NEXT STOP: AUTONOMY — SEIZING EUROPE'S PUBLIC TRANSPORT OPPORTUNITY

movingfutures

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EXECUTIVE SUMMARY

Autonomous driving holds vast potential for Europe's public transport systems. This white paper shows that the market is not only ready but offers a substantial and economically viable opportunity for autonomous vehicles (AVs). In a time of increasing driver shortages and the need for climate-friendly, inclusive mobility, automation will be essential to sustain and expand service quality in both urban and rural areas.

Using existing European bus fleets across 28 individual countries as a baseline, this analysis models their replacement with autonomous shuttles and buses over a 20-year horizon. Adoption is driven by cost competitiveness: once AVs reach cost parity with manual operation, uptake accelerates rapidly. Across three cost scenarios, i.e. optimistic, moderate, and pessimistic, the results are consistent: demand for AVs in public transport will be strong and scalable.

In the optimistic scenario, Europe could operate over two million autonomous shuttles and more than 300,000 autonomous buses after 20 years; even under pessimistic assumptions, nearly one million shuttles and over 100,000 buses could enter service. Early adoption begins in higher-cost markets, followed by widespread deployment once technology costs fall. Flexible, on-demand service models show the highest growth potential, as autonomy enables more adaptive operations that better match real mobility needs.

The key insight is clear: Europe's public transport operators are ready for autonomous technology once it becomes operationally and economically viable. Automation can significantly increase efficiency and accessibility while maintaining or improving service quality, offering higher performance at a comparable or lower cost. The opportunity is tangible and measurable. To realize it, technology providers, policymakers, and operators must now align to move from pilot projects to full-scale fleet deployment. The market is ready; what remains is to seize it.

INTRODUCTION

Autonomous driving has long promised to reshape the way people move. Yet today, much of the global attention - and investment - remains concentrated on ride-hailing and private taxi services, particularly in the United States and China. The result is a growing imbalance: while fleets of autonomous vehicles are starting to be deployed at scale in these markets, Europe risks being left behind in a field where the potential for transformation is just as significant, if not greater.

We believe it is time to send a clear and simple message: if the technology for autonomous vehicles is ready, there is a real, scalable, and economically viable market for them in European public transport. Especially in times of increasing driver shortages, autonomous driving is not a nice-to-have technology; it will become the backbone and key technology of public transport, particularly if we want to maintain or improve the status quo of transportation quality, which in turn is essential to achieve climate targets and increase societal justice.

This message is of utmost urgency. As the leading self-driving technology providers and automotive players make critical investment and development decisions, there is a risk that they will overcommit to ride-hailing models in Asia and North America. Public transport in Europe, one of the backbone industries of the continent's mobility system, must not be overlooked. The opportunity is simply too large: for companies, for people, and for society at large.

It is true that the European public transport market is different from what private companies might hope for in some regards. Procurement cycles are longer, and decision-making processes often extend over several years. These characteristics may make the market appear less attractive for agile digital players seeking the rapid growth curves and "hockey stick" returns often expected in venture-driven business cases. Yet precisely because of its structured nature, this market offers stability, predictability, and scale: the very foundations required for a sustainable deployment of autonomous vehicle technology.

Our argument is straightforward. Public transport in Europe today represents a substantial and growing demand for buses, many of which will need to be replaced over the coming decade. These fleets are the lifelines of urban and rural mobility, serving millions of passengers every day. If autonomous driving technology can be integrated into these fleets, the benefits are multifold: higher efficiency, improved safety, lower operating costs, and greater accessibility for passengers. Importantly, there is also a price point that operators are prepared to pay for autonomous vehicles, provided the technology is proven and reliable.

To make this case tangible, a group of experts from the public transport sector, together with movingfutures's mobility experts, have developed a structured methodology to size the potential market for autonomous vehicles in European Public Transport. This white paper summarizes our approach and results.

The message is clear: the market is there - ready and waiting – for AVs in public transport. The question is no longer whether there will be demand, but whether technology providers, policymakers, and operators are ready to seize it.

ASSUMPTIONS AND GUIDING PRINCIPLES

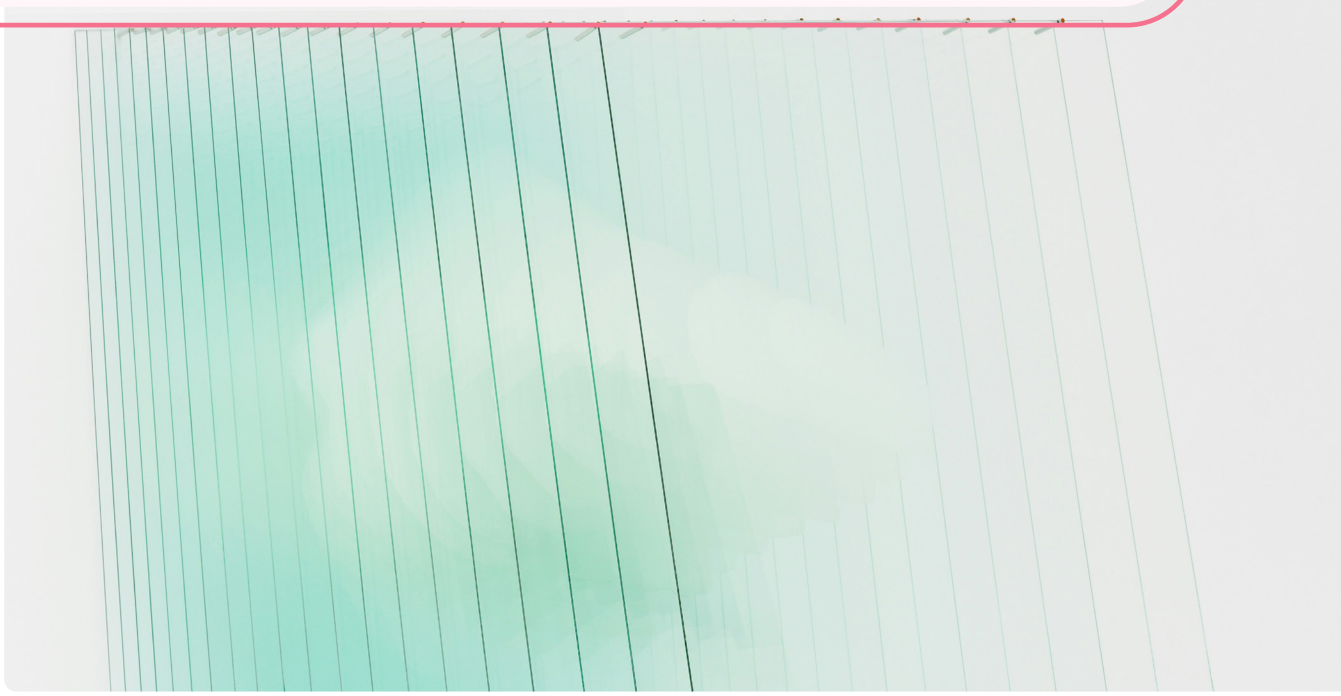
To ensure transparency and clarity in how this white paper approaches the estimation of market size for AVs in European public transport, we outline below the key assumptions and guiding thought processes that informed our methodology and scenario design.

01

Technological Agnosticism – Not Blindness

Our analysis is deliberately technology-agnostic, meaning we do not favor or exclude any specific vehicle technologies, self-driving stacks, or providers based on their origin, current market focus, or stage of maturity. However, this is not to be confused with technological blindness. We are aware of what is currently possible, what has been promised, and what has proven realistic based on past developments.

Rather than constraining the analysis to today's technological limitations, we adopt a "what makes sense" perspective—assuming that, if the market opportunity is large and meaningful, solutions will emerge and scale accordingly. In this sense, we aim to highlight the demand potential, not just what is deliverable with today's technical capabilities. However, all our models include a 5-year delay for large buses in comparison to smaller autonomous shuttles given the current progress that both vehicle types show in respect to automation.



ASSUMPTIONS AND GUIDING PRINCIPLES

02

Public Transport at the Core

This white paper places public transport at the center of its scope. We are convinced that Europe has a historically strong position in public transport that deserves to be carried on and transformed into an autonomous age. As such, we exclude individual ownership models and ride-hailing services in the classic taxi-like sense from our analysis. These forms of transport, while part of the broader mobility ecosystem, are individualized by their nature, and less efficient in terms of urban space and environmental impact. The two vehicle types we include in our model are: large autonomous buses, similar in size to today's urban buses and autonomous shuttles. Our model assumes autonomous shuttles to have an average capacity of eight seats. This explicitly includes smaller shuttles with a minimum capacity of four seats, as well as larger shuttles with a capacity of twelve seats. Modelling these two vehicle types as separate entities has led to complex replacement scenarios, which are strongly dependent on the specific use case. Therefore, we decided to model autonomous shuttles as one unit with an average capacity of eight seats, spanning from four to twelve.

We firmly believe that public transport is and should remain a public good, and AV services should primarily contribute to improving accessibility, efficiency, and sustainability within this system. Thus, our analysis focuses exclusively on use cases aligned with shared and publicly accessible services. This should not contradict service quality in any way. Much rather, if autonomous technology is deployed accordingly, it can increase both the service quality and the efficiency and availability of the service itself.

METHODOLOGICAL APPROACH

Our analysis begins with today's European bus fleets. This starting point ensures a realistic baseline: existing buses are already funded through public budgets, meaning that any future replacements we model reflect a realistic and 'already paid for' logic.

Fleet baseline. We drew on the ACEA Vehicles in Use Report , which provides the total number of registered buses per country. While the dataset does not distinguish between bus types, it establishes the scale of national fleets. To segment this fleet, we used the ICCT Europe Fact Sheet on annual bus sales, which reports a 13:6 ratio to allocate each country's fleet between city and rural buses.

Operating costs. For cost structures, we worked with German's VDV costs benchmarks as our baseline. Costs included drivers, energy, maintenance, depreciation, overheads, and insurance. To ensure comparability, we adjusted these values using purchasing power parity (PPP) multipliers derived from Eurostat, with Germany as the reference. All costs were projected into the future over 20 years at an annual inflation rate of 2%. We deliberately refrained from assigning calendar years to this horizon: "Year 1" marks the starting point with a specific costs per kilometer, allowing technology providers and other organizations to align results with their own development timelines.

Adoption logic. Adoption of AVs is modeled via take rates, which represent the share of annual fleet replacement that shifts to AVs. We assumed an average annual fleet replacement rate of 10%, meaning every year, one out of ten buses is replaced with a newer model on average. Depending on the respective cost competitiveness of AVs, take rates vary between 1% and 100%, meaning full adoption. The full take-rate to cost comparison matrix is displayed in Table 1. The take-rates are a key ingredient for the later model and therefore have been developed in two digital challenger workshops with all authors. There have been good arguments to apply both higher and lower take-rates across the board, but we are convinced that these numbers reflect a solid middle ground that serves the purpose of this analysis. Finally, to properly differentiate between urban and rural use cases when refining the distribution further, we assigned each country an urbanization value using United Nations World Urbanization Prospects.

[1]When referring to European countries, we consider EU27 nations, excluding Bulgaria and Malta due to a lack of suitable data, but including Norway, Switzerland, and the United Kingdom.

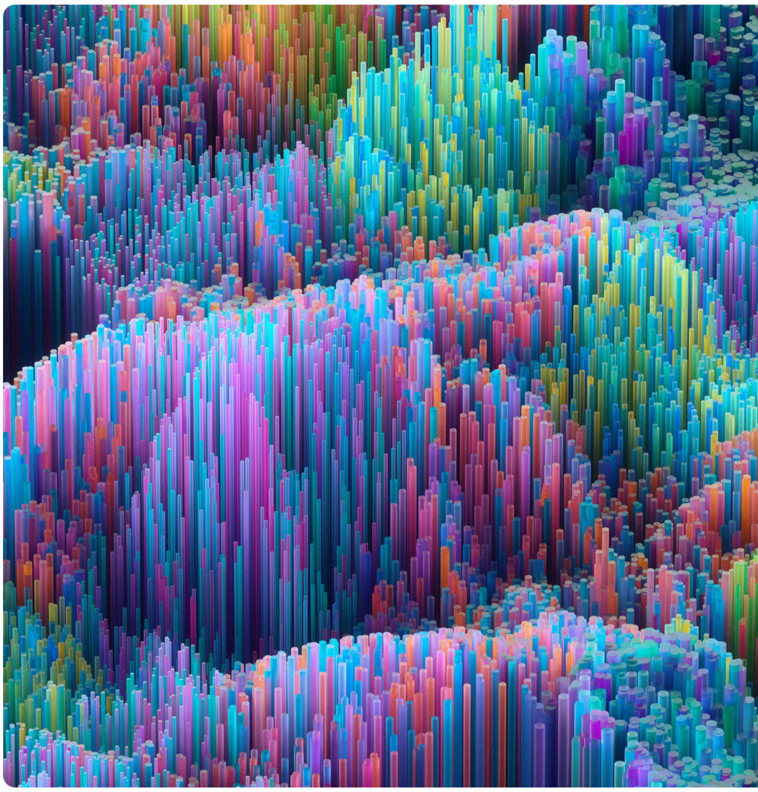
[2]ACEA, 2025 Report – Vehicles on European roads 2025 - ACEA - European Automobile Manufacturers' Association – last accessed October15th, 2025

METHODOLOGICAL APPROACH

Table 1: AV Take-rates per country group depending on cost competitiveness

Costs per km AD to manual	Take-rate Defined as the share of the annual outfleeted buses (10% of total bus fleet) that are replaced by AVs
€1 more expensive to cost parity	1%
Cost parity to €1 cheaper	30%
Cost savings €1-2	70%
Cost savings > €2	100%

In addition, we modeled three cost scenarios, i.e. optimistic, moderate, and pessimistic, covering a range of possible trajectories for autonomous vehicles as displayed in Figure 1. These three scenarios describe different trajectories of the cost curve for AVs over a 20-year period. While both the moderate and the optimistic scenario reach a cost point of €0.70 per kilometer, they reach this level with different speeds. The optimistic scenario assumes early cost drops, while the moderate scenario assumes a more linear curve. We have decided to opt for €0.70 / km as the lowest point, as this is, from the many conversations we have had with different tech providers, the lowest realistic number we have heard. The pessimistic scenario does not reach this level of efficiency after 20 years but gradually declines from €7.00 to €3.20 after 20 years. For the highest value of €7.00 / km, we have opted for a starting point that is close to the currently most expensive manual bus operation in our data set (Switzerland). Again, keep it mind that these timelines do not represent actual years, but offer some orientation for each technology provider to position themselves on any given cost point within their development timeline and derive the respective demand.



[3]ICCT, 2023 https://theicct.org/wp-content/uploads/2023/08/EU-HDV-truck-market-update-fact-sheet-for-posting.pdf - last accessed October 15th, 2025

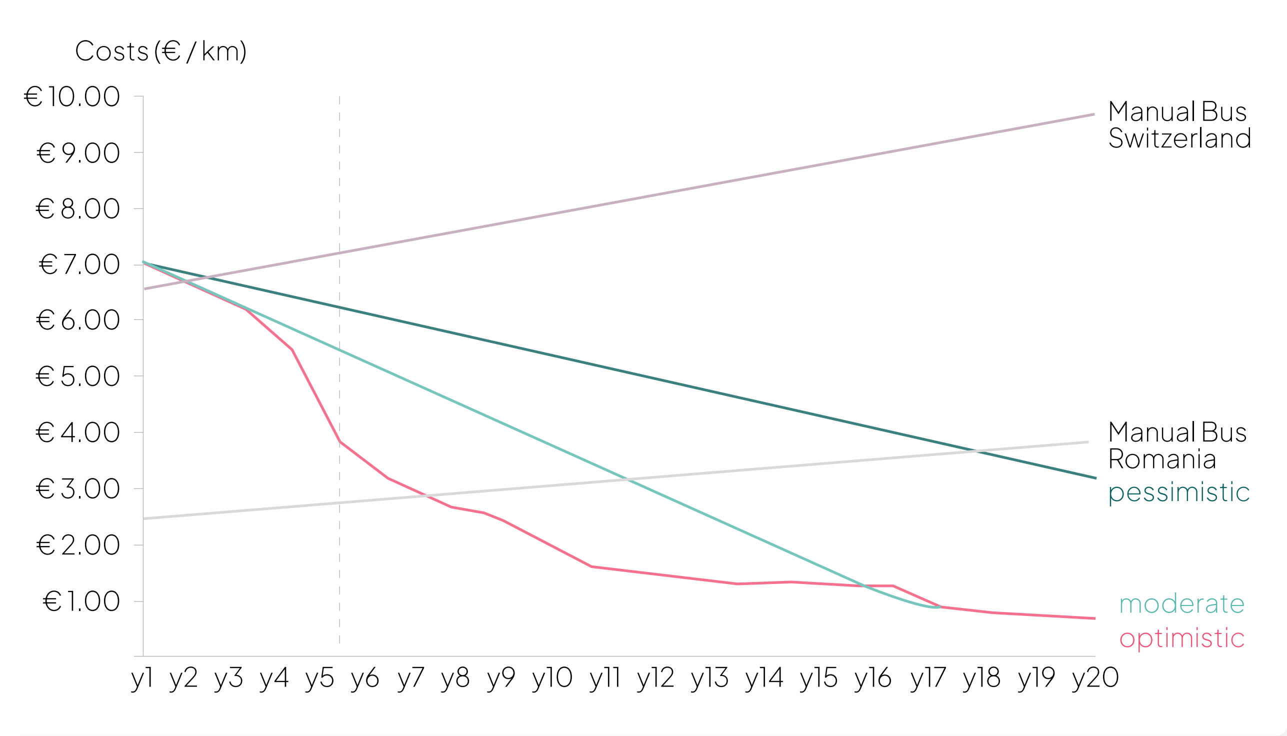
[4]The source data also includes long-distances coaches which be have excluded from the dataset for our analysis

[5]VDV („Verband Deutscher Verkehrsunternehmen“) translates to association of German transport companies

[6]VDV, 2025 Deutschlandangebot 2040: ÖPNV finanzieren & Verkehrswende gestalten | VDV - Die Verkehrsunternehmen – last accessed October 15th, 2025

METHODOLOGICAL APPROACH

Figure 1: Three scenarios of cost development of AVs over time; highest cost and lowest cost country plotted for reference

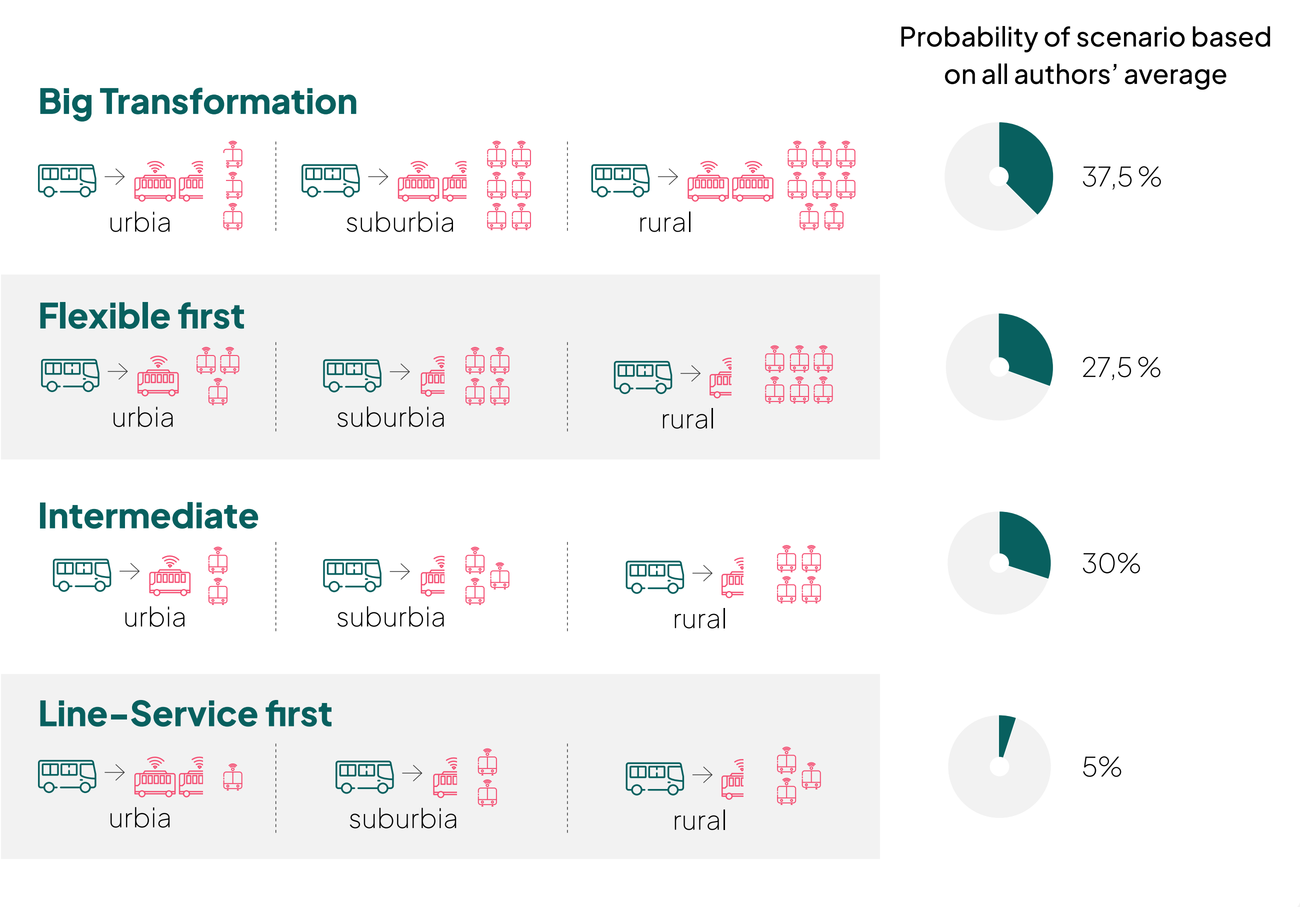


Service replacement logics.

Beyond cost, autonomy enables a fundamental redesign of service delivery. Much of today's planning restrictions around the predominant line services are based on the presence of a human driver. For example, shift planning, central hub locations, break points and timing. Once the driver is no longer in the vehicle, the service can become more flexible, allowing for a significantly better matching of supply and demand both in spatial and temporal dimensions. To account for the different service concepts and average utilizations of services, we differentiated between three operating environments: urban cores, suburban belts, and rural areas.

METHODOLOGICAL APPROACH

Figure 2: Replacement scenarios for urban, suburban and rural areas along the three replacement logics: flexible first, intermediate, line-service first



These replacement logics are necessarily stylized, as European public transport networks differ widely by country and city. Therefore, we modeled different replacement scenarios that either favored traditional fixed-route services (with large AD buses) or placed a stronger emphasis on flexible mobility (with AD shuttles). In an intermediate scenario, we assumed a combination of both. Finally, in a major transformation scenario, we assumed that as costs per mile decrease, policymakers may significantly enhance service quality, enabling society to achieve a meaningful shift in modal share from private vehicles to shared, flexible public mobility.

Our four different replacement scenarios are displayed in Figure 2. The resulting complexity of scenarios both in price and in service type is hard to display in a white paper on a European strategic level. Therefore, the findings will focus on the Flexible first scenario with some more level of detail and only briefly compare the three other logics among each other. Ultimately, we hope that the introduction of AVs will be a moment to also fundamentally reflect on the type of service that these vehicles can and should provide. Thus, we have focused on the Flexible first scenario in the findings.

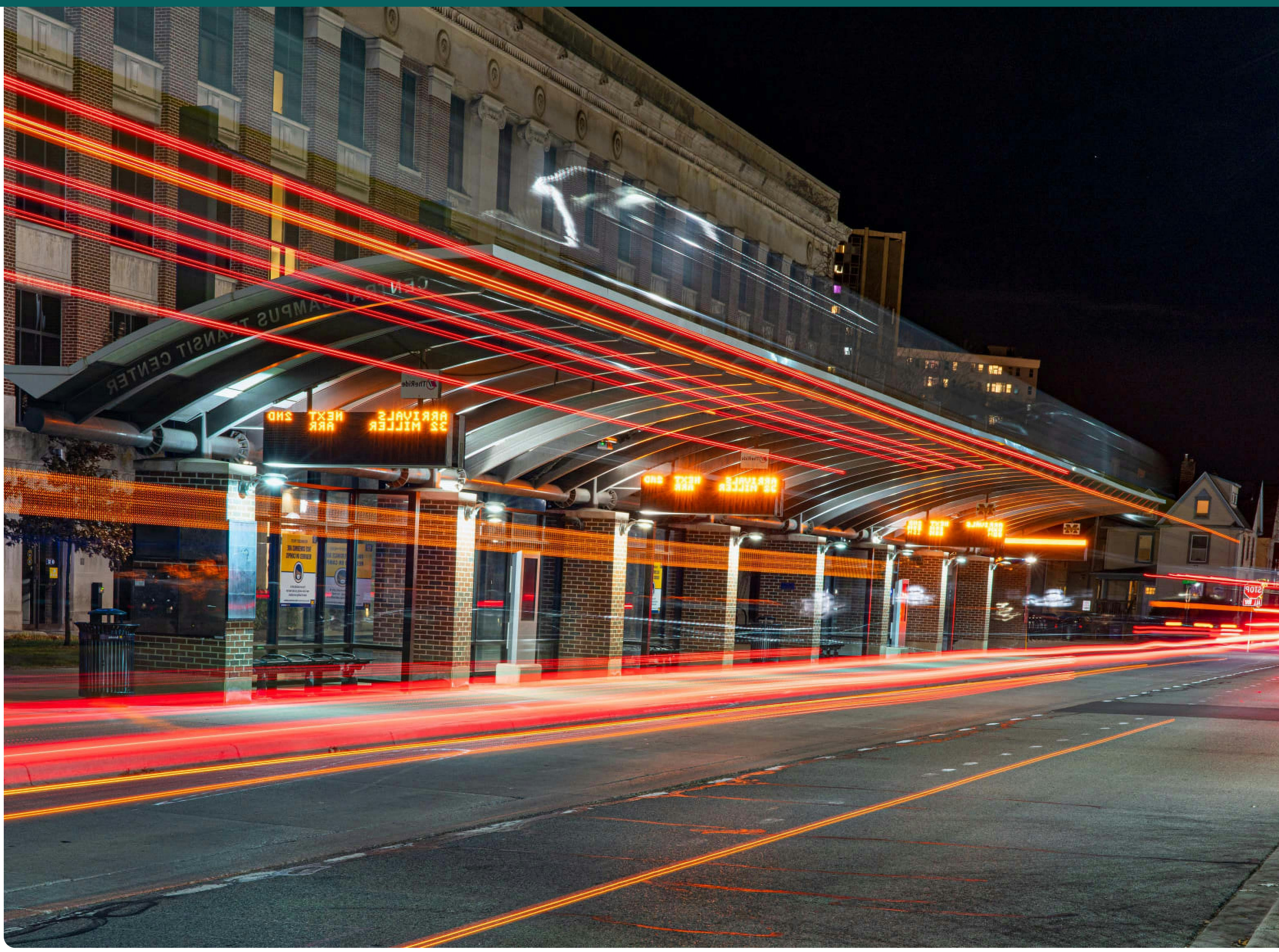
Overall, the replacement scenarios proposed here provide a structured framework to capture how autonomy may not only substitute vehicles but also reshape service design; an absolute necessity to properly estimate future demand of AVs.

METHODOLOGICAL APPROACH

Fleet evolution.

Each year, the model calculates how many newly procured buses are autonomous, depending on country, cost scenario, and relative cost difference. The respective replacement scenario then dictates which and how many AVs will be added to the fleet instead of the previously manually driven large bus. AVs are also assumed to have a service life of eight years for AD shuttles and ten years for AD buses, after which they are replaced by new autonomous units. The model therefore captures both first-time adoption and ongoing fleet renewal.

Overall, this methodology delivers a transparent and scalable framework: it starts from a funded baseline of existing bus fleets in each country, adjusts for country-specific economics, models adoption as a function of cost competitiveness and environment-specific replacement scenarios, and simulates the evolution of Europe's AVs public transport fleets over 20 years under multiple scenarios.



FINDINGS

The modeling results provide a clear picture of how the European market for autonomous vehicles in public transport evolves under our three different cost scenarios—optimistic, moderate, and pessimistic. The results are presented along four analytical dimensions: the annual vehicle intake, the total autonomous fleet size, exemplary country-level adoption patterns, and comparison of the three replacement scenarios.

Annual vehicle intake

Looking at the total number of autonomous vehicles added per year across all modeled countries, the results show a clear ramp-up pattern in all scenarios, with varying speeds and magnitudes of growth.

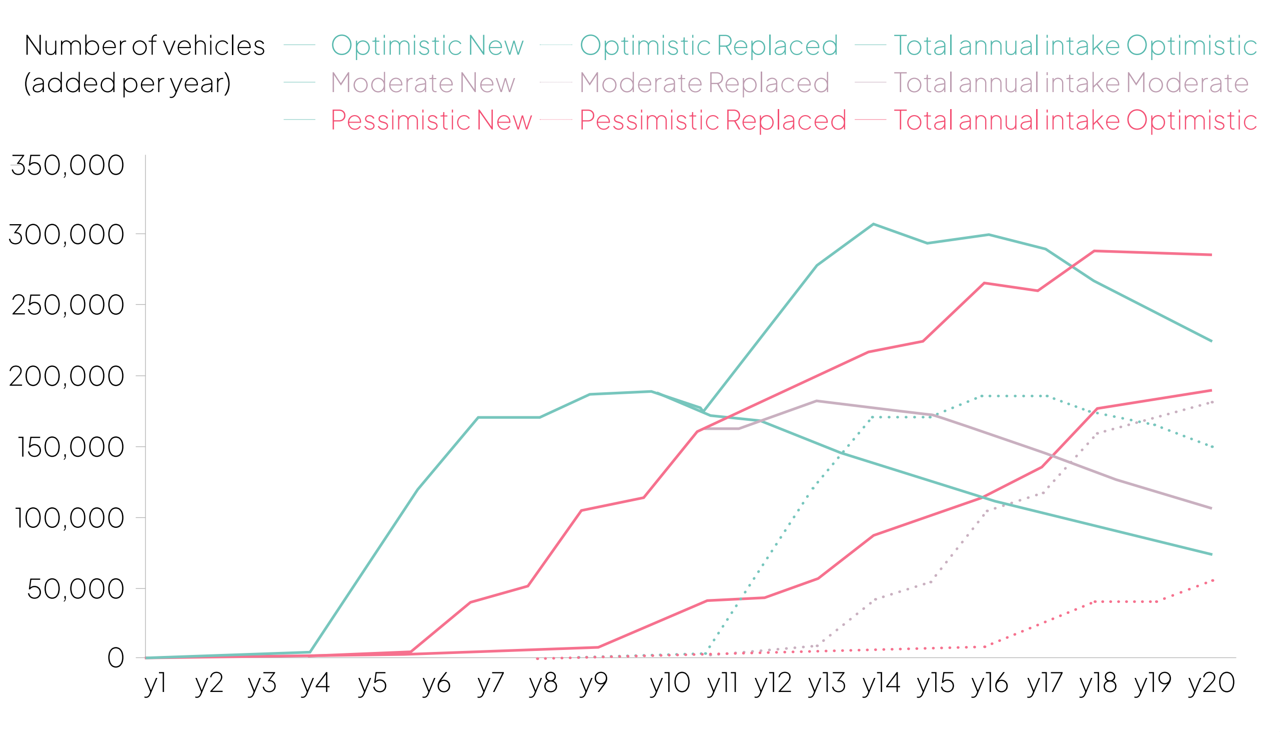
In the optimistic scenario, the annual intake of autonomous shuttles starts from a very low base, with roughly 1,000 vehicles added in year three (at a price point of € 6.20 p. km), as only a few high-income countries reach early cost advantages. The ramp-up accelerates sharply thereafter, peaking first at 172,000 new vehicles added in year seven, as major European markets achieve cost competitiveness. A second, higher peak occurs in year ten, when both new adopters and the beginnings of the first replacement wave of early autonomous vehicles overlap, leading to over 188,000 vehicles added in a single year. After this peak, the annual intake gradually declines as the market reaches saturation, and replacement becomes the dominant driver of demand which, in sum, still grows until year thirteen.

In the pessimistic scenario, the initial adoption pattern is similar but much slower. The market reaches its highest annual intake in year nineteen, with around 140,000 vehicles added. The relevant replacement phase, in this scenario, has not reached its peak as it lies beyond the modeled twenty-year horizon, reflecting the delayed overall uptake.

The moderate scenario follows a balanced trajectory between the two extremes—achieving steady yet delayed growth compared to the optimistic case.

FINDINGS

Figure 3: Total number of AD Shuttles added per year - differentiated between new AVs



For autonomous buses, similar dynamics are observed but at a smaller scale. In the optimistic case, annual intake begins in year five with approximately

7,450 vehicles

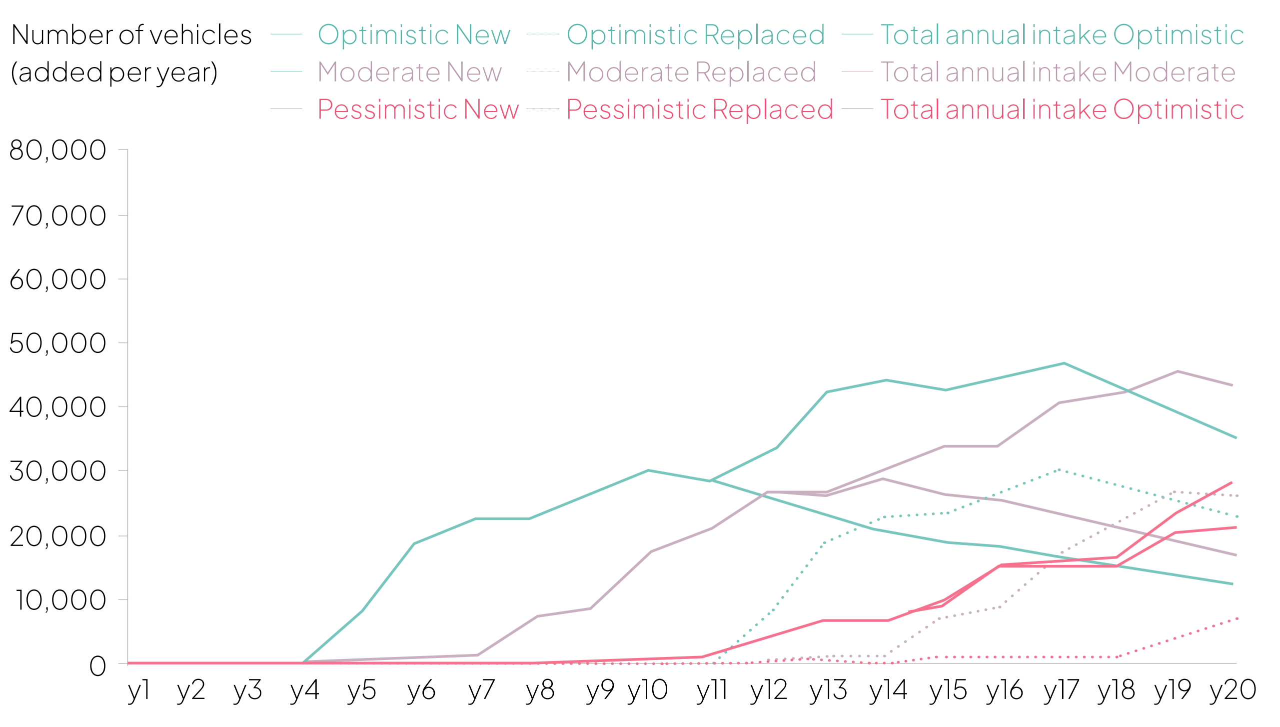
rising to a peak of

30,200 buses

in year ten, before slowly decreasing as the fleet matures, while replacements of the initial intakes start to kick in. Under pessimistic assumptions, the first significant intake begins later and peaks at 21,200 vehicles in year twenty.

FINDINGS

Figure 4: Total number of AD buses added per year - differentiated between new AVs



Total autonomous fleet size

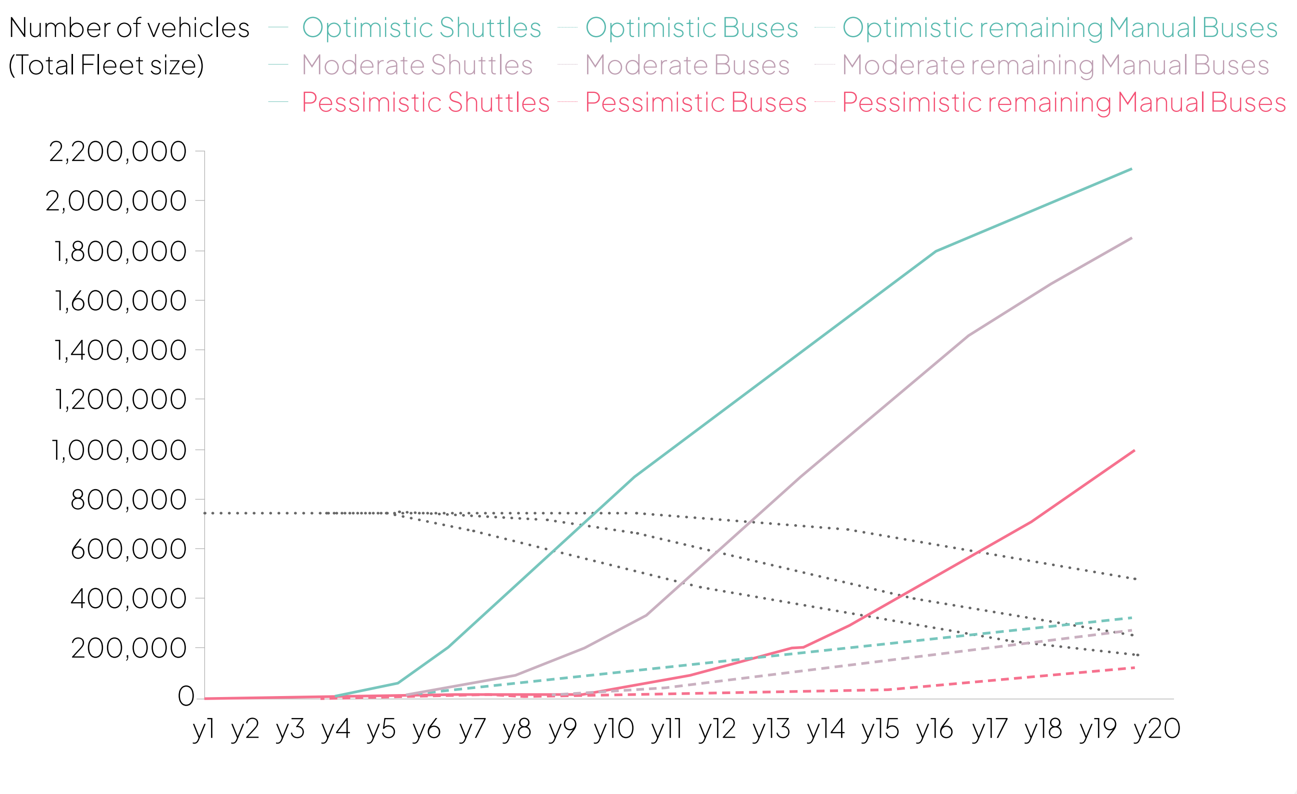
When aggregating annual additions into total fleet size, the scale of potential adoption becomes evident.

For autonomous shuttles, the total European fleet reaches approximately 2,100,000 vehicles in the optimistic scenario after twenty years. The moderate scenario follows, with around 1,850,000 shuttles, indicating that total market potential remains substantial even with slower adoption. In the pessimistic case, the total fleet reaches 995,000 shuttles, with most growth occurring only after year nine, when costs begin to align with and outperform manual operation.

For autonomous buses, the total installed base reaches 320,000 vehicles in the optimistic case, approximately 270,000 in the moderate scenario, and 116,000 under pessimistic assumptions. Across all scenarios, the trajectories mirror the shuttle market, but at lower volumes due to later introduction and the modeled replacement scenarios for suburban and rural environments.

FINDINGS

Figure 5: Total number of vehicles



Country-level adoption patterns

To illustrate the adoption dynamics on a more tangible national level, we displayed selected countries: Germany, Spain, Belgium, Austria, and Switzerland in the optimistic scenario. The results show distinct national trajectories shaped by cost competitiveness over time, relation between rural and urban services, and existing bus fleet sizes. High-cost markets such as Switzerland reach earlier adoption due to higher baseline costs, while larger markets like Germany and Spain show delayed but stronger annual intakes once cost parity is achieved due to their overall larger bus fleet size.

Across many countries (Spain and Germany being visual examples), the data reveals a two-peak adoption pattern: an initial wave between years five and eight, depending on the specific cost comparison, driven by first deployments, and a second wave between years twelve and fifteen, linked to the replacement of early autonomous fleets and continuing expansion.

FINDINGS

Figure 6: Annual intake of AD shuttles (both newly added and replacing existing ones) per year for selected countries

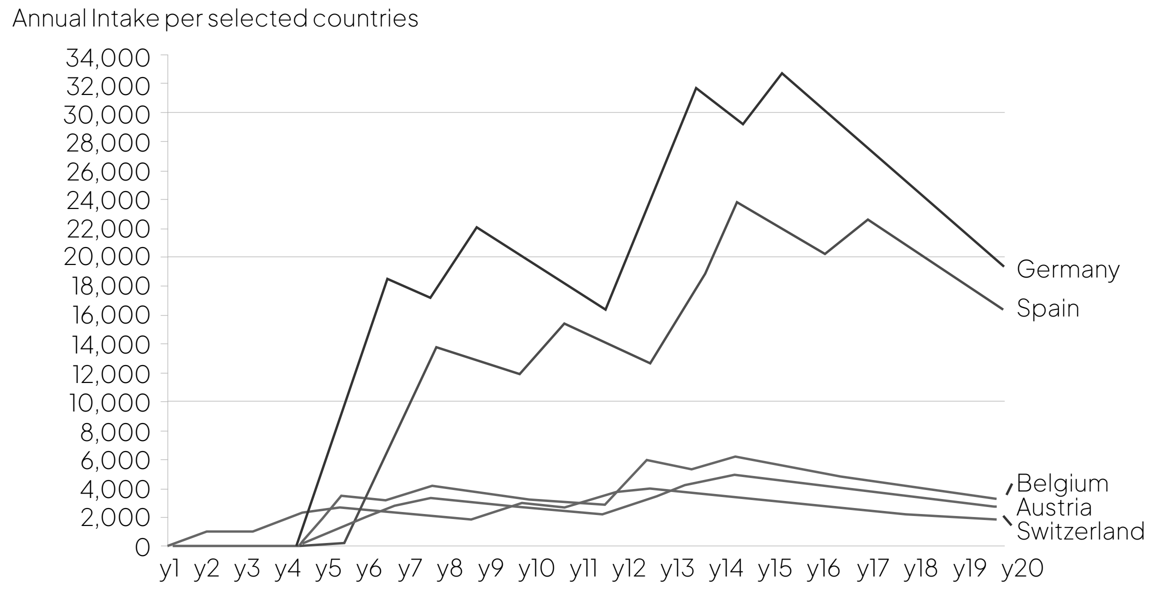
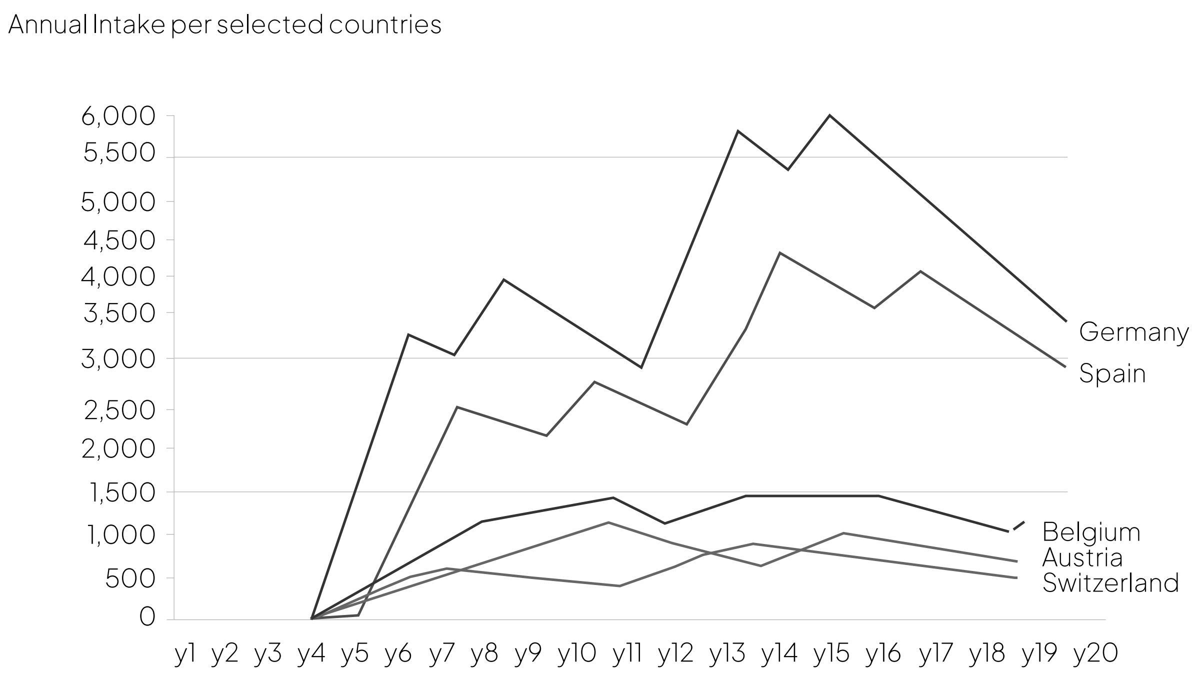


Figure 7: Annual intake of AD buses (both newly added and replacing existing ones) per year for selected countries



FINDINGS

Comparison of different replacement scenarios

The model calculated all year-over-year developments for all three replacement scenarios. However, as mentioned above, we focused our findings section on the Flexible first scenario. We will only briefly discuss the results of the comparison of the three replacement scenarios (Flexible first, which is discussed in detail above, Intermediate, and Line-Service first). We see that with an increasing focus on line-services, the number of shuttles decreases while the number of buses increases. The sensitivity across these three replacement scenarios is pronounced. Ultimately, each city, each region, and each country must develop their own specific way of how much they want to allow AVs to not only transform the technology but also the way in which public transport serves their community. The three replacement scenarios here offer a first indication.

Table 2: Comparing the total fleet size of the three replacement scenarios after 20 years

	Replacement Scenarios							
	Big Transformation		Flexible First		Intermediate		Line-Service First	
Optimistic	495,835	2,763,956	320,772	2,120,941	364,538	1,477,926	481,158	964,523
Moderate	417,962	2,407,960	270,425	1,848,129	307,309	1,288,298	405,637	839,746
Pessimistic	181,766	1,294,198	116,048	994,928	132,477	695,659	174,071	448,905

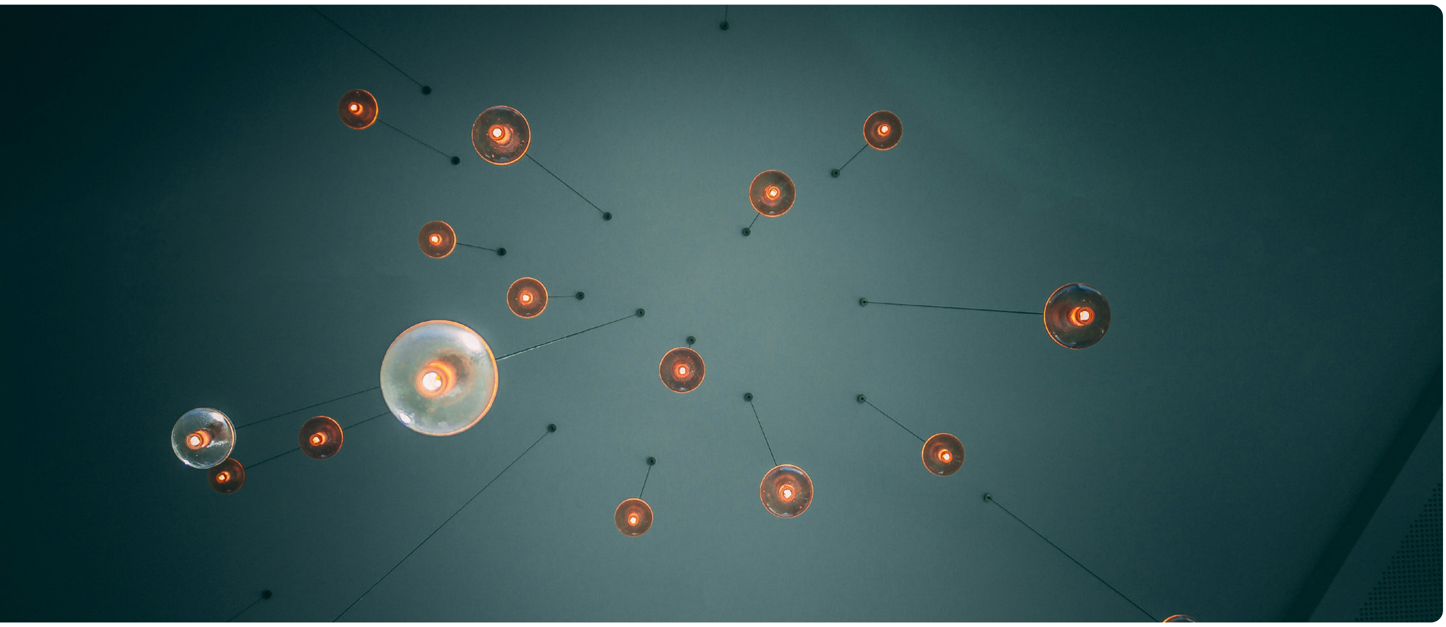
FINDINGS

Key insight

Across all scenarios—pessimistic, moderate, and optimistic—the model consistently demonstrates a significant and scalable demand for autonomous vehicles in European public transport.

AVs have the potential not only to sustain Europe's public transport system, but also to scale it far beyond today's capacity. Even if Europe were to deploy more than two million autonomous shuttles (as predicted by the optimistic scenario), this would represent only a fraction of the continent's 250 million private cars. Far from being excessive, this scale-up would mark a realistic and efficient shift toward shared, space-efficient mobility. Automation will also unlock new demand: more people, including elderly, young, and mobility-impaired passengers, will gain access to flexible services, while travel time itself becomes more productive and enjoyable. As costs per kilometer decline compared to today's operations, autonomous shuttles and automated buses will enable higher service levels at lower or comparable budgets. When considering the potential integration of private AD fleets (such as ridehailing providers) in mixed private-public fleet models, we could further enhance coverage and efficiency. In sum, autonomy offers public transport the chance not only to maintain its role as Europe's mobility backbone, but also to expand its modal share, reclaim space from private cars, and deliver a more inclusive and sustainable mobility future. Both shuttles and buses show clear market potential, and the analysis underlines a simple but powerful message:

European operators are ready for autonomous technology once it becomes operationally and economically viable. Seizing this opportunity will likely lead to a fundamental shift in how people move both in cities and in rural areas. The modelling applied here predicts an increase in service quality at similar costs or a similar service at significantly lower costs. We prefer the former, as it is through such fundamental changes that autonomous driving can truly reveal its full potential for society at large.



LIMITATIONS

As with any modeling exercise of this scale, several simplifying assumptions were made to ensure clarity and comparability across all European markets.

Firstly, to an extent, we decided to model bus replacement in isolation. Our model does not consider modal shifts, especially those from non-public transport users into the newly created capacities in some of our more optimistic scenarios. Some of these do imply a reduction in private car usage. However, modeling these effects goes beyond the purpose of this white paper.

Secondly, the many discussions that we had while developing this white paper clearly reveal the difficulties of assessing a heterogeneous market like the European transport market, with all its regional and local specificities, without making the model unbearably complex to be comprised into a whitepaper. That's also the main reason that the – by now rather powerful model – will be transferred into an online tool so that everyone can work on their own scenarios given their specific assumptions for the input variables.

Thirdly, our approach to country-level cost modeling relies on purchasing power parity (PPP) adjustments. While this method carries certain methodological limitations, it provides a robust and transparent way of reflecting economic differences across Europe without overcomplicating the model.

Finally, the replacement rate, i.e. the rate with which manual buses leave the fleet at the end of their life, is fixed at 10% per year. There are good arguments that, in reality, we will see higher replacement rates once AVs achieve significant cost advantages. More specifically, PTOs will start decommissioning buses that are still ok to use but, due to their high operating costs in relation to AVs, will be decommissioned nonetheless. This would speed up the adoption rate of AVs significantly.

Overall, the modeling approach deliberately balances analytical depth with transparency and usability. We prioritized a framework that allows meaningful, comparable insights at the European level over an exhaustive treatment of every local variance. We are confident that, despite its simplifications, this methodology provides a sound foundation for assessing the market potential of autonomous vehicles in public transport.

CONCLUSION & NEXT STEPS

This white paper demonstrates a clear and quantifiable message: Europe's public transport market is ready for autonomous vehicles. The opportunity is not theoretical, it is measurable, scalable, and anchored in a fleet that already exists and will inevitably need renewal. Across all modeled scenarios, our analysis shows a strong and growing demand for autonomous buses and shuttles once the technology reaches operational and economic maturity.

Europe's unique public transport ecosystem, structured, stable, and publicly funded, offers exactly the kind of environment in which autonomy can move from pilot projects to fleet-scale deployment. Public transport provides the foundation for large-scale adoption that delivers both economic efficiency and public value.

The findings underline that the key question is no longer whether there will be a market for autonomous vehicles in public transport, but how fast and by whom it will be captured. Technology providers, policymakers, and public transport operators now face a shared window of opportunity: to align strategies, define common standards, develop solutions that consider the needs of public transport and establish the conditions for deployment at scale.

This white paper thereby marks a beginning, not an end. As mentioned above, we are in the process of transferring the underlying model into a web-based tool so that everyone can model their specific demand for AVs for their city, region or country with specific and individual input parameters.

The potential is clear.

The market is ready.

Now it's time to move from pilots to fleets that can unlock the full potential of autonomous vehicles for everyone.

This white paper was prepared and published by movingfutures GmbH (registered in Hamburg under HRB 175579) in collaboration with experts from the European public transport sector. The analysis, assumptions, and conclusions presented herein are based on publicly available data, professional expertise, and informed modeling. While every effort has been made to ensure accuracy and reliability, movingfutures GmbH makes no representations or warranties, express or implied, as to the completeness or correctness of the information contained in this document. The results and projections are intended for informational purposes only.

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