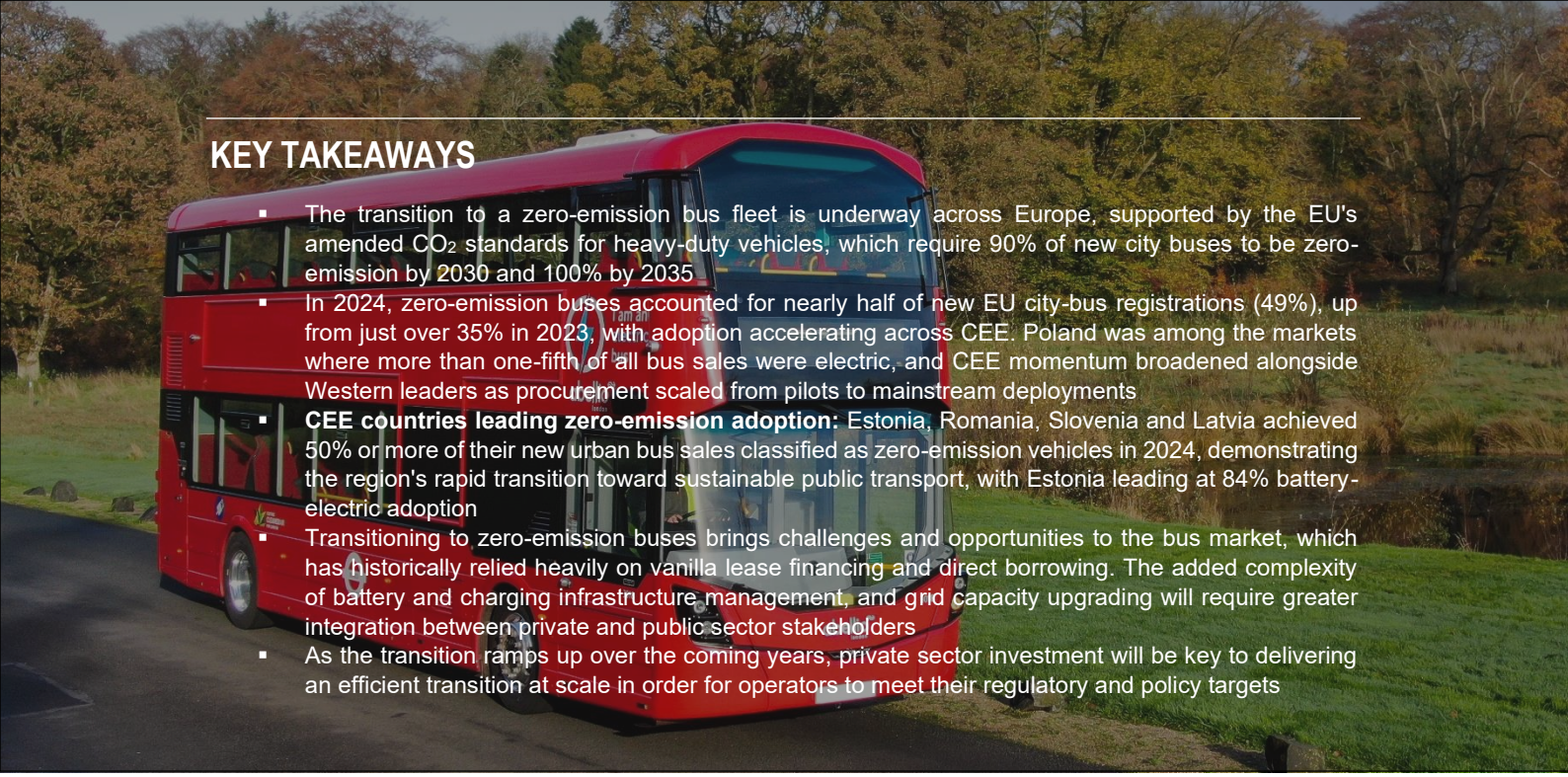


## KEY TAKEAWAYS

- The transition to a zero-emission bus fleet is underway across Europe, supported by the EU's amended $CO_2$ standards for heavy-duty vehicles, which require 90% of new city buses to be zero-emission by 2030 and 100% by 2035
- In 2024, zero-emission buses accounted for nearly half of new EU city-bus registrations (49%), up from just over 35% in 2023, with adoption accelerating across CEE. Poland was among the markets where more than one-fifth of all bus sales were electric, and CEE momentum broadened alongside Western leaders as procurement scaled from pilots to mainstream deployments
- **CEE countries leading zero-emission adoption:** Estonia, Romania, Slovenia and Latvia achieved 50% or more of their new urban bus sales classified as zero-emission vehicles in 2024, demonstrating the region's rapid transition toward sustainable public transport, with Estonia leading at 84% battery-electric adoption
- Transitioning to zero-emission buses brings challenges and opportunities to the bus market, which has historically relied heavily on vanilla lease financing and direct borrowing. The added complexity of battery and charging infrastructure management, and grid capacity upgrading will require greater integration between private and public sector stakeholders
- As the transition ramps up over the coming years, private sector investment will be key to delivering an efficient transition at scale in order for operators to meet their regulatory and policy targets

*Driving Change: The Zero-Emission Bus Transition in Central and Eastern Europe*

## EDITORIAL NOTE – PETER RADFORD, INVESTMENT DIRECTOR, IMPACT TEAM

The Central and Eastern Europe (CEE) region presents a particularly compelling case for zero-emission mobility transition. With rapid urbanisation, persistent air quality challenges in major cities like Warsaw, Budapest and Prague, and strong policy momentum driven by EU integration, CEE countries are positioned to leapfrog traditional transport infrastructure. The region's lower operational costs, combined with substantial EU funding support through mechanisms like the Recovery and Resilience Facility, create unique conditions for accelerated zero-emissions bus deployment that can serve as a model for emerging markets globally. Recent data underscores this potential, with several CEE countries now achieving over 50% zero-emission shares in new bus sales[1], demonstrating the region's ability to rapidly scale once deployment begins.

At Amber Infrastructure, we have witnessed firsthand the region's infrastructure transformation through our role as investment adviser to the Three Seas Initiative Investment Fund, overseeing the investment of c.€1bn across CEE markets. The zero-emission mobility transition represents a niche, but crucial illustration of the broader infrastructure modernisation taking place across the region—combining environmental imperatives with commercial opportunities. This report draws on our significant regional and sectoral experience to outline not just the scale of the opportunity, but the practical pathways for infrastructure investors to participate in what we believe will be one of the defining infrastructure themes of the next decade across CEE.

## TRANSITIONING TO ZERO-EMISSION MOBILITY

A growing coalition of countries, cities, businesses and other institutions are pledging to achieve net zero-emissions. Over 140 countries, including the biggest emitters – China, the US and EU – have set a net zero target, covering an estimated 87% of greenhouse gas ('GHG') emissions[2]. Transitioning to net zero is one of the greatest challenges that we face in the next decade. The transport sector is one

[1] European Federation for Transport and Environment
[2] Net Zero Tracker: NET ZERO STOCKTAKE 2024

of the largest sources of GHG emissions, accounting for more than a third of global energy-related $CO_2$ emissions[3]. In recent years, advancements in low and zero-emission technologies, such as batteries, hydrogen and biofuels, are enabling a transition to a net zero transport sector. This has been supported by a number of government initiatives including:

- In Europe, the EU's Fit for 55 plan, commits Member States to a 55% reduction in GHG emissions by 2030, the EU has set a target for 2035 for only selling zero-emission cars and vans; and
- At COP27 in November 2022, delegates signed the *Accelerating to Zero Coalition*, committing to a global zero-emission vehicle sales target by 2040.

Meeting these targets requires a significant increase in infrastructure spending across all forms of transport, from micro e-mobility through to improvements in complex rail infrastructure. Governments and businesses are on a journey to decarbonise mobility across all forms of transport, with the largest contributor being road transportation. In the EU alone, road transport accounts for over 70% of transport $CO_2$ emissions[4], and similar figures are estimated for emissions across the globe.

Currently, public funding focuses on Research and Development ('R&D') and various infrastructure grants such as the EU's European Green Deal. This has led to the zero-emission bus sector being a leader in decarbonisation; it is estimated that transitioning from an internal combustion engine ('ICE') to a zero-emission bus reduces $CO_2$ emissions by around 75%[5] - and actual savings may be higher if newer buses lead to a modal shift from passenger cars to public transport. Governmental funding will play a major role in accelerating the zero-emission transition although alone it will not be enough to deliver the transition, necessitating the involvement of private capital.

## THE CASE FOR ZERO-EMISSION BUSES IN EUROPE:

For many living in larger cities, the daily sight of a zero-emission bus has become commonplace. For the purposes of this report, zero-emission buses include battery electric buses, hydrogen fuel cell buses, and trolleybuses. Global sales of electric buses reached **more than 70,000 in 2024[6]** (up from 50,000 in 2023 as per the 2024 outlook), driven by renewed growth in China and a 15% increase in Europe[7]. The electric bus market is experiencing rapid acceleration, estimated globally at **USD 64.2bn in 2024** and projected to reach **USD 187.8bn by 2032**, growing at 14.2% annually[8].

Public transport policy is often decentralised to a municipal level, with some notable examples of cities leading the way. In 2024, Vilnius's public transport operator Vilniaus viešasis transportas (VVT) secured €80m in co-financing from the EBRD and NIB to procure up to 73 electric trolleybuses and up to 85 battery-electric buses, complemented by national funding. This trend looks likely to accelerate; ambitious targets are evident at the local level - driven largely by demand-side policies from cities and national governments. For example, in CEE, Latvia are targeting a fully zero-emissions bus fleet by as early as 2030, Estonia by 2035 and over half of all European capital cities planning for a fully zero-emission fleet by 2040 (highlighted in Figure 1).

[3] International Energy Agency
[4] European Parliament - 2019
[5] International Council on Clean Transportation
[6] IEA Global EV Outlook 2025
[7] IEA Global EV Outlook 2025
[8] Statzon

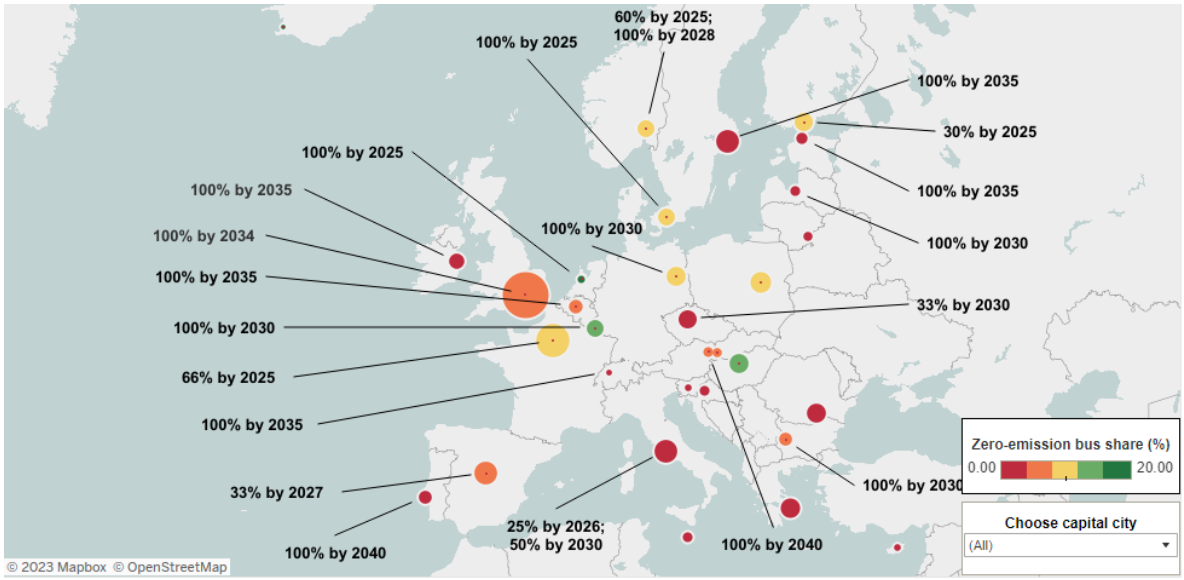



Figure 1: Zero-emission Bus Targets for Europe's Capital Cities (June 2022)[9]

## SNAPSHOT: ZERO-EMISSIONS BUS ADOPTION

- **Zero-emission city buses are scaling rapidly**: In 2024, 49% of all new EU city buses were zero-emission (including both battery electric and hydrogen), demonstrating accelerated adoption across the region[10], making city buses one of the early success stories of the European Green Deal
- **CEE countries leading zero-emission adoption:** Over half of new urban bus sales in Estonia, Romania, Slovenia and Latvia were classified as zero-emission vehicles in 2024, demonstrating the region's rapid transition toward sustainable public transport, with Estonia leading at 84% battery-electric adoption[11]
- **Estonia demonstrates rapid transformation potential:** Estonia jumped from 0% zero-emission new city bus sales in 2023 to 84% battery-electric in 2024[12]—illustrating how quickly CEE markets can scale once deployment begins, with Tallinn receiving its first electric buses in April 2024

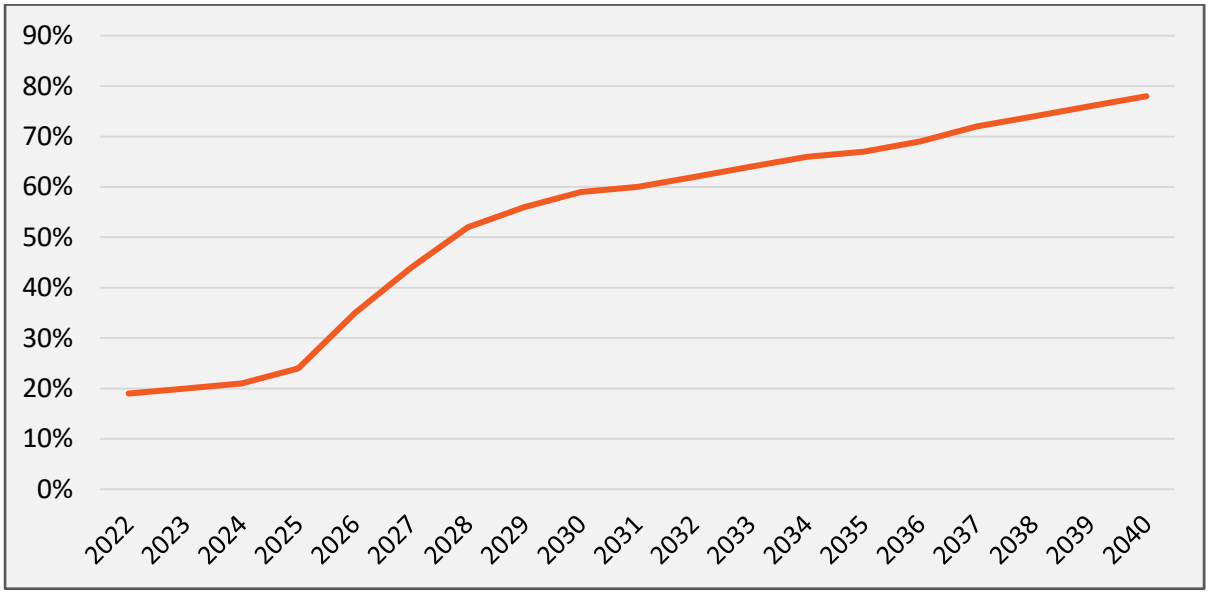
## EUROPEAN ZERO-EMISSION BUS MARKET

As the growing liberalisation of the bus sector across the EU continues, the European market offers a unique opportunity for the public and private sectors to partner. On the demand side, uptake has been primarily driven by EU legalisation, in particular, the Clean Vehicles Directive. The Directive sets national procurement targets for 'clean' buses of 24–45% in 2021–2025 and 33–66% in 2026–2030 based on a country's population and GDP, with at least half of these targets to be met with zero-emission buses[13]. Data shows the European zero-emission bus fleet has increased more than fivefold in the last five years. To provide an indication of cost, an electric vehicle ('EV') bus is €500,000 (compared to around €300,000 for a diesel bus) which would require a total investment of c.€2tn during the rest of the decade.

[9] International Council on Clean Transportation
[10] EcoWatch
[11] DVV Media, via Transport & Environment
[12] Transport & Environment
[13] European Commission, ZERO-EMISSIONS BUS Systems and Services, 2024

While diesel-powered sales retain their market share, the last several years have seen a marked increase in the volume of electrically chargeable buses sold. In 2024, nearly 16%[14] of new buses sold in the EU were electrically chargeable. While electric bus sales saw a significant increase of 26.8% in 2024, diesel buses still held a 63.1%[15] market share. Notably, electric buses grew in part at the expense of hybrid-buses, which saw sales decreasing to below 10% market share in 2024[16]. Geographically, Western Europe continued to see the fastest uptick in sales.

Electric Bus Sales vs Total Bus Sales in the EU




**Electric bus sales vs Total sales**
**Source*: Bloomberg New Energy Finance (BNEF)***

Despite rapid growth in new registrations, zero-emission buses still represent a minority of the total fleet. To meet the EU's ambitious targets, the shift to zero-emission buses will still need to increase significantly. Nevertheless, there are many building blocks already in place to enable the transition. Key enablers include:

## Regulation

- EU Clean Vehicles Directive requires countries to have a certain share of low-emission vehicles in their public procurement of buses
- National implementation policies are generally contained within the EU-mandated alternative fuel infrastructure National Implementation Reports ('NIRs') or National Recovery Plans ('NRPs'), with local targets contained within city sustainability or development plans
- The EU's amended $CO_2$ standards for heavy-duty vehicles require that 90% of new city buses be zero-emission by 2030, and 100% by 2035, with some EU countries setting more ambitious targets (e.g., the Netherlands and Denmark)

[14] European Automobile Manufacturers' Association (ACEA)
[15] ACEA
[16] ACEA

## Government Support

- European funding support for local authorities to deploy Low Carbon Mobility infrastructure and decarbonisation through the Connecting Europe Facility (c.€1.6bn)

- Other initiatives are being undertaken on a national basis. For example, in Poland the NFOŚiGW Green Public Transport programme co-finances municipal zero-emission buses and charging infrastructure (multiple calls since 2021); in Romania, national/EU programmes have backed major e-bus procurements in cities such as Bucharest and Cluj-Napoca (RRP and Cohesion funds)

- CEE funding (RRF, CEF) coupled with IFI lending (EBRD, EIB, NIB) and co-financing agreements—often via PPP/e-MaaS contracts bundling buses, depot charging and grid upgrades—are de-risking CapEx and encouraging private capital (see Vilnius case study)

## Industry Strategy & Impact Objectives

- Strong commitments from vehicle manufacturers towards decarbonisation (e.g., Daimler Truck has committed to sell only zero-emission city buses from 2030, MAN has committed to 50% of sales equipped with an electric drive by 2025)

- Zero-emission vehicles allow fleet operators to meet their impact goals and be viewed more positively by their own stakeholders

- Operators are increasingly setting fleet-wide zero-emission timelines and linking contracts to clear performance KPIs (uptime, energy per km), aligning decarbonisation goals with measurable service quality and total-cost-of-ownership improvements

With the demand drivers in place and a growing supply chain across the bus, battery and EV charging sectors, the next question is what solutions are available for public and private operators to deliver the transition. We expect a number of delivery models to be deployed, from public sector direct borrowing and ownership, through traditional leasing solutions. We also anticipate seeing significant growth of e-mobility-as-a-service solutions ('eMaaS'), which will necessitate a deep and long-term collaboration between the public and private sectors – a core element in the overarching market opportunity for infrastructure investors.

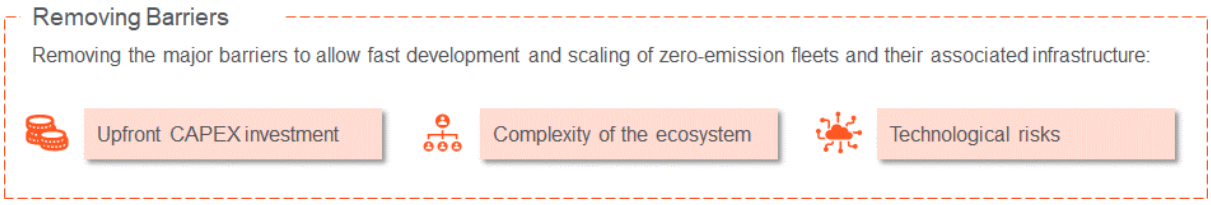



Figure 2: The challenges of transitioning to a zero-emission fleet

## MARKET OPPORTUNITY FOR INFRASTRUCTURE INVESTORS

The transition to zero-emission fleets is the first wholesale change to the bus sector's operating model in over a century. This fundamental change brings with it the opportunity to innovate, and the sector is already seeing new market entrants across manufacturers (bus and charging infrastructure), operators and financiers. The future electrification of mobility services, much like most of the automotive world, is a matter of when, not if. At Amber, we see significant opportunity across the industry from (a) investing in well-established bus operating companies with focused environmental agendas and in markets with well-established Public Transport Authority ('PTA') frameworks, to (b) offering eMaaS to smaller operators.

The fleet financing sector has historically relied heavily on asset finance/leasing and direct ownership; this is unlikely to change for larger operators who have access to deep pools of liquidity and in-house expertise. However, smaller operators are increasingly turning to alternative solutions to meet the challenges of greater upfront capital expenditure (both in relation to the buses and the infrastructure) and the additional complexity of successfully integrating a zero-emission fleet into their day-to-day operations.

Whether it is bus, car or taxi, one model that has seen significant growth in recent years is the concept of eMaaS. eMaaS is the provision of a holistic solution to operators of zero-emission transport, where customers can access EVs on a pay-per-use basis. In essence, eMaaS assembles a variety of transportation operators into a single ecosystem of mobility. It allows firms with expertise across all different aspects of the supply chain, including finance, telematics, buses, batteries, EV charging, grid infrastructure/power supply and in some cases real estate to work together and accelerate transition whilst delivering an efficient, cost-effective transport service for their end customers.

An example of this ecosystem is Amber's investment into Zenobe, below. This innovative charging solution includes a static Battery Energy Storage system at the London based depot that ensures Abellio London's charging requirements are met by the local grid infrastructure. This is an important step in tackling London's air pollution and supports the Mayor's commitment to zero-emission transport in the capital.

**Case study: UK Bus Depot**


**Providing innovative charging solutions**

**An Amber-managed fund invested into Zenobe Energy to install a charging infrastructure solution at an Abellio bus depot in London in 2020**

- Innovative charging solution includes a static Battery Energy Storage system at the depot that ensures Abellio London's charging requirements are met by the local grid infrastructure
- The Amber-managed fund financed the charging infrastructure and leveraged further finance from private sector lenders for the bus chassis and batteries
- Each bus is forecast to reduce carbon emissions by **37 tonnes** and remove **31kg of NOx** per year

Amber anticipates that larger bus operators are likely to continue financing part or all of the supply chain themselves through traditional bank markets (such as the bus chassis or the EV charging infrastructure). We are already seeing a number of the larger fleet operators establish their own charging infrastructure arm, recruit in-house electrical engineering expertise and/or are directly engaged with the 'second life' battery market.

However, for smaller operators, or for those operators that are making their first steps into the zero-emissions bus market, we see a number of benefits associated with eMaaS in relation to the optimisation of finance, integrated assets under one long term contract and the transfer of specialists risks away from these bus operators to experts in their fields.

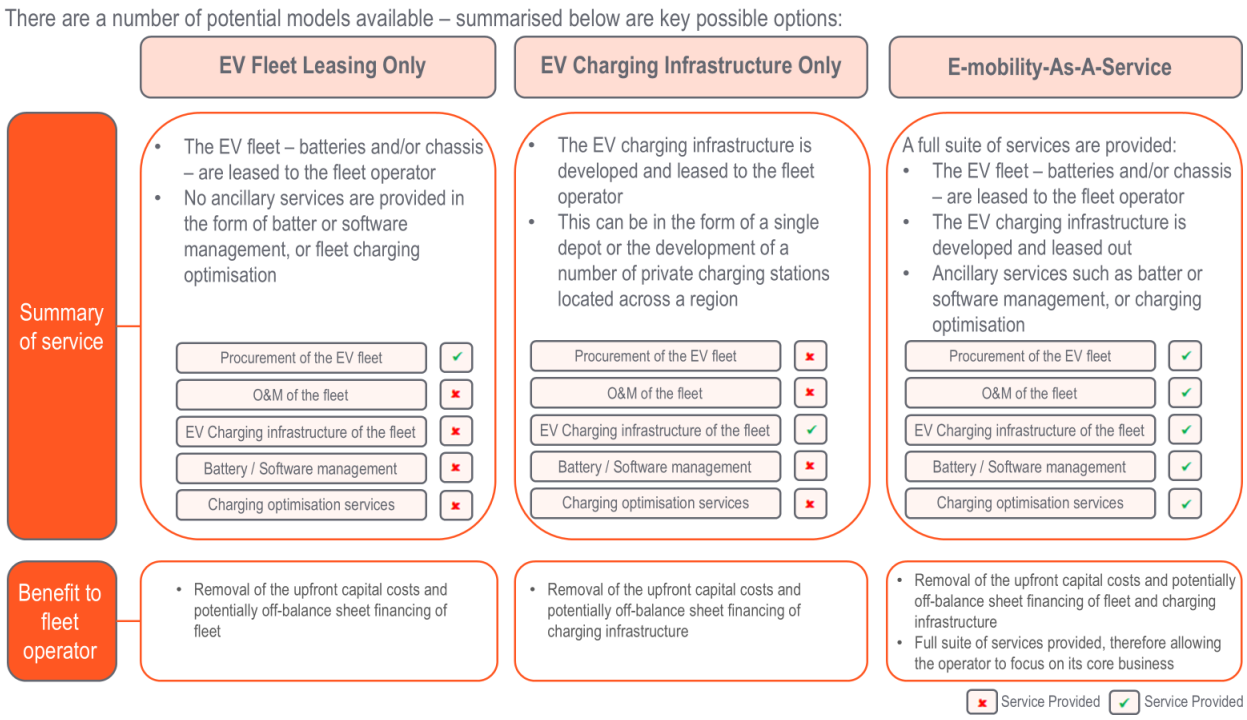
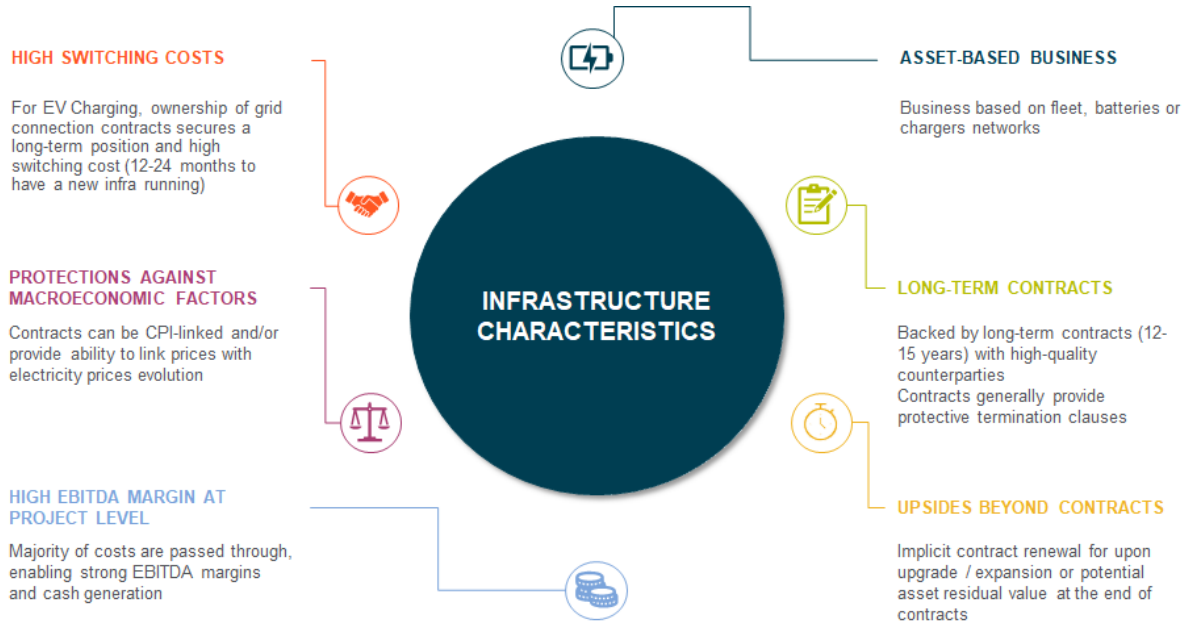



Figure 3: Business models

## KEY INVESTMENT CHARACTERISTICS

For infrastructure investors, the transition to electric buses offers a unique opportunity to engage in a sector that benefits from long term contracts, often inflation linked, with stable yielding returns from initial investment. Whether investing directly into operators or through supporting eMaaS there are a number of characteristics that are attractive to infrastructure investors.



## BARRIERS AND ENABLERS IN CEE

While the opportunity for investment in the CEE region is significant, there are unique barriers and enabling factors that shape the market. These include regulatory fragmentation between countries, varying levels of procurement expertise, supply chain maturity, and access to EU and private funding. At the same time, the region benefits from competitive costs, strong policy momentum, and growing alignment with EU climate and air quality targets.

### Key Barriers

- **Regulatory Fragmentation**: Varying national implementation of EU directives creates complexity across different CEE markets, requiring localised approaches to project development
- **Municipal Procurement Capacity**: Smaller cities may lack the technical expertise to structure complex zero-emission bus procurements, creating opportunities for integrated service providers
- **Grid Infrastructure Readiness**: Some CEE markets require parallel investment in charging infrastructure and grid upgrades to support large-scale zero-emission deployment

### Key Enablers

- **Cost Competitiveness**: Lower operational costs and a competitive manufacturing base make CEE markets attractive for both operators and investors
- **Strong Policy Momentum**: EU integration pressures and air quality compliance requirements create sustained demand for zero-emission solutions
- **EU Funding Access**: Substantial EU funding through RRF and other mechanisms reduces project risk and improves investment returns
- **Growing Technical Expertise**: Regional manufacturers and service providers are developing sophisticated capabilities, reducing reliance on Western European suppliers

#### LITHUANIA'S PUSH: ELECTRIFYING URBAN MOBILITY IN VILNIUS

Lithuania, and especially its capital Vilnius, is rapidly advancing sustainable urban mobility in response to air quality, climate commitments, and EU policy drivers. The city is investing heavily in modernising its public transport fleet, with a major push toward electric buses and trolleybuses.

Lithuania's approach exemplifies how CEE cities are financing zero-emission bus transitions: combining EU funding with international institutional support (EBRD, NIB, EIB) to make large-scale fleet electrification affordable for municipal budgets.

**Key Projects & Developments**:

- In 2024, the EBRD and NIB announced €80m co-financing for VVT to procure up to 73 electric trolleybuses and up to 85 battery-electric buses; VVT plans to fully renew its trolleybus fleet by end-2026
- Separately, Lithuania will add over 300 new electric buses across the country (including 195 for public operators), with €55m in funding. This is part of a national initiative to modernise fleets and reduce emissions

- The EIB is also supporting Vilnius's transition, with projects aimed at replacing old diesel and CNG buses with new electric and hydrogen models

**Impact and Ambition:**

- Vilnius is also expanding new bus routes and enhancing accessibility, with the goal of providing cleaner, quieter, and more reliable public transport for its residents
- These investments are expected to significantly lower $CO_2$ emissions, improve urban air quality, and set a model for other Baltic and CEE cities

**Strategic Importance:**

- The projects align with EU Fit for 55 and Green Deal goals, demonstrating Lithuania's commitment to decarbonising urban mobility
- By leveraging EU and international funding, Vilnius is positioning itself as a regional leader in sustainable transport, with ripple effects for the country's broader economic and environmental objectives

## RISK ANALYSIS

While providing attractive, long term and stable cashflows, investors will need to work closely with their operators and/or their service providers are managing the key risks associated with zero-emission buses, including:

| Key Risk | |
|---|---|
| **Battery Management** | Batteries will be designed and sized with the specific route and operational characteristics in mind. Regular monitoring of the battery state of health (through telematics) to ensure longevity and asset performance |
| **Battery Replacement** | Batteries have an eight to twelve-year asset life, and high usage assets are likely towards the lower end of this range. During the bus life, the battery will need to be replaced and the cost of this replacement (offset by the residual value of the battery being replaced) needs to be carefully assessed |
| **Lease Management** | Zero-emission buses are expected to last longer than the ICE buses they replace given fewer moving parts. Additionally, the buses already conform to zero-emission standards and are unlikely to need replacing due to environmental standards/air quality regulations. Chassis life may also last beyond the initial lease and thought needs to be given of future lease value |
| **Interoperability** | With the charging infrastructure, batteries and chassis all having different manufacturers, warranties and asset lives, proactive asset management will be required to maximise asset performance and longevity |
| **Supply Chain Management** | When local governments procure from operators (whether through route contracts, concessions, or franchises), operators will need to pull together a robust supply chain in order to commit to a firm price in their bids. Relationships need to be built in advance of tenders and with the anticipated growth of the sector, establishing and managing long term partnerships with battery providers and manufacturers will be key to success |

| | |
|---|---|
| **Environment, Social and Governance** | The introduction of zero-emission buses brings strong environment credentials (especially when operators and financiers have given due thought to the second life/recycling of batteries) beyond $CO_2$ savings, with improved air quality, reduced noise pollution and passenger journey satisfaction. The availability of grant funding at national and international level will also ensure that zero-emission buses are delivered across urban and regional centres |

Across CEE, zero-emission bus projects face distinct risk that investors should plan for, profiles beyond what is expected from the sector itself. Varying national transposition of EU rules creates regulatory and procurement uncertainty that may alter technical specs or timelines mid-process. Similarly, grid upgrades – as in any market – bring technological and logistics challenges of their own, although the region is growing accustomed to the sector, with an increasing number of suppliers across the board.

While the transition to zero-emissions buses brings with it new risks, well designed and managed projects will also provide opportunities for investors. For example, the concept of battery residual value risk is relatively new for most investors. However, by forward planning at the design stage and putting in place the telematics to allow for active asset management battery performance and residual value risk can be successfully managed.

## OUR TAKE ON ZERO-EMISSIONS BUSES

In addition to attractive returns, investment in zero-emission buses offers investors the opportunity to be part of a sector that benefits from strong ESG credentials. Beyond the $CO_2$ reductions achieved by transitioning the fleet, new buses deliver a range of benefits: from improved air quality for local residents; lower noise levels potentially allowing vehicles to run earlier or later in the day; and improved rider environments with the introduction of products such as USB charging and Wi-Fi on buses. Amber anticipates that the transition to zero-emission buses will increase demand for buses, helping shift communities away from their individual cars or taxis onto a more efficient public transport system with significantly lower per head $CO_2$ emissions.

With local, national and international policy pushing demand side levers, through both sector liberalisation and net zero targets, and with a growing supply chain that can deliver a fit for purpose product, our expectation is for a rapid transition of the zero-emission bus sector over the coming years across all geographies. In particular we see a growing number of experienced delivery partners in the market willing to work with the public sector to find innovative solutions.

There will be challenges to be overcome, not least due to the added complexity of successfully delivering and managing a fleet of zero-emission buses compared to a traditional internal combustion engine fleet. Given the current uncertain macro-economic environment and with governments' finances facing significantly higher borrowing costs, this will inevitably reduce the longer-term availability of public funding.

As such, our expectation is that there will be significant opportunities for the public and private sectors to collaborate and deliver innovative solutions whilst meeting sustainability goals. We are already seeing the delivery of these public and private collaborations such as Rock Road, an investment made through the Amber managed Mayor of London's Energy Efficiency Fund ('MEEF'). In the CEE region, Amber has partnered with NeoT through the Three Seas Initiative Investment Fund (3SIIF) to accelerate the transition to zero-emission bus fleets, providing financing and operational solutions to boost both the transition, as well as the proliferation of associated infrastructure. The long-term plan is to further accelerate the transition by incorporating a broader mix of zero-emission fleet types, ensuring that incoming urban mobility fleets are both future-proofed and scalable for public benefit.

*"With nearly half of new EU city buses now zero-emission and CEE countries leading both manufacturing and adoption, the market fundamentals are exceptionally strong. Success will depend on experienced investors who can work in long-term partnership with public and private stakeholders to manage the complexity of this transition."*

**Christian Roy**
***Head of CEE, Amber Infrastructure Group***

## CONCLUSIONS & TAKEAWAYS

The CEE region represents one of Europe's most dynamic opportunities for zero-emission bus investment. With 49% of new EU city buses being zero-emission in 2024 and CEE countries emerging as leaders in both manufacturing and rapidly scaling adoption, the market fundamentals are exceptionally strong. The combination of EU funding support, regulatory momentum, cost competitiveness, and growing technical expertise creates conditions for sustained growth over the coming decade.

For infrastructure investors, the CEE zero-emission bus market offers the rare combination of strong policy tailwinds, attractive returns, and meaningful ESG impact. The region's demonstrated ability to scale zero-emission bus deployment - exemplified by cities like Tallinn - proves that the technical and operational challenges can be successfully managed with the right partnerships and financing structures.

As municipal budgets face constraints and the pace of transition accelerates, the role of private capital and innovative financing models will become increasingly critical. The window for establishing market leadership in this transformational sector is narrowing, making early engagement essential for investors seeking exposure to Europe's most dynamic e-mobility market.

Amber looks forward to continuing to work with our private and public sector partners in delivering capacity across the sector. The scale of transition to a decarbonised transport system will bring many opportunities for experienced investors who seek to deploy their capital through the numerous routes to market, whether that be through a direct operator investment or via partnerships with integrators. Transition brings new risks that need to be managed, making experience and the ability of investors and operators to work in long term partnership with many stakeholders crucial to a project's success.

**Click to be redirected to Amber's website**