials and the local startup scene, Scania has joined Combient and Combient Foundry, a network and accelerator established to help Nordic companies stay competitive.

FIGURE 18

EXCERPT OF PARTNERSHIP LANDSCAPE



Source: Capgemini Research



## CHOOSING THE RIGHT FORM OF PARTNERSHIP

As well as choosing the right partner, OEMs should also take care to choose the right form of partnership. Once again, different models will suit different objectives. Aspects to consider include the level of control required over the partnering entity and the level of risk that is acceptable, as well as the desired intensity of collaboration.

In the rest of this chapter, we describe some of the available forms of partnership: venture client model, joint venture, acquisition, and cooperation.



## VENTURE CLIENT MODEL

In this model, a corporation buys a startup's solution with the intention of using it to improve or create a new product, a process, a business model, or an entire business. Traditionally, the larger company might have bought equity in the startup, but here they instead buy rights to the product. The corporate becomes the first major client of the startup, and applies the solution immediately in a real business environment.

The model has several advantages. Since corporations are buying startups' solutions rather than their equity, they no longer have to compete with professional venture capitalists for the best startups. The model also provides an effective method of solving problems across the organization. By setting up a venture client unit networked with decision-makers in every department, the corporation can rapidly disseminate startup solutions. In addition, it can run many proofs of concept with startups simultaneously.

This model is already starting to be used in the automotive industry (notably at BMW, where it was pioneered). We recommend that truck OEMs consider it.



## JOINT VENTURE

A joint venture is a subsidiary that is founded and managed by at least two independent companies. These companies contribute capital and know-how to the joint venture, and they share the management responsibilities and financial risks. However, the joint venture itself is a legally autonomous company that acts independently.

This form of partnership is already widely used by truck OEMs. For example, the TRATON Group and Hino Motors set up HINO & TRATON Global Procurement to realize synergies in procurement and jointly expand their global supplier

network. Joint ventures are also often used to operate in markets that are subject to regulatory restrictions: TRATON Group's MAN brand and Chinese company Sinotruk have set up a joint venture to develop a heavy-duty truck for the Chinese market.

Joint ventures do not always fulfill their promise. For example, LoadFox, a logistics platform founded jointly by MAN Truck & Bus and BCG Digital Ventures in 2017 ceased operation in 2020. A joint venture focused on developing driverless trucks, Starsky Robotics, also shut down in 2020.

Setting up a joint venture is capital intensive and can involve organizational complications, so it has to be thought through properly. Points to consider include the number of companies cooperating, the area of cooperation (e.g. specific technology), and the style of equity participation (equal or unequal partners).



## ACQUISITION

Mergers and acquisitions are a way to gain full control of a startup or other company. Acquisitions are of special interest when OEMs want to secure exclusive rights to innovations.

The truck industry commonly engages in mergers and acquisitions when the target company has proved its worth in future-oriented fields of technology. For example, Daimler Trucks recently acquired a majority stake in Torc Robotics, a pioneer within the field of autonomous driving. By doing so, Daimler Trucks aims to create a uniquely innovative team to bring autonomous trucks to market.



## COOPERATION

Cooperation is characterized by the fact that the companies partnering up, for example through a joint venture, are in direct competition with each other, in the same market. Partnerships of this kind can help the parties to share risks, increase investment, pool know-how, and accelerate innovation.

Cooperation is increasingly popular within the commercial vehicles sector. One of the latest examples is the partnership between Daimler Trucks and the Volvo Group, who have announced a collaboration for the development, production, and marketing of fuel cell systems in heavy commercial vehicles, among other fields. This cooperation will take the form of a new joint venture in which both companies hold 50% of the equity.



# BUS INDUSTRY:

## REALIZING THE POTENTIAL



**Alexander Schabert**  
*Chief Commercial Officer (CCO), ViriCiti*

Many of the same challenges and opportunities that face truck OEMs also apply to buses. Emission regulations, for example, are forcing OEMs worldwide to reshape their bus product portfolios.

As part of our research, Capgemini had the opportunity to discuss some of the topics of this report, as well as the important issue of autonomous driving, with Alexander Schabert, CCO of ViriCiti. This company is involved in some of the world's largest commercial electric operations (city buses and trucks) in over 20 different countries.



ViriCiti was founded in 2012 by four engineers. They started by building an efficient and scalable fleet telematics platform specially designed for electric commercial vehicles. Since then, the growing organization has specialized in combining the newest internet technologies with electric vehicle knowledge. ViriCiti now offers a platform that serves both bus operators and OEMs. From energy management to maintenance, its online monitoring system provides detailed insights, individually tailored to the needs of fleets.

Below are some extracts from our interview with Alexander Schabert.

## SUSTAINABLE TRANSPORTATION



### **How great is the pressure on operators to replace parts of their fleets with buses powered by alternative powertrains?**

The pressure is definitely on, worldwide. China has been the first to make a start, electrifying about 80,000 buses per year. Electrification has become a very political issue there. Chinese bus operators belong mostly to the cities, municipalities, and public authorities, and are thus directly influenced by politics to become greener.

China's electrification focus is showing the rest of the world how to effectively make use of e-buses in city centers, and this has now become a global trend. Governments all over the world are focusing on electrifying the public transport segment. Electrification for buses is a good place to start because of their pre-defined routes and high utilization in city centers.

### **What challenges arise from the transition to alternative powertrains?**

From my perspective there are three major challenges:

1. At present, the biggest challenge is range. Many operators only have a few electric buses in their fleets. Fleet managers' biggest questions are whether bus services are able to run under different environmental conditions (very hot or cold weather, heavy traffic).
2. Charging infrastructure becomes crucial once electric buses represent a large part of the fleet. Fleet managers are growing increasingly concerned about how many electric buses or trucks can run with the existing electrical infrastructure. There needs to be a lot of investment in the infrastructure to facilitate larger bus

fleets. Over time, battery capacities will become larger, which will enable longer ranges. However, the grid infrastructure will then need even higher capacities or be smarter to charge all the electric buses fast enough.

3. Given the costs of electric buses and also the charging infrastructure, the financial aspects are another challenge. Fleet managers question how long the vehicles' components (especially batteries) will last. A bus, for example, is expected to be used for 12 years. Will the battery last for the same period and, if not, what are the costs of replacement in five to six years?

### **What impact does this have on urban infrastructure?**

Two different types of charging are possible for buses. In the first, buses always charge overnight at the depot, so the complete charging infrastructure needs to be set up there. Because bus operators normally own the depot and the ground on which it is built, they would have full responsibility for solving this challenge.

The other possibility is using charging stations during the day, making use of "opportunity charging." This includes charging stations at final destinations and at bus stops that the bus passes along its route. Opportunity charging stations – certainly those at bus stops – are typically owned by the municipality, and in this case, the municipality should be responsible for setting up the charging infrastructure.

Both forms of charging have a massive impact on the power supply. Within the city, it is important to look at the power lines and choose the right spots for setting up charging stations. At the depot, the biggest issue is the huge amount of power that is needed to charge the complete fleet.

### **What potential is there for fuel cell technology?**

The fuel cell has some advantages. It guarantees a longer range than an on-board battery. In terms of charging management, the fuel cell can be handled via the available infrastructure at fuel stations. Thus, processes and infrastructure would not have to change significantly to accommodate hydrogen.

But as soon as energy density in batteries increases and the charging infrastructure becomes smarter with the "smart grid," the balance could easily tip toward battery electric buses and away from fuel cell technology.

## CONNECTED SERVICES



### How big is the potential for connected services in the bus segment?

I see the bus sector as an interesting one for connected services. There are a lot of stakeholders to be considered, e.g. passengers, drivers, maintenance managers, and financial managers. Each stakeholder is interested in a different kind of data.

First, it will be necessary to raise stakeholder awareness because bus organizations are generally not yet data driven. You must start at the beginning, explaining the added value of the data. I believe the most important stakeholders to convince of the benefits of getting more data from their buses are the maintenance managers, who are mostly interested in technical data.

A big discussion at the moment is around the smart workshop and how it should be able to receive real-time alerts from vehicles or, even better, predict issues before they happen. Using this technical vehicle data efficiently will be a big potential cost saver for bus operators.

### What are the most relevant connected services in terms of making everyday life easier for the various target groups (e.g. bus drivers, fleet managers, city transportation managers)?

With new vehicle technologies, every stakeholder will be affected to some extent. Therefore, we need different connected services.

One of the key problems is energy management and predicting precise ranges for the buses, in order to plan and monitor whether they can complete their routes. Therefore, for control centers, precise range predictions will be crucial.

Connected services related to bus and battery health are also very important. With the latest internet technologies, it is possible to transfer enough data from vehicles into the cloud in real time, to be able to create a virtual digital twin of the bus. This will be extremely useful in terms of predictive maintenance and battery health predictions.

Another key stakeholder of the electric bus is the driver. Drivers must be trained to use the regenerative braking of electric buses properly to get more range out of the existing battery capacity. Good software tools can help drivers get the maximum out of their batteries.

With regard to charging infrastructure, a key connected service will be load balancing. This will take into account when a vehicle needs to leave and how much energy it will need to fulfill a certain trip. Based on that, the charging process is planned for each vehicle while also aiming to reduce the required power as much as possible and therefore save costs by not having any power peaks.

### What technical challenges could stand in the way of offering intelligent services?

From my experience, the biggest problem is missing standards. Standards would make it possible for the same data to be read out from vehicles made by different OEMs.

The sector desperately needs to create standards such as a Fleet Management System (FMS) standard for electric trucks and electric buses. The current version of the standard only covers hybrid buses and does not include any of the relevant parameters that need to be monitored for fuel cell or battery electric buses.

Without these standards, consistent and efficient data usage is not possible. Missing standards in general limit the operators' utilization of electric buses and connected services.

## STRENGTHENING INNOVATION



### Why is a successful digital ecosystem necessary for all stakeholders?

In order to ensure cost-effective and reliable bus operation, data flow within the ecosystem is essential, especially with regard to efficient energy and charging management. This data flow is only possible if all relevant players participate in the ecosystem.

### **What partnerships should OEMs build to create a successful digital ecosystem?**

From our perspective, operators need to build ecosystems themselves, while OEMs should create standards. In nearly all cases, operators already have software systems in place.

Since different operators use different systems, OEMs must be flexible in this respect. OEMs cannot just impose their own way of doing things but must be able to integrate themselves into their customers' existing IT landscapes.

I believe OEMs need to rethink their data sharing strategy. OEMs that are transparent in sharing bus data will create a head start so that customers can operate their buses more cost-effectively.

### **What standards should partnerships adopt for technology and data?**

The most important aspect is standardizing the available parameters for vehicle and battery data. Right now, operators demand access to certain data in their tenders. This, however, differs with every tender and makes it very inconvenient for the OEMs but also for the software vendors, as every customer has a special wish that needs to be taken care of.

Standardizing the bus parameters and giving access to as many parameters as possible will help the OEM to win a tender and more importantly, help the operator to have a more effective bus operation with all required data.

### **Who will have data sovereignty in the future? What should the strategy be here?**

In my opinion, data that is necessary for further product development should remain with the OEM, but data necessary for effective fleet operation should be made available to fleet managers.

## **AUTONOMOUS DRIVING**



### **What level of autonomous driving (between 0 and 5) have OEMs currently reached? What level do they expect to achieve between now and 2025?**

There are some tests and initiatives from OEMs to convince customers to move toward level 2–3. I guess this is also the level we can reach by 2025.

### **How open are operators to autonomous driving, and particularly to level 4–5?**

For most operators this topic is still far in the future. There are some tests going on worldwide with small autonomous buses, but these tests are mostly on private grounds, always with a driver on board, and at a very slow speed.

### **What would be the advantages of autonomous driving for urban traffic?**

Especially in rural areas, I see a lot of potential. Instead of having a bus come by twice a day on a fixed route, an autonomous bus fleet could pick up passengers on demand and drive them to larger hubs. At the larger hubs, larger buses can serve a city's main routes on a fixed but frequent schedule.

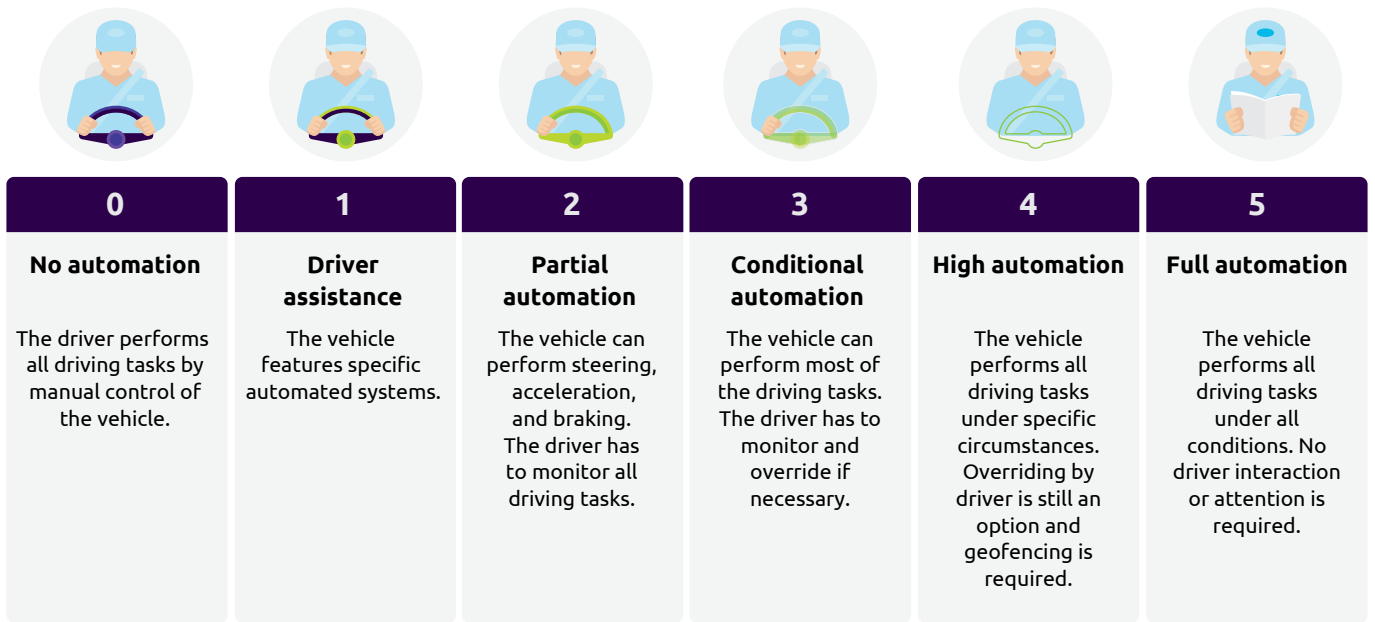
Apart from flexibility, the other big advantage is that it will save a lot of costs. The driver is the biggest of all the operational costs. Autonomous driving would therefore either lead to a cheaper bus service, or to a better, more frequent service (with more vehicles) for the same cost.

## **NOTE**

The local nature of the bus business means that it is the operators who will have to build the ecosystems. This contrasts with the truck industry, where Capgemini believes OEMs will be responsible for ecosystems.

**FIGURE 19**

OVERVIEW OF INNOVATION SOURCES THAT COMPANIES PARTNER UP WITH AND DURATION OF THESE PARTNERSHIPS.





# CONCLUSION:

## ACT NOW TO ESTABLISH A LEAD IN COMMERCIAL ELECTRIC VEHICLES



### Sustainable transportation

- ✔ Although EVs are more expensive than conventional vehicles, movements in battery technology, energy prices, and taxation will narrow the TCO gap by 2030.
- ✔ FCEVs are probably better for long-haul journeys and heavy payloads, BEVs for short distances and light loads. For sustainability, FCEVs will be preferable to BEVs; both will outperform diesel.
- ✔ New infrastructure will be needed to accommodate heavy-duty vehicles with their high power and energy needs and specific space, parking, and access requirements.
- ✔ OEMs can gain an advantage over new entrants by building on their rich truck experience, and by working with existing customers to prepare them for the transition to EVs.



### Connected services

- ✔ Commercial vehicle customers value connected services and are more willing than passenger vehicle customers to pay for them. Chinese customers are especially enthusiastic.
- ✔ OEMs themselves can derive value from connected services by leveraging three major revenue streams: service provision, service integration, and data monetization.
- ✔ OEMs should tailor their service portfolios to reflect local preferences for specific categories of service. Safety is the most important category in Germany, efficiency in China, while the US tends to value convenience.
- ✔ OEMs should rigorously trial each service that they propose to launch and terminate trials swiftly if set objectives are not being met.



### Strengthening innovation

- ✔ For an agile response to new technologies, competitors, and regulations, OEMs should build an ecosystem of partnerships supplementing their internal capabilities around digital services, business models, and technology.
- ✔ OEMs should monitor the market to find the best prospective partners, also considering less traditional candidates such as universities. Rapid partner evaluation processes are also needed.
- ✔ OEMs should evaluate the full range of partnership models including newer ones such as venture client and cooptation.
- ✔ Alternative approaches to fostering internal innovation such as innovation centers and separate innovation companies should also be investigated.

Historically, the commercial vehicles sector may sometimes have had a reputation for relative conservatism and for following in the wake of passenger vehicle OEMs. Now that reputation looks set to change, because some of the most exciting developments in the automotive industry are even more relevant to trucks and buses than to passenger cars. By getting to grips with the issues described in this report before their rivals do, companies can secure a competitive edge in this dynamic new world – and perhaps blaze a trail for the rest of the automotive industry.

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The Taking the lead with sustainable transportation study is part of Capgemini's **Smart Mobility Connect**, a series of custom automotive offers that address the need for customer centricity. Smart Mobility Connect empowers clients to digitalize their core business and customer-facing channels (connected customer), monetize new growth potential (connected services and products), expand the profit pool with new partnerships (connected ecosystem), and transform to a customer-centric business, leveraging the overarching AI-enabled customer engine platform. <https://www.capgemini.com/service/invent/smart-mobility-connect/>

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