A STUDY ON THE MARKET FOR IN-VEHICLE DATA IN THE EU

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A STUDY ON THE MARKET FOR IN-VEHICLE DATA IN THE EU

Copenhagen Economics

Connectivity enables remote access to vehicle data. **Original Equipment Manufacturers (OEMs)** of vehicles oversee and control access to data. Meanwhile, some aftermarket service providers push for expanded access to further enhance their offerings for vehicle owners.

OEMs HAVE INCENTIVES TO PROVIDE ACCESS TO IN-VEHICLE DATA, PARTICULARLY FOR COMMERCIAL VEHICLES

OEMs have incentives to ensure the quality of aftermarket services if it impacts their competitive edge and market position in vehicle markets

Competition among OEMs is strong, but the importance of aftermarkets varies between private and commercial customers

The quality and costs of aftermarket services feature heavily in the buying decision of a commercial vehicle and commercial customers rely on vehicle data for fleet management.

Consumers may, at least at present, find it difficult to factor in aftermarket services in their car-purchase decisions.

MARKET OUTCOMES ARE NOT CONSISTENT WITH MARKET FAILURE IN ACCESS TO IN-VEHICLE DATA

Vehicle data is available from non-OEM sources, and existing regulations ensure data access and sharing.

OEMs provide third parties with data on vehicle location, health, and driver behaviour.

Over 100 data points for some passenger car models

Over 300 data points for some heavy-duty vehicles

Strong adoption of data services in commercial vehicles, driven by consumer demand for services essential to their businesses, such as fleet management solutions.

Limited adoption of data services for private cars such as usage based insurance, likely driven by low demand.

Consumers appear satisfied with current services and show limited willingness to pay extra

NEWLY INTRODUCED REGULATIONS WILL FURTHER REGULATE ACCESS TO IN-VEHICLE DATA

Data Act (effective in 2025)

Mandates access to raw and pre-processed data generated by connected vehicles under fair, reasonable and non-discriminatory (FRAND) terms.

EV-specific regulations

The Battery Regulation and Renewable Energy Directive mandate access to battery and charging data for eMobility services.

For further information, see the full study at www.copenhageneconomics.com

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EXECUTIVE SUMMARY

Modern vehicles feature connectivity functions that allow remote access to the vehicle's data, such as its door lock status, location, or fuel efficiency on recent trips. Vehicle manufacturers (henceforth, original equipment manufacturers or "OEMs") design these features into their vehicles and manage access to guarantee the safety and security of their products.

Some aftermarket providers have suggested that OEMs exercise sole control and hold a monopolistic position on in-vehicle data.[1] There are concerns that OEMs may restrict access to this arguably important input, allegedly resulting in the following:

- Limited development of data-driven services due to limited access, high cost, and lack of standardisation of data across car brands.
- Creation of an unlevel playing field if OEMs' own aftermarket services are used to gain an unfair competitive advantage against independent firms.

Against this backdrop, the European Commission has proposed regulation in this matter since at least 2017. In 2022, the EC opened a public consultation to understand the potential need to introduce a sector-specific regulation on the access of in-vehicle data, function, and resources additional to the Data Act which comes into force next year.

To inform the policy debate, the European Automobile Manufacturers' Association (ACEA) has asked Copenhagen Economics ("CE", "we", "us") to assess whether market failures related to access to in-vehicle data could justify regulatory intervention. Considerations related to access to function and resources (so called "write-access") go beyond sharing data. They may imply the ability to modify the software of the vehicle which entail additional specific questions beyond the scope of this study, such as those related to cybersecurity and safety.

We find that there is insufficient evidence to establish the existence of a market failure. We summarise our main findings below: (i) first, we explain that evidence suggests OEMs do not have an incentive to restrict access to data; (ii) then, we explain that market outcomes are not consistent with market failures; and (iii) finally, we explain how regulatory measures already in place will likely address any residual concern.

OEMs have incentives to provide access to in-vehicle data particularly for commercial vehicles

[1] A related and parallel debate relates to whether or not access should be provided to some of the vehicle's functionalities (e.g. locking or unlocking doors) or their resources (such as the dashboard).

Vehicles are durable goods that require additional services during their lifetime. In economics, this creates a situation where there is a primary market (for vehicles) and one or many associated aftermarkets (e.g., for repair and maintenance, insurance, etc.). In-vehicle data is a potential input into aftermarket services and can improve their quality.

Our economic assessment starts by identifying plausible mechanisms through which competition could in theory be restricted and result in harm to consumers (i.e., "theory of harm"). We find the following two plausible '*theories of harm*':

- First, due to their presence in some aftermarkets, primary market suppliers (OEMs) may restrict access to data from aftermarket suppliers if this diverts downstream customers to their own aftermarket services.
- Second, as the sole controllers of data access, OEMs may have an incentive to restrict access to these data and charge high prices.[2] This will result in a suboptimal level of data being supplied and, if true, less choice for consumers.

As a matter of economics, both of these '*theories of harm'* depend crucially on OEM incentives. OEMs would not have an incentive to degrade the quality of aftermarket services, for example, by undersupplying data to third-party providers, if that would affect their competitive offering and position in the primary market of selling vehicles (i.e., aftermarkets and primary markets are interdependent and function as a 'system'). Insofar as any restrictions to the provision of data would jeopardise sales in the primary market, competition in primary markets would discipline OEMs.

We find that these conditions differ between privately owned passenger cars and commercial vehicles, including light commercial vehicles (LCVs) such as vans, heavy-duty vehicles (HDVs) such as trucks and buses, and passenger cars owned by professionals (e.g., rental and leasing companies), as follows.

For **commercial vehicles**, especially HDVs, the available evidence suggests that the costs and quality of aftermarket services have a significant impact on the choice of vehicle in the primary markets. Professional customers are typically sophisticated and informed. They consider the total cost of ownership of the vehicle and the availability of aftermarket services in their purchase decision,[3] as also confirmed by the Commission in recent assessments.[4] The link between the primary market and its aftermarkets, and the presence of competition among OEMs in those primary markets, are likely to mitigate any risk of undersupply of data for commercial vehicles.

[2] The total cost of ownership will generally also take into account how downtime affects the firm's profitability.

[3] In the case of buses, for example, procurement takes place through tenders which often include among the requirements the level and detail of vehicle data available, including often adherence to specific industry standards.

[4] European Commission (2021). Commission Evaluation Report on the Operation of the Motor Vehicle Block Exemption Regulation (EU) No 461/2010 and European Commission (2020). Case M.9730 – FCA/PSA.

For **privately owned passenger cars**, at present, there is not sufficient evidence to conclude that competition in primary markets disciplines aftermarket services. Cars represent a significant part of consumers' budgets, and aftermarket services, particularly repair and maintenance and insurance, account for a significant share of the total cost of owning a car (around 20 per cent). Some competition authorities have, however, found that lay consumers may have difficulties in assessing total 'life cycle' ownership costs across brands, and there is currently limited evidence to suggest that the availability of aftermarket services would drive consumers' choices over cars.[5] The development of data-driven aftermarket services is still in its early stages. Therefore, it is premature to determine whether consumers will in future put greater weight on increasingly data-driven aftermarket services.

Evidence of market outcomes is not suggestive of market failures

We assessed available evidence to understand whether there is evidence of an undersupply of data-driven services that are demanded by users. The evidence we reviewed does not appear to support these concerns, as follows:

First, OEMs already make in-vehicle data available to third parties based on customer consent. Data availability varies across OEMs in passenger cars, covering information on vehicle health, location, speed, mileage, fuel consumption, and, in the case of EVs, battery status with certain passenger car OEMs sharing more than 100 data points. Data availability is higher, especially for HDVs, which can provide more than 300 data points, including calculated scores measuring vehicle performance.

In general, data generated and transmitted depends on several elements, including vehicle architecture design, cybersecurity, privacy and data protection considerations. OEMs compete on factors related to the main function of the vehicle (such as reliability, range, etc.), and data collection; transmission is only an incidental activity and implies extra costs. Therefore, OEMs usually collect (and transmit) only data for the provision of their own services or data that is specifically relevant for their customers and the operation of the vehicle in line with the data minimization principle.

Second, in-vehicle data is often available via other, non-OEM, sources such as third-party dongles connecting to the OBD-II port, which gives access to many data points relevant for aftermarket services (e.g., vehicle diagnostic). Smartphone devices are a further source of data and can provide location-based data including, for example, speed, acceleration, and braking conditions, when the driver is inside the car. In the case of vehicles based on Google Android Automotive operating system, (standardised) vehicle data can be accessed directly on-board by third-parties app developers.

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[5] European Commission. (2021). Commission Evaluation Report on the Operation of the Motor Vehicle Block Exemption Regulation (EU) No 461/2010

Third, OEMs are already subject to more than 15 existing regulations related to data access and sharing. In particular, the Repair and Maintenance Information (RMI) Regulation and the recently renewed Motor Vehicle Block Exemption Regulation (MVBER) mandate unrestricted access to repair data and on-board diagnostics (OBD), and their objective is to ensure fair competition on the repair and maintenance aftermarket and the soon-to-be implemented Data Act.

Fourth, the current limited take-up of data services by passenger car customers appears to be driven by consumer preferences rather than the undersupply of data. Survey evidence suggests that private drivers are currently unwilling to pay extra for aftermarket services supported by data and most car owners are satisfied of connected cars' features. Commercial owners of passenger cars show a significantly higher take-up of data services compared to private owners, even though they often have the same vehicles and data available. In the HDV market in particular, demand for in-vehicle data access services by fleet operators continues to increase with almost all fleet operators with more than ten trucks using vehicle data in their operations This suggests that OEMs provide data to meet demand where it exists, and that to date this appears to be mainly in the commercial segment.

The lack of standardisation may affect the level of data available in the passenger car segments, but industry efforts are underway. Aftermarket service providers have highlighted that standardisation of the available data points across different OEMs can foster further development of related aftermarket services, because it can help guarantee that services are capable of reaching sufficient scale. This effect is likely to be stronger in passenger car sectors, where lower take-up and greater diversity in customer requirements imply that customers from multiple OEMs may be required to reach sufficient critical mass. This may affect OEM incentives, because the decision to provide more data by an individual OEM may not be sufficient to improve its vehicles' aftermarket services. There are a number of industry initiatives, business and technological solutions (e.g. via Google Android Automotive operating system) aimed at reaching more standardisation, but these are so far mostly focused on commercial vehicles.

Finally, we examined four aftermarket services commonly referenced in policy discussions as use cases for in-vehicle data: predictive repair and maintenance, usage-based insurance (UBI), fleet management services, and electromobility services. Based on current market developments, it appears unlikely that access to OEM vehicle data is a barrier to competitive outcomes in these aftermarkets.

At this stage, the market potential for predictive maintenance and usage-based insurance currently appears limited, given the limited take-up of service offerings already available. Fleet management services are, by their very nature, targeted at commercial customers. These services are very developed across OEMs, and the market is led by large independent aftermarket players. Some of these providers also offer some features of predictive maintenance, such as optimal planning of regular services to minimise downtime across a fleet. Lastly, the market for electromobility services is still developing, with a variety of participants ranging from digital start-ups to established energy companies. Charging experience is a significant factor for consumers when selecting an electric vehicle (EV) brand, thus creating incentives for OEMs to supply the necessary battery data to providers of e-mobility services demanded by EV drivers.

Newly introduced regulations are expected to further enable access to in-vehicle data

A number of recently introduced regulations are likely to provide further safeguards to pre-empt the market failures that could in theory emerge with respect to in-vehicle data.

Notably, the Data Act, which will become effective in 2025, introduces a significant overhaul of the rights and obligations of providers of connected products, including connected vehicles. The Data Act will allow users, and third parties authorised by users, to have access to raw and pre-processed data generated by connected vehicles, and outlines compensation principles for this access, ensuring fair, reasonable, and non-discriminatory access (FRAND). We expect that the Data Act will mitigate any issues related to OEMs withholding certain data from aftermarket service providers that could arise in the case of a market failure. It will also mitigate any concerns related to the pricing of data by enforcing FRAND conditions. The Data Act mandates data to be readily available, thus reducing concerns over the timing of data access.

Moreover, other EV-specific regulations, such as the Battery Regulation and Renewable Energy Directive, will mandate access to battery and charging data, part of which will most likely be already within the scope of the Data Act. This exemplifies the existing web of current and forthcoming EU regulations governing the sharing and access of in-vehicle data from connected vehicles.

CHAPTER 1

CONNECTED VEHICLES GENERATE DATA THAT COULD BE USED IN THE AFTERMARKET SERVICES

Key takeaways

- Modern vehicles feature connectivity functions, allowing remote access to the vehicle's data. Around 90 per cent of new vehicles in Europe now have connectivity features; however, connected vehicles account for less than 30 per cent of the car parc.
- In-vehicle data may potentially improve automotive aftermarket services such as repair and maintenance, insurance, fleet management, and e-mobility.
- OEMs manage access to in-vehicle data, maintain vehicle operations, and protect customer data and privacy.
- The European Commission has enacted horizontal economy-wide data access legislation through the Data Act and is considering further sector-specific legislation. This is due to concerns identified by some stakeholders that certain market failures result in an undersupply of data

This chapter provides a background for our study. We discuss the increasing penetration of connected vehicles (Section 1.1) and the interest in the data they generate and transmit to develop new complementary services (Section 1.2). Finally, we summarise the policy debate and regulatory initiatives related to access to this data (Section 1.3).

1.1 NEW CONNECTED VEHICLES GENERATE AND TRANSMIT AN INCREASING AMOUNT OF DATA

1.1.1 Vehicle connectivity allows certain in-vehicle data to become accessible over the air

Modern vehicles are increasingly equipped with an array of sensors that collect and process significant amounts of data, which are often crucial for their functionality. These sensors monitor various aspects of the vehicle ranging from engine diagnostics or tyre pressure to the presence of nearby objects or its drivers' hand positioning, and are designed to enhance efficiency or improve functionalities. Many of the data points produced are not stored even in the vehicle, because they are designed to be used immediately.

Emerging technological trends, particularly the shift towards electric/electronic architecture and software-defined vehicles, are expected to further amplify data generation.[6] These advanced architectures enable vehicles to perform more complex computing tasks, such as autonomous driving.

This trend is accompanied by improvements in vehicle connectivity. Embedded telematic systems enable vehicles to connect with the internet by transferring data and receiving information, in other words, connected vehicles.[7] This connectivity can have different levels: from very basic connectivity allowing for emergency calls and road assistance to more advanced solutions such as over-the-air updates and infotainment and next-generation connectivity for autonomous driving, allowing vehicles to communicate with all their surroundings.[8]

In particular, telematics can transmit in-vehicle data received from the vehicle's electronic system through a gateway. This gateway collects certain pre-programmed signals from the vehicle, and often does not include all the data generated or stored in the vehicle.

In addition to OEMs' embedded telematics, there are other options that allow transmission of in-vehicle data, such as retrofitted aftermarket hardware (e.g., dongles) or other devices such as smartphones.[9]

1.1.2 Share of connected vehicles is increasing

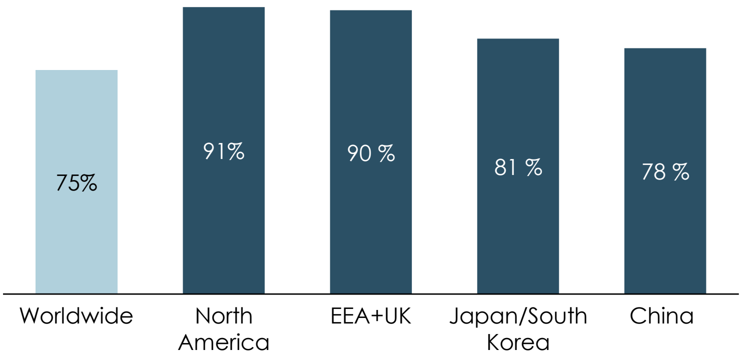
Many OEMs launched their first connected vehicles in Europe during the 2010s, and there has been accelerated growth in recent years. BMW introduced its first connected vehicle in 2009, Volkswagen launched them in 2014,[10] and Ford started connecting vehicles in late 2018.[11] Most new models now provide advanced connectivity, as OEMs

[6] Electric/electronic architecture refers to the design and integration of a vehicle's electrical and electronic systems – including electronic control units, sensors, actuators, etc – to ensure their seamless operation. See Medium (2023). Understanding Automotive E/E Systems, Available here. (Accessed: 11 September 2024). Software-defined vehicle refers to a vehicle whose functions and features are primarily enabled through software. Deloitte (2024). Software-Defined Vehicles – A Forthcoming Industrial Evolution, Available here. (Accessed: 11 September 2024).
[7] Telematics, or telematics systems, refer to integrated technologies combining telecommunications, informatics, and wireless devices to gather and transmit vehicle data remotely. HEAVY.AI (2024). Vehicle Telematics, Available here. (Accessed: 11 Sep tember 2024). Berg Insights defines embedded telematic systems as "an automatic system designed for passenger cars and commercial vehicles that incorporates some form of cellular communications." See Berg Insight (2024). The Global Automotive OEM Telematics Market – Executive Summary, Available here. (Accessed. 15 September 2024).
[8] Vehicle-to-everything (V2X) technology consists of wireless connectivity, sensors and cameras, enabling vehicles to exchange real-time information with other vehicles (V2V), pedestrians (V2P), networks (V2N), infrastructure (V2I), devices (V2D), the grid (V2G), and the cloud (V2C). PwC (2023). Digital Auto Report 2023 (Volume 2).
[9] Data can be transmitted over short distances using USB, Bluetooth, or Wi-Fi to a smartphone and SIM card, or directly over longer distances using an embedded SIM card. Some dongles include a built-in GPS, while others utilise the smartphone's GPS to supplement or by-pass the vehicle's built-in GPS system.
[10] Volkswagen (2024). Volkswagen VW Connect, We Connect & Car-Net, Available here. (Accessed: 28 November 2024).
[11] Formerly known as SYNC Connect. Ford (2024). What is FordPass® Connect? Available here. (Accessed: 11 September 2024).

continuously compete to offer drivers digital services (including with connection to 3G or 4G mobile networks).[12]

According to research company Berg Insights, about 75 per cent of all new vehicles sold globally in 2023 were equipped with an OEM embedded telematics system, up from 72 per cent in 2022, see Figure **1**.[13,14] When examining regional trends, North America, EEA and the UK stand out in telematics services, with a share of around 90 per cent of new vehicles being connected vehicles.

Figure 1
Share of new vehicles with OEM embedded telematic system in 2023, by region
Percentage



Source: Berg Insight (2024).

Considering all vehicles on the road (i.e., not just new vehicles), the share of connected vehicles accounted for about 24 per cent in the EU in 2021.[15] Looking ahead, consulting firm PwC predicts the penetration of connected vehicles in Europe will increase to reach 27 per cent in 2025 and 83 per cent in 2035, but there is a significant degree of uncertainty in the estimates.[16]

[12] Since April 2018, all new vehicles released in the European market need to have a connectivity system (at least 2G) to comply with the eCall regulation, which mandates that vehicles must automatically transmit an absolutely necessary minimum set of data (MSD) – such as the vehicle location, and the number of passengers – to emergency services in the event of a serious accident. See European Commission (2015). Regulation (EU) 2015/758 of the European Parliament and of the Council of 29 April 2015 concerning type-approval requirements for the deployment of the eCall in-vehicle system based on the 112 service and amending Directive 2007/46/EC. However, we note that the modem for eCall cannot be used for other services and OEMs need to add additional connectivity systems if they want to offer digital services.
[13] Berg Insight (2024). The Global Automotive OEM Telematics Market – Executive Summary, Available here. (Accessed. 15 September 2024).
[14] Global vehicle sales experienced a notable rebound in 2023, exceeding 72 million units, which marks a 10 per cent increase compared to 2022. ACEA (2024). Economic and Market Report – Global and EU auto industry: Full year 2023.
[15] Statista (2021). Connected vehicles as a share of the total car parc in the European Union (EU-27) in 2021, with a forecast for 2025, 2030, and 2035, Available here. (Accessed. 15 September 2024).
[16] For example, we can expect that vehicles currently equipped with technologies such as 3G will lose connectivity features as mobile network operators may stop providing coverage for 2G/3G connectivity.

Analysts previously forecasted the rapid and extensive adoption of digital services driven by connectivity and in-vehicle data, predicting significant changes in consumer experiences and industry profits. Various studies initially estimated the market potential to be worth hundreds of billions of euros. For instance, McKinsey projected in 2016 that the market potential for connectivity services could range from USD 450 billion[17] to USD 750 billion by 2030 (corresponding to EUR 426 to EUR 719 billion[18]).[19]

These estimates did not pan out. More recently, in 2021, McKinsey stressed that the monetisation from vehicle data has grown more slowly than what they expected in their 2016 report. Their updated projection for 2030 now ranges from USD 250 billion to USD 750 billion (corresponding to EUR 236 to EUR 719 billion[20]), with the lower bound significantly reduced by almost 45 per cent.[21] For context, the entire automotive aftermarket was valued at EUR 243 billion in 2022.[22]

1.2 IN-VEHICLE DATA COULD BE USED IN AFTERMARKET SERVICES

Industry analysts have identified a number of potential applications for in-vehicle data that enable advanced functionalities and possibly improve existing complementary services in the existing automotive aftermarkets.

The aftermarkets are part of an extremely complex value chain and include a variety of services and players going beyond the automotive industry, from vehicle parts suppliers, repair and maintenance, and fleet management services to finance/insurance and infotainment services provided by technology companies, see Figure **2**. The contour of the aftermarkets is continuously evolving. For example, the advent of EVs has created a whole new set of e-mobility services and respective providers.[23]

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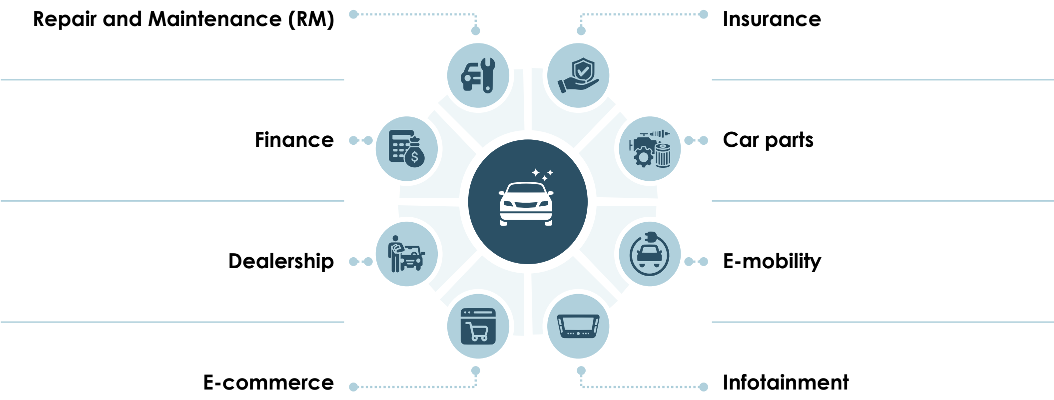
[17] Specifically, this study includes nine clusters providing value through the vehicle lifecycle (i.e., mobility insurance, vehi cle/fleet health and monitoring, safety and security, seamless in-vehicle experience, etc.) that could deliver USD 250 billion to USD 400 billion in annual incremental value for vehicle players in 2030.
[18] As of 29 November 2024, the USD-EUR exchange rate was 0.95. European Central Bank (2024). US dollar (USD), Available here. (Accessed: 29 November 2024).
[19] McKinsey & Company (2016). Monetizing car data.
[20] As of 29 November 2024, the USD-EUR exchange rate was 0.95. European Central Bank (2024). US dollar (USD), Available here. (Accessed: 29 November 2024).
[21] McKinsey & Company (2021). Unlocking the full life-cycle value from connected-car data.
[22] Quantalyse (2023). The automotive digital transformation and the economic impacts of limiting data access.
[23] For example, Charge Point Operators (CPOs) are responsible for managing the physical recharging infrastructure, whereas eMobility Service Providers (eMSPs) handle the digital end-customer services (e.g., access, payments, etc.). See CRA (2023). Competition analysis of the electric vehicle recharging market across the EU27 + the UK.

Figure 2
Examples of aftermarket services



Source: Copenhagen Economics

We note that some data-based aftermarket services require not only access to in-vehicle data but also access to vehicle resources and functions ("write access" instead of only "read access"). For example, a service that opens and closes a vehicle trunk remotely (e.g., for safe parcel drop-off) would need read access (whether the trunk is open or closed) and write access (to actively open or close the trunk). Assessing write access entails additional considerations related to vehicle operations, safety, and cybersecurity, as it implies the ability to modify the software of the vehicle, which are beyond the scope of this study.

We have identified four aftermarket services commonly referenced in policy discussions as examples of use cases for in-vehicle data, which we address in more detail in our study:

A. Predictive repair and maintenance;
B. Usage-based insurance (UBI);
C. Fleet management services;
D. Electric mobility (e-mobility) services specific to EVs.

A. Predictive repair and maintenance

In the aftermarket of vehicle repair and maintenance, in-vehicle data can support predictive maintenance services, for example, by alerting customers of potential issues before failures occur. Related practices, such as remote diagnostics, are also becoming increasingly used.

B. Usage-based insurance (UBI)

Motor insurance companies can rely on in-vehicle data to get a more accurate risk profile of their customers. In particular, insurers can offer usage-based insurance (UBI) products such as pay-as-you-drive or pay-how-you-drive, where premiums are based on drive time and driver behaviour. This, in theory, allows lower-risk drivers to save money and incentivises safer driving, but could increase prices for riskier drivers. Relevant data often includes driving location, mileage, trip time, speed, and driving behaviour indicators (e.g., braking and cornering).[24]

C. Fleet management services

Fleet management services in the automotive sector have been revolutionised by telematics solutions that use data on vehicle performance, location, usage, and driver behaviour. These solutions allow fleet managers to improve their fleet operations, identify cost issues, and optimise driving behaviour, thereby saving fuel and reducing accidents.[25]

D. Electric mobility services

In-vehicle data could support additional services specific to electric vehicles (“EVs”). Due to their nature, EVs require more planning around charging trips, and data could improve smart charging and route optimisation.[26] In-vehicle data can include charging parameters of the battery that are communicated between the electric vehicle battery management system and the charging point infrastructure (EV charging point communication).[27] For example, information on the vehicle’s battery and its status can allow EV charging service providers the ability to better communicate with the users when to charge their vehicles (to save energy costs) or on route planning.[28]

1.3 THE COMMISSION CONSIDERS SECTOR-SPECIFIC REGULATION FOR ACCESS TO IN-VEHICLE DATA

Currently, OEMs collect and control, to some extent, access to in-vehicle data to ensure vehicle operations while ensuring customer data protection and privacy.

Aftermarket stakeholders, certain academics, and researchers at the European Commission Joint Research Centre (JRC) have suggested that OEMs exercise sole control or hold a monopolistic position on in-vehicle data.[29] Accordingly, they argue that this may result in restricted access to in-vehicle data and the following potential market failures:

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[24] Consumer Federation of America (2021). Watch where you’re going: what’s needed to make auto insurance telematics work for consumers.

[25] For diversified fleets with multiple vehicle brands, these services provide multi-brand data accessed through different ways (e.g., retrofit-dongles or third-party marketplaces), enabling comprehensive oversight and efficient fleet operation.

[26] CRA (2023). Competition analysis of the electric vehicle recharging market across the EU27 + the UK.

[27] For an overview of the data needed for EV charging to facilitate smart grid management, see ChargeUp Europe (2024). Access to In-vehicle Data for EV Charging: Consumer and Grid Benefits .

[28] In the case of smart charging, the EV charging rate can be adjusted to support the local network by extending or deferring charging times to low demand periods, thus introducing costs savings for the consumer. Another potential application is bidirectional charging, commonly referred to as vehicle-to-grid (V2G), where the electricity is fed back to the grid.

[29] Joint Research Centre (2018). Access to digital car data and competition in aftersales services. JRC Digital Economy Working Paper 2018-06.

- limited development of data-driven services due to limited access, high cost, and no standardisation of data across vehicle brands;
- risk of competition issues/unlevel playing field between the different actors in the aftermarkets where OEMs are active.

In light of this, the EU, and specifically the Directorate-General for Internal Market, Industry, Entrepreneurship, and SMEs (DG Grow), opened a public consultation in 2022 on the potential need to introduce a sector-specific regulation on the access of in-vehicle data.[30]

Existing claims of market failures have failed to consider (a) how competition dynamics in the primary market of vehicles may influence OEM's incentive to provide access to in-vehicle data in the aftermarket, (b) whether there is evidence of insufficient access being provided to in-vehicle data, and (c) whether other factors, such as consumer demand for in-vehicle data-related services, may explain the extent of data collected and used.

In the following chapters:

- First, we assess the link between competition in the primary markets and aftermarkets and establish that OEMs have incentives to provide access to in-vehicle data in aftermarket when beneficial for consumers.
- Second, we assess whether market outcomes are consistent with any potential market failure identified above by investigating (a) the availability of in-vehicle data in the market, (b) the consumer demand/willingness to pay for services based on this data, and (c) the current competition between OEMs and independent players in aftermarket services where data can be used.
- Third, we remind the reader that there is a wave of forthcoming regulations that would also address any potential issue related to restricted access to in-vehicle data.

[30] The accompanying document, "Call for evidence for an impact assessment", already proposed a set of policy options from the definition of a minimum list of data, function and resources to be made available, to more far-reaching options regulating governance rules and access. European Commission (2022). Call for evidence for an impact assessment - Ares(2022)2302201.

CHAPTER 2

OEMS HAVE INCENTIVES TO PROVIDE ACCESS TO IN-VEHICLE DATA, PARTICULARLY FOR COMMERCIAL VEHICLES

Key takeaways

- The concerns raised by some stakeholders boil down to two principal mechanisms through which competition could be impaired: (i) foreclosure of competing aftermarket service providers, and (ii) undersupply of data.
- As a matter of economics, these 'theories of harm' are unlikely to hold if (i) the market for vehicles (primary market) is competitive and (ii) there is a strong enough link between aftermarket services. OEMs would not have an incentive to restrict the supply of, and access to, in-vehicle data insofar as this would adversely affect OEMs' sales in the primary market.
- With regard to commercially owned vehicles, there is evidence of a link between the primary and secondary markets. Sophisticated commercial buyers take into account the total cost of ownership over the lifetime of the vehicle, including the costs and quality of aftermarket services. Commercial users also rely on vehicle data for important business activities, such as fleet management services, particularly in heavy-duty vehicles.
- For privately owned vehicles, there is currently no conclusive evidence of primary market competition disciplining OEMs' incentives in the aftermarkets. It is premature to assess how the increasing role of data-driven service will influence customers' choices in the future.

Central to an economic assessment of potential market failures is an understanding of the incentives at play. Below, we first set out whether and under what conditions OEMs would have an incentive to provide access to in-vehicle data (Section 2.12.1), and then whether these conditions are likely to hold in the context of passenger cars, light commercial vehicles, and heavy-duty vehicles (Section 2.22.2).

2.1 OEMS' INCENTIVES TO SHARE IN-VEHICLE DATA DEPEND ON THE LINK BETWEEN PRIMARY MARKETS AND AFTERMARKETS

According to economic theory, OEMs' incentives and ability to exploit any market power for the provision of data that may be used as an input in the aftermarket depends on market circumstances in both the **primary markets,** where vehicles are sold and purchased, and in the **aftermarkets** relating to this data.[31]

[31] OECD (2017). Competition issues in aftermarkets.

Often, consumers buy durable goods (the primary product) that require aftermarket services during their life cycle. Aftermarkets are widespread in the economy, with examples including repair and maintenance for vehicles, cartridges for printers, apps for smartphones, and software for hardware components. Many of these markets have been widely studied in the economics literature and competition case practice.

Any incentives for a producer of primary products to leverage its dominance in the provision of an input to aftermarkets ultimately depend on two conditions:

a) the interdependence between the fore and aftermarket (i.e., system markets dynamics);
b) the degree of competition in the primary market.

Below, we present the relevant economic framework and its application in the context of connected vehicles by discussing the following:

- There are potential competition issues that may arise in the context of aftermarkets.
- Competition at the level of system products can limit risks of OEMs' market power in aftermarkets.
- Multiple factors influence the presence of system markets competition dynamics.

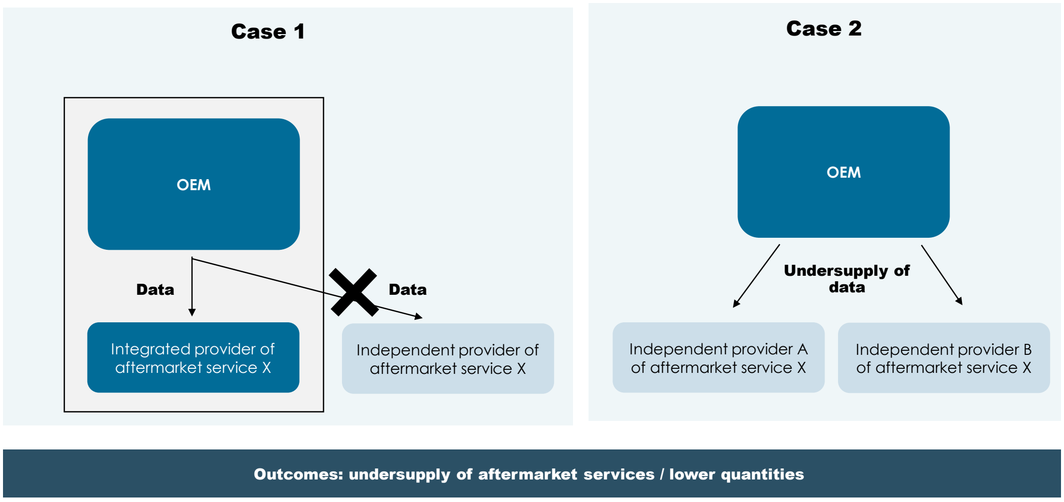
There are potential competition issues that may arise in the context of aftermarkets

Normally, aftermarket services are bought after the purchase of the primary product (the vehicle) and those services need to be compatible with the brand/model of the primary product. In theory, this can create a lock-in problem: at the time the aftermarket service is purchased, the primary purchasing decision is already taken, and often cannot be reversed (e.g., it may not be sensible to switch vehicle because a repair is too expensive once the vehicle is owned).

This may create a competition risk, as primary product producers (in this case, OEMs) may have incentives to exploit consumers in the aftermarkets. By making it difficult for other aftermarket players to serve its specific brand or model, (e.g., allowing only branded spare parts), an OEM could also monopolise the hypothetical aftermarket of complementary services for its primary product.

In the context of connected vehicles, in-vehicle data could be used as input for the provision of certain aftermarket services. We assume that a hypothetical OEM of vehicle brand A has exclusive control over in-vehicle data, which can be used to provide aftermarket service X to the vehicle. In this case, the data controlled by the OEM is an important input (upstream) to the aftermarket service (downstream), see Figure **3**.

Figure 3
The OEM may refuse or limit the supply of in-vehicle data



Source: Copenhagen Economics

In this stylised setting, the OEM could have incentives to increase its profit by:

a) imposing excessive conditions and supracompetitive monopoly prices for the access of that data to the aftermarket providers of service X, and/or
b) refusing to supply the data to aftermarket providers and using the data to provide the service X itself, thus obtaining an unfair competitive advantage by foreclosing rivals downstream.[32]

Both scenarios would harm consumers. Applying this logic across all vehicle brands and in-vehicle data useful for aftermarket services, there could be a suboptimal supply of in-vehicle data in the aftermarkets if these theories of harm apply. This would limit the development of aftermarket services based on data. As we show below, whether these '*theories of harm*' would hold depends on the strength of the link between primary markets and aftermarkets, and the level of competition in aftermarkets.

Competition at the level of system products can limit risks of OEMs' market power in aftermarkets

[32] We note that the choice for the OEM to foreclose rivals downstream depends on the expected downstream extra profits that the OEM downstream unit would gain from customers diverted from the foreclosed rivals compared to the loss in upstream profits from restricting supply of data input to downstream rivals.

Primary and secondary products (the aftermarket services) present complementarities and generate value when combined. Together, the primary product and its associated aftermarket can form a "system" product. Kats and Shapiro (1994) defined "*systems as collections of two or more components together with an interface that allows the components to work together"*.[33] These systems may compete as a kind of bundle with other systems in what can be called system markets.

In practice, under the system competition framework, potential buyers of primary products may take into consideration the expected need, availability, quality, and costs of the future aftermarket services related to the product. Consequently, customers' decisions on which primary product to purchase will be influenced by the conditions of the aftermarket services linked to it. In the presence of competitive primary markets, this will have an impact on sales in the primary market.

Moreover, under these circumstances, primary product producers that attempt to monopolise the aftermarket, e.g., by making services or products provided by other aftermarket players incompatible with their brand and charging higher prices for the service to existing customers, will likely have a negative reputational effect and lead new customers to move to other brands of primary products.

Therefore, **producers of primary products do not have incentives to exploit consumers in the aftermarkets if the following two conditions are met:**

a) **aftermarkets and primary markets are interdependent and function as a 'system'**, in other words, consumers' choices over products in the primary market are influenced by the availability, quality, and prices of aftermarket services;
b) **the primary markets are competitive**.

These two conditions would ensure OEMs have the right incentives to provide in-vehicle data to aftermarket players to develop and/or improve services that are valued by customers, as that would improve their competitive offering and position in the primary market for vehicles.

Multiple factors influence the presence of system market competition dynamics

The presence of system market competition is more likely if customers take into account the whole-life cost of the system when buying the primary product and when a reputational effect exists, namely, when *"setting a supra competitive price for the secondary product would significantly harm a supplier's profits on future sales of its primary product."*[34]

[33] Katz and Shapiro (1994). Systems Competition and Network Effects. Journal of Economic Perspectives, 8(2), p 93-115.
[34] Office of Fair Trading (2004). Market definition.

In particular, the ability and willingness of customers to consider the overall lifetime costs of a product when making their purchasing decisions depend, among others, on the following factors:

1. **The level of aftermarket costs in proportion to the total costs of the product**. Customers are more likely to consider aftermarket services if their cost is significant relative to the cost of the primary product.
2. **The quality of information available to consumers to compare the costs of aftermarket services across primary product brands**. Information available from specialised reviews and websites, consumer associations, or repeat buyers' experiences may allow consumers to estimate future aftermarket costs.
3. **The level of customer sophistication**. In general, professional/commercial buyers tend to have a better understanding of the market than private buyers, and to make more informed decisions.

2.2 COMPETITION AMONG OEMS AND THE LINK WITH AFTERMARKET SERVICES INDICATE THAT OEMS HAVE INCENTIVES TO PROVIDE IN-VEHICLE DATA, PARTICULARLY IN THE COMMERCIAL VEHICLE MARKET

Applying the above framework, we assessed whether aftermarket conditions can influence customers' choices in the primary markets of different vehicle types.

In summary, we find that passenger cars for retail customers (private owners) and commercial vehicles exhibit different conditions. For privately owned passenger cars, while some consumers consider total ownership costs and technology features, there is limited evidence of brand switching based on aftermarket service availability. For commercial vehicles, aftermarket services significantly influence primary market choices, as professional customers consider the total cost of ownership and service availability.[35]

Further, we find that primary markets are highly competitive, with a strong level of innovation. Our assessment underlying these findings is presented as follows.

2.2.1 There is a link between primary and aftermarkets, especially for commercial vehicles

Private consumes of passenger cars value, to some extent, aftermarket services especially related to connectivity

[35] As specified further in the report, commercial vehicles also include passenger cars owned by professional customers such as rental and leasing companies or used by other commercial customers such as taxi drivers and police forces.

In this section, we consider passenger cars owned by private individuals. According to some estimates, privately owned cars account for around 85 per cent of the existing passenger car parc.[36] However, the share is significantly lower for new cars (only around 50 per cent)[37] where connectivity is more widespread, as new cars are increasingly bought by commercial customers such as rental or leasing companies.[38]

In the context of the Motor Vehicle Block Exemption Regulation (MVBER), the Commission assessed the relevant market (in competition law terms) for repair and maintenance services and spare parts for passenger cars, considering they are predominantly owned by private consumers. In those circumstances, the Commission considered that it was challenging for consumers to grasp future vehicle maintenance costs. Other national competition authorities shared the same view.[39]

However, we cannot exclude the possibility that conditions in aftermarket services, especially connectivity services, may affect consumers' choice of vehicle brand.

First, car purchases are often a significant expense in consumers' budgets, and aftermarket services can contribute to a significant share of the total cost of owning a car.[40] For example, the Car Cost Index (CCI) provided by LeasePlan International[41] estimated that in 2022 in Europe, the average monthly cost of owning and operating a car for a period of four years, assuming an annual mileage of 30,000 km, was between EUR 905 (in Greece) and EUR 1,131 (in Switzerland). [42] Repair and maintenance (including tyre change) and insurance costs accounted for around 20 per cent of the total cost of ownership, and together with fuel/power costs, accounted for 35 to 50 per cent of the total costs, depending on the types of vehicle (electric vehicles, EV, or vehicles with internal combustion engine, ICE), see Figure **4**.

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[36] Boston Consulting Group (2023). Aftermarket 2030 – The Fleet Imperative.

[37] Deloitte (2017). Fleet management in Europe.

[38] Passenger cars used by commercial customers such as rental companies, taxi drivers, police forces, etc. are considered in the following section among commercial vehicles.

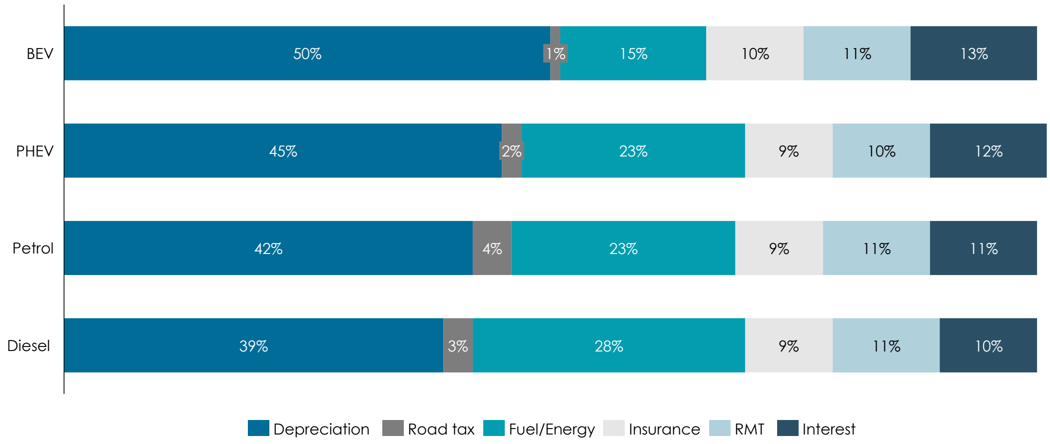
[39] See for example, Autorité de la concurrence (2012). Opinion no. 12-A-21 of 8 October 2012 on competition in the vehicle repair and maintenance sector and the spare parts manufacturing and distribution sector. or CMA (2022). UK competition law: Motor Vehicle Block Exemption Regulation – Consultation Document.

[40] The total cost of ownership is the purchase price of a product plus all the costs for operating it, which include costs related to aftermarket services, such as repair, maintenance, and tyre change, which are necessary to ensure vehicle safety (e.g., replacing brake pads, or oil change, or mechanical repairs and vehicles inspections), and insurance (which all vehicles driven on the road in Europe must take out), together with other expenses such as fuel, road tax, and financing costs. Certain operating costs are variable and depend on vehicle usage, such as fuel and repair and maintenance, while others, for example, standard insurance, and road tax, are "fixed" costs of ownership. In the total cost of ownership, the initial purchase price is factored in as a depreciation cost, subtracting the residual value of the product at the end of the period considered, (e.g. for a TOC of a product over four years, the depreciation takes into account the value of the product after that period).

[41] LeasePlan International (2023). Car Cost Index 2022.

[42] Data is based on different vehicle segments (volume vehicles, premium vehicles, and LCVs of different dimensions) and fuel types (i.e. BEV, PHEV, petrol, and diesel).

Figure 4
Breakdown of total cost of ownership of passenger cars in the EU, 2023



Note: RMT refers to "Repair, Maintenance and Tyres". The TCO breakdown includes all four fuel/energy types across the 22 European countries. In addition to PCs, a few LCVs are included in the estimation.
Source: LeasePlan International (2023).

Second, information on aftermarket costs is often available to consumers, including online. Several sources, including specialised review websites and consumer associations, offer comparisons services that measure the quality and cost of certain aftermarket services across specific vehicle models using a set of assumptions on, for example, mileage, and type of drive. [43] This can help consumers to make an informed choice that considers the lifetime cost of a product when comparing various OEMs in the primary market. The availability of this type of information was mentioned by the OECD as an important factor to support system market competition.[44]

Third, consumers appear to consider total ownership experience and the availability of digital services and connectivity features as relevant factors when choosing a vehicle brand. This is confirmed by multiple consumer surveys, see an overview in Table **1**. Those factors are related to the quality of aftermarket and complementary services and, especially, with services more likely to rely on in-vehicle data.

[43] For example, in Germany: ADAC (2024). Übersicht: Autokosten aller Modelle von A bis Z, Available here. (Accessed 11 September 2024). or in Italy: AutoScout24 (2023). Ecco i costi di manutenzione delle auto più vendute in Italia, Available here. (Accessed: 11 September 2024).
[44] OECD (2017). Competition issues in aftermarkets.

Table 1
Consumer surveys suggest that the ownership experience and digital/technology features matter in private drivers' choice of car brand

COMPANY	YEAR	QUESTION	FINDINGS	COUNTRY COVERAGE
Deloitte[1]	2024	What are the most important factors driving the choice of brand for your next vehicle?	• On average, 26 per cent of consumers consider the quality of the overall ownership experience to be an important factor driving the choice of vehicle brand.	• EMEA countries (including Austria, Belgium, France, Germany, etc.)
Deloitte[1]	2024	Why are you considering a switch to another vehicle brand?	• On average, 30 per cent of consumers consider the availability of a desired technology/feature as one of the main factors for switching to another brand of vehicle.	• EMEA countries (including Austria, Belgium, France, Germany, etc.)
McKinsey & Company[2]	2024	Are you willing to change automotive brands to get better connectivity?	• 39 per cent of German consumers would be willing to switch OEM brand for better connectivity.	• Germany, the US and China

Source: Copenhagen Economics based on [1]Deloitte (2024), [2]McKinsey & Company (2024),

Evidence that consumers care about digital car features can also be seen in the fact that Audi was forced to incorporate wireless Apple CarPlay due to customer demands and after its direct competitors already integrated it, see Box **1**. Therefore, we could expect OEMs to have incentives to provide in-vehicle data if that would support a digital/connectivity feature highly demanded by consumers.

Box 1 Audi integrated Apple CarPlay following a push from customers

Audi was initially hesitant to support Apple CarPlay, particularly the wireless version, due to concerns over integrating Apple's software with its own proprietary MMI (Multi Media Interface) system. However, growing consumer demand for seamless smartphone integration in vehicles has led Audi to gradually adopt CarPlay across its models.[1]

- Initially, Audi offered only wired CarPlay, which required users to connect their iPhones via USB. Many Audi customers expressed frustration with this limitation, especially as other premium brands, such as BMW, began offering wireless CarPlay. Audi customers' demand for wireless CarPlay and the overall market trend towards wireless connectivity pushed Audi to eventually include wireless CarPlay in newer models.
- The shift came as Audi recognised that to stay competitive, particularly in the premium segment, they needed to offer the same level of convenience and integration that customers were experiencing with other brands. This move was part of a broader industry trend in which automakers have had to adapt to the increasing importance of smartphone integration in the driving experience.[2]
- By 2020, Audi began rolling out wireless CarPlay in several models, aligning itself with consumer expectations and market standards.[3]

Source: [1]Automative News (2024), [2]McKinsey & Company (2023), [3]CNET (2020).

Furthermore, the share of EVs in the passenger car market is increasing. In general, private EV drivers have been considered more interested in digital services related to vehicles than drivers of traditional vehicles.

Finally, the development of data-driven aftermarket services is still in its early stages. Therefore, it is premature to determine whether consumers will in future put greater weight on increasingly data-driven aftermarket services.

Aftermarket services are an important factor for brand choice of commercial vehicles

In the context of commercial vehicles, including light commercial vehicles (LCVs) such as vans, heavy-duty vehicles (HDVs) such as trucks and buses, and passenger cars owned by professionals (e.g., rental, and leasing companies), the importance of aftermarket services is clear.

The European Commission and national competition authorities have recognised that professional customers take into account the cost of aftermarkets when choosing a vehicle brand in several instances:

a. The Commission noted in its evaluation of the MVBER that for non-passenger cars "*where the higher presence of professional consumers might result in more complex purchasing patterns*", aftermarket markets might not be considered separate from primary markets.[45]

[45] European Commission. (2021). Commission Evaluation Report on the operation of the Motor Vehicle Block Exemption Regulation (EU) No 461/2010.

b. The CMA, in its Guidance on Motor Vehicle Agreements, mentioned: "*buying behaviour may significantly differ between buyers of trucks who purchase and operate a fleet, and who take into account maintenance costs at the moment of purchasing the motor vehicle and buyers of individual motor vehicles*"[46] (emphasis added).

c. The importance of the aftermarket service network as a parameter of competition between OEMs in the market for LCVs is also acknowledged in the European Commission's competition assessment of the merger between Fiat Chrysler Automobiles (FCA) and Peugeot Société Anonyme (PSA), which created Stellantis.[47] There, market players in LCVs have highlighted that a brand's service network is important for the success of OEMs, stating that "*large market shares are typically related to a larger service and repair network, which is an additional selling point*" or "*[...] the quality and wideness of a manufacturer's service network in the LCV segment is key*".

In general, professional buyers of commercial vehicles are often sophisticated customers who are better at evaluating the life cost of the vehicle than private buyers.[48] They have detailed knowledge of the market and use more comprehensive information than occasional private customers. For them, vehicles are essential assets for production, and as rational economic operators, their objective is minimising downtime and optimising costs, especially since, in most cases, they operate in highly competitive markets with razor thin margins, such as logistics. Therefore, **the total cost of ownership and the quality of aftermarket services feature heavily in the buying decision of a commercial vehicle**. We note that for commercial customers, the real cost for repair and maintenance services is not only represented by what the workshop/garage charges for the repair, but it includes the implicit cost of vehicle downtime while it cannot be used as an input for production, particularly for unplanned repairs.

The importance of aftermarkets is particularly pronounced for HDVs, which are more complex vehicles and require highly specialised aftermarket services. There, OEMs only provide a part of the vehicle, the truck chassis, which needs to function together with other parts such as the body, the trailer, and in some cases the external machine. Professional customers expect OEMs to provide complementary services and specific equipment that allow the efficient integration of all different parts of the vehicle to fulfil the transportation function. Therefore, **negotiating processes and contract specifications are generally complex and detailed.** For example, most of the procurement in the market for buses and coaches is based on public and private tenders that include detailed requirements specified by sophisticated customers, including public entities. These requirements can vary substantially and often cover specific data and access terms.

Overall, OEMs have recognised the importance of providing access to in-vehicle data to be competitive in the primary market. In the HDV market, many OEMs have been installing

[46] CMA (2023). CMA Guidance on Motor Vehicle Agreements - CMA Guidance.
[47] European Commission (2020). Case M.9730 – FCA/PSA.
[48] We note that this is valid also for commercial customers of passenger cars such as rental companies.

telematics units for several years and generally provide access to telematics data to users and their third-party service providers as part of their fleet management services package. There are also examples of LCVs' OEMs offering access to sets of data related to, for example, vehicle health status as a complimentary feature in the vehicle offer without any additional cost; see, for example, the service provided by Ford Pro Telematics Essentials.

2.2.2 OEMS compete intensely in separate primary markets of passenger cars, light commercial vehicles, and heavy-duty vehicles

In the presence of a link between aftermarkets and primary markets, the intensity of competition among OEMs in the primary market, namely, the market for vehicles, can act as a significant driver for OEMs to ensure a competitive offer of aftermarket services connected to their brand.

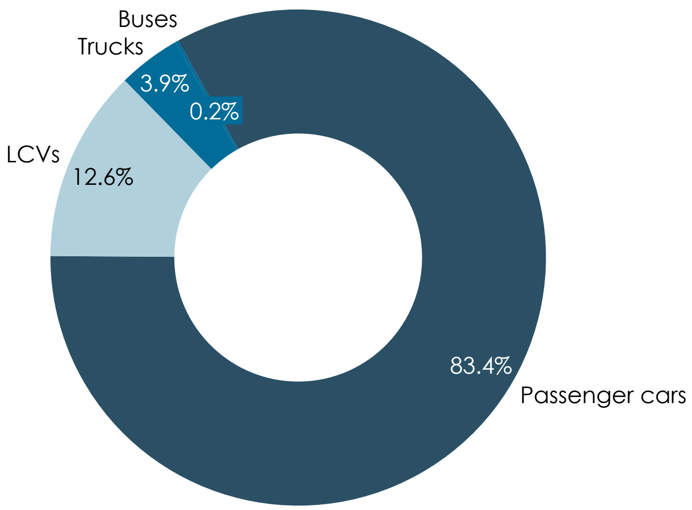
Different types of vehicles present distinct features in terms of product characteristics and purposes while also exhibiting specific demand and supply conditions. These distinctions reflect the presence of multiple, separate primary markets with different market participants and types of customers involved. This has been recognised in previous Commission market assessments in the context of merger control and sector regulation (e.g., MVBER).[49][50] Distinct primary markets may affect the economic incentives and behaviours of OEMs with respect to the aftermarkets connected to their products. Therefore, any assessment and conclusions on market functioning in the context of sharing and accessing in-vehicle data should take into consideration the specificities of each vehicle type.

For the purpose of this section, we consider the following high-level primary markets:
- Passenger cars;[51]
- Light commercial vehicles (LCVs);
- Heavy-duty vehicles (HDVs) with further segments (e.g., trucks and buses/coaches).

In 2022, passenger cars[52] – vehicles primarily designed for the transport of people – accounted for about 83 per cent of EU vehicle production. Light commercial vehicles (LCVs) – built to carry both goods and passengers – represented 13 per cent.[53] Finally, heavy-duty vehicles (HDVs) – trucks and buses designed for transporting heavy loads and used exclusively by commercial customers[54] – made up 4 per cent, see Figure **5**.

[49] For example, see European Commission (2020). Case M.9730 – FCA/PSA. and European Commission (2010). Case No COMP/M.6267- VOLKSWAGEN / MAN.
[50] European Commission (2010). Commission Regulation (EU) No 461/2010 of 27 May 2010 on the application of Article 101(3) of the Treaty on the Functioning of the European Union to categories of vertical agreements and concerted practices in the motor vehicle sector.
[51] We note that certain passenger cars can also be categorised as commercial vehicles, depending on the use case. This can be for example, company fleets, rental cars, taxis, or police cars for public authorities.
[52] They have a design gross vehicle weight (DGVW) of up to 3.5 tonnes. The market of PCs can be further segmented into categories such as sports, luxury, multipurpose, family-oriented, and small cars.
[53] They have a design gross vehicle weight (DGVW) typically between 3.5 to 7 tonnes. LCVs are typically classified into small, medium, and large segments within the market.
[54] They have a design gross vehicle weight (DGVW) typically above 7.5 tonnes.

Figure 5
Vehicle production in the EU by type in 2022
Percentage share



Notes: LCVs refer to data on vans.
Source: ACEA (2023).

Each primary market is undergoing the electrification transition at a different pace due to varying customer trust, regulatory pressures, and technological requirements (e.g., availability of EV charging points).[55] Passenger cars are leading the electrification shift, with EVs accounting for 22 per cent of new EU vehicles sold in 2022, while the share is lower for LCVs and HDVs, see Appendix A.[56] This is a relevant factor, as EVs generate an important demand for digital services based on data such as smart charging, route optimisation, and charging point mapping.[57]

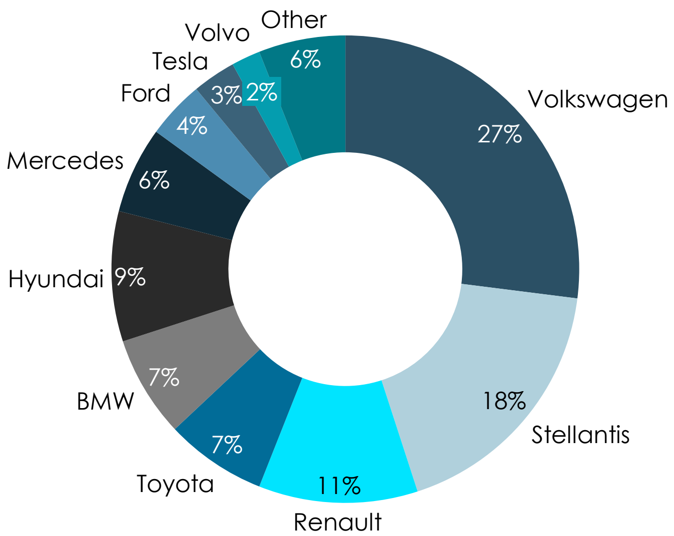
Overall, all primary markets are competitive (despite differences in the number of players and concentration). Competition can also be seen in the innovative efforts undertaken by OEMs. European OEMs are among the largest R&D spenders in Europe. Notably, investing more than EUR 73 billion in R&D in 2022, the automotive sector is the private sector with the highest R&D spending in the EU (accounting for 31 per cent of the total R&D in the EU).

[55] International Energy Agency (2023). Global EV Outlook 2023.
[56] This lag can be attributed to the significant investment needed in EV charging infrastructure along freight routes and the limited technology available for long-haul applications such as high battery capacities. See European Commission (2018). IMPACT ASSESSMENT accompanying the document Proposal for a Regulation of the European Parliament and of the Council setting CO_2 emission performance standards for new heavy-duty vehicles.
[57] CRA (2023). Competition analysis of the electric vehicle recharging market across the EU27 + the UK.

Below, we assess each vehicle category separately to account for their distinct features in terms of customer needs and preferences, as well as in the value chains and services associated with each market.

Passenger cars (PCs)
The market for passenger cars offers a wide variety of vehicles in terms of size, functionality, and luxury level.[58] Overall, the market is highly competitive, with a large number of players, see Figure **6**. Market shares are relatively volatile, with significant new entries in the past years[59]. Additionally, the rise of EVs is adding further competitive pressures. For instance, Tesla experienced a 57 per cent increase in EU PC sales from 2022 to 2023.[60] Competitive pressures are also coming from the growing importance of Chinese EV OEMs, marking a significant shift in the global passenger car market.

Figure 6
New EU Passenger cars registrations in 2023, by brand
Percentage share



Source: ACEA (2024).

Light commercial vehicles (LCVs)

[58] Specifically, the main sub-segments include i) mini cars, ii) small cars, iii) medium cars, iv) large cars, v) executive cars, vi) luxury cars, vii) sport cars, viii) sport utility vehicles and iv) multipurpose vehicles. European Commission (2020). Case M.9730 – FCA/PSA.
[59] This was emphasised in the recent FCA/PSA merger case. European Commission (2020). Case M.9730 – FCA/PSA.
[60] Car Sales Statistics (2024). 2023 (Full Year) Europe: Best-Selling Car Manufacturers and Brands, Available here.(Ac cessed: 11 September 2024)

The primary purpose of LCVs is to transport goods and passengers. Additionally, there are LCVs produced for specific purposes, such as ambulances, refrigerated delivery vans, caravans, etc. In many cases, specific purpose vehicles may be retrofitted by third-party suppliers .

Buyers are typically business customers, who are expected to be more cost-minded than private owners, and in particular, value price and total cost of ownership (TOC) when making purchasing decisions, as well as service networks.

The LCV market is competitive, with a significant number of market payers. Specifically, the main players are Stellantis, Renault, Ford, Mercedez-Benz and Volkswagen with fairly distributed market shares, see Table **2**.

Table 2
EU27 LCV OEM market shares in 2022, by group and brand

GROUP	MAIN BRANDS	MARKET SHARE
Stellantis	Citroën, Peugeot, Opel, Fiat	34 %
Renault	Renault, Dacia	18 %
Ford	Ford	16 %
Mercedes–Benz	Mercedes–Benz	12 %
Volkswagen	Volkswagen, SEAT, Skoda	11 %
Toyota	Toyota	5 %
Iveco	Iveco	2 %
Others	Others	2 %

Source: Copenhagen Economics, based on International Council on Clean Transportation (2024).

Finally, while market shares remain relatively stable, and there have been no significant new entrants in recent years, no concerns were found by competition authorities in the recent EU merger case involving FCA and PSA Group, now known as Stellantis.[61]

Heavy-duty vehicles (HDVs)
HDVs are used for large-scale commercial and industrial purposes and can be divided into the following:

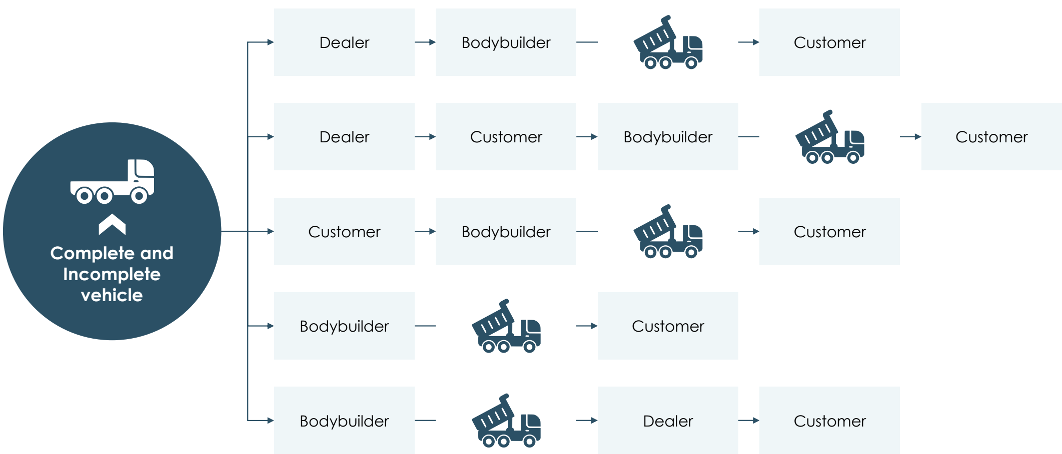
- Trucks;
- Buses/Coaches.

[61] Remedies were offered by the parties in a few geographic markets which, according to the Commission, "*allow the mainte nance of effective competition in the market after the transaction*". European Commission (2020). Case M.9730 – FCA/PSA.

These two segments exhibit important differences. Trucks are mainly used for long-haul transport, distribution, and construction haulage, as well as for speciality purposes such as municipal services, firefighting, etc.[62] In contrast, buses and coaches are predominantly used by private and public operators for specific social needs, in particular, public transportation and tourism services. Therefore, data, functions, and resources and their applications differ within the HDV market.[63]

The HDV value chain is more complex than the passenger cars and LCV markets. In particular, depending on their mission, most HDVs are custom built individually, often through a multi-stage process, to meet specific customer requirements. This results in a complex supply chain involving multiple players such as OEMs, bodybuilders, system/equipment integrators and dealers, see Figure 7.

Figure 7
The HDV value chain involves multiple market players



Source: Copenhagen Economics, based on Volvo Group research

Each stage of the supply chain has a specialised role but must work in close collaboration to meet the specific needs of customers.

OEMs are responsible for producing the base chassis and core components of HDVs. The OEM market is competitive, with six main brands – Volvo, Renault, DAF, Daimler, Scania, MAN, and Iveco – having a market share between 27 per cent and 9 per cent, see Table **3**. The lower number of players compared to passenger cars and LCVs is in part due to the high scale economies in vehicle manufacturing and lower overall volume of vehicles than in the other two markets.

OEMs have fully developed EU-wide service networks as the truck aftermarket is specialised (e.g., while many independent repairers often serve both passenger cars and LCV

[62] ACEA (2023). Fact sheet: trucks. European Commission (2010). Case No COMP/M.6267 – VOLKSWAGEN / MAN.
[63] ACEA (2023). Fact sheet: buses. European Commission (2010). Case No COMP/M.6267 – VOLKSWAGEN / MAN.

drivers across brands, they may not have the capabilities to repair HDVs). Their main customers are sophisticated large fleet owners, who are particularly price sensitive, demand tailored solutions for their needs, care about service networks, and are very knowledgeable of the market.

Table 3
EU27 trucks (>7.5t) OEM market shares in 2022, by group and brand

GROUP	MAIN BRANDS	MARKET SHARE
Volvo Group	Volvo, Renault	26 %
Traton (Volkswagen)	Scania, Volkswagen, MAN	24 %
Daimler Truck	Mercedes–Benz Trucks	21 %
Paccar	DAF	16 %
Iveco	Iveco	8 %
Others	Others	5 %

Note: Market share is calculated as the weighted average between new registrations by OEM in the segment covered and not covered by adopted CO2 standards.
The sum of the market shares does not equal 100% because the values have been rounded.
Source: Copenhagen Economics, based on International Council on Clean Transportation (2024)

Bodybuilders provide essential tailor-made customisations to the chassis of HDVs to fulfil certain functional and aesthetic needs. These enhancements can encompass a range of features, including specialised equipment mounts, custom storage compartments, and modifications to enhance payload capacity. The market for bodybuilders is highly fragmented, with several hundred players, often with only a local presence.

Finally, system integrators provide comprehensive solutions by combining various components and technologies into a cohesive system for HDVs; the market is more concentrated, with few large players.

CHAPTER 3

EVIDENCE NOT SUGGESTIVE OF MARKET FAILURE REGARDING IN-VEHICLE DATA

Key takeaways

- The available evidence does not support the notion of market failures in the provision of in-vehicle data. Notably:
  - Most OEMs make available multiple data points to third-party service providers via their cloud servers.
  - Data access is more common for commercial vehicles, with more than 300 data points shared by certain OEMs in the HDV market, and significant and growing shares of new HDVs connected to OEM data portals.
  - Users can collect and share data through other non-OEM sources, such as external dongles connected to the OBD-II Port or smartphones (for location data).
  - Existing regulations, such as the RMI Regulation and MVBER designed to ensure fair competition in certain aftermarkets, already mandate unrestricted access to some information by repairers.
- In-vehicle data access is more limited for private drivers, but this appears to be driven by lack of demand.
- Lack of standardisation in data points available may contribute to lower development of digital services for passenger cars; however, it is necessary to balance any standardisation efforts with OEMs competing in vehicle design.
- Among often-cited use cases of in-vehicle data, predictive maintenance and usage-based insurance appear to have limited market potential, while fleet management services and e-mobility services continue to grow in competitive and dynamic markets with independent players.

In this chapter, we test whether market outcomes are consistent with the suggestion that there is an undersupply of data to aftermarkets, resulting in a lack of data-driven services despite consumer demand for such services.

Below, we first assess the current availability of OEMs' in-vehicle data, given technical and safety constraints, highlighting more advanced solutions for commercial vehicles where the demand for data is higher (Section 3.13.1). We further consider alternative solutions for obtaining this data (Section 3.23.2) and existing regulations that already ensure that OEM in-vehicle data is shared (Section 3.33.3). We then evaluate the varying demand conditions for data-related services in both passenger cars owned by private customers and commercial vehicles (Section 3.43.4), as well as potential challenges in developing new services due to the lack of standardised data across different vehicle brands (Section 3.53.5). Finally, we investigate the potential impact of in-vehicle data in four different aftermarkets with clearly defined use cases (Section 3.63.6).

3.1 OEMS PROVIDE IN-VEHICLE DATA

3.1.1 There is a diversified and increasingly broad offer of in-vehicle data by OEMs

Level of data availability and access conditions depends on technical factors and security and safety considerations

At the outset, we note that contrary to other connected devices, the collection and transmission of data is a feature that is only incidental to the main objective of connected vehicles, which is to transport passengers and goods.

The design of vehicles is optimised to ensure safe and efficient transport, and this is one of the key parameters of competition between OEMs. This is also how vehicle architecture is ultimately designed and processed.

Therefore, when considering how and which data points are ultimately collected and transmitted off-board via the OEM's telematic system, there are many cost safety and legal considerations that are taken into account by the OEM, see Appendix **B**. For example, many data generated by sensors around the vehicle are used only for its designed purpose and never stored (e.g., the anti-lock braking system (ABS) may collect information on whether wheels are locking to change the pressure on brakes, but this information is not stored, given its lack of usefulness). Any additional collection and storage of data for off-board transmission can be costly and can ultimately affect the vehicle's performance, thus affecting safety and sales.

Furthermore, OEMs must comply with existing legal requirements on privacy (e.g. ePrivacy Directive)[64] and data protection (GDPR which limit their ability to collect and upload the data in the first place.[65] In particular, the GDPR contains the principle of data minimization (Article 5(1)(c) of the GDPR[66] and Article 4(1)(c) of Regulation (EU) 2018/1725), which expresses that personal data must be "*adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed*".[67] The European Data Protection Supervisor, further define the data minimisation principle explaining that wherein a data controller (in this case the OEM) should "*only collect personal data that they really need and should keep it only for as long as they need it*."[68]

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[64] European Commission (2002). Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 con cerning the processing of personal data and the protection of privacy in the electronic communications sector (Directive on pri vacy and electronic communications).
[65] In-vehicle data can often be considered as personal data as they can indirectly convey information on the driver (e.g. driving habits), and thus can be subject to the GDPR.
[66] European Commission (2016). Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and re pealing Directive 95/46/EC (General Data Protection Regulation).
[67] Article 5(1)(c) of the GDPR.
[68] See European Data Protection Supervisor (2024). Glossary, Available here. (Accessed: 28 November 2024).

In this context, it is to be expected that not all data generated during vehicle operations will be collected, stored, and transmitted. Instead, a careful balance is always made for the inclusion of additional data points or changes in the data transmission rate.

Third parties can access a diverse and expanding range of in-vehicle data in passenger cars

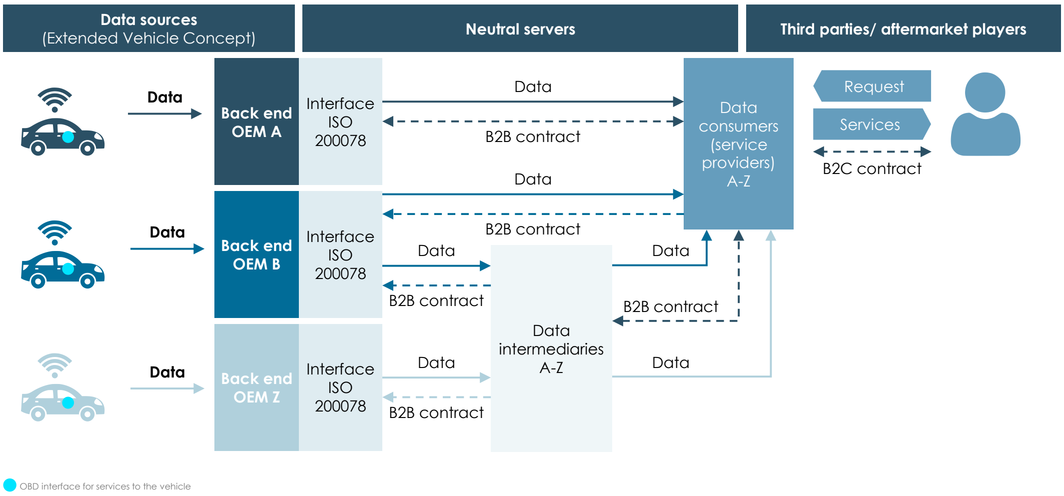
In the following, we present (a) how OEMs provide off-board access to in-vehicle data via the Extended Vehicle (ExVe) concept, (b) the variety of data available through the system, and (c) the conditions of access. We use the example of passenger cars without differentiating between private and commercial use. Several elements are similar in the context of commercial LCVs and HDVs, while more specific solutions for commercial vehicles (including commercial passenger cars, LCVs, and HDVs) are discussed in the next section.

Off-board access system to in-vehicle data via the Extended Vehicle concept
The landscape of in-vehicle data access has evolved, offering third-party developers opportunities to create innovative services for the automotive market. OEMs have invested heavily in developing various interfaces and application programming interfaces (APIs)[69] to facilitate secure and controlled access to vehicle data in the context of the ExVe system

Currently, OEMs make available in-vehicle data to third-party service providers upon users' (drivers') consent via the ExVe or Neutral server web-interfaces. ExVe interfaces connect OEMs directly with interested third-party operators via APIs, whereas neutral servers allow third parties to collect data from one or multiple OEMs without establishing a direct relationship with the OEM, see Figure **8**. In any of these cases, any data is only collected and shared with the consent of the vehicle user or owner.

[69] An Application Programming Interface (API) is an interface connecting mobile applications, developers, and websites with vehicle data. APTIV (2021). What Is an API in Automotive?, Available here. (Accessed: 16 September 2024).

Figure 8
The Extended Vehicle (ExVe) and Neutral server web-interfaces



Source: Copenhagen Economics based on VDA (2021).

The ExVe is a system of standards developed with the intent to facilitate communication between independent stakeholders and vehicle manufacturers to obtain data and function access for the purposes of developing services to a connected vehicle. The Extended Vehicle general information is standardised by the International Organization for Standardization under the reference ISO20077-1:2017,[70] The ExVe includes a web services interface for remote access to in-vehicle data by third parties, which is standardised under ISO20078-1:2021.[71] It is supplemented with remote diagnostic use cases (ISO20080).

This set of standards is technically agnostic and facilitates communication between independent stakeholders and vehicle manufacturers to obtain data and functions access for the purposes of developing services. It ensures that data collected from the vehicle's sensors and systems is transmitted via the vehicle's embedded telematics to an external OEM's backend server in a controlled and secure manner. The ExVe web services interface facilitates the transfer of data to third-party service providers only after obtaining explicit consent from the vehicle's user. This system is designed to uphold stringent security measures to protect the user's privacy and the OEM's trade secrets.

Finally, the ExVe standards cover both web-services interfaces and other interfaces through which in-vehicle data can be accessed. These include, among others, USB ports, Bluetooth, EV charging management, time critical interfaces,[72] and the interface for the OBD connector (see more detailed discussion in next section).

[70] ISO (2017). ISO 20077-1:2017, Available here. (Accessed: 4 November 2024).
[71] ISO (2021). ISO 20078-1:2021, Available here. (Accessed: 4 November 2024).
[72] For example, the Cooperative Intelligent Transport Systems (C-ITS) used for vehicle to vehicle (e.g. warning alerts for objects ahead) or vehicle to infrastructure communication.

The variety of data available through the Extend Vehicle concept
OEM developers' portals (the ExVe web interface) offer information on data points available, their format, and recording frequency, and allow developers to build use cases with dummy data in order to develop their products. Data can be grouped according to use cases (e.g., insurance, maintenance) or broader categories (e.g., vehicle-based data, usage-based data). Data can be recorded over time in predefined intervals (e.g., every 10 minutes) or based on trigger points or events (e.g., engine on).

There is variation between vehicle brands and types in the data points available, but connected vehicles in the passenger car market typically share the following data with users and third parties, both private and professionals:

- Basic data: Information about vehicle location, speed, and route history.
- Diagnostic trouble codes (DTCs): Alerts and information about vehicle malfunctions and performance issues, which are typically also visible on the dashboard.
- Fuel consumption data: Data on fuel levels, average consumption rates, and efficiency
- Engine and transmission data: Metrics such as RPM, temperature, and gear status
- Battery status data: For EVs, data on charge levels, charging rates, and battery health.
- Vehicle usage data: Information on how the vehicle is being used, including driving behaviour and patterns.

In general, it remains challenging to count and compare the number of data points offered by different OEMs as each OEM uses different categorisations, such as data endpoints, data fields, data domains, etc., with different degrees of data aggregation.[73]

Nevertheless, the number of data points made available by OEMs are constantly evolving depending on, for example, features of new vehicle models or the type of contract or customer.[74] For example, BMW started CarData in 2017 with around 60 data points available and now offers around 160 data points.

There is no publicly available comprehensive information on the number of data points transferred to third parties. One OEM interviewed for the study reported over 1.1 billion data retrievals by users or third parties in the last seven years, with currently around 10 million monthly retrievals. The most requested data points for that OEM were mileage data, followed by data related to basic vehicle data, list of vehicle-specific equipment, and geolocation, see Table **4**.

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[73] For instance, one portal might provide a combined "door & window status" data point, while another may list "window status" and "door status" as separate data points.
[74] As described in the report, upon bilateral negotiations, professional customers of passenger cars (e.g., rental/leasing companies) may obtain access to different set of data points and frequencies.

Table 4
Top 10 data points requested by third parties from one OEM

RANKING	DATA POINTS
1	Mileage
2	Basic vehicle data
3	Full SA list
4	GPS latitude
5	GPS longitude
6	Door lock state
7	Vehicle image
8	Remaining fuel
9	Check control messages
10	Heading

Note: Full SA list displays a list of information about the vehicle's special equipment.
Source: Copenhagen Economics, based on OEM interview.

Finally, OEMs may also sell, outside of the ExVe system, aggregated, anonymised vehicle data to third parties and data exchange platforms that can use it to build their own services.[75] For example, mapping service providers can leverage such data to enhance their offerings with real-time traffic updates, optimized routing, and detailed road network mapping. HERE Technologies provides access to an Open Location Data Platform offering map-matching solutions to convert raw GPS traces to a coherent network representation and data is anonymized and aggregated.[76] Developers can leverage this platform to create innovative products, such as apps that guide drivers to the nearest charging EV stations using HERE's routing services. As another example, Geotab fosters partnerships centered on the exchange of anonymized data. This option would involve selling anonymized data to Geotab or purchasing anonymized data, which provides insights into "legacy" or non-OEM-connected vehicles.[77]

The conditions of access to in-vehicle data

Generally, OEMs negotiate access conditions with third-party access seekers considering the specifics of the use case and data needs, with no standard pricing list for access to data on the portal webpage.[78] To our knowledge, among OEMs, only BMW publishes its standard pricing list per single data retrieval and significant volume discounts.[79] Data marketplaces such as HighMobility and Caruso that provide access through neutral servers

[75] Reuters (2024). Stellantis exploring sale of anonymised data packages to service providers, Available here. (Accessed: 28 No vember 2024).
[76] HERE Technologies (2024). Platform overview - Turn spatial data into business value, Available here. (Accessed: 28 No vember 2024).
[77] Geotab. (2021). Mining value from connected vehicle data: How OEMs can lead the next-gen of data-enabled services, Availa ble here. (Accessed: 28 November 2024)
[78] We note that there might be more information provided after enrolment on the portal.
[79] BMW charges EUR 0.29 per single retrieval and EUR 5 per month for one vehicle. BMW offers significant volume discounts for large data retrievals, with a monthly cost of EUR 1.5 per vehicle for unlimited data retrievals for data collected for over 100,000 vehicles. See Price list: BMW Group (2024). Prices, Available here. (Accessed: 4 November 2024).

appear to offer a mix of subscription plans and data credits starting from EUR 99 per month (HighMobility), which can include a range of supporting services, including access to technical advisors.[80]

Aftermarket stakeholders have raised concerns related to the excessive cost of access, as well as long and opaque negotiating processes with OEMs to obtain access to vehicle data. The question of whether prices and access conditions are competitive and/or fair is beyond the scope of this study. We note, however, that many aftermarket stakeholders did gain access, as is clear in the case of commercial customers (discussed below). Moreover, as discussed in Chapter 4, the question of fair price and conditions are expected to be addressed by the Data Act.

More advanced solutions are developed for commercial customers in the LCV and HDV markets

For customers of commercial vehicles (including non-privately owned passenger cars, LCVs and HDVs), with more complex needs and stronger demand for data, OEMs already provide more tailored solutions for data access.[81] The types of data points available, however, are generally similar to those listed above for passenger cars (e.g., vehicle location, health, fuel consumption, and driving behaviour), except for HDVs, which may include additional data specific to their components.

Often, the use of in-vehicle data to build services for commercial vehicles takes place in the sphere of fleet management solutions. The market appears to function well, with several independent players and growing demand.

For example, new LCVs sold by Ford come with Ford Pro Telematics, which includes access to a specific set of in-vehicle data. OEMs offer data packages comprising different sets of data available and reporting frequency (e.g., real-time location data). The price is usually based on monthly subscriptions for each activated vehicle; for example, Ford telematics services is offered at EUR 18 a month per vehicle and may include additional services beyond access to in-vehicle data, such as telematics dashboards, vehicle health alerts, and planned maintenance tracking.[82]

In the case of HDVs, the need for detailed and timely information is even stronger, as the vehicle is composed of parts designed by different players and may include specific body application functions. Consequently, HDV OEMs have been among the first to integrate telematics systems to transmit data from the vehicle and to allow communication (on-board and off-board) between different systems related to other parts of the vehicle (e.g., trailer and body) with several open standards already defined (see more in Section 3.5.2).

Similarly to what is described for passenger cars, HDV manufacturers provide portals for customers and developers to access data, and related mobile applications. Customers can

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[80] High Mobility (2024). Start with the data plan that works for you, Available here. (Accessed: 4 November 2024) and Caruso (2024). Our Pricing Options, Available here. (Accessed: 4 November 2024).
[81] We note that passenger cars in-vehicle data provided by OEMs and neutral servers such as High Mobility can also be used by commercial customers of passenger cars.
[82] Ford Pro (2024). Ford Pro™ Telematics, Available here. (Accessed: 4 November 2024).

get access to data points on the vehicles and drivers at different frequencies (e.g., vehicle location up to every min) and data for regulatory compliance reporting (e.g., tachograph data).[83] More than 100 data items[84] are harmonised and made available through established standards such as FMS[85] (on-board standard)/rFMS[86] (off-board standard) developed by HDV OEMs (see more details in Appendix D). These standards, in use for many years, allow fleet operators to integrate vehicle data with other third-party fleet operator systems on-board (FMS) and off-board (rFMS). Additionally, OEMs often develop proprietary APIs to allow customers and their service providers to access further insights. For example, through Volvo Group's APIs, customers and third parties can access more than 300 data items, including vehicle scores (e.g., braking, coasting), vehicle alerts (e.g., assistance, tyre pressure), and driver times. The number of data items available is constantly evolving with new vehicles (e.g., EVs) and continuous updates on the standards.[87]

For buses, public transport operators access vehicle operational data that can be processed to obtain aggregated traffic operational data for public transport authorities. Similarly to the case of trucks, operators of bus fleets can obtain access to a set of harmonised in-vehicle data that can be integrated with other third-party fleet operator systems on-board (FMS) and off-board/remotely (rFMS). Finally, fleet operators can access information through OEMs' web portals and related mobile applications. For instance, Volvo Connect[88] is a bus fleet management system, launched in 2022, that provides access to real-time data on the health and performance of buses and other services.[89]

3.2 THERE ARE ALTERNATIVE SOLUTIONS FOR COLLECTING AND TRANSMITTING IN-VEHICLE DATA

Beyond OEM solutions, there are various methods for collecting in-vehicle data that cater to diverse market demands. One prominent approach is the use of external telematic solutions provided by third parties, such as hardware dongles, black boxes, and smartphones. Some of these devices can be connected to the vehicle's on-board diagnostic

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[83] European Commission: "*The tachograph is the device that records driving time, breaks and rest periods as well as periods of other work and availability of drivers engaged in the carriage of goods or passengers by road. The purpose of the tacho graph is to enable controls of compliance with the set of EU rules aimed to prevent driver fatigue and to contribute to good working conditions of drivers, road safety and fair competition.*" See European Commission (2024). Tachograph, Available here. (Accessed: 4 November 2024).

[84] Examples of FMS data are vehicle location, fuel, tell-tales, and power take-off (PTO) usage. PTOs are devices that draw power from a motor vehicle. Essentially, PTO acts like a portable generator, allowing you to run appliances and equipment during a power outage. Monitoring PTO can avoid harm to the vehicle.

[85] The FMS interface, connected to the CAN Bus, is used to access FMS data on-board in a standardised way.

[86] The rFMS API is used to remotely access FMS data in a standardised way.

[87] In the example of Volvo Group, third parties can test the API with sample data and then, with customer approval, start retriev ing the data to provide their service without the OEM being in the loop. Volvo Group. (2024). Volvo Trucks Developer Portal, Available here. (Accessed: 26 November 2024).

[88] Volvo Group (2024). Volvo Connect, Available here. (Accessed: 11 September 2024).

[89] While beyond the scope of this study, we note that HDV OEMs such as Volvo Group also allow access to functions and resources of the vehicles for authorised partners. The process requires more steps for cybersecurity and safety prevention and to ensure compliance with data privacy.

(OBD-II) port.[90] This enables the collection of a wide array of data points, including vehicle diagnostics (trouble codes), vehicle speed, location, engine status, fuel level and various sensor readings, driving behaviours, and location information. In particular, the set of information accessible via the OBD-II port is predefined in the Type Approval Regulation; see the next section for more details on the OBD-II port.

The flexibility and ease of use of these dongles, and the ability to use them even with non-connected vehicles, make them a popular choice for customers seeking tailored data insights. Numerous businesses in the telematics industry have been created, especially based on access to the OBD-II port.

Independent telematics service providers play a significant role in the automotive data ecosystem, especially in the aftermarket for fleet management services, by offering advanced data aggregation and analysis services. According to Berg Insights, the number of vehicles shipped with telematic devices from OEMs is equivalent to the number of new telematic devices bought from independent providers, and their growth is projected to remain in line until 2027.[91]

Furthermore, modern smartphones have significant computing power and sensors that allow the collection of relevant information, including live location and speed and acceleration. They are often also the main channel for communication between service providers and customers, and therefore a natural choice for data collection. In a presentation of the "TRL study on access to data – Lot 1" prepared for the Commission (the full report is not yet published), the authors acknowledge that smartphones are an effective alternative to OEM telematics solutions, especially for services that are location data based and do not require additional specific in-vehicle data.[92]

Finally, open-source vehicle operating systems such as Google Android Automotive are becoming increasingly relevant with several OEMs exploring partnerships with Google.[93] The operating system has access to vehicle data which could be made available e.g. for app developers that want to build apps for the drivers. In this case, the access to in-vehicle data happens on-board and data is already standardized across OEMs models to guarantee interoperability (see more detailed discussion in Section 3.5).

3.3 EXISTING REGULATIONS ALREADY ENSURE ACCESS TO CERTAIN IN-VEHICLE DATA

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[90] There are also devices from independent providers that can connect and "listen to" the signals in the controlled area network (CAN) bus system that enables communications between the vehicle electronic control units (ECUs). While the CAN bus signals are usually the intellectual property of OEMs independent providers, some independent providers can reverse engineer the signals transmitted.
[91] Berg Insight (2023). The Global Vehicle Telematics Hardware Market – Executive Summary, Available here. (11 September 2024).
[92] TRL (2021). Study on Access to Data – Lot 1.
[93] Since 2018, most OEMs have explored partnerships with Google. Polestar (Volvo Cars), for example, was the first OEM to adopt Android Automotive with the Google Automotive Services (GAS) in the Polestar 2, followed by Renault, Ford and Gen eral Motors. Meanwhile, BMW, Mercedes-Benz and Stellantis have decided to adopt the open source version for Android Auto motive (without GAS). Knobloch & Gröhn GbR (2022). Trends in Telematics 2022.

The European automotive industry is already extensively regulated, with more than 15 EU provisions that address in-vehicle data to varying degrees. These are both horizontal regulations related to the data economy, which span a broad range of sectors including data protection, or sector-specific regulation dealing with different topics such as transportation, environmental concerns, EVs, the aftermarket, safety, and driver-specific legislation. Some regulations mandate that OEMs must make data available to third parties (e.g., the On-Board Fuel Consumption Monitoring (OBFCM) for LDV Regulation), while others mandate OEMs to share data with relevant competition authorities (others: National Access Points), which then make this data available (e.g. Real-Time Traffic Information (RTTI) Regulation). A comprehensive overview of the existing regulations covering the sharing and access of in-vehicle data is provided in Appendix C.

Among them, two key existing regulations are particularly important for access to in-vehicle data and aftermarket services for repair and maintenance and spare parts, namely the Regulation on Repair and Maintenance Information (RMI) and the Motor Vehicle Block Exemption Regulation (MVBER). Additionally, the Data Act, which covers all connected devices and is probably the most comprehensive regulation for access to data to date, will impose further obligations on OEMs, which are discussed in Chapter 4.

The Type Approval Regulation Nos. 2018/858[94] governing the homologation and placing on the market of vehicles also contains provisions and delegated acts governing access to RMI. This mandates OEMs to share certain in-vehicle data with independent repairers and other aftermarket players to sell vehicles in the EU.[95]

The RMI Regulation's stated objective is to guarantee fair competition in the repair and maintenance aftermarket and the right to repair for third parties. Specifically, the Regulation mandates OEMs to provide unrestricted, non-discriminatory, and standardised access to certain repair and maintenance information to independent service providers. This includes access to the vehicle on-board diagnostic port, diagnostic information (e.g., diagnostic trouble codes, data record information, and two-directional monitoring and test data) equipment, tools, complete references, and available downloads of applicable software and vehicle RMI.

The RMI Regulation was at the centre of the recent judgement of the European Court of Justice on 5 October 2023 in the *ATU Auto-Teile-Unger and Carglass v. FCA Italy* case (C-296/22).[96] The ECJ held that both read and write access to the direct vehicle data stream via so-called on-board-diagnostic (OBD) ports must be granted by law to independent vehicle repairers, and that any restrictions by vehicle manufacturers may not exceed the legal standards set out in Regulation (EU) 2018/858.

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[94] European Commission (2018). Regulation (EU) 2018/858 of the European Parliament and of the Council of 30 May 2018 on the approval and market surveillance of motor vehicles and their trailers, and of systems, components, and separate technical units intended for such vehicles, amending Regulations (EC) No 715/2007 and (EC) No 595/2009 and repealing Directive 2007/46/EC**.** Thus, this Regulation amended Type Approval Regulation Nos. 715/2007.

[95] The Type Approval Regulation has enabled access to in-vehicle data since 2007 (Regulation No. 715/2007), The primary objective of this regulation is to certify that new vehicles sold, registered, or put into service comply with safety and emissions standards.

[96] Loyens and Loeff (2023). European Court of Justice rules on access to vehicle data, Available here. (Accessed: 11 September 2024).

The ruling clarifies that OEMs must adhere to the legal requirements concerning access to OBD information and diagnostic tools without imposing unwarranted barriers on third parties. Specifically, both read and write access to the direct vehicle data stream via OBD ports must be granted by law.

In addition to this regulation, the Motor Vehicle Block Exemption Regulation (MVBER) and its Supplementary Guidelines play a crucial role in ensuring the fair and competitive distribution of vehicles, spare parts, and associated RM services. [97] Specifically, this Regulation requires that independent operators have unrestricted access to information necessary to conduct vehicle repairs under the same conditions as members of OEMs' authorised networks.

In April 2023, the European Commission extended the MVBER for another five years and revised the Supplementary Guidelines.[98] One notable update clarifies that vehicle-generated data may be an essential input for providing repair and maintenance services. This implies that vehicle-generated data must be shared on a non-discriminatory basis with independent operators on the same basis as with official authorised repairers.

3.4 DIFFERENT DEVELOPMENTS OF DATA-DRIVEN SERVICES LIKELY REFLECT DIFFERENCES IN CUSTOMER DEMAND

In this section, we assess whether the most likely explanation for the lack of in-vehicle data services in the passenger car sector is insufficient demand or OEMs' restriction of access to these data.

First, we highlight the different demand and adoption of data and data-driven services in passenger cars for private owners compared to commercial customers, even when the vehicle is the same. This is despite the fact that the same aftermarket players and OEMs are present in both settings.

In the market for commercial vehicles, professional and more sophisticated buyers present a stronger demand for data-driven services that facilitate fleet operations, reduce vehicle downtime, or allow for efficient planning of planned downtime. This is reflected in the greater prevalence of telematics and data-driven services available for commercial vehicles.

[97] European Commission (2010). Commission Regulation (EU) No 461/2010 of 27 May 2010 on the application of Article 101(3) of the Treaty on the Functioning of the European Union to categories of vertical agreements and concerted practices in the motor vehicle sector; and European Commission (2023). Communication from the Commission Amendments to the Commission Notice – Supplementary guidelines on vertical restraints in agreements for the sale and repair of motor vehicles and for the distribution of spare parts for motor vehicles 2023/C 133 I/01.

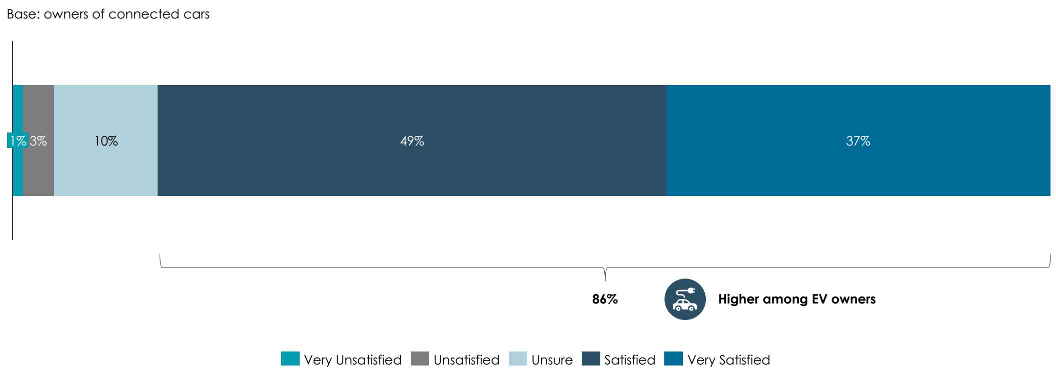
[98] European Commission (2023). Antitrust: Commission prolongs Motor Vehicle Block Exemption Regulation and updates the Supplementary Guidelines, Available here. (11 September 2024).

3.4.1 Private drivers have little demand for data-based aftermarket services

Despite the automotive industry's initial high expectations for new digital services, private drivers have shown limited interest in these offerings.

Customers seem satisfied with the available connected vehicle services. In fact, a recent survey carried out by harrisX for Ford reveals that 85 per cent of connected car drivers are already very satisfied with the existing features offered, see Figure **9**.

Figure 9
Share of car owners satisfied/very satisfied with connected car features, products and services
Percentage



Note: Owners of connected cars were interviewed via an online survey across 5 EU markets + the UK.
Source: harrisX (2021).

A 2024 survey by Deloitte highlights a general reluctance to pay extra for data-driven services, with only 20 per cent of EU consumers willing to spend more on connectivity features.[99] McKinsey's research also supports this, indicating that most buyers of internal combustion engine vehicles consider that connectivity features[100] should already be included in the vehicle without additional costs.[101] Another McKinsey survey indicates that consumers will pay for essential or standout features but not for niche or bundled ones.[102] A global survey by Capgemini's found that the connected vehicle services most valued by customers relate to safety features offered by OEMs, such as crash prevention during driving.[103]

Finally, the harrisX study suggests that private customers prefer that OEMs handle their in-vehicle data. This finding aligns with Deloitte's consumer survey, where OEMs

[99] Deloitte (2024). Deloitte Global Automotive Consumer Study Key Findings: EMEA Focus Countries.
[100] Out of 21 connectivity features (e.g., intelligent parking spot finder, real-time traffic information, etc.), ICE buyers consider all
of them to be basic features rather than optional ones they would pay for.
[101] McKinsey & Company (2023). How do consumers perceive in-car connectivity and digital services?
[102] McKinsey & Company (2024). Car connectivity: What consumers want and are willing to pay.
[103] Capgemini (2020). Connected vehicle trend radar 2.

received the highest scores among entities with whom consumers would feel comfortable sharing their data (noting that most consumers reported discomfort in sharing their data overall).

While not related specifically to in-vehicle data-based services, the uptake among private drivers of OEMs' subscription plans related to car connectivity services has so far been below expectations.[104] This contrasts with the commercial sector, where there is widespread adoption of connected services despite similar pricing.[105] This difference is likely driven by differences in demand.

3.4.2 More widespread adoption of services related to in-vehicle data for commercial vehicles due to higher demand

Commercial vehicle operators show a higher uptake of services based on in-vehicle data, driven by tangible benefits in fleet management and operational efficiency. This highlights the disparity in demand between private and commercial vehicle users.

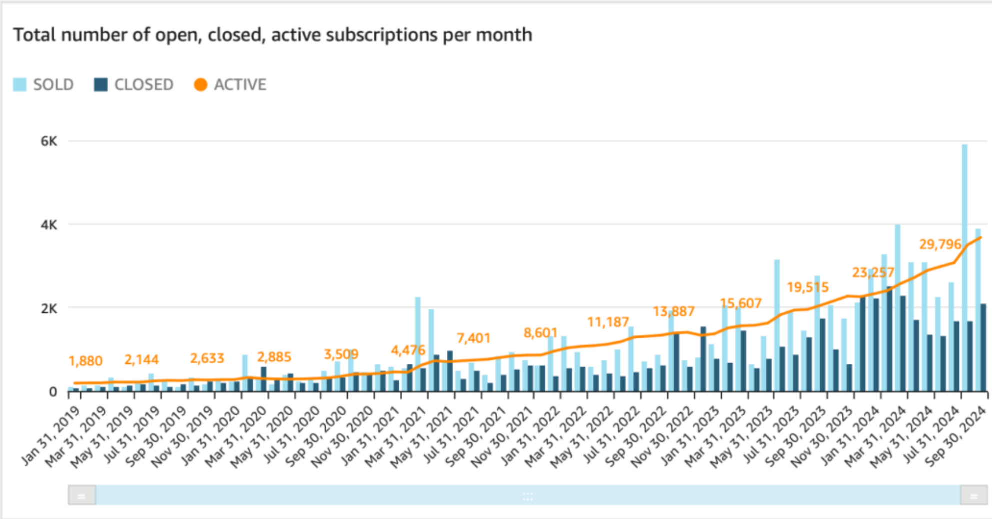
This difference is driven by the different nature of the use of vehicles by private and commercial users. For example, data services on vehicle health and monitoring for the exact same type of vehicle are made available to commercial and private consumers, sometimes for the same vehicle (e.g., passenger car), but only taken up by commercial consumers.

One OEM interviewed for the study explained that there are distinctions between retail (privately owned) vehicles and commercial fleet vehicles. The general factory capabilities for the two vehicles are very similar (sometimes the same passenger car model can be used). However, fleet customers can add additional data or data trigger conditions to the vehicle, depending on their individual needs. This is negotiated bilaterally. Similarly, vehicles ordered from the telematics division may involve contracts with fleet operators who can choose either essential fleet data or more advanced versions and configure available data activated on the vehicle.

Finally, among commercial vehicles, we note that demand is even higher for more complex HDVs. As evidence of the high adoption of data services among HDV customers, one OEM reported more than 1,000 API accounts connected to its portal transmitting data from more than 100,000 connected trucks. Another OEM stated that active subscription to access in-vehicle data now covers 40 per cent of their new trucks. Moreover, the OEM highlighted that most operators of fleets with more than ten trucks (around 90 per cent) do rely on fleet management services based on in-vehicle data whether from the OEM or other independent aftermarket service providers. A third OEM indicated that their data access service subscriptions continue to increase over time, see Figure **10**.

[104] Carscoops (2023). BMW Stops Subscription Service For Heated Seats After Backlash, Available here. (Accessed: 4 November 2024).
[105] See discussion on the growing market for fleet management services based on subscription.

Figure 10
Trend in number of data access subscriptions from a selected HDV's OEM



Source: HDV's OEM interviewed for the study.

3.5 LACK OF STANDARDISATION MAY LIMIT DEVELOPMENT OF NEW PRODUCTS, BUT ONGOING INDUSTRY EFFORTS ARE PRESENT

3.5.1 The standardisation process is improving but remains a concern for private passenger cars

Some OEMs and aftermarket service providers suggest that a lack of standardisation in terms of the available data points and the format of these data points may prevent the creation of a sufficient critical mass for profitable new service offerings to be developed in the passenger car sector for private customers. In particular, the absence of data standardisation is viewed as an obstacle for in-vehicle data aggregators and service providers aiming to develop cross-brand use cases. This limitation hinders the advantages gained from economies of scale and the scope associated with the use of data.

Despite the technical challenges and the trade-off between standardisation and innovation, there are both stakeholders' initiatives (e.g., the Connected Vehicle Systems Alliance, COVESA) and business solutions (e.g., neutral servers/data aggregators) that enhance standardisation of connected passenger cars.

As part of the open stakeholders initiative, OEMs are collaborating with other industry players through the COVESA initiative to develop a common framework for vehicles' signal specification, which helps create a harmonised description of vehicle data from different brands and models, see Appendix D.

In terms of business solutions, neutral servers for the in-vehicle data of passenger cars, such as High-Mobility.com and Caruso, aim to offer a single interface for accessing standardised data across various brands. Caruso estimated that around 90 per cent of connected vehicles would be linked to its servers by 2025,[106] while 28 different vehicle brands are available on High-Mobility.com. According to their website, High-Mobility.com transmits over 100 million data updates daily. These neutral servers harmonise data across OEMs and package the data efficiently, thus limiting the standardisation costs for downstream third-party access seekers. However, the viability and success of these data exchanges remain uncertain.[107] One OEM interviewed for this study highlighted that the volume of data requests from the neutral server (which should aggregate requests from several third parties) is lower than the volume of requests received from individual third parties directly on the OEM ExVe.

Finally, large technology companies have also made significant strides in the automotive industry. Operating system platforms for vehicles, such as the open source Android Automotive (also known as Android Automotive OS or AAOS) provide an on-board application framework that can support data standardisation across different vehicle brands.[108]

In particular, OEMs that want to use Android Automotive are required to implement the vehicle hardware abstraction layer (VHAL). Through the VHAL, vehicle's sensor signals, information, functions, etc. are standardised into defined properties that app developers can then use to develop and provide applications for the car across OEMs brands and models. Therefore, the VHAL interface works as a standardisation software to define the properties OEMs can implement. Each property is assigned a unique identifier (property ID) and includes metadata (e.g. type, access level, supported range or values). It is based on access (read/write/subscribe) to a property, which is an abstraction for a specific function.[109]

Aside from the basic operation system itself, Android Automotive includes Google's most popular apps (e.g. Google Maps) as well as the Google Play Store, which is the entry point for third-party apps. Alternatively, OEMs can opt for the open-source version of Android Automotive without including Google Automotive Services (GAS) and have a non-Google operated app store (e.g. Faurecia Aptoide).[110]

In the future, this integration may facilitate the development of a unified ecosystem where authorised third-party apps can access and utilise vehicle data seamlessly. Whether integrated with Google's commercial ecosystem or operating independently, Android Automotive may play a significant role, potentially becoming a de facto technical standard in

[106] Caruso (2024). From Connected Cars to Connected Business, Available here. (Accessed: 4 November 2024).

[108] Android Open Source Project. (2024). Android Automotive, Available here. (Accessed: 27 November 2024). In contrast to An droid Auto, Android Automotive is a full operating system running on the vehicle's device, not relying on a smartphone to operate.
[109] Android Open Source Project (2024). Android OS Documentation - Overview, Available here. (Accessed: 27 November 2024).
[110] Knobloch & Gröhn GbR (2022). Trends in Telematics 2022. Examples of OEMs include Volvo cars, Ford and Renault.

the automotive sector in the near future.[111] According to Gartner, by 2028, 70 per cent of vehicles sold globally are expected to have the Android Automotive operating system, up from less than 1 per cent in 2022.[112] Such initiatives highlight the growing influence of large technology companies in the automotive industry.

3.5.2 There are more standardisation solutions for commercial vehicles

The segment of commercial vehicles, and especially HDVs, appears to be more developed on this front as a reflection of stronger market forces and a clear need to integrate data from different OEM brands into third-party systems.

For commercial passenger cars and LCVs, there are several independent telematics players in the fleet management market that are capable of aggregating OEMs' in-vehicle data in multi-brand fleets, for example, Geotab. In fact, most OEMs providing telematics data (in-vehicle data on vehicle locations, fuel, etc.) advertise the possibility of integrating in-vehicle data they provide into third parties' fleet management systems preferred by the customer (fleet owner). For example, the Ford Pro Data Services platform in Europe can be integrated via APIs with Geotab, Mix Telematics, Verizon Connect, and many more.[113]

For HDVs, the market is even more advanced. Truck and bus telematics systems already collect a set of relevant in-vehicle data harmonised and standardised across OEM brands based on well-established open standards such as FMS (on-board transfer) and rFMS (off-board/cloud transfer). Thanks to those standards, HDV operators can access and combine in-vehicle data from different OEM brands on their preferred fleet management systems. Moreover, the industry is working on other standards to allow data transfer and communication between the different parts of the vehicle, such as between the OEMs' chassis and trailer and body parts, see Appendix D.

3.6 THERE IS NO EVIDENCE THAT ACCESS TO DATA IS A BARRIER TO NEW DEVELOPMENTS IN AFTERMARKETS

In this chapter, we test whether market outcomes are consistent with the claimed market failures that OEMs' control over in-vehicle data may (a) limit the development of digital services in certain aftermarkets and (b) lead to an unlevel playing field in aftermarkets where OEMs are active. According to the latter concerns, OEMs have the ability and incentive to favour their own integrated services by discriminating/restricting access to valuable in-vehicle data to downstream competitors.

[111] Knobloch & Gröhn GbR (2022). Trends in Telematics 2022. Examples of OEMs include BMW, Mercedes-Benz, Volkswagen and Stellantis.
[112] Gartner (2022). Gartner Identifies Top Five Automotive Technology Trends for 2022, Available here. (Accessed: 27 November 2024).
[113] Ford Pro (2024). Ford Pro™ Data Services™, Available here. (Accessed: 11 September 2024).

Specifically, we focus on four aftermarket services with a more established (at least in the policy debate) use case for in-vehicle data. For each case, we assess the general level of competition in the broader aftermarket, the extent to which in-vehicle data have the potential to improve the service, the position of OEMs' integrated solutions in that aftermarket, and whether OEMs' use of in-vehicle data can significantly limit the ability for independent providers to compete on an equal footing.

Table 5
Role of in-vehicle data in selected use cases

AFTERMARKET / IN-VEHICLE DATA USE CASE	COMPETITION IN THE AFTERMARKET	USE OF IN-VEHICLE DATA IN THE MARKET
Repair and maintenance / Predictive maintenance	• Independent repairers (IRs) still represent more than half of aftermarket • Rise in EVs and advanced driver-assistance systems (ADAS) lower repair needs and require more expertise (in favour of OEMs) • Older vehicles typically more likely to use IRs	• Require strong data analytics capabilities and investments • OEMs offer basic solutions relying mostly on diagnostic trouble codes (DTC) • IRs can access the same data points by regulation (RMI), but limited development of own solutions • No clear interest from private customers • Services already offered by some fleet management providers
Motor insurance / Usage-based insurance (UBI)	• Market is competitive • New entry from Insurtech and other non-traditional players • OEMs trying to enter into partnership with insurers, but with mixed results	• Currently limited adoption of UBI products despite stated interest from customers and possible privacy concerns on being monitored • UBI now based on driver location, speed, and acceleration data points at high frequencies • Most insurers are currently not capable of using richer datasets in their risk assessment • Dongle and smartphone cheaper alternatives to OEM in-vehicle data (but lower quality)
Fleet management services (FMS)	• Market is highly competitive – largest player with less than 10 per cent of market share • Independent telematics providers leading the market; OEMs have minor share	• Fleet optimisation (e.g., vehicle location, fuel consumption, driving behaviours) • External dongles/smartphones viable alternatives to OEMs in-vehicle data • OEMs can integrate with existing fleet management solutions
e-mobility services/ smart charging/ route planning	• Nascent market with mix of players (start-ups vs energy providers vs OEMs) and high degree of innovation	• Battery data potentially useful, especially for smart charging, but unclear how essential • Already solutions from independent players • Charging is important factor for EV drivers, OEMs have incentives to ensure the best possible charging experience

Source: Copenhagen Economics

3.6.1 Predictive maintenance unlikely to divert significant share of customers away from independent garages

One aftermarket often mentioned as a potential use case of in-vehicle data is the market for repair and maintenance services. Studies claim that in-vehicle data can be used to develop digital services that use information on vehicle health data and equipment performance to engage in predictive maintenance (also called prognostics) and identify issues before the vehicle breaks down and before they are identified by the on-board computer.[114]

According to these studies, monitoring and analysing may allow better detection of the likelihood of components' critical failure and plan maintenance than the on-board computer (which is already designed to inform the passenger if some vehicle feature requires attention). Such a system could benefit users by giving them more time to plan repairs and optimising the maintenance process, for example, by limiting the need for regular garage visits or other preventive maintenance that does not take vehicle status into account (e.g., changing brake oils at fixed intervals) or by allowing components to be repaired before they are obsolete.

Additionally, in-vehicle data has been identified as potentially relevant also for other services such as "remote diagnostics" which would allow a user to understand the repair needs and costs ahead of the visit to the garage (this would require less data than predictive maintenance).

Some commentators raised concerns that OEMs' privileged access to in-vehicle data may create a market failure. OEMs would have incentives to favour their own authorised garages for the provision of these in-vehicle data-based services, thus creating an unlevel playing field and penalising independent repairers (IRs).

Independent repairers are not losing grounds against OEMs' authorised garages due to lack of access to in-vehicle data

The size of the aftermarket in six EU countries[115] and the UK for repair and maintenance services is estimated at EUR 150,2 billion in 2024, according to Berylls Strategy Advisors.[116] Maintenance works account for the largest share (29 per cent) of the market for IRs, followed by repairs and collisions. Roland Berger's survey of aftermarket players and customers indicates that expenditures on repair and maintenance have remained quite stable across key EU markets, such as Germany and France.

The market position of OEMs and independent repairers IRs has remained stable across the years, with IRs accounting for 65 per cent of the market, compared to 35 per cent for OEMs in 2024, according to Berylls Strategy Advisors.[117]

[114] Quantalyse (2023). The automotive digital transformation and the economic impacts of limited data access.
[115] The six EU countries are Germany, France, Italy, Spain, Poland, and Norway.
[116] This includes collision repairs. Berylls Strategy Advisors (2024). Competitiveness in the automotive aftermarket in the context of the technology shift.
[117] Berylls Strategy Advisors (2024). Competitiveness in the automotive aftermarket in the context of the technology shift.

IRs are often smaller, family-run businesses with fewer employees and financial resources compared to OEMs' authorised garages. However, there are also larger service chains in the IR segment. IRs focus on personalised service, cost-effective solutions, and long-term client relationships. In contrast, OEM garages are larger and equipped with proprietary tools, and trained workers. In general, visits to OEM garages are more expensive, as they can provide advanced capabilities and specialised services but also incur higher overhead costs. Each type of player caters to different customer needs.

The aftermarket is experiencing significant trends that are reshaping the competition between IRs and OEM-authorised garages. Access to in-vehicle data is likely to have only a minor impact on market competition compared to these major trends.

On the one hand, the ageing of the car parc is increasing the demand for repairs and maintenance in a segment, older vehicles, where independent repairers have traditionally been stronger due to their cost-effective services and extensive experience in dealing with a wide range of vehicle issues.[118]

On the other hand, the electrification of the existing vehicle parc and the introduction of complex systems such as advanced driver-assistance systems (ADAS) are likely to lower demand for repair and maintenance services, especially for IRs. EVs tend to have lower repair costs and fewer routine services (e.g., oil changes) compared to their ICE counterparts, and any required maintenance tends to be more specialised because systems are more complex. The presence of complex systems in modern vehicles requires specialised skills and smart tools to operate repair tasks (e.g., sensors and camera calibrations and replacements). Independent repairers need significant investments in training and technology to maintain their competitiveness in this evolving landscape.[119]

Finally, ICDP noted that this combination of decreasing demand and higher technological complexity of repairs will affect the viability of all the repairers, both independent garages and OEMs' authorised repairers, going forward.[120]

No clear evidence that OEMs' predictive maintenance services could affect IR competitiveness

In this context, it remains highly uncertain whether access to OEMs' in-vehicle data for the provision of predictive maintenance services would have any meaningful impact on the balance of power between OEMs and IRs, especially for the segment of private drivers.

First, as explained in Section 3.3, there are already regulations in place in the sector to ensure unrestricted access to repair and maintenance information (RMI) to IRs required to maintain a level playing field. In particular, the recent extension of the MVBER specifies

[118] Berylls Strategy Advisors (2024). Competitiveness in the automotive aftermarket in the context of the technology shift.
[119] We also note that vehicles are becoming increasingly software-defined, and domain control units are responsible for multiple core vehicle functions. Against this background, repairs on single parts of the vehicle may require access (and modifications) of key software that interacts with multiple components, increasing security risks and putting IRs at a disadvantage.
[120] ICDP (2020). The European Aftermarket of Tomorrow.

that in-vehicle data are in scope. Therefore, any in-vehicle data that OEMs use to provide repair and maintenance services to their customers should also be made available to IRs. For example, one OEM interviewed for the study noted that independent garages can now remotely access connected vehicle data, among others, on diagnostic trouble codes and service due dates, and even be inserted as preferred repairer contacts in the vehicle dashboard. However, the OEM observed almost no uptake of the service by independent garages.[121]

Second, even if OEMs could utilise their access to in-vehicle data for predictive maintenance services, it is not clear that this would result in customers being tied exclusively to their OEMs' authorised garages. While connected vehicles have been in the market for several years, industry experts tend to agree that so far OEMs "*have not yet fully managed to translate the potential of in-vehicle data into improved customer value and loyalty*".[122]

In relation to this, some commentators are concerned about OEMs' control of the communication with the driver via the human machine interface (HMI). According to them, this would allow OEMs to capture customer relationships, disadvantaging IRs. Yet, it is not clear how communication via HMI would be significantly more effective than any other means available to IRs, such as phone, apps, or emails.[123] Moreover, after the OEM informs a driver about the need for a service, the driver can still choose their preferred supplier and garage.[124]

Third, consumers are highly price sensitive in this aftermarket. A consumer survey in the Quantalyse study commissioned by FIA showed that only around 20 per cent of consumers would pay between 6 and 20 per cent extra for the services of independent garages that require access to in-vehicle data.[125]

Comparing the two segments of private and commercial customers, the lack of successful predictive maintenance services for passenger cars appears to be driven by a lack of interest on the demand side rather than the absence of a sufficiently good product. Notably, for commercial vehicles, where the benefits of reducing repair and maintenance costs are more evident, some features of predictive maintenance, such as optimal planning of maintenance services to minimise downtime across a fleet, are already offered by independent telematics service providers. For example, Geotab's new Maintenance Centre within its MyGeotab offer provides predictive and preventive maintenance notifications,

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[121] Similarly, another OEM noted that recent regulation required OEMs to make available for independent repairers the option to download in bulk vehicle repair and maintenance information. Also in that case, however, almost no repairer made use of that service.

[122] ICDP (2020). The European Aftermarket of Tomorrow.

[123] The Quantalyse report suggests that only two per cent of customers would switch from using an IR to an OEM dealership's service if the service offered by the OEM dealership could be communicated via the vehicle dashboard. Quantalyse (2019). The automotive digital transformation and the economic impacts of existing data access models.

[124] Notably, two consumer surveys in 2019 and 2023 presented in two studies by Quantalyse asked what a driver did after receiv ing an alert. In the Quantalyse 2023 survey, only 10 per cent of respondents reported that they would directly book an appoint ment with the OEM garage as a reaction to a maintenance alert (and among those, it is not clear what share would in any case normally go to OEM garages). In the Quantalyse 2019 survey, 40 per cent would go to OEMs, 26 per cent to IRs and another 20 per cent would first ask multiple garages for a quote.

[125] Quantalyse (2019) p.102. We note the question was hypothetical, with no clear definition of the type of services that the consumer would receive.

while Actia, supplier of electronic components, also appears to include in its telematics offers such as iCAN predictive maintenance services.[126]

3.6.2 Insurance companies are able to offer competitive UBI insurance products

Motor insurance is another service in which the use of in-vehicle data has been seen as potentially valuable. It can provide new types of insurance products and services that take into account driver behaviours, namely usage-based insurance (UBI). Additionally, it can improve claims processes and liability detection following an accident.

Some commentators raised concerns that OEMs' privileged control of in-vehicle data may create a market failure by limiting access to it and possibly using it to build their own insurance products.

In what follows, we provide a high-level overview of the status of the motor insurance market and the main trends affecting the competitive landscape, the development of UBI products by different players, and the role of OEMs. We then argue, based on existing evidence, that consumer demand for UBI products remains uncertain, and there is still a lack of clarity on how to use new forms of in-vehicle data beyond what is offered in already existing solutions based on, for example, smartphone devices.

The motor insurance market is fragmented, with entries from digital players

The European motor insurance market is saturated, as basic automotive insurance is mandatory in all Member States. This typically consists of compulsory motor third-party liability (MTPL) insurance to cover damage to third parties, which accounted for around 55 per cent of total motor premiums paid by policyholders in 2016.[127] In addition, there are other subcategories of insurance policies that provide optional coverage for different types of unforeseen events involving motor vehicles.

In 2022, the motor insurance market was the second largest category in the broader non-life insurance sector (19 per cent)[128] with a market size, in terms of gross written premiums, of EUR 176.80 billion in 2024. The market is expected to grow at an annual rate of 1.33 per cent (CAGR 2024–2029), resulting in a market volume of EUR 188.90 billion by 2029.[129]

Key players in the European motor insurance market include established international insurance providers, such as Alllianz SE, AXA SA, Munich RE, Swiss Re AG, and Assicurazioni Generali SpA.[130] However, the market remains fragmented, with a large number of players that vary across Member States, see Figure **11**.

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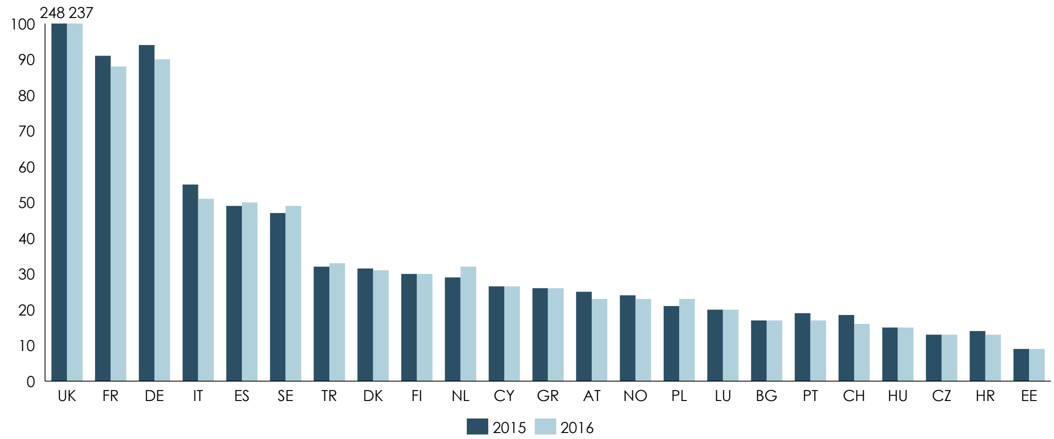
[126] ACTIA (2024). Connected and predictive maintenance, Available here. (Accessed: 17 September 2024).
[127] Insurance Europe (2019). European Motor Insurance Markets.
[128] ICMIF (2023). European Mutual Market Share 2023.
[129] Statista (2024). Motor Vehicle Insurance – Europe, Available here. (Accessed: 11 September 2024).
[130] Mordor Intelligence (2024). Europe Car Insurance Market Size & Share Analysis – Growth Trends & Forecasts (2024 - 2029), Available here. (Accessed: 11 September 2024).

Figure 11
Number of motor insurers per country 2015–2016



Source: Insurance Europe (2019)

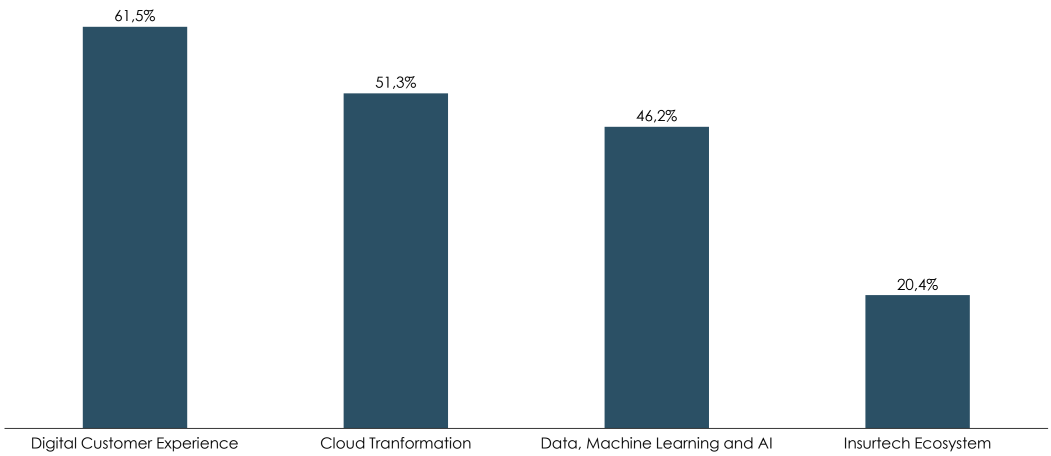
Drivers normally purchase their motor insurance directly from insurance providers.[131] Insurance products are not perceived as highly differentiated, with price being the main competition driver and main factor for switching provider, according to the Deloitte survey. However, the sector may also present a certain degree of customer inertia with moderate price sensitivity and high customer acquisition costs.[132]

While insurance more broadly has normally been a traditional industry, the past years have brought a wave of entry from new players, also called Insurtech, which aims at digitalising and simplifying manual processes such as processing claims and underwriting with innovative solutions.[133] Incumbents are exploring partnership with this new set of players – a similar dynamic as observed with incumbent banks and fintech players.

This push to modernise the sector is further seen in investments in areas such as digital customer experience, cloud transformation, and machine learning or AI, see Figure **12**.

[131] The Quantalyse survey indicates that 65 per cent of consumers interviewed purchased their insurance directly from a dedicated insurance company, 19 per cent via an independent broker, and only 4 per cent as a bundled offer during vehicle purchase.
[132] Quantalyse note that marketing costs accounts for one third of customer acquisition costs.
[133] CNBC (2024). The world's top 150 Insurtech companies: 2024, Available here. (Accessed: 11 September 2024).

Figure 12
Investment by motor insurance companies in the UK in 2022
Percentage



Source: Satista (2023)

Besides new Insurtech players, in the past years, analysts have identified various non-traditional players that could credibly seek to disrupt the insurance value chain. Those include big tech companies, OEMs, telecom operators, new mobility players, and telematics suppliers.[134] While the industry perceives them as potential threats, their actual presence remains marginal, with few OEMs active in Europe.

UBI solutions have already been developed, but consumer interest remains low

Insurance companies emphasise how connected vehicle data can be used to improve their UBI products (see Box 2) and facilitate claim processing and accident reconstruction.[135]

[134] EY (2023). How auto insurers can grow as a decade of disruption approaches, Available here. (Accessed: 6 November 2024).
[135] According to insurers, UBI could have the effect of reducing both consumers' premiums and insurers' costs by incentivising better driving behaviour.

Box 2 Usage-based insurance (UBI) products

There are three primary types of UBI products: Pay-as-you-drive (PAYD), pay-how-you-drive (PHYD), and manage-how-you-drive (MHYD). Each type of UBI product offers different benefits.

- PAYD focuses primarily on the distance driven, charging premiums based on the number of miles or kilometres covered by the driver.
- PHYD takes a more detailed approach by evaluating driving behaviours such as speeding, harsh braking, and cornering to determine premiums.
- MHYD combines elements of both PAYD and PHYD but adds a layer of driver coaching and feedback, helping drivers improve their habits over time.

Studies have demonstrated that driving behaviour variables can already significantly improve the ability to assess driver risk compared to static information on which traditional policies are based (e.g., gender, zip code, age, etc.). [1]

Source: [1]Verbelen & Antonio (2018).

According to those stakeholders, advanced OEM embedded telematics systems could provide more and better-quality data than currently available on driver behaviour and context (vehicle conditions and surroundings) at high frequencies. Nevertheless, insurers worry that OEMs limit access to this data, potentially impeding the development and market acceptance of UBI products and their benefits.

Current evidence, however, does not seem to suggest that OEMs are hindering the development of this product in the motor insurance aftermarket.

First, the market for telematics insurance services is exhibiting strong growth driven by smartphone-based solutions developed by specialised telematics players (often in partnerships with insurers, OEMs, and data analytics companies).

Second, while a number of survey results have long shown consumers' general appetite for these products, over the years consumers' adoption (revealed preferences) has been at best limited, thus questioning the real demand for UBI.

Third, the ability of additional data from OEMs to improve existing UBI products and increase consumer appetite is unclear.

In what follows, we discuss each point in more detail.

The market for telematics insurance services (UBI) is exhibiting strong growth

The UBI concept has been around for nearly 20 years, with the first offers from Progressive in the US in the early 2000, before the introduction of connected OEM vehicles with embedded telematics.

Traditionally, drivers were asked to install external telematics hardware on the vehicle, for example, a dongle on the OBD/OBD-II port or a black box, to monitor factors such as location, driving speed, braking patterns, cornering, and mileage. The cost and time of installing external devices have been seen as a barrier to the widespread acceptance of UBI products in Europe, with notable exceptions of selected markets such as Italy (where these policies hold about 25 per cent market share) and the UK (holding 11 per cent).[136]

However, increased adoption of UBI products based on smartphone apps is drastically reducing these frictions, since drivers are already familiar with the device and do not need to install any additional hardware.[137] Modern smartphones can track speed (e.g., instances of exceeding speed limits), driving manoeuvres (such as harsh braking or sharp cornering), location, and driver distraction metrics (e.g., handling phone while driving). This data can be enhanced with contextual information from other sources, including weather, road conditions, traffic density, and accident-prone areas. Berg Insights reports that the top three insurers offering UBI policies in the US have all implemented smartphone-based solutions to complement or replace the older OBD dongles. Additionally, companies specialising in smartphone-based insurance telematics for UBI products have gained substantial market share in recent years.[138] See Box 3 for examples of smartphone-based UBI solutions.

Box 3 Examples of smartphone-based UBI solutions

- *DigitalDriver™ (Octo Telematics)*[1]
  Used for UBI: With this app, insurance companies can accurately define customer pricing. Digital Driver™ – Try Before You Buy: The Digital Driver™ – Try Before You Buy app allows insurance companies to attract new policy holders interested in a telematics programme. From the trial, new users can then be sorted and filtered and provided with a price estimate based on their individual risk score.
- *DriveWell Platform (Cambridge Mobility Telematics)*[2]
  DriveWell gathers sensor data from millions of IoT devices – including smartphones, proprietary Tags, connected vehicles, dashcams, and third-party devices – and combines it with contextual data to create a unified view of vehicle and driver behaviour. Our platform runs on hundreds of different phones, using sensors to detect driving behaviour.

Source: [1]Octo Telematics (2024), [2]Cambridge Mobile Telematics (2024)

The insurance telematics value chain is presently very dynamic, intersecting various industries. Established insurers, such as UnipolSai, Generali, Allianz, and AXA, are already

[136] PTOLEMUS Consulting Group (2022). Usage-based insurance is growing globally but its dynamics are still regionally specific, Available here. (Accessed: 11 September 2024).
[137] Telematics solutions based on smartphones can include a tag device to be kept in the vehicle that tracks driving data and transmits them to the smartphone via Bluetooth when in proximity. This reduces the risk of misuse (e.g., drivers leaving the smartphone at home when taking the vehicle).
[138] Berg Insight (2023). Insurance Telematics in Europe and North America – Executive Summary, Available here. (11 Septem ber 2024).

engaged in this sector. Insurance companies have the option to either create telematics programmes on their own or collaborate with partners in the Insurtech field, or smartphone-based telematics firms such as Cambridge Mobile Telematics or Arity. According to Berg Insights, the market is vibrant, with several leading players including telematics suppliers (e.g., Octo Telematics and Targa Telematics) and data analytics companies (e.g., LexisNexis Risk Solutions and Verisk).

Against this background, the insurance telematics market offering UBI products is currently in a phase of growth that is expected to accelerate in the coming years. Berg Insight estimates that the total number of UBI policies in force in Europe reached 13.6 million at the end of 2022.[139] Growing at an average rate of 8.9 per cent, the number of insurance telematics policies in force in Europe is estimated to reach 20.7 million by 2027.[140]

OEMs started to explore the insurance sector in various ways, ranging from a) providing in-vehicle data to insurers to b) creating their own UBI products, often in partnership with insurers and/or telematics firms.

Regarding the first case, OEMs are starting to offer APIs to access data on drivers' behaviours and mileage to developers of insurance products. For example, developers can use BMW CarData to make pay-as-you-drive insurance contracts, while Mercedes provides odometer data for similar pay-as-you-drive insurance products offered by the UK company By Miles . OEM embedded telematics solutions are, however, still very far from widespread, as seen in Chapter 1. They face competition from specialised telematics providers, which can offer insurers cross-brand solutions and coverage of non-connected vehicles, and most importantly, their dongle solutions usually present lower unit costs for insurers. An OEM interviewed for this study explained that they are running a proof-of-concept with an insurance company to test the feasibility of using OEM in-vehicle data instead of the traditional dongle in UBI. The OEM in-vehicle data provided the same insights as the dongle, but according to the OEM, it was significantly more costly than the external dongle alternative at scale, due to higher cloud costs, so the project was abandoned.

With respect to the second case, while studies argued that OEMs could capitalise on their "privileged access" to in-vehicle data, thereby securing a competitive edge over traditional insurance providers, most OEMs partnered with established insurance providers (e.g., Jaguar Land Rover (JLR) with Allianz[141]) and/or specialised insurance telematics companies (e.g., Ford with Octo Telematics).[142] The insurance sector is highly regulated and complex, requiring competences that are significantly different from the core business of OEMs. Special licences are needed to offer insurance, and no activities may be carried out without valid registration from the respective national authorities. Breaches can be

[140] Berg Insight (2023). Insurance Telematics in Europe and North America – Executive Summary, Available here. (11 Septem ber 2024).
[141] Allianz partnered with Jaguar Land Rover (JLR) and launched an embedded insurance program, Simply Drive service, which is available for every vehicle, offering clients the convenience of immediate and complimentary insurance coverage for the first month of ownership, making the purchase quicker and easier. Allianz Partners (2023). Jaguar Land Rover and Allianz Partners launch Simply Drive, Available here. (Accessed: 11 September 2024).
[142] Ford (2021). OCTO Telematics and Ford Team Up to Provide More Accurate Auto Insurance Risk Scores, Available here. (Accessed: 4 November 2024).

penalised by administrative and criminal sanctions. The market entry barrier for non-established players is very high.

Certain statistics indicate a rise in the number of OEM UBI programmes worldwide, yet evidence on the success of these programmes is lacking.[143] On the contrary, there are examples of OEMs, for example, Ford, that have already discontinued their insurance programmes in Europe due to high costs and limited customer demand.[144]

Overall, entering the insurance market is not as straightforward as it appears. After Tesla CEO announced that the EVs OEM was creating a "major insurance company",[145] Warren Buffett, whose Berkshire Hathaway conglomerate has significant operation in the insurance market, said: "*The success of the auto companies getting insurance business are probably as likely as the success of the insurance companies getting into the auto business*."[146]

Consumers' demand remains uncertain
Despite recent growth, the telematics insurance sector's coverage remains limited, currently accounting for still less than 10 per cent of the total European car parc. Some commentators believe the market is still emerging, and access to more data from connected vehicles could allow further expansion. Many reference consumer surveys show general interest and readiness to take UBIs.

For example, EIOPA reported already in 2019: "The general perception and acceptance of UBI is today overall positive around 80 per cent, especially the younger generation. This attitude has improved even compared to 2015, when about 60 per cent to 80 per cent of consumers was comfortable with behaviour-based pricing".[147]

However, for years, actual consumer behaviour has differed from their stated interests in those surveys. In another consumer survey of 2017, 20 per cent of respondents in the Netherlands even stated that they "would definitely take a usage-based car insurance" – a share largely below the current 2024 adoption in the country.

The deviation is unlikely to be solely due to the lack of more advanced UBI products based on more extensive and real-time access to OEM in-vehicle data. Existing UBI programmes from independent providers based on driving behaviour data, such as location, acceleration, harsh braking and mileage, already offer substantial premium savings for safer passengers (e.g., safe drivers can save up to 20 per cent on their annual premium

[143] Quantalyse (2023). The automotive digital transformation and the economic impacts of limiting data access; and PTOLEMUS Consulting Group (2021). UBI Global Study 4th Edition: Connected Auto Insurance, Available here. (Accessed: 14 September 2024).
[144] According to market research firm PTOLEMUS Consulting Group, OEM-led programmes have been growing and now account for 2 in every 5 mileage-based insurance programmes worldwide. PTOLEMUS Consulting Group (2021). The influx of OEMs into connected insurance is the tip of the iceberg for the global UBI industry, Available here. (Accessed: 14 September 2024).
[145] Futurism (2020). Elon Musk says Tesla is launching an insurance company, Available here. (Accessed: 14 September 2024).
[146] CNBC (2019). Buffett knocks Elon Musk's plan for Tesla to sell insurance: 'It's not an easy business', Available here. (Ac cessed: 14 September 2024).
[147] European Insurance and Occupational Pensions Authority (2019). Big data analytics in motor and health insurance: A thematic review.

with MotionSmart)[148], and smartphone-based solutions allow lower installation costs. Despite this, their takeout is still small.

According to a 2021 consumer survey in the US by Standard and Poor, the top three reasons respondents gave for not having a UBI app were: satisfaction with their current insurance coverage, the app not being offered by their insurance provider, and concerns about privacy.[149]

It is not clear whether extensive data transmission would improve UBI products

Insurers argue that vehicle sensor data would allow for better contextualisation of driving behaviours compared to, for example, smartphone data. For example, sensor data detecting the presence of objects in their vicinity could help distinguish a harsh braking made for safety reasons from one resulting from hazardous behaviour.

However, the current ability of insurance providers to process and use additional data points for risk assessment beyond the ones currently used (e.g., location, speed, driving behaviour) remains uncertain. According to multiple OEMs that cooperated with insurers, there was limited interest from insurers in additional data, such as information on advanced driver-assistance systems activation proposed by OEMs.

Insurers further stressed the importance of high-frequency data for UBI products. However, current vehicle architectures and telematics systems may not allow for real-time data transmission. For example, according to one OEM interviewed for this study, insurers in the Italian market, the most developed one in terms of UBI adoption, required extremely high data frequencies (around 100 signals per second) to reconstruct an accident and correctly establish liability (a main source of savings for insurers, due to the high costs normally required). This was beyond what is possible with the current OEMs' embedded telematic systems (data transmitted each second at 1Y Hz). For this type of service, insurers now rely on providers of specialised telematic hardware. In general, data gathered at high frequencies incur greater expenses for data transmission and processing.

3.6.3 Fleet management service is a competitive space with several non-OEMs providers

The aftermarket for fleet management services is where in-vehicle data are used the most. Highly sophisticated and cost-conscious commercial customers are willing to pay for solutions based on in-vehicle data that can be used to optimise operations and increase their fleets' efficiency. The main market for fleet management services has always been in the

[148] Insurance Innovation Reporter (2021). MAPFRE Partners with Cambridge Mobile Telematics to launch UBI Program, Available here. (Accessed: 8 November 2024).
[149] See S&P Capital IQ. (2021). Survey finds customer inertia stymies private auto UBI Adoption. We note that there could also be a component of adverse selection, where only the drivers who perceived themselves as good drivers would select into the programmes.

HDVs segment, where OEMs and independent players have been early adopters in providing fleet management solutions even before the rise of telematics.[150]

The overall fleet management market has evolved into a multi-billion-euro industry in Europe, with the market size estimated at USD 7.20 billion (corresponding to EUR 6.81 billion[151]) in 2024 and projected to reach USD 12.62 billion by 2029 (corresponding to EUR 11.94 billion[152]).[153]

Fleet management solutions remain an ambiguous concept, which can include a broad range of functions such as driver, speed, fuel, and vehicle management. Berg Insight defines a fleet management solution as "a vehicle-based system that incorporates data logging, satellite positioning and data communications to a backoffice application."[154]

Fleet management solutions rely on information on the vehicle, such as vehicle location, engine and fuel consumption, diagnostics, and maintenance, and increasingly camera data, to provide vehicles, drivers, and operations management functionalities, and regulatory compliance and reporting services.[155] Consumers and aftermarket players can access this fleet management data either via solutions provided by OEMs (e.g., remotely via OEMs portals) or via telematics hardware provided by aftermarket players and installed in the vehicle.

According to Berg Insights, there were 14.8 million fleet management systems with cellular communication active in Europe in 2022, with a penetration rate among non-privately owned vehicles of 22 per cent (significantly higher than the penetration of other services such as UBI in Europe) and projected to grow at 37.7 per cent in 2027.[156] This includes systems provided both by aftermarket players and OEMs (embedded telematics).

The competitive landscape of the market for fleet management systems (including all commercial vehicles) is highly fragmented, with the top 38 players having at least 100,000 active units in Europe and the largest player (Targa Telematics) commanding a market share of less than 5 per cent. The market is broadly divided between specialised independent telematics solution providers that lead the market, large players active in other sectors such as IT, and other aftermarket services (e.g., MICHELIN Connected fleet) and OEMs.

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[150]As we discussed in Section 3.5, HDV OEMs developed a standard for on-board collection of vehicle data across different brands (FMS) before telematics was used in vehicles and without any regulatory push to meet aftermarket and customer needs. With the rise in telematic solutions, remote FMS has been introduced, offering the off-board solutions available today.
[151] As of 29 November 2024, the USD-EUR exchange rate was 0.95. European Central Bank (2024). US dollar (USD), Available here. (Accessed: 29 November 2024).
[152] As of 29 November 2024, the USD-EUR exchange rate was 0.95. European Central Bank (2024). US dollar (USD), Available here. (Accessed: 29 November 2024).
[153] Mordor Intelligence (2024). Europe Fleet Management Market Size & Share Analysis – Growth Trends & Forecasts (2024 – 2029), Available here. (Accessed: 14 September 2024).
[154] Berg Insights (2023), Fleet Management in Europe (18th Edition), Executive Summary, Available here (Accessed: 4 November 2024).
[155] This data can be collected via on-board systems installed in the vehicle or alternatively collected and transmitted off-board through telematics systems already discussed in this report, either provided by independent telematics players or directly by OEMs (embedded solutions).
[156] We assume this refers to telematics systems. This covers all commercial vehicles, including passenger cars not owned by private individuals. Berg Insights (2023), Fleet Management in Europe (18th Edition), Executive Summary, Available here (Accessed: 4 November 2024).

The presence of independent providers as market leaders indicates that OEMs do not dominate the market. Even in the segment of HDVs, where HDV manufacturers have been at the forefront in the provision of this type of service (as discussed in Section 3.1.1 and Section 3.4.2), solutions by independent providers remain competitive.[157] One OEM estimated that around 90 per cent of fleet owners with more than ten trucks use fleet management solutions, while only 40 per cent of the OEM's new customers use solutions provided by the OEM. This indicates that a large portion of fleet operators still rely on independent providers. In particular, independent providers offer more tailored solutions for multi-brand fleets.

Finally, we also note the emergence of partnerships among OEMs and aftermarket players, with examples especially in the LCV and commercial passenger car segments. For instance, Ford, which offers its Ford Pro fleet management service as end-to-end solutions, partnered with Verizon Connect and allowed integration with Geotab and other major fleet management services. Additionally, there are also cooperation initiatives among smaller aftermarket players to benefit from scale economies.

3.6.4 Electromobility services are still emerging with multiple solutions currently developed

Electromobility, often referred to as e-mobility, encompasses the use of EVs and other forms of transportation powered by electricity, typically through batteries or other energy storage systems. This encompasses battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and fuel cell electric vehicles (FCEVs).[158] Although still in its early stages of development, the sector is experiencing rapid growth. In August 2024, more than 60 per cent of new EU vehicle registrations were EVs (compared to around 45 per cent in May 2023), with BEVs at 14.4 per cent, and HEVs (including plug-ins) accounting for 38.2 per cent. [159]

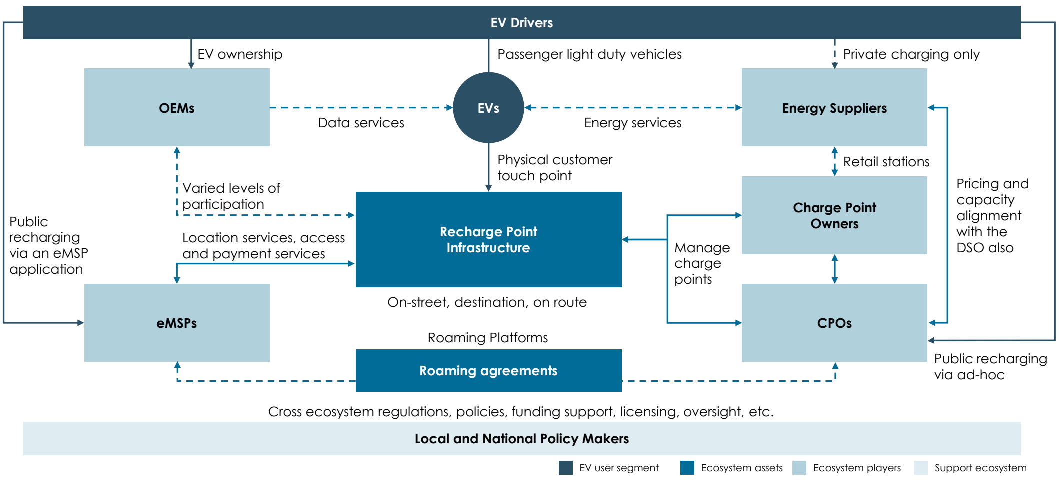
[157] Leading HDV manufacturers such as Volvo Group, Daimler, Scania, and DAF provide telematics devices pre-installed in their vehicles. Additionally, they are progressively incorporating fleet management hardware in new European trucks as a standard, paired with corresponding aftermarket fleet management services (e.g., Fleetboard by Mercedes-Benz and Dynafleet by Volvo Group and Scania Fleet Management).

[158] Gartner (2024). Electro mobility (e-mobility), Available here. (Accessed: 14 September 2024).

[159] ACEA (2024). New car registrations: -18.3% in August 2024; BEV market share down by almost one third), Available here. (Accessed: 14 September 2024).

This shift from internal combustion engine (ICE) vehicles to EVs has created a new charging ecosystem involving numerous market players with different levels of vertical integration from OEMs to (state-owned) energy suppliers, recharging infrastructure providers, and related service companies, see Figure **13**. At the core of this ecosystem is the EV charging infrastructure, where electricity from energy suppliers is delivered to EVs through charging points. In turn, e-mobility service providers (eMSPs) facilitate the financial transaction and services between the EV driver and all other participants, such as charge point operators who manage the physical recharging infrastructure assets, as well as charge point owners and energy suppliers.

Figure 13
E-mobility ecosystem and value chain



Source: CRA (2023)

Some players in the ecosystem are start-ups focused exclusively on EV recharging, often expanding vertically as they mature. For instance, a startup might begin by manufacturing hardware and eventually transition into a fully integrated role as both a CPO and an eMSP. A notable example is the startup Allego, which became one of Europe's leading charging networks by providing more than 35,000 charging points across 16 EU countries, also acting as an eMSP.[160] Furthermore, the startup eMabler created an open EV charging platform, making it easier to integrate EV charging infrastructure into other business systems such as mobile apps, existing customer base platforms, and payment options.[161]

In addition, established companies from related sectors (e.g., equipment manufacturing, technology, oil and gas, etc.) are increasingly entering the e-mobility market. For instance, Shell Recharge has developed one of Europe's largest public charging station

[160] Allego (2024). Europe's leading charging network, Available here. (Accessed: 14 September 2024).
[161] eMabler (2024). eMabler Open EV Charging Platform, Available here. (Accessed: 14 September 2024).

networks, providing access to more than 700,000 charging points, available for users through the Shell Recharge App or a dedicated charge card.[162]

A variety of new aftermarket services have emerged to support EV drivers within the ecosystem. These services are often accessible through mobile apps, including smart charging, route, and range optimisation, see Box **4**.

Box 4 Example of electromobility services

Smart charging[1]

- Smart charging refers to advanced charging systems designed to optimise the EV charging process. In particular, it determines when and how an EV plugged into a smart charger will receive power for charging by considering various factors, notably electricity demand, time of the day, battery state of charge, and customers' preferences. By throttling the EV charging rate, smart charging supports the local grid by extending or deferring charging times to low-demand periods, resulting in cost savings for consumers.
- When an EV is connected to a charging station, information regarding the vehicle's charging time, speed, and power level is sent via Wi-Fi / Bluetooth to a cloud-based management platform. This platform compares vehicle data to the local grid's capacity and the energy usage of the charging site at that given moment. Then, this information is analysed in real time to facilitate automated decisions about the optimal charging times.
- Additionally, notifications can be sent to drivers, for example through mobile apps, to alert them about the optimal times to charge their EVs.

Route and range optimisation[2,3]

- EV route planning refers to the process of selecting and optimising the travel route of EVs, which in addition to other route planners also takes into account battery range, state of charge, and available charging locations.
- Since EV chargers are not widespread and EV charging is still time consuming, long journeys often require careful planning.

Source: [1]Eurelectric (2023), [2]RST (2024), [3]Volteum (2023).

[162] Shell (2024). Easily charge your car at home and on-the-go with Shell Recharge, Available here. (Accessed: 14 September 2024).

In-vehicle data can support the provision of these services. In particular, information on the vehicle's battery and its status (e.g., state of charge, state of power, state of health)[163] can allow EV charging service providers the ability to better communicate with the users about route planning or when to charge their EVs. Users can receive notifications through a mobile application when the battery has reached a certain charge level. Additionally, the vehicle and charging locations allow the identification of charging point positions and key parameters (e.g., status and capacity). In the case of vehicle-to-grid (V2G) systems, in-vehicle data on connection status, charge/discharge rates, and grid demand are essential for optimal performance. This market is dynamic, with numerous players offering these services. A significant number of electromobility apps are available, many of which are developed by independent third parties. Despite the presence of OEMs offering similar solutions, third-party apps have proven particularly popular among EV drivers. For example, the most popular EV applications available on the App Store in Denmark in 2024 are developed by third parties and include PlugShare, ChargePoint, Monta Charge, Chargemap, Octopus Electroverse, IONITY, and A Better Routeplanner.[164]

A harrisX study conducted for Ford indicated that energy costs are the most significant factor when consumers choose where to charge their EVs.[165] Moreover, according to a Deloitte consumer survey, the time required to charge is among the two most important concerns regarding battery electric vehicles (BEVs), together with the driving range.[166] Therefore, charging experience plays a significant role in the brand choice of EV consumers. Overall, connectivity services appear to be more important for EV consumers. According to a McKinsey's survey,[167] more than half of customers with BEVs would consider switching OEMs for better connectivity. Additionally, the harrisX survey conducted for Ford highlights that, overall, EV drivers are more aware of connected vehicles and their benefits compared to drivers of traditional vehicles.[168]

EV consumers place a high value on charging experience when choosing a vehicle due to the long duration of charging stops, and the potentially significant impact on vehicle ownership costs due to variation of costs depending on time and place of charging. Therefore, we expect these market forces to drive OEMs to supply the data necessary for electromobility services and guarantee an effective and competitive outcome in this aftermarket (as that will affect OEMs' competitive position in the primary market of selling EVs).

[163] State of charge (SoC) represents the current charge level of a battery as a percentage of its total capacity. State of power (SoP) indicates the maximum power output that the battery can deliver at a specific moment. State of health (SoH) assesses the overall health and lifespan of the battery compared to its original condition. Epic Power (2020). State of Charge, Health and Power in batteries. Definition, Available here. (Accessed: 14 September 2024).
[164] See App Store (2024). EV charging applications. Applications with over 3,000 reviews and a rating of 4 out of 5 or higher in the App Store.
[165] Ford (2023). Ford Teams Up with Industry Innovators Octopus Energy and Tibber for Next-Gen Smart Charging to Save Drivers Money, Available here. (Accessed: 17 September 2024).
[166] Deloitte (2024). Deloitte Global Automotive Consumer Study Key Findings: EMEA Focus Countries, 2024).
[167] McKinsey & Company (2024). Car connectivity: What consumers want and are willing to pay.
The survey includes 1,649 respondents across Germany, the US and China.
[168] harrisX (2021). VDA insights research presentation – Qual & Quant Insights Report. The survey includes more than 2,400 respondents across six markets (Germany, France, Italy, Spain, Poland, the Netherlands, and the UK). Across all questions related to connected vehicles and their benefits, a greater proportion of EV drivers demonstrated a deeper understanding of the topic compared to traditional vehicle drivers.

CHAPTER 4

Newly introduced regulations will enable further access to in-vehicle data

Key takeaways

- Starting in 2025, raw and pre-processed data generated by connected vehicles will be made available to users and third parties on their behalf on FRAND terms under the newly introduced Data Act.
- Availability of high-frequency in-vehicle data is expected to increase as the Data Act mandates that the data must be readily available when requested.
- Other forthcoming EV-specific regulations, namely the Battery Regulation and the Renewable Energy Directive, will mandate additional access to data related to the battery, possibly already within the scope of the Data Act.

Even if concerns existed on OEMs restricting access to in-vehicle data, the Data Act, which comes into force in 2025 and, specifically for EVs, other regulations such as the Battery Regulation and the Renewable Energy Directive, are already designed to address such concerns and will likely have a significant impact.

The Data Act will grant users of all connected devices across Europe, and third parties authorised by users on their behalf, access to the raw and pre-processed data generated by connected vehicles from the use of the device.[169] As this is a horizontal economy-wide regulation, it also covers connected vehicles. The Regulation further provides principles on compensation for access that, for third parties, should be determined under fair, reasonable and non-discriminatory access (FRAND) conditions.

By its design, the Data Act is expected to address the following concerns related to in-vehicle data:

- incomplete sharing by OEMs, given the mandate that all data should be accessible for third parties who do not compete with OEMs on the primary market (which, by definition, includes independent aftermarket service providers);
- any concerns related to unfair prices or trading conditions.

We discuss the Data Act in more detail below, and we also assess other regulations directed at EV-specific data.

The Data Act

The Data Act comes into effect in September 2025 and is aimed at enhancing the EU's data economy and fostering a competitive data market by making data generated by

[169] A connected device is defined as a product that can generate, obtain, or collect data about their use, performance, or envi ronment and that can communicate this data via a cable-based or wireless connection.

connected devices and related services more accessible and usable.[170] The stated purpose of the Data Act is to encourage data-driven innovation and increase data availability across the economy.

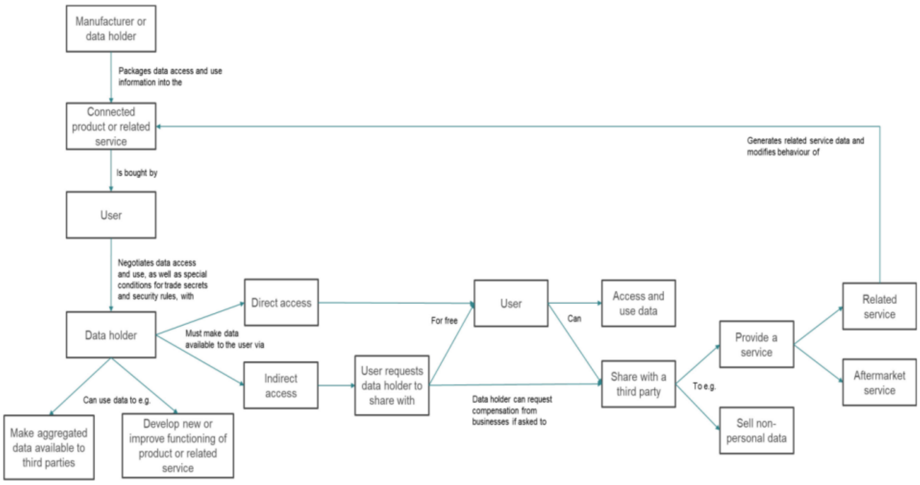
In particular, the Data Act is designed to ensure fairness in the allocation of the data value among the EU market players by setting out harmonised rights and conditions on who must share data, who can access it, how it can be used, and for which specific purposes.

Related to the topic of this paper, a key provision of the Data Act is that it provides legal grounds on which third parties can request access to data generated by connected devices. Under the Data Act, OEMs must provide data under fair, reasonable, and non-discriminatory terms (FRAND) to third parties upon request by the user. The Regulation leaves it up to the OEM to assess whether it is technically feasible to provide access to certain data in real time and continuously, or whether the data has to be provided instead with intervals.

Access by third parties to this data requires a formal agreement with the OEM that specifies compensation and the technical modalities for sharing, see Figure **Figure 14**. Third parties are not allowed to use the data to create products that compete with the original device (in this case, the vehicle), and they cannot share the data unless it is for providing a user service.

[170] European Commission (2023). Regulation (EU) 2023/2854 of the European Parliament and of the Council of 13 December 2023 on harmonised rules on fair access to and use of data and amending Regulation (EU) 2017/2394 and Directive (EU) 2020/1828 (Data Act).

Figure 14
Access to and use of data in the IoT context



Source: European Commission (2024).

When considering connected vehicles, the data in scope are all raw and pre-processed data generated from the use of the connected vehicle (i.e., product data) or a related service (i.e., related service data) that is readily available to the OEM,[171] along with the necessary metadata to make it understandable and usable. Raw data includes all data collected by the sensor. Pre-processed data include information from sensors that has been converted into physical quantities or qualities such as temperature, pressure, flow rate, position, acceleration, or speed.

On the other hand, information inferred from data through additional investments and complex proprietary algorithms is not considered "pre-processed" and falls outside the scope of the Regulation. The distinction between pre-processed and derived data may not always be clear-cut, leaving some uncertainty.

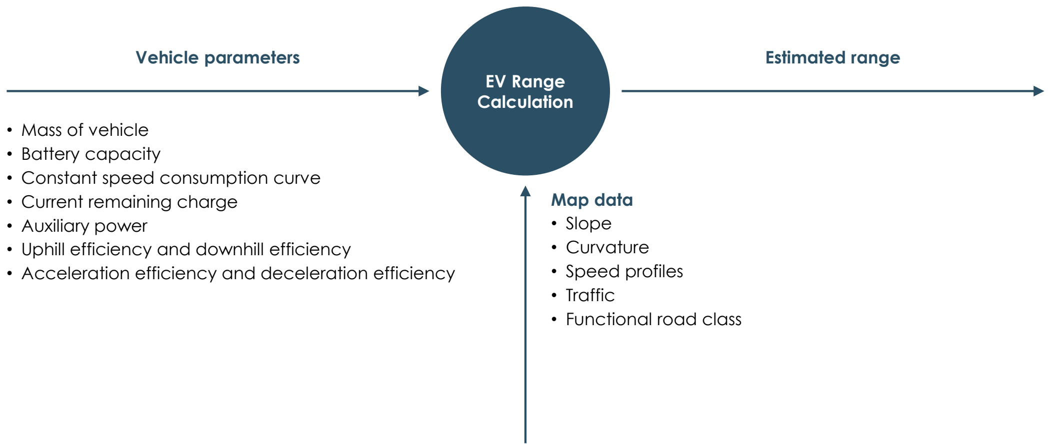
A frequently cited example is the data on an EV's remaining range given its current charge. This metric is based on proprietary algorithms and is thus outside of the scope of the Data Act. However, some OEMs, such as BMW and Volkswagen, already offer access to this metric. Moreover, these data can be derived from the raw and pre-processed data that are available, and the provision of better estimates could be a valuable product that third parties can provide.

Non-OEM players already provide their own estimates of range using some vehicle data and other sources to perform their own calculations. This is particularly useful for route-planning services such as TomTom, see Figure **15**. Similarly, A Better RoutePlanner, an

[171] Data reflecting user actions or events associated with the vehicle.

app designed specifically to design routes for EV users, also provides its own range estimates for a trip using raw data from the vehicle.

Figure 15
TomTom's example of EV range calculation based on multiple parameters



Source: TomTom (2022).

Diagnostic trouble codes (DTC) are another ambiguous example of data that could fall under the Data Act as non-substantially modified data.[172] Nevertheless, as we saw in the previous section, DTCs are already covered under RMI provisions under Annexe X of the Type Approval legislation, so independent operators already have access to it, regardless of the Data Act. Contrary to other industries, the Data Act does not operate in a vacuum in the automotive sector; rather, it is inserting itself in a complex regulatory landscape. As such, rather than introducing rules on data access and sharing (as would be the case in other sectors), to a certain extent, it complements this legislative framework.

An additional aspect relates to the frequency of access to data. The Data Act allows OEMs to evaluate whether it is "*relevant and technically feasible*" to provide data access "*continuously and in real-time*" for users and third parties.[173] As outlined in the Data Act's Q&A document, this flexibility is needed, as not all connected vehicles (and not all data) are configured to allow direct data access.[174] In making this assessment, OEMs may consider factors such as the technical feasibility of direct access, the costs associated with necessary technical modifications, and the challenges of safeguarding trade secrets, intellectual property, or ensuring vehicle security. As explained in Section 3.1 and the appendices, these are important considerations for OEMs.

[172] See for example FIGIEFA (2023). Infographic – The Data Act and Vehicle Data: Scope of Data, Available here. (Accessed: 17 September 2024) and JIPITEC (2018). Data Governance in Connected Cars: The Problem of Access to In-Vehicle Data.
[173] See Articles 4 and 5 of the regulation.
[174] European Commission (2024). Frequently Asked Questions – Data Act.

Finally, the Data Act mandates that OEMs must provide a clear list of the data that users will be able to access. This could enhance transparency and provide users with better information to evaluate potential aftermarket services available based on that dataset. This could strengthen the importance of in-vehicle data in influencing brand selection, thereby boosting system market competition and prompting OEMs to provide even more data.

The Batteries Regulation

The Batteries Regulation[175] aims to ensure the sustainable production, use, and disposal of batteries. It covers the whole lifecycle for all types of batteries and their second life, which includes repair, remanufacturing, recycling, and reusing of different types of batteries.

Under this Regulation, OEMs are mandated to provide independent operators with non-discriminatory, read-only access to a set of battery parameters needed for determining the state of health (SoH) and expected lifetime of batteries. This includes data on the state of certified energy (SOCE) for EV batteries. Stationary battery energy storage systems and lightweight mobile transportation (LMT) batteries include data on remaining capacity, the evolution of self-discharge rates, and more.

Finally, data on the lifetime of batteries include energy and capacity throughput, as well as information on harmful events such as deep discharges and exposure to extreme temperatures.[176]

Additionally, OEMs are mandated to share specific data with third parties in the battery passport.[177] The battery passport includes information relating to the battery model and battery-specific information, including information resulting from the use of that battery. Specifically in terms of data points, OEMs need to share data on the SoH, state of charge (SoC), number of charging and discharging cycles, performance and durability parameters, battery status (i.e., defined as ‘original’, ‘repurposed’, ‘re-used’, ‘remanufactured’,” or ‘waste’), and more.[178]

The Renewable Energy Directive

The Renewable Energy Directive (RED III),[179] which was revised in 2023, establishes a legal framework for the development of clean energy across all EU sectors.

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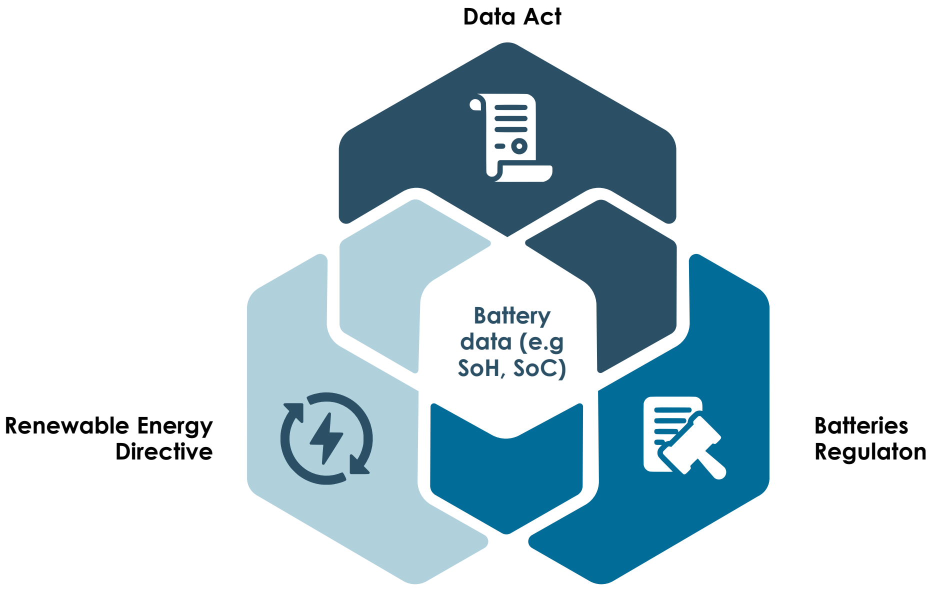
[175] European Commission (2023). Regulation (EU) 2023/1542 of the European Parliament and of the Council of 12 July 2023 concerning batteries and waste batteries, amending Directive 2008/98/EC and Regulation (EU) 2019/1020 and repealing Di rective 2006/66/EC.
[176] See Annex VII of European Commission (2023). Regulation (EU) 2023/1542 of the European Parliament and of the Council for the complete list of parameters for determining the SoH and expected lifetime of batteries.
[177] One key novelty of this regulation is the introduction of mandatory digital battery passports for lightweight mobile transportation (LMT), industrial batteries with a capacity greater than 2KWh and EV batteries (EVBs).
[178] See Annex XIII of European Commission (2023). Regulation (EU) 2023/1542 of the European Parliament and of the Council for the complete list of the information to be included in the battery passport.
[179] European Commission (2023). Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652.

In addition to the requirements laid down in the Batteries Regulation, the RED II mandates OEMs to provide non-discriminatory access to real-time data related to the battery state of health, state of charge, capacity, and power set point, as well as the location of EVs where appropriate, to battery owners and users, as well as to third parties (with explicit consent, on the owners' and users' behalf). Unlike the Batteries Regulation, which does not mandate real-time data sharing, RED III emphasises the importance of providing this information immediately. This Directive does not allow OEMs to profit from data sharing, even to cover costs.

It is evident that several data points are mandated to be shared by OEMs concurrently by different regulations, see Figure **16**.

Figure 16
Example of overlap in the requirement of OEMs to share battery data



Source: Copenhagen Economics

CONCLUDING REMARKS

The Draghi Report's assessment of regulation in the automotive industry highlights that "*multiple pieces of legislation have overlapped during the past decade, and more can be expected in the incoming years towards 2030. Legislation has not always been fully coherent.*"[180] In line with this, the Draghi Report recommends that policy makers work to "*ensure regulatory coherence, predictability and appropriate timing and consultation for upcoming regulation.*"[181] This consideration is also reflected in the Political Guidelines of the European Commission President Ursula von der Leyen for the 2024–2029 mandate, stating that the priority should be on developing a comprehensive EU Data Union Strategy by leveraging *existing* rules to establish a clear, simplified, and coherent legal framework for businesses and administrations to share data.[182]

Our report provides an economic framework for the assessment of concerns raised by certain stakeholders that market failures may exist in accessing in-vehicle data. We draw on well-established economic theory relating to potential concerns in aftermarket services, which are linked to a primary market purchase, and assess market developments in these aftermarkets, particularly those that could use in-vehicle data.

Our findings suggest that there is no strong evidence of adverse undersupply of data to aftermarket services. First, for commercial vehicles, we find that there is likely a significant incentive for OEMs to ensure the quality of aftermarket services in order to compete effectively in the primary market of vehicles. Further, we observe that data-driven services permeate sectors where there is user demand: this is particularly the case for commercial users, but also to a lesser extent for EVs, including those with a private owner. In fact, the very same models of passenger cars often have the same data available for commercial and private owners, but only commercial users choose to use this capability. Evidence suggests that consumer demand for data-based aftermarket services has, to date, remained modest relative to commercial vehicles. Providing access to more in-vehicle data could require costly changes to vehicle architecture, which could affect its performance and main function (that of transporting people and goods).

Finally, recent regulatory developments in the EU have already been designed to further enhance access to data in aftermarkets for connected devices. Particularly, the Data Act is an overarching legislation that comes into force in September 2025 and will overhaul access to data in all connected devices, including vehicles.

In all, therefore, we conclude that the economic case for further sector regulation for in-vehicle data is not well founded.

[180] European Commission (2024), The future of European competitiveness Part B | In-depth analysis and recommendations, p. 146 (the Draghi Report).
[181] *Ibid, page 152.*
[182] Ursula von der Leyen (2024). Political guidelines for the next European Commission 2024–2029 – Ursula von der Leyen.

GLOSSARY

ACRONYM	DESCRIPTION
ABS	Anti-Lock Braking Systems
ACEA	European Automobile Manufacturer’s Association
ADAS	Advanced Driver-Assistance Systems
BEVs	Battery Electric Vehicles
CAN	Controlled Area Network
CCI	Car Cost Index
C-ITS	Cooperative Intelligent Transport Systems
CONVESA	Connected Vehicle Systems Alliance
CPO	Charge Point Operator
DGVW	Design Gross Vehicle Weight
DTC	Diagnostic Trouble Code
ECU	Electronic Control Unit
E-mobility	Electromobility
eMSPs	eMobility Service Providers
EV	Electric Vehicle
EVBs	EV Batteries
ExVe	Extended Vehicle
FCEVs	Fuel Cell Electric Vehicles
FMS	Fleet Management Services
FRAND	Fair, Reasonable and Non-discriminatory Access
GAS	Google Automotive Services
GDPR	General Data Protection Regulation
HDV	Heavy-Duty Vehicle
HMI	Human Machine Interface
ICE	Internal Combustion Engine
IRs	Independent Repairers
LCV	Light Commercial Vehicle
LMT	Lightweight Mobile Transportation

MHYD	Manage-How-You-Drive
MTPL	Motor Third Party Liability
MVBER	Motor Vehicle Block Exemption Regulation
OBD	On-Board Diagnostic
OBFCM	On-Board Fuel Consumption Monitoring
OEM	Original Equipment Manufacturers
PAYD	Pay-As-You-Drive
PC	Passenger Car
PHEV	Plug-in Hybrid Electric Vehicle
PTO	Power Take-off
RED	Renewable Energy Directive
rFMS	Remote Fleet Management System
RM	Repair and Maintenance
RMI	Repair and Maintenance Information
RMT	Repair, Maintenance and Tyres
RTTI	Real-Time Traffic Information
SoC	State of Charge
SOCE	State of Certified Energy
SoH	State of Health
SoP	State of Power
TOC	Total Cost of Ownership
USI	Usage-based Insurance
V2C	Vehicle-to-cloud
V2D	Vehicle-to-devices
V2G	Vehicle-to-grid
V2I	Vehicle-to-infrastructure
V2N	Vehicle-to-networks
V2P	Vehicle-to-pedestrians

V2V	Vehicle-to-vehicle
V2X	Vehicle-to-everything
VHAL	Vehicle Hardware Abstraction Layer

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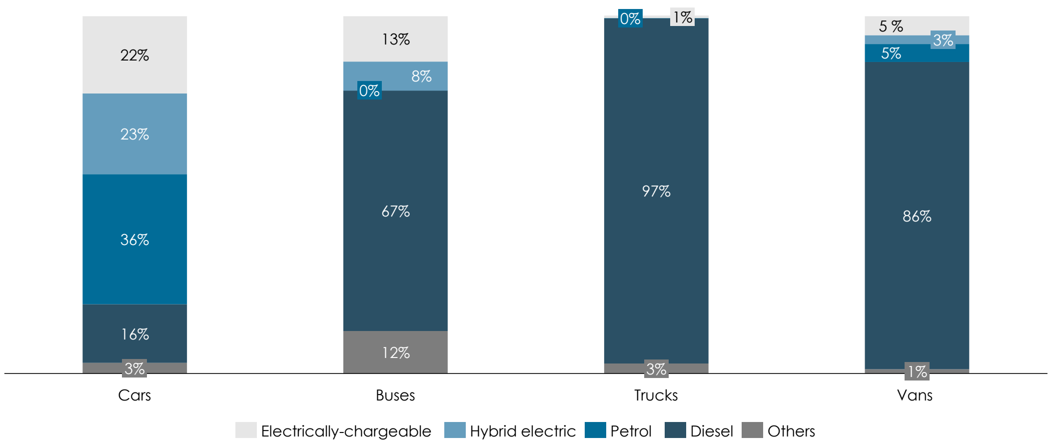
APPENDIX A
ELECTRIFICATION OF THE CAR PARC

Each primary market is undergoing the electrification transition at different pace due varying consumer trust, regulatory pressures, and technological requirements (e.g. availability of EV charging points).[183] In particular, passenger cars are leading the electrification shift with 22 per cent of new EU vehicle sold in 2022 being electrically-chargeable. In contrast, LCVs and HDVs, particularly trucks, are progressing at a slower pace, see Figure **17**. This lag can be attributed to the significant investment needed in EV charging infrastructure along freight routes and the limited technology available for long-haul applications such as high battery capacities.[184] This is a relevant factor as EVs generate an important demand for digital services also based on data such as smart charging, route optimisation and recharging point mapping.[185]

Figure 17
New EU vehicle sales by power source in 2022
Percentage



Source: ACEA (2023)

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APPENDIX B
TRANSMITTING DATA IS COSTLY

The current data access conditions observed in the market must be understood within the context of significant technical constraints due to existing vehicle electronics architectures and requirements in terms of data privacy and cybersecurity risks.[186] OEMs compete by innovating and independently designing their vehicles for transportation. This results in vehicles brands and models having different designs and electronic architectures which influence the way in-vehicle data is generated. Therefore, low levels of data standardisation are the results of highly competitive markets where OEMs try to outcompete each other's by innovating and differentiating their vehicle designs and features, rather than potential market failures.

Currently, most vehicles present distributed architectures. These architectures involve actuators and sensors communicating, through the CAN bus network,[187] raw data to electronic control units (ECUs), to make internal calculation and ensure functions of the vehicle. Processed data is then shared with other ECUs or advanced modules until it reaches the central gateway. The central gateway consolidates data from various vehicle domains like body, powertrain, and infotainment, and relays important information to the dashboard, the on-board diagnostic port (OBD-II) and off-board to the ExVe.

To manage the data flow in a distributed architecture, OEMs define trigger events that dictate when certain predefined signals are collected and transmitted to the central gateway. Vehicle architectures vary significantly between manufacturers, leading to variations in data identifiers and trigger conditions. There are thousands of signals and most of them do not have any use outside of the operations of the vehicle. The trigger events are configured within technical limits and tailored to the needs of specific vehicle functions or fleet operators while ensuring efficiency and data minimisation.

Modifying the available data in the gateway and the frequency at which it is collected is technically challenging and costly. Introducing new data points may require extensive reprogramming and potentially redesigning the vehicle's electronic architecture, which can significantly impact costs and resource optimisation. In particular, the CAN bus network that transmits data signals between ECUs is designed to handle a finite amount of data traffic. Excessive demands for data extraction can lead to congestion, thereby affecting the performance and reliability of the vehicle's critical functions. This technical limitation can act as a barrier to providing extensive data access as it increases risks of operational inefficiencies and, at the extreme, failing of the vehicle core functions (e.g. braking system).

In the future, according to industry experts, OEMs are expected to develop domain centralised architectures, see Figure **18**. These new architectures represent an evolution from

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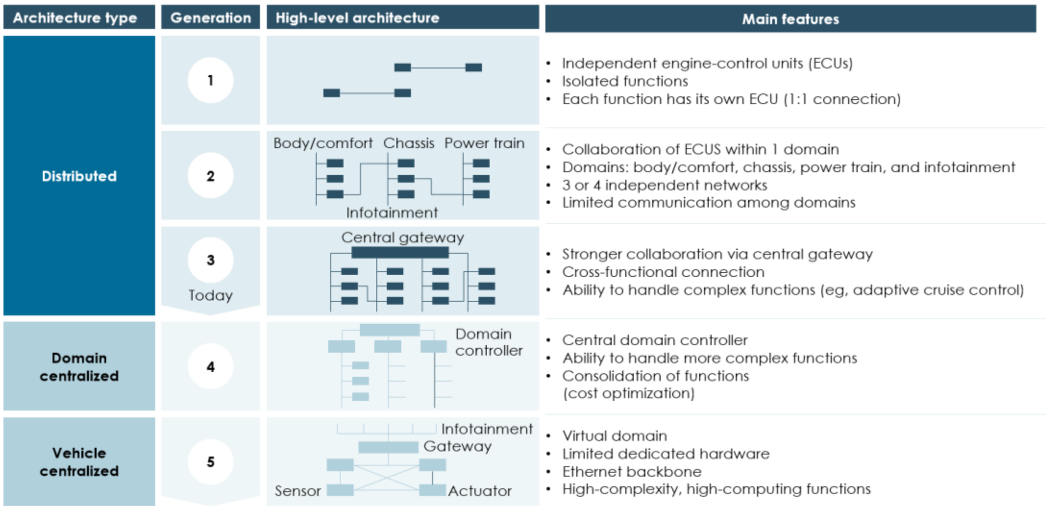
[186] Vehicle Electronics Architecture represents the structured configuration of electronic components, modules, and networks within a vehicle which enables the integration of diverse electronic systems like engine control units, infotainment, safety sys tems, and beyond.
[187] A controller area network (CAN) is a vehicle bus standard designed to enable efficient communication primarily between elec tronic control units (ECUs).

traditional distributed systems to a more centralised approach. In this model, data collection and processing are managed by fewer, more powerful central units rather than numerous distributed ECUs. This centralisation will enable more efficient handling of larger volumes of data and facilitates real-time processing and highly complex functionalities. As a result, vehicles may be able to support more sophisticated and flexible data collection and vehicle-to-everything (V2X) communication. However, this shift requires significant redesign and investment.

Figure 18
The electrical/electronic(E/E) architecture



Architecture type	Generation	High-level architecture	Main features
Distributed	1		• Independent engine-control units (ECUs) • Isolated functions • Each function has its own ECU (1:1 connection)
	2	Body/comfort Chassis Power train Infotainment	• Collaboration of ECUS within 1 domain • Domains: body/comfort, chassis, power train, and infotainment • 3 or 4 independent networks • Limited communication among domains
	3 Today	Central gateway	• Stronger collaboration via central gateway • Cross-functional connection • Ability to handle complex functions (eg, adaptive cruise control)
Domain centralized	4	Domain controller	• Central domain controller • Ability to handle more complex functions • Consolidation of functions (cost optimization)
Vehicle centralized	5	Infotainment Gateway Sensor Actuator	• Virtual domain • Limited dedicated hardware • Ethernet backbone • High-complexity, high-computing functions

Source: McKinsey & Company (2019).

We note that vehicles with greater software component could entail greater cybersecurity risks (malicious actors could gain control to vehicle core functions from interconnected domain units). Consequently, OEMs are developing their vehicles following security by design principle, ensuring, for example, that certain sensible data from the driver is not transmitted or even stored in the vehicle by design – thus not accessible by either OEMs or third parties. One OEM gave the example of cameras inside the vehicle that can detect driver distraction, in that case the vehicle system registers the event to activate alerts/safety systems while the camera image is immediately deleted.

Finally, access conditions experienced by aftermarket stakeholders are also affected by existing regulations on privacy and personal data the OEMs must comply with. Specifically, OEMs need to comply with the e-Privacy Directive and, since in-vehicle data can often be considered personal data, with General Data Protection Regulation (GDPR). OEMs need to obtain consent from the customers/driver to share in-vehicle data with third parties, but they also need customer consent to collect and store that data in the first place (even for the OEMs themselves). OEMs set up necessary systems/processes to acquire consent by the driver both for collecting and storing the data in their servers and for sharing the data with third parties, which also need to request consent. Consent process may create friction to data access. However, there are examples of OEMs devising solutions to provide more streamlined consent processes as those can frustrate customers and have a negative reputational effect. BMW for example now offer two consent process options: one asynchronous (e.g. consumer receive separate email communicating a data access clearance pending) and one synchronous where third-party application can direct the consumer to the BMW portal to obtain direct clearance.[188]

[188] BMW Group (2024). BMW CarData Integration Guide API v2, Available here. (Accessed: 26 November 2024).

APPENDIX C

EXISTING REGULATIONS COVERING DATA ACCESS AND SHARING IN THE AUTOMOTIVE INDUSTRY

Table 6

Several existing regulations mandate access to in-vehicle data

Existing legislation	Application	Field	Vehicle category	Type of data	Type of access	Description	Notes
General Data Protection Regulation (GDPR) Regulation (EU) 2016/679	2018	Data protection	All	Personal data	Unspecified	• Data subjects have a right to data portability that allows them to receive their personal data (e.g. location data) from a data controller, or have them transmitted directly from one data controller to another. • Thus, OEMs need to implement systems and processes to allow data subjects to download their personal data upon request. • However, this regulation does not facilitate B2B data sharing.	• As most driver and vehicle data are considered personal data, this regulation is relevant. • Even if it does not require data access, Article 5.3 of the **E-privacy** directive requires prior consent for gaining access and storing of information. Thus, processing of vehicle data is subject to the consent requirement under the E-privacy Directive, • In general, OEMs are required to share in-vehicle data. However, if consumers have not given their consent for OEMs to share their data, it creates a limbo situation. • It must be noted that the number of requests for data portability under GDPR is very low.
Real-Time Traffic Information (RTTI) Delegated Regulation (EU) 2022/670	2026	Transport	L, M, N, O	Road traffic data	Any access point	• OEMs need to share traffic and travel data in real-time.	
Motor Vehicle Block Exemption Regulation (MVER) Regulation (EU) 461/2010	2010	Aftermarket	M, N, O	R&M and OBD data	Unspecified	• Vehicle-generated data is viewed as an essential input to which independent operators in the R&M sector must have	

						unrestricted access on an equal footing as members of OEMs' authorized networks.
Repair and Maintenance Information (RMI) Regulation (EU) 2018/858	2018	Aftermarket	M, N, O	R&M and OBD data	Through OBD port	• OEMs need to ensure that independent operators have access to unrestricted, standardised and non-discriminatory access to vehicle OBD, information, diagnostic and other equipment, tools including the complete references, and available downloads, of the applicable software and vehicle RMI.
Type approval of motor vehicles with respect to emissions from light PCs and LCVs (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information Commission Regulation (EC) 715/2007	2007	Environment	M1, M2, N1 and N2	OBD and CO_2 emissions data	Through OBD port	• OEMs need to provide unrestricted access to relevant OBD and vehicle R&M information to independent operators in a standardized, non-discriminatory format.
Technical requirements and procedures for the approval of motor vehicles and engines with respect to emissions for HDV (Euro 6) Commission Regulation (EU) 582/2011	2011	Environment	M1, N1, M2, N2 > 2.6t, M3, N3	OBD and CO_2 emissions data	Through OBD port	• OEMs need to receive an EC type-approval of vehicles and engines with regard to emissions and vehicle R&M information for HDV. • As part of the approval procedure, OEMS need to provide data and ensure that all vehicles are equipped with an OBD system. • The OBD in-use performance related data need to be stored and made available without any encryption through the standard OBD communication protocol by the OBD system.
On-Board Fuel Consumption Monitoring (OBFCM)	2017	Environment	M,N	Diagnostic and fuel	Through OBD port	• OEMs need to ensure that all vehicles are equipped with an OBD system, and shall

for LDV Commission Regulation (EU) 2017/1151				consumption data			be designed, constructed and installed on a vehicle so as to enable it to identify types of deterioration or malfunction over the entire life of the vehicle.
CO2 emissions and fuel consumption for HDV Regulation (EU) 2017/2400 and 2019/1242	2017	Environment	M2, M3, N1, N2, N3 not under Reg. 2019/63, O3 and O4	CO2 emissions and fuel consumption data	Through OBD port	•	OEMs need to have on-board fuel and/or energy consumption monitoring devices accessible for the European Commission to monitor CO2 and energy consumptions.
Real-world emissions for LDV Implementing Regulation (EU) 2021/392	2021	Environment	M1, N1	Real-world emissions data	Through OBD port	•	OEMs need to collect real-world data together with the VINs of new PCs and new LCVs hat are recorded by on-board fuel and/or energy consumption monitoring devices.
Safety-Related Traffic Information (SRTI) Delegated Regulation (EU) 886/2013	2015	Safety	L, M, N, O	Road traffic data	Any access point	•	OEMS need to share certain road safety-related data in real-time to authorities or service providers.

Event Data Recorder (EDR) for passenger cars and vans Delegated Regulation (EU) 2022/545	2022	Safety	M1, N1	Event data	Through OBD port	• Crash-related data recorded by the Event Data Recorder (EDR) need to be made available for retrieval through the serial data port on the standardised data link connector.	• The legislation does not specify who else can access the data, leaving it to national laws to determine additional entities like insurance providers who may access EDR data for assessing claims. • The EDR data becomes accessible through the OBD port or directly from the EDR if the OBD port is no longer functional, under certain conditions laid out at the national level.
Automated Lane Keeping Systems (ALKS) UN Regulation no. 157	2022	Safety	M1 (if fitted with ALKS)	ALKS data	Unspecified	• OEMs shall have processes aimed at collecting vehicle data, and data from other sources to monitor and analyse safety-relevant incidents/accidents caused by the engaged automated driving system • Data stored in the DSSAD shall be easily readable in a standardized way via the use of an electronic communication interface, at least through the OBD port. • The OEM shall provide instructions on how to access the data.	• Currently, while there might be possibilities for third parties to access ALKS data through the OBD port, the systems themselves are not open for third-party service provision or modification. • Also, the commercial scope for such access is limited.
Automated Driving Systems (ADS) Implementing Regulation (EU) 2022/1426	2022	Safety	M, N (if fitted with ADS)	ADS and EDR data	Through OBD port	• ADS data stored shall be easily readable in a standardised way via the use of an electronic communication interface, at least through the OBD port. • The OEM shall provide instructions on how to access the data.	
Intelligent Speed Assistance (ISA) Delegated Regulation (EU) 2021/1958	2022	Safety	M,N	ISA System use data	Unspecified	• The real-world driving information, to be collected and provided for the assessment of the performance of ISA systems, should be generic and not linked to any individual motor vehicle or driver. Manufacturers may use any available means for gathering data.	

Tachograph Regulation (EU) 165/2014	2020	Driver (social legislation)	N1 > 2.5t, N2, N3, M2, M3	Driver, driver activity and vehicle related data	Multiple types of access depending on the data	• OEMs must ensure that data collected by the tachograph (e.g. driving time, vehicle speed, rest periods, etc) in commercial vehicles can be accessed and transmitted to vehicle owners (i.e. transport undertaking) and competent control authorities. • Then, vehicle owners can share this data with third parties for fleet management services.	• Tachograph data is mainly for the protection of the driver and is used to verify that labor rules regarding driving times are adhered to.

Note: According to the United Nations Economic Commission for Europe (UNECE), vehicle categories are classified as follows:[189]
L: motor vehicles with fewer than four wheels ;
M: motor vehicles for passenger transport (M1: vehicles designed for passenger transport with no more than eight seats, M2: vehicles designed for passenger transport with more than eight seats, having a maximum weight not exceeding 5 tonnes, M3: vehicles designed for passenger transport with more than eight seats, exceeding 5 tonnes) ;
N: motor vehicles for good transport (N1: vehicles used for goods transport with a GVW of up to 3.5 tonnes, N2: vehicles for goods transport with a GVW of 3.5 to 12 tonnes, N3: vehicles for goods transport with a GVW over 12 tons9) ;
O: trailers.

Source: Copenhagen Economics based on ACEA research.

[189] United Nations Economic Commission for Europe (2017). Consolidated Resolution on the Construction of Vehicles (R.E.3), Revision 6.

APPENDIX D

STANDARDISATION INITIATIVES FOR IN-VEHICLE DATA

THE CONNECTED VEHICLE SYSTEMS ALLIANCE (COVESA)

COVESA is an open and member-driven alliance focusing on developing standardised approaches and technologies for connected vehicles.[190] Originally known as the GENIVI Alliance, COVESA has grown to include over 160 members today. Notable OEMs such as Ford, Volvo Cars, BMW Group, and Honda, along with first-tier and services suppliers are members of this alliance.

Introduced in 2016, one of COVESA's prominent initiatives is the Vehicle Signal Specification (VSS).[191] VSS provides a common framework for vehicle data by transforming complex network signals into a standardised, OEM-independent data model.

Specifically, VSS offers a domain data taxonomy for vehicle signals, which includes:

1. a syntax for defining vehicle signals in a structured manner;
2. a catalogue of vehicle-related signals.

By providing a uniform format for data, VSS significantly enhances data integration and interoperability, ensuring seamless communication among diverse vehicles, infrastructure, and devices, regardless of the brand or technology. For instance, the collected signal for speed from different vehicles might vary across vehicles models or OEMs. VSS standardises this signal under the label “Vehicle Speed”, facilitating consistent data access.

The VSS has evolved significantly since its introduction.

- In 2016, the earliest versions covered fundamental vehicle functions (e.g. speed, fuel, engine status, etc).
- In 2018-2019, advanced driver-assistance systems (ADAS) data points were introduced (e.g. lane keeping, adaptive cruise control etc). Additionally, a broader range of infotainment signals was integrated (e.g. media playback, volume control, etc).
- In 2022, the release of VSS version 3.0 brought important improvements, particularly with the introduction of "Overlays," which allow to customise the standard catalogue to better meet specific needs, such as adding proprietary vehicle data.[192] In addition, new signals for EVs were added (e.g. battery status, charging speed, etc).
- In 2024, the latest official release, VSS 4.2, introduced a significant number of new signals (e.g. engine coolant, screen mirroring, wheel angular speed, etc).[193]

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[190] COVESA (2024). The Connected Vehicle Systems Alliance, Available here. (Accessed: 26 November 2024).
[191] COVESA (2024). The Connected Vehicle Systems Alliance, Available here. (Accessed: 26 November 2024).
[192] GitHub (2022). Vehicle Signal Specification v3.0, Available here. (Accessed: 26 November 2024).
[193] GitHub (2024). Vehicle Signal Specification v4.2, Available here. (Accessed: 26 November 2024).

EXAMPLES OF CURRENT STANDARDS RELATED TO IN-VEHICLE DATA IN THE HDV MARKET

Fleet Management System (FMS) / Remote Fleet Management System (rFMS)[194]

- In 2002, the European HDV OEMs Volvo (including Renault), MAN, Daimler, Scania, DAF and Iveco jointly developed the FMS standard to make OEM-independent applications for telematics possible by mutually agreeing to provide access to vehicle data.
- Thus, the OEMs developed a common interface as an open standard based on the FMS standard.
- The rFMS standard is an evolution of the FMS standard with capability to remotely access vehicle data through the backend system.

ISO 11992-X[195]

- Implemented by all OEMs with varying integration levels, this standard specifies the requirements for the truck-trailer communication. It is based on the SAE J1939 protocol using the CAN for data exchange.
- The communication architecture is designed to route data through the brake Electronic Control Unit (ECU).

DIN-4630[196]

- This standard defines the data parameter specification for body application units in commercial vehicles. More specifically, it aims to establish a unified framework for the communication between the vehicle's chassis, body components and telematics.
- The ambition of DIN-4630 is to become an ISO standard, which would enhance its acceptance and applicability across the industry.
- Overall, it is expected to simplify the overall digitalisation journey by providing a standardised approach to OEM body communication.

[194] TRL (2017). Access to In-vehicle Data and Ressources - Final Report.
[195] ISO (2014). ISO 11992-4:2014, Available here. (Accessed: 26 November 2024).
[196] Bär CargoConnect. (2024). The standardised data interface Bär CargoConnect, Available here. (Accessed: 26 November 2024).