Clean Bus Report

An overview of clean buses in Europe

ASSURED

Foreword to Clean Bus Report 2022

As this report is published, we are witnessing impressive developments in the field of clean buses, which are quickly transforming the way public transport is operated in our cities. To fully appreciate how quickly this is happening, we should recall that when the ASSURED project started, in 2017, we had around 20,000 alternatively fuelled buses on our streets, of which less than a thousand zero-emission ones.

In that year, the Commission, together with the Committee of the Regions, launched the Clean Bus Deployment Initiative, bringing together transport authorities, cities and regions. We then put in place a supportive policy framework with the revised Clean Vehicles Directive, promoted research, innovation and deployment, including through projects like ASSURED, JIVE/JIVE2 and the Clean Bus Europe Platform, and most importantly we – policy makers, public authorities, transport operators, manufacturers – worked together and created long-term certainty for the deployment of these technologies across the EU. And it is fair to say that the results of these combined efforts are beginning to show: the number of electric buses in our streets has increased dramatically, from 1,600 electric buses in 2018 to more than 7,000 today, while the overall number of clean buses on our streets has gone from just above 20,000 in 2018 to more than 30,000.

And this is only the beginning: not only we see new orders for zero-emission buses in our cities announced almost every month, but new factories are also being opened for the production of zero-emission buses in Europe. It becomes more and more evident that a push for clean buses is also a push for competitiveness, jobs and growth, and an important help to the recovery of one of the sectors hit hardest by the COVID-19 pandemic.

Many businesses in the public transport sector have had to face immense operational and financial difficulties in the last two years; by providing financial support for zero-emission buses in the context of NextGenerationEU and the Recovery and Resilience Facility, we can help public transport authorities, operators and vehicle manufacturers build back better and prepare for the upcoming challenges.

Because as impressive as this transition has been so far, we must not forget that more still needs to be done: the coming years will represent a decisive moment for the achievement of our climate commitments and the European Green Deal's objective of becoming the first climate-neutral continent by 2050.

For the transport sector, this means a 90% reduction of GHG emissions. With the Sustainable and Smart Mobility Strategy, we set out the visions and announced concrete measures to meet this goal; a first set of proposals was published in the "Fit for 55" Package, and later this year we will propose new CO_2 emission performance standards for heavy-duty vehicles.

These ambitious objectives require a much more efficient mobility system, relying on a stronger and cleaner public transport: zero-emission buses will feature prominently in this context, as will their ongoing promotion through initiatives like the Clean Bus Europe Platform and research projects like ASSURED.

Herald Ruijters
Director Investments, Innovative and Sustainable transport
European Commission, DG MOVE

Clean buses for greener, liveable cities

While the climate crisis remains on the top of the agenda, the momentum for clean vehicles remains right alongside it. Discussions on how we work towards changing the future direction of our planet quickly steer towards the topic of public transport; they often conclude with a plea to further advance clean public and shared mobility.

In 2016, I wrote a similar introduction for the first e-Bus Report, published by the ZeEUS project. We recognised a growing trend towards the electrification of buses and a genuine commitment towards cleaner and quieter cities. Five years since then, I believe we can celebrate a true breakthrough. There has been an explosion in the development, technology maturity and deployment of electric bus fleets. UITP, together with its members, have been at the forefront, proactively steering and promoting clean public transport as the backbone of our mobility system.

More than ever, we see not only the will, but also the actions from operators and cities to meet their transport emissions reduction targets. These targets on air pollution and noise levels, combined with financial support schemes at regional, national and EU level have proven highly effective in supporting modal shift as well as clean bus deployment and fleet renewal. The data collected for this report underlines this: the share of clean buses increased from 14.5% in 2017, to 22.9% in 2021 - a hike of 88%. The highest growth was for battery electric buses: their numbers grew from 481 in 2017 to 3,538 in 2021.

At UITP we know what it means to advocate for the necessary cause of public transport and clean modes, and to actively work on solutions that enable change. It is projects such as ASSURED, JIVE and the Clean Bus Europe Platform, that translate this into action, eliciting and sharing knowledge on the different technologies, and ensuring it reaches out to the entire sector. Today, cities and operators can choose among a wide array of solutions that suit their decarbonisation goals. The cooperation among projects has been, and still is, essential to achieve the technological and operational advancement we witness today, thus reassuring the transition towards cleaner and more sustainable bus fleets.

To boost the deployment of large-scale fleets of e-vehicles through interoperability and standardisation is an ambitious objective. It requires bringing together an entire sector. Industry, cities, operators, academia – with their knowledge, but also with their different interests and needs. The role of ASSURED in this field has been key. The project has created a unique collaboration spirit, bringing around the table key stakeholders in the sector to work together towards our common goal: developing interoperable solutions that facilitate massive deployment all around Europe.

ASSURED has supported the work of standardisation bodies worldwide, developing tools to test and verify interoperability of e-bus charging. The 'ASSURED 1.1 Interoperability Reference' is available to support bus operators to test and verify that their new chargers and vehicles are interoperable with existing ones and with those of other brands. It is a great example of how research, collaboration and knowledge exchange can facilitate tangible progress for our sector.

The ASSURED Clean Bus Report highlights this progress. Created through the valuable collaboration with fellow EU-initiatives JIVE and the Clean Bus Europe Platform, it provides an updated overview of the European market for clean buses. Furthermore, it compares figures of 2017 and 2021, presenting (another) proof that cities and operators acknowledge the win-win situation of the decarbonisation and electrification of urban transport.

We would like to express our deepest gratitude to all public transport operators, authorities, manufacturers, and suppliers for their invaluable contribution to this report. Moreover, we celebrate them for committing to a better, more sustainable world.

Umberto Guida
Senior Director Knowledge & Innovation
UITP

As coordinator of ASSURED, VUB-MOBI is proud that the project has created a fast track to accelerate the deployment of electric Heavy and Medium-Duty vehicles. With the ambition of achieving clean HD and MD urban transport, ASSURED provides clear answers to the current challenges on the electrification in cities, and on the development of high-power fast charging infrastructure and smart tools for fleet management comprising energy and cost-saving eco features.

The ASSURED high-efficiency fast charging solutions enable high interoperability between electric buses and chargers of different brands. The development of such solutions has been paralleled by the conceptualisation of key standardisation and norms on interoperability for both electric vehicles and chargers already validated in real-operation demonstrations in the EU cities Barcelona, Osnabruck, Gothenburg, Eindhoven and Jaworzno.

The smart design and fleet management tools developed within the project enable the optimisation of on-board vehicle battery systems for ultrafast charging with cost-effective solutions, as well as to advance fleet management with digital twin models comprising features such as eco-driving, eco-comfort and eco-charging.

The innovative ASSURED solutions will allow boosting the electrification in cities towards 2ZERO, clean and sustainable transport.

Prof. Joeri van Mierlo
Director VUB-MOBI (Mobility, Logistics and Automotive Technology Research Centre)
and ASSURED Coordinator

Since launching in 2017, the JIVE projects have enabled the scale up of Europe's fuel cell bus sector from 10s to 100s of vehicles. The consortium of city councils, transport authorities and operators have achieved the projects' main goal: to stimulate the fuel cell bus market.

With over 200 JIVE buses currently on the road, and 110 more vehicles scheduled for delivery by the end of 2022, the projects have led to substantial price reductions and have catalysed the development of new models (including 18m and coaches). Beyond JIVE, we are already seeing commitments for deployment of 1000s of fuel cell buses in Europe by 2025.

The JIVE consortium has enjoyed a strong collaboration with European projects such as ASSURED and the Clean Bus Europe Platform to work towards the common goal of decarbonising the bus sector and meeting the Clean Vehicle Directive targets over the coming decade.

Madeline Ojakovoh
JIVE Coordinator, Principal Consultant at Element Energy, an ERM Group Company

Clean air, ensuring healthier and more liveable communities, is a key priority for transport authorities and operators. The bus sector is demonstrating strong commitment to the decarbonisation goals and is embracing clean technologies and innovation whilst investing in substantial fleet renewal in many of our cities. As the Chair of the UITP Bus Committee, I am extremely proud to see our members actively supporting this transition, sharing their knowledge and expertise on clean bus deployment, thus helping advance the sector and deliver substantial benefits to our respective communities.

Michael Renshaw
Executive Director Transport for Greater Manchester, and UITP Bus Committee Chairman

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Chapter 1
Introduction

Five years have passed since the release of the last ZeEUS eBus Report, which showcased the first steps in the electrification of public transport of 92 cities around the world. At that time, the scope of the report were battery electric buses, plug-in hybrids, and dual mode trolleys, and targeted selected bus routes. The ZeEUS project represented a real breakthrough for the deployment of battery electric buses and trolleybuses in the demonstration cities, where project partners started literally from scratch to test and play with the new technology, learning by doing, and creating an enormous knowledge body that is today the basis of the operations we see in many cities.

Since then, the technological development and maturity of low- and zero-emissions powertrains allow that cities and operators can choose the most suitable technology to define their energy transition strategy. This is a major step when looking at the flexibility and market offer available only five or six years ago. Today, zero-emission technologies are increasingly gaining pace, and the steadily increasing shares of battery electric and fuel cell hydrogen vehicles show that the market is ready for massive adoption.

Alike the situation for battery electric vehicles some years ago, it is expected that the next five years see major developments for hydrogen buses, with significantly advanced knowledge and expertise by the operators thanks to research projects such as JIVE and facilitated by initiatives like the Clean Bus Europe Platform (CBEP).

In addition, important advancements in the field of interoperability and standardisation, automation, and IT intelligence for fleet management, make it is possible to operate a fleet of clean buses with high efficiency. Many of these developments have been explored and validated within ASSURED.

ASSURED contribution to fleet electrification

ASSURED is aimed at boosting the deployment of urban commercial electric fleets (buses, trucks and vans) across Europe and ensure their integration with high power fast charging infrastructure.

With a strong focus on electric buses, the project has developed and delivered key innovations that enable the optimisation of fleet operation, like the interoperability and standardisation of e-bus charging through high power fast charging solutions, and the introduction of intelligent tools for smart charging and energy storage systems.

These solutions have contributed to reducing the total cost of ownership and operational costs, thus increasing the competitiveness of the technology, user acceptance, and facilitating mass adoption and fleet upscale. By reducing the cost and improving the efficiency, operators can fulfil the service requirements at ease and provide high quality public transport. Additional elements explored within the project were how to improve grid stability to ensure a secure energy supply, essential for future uses when a larger number of vehicles will rely on the charging infrastructure.

One of the project's key milestones has been the release in July 2019 of the ASSURED 1.0 Interoperability Reference, and its updated ASSURED 1.1 version, which has made it possible to test and verify the interoperability of charging infrastructure for battery electric heavy-duty vehicles. This reference was tested and successfully demonstrated in Barcelona and Osnabruck to charge buses with chargers of different brands in real operation, and the results of the tests were the basis for the final updated reference. In the same spirit, the Gothenburg demonstration has demonstrated several interoperable charging solutions for different type of vehicles (e-bus, e-truck and e-car).

Another key milestone has been the development of smart tools for optimised fleet operation, charging and energy storage, targeted to the demo fleets in Eindhoven and Jaworzno. The Eindhoven demo fleet will be scaled up from 43 to 100 e-buses in 2022. The solutions applied to the Jaworzno demo fleet have achieved significant cost reductions and increased efficiency of the charging.

Finally, ASSURED has brought together the most relevant players along the entire value chain of electric mobility to collectively address the standardisation and interoperability challenges and develop solutions that enable the full electrification or urban commercial fleets. In this sense, the project is an outstanding example of how cooperation between the end users, industry, technology companies and academia can provide fruitful results that help advance the sector and make a difference.

Still, the work to ensure cleaner and more sustainable cities does not end here. We still need more efforts to ensure that citizens choose public transport and urban buses because it is more convenient, comfortable, and efficient than private cars. In this sense, the ASSURED legacy is ready to be transferred to other interesting applications, like e-BRT systems. What are the next steps and how we can continue innovating and developing solutions to advance the sector is about to be revealed.

What is a clean bus?

When it comes to clean buses, there is a wide range of available, mature technologies. According to the fuel supplied to the powertrain and emissions generated, these technologies can be categorised as either clean (low-emissions) or zero-emissions.

In line with the scope of the ASSURED, JIVE and CBEP projects, this report focuses on the below categories of clean and zero-emissions urban buses (Class I). However, we acknowledge that other categories are in operation with different capacity (mini and midi buses) and vehicle Class.

The ASSURED Clean Bus Report has adopted the definitions provided in the Clean Vehicles Directive (EU Directive 2019/11610):

A clean bus is fuelled by:

- Electricity
- Hydrogen
- Natural gas (CNG, LNG)
- Most biofuels not blended with conventional fossil fuels
- Synthetic and paraffinic fuels not blended with conventional fossil ones
- Liquefied petroleum gas (LPG)

A zero-emission (tailpipe) bus is a vehicle:

- Without an internal combustion engine
- With an internal combustion engine emitting less than 1g CO_2/kWh or less than 1g CO_2/km

Battery electric bus

Battery electric buses are all-electric or purely electric vehicles with an electric propulsion system that uses chemical energy stored in rechargeable battery packs. Battery electric vehicles (BEVs) use electric motors and motor controllers for propulsion instead of internal combustion engines (ICEs). They have no ICE, fuel cell or fuel tank and derive all their power from their battery packs.

Automated infrastructure mounted pantograph in Gothenburg (Source: Volvo Group)

Battery buses are charged statically using mechanical and electrical equipment. Different technologies for battery charging can be found on the market, all of them with similar functionalities but with specific advantages and drawbacks which are considered by cities or operators in their selection according to what fits better in their overall strategy. The most common charging technologies are conductive, via manual connectors, roof-mounted pantograph, infrastructure-mounted pantograph, ground-based automated connection device, flash-charging. For trolleybuses technologies include catenary charging and In-Motion-Charging.

Automated charging roof-pantograph in Osnabrück (Source: Stadtwerke Osnabrück)

Based on the data collected for this report, for fleets hosting more than 10 battery-electric vehicles, the most common technology is conductive manual plug for overnight charging, followed by automated roof-mounted pantograph. Regarding the automatic connection device, roof-mounted pantographs are most found among the surveyed urban bus systems being present in 20 cities, followed by infrastructure-mounted.

Plug-in hybrid electric bus

The main feature of plug-in hybrid buses is that motion is achieved through an electric motor using energy stored in rechargeable batteries, similar to BEVs. However, an internal combustion engine is used only as a backup. The main difference with conventional hybrid buses (not in the category of clean buses for this report) is that hybrid buses use the ICE to provide most of the power.

Plug-in electric hybrid vehicle (Source: TEC, Wallonia)

Fuel cell hydrogen electric bus

Fuel cell hydrogen buses use electric energy produced through an electro-chemical reaction both for the powertrain and for a support battery charging. Energy stored in the batteries adds additional power in demanding situations like a rapid acceleration or gradients. Only water and heat are emitted because of hydrogen consumption. The biggest advantage of this technology is the longer range, allowing normal daily public transport bus operations with no intermediate refuelling stops.

Hydrogen bus in Cologne (Source: Regionalverkehr Köln GmbH)

Trolleybus

A trolleybus is a dynamically charged electric bus. The dynamic charge is provided through direct contact between the trolleybus' poles and the overhead wires. Trolleybuses can optionally be equipped either with limited off-wire capability, a small diesel engine or battery pack, for auxiliary or emergency use only. However, today's trolleybus technology can provide "hybrid electric bus" features on demand.

Trolleybus in Budapest (Source: Budapesti Közlekedési Központ)

Battery trolleybuses

These are bus-type vehicles propelled by an electric motor, drawing power from overhead wires via connecting poles called trolleys. Power is supplied either from a central power source that is not onboard the vehicle or via on-board rechargeable batteries. This enables the vehicles to run electrically while independent of the overhead wires for part of their route while maintaining full operational capability. Battery trolleybuses are charged dynamically using the existing trolleybus catenary, or static with a device for connecting to the electrical grid. This combination of technologies allows cities with existing trolleybus infrastructure to expand the network without necessarily expanding the infrastructure. This is a direct substitute for trolleybuses that use a diesel range extender for extended trolley lines, or as a backup in case of disruption in the infrastructure.

Battery trolleybus driving on battery-mode disconnected from overhead wires in Cagliari (Source: Consorzio Trasporti e Mobilità S.p.A.)

Natural gas vehicles

Natural gas is a fossil fuel mainly composed by methane that is compressed to increase energy density. Biomethane or bioCNG (Compresses Natural Gas) is one of the many biofuels, a non-fossil variant that is collected from biomass fermentation. LNG (Liquified Natural Gas) is cooled natural gas that achieves higher energy density than CNG. Both types of vehicles use combustion engines, thus emissions for them are the same.

CNG bus, Ciudad Real (Source: Grupo AISA)

Biofuels

Fuels deriving from organic material are all included under this term. Other than bioCNG, common biofuels are bioethanol and biodiesel. Both are a result of biomass treatment as opposed to long time-consuming natural processes forming fossil fuels. It is important to note that vehicles using liquid biofuels, synthetic and paraffinic fuels, are only considered clean if they are not blended in any proportion with conventional fossil fuels.

Clean bus deployment: global dynamics and trends

Climate change and local air pollution are the main factors driving the transition towards clean- and zero-emission technologies in the transport sector. Around the world, national and local governments have issued transport decarbonisation visions and plans, and set up targets and timelines supporting the transition from fossil-fuelled fleets towards clean and zero-emission technologies. These visions and plans are often part of the supra-national and/or local air, or climate plans, and include measures to decarbonise both the transport and the energy sectors, as these are intrinsically interrelated: in the mid- and long-term, it is not possible to pursue the transition to zero-emission fleets without decarbonising the energy sources powering zero-emissions fleets. The electricity supplied, both to power the battery packs and to produce hydrogen, needs to come from certified renewable sources.

Globally, cities are showing strong will and leadership to decarbonise their transport system through the announcement of official commitments for the adoption of zero-emission technologies (quotas for new bus procurement), and the definition of transition plans, setting targets and timelines to achieve these plans. It can be said that this is the first step when it comes to the successful deployment of clean and zero-emission buses; once the policy framework and the strategy are in place, the stakeholders follow. This is the case of EU member states like Austria, Denmark and the Netherlands, but also the US State California and countries like New Zealand, Chile, Colombia and Cape Verde, whose governments have not only announced official commitment to full decarbonisation of the bus fleet, but also set up targets.

Several projects and initiatives build on the positive drive of national and local governments, e.g. in Europe (EU-27), and because of the revised CVD, the Clean Bus Europe Platform project; in Latin America, with the Zero Emission Rapid-deployment Accelerator (ZEBRA) Partnership project; or in the Global South, thanks to the TUMI e-Bus Mission. These initiatives and projects are the result of the strong leadership shown by national and local governments towards the decarbonisation of urban transport.

The following sub-sections provide a more detailed view per region, highlighting the policy framework, the existence of national and local decarbonisation plans, and the targets and timeline set up to achieve it. Whenever available, a glance into the registrations of clean and zero-emission buses is also provided.

Finally, it is worth mentioning that this report is being released in the beginning of the third year of the COVID-19 pandemic. The previous two years have been extremely challenging for public transport operators across the world. The sanitary situation impacted severely bus service provision, with increased costs due to the new cleaning and disinfection procedures related to the disease, but also due to drastic reductions in ridership levels and yearly passengers carried, with the consequent impact of revenues. At the time of writing, ridership starts improving, with some operators reaching 80% of the 2019 ridership values. Still, it is expected that the sector will not fully recover to pre-2020 ridership levels until 2023. This should be considered when exploring Section 2. Cities.[1]

[1] UITP has been monitoring the effects of the COVID-19 pandemic on ridership levels by collecting the data from its members for bus, metro and tramways services. These data, and many other publications related to the pandemic are available for UITP Members on UITP MyLibray's dedicated COVID-19 Knowledge Hub.

Europe: The role of the EC Clean Bus Deployment Initiative and the Clean Bus Europe Platform

The momentum for clean buses in EU-27 has been fostered through supporting policy and financing frameworks as well as various initiatives and projects.

The Clean Bus Deployment Initiative, launched by the EC in July 2017, foresaw three main pillars to support and boost clean bus technologies. The initiative set up the policy framework for the future deployment in Europe, through the Clean Vehicle Directive (CVD)[2], which sets mandatory targets for the public procurement of clean and zero-emission buses, and that entered into force in August 2021 for the next 10 years. Other policies supporting clean bus deployment are the Alternative Fuels Infrastructure Directive (AFID), which defines what is a clean technology and sets up targets for the deployment of alternative fuel charging and refuelling infrastructure, and the EC Green Deal, which establishes the framework for a climate-neutral Europe by 2050 and includes the Fit for 55 Package.

The funding and financing framework has been secured by the creation of the dedicated mechanisms like the "European Green Deal Investment Plan and Just Transition Mechanism", aiming to mobilise public investment and help unlock private funds through EU financial instruments, notably InvestEU, which would lead to at least €1 trillion of investments[3]. Against this background, the EC launched the Clean Bus Europe Platform (CBEP) project to support knowledge and experience exchange. The platform is the strategic line of action to facilitate and support the implementation of the CVD targets, as well as to boost the deployment of clean buses across EU-27. To this end, the platform brings together cities, transport authorities and operators to exchange know-how and expertise. Together with the industry, financing and funding entities and associations, the platform is the "place to be" for any stakeholder interested in clean bus deployment.

It is undeniable that the CVD can pose a challenge to cities and operators, but it is equally an opportunity to improve the image of the urban bus, boost operational efficiency and thus improve the quality of the service. In this sense, sharing knowledge and expertise is key to ensure a fair transition to cleaner and zero-emissions bus operations. There is no doubt that the Clean Bus Europe Platform and other projects to come will accompany cities, public transport administration, operators, and citizens, on the path to achieve public transport carbon neutrality.

Electric bus depot in Berlin (Source: Berliner Verkehrsbetriebe)

[2] The Clean Vehicle Directive was adopted by the European Parliament and Council in June 2019. The Directive needed to be transposed into national member states' law by 2 August 2021; the date from which it entered into force.

[3] More information is available on the EC website: Financing the green transition: The European Green Deal Investment Plan and Just Transition Mechanism.

In addition, countries like Austria, Denmark, Finland, the Netherlands, Norway, Switzerland and the United Kingdom have signed the "Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles 2021". The collective ambition is to accelerate the deployment of zero-emission medium- and heavy-duty vehicles and related infrastructure that enable these technologies to reach 30% of newly procured vehicles by 2030, enable a full transition in new fleets by 2040, and to facilitate the achievement of net-zero carbon emissions by 2050[4].

Examples of best practices in Europe

The City of Eindhoven (the Netherlands) deployed the largest fleet ever seen in continental Europe back in 2016, a status that was kept until 2018. A total of 43 articulated battery electric buses were put into service with opportunity charging via automatic roof-mounted pantographs. The charging infrastructure was installed at the depot, conveniently situated only one kilometre away from Eindhoven central station, which serves as the endpoint for the main lines of Eindhoven's bus system. Now, after five years of successful operation, the Eindhoven fleet is about to be scaled up to 100 buses, building on the lessons learned and ASSURED takeaways.

Schiphol Airport in Amsterdam is one of the largest airports in the world, and a main transport hub for the country. Since 2018, bus operator Connexxion operates over 200 battery electric buses 24/7, bringing passengers to the airport and running transfers between terminals.

Groningen-Drenthe (the Netherlands), deployed in 2019 a total of 164 multi-brand electric bus fleet whereby VDL, Heuliez Bus and Ebusco vehicles are sharing an interoperable Heliox charging system. The charging infrastructure counts 23 opportunity fast charging points with roof-mounted pantograph technology along the route, and four depot charging locations fitted with CCS plugs and roof-mounted pantograph technologies. In addition, after a small pilot of two buses launched in 2017, 20 VanHool fuel cell hydrogen buses joined the fleet in late 2020, supported by the FCHJU as part of the JIVE2 project.

Depot charging infrastructure in Groningen – Drenthe (Source: OV Bureau Groningen Drenthe)

[4] Read the full MOU here.

VanHool fuel cell hydrogen buses are also in operation in Cologne and Wuppertal, with 30 and 10 vehicles respectively, all of them placed in the same order. A successful pilot of two hydrogen fuel cell buses was in operation in Cologne in 2014, where fuel cell hydrogen technology was trusted to progressively decarbonise the bus fleet. In Wuppertal, battery electric vehicles did not match operational requirements at that time, while the longer range of fuel cell buses allowed to introduce zero-emission buses in the fleet. Hydrogen for buses is produced locally using electrolysers powered by the AWG Waste-to-Energy plant in Wuppertal.

The first fuel cell hydrogen bus beyond any pilot phase in Spain is running in Torrejón de Ardoz, contracted by Madrid Region (CRTM) and operated by Alsa. In addition, 10 hydrogen buses will be added to Madrid's public bus operations by EMT Madrid, who recently tendered the design and construction of a green-hydrogen production solar plant, financed under the FEDER funding scheme. Also in Spain, Barcelona will add the first hydrogen-powered bus to its bus fleet in 2022, in the frame of the JIVE/JIVE2 project. Halfway across the Mediterranean sea, in Mallorca, EMT Palma awarded in February 2022 five hydrogen units to Solaris, which will be also powered by solar produced hydrogen in the frame of the EU H2020 Green Hysland project.

A mass substitution of diesel vehicles by new CNG buses is ongoing in Madrid. In fact, EMT Madrid plans to phase out all diesel buses by December 2022. To do so, in 2021 520 CNG units were awarded to Solaris, Scania and EvoBus, that are being gradually commissioned between 2021 and 2023. According to the data collected for this report, the EMT Madrid fleet composition in 2017 was 50% CNG, 48% diesel and 2% electric buses, while in 2021 CNG buses accounted for 78%, while 15% were diesel fuelled and 6% electric powered.

Trasporto Passeggeri Emilia Romagna (TPER) awarded Scania and Industria Italiana Autobus (ex BredaMeranini) a contract for 15 LNG inter-city buses and 31 LNG class-II. The units are to serve the metropolitan area of Bologna and entered into service between late 2019 and mid-2020. With a maximum range close to 1,000 km, LNG buses were chosen by TPER to provide a cleaner suburban and interurban service in the area. Bologna had already a deep experience in natural-gas powered buses, technology already adopted for buses in 2002 (Doheim, R.M. & Farag, Alshimaa & Kamel-Ahmed, Ehab. 2020).

A glimpse at the evolution of clean technologies in the European bus market

Since the release of the previous ZeEUS eBus Report in 2017, the European bus market has moved from the pilot phase to the commercial service of clean and zero-emissions vehicles.

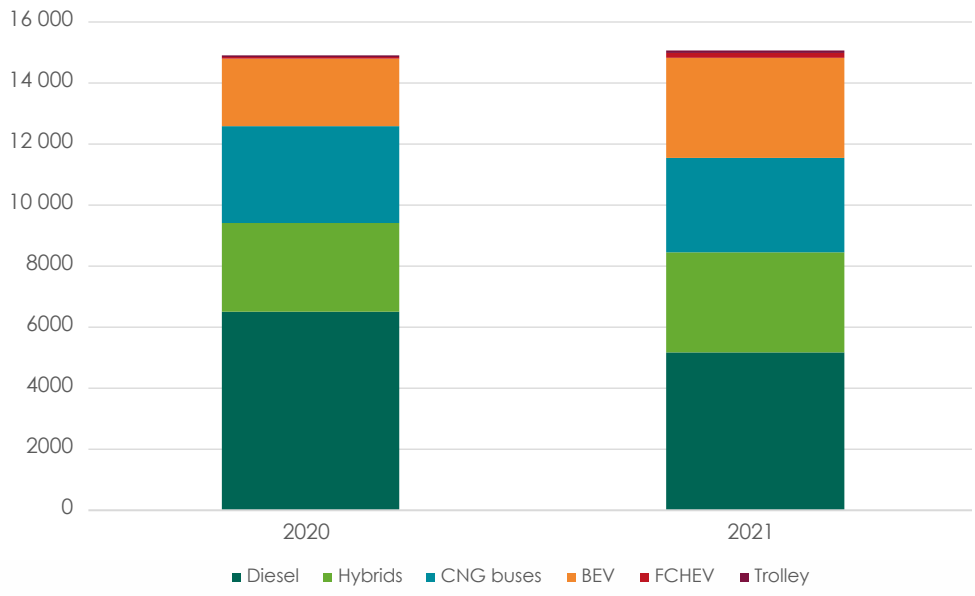
This section aims to provide a short but comprehensive glimpse of the evolution of the clean bus technologies market. It is based on selected figures provided in the Chatrou CME Solutions Report[5] on registrations of alternative drivelines 2021, complemented with selected results from the data collected among the cities that contributed to the elaboration of this report.

In this sense, it is important to note that the data collected in this report covers a period of five years, when cities' transition plans expand over a longer timeline. Thus, no conclusions on Europe's overall transition should be made. However, the positive evolution of the market of new registrations, and the increasing number of clean buses in the cities gathered in the report are encouraging signs that the transition to cleaner fleets is well underway.

When looking at the overall stage of clean bus deployment (further explained in the Approach section), we can see that the piloting phase has been passed: on average, cities position themself just over stage 2 (Small lines and simple operations). More precisely, 46 cities claim to be in stage 2 or 3 (More lines and larger service) for clean bus deployment in their fleets.

In 2021, the European bus market registered 15,061 new vehicles, showing a small increase compared to 2020, with 14,893 new registrations (Chart: New urban buses registered per propulsion type. Source: Chatrou CME Solutions). Although diesel vehicles still account for most of the registrations, the share of new registrations has decreased from 43% in 2020 to 34% in 2021 (25% reduction). This rapid decrease shows a fast shift towards alternative drivelines. Today, 43.8% of new registrations are diesel-free vehicles, of which 21.8% are battery electric and 20.5% CNG vehicles.

New urban bus registered per propulsion type



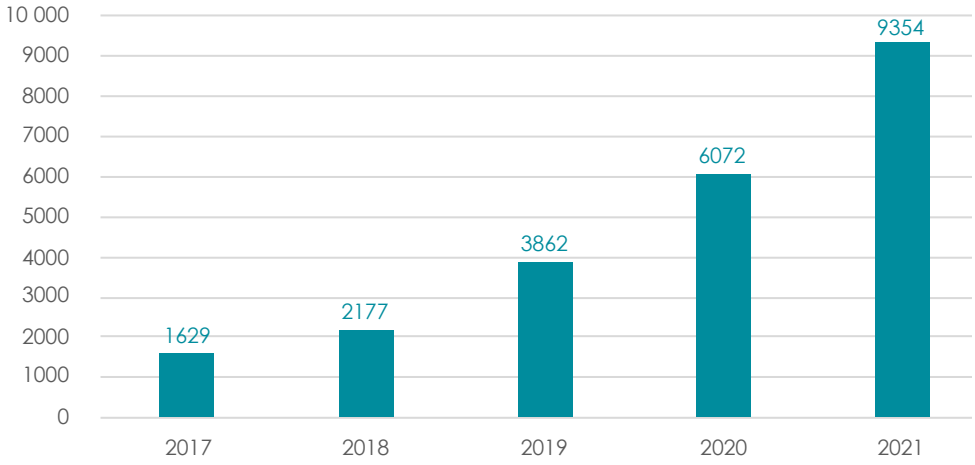
Source: UITP elaboration on data by Chatrou CME Solutions, Alternative Drivelines for City buses 2020/2021

[5] The scope of the Chatrou Report includes EU-27 countries, Switzerland, Norway, Iceland and UK.

The share of new registrations of battery electric buses is steadily growing from 12% in 2019, to 15% in 2020 and 22% in 2021. The adoption of electric vehicles is accelerating for two reasons. On the one hand, it is pushed by top-down policies like the Clean Vehicles Directive (and national regulations), which establishes mandatory quotas for newly procured buses: 22.5% of the newly procured buses should be zero emission buses in public tenders from 2021 to 2026. On the other hand, electric vehicles demonstrated to be very competitive in terms of operational and maintenance costs with other technologies. As reported by one of the operators surveyed, "All new investments are basically electric vehicles because of their lowest TCO".

The total bus stock has become almost six times larger in the last four years, growing from 1,629 estimated units in 2017 to 9,354 units at the end of 2021 (Chart: Battery vehicle stock in Europe). It is remarkable that in 2021, three countries registered over 500 electric vehicles for the first time: Germany (555), UK (540) and France (512), which accounts for the half of the 2021 new registrations 3,282 BEV.

Battery vehicle stock in Europe



Source: UITP elaboration on data by ZeEUS eBus Report #2 and Chatrou CME Solutions, Alternative Drivelines for City buses 2020/2021

Looking at the cities involved in the ASSURED Clean Bus Report, it is relevant how the number of cities with at least one electric vehicle doubled from 35 in 2017, to 71 in 2021. In some cases, battery electric buses represent just the first approach to the new propulsion system, e.g. Aranjuez (Spain), Rethymno (Greece) and Prague (Czech Republic), but in other cases they are already integrated in the commercial service. Amstelland-Meerlanden (the Netherlands), Osnabruck (Germany) and Jaworzno (Poland) are the case studies with the highest share of electric vehicles, representing 70%, 65% and 62% of the entire fleet.

In terms of absolute numbers, electric vehicles increased from 481 in 2017 to 3,538 in 2021, representing the 38% of the European e-vehicles stock. London and Paris are the cities with the larger number of electric vehicles, with respectively 728 and 400 bus units, even if these correspond to 8% of the entire fleet.

Focusing on CNG, in Europe the number of bus registrations slowed down after two years of growth, remaining over the 20% of new vehicles with 3,088 new bus units in 2021. France confirms to be the leader country, accounting for 54% of total CNG vehicles registered in 2021, followed by Spain (11%) and Italy (6%).

As per the cities involved in this report, the figures for 2021 show that Madrid has the highest number of CNG vehicles namely 1,634, followed by Paris, 600, and Nantes, 390. The last four years, the number of cities with a share of more than 50% of CNG vehicles compared to the entire fleet doubled. Ravenna is the only city having 100% of its fleet composed by natural gas.

The market share by bus manufacturer shows that manufacturers are competing for the leadership of the European market in the different clean technologies. The electric vehicle sector appears to be quite balanced, with Solaris, BYD-Alexander Dennis Ltd, Mercedes and Yutong, registering over 300 electric buses in 2021. Compared to 2020, the market share of electric buses slightly increased from 39.3% to 42.7%.

Regarding the CNG solution, Iveco Bus increased in 2021 its market leadership, increasing the number of bus units registered from 955 in 2020 to 1,269 last year. Moreover, Iveco Bus represents alone over 40% of the market share and when taking also the second and the third manufactures in terms of number of units, Scania (539) and MAN (489), they cover 75% of the entire CNG fleet registered in 2021.

When looking into the evolution of fuel cell hydrogen buses, we can see that numbers soared in the last 12 months. 158 vehicles have been registered in 2021, 50% more compared to all vehicles registered in the previous nine years. This growth was concentrated in the UK, 68 vehicles, the Netherlands, 37 vehicles, and Germany, 33 vehicles.

The larger manufacturer of fuel cell buses is Wrightbus, the English producer of the first hydrogen double decker bus, with 71 vehicle registrations at the end of 2021. Other main OEMs are Solaris (37), Van Hool (21) and Caetano (20).

According to our survey, the hydrogen solution has been integrated into commercial service in 11 cities in 2021, compared to six cities in 2017. Only in two cities the technology represents more than 10% of the total fleet: Cologne and Frankfurt-Höchst.

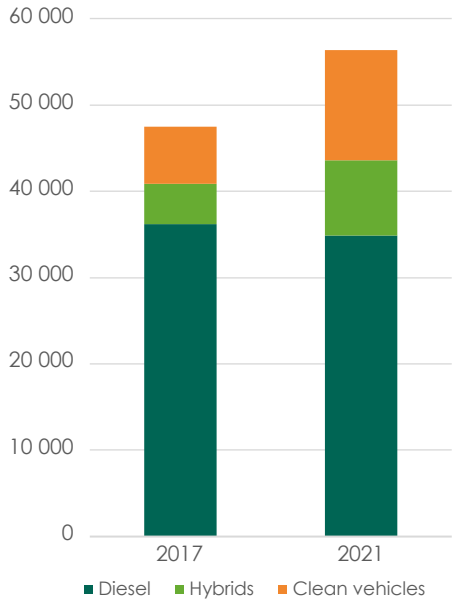
Hydrogen double decker bus (Source: Transport for London)

Below are the overall results of the survey conducted within the ASSURED project.

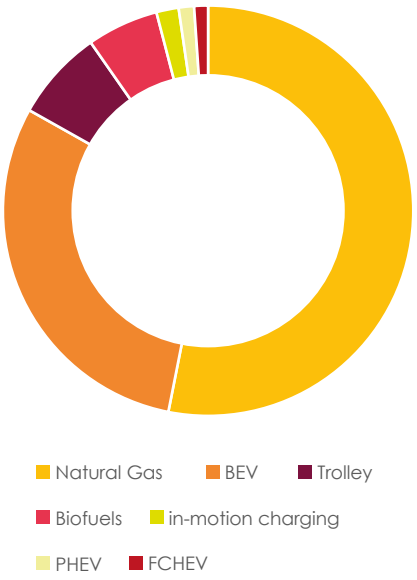
One of the positive developments in the sample cities investigated is that the total number of buses increased by 19%, exceeding the 50,000 bus units.

The number of diesel vehicles decreased by 1,052 in the last four years, an approximate 3% of the total number of diesel vehicles present in 2017 (Chart: Number of clean buses). At the same time, the number of clean buses increased by 88%, almost doubling the number of clean vehicles compared to 2017. The share of diesel-free vehicles increased from 15% to 23%, and currently there are 12,504 clean buses circulating in the cities included in the ASSURED report.

Number of clean buses
Source: UITP ASSURED survey



Share of clean buses
Source: UITP ASSURED Clean Bus Report survey

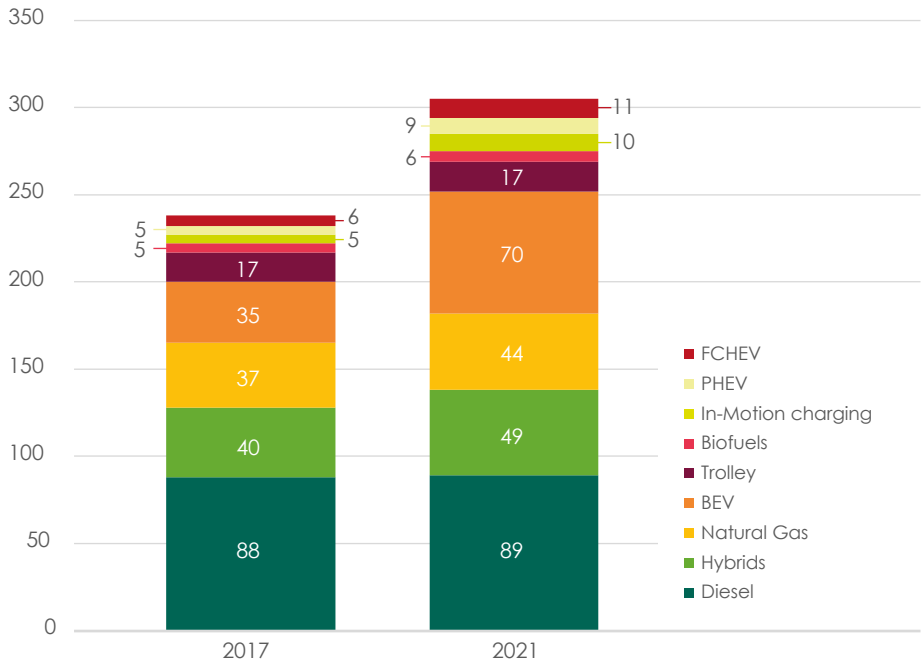


The technology that registered the fastest increase is the Battery Electric Vehicles, which increased from 481 to 3,538 units, growing by about 635% in the last four years. As of 2021, the share of clean vehicles in use is composed of more than half of CNG vehicles (54%), followed by 28% of battery electric vehicles.

Looking at the distribution of propulsion solutions by the number of cities, diesel is still the most common technology, present in 89 out of the 100 cities investigated. This situation it is not surprising because it is not easy to replace the entire fossil fuel fleet in just four years, but the increasing number of cities that introduced alternative propulsion vehicles shows the effects of the European environmental policies for clean transport (Chart: Number of public transport system by propulsion).

The number of cities with at least one battery-electric vehicle increased from 35 in 2017 to 71 in 2021, and the cities that introduced natural gas solutions moved from 37 to 44. Also, in the cases of In-Motion Charging, FCHEV and PHEV, the number of cities using these solutions doubled in the last four years, whereas the number of cities with trolleys solution remains constant at 17.

Number of cities with at least one vehicle per propulsion type



Source: UITP ASSURED Clean Bus Report survey

From the collected survey answers, we can see that the average fleet age in Europe is eight years and two months, only a bit over half the expected lifetime for an urban bus unit. A total of 12 cities has a remarkable average fleet age lower than four years, while 48 cities outstand the surveyed average for that indicator.

Latin America

The Latin America region has witnessed a remarkable deployment of clean bus technologies in the last years. Chile and Colombia announced their commitment to procure only zero-emission buses from 2035 on, as indicated in their national plans. Costa Rica has committed to full fleet transition by 2050, and Uruguay has announced the intention of procuring only zero-emission buses by 2040. Chile and Uruguay are also signatory parties of the "Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles 2021".

In addition to the political drive of these countries, one of the main initiatives supporting clean bus deployment in the region is the Zero Emission Rapid-deployment Accelerator (ZEBRA) Partnership.

The project, co-led by ICCT and C-40, was launched in 2019 with the aim of supporting the transition to zero-emission buses in leading Latin American cities. The project has the goal of ensuring the procurement of 3,600 e-buses in the region, and with the scope on cities like Medellin, Mexico City, São Paulo, and Santiago de Chile. Similar to the CBEP in EU-27, ZEBRA brings together cities, the bus industry, and financial institutions to ensure the political commitment of the cities involved, secure the availability of zero-emissions buses and investment on e-bus projects, and facilitate knowledge-sharing and exchange on bus electrification among cities.[6]

[6] https://www.c40.org/what-we-do/scaling-up-climate-action/transportation/zero-emission-rapid-deployment-accelerator-zebra-partnership/

In terms of market deployment, according to e-Bus Radar, an organisation that monitors e-bus adoption in Latin America, a total of 2,564 battery e-buses are in operation as of February 2022. Nearly one-third of them are trolleybuses, while the other two-thirds are battery electric buses, mostly solo buses with a length span between 12 and 15 meters. Articulated buses are a bit behind on the ramp-up phase, but implementations can be found in São José dos Campos, Cali, Bucaramanga, Medellín or Mexico City.

An electric bus in Santiago, Chile (Source: Shutterstock)

As of March 2022, frontrunners among Latin American cities are Santiago de Chile and Bogotá. In Santiago, public transport system Transantiago maintains the leadership as the largest e-bus fleet outside China, with about 800 e-buses, of a total fleet of 6,800 buses in operation. The new contracts awarded in February 2022 will bring forward the electrification of the Transantiago fleet, adding 941 e-buses by 2025, which will represent the 25% of the total bus fleet.

In Bogotá, Colombia, the first articulated BRT bus was tested in 2017. The fleet of TransMilenio counts currently 655 e-buses in operation, out of the 1,485 buses that have been already awarded and expected to be commissioned along 2022. Furthermore, 1,800 CNG buses have been deployed since 2020, with 745 of them being articulated and biarticulated buses operating the BRT main axes. Smaller high-capacity bus systems in the country are introducing e-buses in their operations, which add up to reach the planned total number of 1,589 e-buses in the country for 2022.

Brazil hosts the BYD-Marcopolo partnership which delivered the first 12 22-meter e-buses in the Linha Verde corridor in São José dos Campos in November 2021. The city of Goiânia has also tested the articulated BYD– Marcopolo buses in a 14 km BRT line and plans to fully electrify it soon. Metrobus (Goiânia's public transport operator) plans to introduce 110 buses as soon as in 2022.

Mexico City has the largest bus fleet, with approximately 22,300 buses in operation. In summer 2021, Ciudad de Mexico deployed a total of 10 Yutong battery electric articulated buses to join the fleet operating BRT line 3, while the city counts nearly 500 trolleybuses.

The United States and Canada

In the United States and in Canada, the policy framework on clean buses is yet incipient. Only the US State of California has officially approved binding targets for the deployment of clean buses in its "Innovative Clean Transit (ICT) regulation" of 2018. From 2029 on, all newly procured buses by California's public transit agencies will have to be zero-emission, while by 2040, the total bus fleet will have shifted to zero-emissions. Similar goals apply for Seattle and Washington DC, aiming for a 100% renewal-energy-powered fleet by 2040 and 100% zero-emission bus fleet respectively.

In addition, 15 US States (California, Colorado, Connecticut, Hawaii, Maine, Maryland, Massachusetts, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Rhode Island, Vermont, Washington, and the District of Columbia) signed the "Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding 2020" in which the signatory states agree to work together to foster "a self-sustained market" of zero-emission medium- and heavy-duty vehicles, and from 2050 on, to "strive to make sales of all medium- and heavy duty vehicles in their jurisdictions" zero-emission, achieving 30% of the sales zero-emissions by 2030.[7]

MTA electric bus in New York City, USA. (Source: Marc A. Hermann / MTA)

Likewise, Canada is also a signatory party of the "Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles 2021", together with several European countries and Chile, New Zealand, Turkey, and Uruguay.

UITP calculations were done using the last release of APTA's Public Transportation Vehicle Database in 2020 for the USA. A share of 30% on the total regular public transport bus fleet fell under the clean bus definition given by the European Clean Vehicle Directive. Out of them, 72% (12,655 vehicles) were powered by natural gas, 6% (1,027) were BEV, FCHEV or trolleybuses, and the rest were other clean bus technologies such as biofuels.

In December 2021, Calstart, a clean transportation industry consortium with headquarters in California, released the "Zeroing in on ZEBS" report, which offers an exhaustive review of zero-emission bus deployment in the USA and Canada.

[7] https://www.energy.ca.gov/sites/default/files/2020-08/Multistate-Truck-ZEV-Governors-MOU-20200714_ADA.pdf

Battery electric buses in the USA added up to 3,364 vehicles, while 169 fuel cell electric buses were in operation, being the latest technology pointed out by many transit agencies to deploy their zero-emission bus strategies better meeting their operational needs. In Canada, a total of 596 battery electric buses were in operation and 10 fuel cell hydrogen buses were planned or announced in September 2021.

Electric bus in Montréal (Source: STM/ Julien Perron-Gagné)

While most of the ZEB fleets are modest with up to 10 vehicles, the USA and Canada are on the road to a large fleet upscale, already revealed by the 27% ZEB total number growth between 2020 and 2021 in the USA.

In Canada, according to a recent study from the bus operator Cutric, the national bus fleet had in January 2022 up to 825 compressed natural gas buses in operation.

In brief, updated data on ZEB show a clear ramp-up trend in clean buses weight among USA transit bus fleets, which will be most probably constated in the next Public Transport Vehicle Database release.

India

The Government of India is working to accelerate electric bus deployment since 2015, when the Faster Adoption and Manufacturing of (Hybrid and) Electric Vehicles (FAME) subsidy scheme was launched. To foster the progressive technology transition towards efficient electric and hybrid vehicles, the FAME scheme tackles the impact of higher costs associated with lower or zero-emission bus adoption.

The second phase of the scheme, FAME-II, was approved in 2019 with an outlay of Rs 10,000 crore (USD1,308,464) for three years, out of which 86% is allocated to demand incentive to create demand for electric vehicles. However, in addition to the higher cost of e-buses, the COVID-19 pandemic induced financial constraints that have caused Indian bus agencies to postpone their plans for pilots and scale up of e-buses under FAME-II. For this reason, FAME-II has been extended until March 2024. Focusing on the bus industry, the scheme will induce e-bus demand by supporting the purchase of 7,000 e-buses for urban and interurban services in several cities around the country.

The Convergent Energy Services Limited (CESL), under the second phase of FAME-II, aggregated e-bus demand across the biggest five cities in India under the "Grand Challenge" initiative, bringing together Delhi, Kolkata, Bengaluru, Hyderabad, and Surat. The scheme includes fully electric buses and aims to reduce the operating costs for cities. It is expected that standardising the tendering conditions in different cities will induce the homogenisation of the electric bus fleets across the country, leading to a reduction of the total operational costs and a faster deployment in an affordable manner and at scale.

Apart from central government funded projects, smaller initiatives driven by state governments and cities are in place, such as the 350 e-buses subsidised by the Pune municipal corporation, or the 50 vehicles supported by the Kerala state government.

Data collected for an ongoing UITP India project reveals important numbers about electric buses being deployed in the main cities of India. As of February 2022, 386 electric buses are in operation in Mumbai, 300 in Delhi, 250 in Pune, 200 in Ahmedabad and 180 in Navi Mumbai. All electric buses in India range between a length of 9 and 12 meters and correspond to a mix of manufacturers, including Ashok Leyland, JBM Auto Ltd, Olectra Greentech, and Tata Motors.

Charging electric buses in Ahmedabad, India (Source: UITP India)

MENA Region

Clean bus deployment in the MENA region faces various challenges, but there is a commitment to achieve the goals of GHG emission reduction and urban air-quality improvement.

After the deployment of modest CNG city bus fleets and electric bus pilots being in operation in Cairo and Alexandria in the past years, the Government of Egypt announced in February 2022 that its entire public transport bus fleet will be powered by natural gas and electricity within the next five years. This announcement follows the production of the first e-bus manufactured in Egypt by MCV in 2021.

Qatar made a similar announcement in 2021, stating that 100% of the bus fleet will be zero-emission by 2030. The transition will be made gradually, with the nearest partial goal of converting 25% of the fleet soon to be reached by introducing 741 e-buses, before the country is hosting the FIFA World Cup in late 2022.

Amman, in Jordan, is introducing 15 battery electric buses funded through an EBRD loan to execute their fleet renewal plan.

Electric bus in Dubai
(Source: RTA)

The United Arab Emirates targets a full electric fleet as part of their net zero strategy for 2050. The Union has hosted several pilots in Abu Dhabi, Dubai, and Sharjah. The Dubai Roads and Transport Authority (RTA) tested a dynamic wireless charging system in 2020. More recently, two e-buses are being tested between November 2021 and March 2022 on a shuttle line with opportunity charging boosts at end stops. As announced by Mohamed Al Ali, the Director of Buses at RTA in the UITP MENA Transport Congress and Exhibition hosted in Dubai in February 2022, e-bus commercial operations will start in 2025. In addition, Abu Dhabi is rolling out two pilots with battery electric buses for school and shuttle services but aiming for a larger deployment including regular public transport operations in the near future.

An ambitious e-BRT line started operations back in 2017 in Marrakesh, Morocco. A total of 15 e-buses run on this first line, with a total length of 8 km, three of them equipped with overhead wires that charge on-board batteries while in motion.

Australia and New Zealand

The New South Wales Government has set the goal of transitioning the State's fleet of 8,000 buses to zero-emission buses by 2030. The first 12 buses were deployed in October 2021 and up to 40 additional buses are expected to be running in Sidney by early 2022.

Australia's capital Canberra will soon add the first 12 battery-electric buses to the local public transport operator fleet, while an additional 90 zero-emission buses are being procured in the first quarter of 2022. The ACT government set the goal of having a full-electric bus fleet operational in Canberra by 2040 the latest.

New Zealand is also signatory party of the "Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles 2021".

Sub-Saharan Africa

The electrification of public transport in Sub-Saharan Africa is the opportunity to transition also from informal bus services to public transport networks. New BRT networks in the region find electric bus technology ready to be implemented from the first ride if supported by the public administration.

As an example, the new BRT system in Nairobi, Kenya is planned to start operations by the end of 2022. On 1 February 2022 the call for offers was officially launched by the Nairobi Metropolitan Area Transport Authority, inviting firms to present their bids for operations with clean buses (i.e. battery electric, hydrogen, or biogas or hybrid). In parallel, the first electric bus in Kenya was rolled out in January 2022, designed by Opibus, claiming to be the first African designed electric bus, or Sub-Saharan Africa at least.

South Africa's first two full-electric buses started commercial operations in July 2021 as part of a pilot with an expected duration of one year, after a test period without passengers.

Abidjan, Ivory Coast, counts a significant fleet of CNG buses run by SOTRA (Abidjan Transport Company). A total of 450 CNG buses were commissioned already in 2018, 50 of them being high-capacity articulated, with additional orders bringing the total to 700 buses. Out of these, 100 buses are high-capacity articulated vehicles. They are incorporated in the urban bus transport system in Abidjan.

Natural Gas bus for SOTRA in Abidjan, Ivory Coast (Source: SOTRA)

China

The Chinese government's strategy for new energy vehicles sets the national goal to achieve carbon neutrality by 2060. However, the term "new energy vehicles" (NEV) does not match perfectly with the clean bus definition applied in this report. In China, NEV include electric buses (both battery and fuel cell hydrogen) and hybrid units but excludes natural gas vehicles.

As of 2020, 704,381 urban buses were in operation in China. Out of them 509,193 units fall under the definition of Clean Bus as provided by the EU Clean Vehicle Directive, representing 72% of the national urban bus fleet. With regards to the technology share, battery electric represented 54% (378,700 buses) of the total fleet, and natural gas 18%. Fuel cell hydrogen and trolleybus technologies were only present in small numbers.

Looking to the distribution per regions, in absolute figures, the Guangdong province has the highest number of NEV deployed, exceeding the 86,000 units in 2020, followed by Shandong with more than 45,000 vehicles, and Jiangsu and Zhejiang, both with more than 20,000 vehicles in operation. However, in relative terms, Hunan is the province with the highest share of NEV over total fleet, with a ratio of 86.8%.

Electric bus depot in Shenzhen (Source: Shenzhen Bus)

Electric buses in China perform 133 km/day on average, with the Lanzhou fleet leading the race with 203 km/veh-day, closely followed by Guangzhou with just below 200 km/veh-day. Figures on energy consumption differ by regions between 80 kWh/100km and 95 kWh/100km. The lowest rate is achieved the Southwest region of China while the highest are found in Northeast and South China. Since operational constraints are usually raised as main drawbacks for e-bus mass adoption, figures arriving from China show that those are diluting at a steady pace.

The share of natural gas buses is decreasing at a similar rate as diesel ones, while battery electric vehicles are taking over the urban public transport bus service. However, fuel-cell hydrogen buses are gaining more and more presence also in China.

Batteries and hydrogen are two of the most promising zero-emission technologies in China. Some cities, such as Shenzhen, have opted for batteries, but Foshan, a fast-growing city with a population of 8 million, chose the hydrogen energy economy. Already in 2016, Foshan launched its first line operated with hydrogen buses,

and currently about 1,000 hydrogen buses are running on 28 lines. The Foshan Hydrogen Development Plan sets targets for the number of fuel cell vehicles (and other industrial vehicles) that should be procured until 2030: up to 2,500 buses by 2025 and 4,000 buses by 2030. The city has a current network of 20 hydrogen refuelling stations (HRS) and plans to reach 57 by 2030. The local administration and the central government provide support and heavy investments to this massive, ambitious plan.[8]

Electric bus in Shenzhen, China (Source: Shutterstock)

By the end of 2021, 440 clean hydrogen powered buses were serving nine lines in Zhangjiakou. Recently, 655 fuel-cell hydrogen buses were added to Zhangjiakou fleet so 1,100 fuel-cell hydrogen electric buses were in full-operations during the Winter Olympic Games Beijing 2022.

[8] https://meethydrogen.com/resource/foshan-the-hydrogen-technology-city

Approach of this report

The ASSURED Clean Bus Report is a collective effort: it has been possible thanks to the contribution of key stakeholders in the field of clean bus deployment. As such, its value lies on the up-to-date data and general information provided by its contributors: cities, public transport authorities and operators, bus manufacturers and charging systems suppliers.

The report is organised in five chapters. Chapter 1 provides a general overview of the state of clean bus deployment in several regions, some notes on the policy framework, and a selection of examples. This chapter is not intended to be an exhaustive compilation of the many remarkable examples of clean bus systems currently in operation. Its aim is to provide a first glance into the topic and support it with interesting use cases. Chapter 2 presents in factsheet style the bus systems of the contributing cities and operators, including year-round 2021 data, unless indicated otherwise. The city factsheets present different profiles, considering operations from small number of buses to the larger fleets with thousands of buses. All of them contribute to shape the reader's own conclusions aside from the ones that are humbly presented in this document. Chapters 3 and 4 provide a glimpse into the applications available on the market for buses and charging infrastructure.

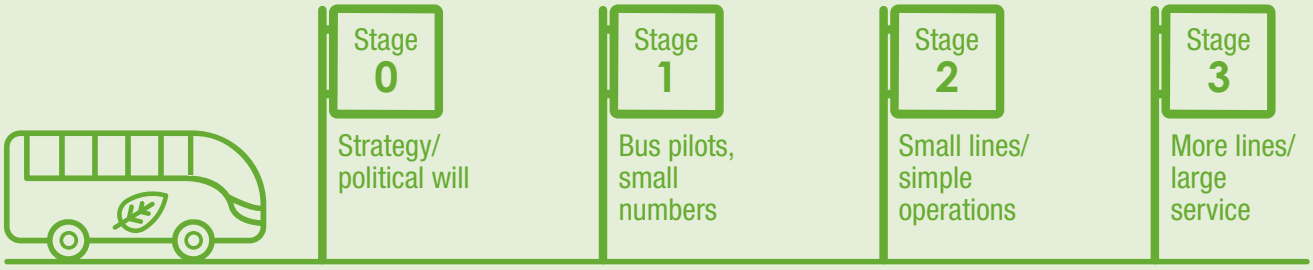
A vast number of actors in bus operations in Europe have been individually contacted to share their view on fleet decarbonisation and clean bus technology adoption, as well as to provide data on their current fleets and operations. The data were collected through a survey with several sections: selection of operational data; clean bus strategy and vision; bus fleet data with two-time data points (2017 and 2021); and specifications for charging and refuelling infrastructure.

Now we underline some considerations for the readers.

The report gathers a total of 100 cities and bus systems, with an aggregated fleet that represents one quarter of the European bus stock. The data are presented in a comprehensible way, guiding the reader through a few indicators, as well as specific details of fleet or infrastructure composition.

This report applies the definition of "clean" and "zero-emissions" (at tailpipe) bus as provided in the Clean Vehicles Directive (EU Directive 2019/11610). The carbon emissions of the energy mix of the countries represented are out of the scope of this report.

The survey included a self-assessment of the clean bus strategy and vision, where respondents were asked to indicate in which phase of the deployment process would they place their systems. Respondents could choose among a set of four stages: Stage 0, for those cities that have a strategy for clean bus deployment in place, as well as political will; Stage 1, for cities that have started pilots with small numbers of buses; Stage 2, for cities with small lines and simple operations; and Stage 3, for cities with mature deployment with more lines and large services in operation. Rather than matching any set of accountable indicators, this response followed from their own feeling and expectations.



As for the number of buses per technology, figures should be examined keeping in mind that vehicles are constantly added to and removed from fleets. Most importantly, the life span of buses is well beyond the comparison between 2017 and 2021, thus any decrease of share of clean buses should be further investigated through the provided tables. If any, most of the slight decreases in the percentages are due to the introduction of hybrid or even diesel EUROVI bus as a "cleaner" solution to replace units with a reassuring and affordable technology at the purchase time. The quotes provided by the cities may also clarify the direction they are taking when it comes to clean bus deployment.

As a last remark for Chapter 2, the reader should not disregard the effect of the COVID-19 pandemic on ridership. The number of passengers carried per year is an interesting indicator for operators and municipalities who may read this report as a collection of interesting benchmarks, but although the place-kilometre offered by operators in 2021 was restored almost to the pre-pandemic levels, the number of passengers still does not reflect the real service.

In Chapter 3, the reader must understand that a collection of bus models is presented. The content of the chapter is built from the answers collected from a survey sent to bus manufacturers, thus it must not be seen, nor was intended, as a single-stop catalogue of clean buses. The specifications shown for the different vehicles have been checked by the content review team at UITP and VUB; however, they should not be taken as final or exact values.

These remarks apply also for Chapter 4.

Chapter 2
Cities

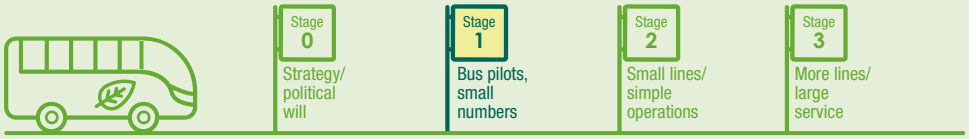
Klagenfurt am Wörthersee

Austria

Klagenfurt Mobil GmbH

Stage of deployment

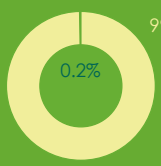
Currently, one electric bus accounts for 1.4% of the fleet, but a tender is planned for the electrification of 2 lines.



The plan is to incorporate a mix of depot charging and opportunity charging electric buses.

- Total average weekday driven veh-km (km)
  n.a.
- City topography
  flat
- Total yearly driven fleet-km (km)
  3.4 M
- Total yearly transported passengers
  15.1 M
- Average fleet age (years)
  9.1
- Average commercial speed (km/h)
  n.a.

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	66	71
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	4	4
Solo (12-15 m)	33	38
Articulated (≥18 m)	29	29
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	1	1
Diesel	65	70

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	1	-
Roof mounted pantograph	1	-

Photo by Manfred Helmer

Vienna

Austria

Wiener Linien

WIENER LINIEN
WIENER STADTWERKE GROUP

Stage of deployment

A fleet of 12 electric small buses have been running for almost 10 years, and fuel-cell hydrogen buses are currently being tested.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

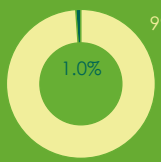
Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

Analysis and operations tests to determine the technology which best suits each route to go electric have been conducted. 75 zero-emission buses (mostly BEV, some FCHEV) will be incorporated in the fleet by 2025.

- Total average weekday driven veh-km (km)
  250
- City topography
  medium
- Total yearly driven fleet-km (km)
  21.7 M
- Total yearly transported passengers
  90.0 M
- Average fleet age (years)
  4.8
- Average commercial speed (km/h)
  18.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	469	423
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	12	12
Solo (12-15 m)	198	130
Articulated (≥18 m)	259	281
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	12	12
Diesel	280	411
Other: LPG	177	-

Charging & refuelling infrastructure

Charging technology	Depot	On route
Roof mounted pantograph	12	2

Photo by Johannes Zinner

Antwerp

Belgium

Bus De Polder nv

DE POLDER

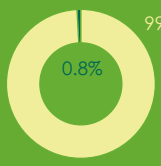
Stage of deployment

Currently there is one battery electric bus pilot: in 2022 we plan to deploy another 30 e-buses.

No more diesel buses will be incorporated in our public transport fleet.

- Total average weekday driven veh-km (km)
  140
- City topography
  flat
- Total yearly driven fleet-km (km)
  3.5 M
- Total yearly transported passengers
  n.a.
- Average fleet age (years)
  12.3
- Average commercial speed (km/h)
  20.2

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	57	57
Bus size	**Total number of vehicles**	
Solo (12-15 m)	53	53
Articulated (≥18 m)	4	4
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	1
Diesel	57	56

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	1	-

Brussels

Belgium

Société des Transports Intercommunaux de Bruxelles

Stage of deployment

Following a reduction of 43% on the diesel-only share, the current bus fleet counts 48% hybrid buses and 4.5% battery electric buses.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

Our fleet will be fully electric by the end of 2035. The next step is the acquisition of about 100 electric buses in 2024.

Current fleet data

Total bus fleet	2017	2021
	700	862
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	12	19
Solo (12-15 m)	527	524
Articulated (≥18 m)	161	319
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	37
Hybrids	-	402
Diesel	700	423

Total average weekday driven veh-km (km)
98

City topography
medium

Total yearly driven fleet-km (km)
31.0 M

Total yearly transported passengers
87.2 M

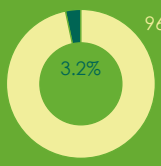
Average fleet age (years)
7.7

Average commercial speed (km/h)
15.8

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	36	-
Roof mounted pantograph	26	2

Clean over total number of driven kilometres, 2021



Share of clean buses

Tienen (Flemish Brabant)

Belgium

Multiobus

Stage of deployment

We launched our first e-bus in 2017. While some of the depots do not have e-buses yet, the main depot is a frontrunner in electrification with 60% e-buses.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

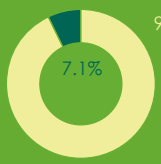
Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

Discussions are necessary for e-buses, for us to gain experience and know-how in this new technology. By 2022, more than 15% of our buses will operate with zero emissions. We believe there is no time to lose!

- Total average weekday driven veh-km (km)
  250
- City topography
  flat
- Total yearly driven fleet-km (km)
  7.0 M
- Total yearly transported passengers
  n.a.
- Average fleet age (years)
  7.0
- Average commercial speed (km/h)
  37.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	118	120
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	4	4
Solo (12-15 m)	86	88
Articulated (≥18 m)	25	25
Double decker bus	3	3
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	1	14
Hybrids	-	14
Diesel	117	92

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	12	-
Infrastructure mounted pantograph	1	-

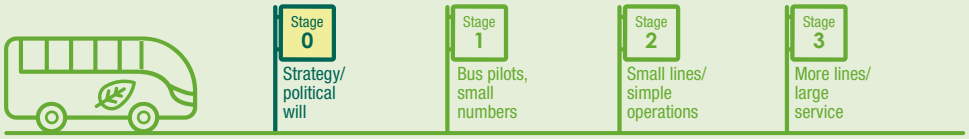
Wallonia

Belgium

Opérateur de Transport de Wallonie

Stage of deployment

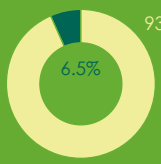
Currently the Plug-in Hybrid Electric Vehicles represent 6% of the total yearly driven km, and 3 new vehicles powered by bioethanol have been added to the fleet.



Several lines are fully operated by Plug-in Hybrid Electric Vehicle.

- Total average weekday driven veh-km (km)
  116
- City topography
  medium
- Total yearly driven fleet-km (km)
  72.8 M
- Total yearly transported passengers
  89.0 M*
- Average fleet age (years)
  8.0
- Average commercial speed (km/h)
  20.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	n.a.	1,720
Bus size		**Total number of vehicles**
Mini/ Midi (<12 m)	n.a.	54
Solo (12-15 m)	n.a.	1,281
Articulated (≥18 m)	n.a.	385
Vehicle propulsion type		**Total number of vehicles**
Battery Electric	n.a.	-
Plug-in Hybrid Electric	n.a.	97
Fuel Cell Hydrogen Electric	n.a.	-
Battery Trolley, In Motion Charging	n.a.	-
Trolley	n.a.	-
Natural Gas	n.a.	-
Hybrids	n.a.	501
Diesel	n.a.	1,119
Other: Bioethanol	n.a.	3

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	101	-
Infrastructure mounted pantograph	-	14

* Data for 2020, including other subcontracted services thus not consistent with the other information shown.

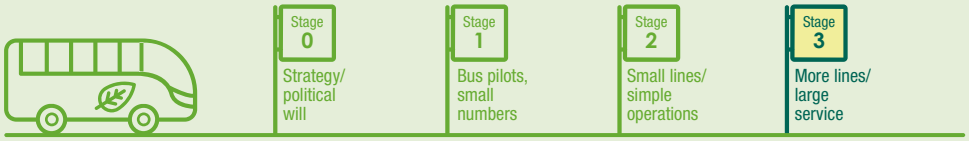
Ostrava

Czech Republic

Dopravní podnik Ostrava a.s.

Stage of deployment

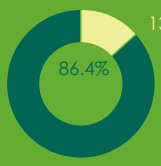
CNG buses are mainly used in daily operations, while battery electric and in-motion charging vehicles are also already running. Fuel-cell hydrogen buses are being tendered in early 2022.



The goal of clean buses accounting for an 80% of the fleet in 2021 was achieved. Next goal is to hit the 88% by the end of 2022.

- Total average weekday driven veh-km (km)
  155*
- City topography
  medium
- Total yearly driven fleet-km (km)
  16.5 M
- Total yearly transported passengers
  n.a.
- Average fleet age (years)
  5.7
- Average commercial speed (km/h)
  18.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	286	292
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	30	27
Solo (12-15 m)	234	201
Articulated (≥18 m)	22	62
Double decker bus	-	2
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	4	6
Battery Trolley, In Motion Charging	-	2
Natural Gas	105	227
Diesel	177	57

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	21	-
Infrastructure mounted pantograph	-	1
Natural gas	2	1

* UITP estimate based on provided data.

Pilsen

Czech Republic

Plzenske mestske dopravni podniky

Plzeňské městské dopravní podniky PMDP

Stage of deployment

Three of the nine trolleybus lines are operated using in-motion-charging along with conventional trolleybuses. The longest route traveled on battery-power is 12 kilometers.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

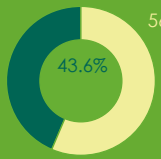
Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

We are preparing the electrification of bus lines to the largest state housing area in the city, aligned with our goal of electrifying the main bus lines using battery trolleybuses with in-motion-charging.

- Total average weekday driven veh-km (km) **193**
- City topography **medium**
- Total yearly driven fleet-km (km) **9.0 M**
- Total yearly transported passengers **66.4 M**
- Average fleet age (years) **6.9**
- Average commercial speed (km/h) **26.3**

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	221	216
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	4	3
Solo (12-15 m)	163	133
Articulated (≥18 m)	54	80
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	1	-
Battery Trolley, In Motion Charging	16	38
Trolley	83	62
Diesel	121	116

Prague

Czech Republic

Dopravní podnik hl. m. Prahy

Dopravní podnik hlavního města Prahy

Stage of deployment

Regular operation of the first e-bus fleet started in Feb 2022. The first IMC trolleybus line will be launched by the end of 2022. Two tenders for new vehicles (14 bipolar e-buses and 15 e-trolleys) are finalised. A third tender for 20 double-articulated e-trolleys in underway. The charging infrastructure for 14 bipolar e-buses is ready.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

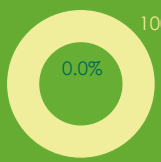
Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

Prague's Climatic Plan targets 50% zero emission buses by 2030, along with 25% diesel and 25% for other cleaner technologies like hybrids or biofuel. After thoroughly testing various technologies, 2022 will see great leaps forward towards a clean bus fleet.

- Total average weekday driven veh-km (km)
  166**
- City topography
  flat
- Total yearly driven fleet-km (km)
  62.3 M
- Total yearly transported passengers
  362.7 M*
- Average fleet age (years)
  6.1
- Average commercial speed (km/h)
  16.8

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	1169	1204
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	65	101
Solo (12-15 m)	622	599
Articulated (≥18 m)	482	504
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	1	1
Battery Trolley, In Motion Charging	1	-
Trolley	-	1
Diesel	1167	1202

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	2	-
Roof mounted pantograph	-	2

* Data for 2020.
**UITP estimate based on provided data.

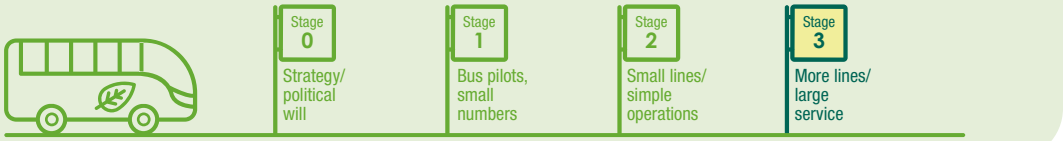
Zealand

Denmark

Movia Public Transport

Stage of deployment

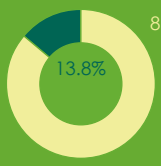
We tender out zero emission bus operation in very large scale. 80 to 100% of buses in the new contracts are zero-emission buses.



Movia has together with its owners (municipalies and regions on Zealand and Islands) set out the target that by 2030, all bus services are fossil-free and minimum 50% of the fleet is zero emission. We expect to perform significantly better in terms of zero emission.

- Total average weekday driven veh-km (km)
  254*
- City topography
  flat
- Total yearly driven fleet-km (km)
  115.0 M
- Total yearly transported passengers
  190.0 M
- Average fleet age (years)
  8.4
- Average commercial speed (km/h)
  27.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	1,392	1,376
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	132	113
Solo (12-15 m)	1,219	1,201
Articulated (≥18 m)	41	62
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	2	160
Natural Gas	44	44
Hybrids	2	10
Diesel	1,344	1,162

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	145	-
Infrastructure mounted pantograph	-	4
Natural gas	41	-

* UITP estimate based on provided data.

Tallinn

Estonia

Aktsiaselts Tallinna Linnatransport

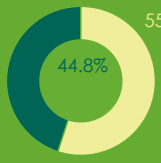
Stage of deployment

In 2022, TLT is procuring its first 15 electric buses, which will be in operation in summer 2023. TLT's strategy sees diesel buses being replaced by environmentally friendly buses by 2025, mainly by CNG buses and at least 15 electric buses.

The City of Tallinn is currently working on the development of urban transport models and, in cooperation with TLT, analysing in-motion charging trolleybuses. Other technologies are in study to shape the future strategy.

- Total average weekday driven veh-km (km)
  232
- City topography
  flat
- Total yearly driven fleet-km (km)
  34.2 M
- Total yearly transported passengers
  62.1 M
- Average fleet age (years)
  6.9
- Average commercial speed (km/h)
  17.2

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	534	616
Bus size	**Total number of vehicles**	
Solo (12-15 m)	335	382
Articulated (≥18 m)	199	234
Vehicle propulsion type	**Total number of vehicles**	
Trolley	58	47
Natural Gas	-	224
Hybrids	44	44
Diesel	432	301

Charging & refuelling infrastructure

Charging technology	Depot	On route
Natural gas	320	-

Urban community of La Rochelle

France

Communauté d'agglomération de La Rochelle

Stage of deployment

Clean vehicles already in operation for some years (electric, CNG): one line is 100% electric, another one 50%. We have 12 CNG buses in operation.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

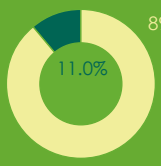
Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

We aim to have a 100% clean fleet in 2030 with two or three lines of e-buses and mainly CNG. The option of fuel cell hydrogen buses are also being evaluated.

- Total average weekday driven veh-km (km) **n.a.**
- City topography **medium**
- Total yearly driven fleet-km (km) **5.3 M**
- Total yearly transported passengers **9.7 M**
- Average fleet age (years) **9.2**
- Average commercial speed (km/h) **n.a.**

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	154	166
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	14	16
Solo (12-15 m)	113	119
Articulated (≥18 m)	27	31
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	8
Natural Gas	-	12
Hybrids	3	7
Diesel	151	138
Other: Bioethanol	-	1

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	7	-
Ground-based	7	-
Natural gas	0*	-

* Natural gas buses are refueled at a public gas refuelling station.

Nantes

France

Société d'économie mixte des transports en commun de l'agglomération nantaise

Stage of deployment

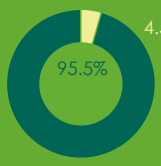
Our main BRT line, Busway, is operated by full electric bi-articulated buses. However, the backbone of the fleet are CNG vehicles, which represent 90% of the total fleet, being most of them articulated.

- Stage 0: Strategy/ political will
- Stage 1: Bus pilots, small numbers
- Stage 2: Small lines/ simple operations
- Stage 3: More lines/ large service

Our commitment is to pursue the procuring of 50% electric buses beyond 2025.

- Total average weekday driven veh-km (km) **144**
- City topography **flat**
- Total yearly driven fleet-km (km) **15.8 M**
- Total yearly transported passengers **38.0 M**
- Average fleet age (years) **10.4**
- Average commercial speed (km/h) **19.0**

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	419	437
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	32	32
Solo (12-15 m)	195	141
Articulated (≥18 m)	192	264
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	22
Natural Gas	333	390
Hybrids	6	6
Diesel	80	19

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	2	10
Roof mounted pantograph	-	22
Natural gas	350	-

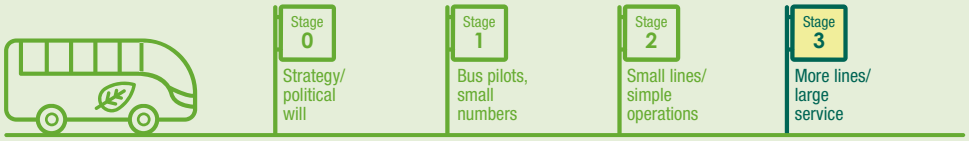
Paris

France

Régie Autonome des Transports Parisiens

Stage of deployment

Currently, clean buses account for 20.8% of the fleet.



> ***Our global long term goal is to achieve 50% of the fleet being electric and 50% of it running on bio-CNG.***

- Total average weekday driven veh-km (km)
  133*
- City topography
  flat, medium
- Total yearly driven fleet-km (km)
  170.0 M
- Total yearly transported passengers
  750.0 M
- Average fleet age (years)
  8.0
- Average commercial speed (km/h)
  17.0

Share of clean buses

2017
n.a.

2021
20.8%

Current fleet data

Total bus fleet	2017	2021
	n.a.	4,800
Bus size		**Total number of vehicles**
Mini/ Midi (<12 m)	n.a.	150
Solo (12-15 m)	n.a.	4,050
Articulated (≥18 m)	n.a.	600
Vehicle propulsion type		**Total number of vehicles**
Battery Electric	n.a.	400
Natural Gas	n.a.	600
Hybrids	n.a.	1,100
Diesel	n.a.	2,700

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	400	-
Roof mounted pantograph	-	-
Infrastructure mounted pantograph	1	-
Natural gas	600	-

* UITP estimate based on provided data.

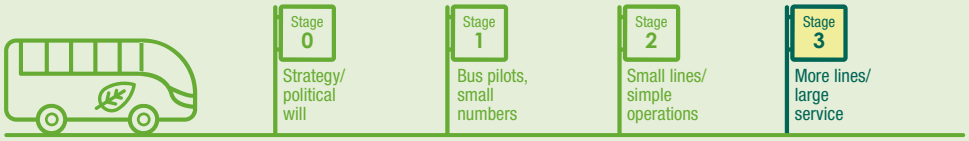
Pau

France

Syndicat Mixte Pau Bearn Pyrenees Mobilites

Stage of deployment

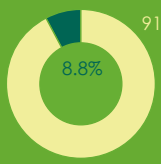
Fébus was the first fuel cell hydrorgen bus 18m lenght model. Eight of these are operating since late 2019 on a successful BRT line, and four additional fuel cell hydrogen buses funded in the frame of the JIVE2 project will be added to the fleet in 2022.



The plan is to purchase clean buses at a rate of 7 buses per year, while bus retrofit is also regarded as a solution. Currently, new Chronobus (BRT) zero-emission lines are being taken into consideration.

- Total average weekday driven veh-km (km)
  212
- City topography
  flat
- Total yearly driven fleet-km (km)
  4.7 M
- Total yearly transported passengers
  7.7 M
- Average fleet age (years)
  9.6
- Average commercial speed (km/h)
  21.5

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	96	106
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	14	8
Solo (12-15 m)	82	88
Articulated (≥18 m)	-	10
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	4	4
Fuel Cell Hydrogen Electric	-	8
Hybrids	-	10
Diesel	92	84

Charging & refuelling infrastructure

Charging technology	Depot	On route
Fuel cell hydrogen	-	8*

* Green hydrogen is refueled overnight.

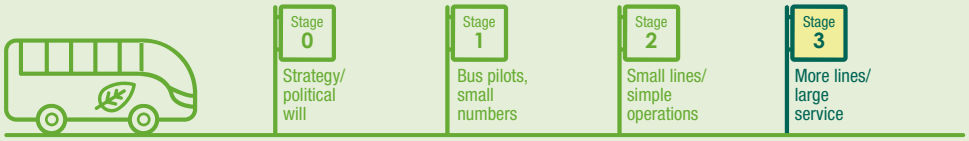
Strasbourg

France

Compagnie des Transports Strasbourgeois

Stage of deployment

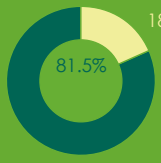
Two full electric lines are in operation with 49 standard size buses since 2021, while the main service is covered by CNG buses. All new 12m buses have been replaced by electric buses since 2020 (49 buses for 2 lines in 2021).



Between 2020 and 2025, CTS strategy is to replace 52 (12m) buses with electric buses, and 35 (18m) buses with CNG buses. After 2025, we will continue renewing our fleet only with zero-emission technologies!

- Total average weekday driven veh-km (km)
  124
- City topography
  flat
- Total yearly driven fleet-km (km)
  9.5 M
- Total yearly transported passengers
  108.6 M
- Average fleet age (years)
  7.9
- Average commercial speed (km/h)
  15.8

Clean over total number of driven kilometres, 2021



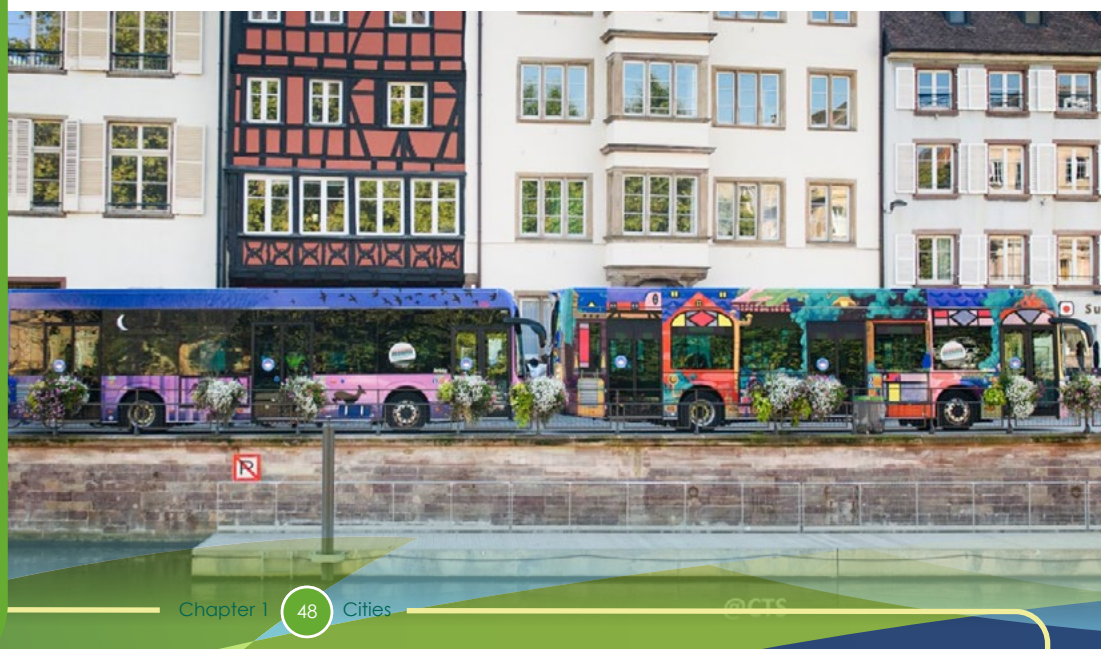
Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	236	234
Bus size	**Total number of vehicles**	
Solo (12-15 m)	137	138
Articulated (≥18 m)	99	96
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	49
Natural Gas	155	158
Hybrids	1	1
Diesel	80	26

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	64	-
Ground-based	1	-
Natural gas	3	-



Toulon

France

Réseau Mistral

réseaumistral

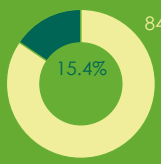
Stage of deployment

A new depot equipped for biogas and battery bus technlogies is on the way. Despite the challenging city topography, 12 electric buses will be delivered soon. An ongoing hydrogen project strive for the introduction of fuel cell hydrogen buses to the fleet.

Our goal is to achieve a share of 50% of clean buses in our fleet by the end of 2025.

- Total average weekday driven veh-km (km)
  89
- City topography
  hilly
- Total yearly driven fleet-km (km)
  12.3 M
- Total yearly transported passengers
  26.6 M
- Average fleet age (years)
  7.4
- Average commercial speed (km/h)
  17.1

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	286	342
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	46	57
Solo (12-15 m)	219	230
Articulated (≥18 m)	21	55
Vehicle propulsion type	**Total number of vehicles**	
Natural Gas	-	50
Hybrids	27	84
Diesel	259	208

Charging & refuelling infrastructure

Charging technology	Depot	On route
Natural gas	50	-

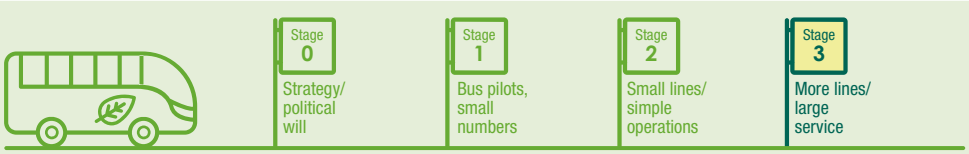
Augsburg

Germany

Stadtwerke Augsburg Verkehrs GmbH

Stage of deployment

Currently, 100% of the fleet run on bio-gas, with a mature deployment of clean bus technologies.



The next step in clean bus deployment is to implement an emission-free drivetrain strategy.

- Total average weekday driven veh-km (km)
  192
- City topography
  flat
- Total yearly driven fleet-km (km)
  5.0 M
- Total yearly transported passengers
  11.9 M
- Average fleet age (years)
  7.0
- Average commercial speed (km/h)
  18.0

Clean over total number of driven kilometres, 2021

Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	85	85
Bus size	**Total number of vehicles**	
Solo (12-15 m)	18	18
Articulated (≥18 m)	67	67
Vehicle propulsion type	**Total number of vehicles**	
Natural Gas	85	71
Hybrids	-	14*

Charging & refuelling infrastructure

Charging technology	Depot	On route
Natural gas	4	-

* CNG hybrids.

Berlin

Germany

Berliner Verkehrsbetriebe

BVG

Stage of deployment

During the ramp-up phase until 2022, insights were gained with the operation of 210 depot charging solo buses and 17 opportunity charging articulated buses and its infrastructure.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

BVG has the biggest bus fleet in Germany. By 2030, BVG will convert this fleet to fully electric – approximately 1,650 – 1,800 buses.An ambitious plan that has started with a ramp-up phase till 2022.

Total average weekday driven veh-km (km)
180

City topography
flat

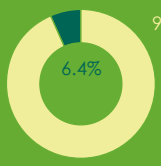
Total yearly driven fleet-km (km)
102.9 M

Total yearly transported passengers
307.0 M

Average fleet age (years)
3.9

Average commercial speed (km/h)
19.1

Clean over total number of driven kilometres, 2021



Share of clean buses

2017
0%

2021
8.9%

Current fleet data

Total bus fleet	2017	2021
	1,386	1,549
Bus size	**Total number of vehicles**	
Solo (12-15 m)	411	457
Articulated (≥18 m)	560	939
Double decker bus	415	153
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	138
Diesel	1386	1411

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	119	-
Infrastructure mounted pantograph	1	4

Cologne area

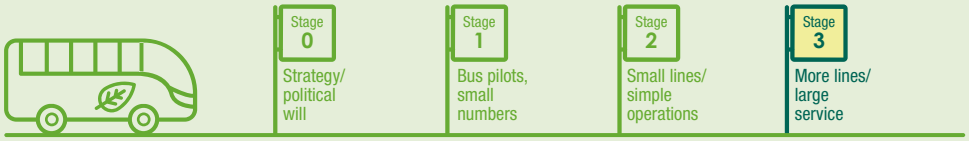
Germany

Regionalverkehr Köln GmbH

Regionalverkehr Köln GmbH

Stage of deployment

At the end of 2021, 38 fuel-cell hydrogen buses and 62 CNG buses were in regular service. In 2022, a further 14 FCHEV will start regular operation in RVK's transport area.



RVK's goal is to convert a large part of the bus service into emission-free and only procure emission-free vehicles by 2030.

Current fleet data

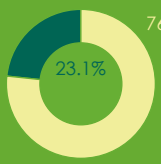
Total bus fleet	2017	2021
	317	377
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	19	28
Solo (12-15 m)	237	293
Articulated (≥18 m)	61	56
Vehicle propulsion type	**Total number of vehicles**	
Fuel Cell Hydrogen Electric	2	38
Natural Gas	3	62
Diesel	312	277

Charging & refuelling infrastructure

Charging technology	Depot	On route
Fuel cell hydrogen	2	3
Natural gas	1	1

- Total average weekday driven veh-km (km)
  230
- City topography
  medium, hilly
- Total yearly driven fleet-km (km)
  12.6 M
- Total yearly transported passengers
  23.0 M
- Average fleet age (years)
  8.3
- Average commercial speed (km/h)
  n.a.

Clean over total number of driven kilometres, 2021



Share of clean buses

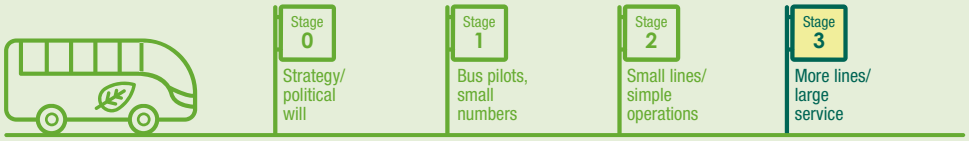
Cologne

Germany

Kölner Verkehrs-Betriebe AG

Stage of deployment

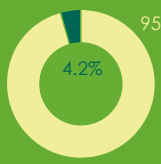
Since 2016, progressive electrification of bus routes reached a total of 8 full-electric lines in 2021, and additional 6 will be electrified with soon-to-be commissioned 51 new battery electric buses.



KVB´s goal is to have an emission-free bus fleet by 2030. With the end of this decade all diesel buses will be substituted by e-buses. In 2023 we will have 118 battery buses in service.

- Total average weekday driven veh-km (km)
  134
- City topography
  flat
- Total yearly driven fleet-km (km)
  15.2 M
- Total yearly transported passengers
  40.2 M
- Average fleet age (years)
  5.4
- Average commercial speed (km/h)
  19.3

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	230	312
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	-	12
Solo (12-15 m)	77	76
Articulated (≥18 m)	153	224
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	8	44
Plug-in Hybrid Electric	-	12
Hybrids	2	2
Diesel	220	254

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	9	-
Roof mounted pantograph	53	15

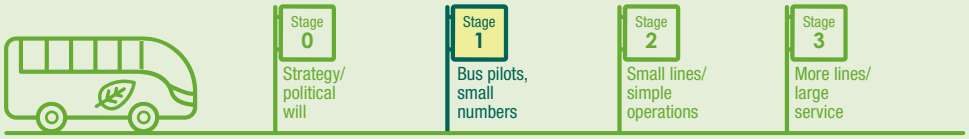
Dresden

Germany

Dresdner Verkehrsbetriebe AG

Stage of deployment

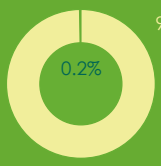
The first electric bus is running now in Dresden, being the first clean bus to be incorporated to the fleet.



DVB aims to reach climate neutrality until 2040, and will stick to the Clean Vehicles Directive in place in Germany since August 2021.

- Total average weekday driven veh-km (km)
  300-500
- City topography
  flat, hilly
- Total yearly driven fleet-km (km)
  13.6 M
- Total yearly transported passengers
  116.7 M*
- Average fleet age (years)
  8.2
- Average commercial speed (km/h)
  20.2

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	141	156
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	1	1
Solo (12-15 m)	15	15
Articulated (≥18 m)	125	140
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	1	1
Hybrids	17	17
Diesel	123	138

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	1	-
Roof mounted pantograph	-	1

* 2020 data including trams.

Düsseldorf

Germany

Rheinbahn AG

Rheinbahn
Einfach. Immer. Da.

Stage of deployment

In the near future, two lines will operate in electric mode with 10 battery electric buses and 10 fuel-cell hydrogen buses, and 52 zero-emissions buses are expected to be in operation by 2025.

Stage 0 — Strategy/ political will

Stage 1 — Bus pilots, small numbers

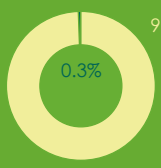
Stage 2 — Small lines/ simple operations

Stage 3 — More lines/ large service

Rheinbahn wants to switch their whole bus fleet to zero-emission to reach the goal of climate neutrality by 2035.

- Total average weekday driven veh-km (km)
  255*
- City topography
  flat
- Total yearly driven fleet-km (km)
  28.3 M
- Total yearly transported passengers
  188.3 M**
- Average fleet age (years)
  5.3
- Average commercial speed (km/h)
  25.2

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	428	475
Bus size	**Total number of vehicles**	
Solo (12-15 m)	231	255
Articulated (≥18 m)	197	220
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	2	4
Hybrids	7	6
Diesel	419	465

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	12	-

* UITP estimate based on provided data.
** Data for 2020.

Frankfurt am Main

Germany

traffiQ Lokale Nahverkehrsgesellschaft Frankfurt am Main mbH

Stage of deployment

Six lines are currently operated by battery e-buses: these lines allow a full day operation without recharging during the day. From summer 2022, longer, more complex lines will be served by fuel cell buses.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

The electrification concept of Frankfurt/Main proposes the complete bus fleet transformation using BEV and FCHEV. The next big step is the planning, building or transformation of the bus depots of the next generation.

- Total average weekday driven veh-km (km)
  n.a.
- City topography
  flat
- Total yearly driven fleet-km (km)
  20.1 M
- Total yearly transported passengers
  33.4 M
- Average fleet age (years)
  5.1
- Average commercial speed (km/h)
  17.6

Share of clean buses

2017
0%

2021
10.1%

Current fleet data

Total bus fleet	2017	2021
	378	405
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	43	57
Solo (12-15 m)	258	234
Articulated (≥18 m)	77	114
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	41
Hybrids	1	1
Diesel	377	363

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	34	-

Frankfurt-Höchst

Germany

Omnibusbetrieb Winzenhöler GmbH & Co. KG

WINZENHÖLER

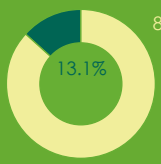
Stage of deployment

Up to 5 lines operate currently with zero emission vehicles. A tender for additional fuel-cell hydrogen electric buses is planned for the near future.

To preserve full operation flexibility, fuel cell has been identified as key technology to achieve long ranges, short refuelling time and best service quality to passengers. Our goal: to increase the current fleet step by step up to full fleet renewal.

- Total average weekday driven veh-km (km)
  240
- City topography
  flat
- Total yearly driven fleet-km (km)
  2.2 M
- Total yearly transported passengers
  n.a.
- Average fleet age (years)
  n.a.
- Average commercial speed (km/h)
  12.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	40	43
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	2	2
Solo (12-15 m)	27	29
Articulated (≥18 m)	11	12
Vehicle propulsion type	**Total number of vehicles**	
Fuel Cell Hydrogen Electric	2	5
Diesel	38	38

Charging & refuelling infrastructure

Charging technology	Depot	On route
Fuel cell hydrogen	-	1

Hamburg

Germany

Hamburger Hochbahn AG

HOCHBAHN

Stage of deployment

Our fleet has around 100 electric buses in service. Today, the focus is on e-buses as a reliable technology, and at the stage of series production, with depot charging as main approach.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

We're moving ahead step by step with eyes wide open, as the market and technology are rapidly evolving! Our goal is to operate a climate- neutral fleet by 2030: sustainability and responsibility for our society's future are important principles we live by.

Total average weekday driven veh-km (km)
220-230

City topography
flat

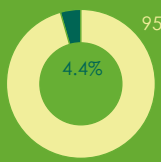
Total yearly driven fleet-km (km)
63.6 M

Total yearly transported passengers
163.4 M*

Average fleet age (years)
6.1

Average commercial speed (km/h)
18.4

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	914	1,100
Bus size	**Total number of vehicles**	
Solo (12-15 m)	595	681
Articulated (≥18 m)	319	419
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	3	99
Plug-in Hybrid Electric	3	3
Fuel Cell Hydrogen Electric	6	2
Hybrids	27	32
Diesel	875	964

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	183	-
Infrastructure mounted pantograph	-	4
Fuel cell hydrogen	2	-

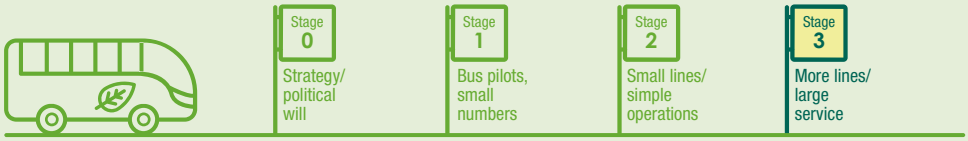
* Data for 2020.

Leipzig
Germany
Leipziger Verkehrsbetriebe GmbH

Leipziger Verkehrsbetriebe

Stage of deployment

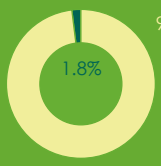
Battery electric buses add up to 21, driving operations and charging tests into regular service. Seventeen additional battery-electric buses are expected to be commissioned within the third quarter of 2022.



Relying on technical developments, an expansion of the electric bus fleet is foreseen with a feasibility study of fuel cell buses.

- Total average weekday driven veh-km (km)
  206*
- City topography
  flat
- Total yearly driven fleet-km (km)
  12.1 M
- Total yearly transported passengers
  21.4 M
- Average fleet age (years)
  5.2
- Average commercial speed (km/h)
  21.7

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	158	194
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	7	7
Solo (12-15 m)	76	77
Articulated (≥18 m)	75	110
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	1	22
Hybrids	18	18
Diesel	139	154

Charging & refuelling infrastructure

Charging technology	Depot	On route
Roof mounted pantograph	21	5

* UITP estimate based on provided data.

Münster

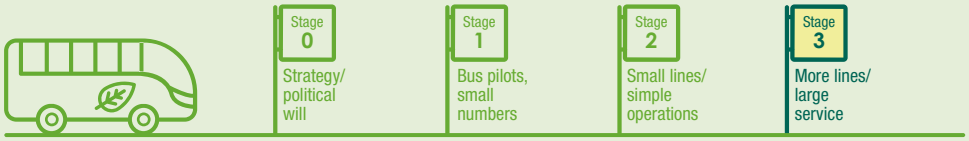
Germany

Stadtwerke Münster

Stadtwerke Münster

Stage of deployment

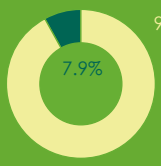
We can count on a fully-incorporated clean bus strategy and further growth is planned, with new buses and ultra-fast-chargers at terminus stops coming each year. In 2021, e-buses saved over 1,000 tonnes of CO_2 emissions, with a potential of 12,000 tonnes after complete transition to e-buses.



As a first-mover, we rolled out electric buses in 2015 and plan to retire the last diesel bus before 2030. Each year, new buses and routes are introduced, provided that state or EU funding for additional cost remains available.

- Total average weekday driven veh-km (km)
  205
- City topography
  flat
- Total yearly driven fleet-km (km)
  9.0 M
- Total yearly transported passengers
  38.0 M
- Average fleet age (years)
  6.5
- Average commercial speed (km/h)
  18.6

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	202	203
Bus size	**Total number of vehicles**	
Solo (12-15 m)	63	59
Articulated (≥18 m)	139	144
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	5	28
Fuel Cell Hydrogen Electric	-	1
Hybrids	2	-
Diesel	195	174

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	5	-
Roof mounted pantograph	38	6
Fuel cell hydrogen	0*	-

* Hydrogen buses are refueled at a public hydrogen refuelling station.

Nürnberg

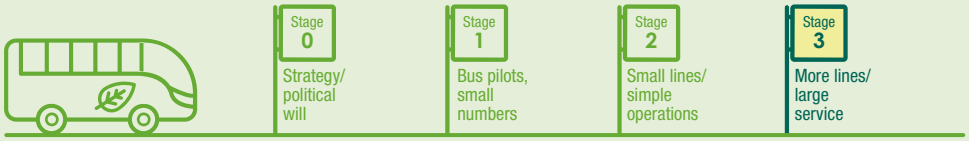
Germany

Verkehrs-Aktiengesellschaft

VAG

Stage of deployment

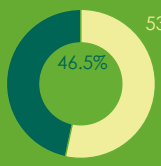
VAG started operating the first e-bus in 2018 and deployed an additional six in 2020. In the future, we will substitute every conventional bus that gets sorted out due to age, with an e-bus. Introduced at the end of 2021, 46 battery buses account for 21% of VAG's bus fleet. Additional 46 are expected by mid-2023.



Our main goal is to replace the complete bus fleet, which comprises about 200 Diesel- and CNG-buses, by zero emission battery e-buses. VAG will have a 100% electric fleet at the end of the 2020s.

- Total average weekday driven veh-km (km)
  200*
- City topography
  flat
- Total yearly driven fleet-km (km)
  11.5 M
- Total yearly transported passengers
  37.0 M
- Average fleet age (years)
  12.0
- Average commercial speed (km/h)
  18.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	180	215
Bus size	**Total number of vehicles**	
Solo (12-15 m)	94	108
Articulated (≥18 m)	86	107
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	46
Natural Gas	92	61
Hybrids	2	2
Diesel	86	106

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	46	-
Natural gas	1	-

* UITP estimate based on provided data.

Osnabrück

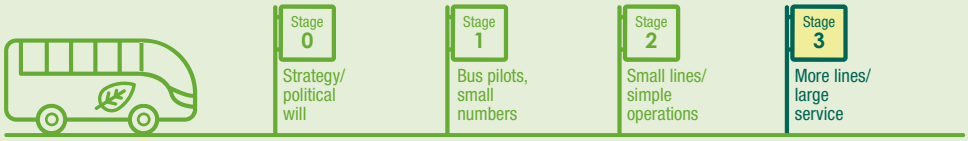
Germany

Stadtwerke Osnabrück AG

Stadtwerke Osnabrück

Stage of deployment

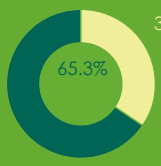
With a solid experience operating e-buses, a big leap has been made since 2017, reaching 65.3% of driven km relying on zero-emission buses.



Our goal is to make Osnabruck greener and more sustainable. For our customers as well as for the people of Osnabruck. Since 2019, we only purchase electric buses, so that by the end of this decade our fleet will be fully electric.

- Total average weekday driven veh-km (km)
  300
- City topography
  medium
- Total yearly driven fleet-km (km)
  6.7 M
- Total yearly transported passengers
  20.0 M
- Average fleet age (years)
  9.3
- Average commercial speed (km/h)
  17.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	94	95
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	3	-
Solo (12-15 m)	37	18
Articulated (≥18 m)	54	77
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	1	62
Diesel	93	33

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	2	-
Roof mounted pantograph	64	17

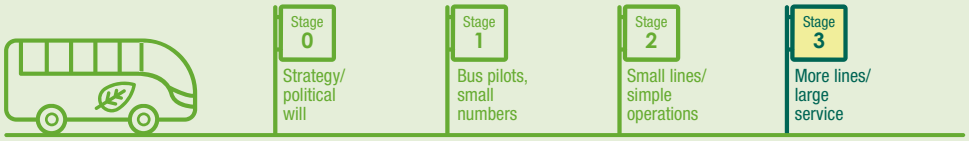
Wiesbaden

Germany

ESWE Verkehrsgesellschaft mbH

Stage of deployment

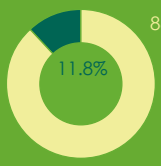
Clean buses represent nearly 10% of the yearly driven km. 120 new battery-electric and 10 fuell-cell hydrogen buses will soon join the fleet.



The strategic goal of ESWE Verkehr is the complete transition of the vehicle fleet to zero-emission public transport. This includes the entire bus fleet as well as all auxiliary vehicles.

- Total average weekday driven veh-km (km)
  n.a.
- City topography
  medium
- Total yearly driven fleet-km (km)
  14.5 M
- Total yearly transported passengers
  40.4 M*
- Average fleet age (years)
  6.0**
- Average commercial speed (km/h)
  18.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	253	326
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	-	3
Solo (12-15 m)	138	180
Articulated (≥18 m)	115	143
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	64
Fuel Cell Hydrogen Electric	-	10
Diesel	253	252

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	56	-
Fuel cell hydrogen	1	-

* Data for 2020.
** Data for 2019.

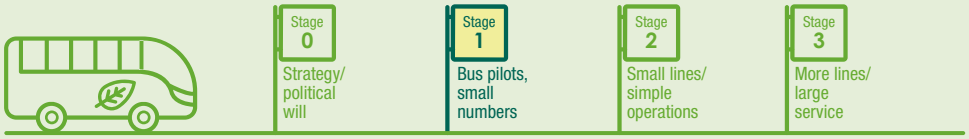
Rethymno

Greece

Municipality of Rethymno

Stage of deployment

An electric mini-bus has been operating as pilot in Rethymno city since 2019. Plans to add 2 more electric buses to operate a municipal public transport are set for 2022.



There is strong political commitment to operate clean buses in Rethymno.

Current fleet data

Total bus fleet	2017	2021
	-	1
Bus size		**Total number of vehicles**
Mini/ Midi (<12 m)	-	1
Vehicle propulsion type		**Total number of vehicles**
Battery Electric	-	1

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	1	3

* Data for 2020.

- Total average weekday driven veh-km (km)
  43
- City topography
  flat
- Total yearly driven fleet-km (km)
  0.2 M
- Total yearly transported passengers
  4,139 *
- Average fleet age (years)
  n.a.
- Average commercial speed (km/h)
  30.0

Clean over total number of driven kilometres, 2021

0.0% Clean bus

Rest of the fleet

Share of clean buses

2017 0%

2021 100%

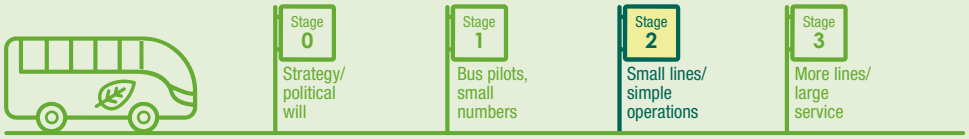
Budapest

Hungary

Budapesti Közlekedési Központ

Stage of deployment

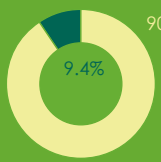
Decades experience in operating a trolleybus network.
A small fleet of battery electric vehicles has been piloted so far.



Our fleet renewal strategy including a transition towards clean buses is yet to be completed and approved, with a potential in expanding the electric trolley bus network and other technologies being in evaluation.

- Total average weekday driven veh-km (km)
  155
- City topography
  medium
- Total yearly driven fleet-km (km)
  86.5 M
- Total yearly transported passengers
  458.0 M
- Average fleet age (years)
  12.0
- Average commercial speed (km/h)
  14.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	1,550	1,553
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	57	67
Solo (12-15 m)	783	774
Articulated (≥18 m)	710	712
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	20	19
Battery Trolley, In Motion Charging	36	60
Trolley	102	85
Natural Gas	71	53
Hybrids	-	29
Diesel	1,321	1,307

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	18	-
Natural gas	4	-

Debrecen

Hungary

Debreceni Közlekedési Zrt.

Stage of deployment

The entire DKV bus fleet shall be gradually replaced by the end of 2024.
In total 119 Euro 6d buses will replace the Euro 5 buses and 12 new e-buses will be added to the current fleet in the first half of 2022.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

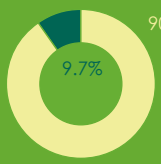
DKV has a target of having 50% of the yearly kms being electric until 2030 (including trams and trolleybuses), 100% electric until 2050.

Current fleet data

Total bus fleet	2017	2021
	148	157
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	-	2
Solo (12-15 m)	106	106
Articulated (≥18 m)	42	49
Vehicle propulsion type	**Total number of vehicles**	
Trolley	23	23
Diesel	125	134

- Total average weekday driven veh-km (km)
  210
- City topography
  flat
- Total yearly driven fleet-km (km)
  8.8 M
- Total yearly transported passengers
  47.5 M
- Average fleet age (years)
  12.0
- Average commercial speed (km/h)
  18.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Reykjavik

Iceland

Strætó

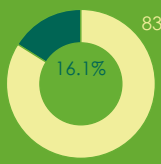
Stage of deployment

Already 12% of the fleet uses clean bus technologies, while plans are set to tender out 10 additional clean buses in 2022, 60 in 2024 and 30 in 2026.

Our goal is to be emissions-free by 2030 the latest!

- Total average weekday driven veh-km (km)
  178*
- City topography
  medium
- Total yearly driven fleet-km (km)
  10.1 M
- Total yearly transported passengers
  9.5 M
- Average fleet age (years)
  n.a.
- Average commercial speed (km/h)
  25.3

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	150	160
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	3	5
Solo (12-15 m)	145	153
Articulated (≥18 m)	2	2
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	15
Natural Gas	2	5
Diesel	148	140

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	-	12
Natural gas	0**	-

* UITP estimate based on provided data.
** Natural gas buses are refueled at a public gas refuelling station.

Brescia

Italy

Brescia Trasporti S.p.A.

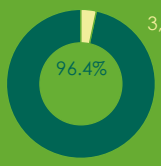
Stage of deployment

The fleet is composed of 90% CNG buses, and it includes also some CNG/electric hybrid vehicles. In the future, the fleet will be made of biomethane, fuel cell hydrogen and battery buses, adopting a test and evaluate approach.

We always believed in the potential of clean buses as we started our conversion to CNG since the early 90s. Today, our service is fully operated by CNG buses, and we have also built an in-house CNG compression and supply system.

- Total average weekday driven veh-km (km)
  110*
- City topography
  flat
- Total yearly driven fleet-km (km)
  8.0 M
- Total yearly transported passengers
  22.6 M
- Average fleet age (years)
  10.62
- Average commercial speed (km/h)
  18.7

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	196	198
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	23	24
Solo (12-15 m)	146	149
Articulated (≥18 m)	27	25
Vehicle propulsion type	**Total number of vehicles**	
Natural Gas	153	180
Hybrids	6	6
Diesel	37	12

Charging & refuelling infrastructure

Charging technology	Depot	On route
Natural gas	2	-

* UITP estimate based on provided data.

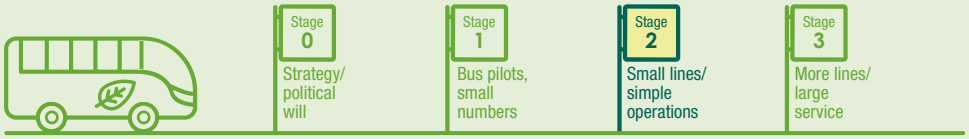
Cagliari

Italy

Consorzio Trasporti e Mobilità S.p.A.

Stage of deployment

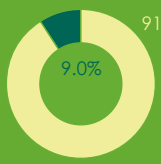
Six ZeEUS battery-trolleys with IMC technology have been in service on line 5 since 2016. Three e-buses are in service on the Line 10 and Line 11 since spring 2021.



CTM plans to renew its entire fleet by 2030 only with clean vehicles based on the following technologies: battery electric, IMC trolleybuses, and fuel cell hydrogen. We expect to achieve the interim goal of about 80% clean vehicles by 2026.

- Total average weekday driven veh-km (km)
  250
- City topography
  medium
- Total yearly driven fleet-km (km)
  13.7 M
- Total yearly transported passengers
  33.3 M
- Average fleet age (years)
  11.5
- Average commercial speed (km/h)
  16.3

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	271	279
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	80	80
Solo (12-15 m)	178	184
Articulated (≥18 m)	13	15
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	3
Battery Trolley, In Motion Charging	6	6
Trolley	26	26
Diesel	239	244

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	3	-

Cesena

Italy

START Romagna S.p.A.

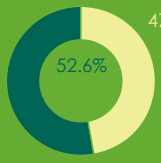
Stage of deployment

The current bus fleet is composed of 50% CNG and 50% diesel buses.

Our plan is to introduce electric vehicles in 2023 and in 2024 reaching up to 15% of the fleet.

- Total average weekday driven veh-km (km)
  106*
- City topography
  flat
- Total yearly driven fleet-km (km)
  3.5 M
- Total yearly transported passengers
  4.5 M
- Average fleet age (years)
  11.5
- Average commercial speed (km/h)
  19.9

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	72	74
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	33	33
Solo (12-15 m)	39	41
Vehicle propulsion type	**Total number of vehicles**	
Natural Gas	33	38
Diesel	39	36

* UITP estimate based on provided data.

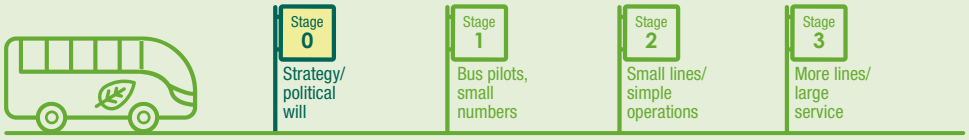
Desenzano del Garda

Italy

Brescia Trasporti S.p.A.

Stage of deployment

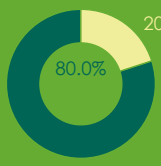
Desenzano del Garda's strategy aligns with the company goals. We aim to introduce PHEV / FCHEV and BEV buses according to the infrastructural costs and technological constraints.



Desenzano is a minor service area. However, we operate 80% of yearly driven km with CNG buses for the ordinary service supply.

- Total average weekday driven veh-km (km)
  117*
- City topography
  medium
- Total yearly driven fleet-km (km)
  0.4 M
- Total yearly transported passengers
  0.2 M
- Average fleet age (years)
  9.8
- Average commercial speed (km/h)
  22.1

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	9	9
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	-	3
Solo (12-15 m)	9	6
Vehicle propulsion type	**Total number of vehicles**	
Natural Gas	4	4
Diesel	5	5

Charging & refuelling infrastructure

Charging technology	Depot	On route
Natural gas	0**	-

* UITP estimate based on provided data.
**Natural gas buses are refueled at a public gas refuelling station.

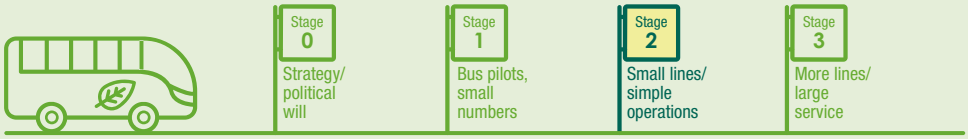
Forlì

Italy

START Romagna S.p.A.

Stage of deployment

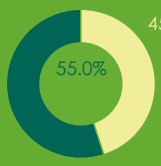
More than 50% of the current yearly fleet-km are operated by CNG vehicles.



> ***Our plan is to introduce electric vehicles in 2023 and in 2024 reaching up to 15% of the fleet.***

- Total average weekday driven veh-km (km)
  129*
- City topography
  flat
- Total yearly driven fleet-km (km)
  3.5 M
- Total yearly transported passengers
  4.5 M
- Average fleet age (years)
  11.5
- Average commercial speed (km/h)
  19.9

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	82	81
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	35	34
Solo (12-15 m)	47	47
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	4	-
Natural Gas	25	38
Diesel	53	43

* UITP estimate based on provided data.

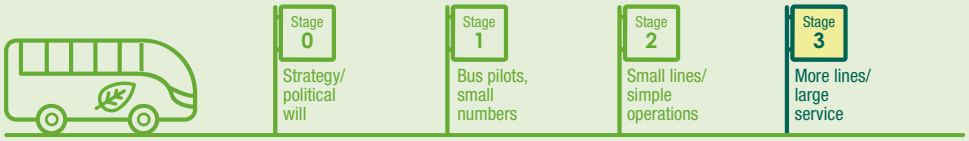
Ravenna

Italy

START Romagna S.p.A.

Stage of deployment

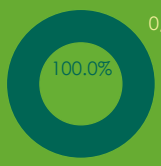
Currently, 100% of the fleet is composed of CNG vehicles, and fuel cell hydrogen buses are planned to enter into service in 2024.



Our plan is to introduce electric vehicles in 2023 and in 2024 reaching up to 15% of the fleet.

- Total average weekday driven veh-km (km)
  169*
- City topography
  flat
- Total yearly driven fleet-km (km)
  2.9 M
- Total yearly transported passengers
  4.4 M
- Average fleet age (years)
  11.5
- Average commercial speed (km/h)
  25.0

Clean over total number of driven kilometres, 2021



0,0% Clean bus

Rest of the fleet

Share of clean buses

2017 100%

2021 100%

Current fleet data

Total bus fleet	2017	2021
	65	64
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	24	24
Solo (12-15 m)	41	40
Vehicle propulsion type	**Total number of vehicles**	
Natural Gas	65	64

Charging & refuelling infrastructure

Charging technology	Depot	On route
Natural gas	1	-

* UITP estimate based on provided data.

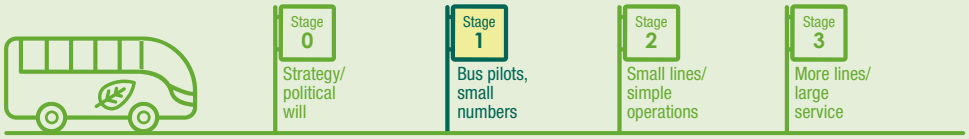
Rimini

Italy

START Romagna S.p.A.

Stage of deployment

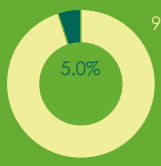
Clean buses cover 15% of the yearly fleet km, with trolleybuses, battery trolleybuses with in-motion-charging, and CNG buses.



Our plan is to introduce electric vehicles in 2023 and in 2024 reaching up to 15% of the fleet.

- Total average weekday driven veh-km (km) **142***
- City topography **flat**
- Total yearly driven fleet-km (km) **6.0 M**
- Total yearly transported passengers **11.8 M**
- Average fleet age (years) **11.5**
- Average commercial speed (km/h) **21.7**

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	139	144
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	34	31
Solo (12-15 m)	82	83
Articulated (≥18 m)	23	30
Vehicle propulsion type	**Total number of vehicles**	
Battery Trolley, In Motion Charging	-	9
Trolley	6	6
Natural Gas	-	7
Diesel	133	122

* UITP estimate based on provided data.

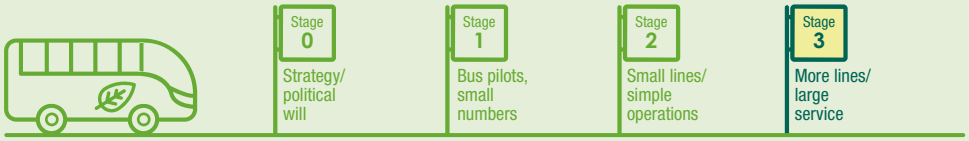
Turin

Italy

Gruppo Torinese Trasporti

Stage of deployment

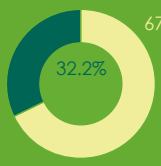
The 98 electric buses account for the 12.7% of the fleet, which allow to run 11 lines on fully-electric mode.



GTT's clean bus strategy sets the goal of 85% of the fleet being electric or CNG powered by 2024. Our biggest next step is a tender for articulated e-buses with opportunity charging. Challenges will mainly be connected to electric power availability.

- Total average weekday driven veh-km (km)
  300
- City topography
  flat
- Total yearly driven fleet-km (km)
  36.2 M
- Total yearly transported passengers
  23.4 M
- Average fleet age (years)
  10.0
- Average commercial speed (km/h)
  15.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	879	753
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	27	30
Solo (12-15 m)	563	484
Articulated (≥18 m)	289	239
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	43	96
Natural Gas	282	213
Diesel	554	444

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	100	2
Induction wireless	-	8
Natural gas	2	-

Riga

Latvia

Rīgas satiksme

Rīgas satiksme

Stage of deployment

Clean buses account for 10% of the fleet, with a mix of fuel-cell hydrogen and CNG buses. The proportion of low and zero-emission vehicles in Riga's public transport rolling stock until 2027 is planned to increase from 47.8% (2021 data) to 57%.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

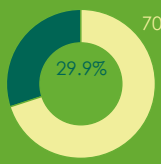
Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

LLC "Rīgas satiksme" is starting the shift to zero emission bus technologies, according to EU decarbonisation goals.

- Total average weekday driven veh-km (km) **216**
- City topography **flat**
- Total yearly driven fleet-km (km) **29.0 M**
- Total yearly transported passengers **57.4 M**
- Average fleet age (years) **13.0**
- Average commercial speed (km/h) **17.3**

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	662	680
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	16	8
Solo (12-15 m)	197	321
Articulated (≥18 m)	449	351
Vehicle propulsion type	**Total number of vehicles**	
Fuel Cell Hydrogen Electric	-	10
Trolley	115	57
Hybrids	137	211
Diesel	410	402

Charging & refuelling infrastructure

Charging technology	Depot	On route
Fuel cell hydrogen	1	-

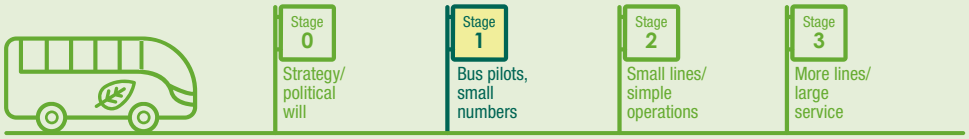
Klaipeda

Lithuania

Klaipeda PT authority

Stage of deployment

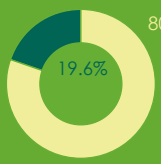
CNG technollogy is fully incorporated accounting for nearly the 20% of the driven-km. Battery electric vehicles are tested and to be incorporated in larger numbers by 2025. The next milestone in clean bus technology is new contracts with operators for the 2025 - 2030 period.



30% of our services was done with CNG and e-buses in 2020 - our goal for 2021 is to achieve 35%. In the 2022-2025 plans, which were approved by the City, we increase the e-fleet by 26 vehicles.

- Total average weekday driven veh-km (km)
  149
- City topography
  flat
- Total yearly driven fleet-km (km)
  11.7 M
- Total yearly transported passengers
  27.5 M
- Average fleet age (years)
  11.0
- Average commercial speed (km/h)
  19.0 - 26.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	176	221
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	30	62
Solo (12-15 m)	121	132
Articulated (≥18 m)	25	27
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	2
Natural Gas	22	59
Hybrids	1	1
Diesel	153	159

Charging & refuelling infrastructure

Charging technology	Depot	On route
Roof mounted pantograph	1	-
Natural gas	1	-

Vilnius

Lithuania

Vilniaus viešasis transportas

Stage of deployment

We're operating five e-buses and are planning to replace old trolleybuses with IMC buses. No buses with combustion engine will be incorporated anymore.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

As a PTO, we're guided by Vilnius' strategic goals. 2030 public transport targets are to reduce the number of conventionally fuelled vehicles to 0%, increase the share of e-vehicles to 55% and the share of alternative fuel vehicles to 45%.

Total average weekday driven veh-km (km)
184

City topography
medium

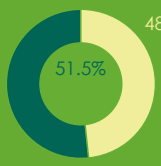
Total yearly driven fleet-km (km)
32.6 M

Total yearly transported passengers
99.6 M

Average fleet age (years)
14.9

Average commercial speed (km/h)
21.6

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	603	673
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	23	23
Solo (12-15 m)	427	485
Articulated (≥18 m)	153	165
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	5
Plug-in Hybrid Electric	1	1
Trolley	250	259
Natural Gas	97	113
Diesel	255	295

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	5	-
CNG, LNG	56	-

Hosingen

Luxembourg

Bartholme Clervaux Autocars S.A.

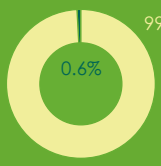
Stage of deployment

We have currently deployed zero-emission buses on several small lines with simple operations. Our next step is to scale-up operations. Our depot in Hosingen is equipped with the latest dynamic fast charging system, which is entirely connected to our operations.

Our aim is to hit 30% zero emission by the beginning of 2023.

- Total average weekday driven veh-km (km)
  230
- City topography
  medium
- Total yearly driven fleet-km (km)
  1.6 M
- Total yearly transported passengers
  n.a.
- Average fleet age (years)
  5.1
- Average commercial speed (km/h)
  n.a.

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	14	27
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	2	10
Solo (12-15 m)	12	17
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	3
Diesel	14	24

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	8	-

Malta

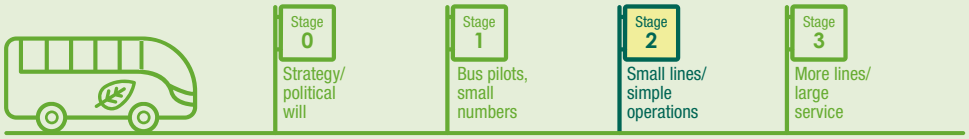
Malta

Malta Public Tranpsort

Malta Public Transport

Stage of deployment

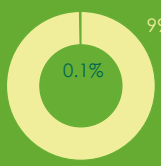
After the replacement of older diesel buses, Malta is testing electric buses in preparation for large e-bus deployment by 2025. A future pilot with fuel cell hydrogen buses is also considered.



Our plan is to replace 120 diesel buses (28% of the current fleet) with electric buses by 2023-2025. In the last 5 years we invested heavily in 300 EURO 6 buses to replace older, polluting diesel buses.

- Total average weekday driven veh-km (km)
  185
- City topography
  medium
- Total yearly driven fleet-km (km)
  28.9 M
- Total yearly transported passengers
  35.2 M
- Average fleet age (years)
  6.3
- Average commercial speed (km/h)
  n.a.

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	408	430
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	195	152
Solo (12-15 m)	213	278
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	7
Diesel	408	423

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	5	-

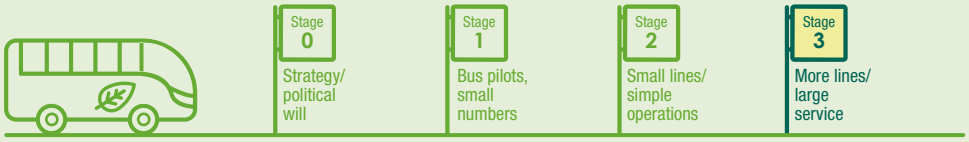
Jaworzno

Poland

Przedsiębiorstwo Komunikacji Miejskiej S.A. Jaworzno

Stage of deployment

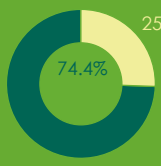
Thanks to a consistent fleet renewal policy, since 2021, approximately 60% of PKM fleet is made of e-buses, allowing to perform over 80% of transport services with environmentally friendly buses.



In 2022, PKM will achieve its electrification target, namely 50 e-buses, of the total 70 buses, and 55 vehicles driven daily. Diesel vehicles perform short services to support operation during peak times, covering a small number of km per day.

- Total average weekday driven veh-km (km)
  278
- City topography
  medium
- Total yearly driven fleet-km (km)
  4.6 M
- Total yearly transported passengers
  11.3 M
- Average fleet age (years)
  5.4
- Average commercial speed (km/h)
  27.2

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	75	69
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	10	10
Solo (12-15 m)	37	43
Articulated (≥18 m)	28	16
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	23	43
Diesel	52	26

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	17	39
Roof mounted pantograph	6	12

Poznań

Poland

MPK Poznań Sp. z o.o.

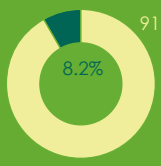
Stage of deployment

Electric buses accounted for the 17% of the total fleet in 2021, while plans for additional 20 to 30 zero-emission buses are set for the second half of 2023. MPK Poznań operates nearly 80 routes with a fleet of over 300 buses. The main goal of our bus fleet renewal policy is to achieve a minimum share of 30% zero-emission buses by 2028.

Though the high costs of acquisition and exploitation of zero-emission buses are a big challenge, we fully support the green transition in public transport and plan to continue introducing cleaner vehicles in our fleet.

- Total average weekday driven veh-km (km)
  n.a.
- City topography
  flat
- Total yearly driven fleet-km (km)
  20.5 M
- Total yearly transported passengers
  n.a.
- Average fleet age (years)
  8.1
- Average commercial speed (km/h)
  n.a.

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	320	338
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	28	28
Solo (12-15 m)	144	152
Articulated (≥18 m)	148	158
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	58
Hybrids	1	1
Diesel	319	279

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	62	-
Roof mounted pantograph	2	15

Warsaw area

Poland

Zarzad Transportu Miejskiego

PUBLIC TRANSPORT AUTHORITY OF WARSAW

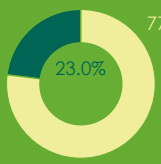
Stage of deployment

We can state without hesitation that Warsaw operates much more than "small lines" with clean buses: 9% of the fleet are e-buses, operating in regular, normal length lines, together with natural gas and biofuel buses.

Warsaw's clean bus strategy is aligned with local, national and EU regulations. They specify deployment targets for new buses and charging/ refueling infrastructure by 2025 and envisions gradual replacement of all buses older than EURO VI standard by 2026.

- Total average weekday driven veh-km (km)
  190*
- City topography
  flat
- Total yearly driven fleet-km (km)
  120. 9 M
- Total yearly transported passengers
  400.2 M
- Average fleet age (years)
  6.6
- Average commercial speed (km/h)
  22.3

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	1,813	1,812
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	130	164
Solo (12-15 m)	624	543
Articulated (≥18 m)	1,059	1,105
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	20	162
Natural Gas	35	318
Hybrids	9	70
Diesel	1,744	1,257
Other: Biofuels	5	5

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	160	-
Roof mounted pantograph	5	23
Natural gas	131	-

* UITP estimate based on provided data.

Braga

Portugal

Transportes Urbanos de Braga, E.M.

TRANSPORTES URBANOS DE BRAGA

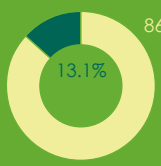
Stage of deployment

Currently we are operating 13 clean fully-electric buses and 25 CNG buses. We are currently preparing public procedures to acquire another 30 electric buses. 55% of the bus fleet will use clean technologies by 2025, while by 2030, 85% of the public transport vehicles will be powered by clean energy sources.

By 2030, TUB plans to reduce the impact of its activity in the urban environment by 60%, with an important reduction in greenhouse gas emissions in the municipality.

- Total average weekday driven veh-km (km)
  205
- City topography
  medium
- Total yearly driven fleet-km (km)
  6.1 M
- Total yearly transported passengers
  8.2 M
- Average fleet age (years)
  16.6
- Average commercial speed (km/h)
  19.3

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	143	168
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	25	25
Solo (12-15 m)	104	129
Articulated (≥18 m)	14	14
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	13
Natural Gas	13	25
Diesel	130	130

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	13	-
Natural gas	1	-

Coimbra

Portugal

Serviços Municipalizados de Transportes Urbanos de Coimbra

Stage of deployment

Since 2019, SMTUC is increasing its fleet with clean buses currently operating in ten lines within city limits .

Stage 0 — Strategy/ political will

Stage 1 — Bus pilots, small numbers

Stage 2 — Small lines/ simple operations

Stage 3 — More lines/ large service

Our aim is to meet and exceed the EU's public transport decarbonisation targets.

Current fleet data

Total bus fleet	2017	2021
	116	164
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	19	49
Solo (12-15 m)	96	114
Articulated (≥18 m)	1	1
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	5	24
Trolley	12	5
Hybrids	1	2
Diesel	115	133

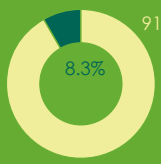
Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	24	-

* UITP estimate based on provided data.

- Total average weekday driven veh-km (km) **106***
- City topography **hilly**
- Total yearly driven fleet-km (km) **6.4 M**
- Total yearly transported passengers **10.2 M**
- Average fleet age (years) **14.6**
- Average commercial speed (km/h) **12.0**

Clean over total number of driven kilometres, 2021



Share of clean buses

Lisbon

Portugal

Companhia Carris de Ferro de Lisboa

Stage of deployment

One line is operating in fully-electric mode using 15 electric buses since 2020, while 30% of the fleet runs with CNG already. The goal is that 47% of our fleet is composed by zero-emissions buses by 2028.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

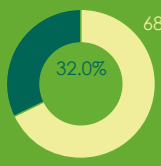
Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

As part of its Green Strategy, CARRIS is committed in reducing GHG emissions by 50%, N0x emissions by 90% and energy consumption by 20% by 2030 (all per passenger-km and compared with 2017).

- Total average weekday driven veh-km (km)
  160
- City topography
  medium
- Total yearly driven fleet-km (km)
  35.4 M
- Total yearly transported passengers
  91.2 M
- Average fleet age (years)
  10.5
- Average commercial speed (km/h)
  17.5

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	600	746
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	53	119
Solo (12-15 m)	457	537
Articulated (≥18 m)	90	90
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	15
Natural Gas	40	211
Diesel	560	520

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	16	-
Natural gas	8	-

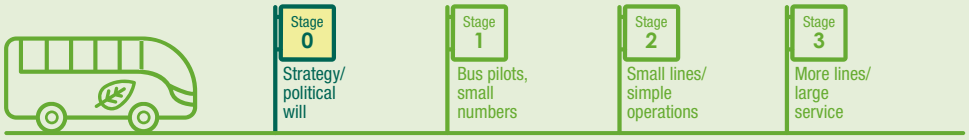
Oradea

Romania

S.C. Oradea Transport Local S.A.

Stage of deployment

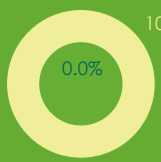
Up to 50 zero emission buses are planned to be procured in the next two years, to achieve a share of 40% clean buses over the total fleet.



Like other transport operators in Europe, we are working on a clean bus strategy aligned with the municipality. Our plans have been included the SUMP for Oradea.

- Total average weekday driven veh-km (km)
  157*
- City topography
  flat
- Total yearly driven fleet-km (km)
  4.6 M
- Total yearly transported passengers
  12.5 M
- Average fleet age (years)
  11.0
- Average commercial speed (km/h)
  14.7

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	90	116
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	15	14
Solo (12-15 m)	71	93
Articulated (≥18 m)	4	9
Vehicle propulsion type	**Total number of vehicles**	
Hybrids	-	16
Diesel	90	100

* UITP estimate based on provided data.

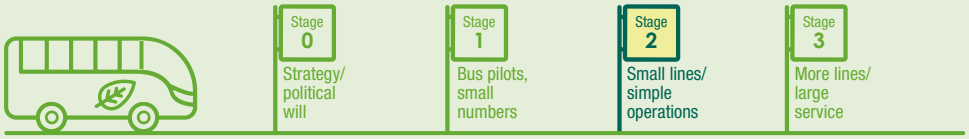
Belgrade

Serbia

Gradsko saobraćajno preduzeće

Stage of deployment

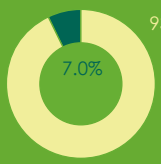
Two full electric lines are in operation in the city center, using a total of 15 ultra capacitor electric buses. 10 e-buses were delivered at the end of 2021, and the tender for the procurement of trolleybuses will be announced in 2022.



Our strategy is to replace diesel buses with zero- and low-emission buses. To do so, 420 CNG buses, 50 electric buses and 80 trolleybuses with in-motion charging are to be introduced by 2025. The first 100 CNG buses will be delivered by June 2022.

- Total average weekday driven veh-km (km)
  n.a.
- City topography
  medium
- Total yearly driven fleet-km (km)
  69.5 M
- Total yearly transported passengers
  n.a.
- Average fleet age (years)
  9.2
- Average commercial speed (km/h)
  18.2

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	960	977
Bus size	**Total number of vehicles**	
Solo (12-15 m)	430	561
Articulated (≥18 m)	530	416
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	5*	15*
Trolley	119	119
Natural Gas	10	4
Diesel	826	839

Charging & refuelling infrastructure

Charging technology	Depot	On route
Roof mounted pantograph	1	6

* Ultracapacitor Electric Vehicle

Košice

Slovakia

Dopravný podnik mesta Košice, a.s.

DOPRAVNÝ PODNIK MESTA KOŠICE

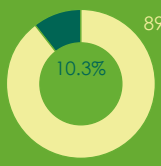
Stage of deployment

New trolleybuses with battery range extender, CNG buses and overnight-charging electric buses will be considered to achieve the stated goals. CNG buses are in service since 2002, and accounted for 5.3% of driven km in 2021. Electric buses are in service since 2014, accounting for the 5 % of driven km in 2021.

Bus operators must comply with EU and national regulations deriving from the Clean Vehicles Directive. They set a minimum of 17% zero-emission buses, and 17% clean buses in our bus rolling stock by 2025, and 24% by 2030.

- Total average weekday driven veh-km (km)
  172*
- City topography
  medium, hilly
- Total yearly driven fleet-km (km)
  11.6 M
- Total yearly transported passengers
  52.9 M
- Average fleet age (years)
  9.2
- Average commercial speed (km/h)
  17.5

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	245	217
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	30	30
Solo (12-15 m)	116	100
Articulated (≥18 m)	99	87
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	23	23
Trolley	18	4
Natural Gas	48	21
Diesel	156	169

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	23	-
Infrastructure mounted pantograph	3	2
Natural gas	1	1

* UITP estimate based on provided data.

Ljubljana

Slovenija

Javno podjetje Ljubljanski potniški promet d.o.o.

LPP skupina Javni holding Ljubljana

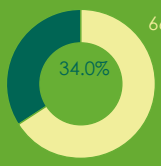
Stage of deployment

A mature use of CNG buses account for the 32% of the fleet.

According to its strategy, Ljubljana's bus fleet will be clean buses only by 2030, with a mix of 70% bio-methane powered buses and 30% battery electric or fuel cell hydrogen buses.

- Total average weekday driven veh-km (km)
  164
- City topography
  flat
- Total yearly driven fleet-km (km)
  11.5 M
- Total yearly transported passengers
  21.5 M
- Average fleet age (years)
  11.2
- Average commercial speed (km/h)
  17.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	217	217
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	17	18
Solo (12-15 m)	53	59
Articulated (≥18 m)	147	140
Vehicle propulsion type	**Total number of vehicles**	
Natural Gas	68	70
Hybrids	-	17
Diesel	149	130

Charging & refuelling infrastructure

Charging technology	Depot	On route
Natural gas	1	2

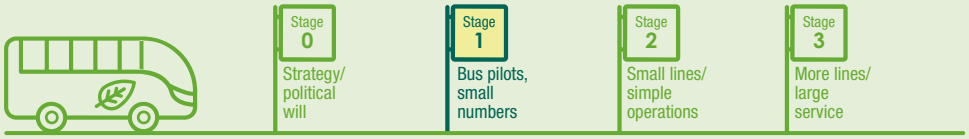
Aranjuez

Spain

Mosamo S.L.U.

Stage of deployment

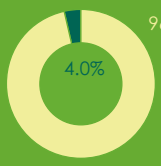
We currently have one 100% battery electric bus with overnight charging in depots. Provided that additional funds or subsidies are given, the next step would be the installation of a second double charger and add three more e-buses, bringing the total to four, or 27% of the total. We have presented a proposal and are awaiting acceptance.



We plan to gradually advance the electrification of our fleet.

- Total average weekday driven veh-km (km)
  171
- City topography
  flat
- Total yearly driven fleet-km (km)
  0.8 M
- Total yearly transported passengers
  1.7 M
- Average fleet age (years)
  4.7
- Average commercial speed (km/h)
  18.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	14	15
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	14	15
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	1
Hybrids	3	3
Diesel	11	11

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	-	2

Barcelona Metropolitan Area

Spain

Àrea Metropolitana de Barcelona

AMB Àrea Metropolitana de Barcelona

Stage of deployment

33 electric buses with overnight charging are currently in operation. 31% of the buses owned by AMB to provide the service through private operators are low- and zero-emissions (27% hybrid, 4% electric). We are also working on the deployment of a new e-BRT line that will be operated with e-buses.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

AMB provides bus services through TMB, its public operator, and several private operators. The goal is to reach a 100% sustainable fleet by 2030, with 30% battery buses. The 2025 milestone is to increase the fleet with 185 new e-buses.

Total average weekday driven veh-km (km)
200-300

City topography
medium

Total yearly driven fleet-km (km)
77.0 M

Total yearly transported passengers
72.0 M

Average fleet age (years)
8.9

Average commercial speed (km/h)
14.8

Share of clean buses

2017
0.1%

2021
3.8%

Current fleet data

Total bus fleet	2017	2021
	706	858
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	197	181
Solo (12-15 m)	468	568
Articulated (≥18 m)	1	69
Double decker bus	40	40
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	1	33
Hybrids	19	235
Diesel	686	590

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	33	-

Barcelona Metroplitan Area

Spain

Transports Metropolitans de Barcelona

Stage of deployment

Our electric fleet will be increased until 2025 with 218 buses. We are operating a small hydrogen bus fleet, which will grow up to 45 buses in 2024.

Stage 0 — Strategy/ political will

Stage 1 — Bus pilots, small numbers

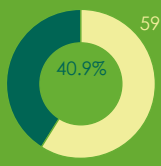
Stage 2 — Small lines/ simple operations

Stage 3 — More lines/ large service

Our strategy is to update and increase the bus fleet with attention to sustainability, energy efficiency and digital transition criteria.

- Total average weekday driven veh-km (km) **200**
- City topography **flat, hilly**
- Total yearly driven fleet-km (km) **45.4 M**
- Total yearly transported passengers **146.6 M**
- Average fleet age (years) **8.5**
- Average commercial speed (km/h) **12.0**

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	1,060	1,135
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	77	80
Solo (12-15 m)	606	625
Articulated (≥18 m)	305	364
Double decker bus	72	65
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	4	30
Plug-in Hybrid Electric	-	1*
Natural Gas	372	363
Hybrids	156	390**
Diesel	528	351

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	3	-
Roof mounted pantograph	30	4
Fuel cell hydrogen	0***	-
Natural gas	1	1

* Not yet into commercial service by the end of 2021.
** 59 vehicles are hybrid CNG.
*** Hydrogen buses are refueled at a public hydrogen refuelling station.

Ciudad Real

Spain

Iberica Concesiones Y Servicios S.A.U.

Stage of deployment

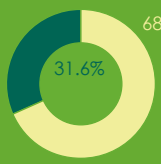
CNG buses add up to the 40% of the total fleet, and jointly they run more than 300,000 yearly driven-km.

- Stage 0: Strategy/ political will
- Stage 1: Bus pilots, small numbers
- Stage 2: Small lines/ simple operations
- Stage 3: More lines/ large service

The renovation carried out in recent years toward a clean bus fleet has been pushed by the introduction of CNG vehicles.

- Total average weekday driven veh-km (km) **137**
- City topography **flat**
- Total yearly driven fleet-km (km) **1.0 M**
- Total yearly transported passengers **1.3 M**
- Average fleet age (years) **9.8**
- Average commercial speed (km/h) **17.0**

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	20	22
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	20	22
Vehicle propulsion type	**Total number of vehicles**	
Natural Gas	-	9
Diesel	20	13

Charging & refuelling infrastructure

Charging technology	Depot	On route
Natural gas	0*	-

*Natural gas buses are refueled at a public gas refuelling station.

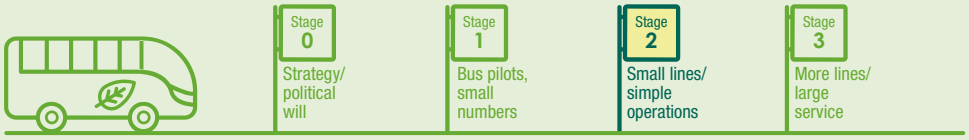
Donostia - San Sebastián

Spain

Compañía del Tranvía de San Sebastián

Stage of deployment

Fully elecric buses have been operating since 2014. Besides, a public tender is being prepared to renew the fleet with 60 fully electric units between 2022-2025. Our target is now to reach 50% of clean buses within the fleet by 2025, and 100% by 2023.



The overall strategy of the company is offering excellent public transport service. This has been achieved with the latest technologies applied to both operations and bus departments.

Current fleet data

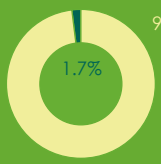
Total bus fleet	2017	2021
	132	142
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	12	13
Solo (12-15 m)	90	92
Articulated (≥18 m)	30	37
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	3	3
Hybrids	24	59
Diesel	105	80

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	3	-

- Total average weekday driven veh-km (km)
  230
- City topography
  flat, hilly
- Total yearly driven fleet-km (km)
  7.3 M
- Total yearly transported passengers
  22.3 M
- Average fleet age (years)
  6.9
- Average commercial speed (km/h)
  17.2

Clean over total number of driven kilometres, 2021



Share of clean buses

La Laguna

Spain

Transportes Interurbanos de Tenerife S.A.

titsa
donde tú vas

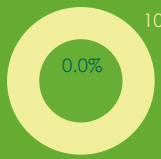
Stage of deployment

Currently, there are no clean buses, but the local administration is exploring the possibility to electrify city centre bus lines.

La Laguna is starting its path towards clean bus technolgies, and is ready to phase out diesel technology.

- Total average weekday driven veh-km (km)
  107
- City topography
  medium
- Total yearly driven fleet-km (km)
  0.9 M
- Total yearly transported passengers
  0.8 M
- Average fleet age (years)
  12.5
- Average commercial speed (km/h)
  21.3

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	n.a.	19
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	n.a.	19
Vehicle propulsion type	**Total number of vehicles**	
Diesel	n.a.	19

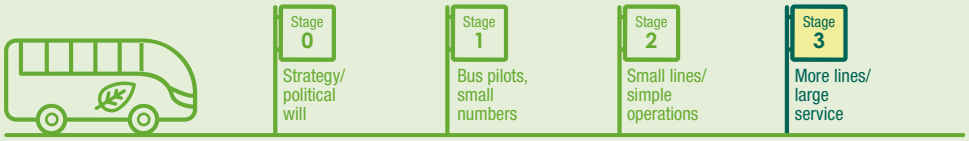
Mallorca

Spain

Consorci de Transports de Mallorca

Stage of deployment

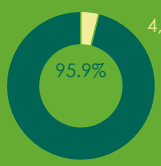
The backbone of operations rely on CNG buses, and is fully deployed. The electric share is settling with on-route charging infrastructure, now under development.



New contracts started in January 2021, specifying clean technologies to account for over 95% of total operations of Mallorca's interurban buses for the next ten years.

- Total average weekday driven veh-km (km)
  n.a.
- City topography
  medium
- Total yearly driven fleet-km (km)
  13.3 M
- Total yearly transported passengers
  9.9 M
- Average fleet age (years)
  1.0
- Average commercial speed (km/h)
  n.a.

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	232	223
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	36	17
Solo (12-15 m)	167	164
Articulated (≥18 m)	29	42
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	9
Plug-in Hybrid Electric	-	9*
Natural Gas	-	196
Hybrids	-	2**
Diesel	232	7

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	9	-
Infrastructure mounted pantograph	1	1
Natural gas	6	-

* Running on diesel until charging infraestructure is ready.
** CNG hybrids.

Madrid Region

Spain

Consorcio Regional de Transportes de Madrid

Stage of deployment

Currently, clean buses account for 12.1% of the fleet, which is a mix of CNG, LNG and one electric vehicle.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

> ***CRTM is supporting the deployment of clean bus technologies, which will be reflected in the new service contracts starting 2024.***

- Total average weekday driven veh-km (km)
  n.a.
- City topography
  medium, hilly
- Total yearly driven fleet-km (km)
  174.4 M
- Total yearly transported passengers
  227.6 M
- Average fleet age (years)
  4.5
- Average commercial speed (km/h)
  22.0

Share of clean buses

2017
11.9%

2021
12.1%

Current fleet data

Total bus fleet	2017	2021
	1,824	2,068
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	130	149
Solo (12-15 m)	1,661	1,862
Articulated (≥18 m)	33	57
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	1
Natural Gas	213	246
Hybrids	254*	366*
Diesel	1,353	1,451

Charging & refuelling infrastructure

Information about charging and refuelling infrastructure is not available.

* 4 vehicles are hybrid CNG.

Madrid

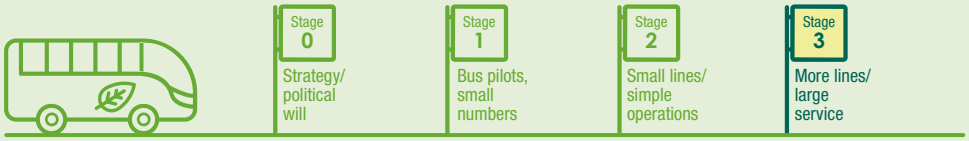
Spain

Empresa Municipal de Transportes de Madrid

EMT MADRID

Stage of deployment

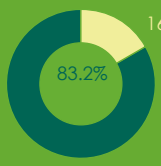
A mature deployment of clean bus technologies adds up to 83% of the driven km, mostly made by CNG buses and an increasing number of e-buses (1% of driven km).



EMT Madrid's strategic plan sets 2023 as the end-date for diesel buses, with electric buses reaching 25% of the total fleet by 2025.

- Total average weekday driven veh-km (km)
  181
- City topography
  hilly
- Total yearly driven fleet-km (km)
  101.7 M
- Total yearly transported passengers
  296.5 M
- Average fleet age (years)
  6.2
- Average commercial speed (km/h)
  12.9

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	2,025	2,081
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	47	41
Solo (12-15 m)	1,893	1,954
Articulated (≥18 m)	85	86
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	23	124
Plug-in Hybrid Electric	8	7
Natural Gas	1,019	1,634
Hybrids	44	37
Diesel	931	279

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	143	-
Induction wireless	-	2
Natural gas	5	-

Pamplona

Spain

Mancomunidad de la Comarca de Pamplona

Stage of deployment

Since 2019, one line is operating in fully-electric mode; the new fleet incorporated in 2022 will be renewable CNG, abandoning the purchase of diesel buses.

Stage 0 — Strategy/ political will

Stage 1 — Bus pilots, small numbers

Stage 2 — Small lines/ simple operations

Stage 3 — More lines/ large service

In 2024, the TUC fleet will have 26 e-buses and 25 renewable natural gas buses (33% of the fleet). The goal is that by 2030 a third of the fleet will be electric and the rest renewable CNG, achieving carbon neutrality.

Current fleet data

Total bus fleet	2017	2021
	140	159
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	3	2
Solo (12-15 m)	87	96
Articulated (≥18 m)	50	61
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	6
Hybrids	21	66
Diesel	119	87

Total average weekday driven veh-km (km)
194

City topography
medium

Total yearly driven fleet-km (km)
7.8 M

Total yearly transported passengers
29.7 M

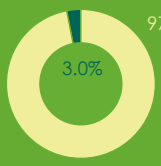
Average fleet age (years)
7.3

Average commercial speed (km/h)
12.7

Charging & refuelling infrastructure

Charging technology	Depot	On route
Infrastructure mounted pantograph	-	2

Clean over total number of driven kilometres, 2021



Share of clean buses

Santa Cruz de Tenerife

Spain

Transportes Interurbanos de Tenerife S.A.

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Stage of deployment

Currently, there is just one line operated by four electric buses, but the plan is to electrify the lines going through the city centre with 11 battery buses.

Stage 0 — Strategy/ political will

Stage 1 — Bus pilots, small numbers

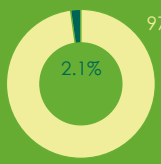
Stage 2 — Small lines/ simple operations

Stage 3 — More lines/ large service

We are committed to stop procuring diesel buses and shift to zero- and low-emissions technologies. Which technology, hybrid, electric or fuel hydrogen cells vehicles, is still under discussion.

- Total average weekday driven veh-km (km)
  98
- City topography
  hilly
- Total yearly driven fleet-km (km)
  5.0 M
- Total yearly transported passengers
  8.1 M
- Average fleet age (years)
  10.62
- Average commercial speed (km/h)
  19.3

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	121	121
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	39	39
Solo (12-15 m)	78	78
Articulated (≥18 m)	4	4
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	4
Diesel	121	117

Charging & refuelling infrastructure

Charging technology	Depot	On route
Infrastructure mounted pantograph	1	-

Tenerife

Spain

Transportes Interurbanos de Tenerife S.A.

titsa
donde tú vas

Stage of deployment

Currently, there are 3 hybrid buses in operation, and the plan is to increase up to 96 hybrid vehicles in the next 2 years.

Stage 0 — Strategy/ political will

Stage 1 — Bus pilots, small numbers

Stage 2 — Small lines/ simple operations

Stage 3 — More lines/ large service

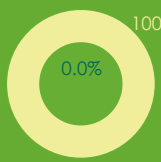
> ***We are phasing out diesel only buses, and we are pleased to align our vision with the city's political will.***

Current fleet data

Total bus fleet	2017	2021
	377	424
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	120	137
Solo (12-15 m)	236	268
Articulated (≥18 m)	21	19
Vehicle propulsion type	**Total number of vehicles**	
Hybrids	-	3
Diesel	377	421

- Total average weekday driven veh-km (km)
  160
- City topography
  hilly
- Total yearly driven fleet-km (km)
  29.8 M
- Total yearly transported passengers
  27.6 M
- Average fleet age (years)
  7.9
- Average commercial speed (km/h)
  32.9

Clean over total number of driven kilometres, 2021



Share of clean buses

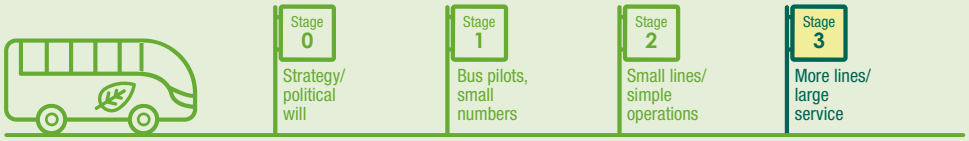
Valdemoro

Spain

Automnibus Interurbanos S.A.

Stage of deployment

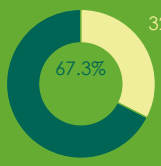
67% of yearly-driven km are made by clean buses, with a significant number of CNG buses in the fleet.



The implementation of two double 150 kWh night-charging chargers and four urban electric buses is in the project acceptance phase.

- Total average weekday driven veh-km (km) **186**
- City topography **flat**
- Total yearly driven fleet-km (km) **1.4 M**
- Total yearly transported passengers **3.0 M**
- Average fleet age (years) **4.9**
- Average commercial speed (km/h) **18.0**

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	20	22
Bus size	**Total number of vehicles**	
Solo (12-15 m)	20	22
Vehicle propulsion type	**Total number of vehicles**	
Natural Gas	7	15
Diesel	13	7

Charging & refuelling infrastructure

Charging technology	Depot	On route
Natural gas buses	1	1

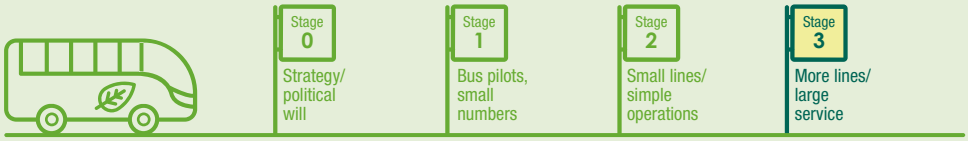
Valencia

Spain

Empresa Municipal de Transports de València

Stage of deployment

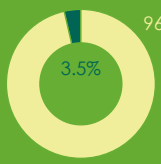
With 2 electric buses in operation since 2019, and 30 CNG buses, 7.2% of the fleet is made of clean technologies. Additional 20 e-buses are to be integrated in the near future.



EMT Valencia plans to renew 6.5% of the fleet each year, it means 32 buses per year, acquiring the most efficient technology available at that time, with the aim of decarbonising our fleet. With this, 51% of the new buses will be zero-emissions and the rest hybrid-biodiesel.

- Total average weekday driven veh-km (km)
  102
- City topography
  flat
- Total yearly driven fleet-km (km)
  18.2 M
- Total yearly transported passengers
  58.3 M
- Average fleet age (years)
  8.0
- Average commercial speed (km/h)
  11.9

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	485	489
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	6	6
Solo (12-15 m)	448	402
Articulated (≥18 m)	31	81
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	2
Plug-in Hybrid Electric	3	3
Natural Gas	73	30
Hybrids	4	251
Diesel	405	203

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	2	-
Natural gas	27	-

Zaragoza

Spain

Avanza Zaragoza

Stage of deployment

Clean buses represent 1% of the jounryes in Zaragoza with 4 buses.
In the near future, 68 additional electric units will join the fleet which will account for the 20% of total journeys.

Stage 0 — Strategy/ political will

Stage 1 — Bus pilots, small numbers

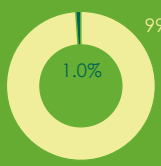
Stage 2 — Small lines/ simple operations

Stage 3 — More lines/ large service

As agreed with Zaragoza council, all new buses joining the service from now on will be fully-electric buses. At the beginning of 2023, we expect to operate 20% of the fleet with e-buses and another 32% with hybrid buses.

- Total average weekday driven veh-km (km)
  175*
- City topography
  flat
- Total yearly driven fleet-km (km)
  20.0 M
- Total yearly transported passengers
  65.6 M
- Average fleet age (years)
  9.1
- Average commercial speed (km/h)
  12.2

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	335	352
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	22	20
Solo (12-15 m)	224	227
Articulated (≥18 m)	86	102
Double decker bus	3	3
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	4
Hybrids	10	111
Diesel	325	237

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	94	-
Infrastructure mounted pantograph	4	-

* UITP estimate based on provided data.

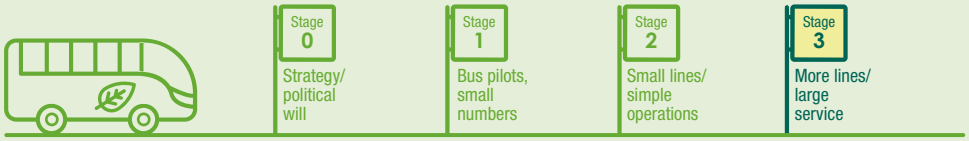
Dalarna County

Sweden

Keolis Sverige AB

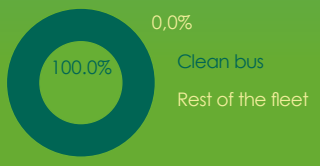
Stage of deployment

The Dalarna bus fleet is fossil free as of 2015, operating one third of the yearly driven km with Biofuels hybrid vehicles and the rest with biodiesel buses.



- Total average weekday driven veh-km (km)
  n.a.
- City topography
  medium
- Total yearly driven fleet-km (km)
  6.0 M
- Total yearly transported passengers
  8.0 M
- Average fleet age (years)
  6.8
- Average commercial speed (km/h)
  28.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	95	91
Bus size	**Total number of vehicles**	
Solo (12-15 m)	74	70
Articulated (≥18 m)	21	21
Vehicle propulsion type	**Total number of vehicles**	
Hybrids	15*	24*
Other: Biodiesel	80	67

* Biodiesel hybrids

Gothenburg

Sweden

Keolis Sverige AB

Stage of deployment

Gothenburg has a mixed fleet with five different types of vehicles. The CNG and Biodiesel are the most used solution, covering for 90% of the yearly km driven.

Stage 0 — Strategy/ political will

Stage 1 — Bus pilots, small numbers

Stage 2 — Small lines/ simple operations

Stage 3 — More lines/ large service

Total average weekday driven veh-km (km)
n.a.

City topography
medium

Total yearly driven fleet-km (km)
20.0 M

Total yearly transported passengers
50.0 M

Average fleet age (years)
7.8

Average commercial speed (km/h)
22.0

Clean over total number of driven kilometres, 2021

Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	323	244
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	5	2
Solo (12-15 m)	228	112
Articulated (≥18 m)	90	108
Double decker bus	-	22
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	4	2
Plug-in Hybrid Electric	7	7
Natural Gas	103	124
Hybrids	32*	21*
Other: Biodisel	177	90

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	2	-
Natural gas	124	-

* Biodiesel hybrids

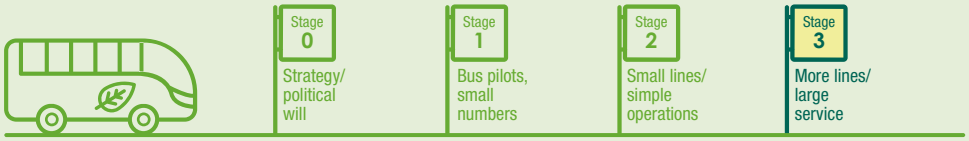
Gothenburg

Sweden

Transdev Sverige AB

Stage of deployment

We are the biggest e-bus fleet in Scandinavia, with 145 electric buses launched in 2020. There is a strong ambition from the PTA to electrify all city buses by 2030.



Our fleet is composed of 372 buses (145 electric, 141 biogas and 86 hybrid buses). The five operation contracts we have with the PTA Västtrafik cover a big part of the city of Göteborg and the entire cities of Mölndal and Partille.

- Total average weekday driven veh-km (km)
  n.a.
- City topography
  flat
- Total yearly driven fleet-km (km)
  n.a.
- Total yearly transported passengers
  n.a.
- Average fleet age (years)
  9.0
- Average commercial speed (km/h)
  n.a.

Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	136	372
Bus size	**Total number of vehicles**	
Solo (12-15 m)	116	n.a.
Articulated (≥18 m)	20	n.a.
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	145
Natural Gas	62	141
Hybrids	-	86
Diesel	34	-
Other: Biofuel (HVO, RME)	40	-

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	206	-
Infrastructure mounted pantograph	-	19

Jönköping

Sweden

Jönköpings Länstrafik

Länstrafiken

Stage of deployment

In 2021 we launched a new contract for 100 buses: 50 of them are driven with local bio gas; the others are fully electric with 11 panto-down technology. Our future goal is to reduce the energy use per passenger-kilometre by 38 % by 2035.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

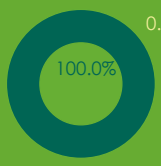
Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

Our existing clean bus strategy sets that all bus traffic shall be driven with 100 % percent renewable fuel by 2025, a goal that we have already achieved in 2021 with our latest traffic agreements/procurement. Our future goal is to reduce the energy use per passenger-kilometre by 38 % by 2035.

- Total average weekday driven veh-km (km)
  277*
- City topography
  flat, hilly
- Total yearly driven fleet-km (km)
  8.1 M
- Total yearly transported passengers
  5.78 M
- Average fleet age (years)
  1.0
- Average commercial speed (km/h)
  23.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	107	103
Bus size	**Total number of vehicles**	
Solo (12-15 m)	75	20
Articulated (≥18 m)	32	83
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	51
Natural Gas	32	52
Diesel	75	-

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	52	-
Infrastructure mounted pantograph	-	11
Natural gas	52	-

* UITP estimate based on provided data.

Karlstad

Sweden

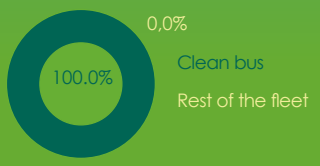
Keolis Sverige AB

Stage of deployment

Karlstad public transport services is fossil-free as of 2015, operating mainly with CNG buses that represent 80% of the fleet and 90% of yearly driven km.

- Total average weekday driven veh-km (km)
  n.a.
- City topography
  flat
- Total yearly driven fleet-km (km)
  5.8 M
- Total yearly transported passengers
  8.0 M
- Average fleet age (years)
  8.1
- Average commercial speed (km/h)
  22.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	62	72
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	3	5
Solo (12-15 m)	49	53
Articulated (≥18 m)	10	14
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	3	7
Natural Gas	59	59
Hybrids	-	3*
Other: Biodiesel	-	3

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	7	1
Infrastructure mounted pantograph	-	2
Natural gas	59	-

* Biodiesel hybrids

Stockholm

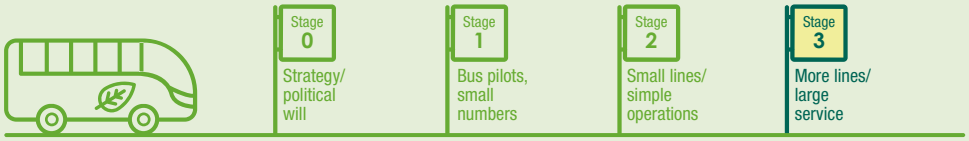
Sweden

Keolis Sverige AB

KEOLIS

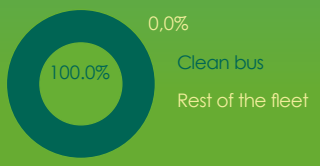
Stage of deployment

Stockholm has a bus fleet based on CNG and Biodiesel/Ethanol vehicles but the new investments will include electric vehicles because of the lowest TCO.



- Total average weekday driven veh-km (km)
  n.a.
- City topography
  flat
- Total yearly driven fleet-km (km)
  50.0 M
- Total yearly transported passengers
  140.0 M
- Average fleet age (years)
  10.7
- Average commercial speed (km/h)
  20.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	894	931
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	2	2
Solo (12-15 m)	416	437
Articulated (≥18 m)	476	492
Vehicle propulsion type	**Total number of vehicles**	
Natural Gas	322	328
Hybrids	59*	49*
Other: Biodiesel and Ethanol	513	554

Charging & refuelling infrastructure

Charging technology	Depot	On route
Natural gas	200	-

* Biodiesel hybrids.

Basel

Switzerland

Basler Verkehrsbetriebe

BASEL ERFAHREN BVB

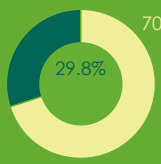
Stage of deployment

With 1 electric bus in operation since 2019 and 38 CNG buses, 30% of the driven km are made by clean buses. B27 project is divided in two tranches. In the first one, 65 electric buses will replace 50% of the current combustion-engine fleet by mid-2023. In a second phase, 64 electric buses will be purchased in 2026.

The B27 bus program will replace the entire bus fleet with new electric buses by 2027 and convert the bus depot, including the workshop, to host the buses with electric engines.

- Total average weekday driven veh-km (km)
  150
- City topography
  flat
- Total yearly driven fleet-km (km)
  6.2 M
- Total yearly transported passengers
  85.8 M*
- Average fleet age (years)
  10.0
- Average commercial speed (km/h)
  18.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	112	113
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	5	5
Solo (12-15 m)	13	13
Articulated (≥18 m)	94	95
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	1
Natural Gas	38	38
Diesel	74	74

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	1	-
Roof mounted pantograph	1	-
Natural gas	38	-

* Data for 2020.

Bulle

Switzerland

Transports publics fribourgeois Trafic SA

Stage of deployment

Currently, discussions with political bodies are ongoing and studies on clean bus strategies are taking place.

We are currently studying the clean bus strategy to be put in place, and carrying out comparison studies in terms of operation and costs between electric buses and fuel cell hydrogen buses.

Current fleet data

Total bus fleet	2017	2021
	8	8
Bus size	**Total number of vehicles**	
Solo (12-15 m)	1	1
Articulated (≥18 m)	7	7
Vehicle propulsion type	**Total number of vehicles**	
Diesel	8	8

Total average weekday driven veh-km (km)
270

City topography
medium

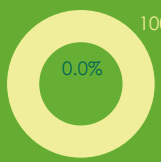
Total yearly driven fleet-km (km)
0.2 M

Total yearly transported passengers
1.4 M

Average fleet age (years)
4.8

Average commercial speed (km/h)
20.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Canton Neuchatel

Switzerland

Transports publics Neuchâtelois

transN
transports publics neuchâtelois

Stage of deployment

The current bus fleet hosts 32 CNG buses accounting for 23% of the total fleet.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

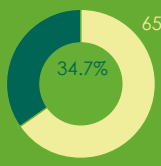
Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

> ***Within our triple zero strategy (Zero drives, Zero energy generation and Zero km energy production), the goal is to hit 62% of the bus fleet being electric by 2026.***

- Total average weekday driven veh-km (km)
  n.a.
- City topography
  medium
- Total yearly driven fleet-km (km)
  4.5 M
- Total yearly transported passengers
  16.1 M*
- Average fleet age (years)
  10.0
- Average commercial speed (km/h)
  40.0

Clean over total number of driven kilometres, 2020



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	127	141
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	17	17
Solo (12-15 m)	44	52
Articulated (≥18 m)	66	72
Vehicle propulsion type	**Total number of vehicles**	
Trolley	32	32
Natural Gas	1	-
Hybrids	6	22
Diesel	88	87

* Data for 2020.

Fribourg

Switzerland

Transports publics fribourgeois Trafic SA

Stage of deployment

A fleet of five fast-charging electric buses are in operation jointly with 10 in-motion charging trolley buses. In-motion charging will be the adopted solution for lines with overhead-wires in part of their route.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

For lines with overhead contact lines, we're deploying IMC trolleybuses to the maximum. For the other lines, we're doing comparative studies of different technologies. We've deployed a fleet of 9m fast-charging buses at the terminus.

Current fleet data

Total bus fleet	2017	2021
	55	54
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	5	5
Solo (12-15 m)	5	4
Articulated (≥18 m)	45	45
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	5*
Battery Trolley, In Motion Charging	-	10
Trolley	12	12
Diesel	35	27
Other: bimode	8	-

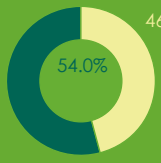
- Total average weekday driven veh-km (km) **238**
- City topography **medium**
- Total yearly driven fleet-km (km) **2.9 M**
- Total yearly transported passengers **15.8 M**
- Average fleet age (years) **5.5**
- Average commercial speed (km/h) **16.0**

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	15	-
Roof mounted pantograph	-	1

* Electric buses were delivered in 2021 but starting operations in 2022.

Clean over total number of driven kilometres, 2021



Share of clean buses

Geneva

Switzerland

Transports Publics Genevois

Stage of deployment

The 35% of the fleet is electric, taking advantage of overhead wires to incorporate in-motion charging electric buses additionally to battery electric and common trolleys.

Stage 0 — Strategy/ political will

Stage 1 — Bus pilots, small numbers

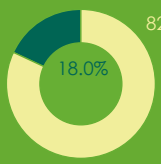
Stage 2 — Small lines/ simple operations

Stage 3 — More lines/ large service

Our goal is to increase capacity with electric articulated and bi-articulated buses achieving total electrification of the fleet by 2030.

- Total average weekday driven veh-km (km) **203***
- City topography **medium**
- Total yearly driven fleet-km (km) **23.4 M ***
- Total yearly transported passengers **84.9 M ***
- Average fleet age (years) **9.0**
- Average commercial speed (km/h) **18.0 ***

Clean over total number of driven kilometres, 2020



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	313	351
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	4	4
Solo (12-15 m)	35	39
Articulated (≥18 m)	274	308
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	12
Battery Trolley, In Motion Charging	33	55
Trolley	48	48
Diesel	232	236

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	12	-
Roof mounted pantograph	4	17

* Data for 2020.

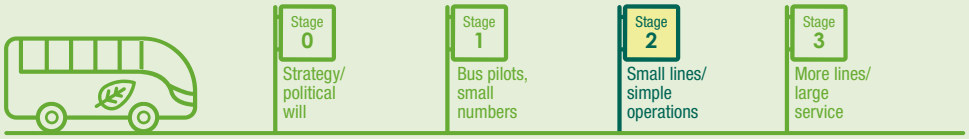
Lausanne

Switzerland

Transports Publics de la Région Lausannoise

Stage of deployment

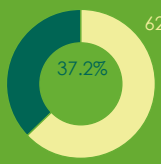
Battery trolleybus vehicles are already in operation. Battery electric buses are planned to complement the clean bus deployment.



The tl are currently building a transition program towards a 100% clean bus fleet by 2030, based on IMC vehicles thanks to its significant overhead contact lines network and both overnight & opportunity charging BEVs.

- Total average weekday driven veh-km (km)
  205
- City topography
  hilly
- Total yearly driven fleet-km (km)
  14.3 M
- Total yearly transported passengers
  57.3 M
- Average fleet age (years)
  6.0
- Average commercial speed (km/h)
  13.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	196	248
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	11	30
Solo (12-15 m)	24	32
Articulated (≥18 m)	155	173
Double decker bus	6	13
Vehicle propulsion type	**Total number of vehicles**	
Battery Trolley, In Motion Charging	-	28
Trolley	86	58
Natural Gas	13	-
Hybrids	-	12
Diesel	97	150

Charging & refuelling infrastructure

Information about charging and refuelling infrastructure is not available.

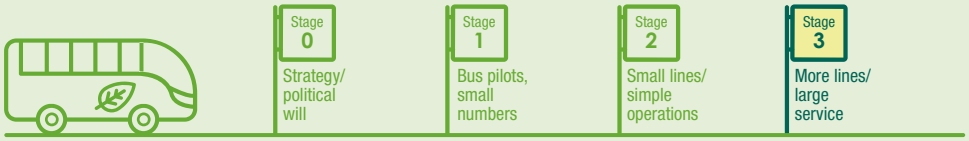
Schaffhausen

Switzerland

Verkehrsbetriebe Schaffhausen

Stage of deployment

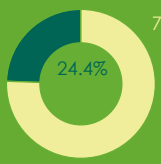
The charging infrastructure on the city bus routes is already fully installed (12x600 kW chargers at the train station).



By mid-2022, we will have 15 BEV and 7 trolley with IMC technology in operation, 50% of our bus fleet then electrified. The diesel and the trolleybuses will be completely replaced by BEV by 2028.

- Total average weekday driven veh-km (km)
  178
- City topography
  medium
- Total yearly driven fleet-km (km)
  2.9 M
- Total yearly transported passengers
  8.4 M
- Average fleet age (years)
  5.0
- Average commercial speed (km/h)
  20.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	39	44
Bus size	**Total number of vehicles**	
Solo (12-15 m)	19	17
Articulated (≥18 m)	20	27
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	12
Battery Trolley, In Motion Charging	-	7
Trolley	7	-
Diesel	32	25

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	17	-
Roof mounted pantograph	-	12

Zurich

Switzerland

Verkehrsbetriebe Zürich

Stage of deployment

In 2022, VBZ will convert eight lines to battery-electric operation by the end of the year. Further next steps are the commissioning of up to 50 battery-electric buses with garage charging and the conversion of two bus routes to battery trolley with IMC.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

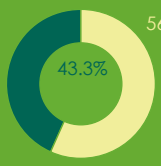
Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

The VBZ put its electric bus strategy "eBus VBZ" in place in 2016, aiming to largely replace the remaining 150 diesel buses by 2030 with vehicles with electric and emission-free drives.

- Total average weekday driven veh-km (km)
  210
- City topography
  flat
- Total yearly driven fleet-km (km)
  15.0 M
- Total yearly transported passengers
  222.0 M
- Average fleet age (years)
  9.4
- Average commercial speed (km/h)
  23.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	226	232
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	15	14
Solo (12-15 m)	41	41
Articulated (≥18 m)	170	177
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	1
Plug-in Hybrid Electric	-	16
Battery Trolley, In Motion Charging	-	10
Trolley	71	73
Hybrids	14	33
Diesel	141	99

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	18	-
Roof mounted pantograph	83	-

Amstelland-Meerlanden

The Netherlands

Connexxion (Transdev Nederland)

Stage of deployment

Transdev Nederland is implementing its clean bus strategy, increasing the number of e-buses to reach a zero-emissions fleet by 2030. To achieve this goal, the Netherlands has developed a long-term vision based on an integrated approach with political and private partners.

The Netherlands' Zero Emission Policy requires that from 2025 on, every new bus must be zero-emission, powered with 100% renewable energy or fuel. From 2030 on, bus transport services must be 100% zero-emissions.

- Total average weekday driven veh-km (km)
  n.a.
- City topography
  flat
- Total yearly driven fleet-km (km)
  n.a.
- Total yearly transported passengers
  n.a.
- Average fleet age (years)
  3.2
- Average commercial speed (km/h)
  n.a.

Share of clean buses

2017
37.7%

2021
69.8%

Current fleet data

Total bus fleet	2017	2021
	265	305
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	7	7
Solo (12-15 m)	61	14
Articulated (≥18 m)	179	266
Double decker bus	18	18
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	100	213
Diesel	165	92

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	84	-
Roof mounted pantograph	100	-

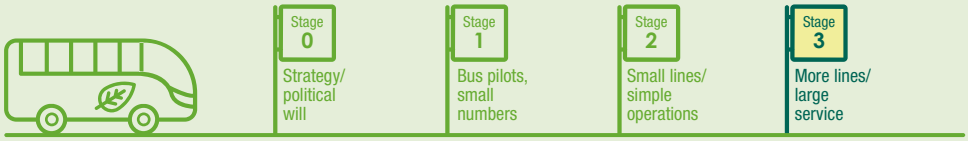
Amsterdam

The Netherlands

Gemeente Vervoerbedrijf Amsterdam

Stage of deployment

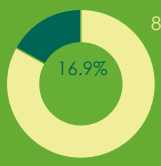
Currently, clean buses account for 20.4% of the fleet, covering 17% of the total yearly fleet-km.



Our policy, based on agreements with the city of Amsterdam, is to introduce battery electric buses and enable the transition to 100% clean public transport by 2025.

- Total average weekday driven veh-km (km)
  180
- City topography
  flat
- Total yearly driven fleet-km (km)
  14.2 M
- Total yearly transported passengers
  30.0 M
- Average fleet age (years)
  n.a.
- Average commercial speed (km/h)
  20.6

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	218	216
Bus size	**Total number of vehicles**	
Solo (12-15 m)	107	100
Articulated (≥18 m)	111	116
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	44
Diesel	218	172

Charging & refuelling infrastructure

Charging technology	Depot	On route
Roof mounted pantograph	44	10

Groningen

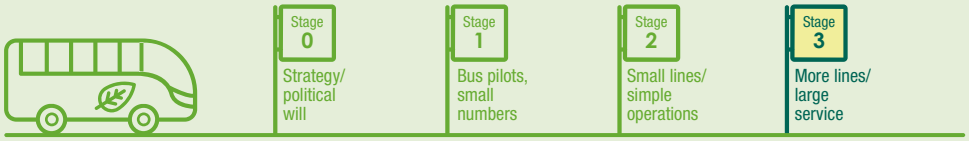
The Netherlands

OV-bureau Groningen Drenthe

ov bureau groningen drenthe

Stage of deployment

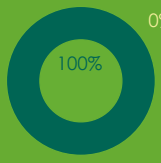
Half of the fleet has been converted to zero-emissions based on the lines' characteristics. This means that there is a mix of depot charging, opportunity charging and hydrogen fuel cell buses.



Our task in the upcoming years is to complete our fleet electrification targeting longer distance regional lines, smaller buses with challenging maximum vehicle weight, and motorway coaches.

- Total average weekday driven veh-km (km)
  n.a.
- City topography
  flat
- Total yearly driven fleet-km (km)
  n.a.
- Total yearly transported passengers
  27.0 M
- Average fleet age (years)
  2.0
- Average commercial speed (km/h)
  n.a.

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	342	379
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	-	23
Solo (12-15 m)	234	191
Articulated (≥18 m)	108	156
Double decker bus	-	9
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	6	158
Fuel Cell Hydrogen Electric	2	22
Other: Biofuel (HVO)	334	199

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	65	-
Roof mounted pantograph	102	23
Fuel cell hydrogen	1	1

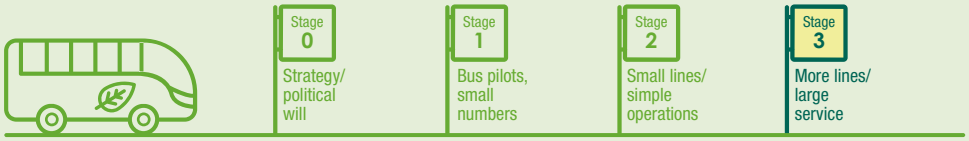
Haaglanden Streek

The Netherlands

EBS Public Transportation

Stage of deployment

The entire contract for regular public transportation is driven by clean buses, in a proportion of 80% CNG buses and 20% electric buses.



EBS's goal is to have 100% clean public transport buses operated from renewable sources by the end 2023.

- Total average weekday driven veh-km (km)
  245
- City topography
  flat
- Total yearly driven fleet-km (km)
  9.2 M
- Total yearly transported passengers
  7.5 M
- Average fleet age (years)
  n.a.
- Average commercial speed (km/h)
  26.3

Clean over total number of driven kilometres, 2021

Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	n.a.	116
Bus size		**Total number of vehicles**
Mini/ Midi (<12 m)	n.a.	23
Solo (12-15 m)	n.a.	93
Vehicle propulsion type		**Total number of vehicles**
Battery Electric	n.a.	23
Natural Gas	n.a.	93

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	6	-
Roof mounted pantograph	17	5
Natural gas	3	-

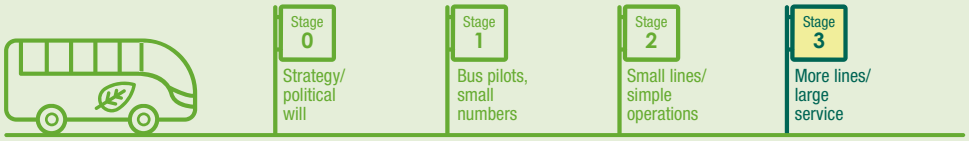
Rotterdam

The Netherlands

Rotterdamse Elektrische Tram

Stage of deployment

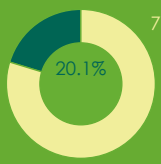
20% of the current yearly fleet-km are made on full electric mode.
Fuel cell hydrogen buses are present since 2017, and 55 e-buses since 2019, with additional 42 in 2022.



Rotterdam copes with issues regarding air quality, accessibility of the city and sustainability of the transport modes. To tackle this, RET aims at the full switch from Diesel to zero emission buses until 2030.

- Total average weekday driven veh-km (km)
  170
- City topography
  flat
- Total yearly driven fleet-km (km)
  14.6 M
- Total yearly transported passengers
  18.0 M
- Average fleet age (years)
  4.8
- Average commercial speed (km/h)
  23.6

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	278	278
Bus size	**Total number of vehicles**	
Solo (12-15 m)	276	276
Articulated (≥18 m)	2	2
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	55
Fuel Cell Hydrogen Electric	2	2
Hybrids	2	103
Diesel	274	118

Charging & refuelling infrastructure

Charging technology	Depot	On route
Roof mounted pantograph	64	16
Fuel cell hydrogen	0*	-

* Hydrogen buses are refueled at a public hydrogen refuelling station.

Voorne Putten & Rozenburg

The Netherlands

EBS Public Transportation

Stage of deployment

The entire contract for regular public transportation is driven by green CNG buses.

Stage 0 – Strategy/ political will

Stage 1 – Bus pilots, small numbers

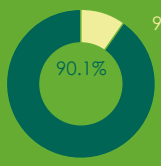
Stage 2 – Small lines/ simple operations

Stage 3 – More lines/ large service

> ***EBS's goal is to have 100% clean public transport buses operated from renewable sources by the end 2023.***

- Total average weekday driven veh-km (km)
  302
- City topography
  flat
- Total yearly driven fleet-km (km)
  4.9 M
- Total yearly transported passengers
  2.5 M
- Average fleet age (years)
  3.0
- Average commercial speed (km/h)
  33.9

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	n.a.	63
Bus size		**Total number of vehicles**
Mini/ Midi (<12 m)	n.a.	10
Solo (12-15 m)	n.a.	53
Vehicle propulsion type		**Total number of vehicles**
Natural Gas	n.a.	53
Diesel	n.a.	10

Charging & refuelling infrastructure

Charging technology	Depot	On route
Natural gas	2	-

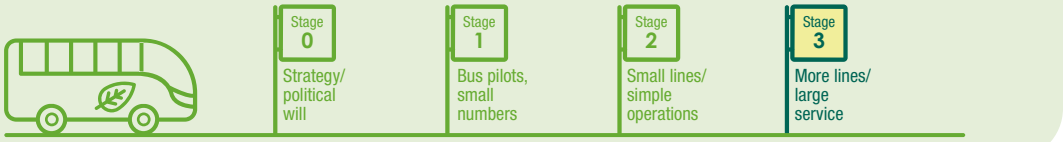
Waterland

The Netherlands

EBS Public Transportation

Stage of deployment

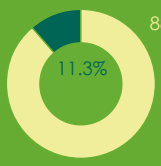
A small project of 10 electric buses has been implemented during the contract, with an average milage of 140,000 yearly driven-km per bus.



EBS's goal is to have 100% clean public transport buses operated from renewable sources by the end 2023.

- Total average weekday driven veh-km (km)
  250
- City topography
  flat
- Total yearly driven fleet-km (km)
  13.1 M
- Total yearly transported passengers
  15.9 M
- Average fleet age (years)
  10.0
- Average commercial speed (km/h)
  38.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	203	203
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	n.a.	8
Solo (12-15 m)	n.a.	160
Articulated (≥18 m)	n.a.	35
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	10	10
Diesel	193	193

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	10	-
Infrastructure mounted pantograph	-	3

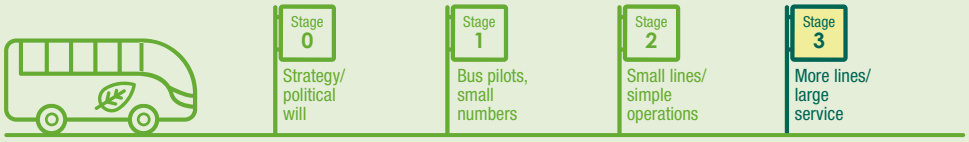
Zuidoost-Brabant

The Netherlands

Hermes (Transdev Nederland)

Stage of deployment

Transdev Nederland is implementing its clean bus strategy, increasing the number of e-buses to reach a zero-emissions fleet by 2030.



The Netherlands Zero Emission Policy requires that from 2025 on, every new bus must be zero-emission, powered with 100% renewable energy or fuel. From 2030 on, bus transport services must be 100% zero-emissions.

- Total average weekday driven veh-km (km)
  n.a.
- City topography
  flat
- Total yearly driven fleet-km (km)
  n.a.
- Total yearly transported passengers
  n.a.
- Average fleet age (years)
  7.1
- Average commercial speed (km/h)
  n.a.

Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	276	276
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	43	43
Diesel	233	233

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	22	-
Roof mounted pantograph	43	-

Brighton-East Sussex Crawley- West Sussex

UK

Brighton & Hove Buses, Metrobus

Stage of deployment

Complete service on two routes with series hybrid vehicles, with geofences delimiting zero-emission driving mode. The operator will introduce 20 new Fuel Cell electric vehicles from late 2022.

Brighton & Hove Buses aims to include 121 zero emission busses in the next three years. In the long term the company would reach zero emission fleet by 2035 and net zero by 2045.

Current fleet data

Total bus fleet	2017	2021
	446	429
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	-	1
Solo (12-15 m)	114	115
Articulated (≥18 m)	22	22
Double decker bus	310	291
Vehicle propulsion type	**Total number of vehicles**	
Hybrids	13	67*
Diesel	433	362

* 54 vehicles drive with a small euro 6 diesel generator that serves as a battery charger. They operate in zero emission mode with the generator switched off in a pre-determined geo fenced zones.

Total average weekday driven veh-km (km)
264

City topography
hilly

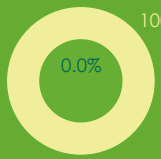
Total yearly driven fleet-km (km)
28.1 M

Total yearly transported passengers
35.8 M

Average fleet age (years)
8.8

Average commercial speed (km/h)
19.8

Clean over total number of driven kilometres, 2021



Share of clean buses

London

UK

RATP Dev Transit London

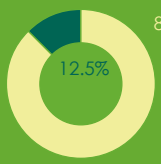
Stage of deployment

In 2021, 12.5% of the driven-km were made by electric buses which showcases the biggest advancements.

In line with TfL's strategy for 100% zero-emission buses by 2034, we plan to move to 25% of fleet by the end of 2022 and 40% e-buses by the end of 2024. Infrastructure challenges are the biggest hurdle, but we're well on the way to achieving this.

- Total average weekday driven veh-km (km)
  155
- City topography
  flat, medium
- Total yearly driven fleet-km (km)
  59.2 M
- Total yearly transported passengers
  174.3 M
- Average fleet age (years)
  7.6
- Average commercial speed (km/h)
  12.0

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	1,173	1,371
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	551	530
Double decker bus	622	841
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	4	313
Hybrids	325	397
Diesel	844	661

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	209	-

London

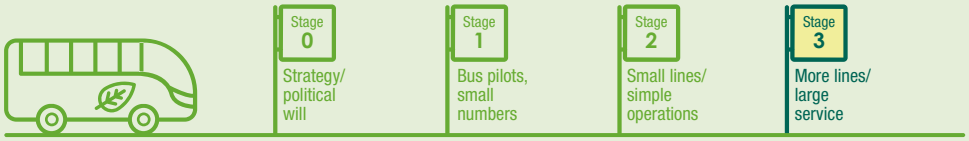
UK

Transport for London*

Transport for London

Stage of deployment

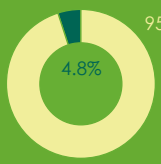
Transport for London currently has contracted over 650 zero-emission buses, including 20 hydrogen buses in the fleet. These vehicles operate across over 40 routes in London by TfL's contracted Bus Operating Companies.



Our aim is to have a fully zero-emission bus fleet by 2034, and will accelerate this where possible. TfL will work with all key stakeholders, such as manufacturers and Bus Operating Companies to achieve this goal.

- Total average weekday driven veh-km (km)
  173
- City topography
  medium
- Total yearly driven fleet-km (km)
  470.2 M
- Total yearly transported passengers
  1,313.0 M
- Average fleet age (years)
  7.1
- Average commercial speed (km/h)
  15.8

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	9,396	8,973
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	2,601	2,422
Solo (12-15 m)	100	92
Double decker bus	6,695	6,459
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	96	728
Fuel Cell Hydrogen Electric	10	22
Hybrids	3,240	3,859
Diesel	6,050	4,364

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	630	-
Fuel cell hydrogen	2	-

* Data for Transport for London includes also the subcontractor RATP Dev Transit London.

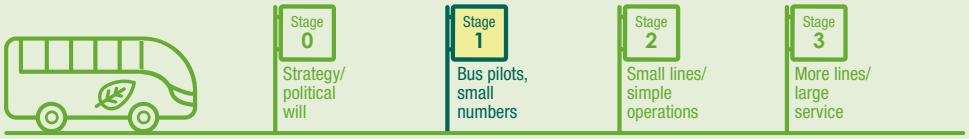
North East region

UK

Nexus

Stage of deployment

Since late 2021, nine electric minibuses account for 3.5% of the fleet. Additional 9 battery-electric buses are due in summer 2022 and the plan to deliver a further 73 zero-emission buses is pending to be funded.



To deliver a carbon neutral North East, we'll initiate actions to make travel net carbon zero, helping to tackle the climate emergency, addressing our air quality challenges, and helping to achieve the UK's net zero by 2050 commitment.

- Total average weekday driven veh-km (km)
  300
- City topography
  meidum
- Total yearly driven fleet-km (km)
  2.0 M*
- Total yearly transported passengers
  75.8 M
- Average fleet age (years)
  8.6
- Average commercial speed (km/h)
  26.0

Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	1,415	1,415
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	234	234
Solo (12-15 m)	637	637
Double decker bus	544	544
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	-	9
Natural Gas	40	40
Hybrids	40	40
Diesel	1,335	1,326

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	5	-
Natural gas	1	-

* Data refers to driven km in Tyne & Wear

West Midlands

UK

Transport for West Midlands

Transport for West Midlands

Stage of deployment

The future strategy is agreed. Some small pilots and large scale roll-out are ongoing. Currently, 34 battery electric and 20 fuel cell hydrogen buses are in operation.

Stage 0 — Strategy/ political will

Stage 1 — Bus pilots, small numbers

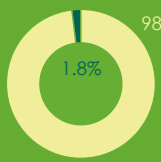
Stage 2 — Small lines/ simple operations

Stage 3 — More lines/ large service

Our bus service improvement plan requires all buses to be zero emisison by 2030, and the concrete strategy is being developed in cooperation with local operators.

- Total average weekday driven veh-km (km)
  145*
- City topography
  medium
- Total yearly driven fleet-km (km)
  111.0 M
- Total yearly transported passengers
  200.0 M
- Average fleet age (years)
  9.2
- Average commercial speed (km/h)
  18.2

Clean over total number of driven kilometres, 2021



Share of clean buses

Current fleet data

Total bus fleet	2017	2021
	2,450	2,410
Bus size	**Total number of vehicles**	
Mini/ Midi (<12 m)	200	193
Solo (12-15 m)	1,000	996
Double decker bus	1,250	1,221
Vehicle propulsion type	**Total number of vehicles**	
Battery Electric	3	34
Fuel Cell Hydrogen Electric	-	20**
Hybrids	20	-
Diesel	2,427	2,356

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	34	-
Fuel cell hydrogen	1	-

* UITP estimate based on provided data.
** Testing phase.

Chapter 3

Bus Manufacturers

Alexander Dennis Limited

ALEXANDER DENNIS

Clean bus specifications

	Enviro 400FCEV	BYD ADL Enviro400EV	BYD ADL Enviro200EV	Enviro 400ER
Vehicle type	FCHEV	BEV	BEV	PHEV
Bus size	Double decker	Double decker	Mini / Midi (<12 m)	Double decker
Total Passengers capacity	90	87	83	90
Gross vehicle weight (kg)	18,600	19,200	18,600	18,000
Top speed (km/h)	70	70	70	70
Airconditioning system	Forced air circulation	Forced air circulation	Full air conditioning	Forced air circulation
Heating system	Electric with heat pump	Electric with heat pump	Electric with heat pump	Thermal
Range (km)	450	250	250	5 (on zero-emission mode)
Year of EU introduction	2022	2019	2016	2019

Electric Motor	Supplier	Voith	BYD	BYD	BAE systems
	Type	Central	Axle-mounted	Axle-mounted	Central
Battery and fuel cell stack	Supplier	Ballard / (Fuel cell) Impact (Battery)	BYD	BYD	BAE Systems
	Total energy (kWh)	70 (Fuel cell) / 30 (Battery)	382	348	32
Charging system	Charging solution		DC plug, AC plug or infrastruc-ture-mount-ed panto-graph	DC plug or AC plug	DC plug
	Charging power (kW)		300	150	150
	Charging time (h/ min)		subject to charging installation	subject to charging installation	subject to charging installation
HRS refueling system	Refuelling system	700 bar			
	Refuelling time (min)	< 10 min			

Alexander Dennis, part of leading global independent bus manufacturer NFI Group, is the world's largest producer of double deck buses and has brought the widest range of low, ultra-low and zero emission buses to market.

BLUEBUS

bluebus

Clean bus specifications

Bus Model name	Bluebus 12 meters	Bluebus 6 meters
Vehicle type	BEV	BEV
Bus size	Solo (12-15 m)	Mini / Midi (<12 m)
Total Passengers capacity	90	35
Gross vehicle weight (kg)	20,000	8,300
Top speed (km/h)	70	70
Airconditioning system	100 % electric	100 % electric
Heating system	100% electric	100% electric
Range (km)	280	200
Year of EU introduction	2015	2011

Electric Motor	Supplier	Siemens	Actia
	Type	Brushless permanent magnet	Brushless permanent magnet
Battery and fuel cell stack	Supplier	BlueSolutions	BlueSolutions
	Total energy (kWh)	420	126
Charging system	Charging solution	Compatible with ABB, IES, Heliox, Comeca...	Wallbox
	Charging power (kW)	100	22
	Charging time (h)	5	6.5

Bluebus was founded in 2007 in Ergué-Gabéric (Brittany) and relies on the strength of a group dedicated to innovation, the Bolloré Group. Thanks to more than 10 years of experience in the design and operation of clean and silent public transport solutions, the company is currently one of the leading manufacturers of 100% electric buses in France. Bluebus provides you with solutions for urban and suburban areas, allowing you to reconsider urban mobility and meet the challenge of the energy transition. Choosing a Bluebus vehicle means opting for a French vehicle combining high technology, performance, design, and respect for the environment.

CAETANOBUS - FABRICAÇÃO DE CARROÇARIAS S.A.

CaetanoBus, part of Toyota Caetano Portugal and Mitsui & Co, is a bus and chassis manufacturer in Portugal. The company has a consolidated offer in vehicles for cities and airports which is a result of its technical capacity in developing unique, customer-oriented mobility solutions. CaetanoBus is also the manufacturer of COBUS, the world's market leader in airport bus transportation. CaetanoBus has been focusing on electric mobility since 1980.

Clean bus specifications

Bus Model name	e.City Gold	H2.City Gold	eCOBUS
Vehicle type	BEV	FCHEV	BEV
Bus size	Mini / Midi (<12 m), Solo (12-15 m)	Mini / Midi (<12 m), Solo (12-15 m)	Solo (12-15 m)
Total Passengers capacity	87	95	110
Gross vehicle weight (kg)	18,884 - 19,450 (depending on battery capacity)	17,700	20,400
Top speed (km/h)	Up to 80	Up to 80	Up to 70
Airconditioning system	Roof (26 kW – 38 kW)	Roof (26 kW)	Roof (36 kW – 48 kW)
Heating system	Electric Water Heater	Electric Water Heater	Electric Water Heater
Range (km)	Up to 300	Up to 400	Up to 70
Year of EU introduction	2018	2020	2013

Electric Motor	Supplier	SIEMENS	SIEMENS	SIEMENS
	Type	Permanent – magnet synchronous	Permanent – magnet synchronous	ELFA system, permanent-magnet synchronous motor
Battery and fuel cell stack	Supplier	Forsee Power	Toyota (fuel cell stack) / Forsee Power (battery)	Actia
	Total energy (kWh)	Up to 420	44	86 – 126
Charging system	Charging solution	CCS Type 2	CCS Type 2	GBT; CCS Type 1 & 2
	Charging power (kW)	Up to 150	Up to 150	Up to 150
	Charging time (h/min)	<4 h	<15 min	30 min – 3 h (depending on charger output)
HRS refueling system	Refuelling system		Hydrogen charging according to SAE J2601-2 and SAE J2799 (IR) protocols	
	Refuelling time (min)		<9 (according to SAE J2601-2 and SAE J2799 (IR) protocols)	

CARROSSERIE HESS AG

Leadership in design, quality and reliability have placed HESS in the front line of pioneering bus building. Because environmentally friendly HESS buses contribute significantly to enhancing the quality of life in cities and urban areas, many public transport companies in Switzerland, Europe and around the world have come to invest their long-term trust in HESS. Flexible thinking and advanced manufacturing technology embodied in our CO-BOLT® modular system will keep us there, continuously opening up new dimensions in design and performance concepts.

Clean bus specifications

Bus Model name	lighTram® 10 Plug	lighTram® 12 Plug	lighTram® 18 DC	lighTram® 19 OPP	lighTram® 25 TOSA
Vehicle type	BEV	BEV In-motion charging	BEV In-motion charging	BEV In-motion charging	BEV In-motion charging
Bus size	Mini / Midi (<12 m)	Solo (12-15 m)	Articulated (≥18 m)	Articulated (≥18 m)	Articulated (≥18 m)
Total Passengers capacity	56 – 88	82 – 102	153	135	200-220
Gross vehicle weight (kg)	18,000	19,000	< 30,000	< 30,000	< 40,000
Top speed (km/h)	80	80	65 DC mode / 80 battery mode	80	80
Airconditioning system	Heat pump	Heat pump	Heat pump	Heat pump	Heat pump
Heating system	Heat pump	Heat pump	Heat pump	Heat pump	Heat pump
Range (km)	n.a.	n.a.	n.a.	n.a.	n.a.
Year of EU introduction	2022	2022	2022	2018	2019

Electric Motor	Supplier	HESS	HESS	HESS	HESS	HESS
	Type	perma-nent syn-chronous magnet motor	perma-nent syn-chronous magnet motor	perma-nent syn-chronous magnet motor	permanent synchro-nous magnet motor	perma-nent syn-chronous magnet motor
Battery and fuel cell stack	Supplier	HESS	HESS	HESS	HESS	HESS
	Total energy (kWh)	333	399	35- 70	153 – 532	132
Charging system	Charging solution	Plug-in CCS2	Plug-in CCS2	DC-charging (in motion charging under catenary)	OPP-charging (opportuni-ty charg-ing)	TOSA (fast con-ductive charg-ing)
	Charging power (kW)	150	150	200	450	600
	Charg-ing time (h/min)	n.a.	n.a.	n.a.	n.a.	n.a.

CHARIOT MOTORS

Chariot Motors together with Aowei Technology and Higer Bus Company Limited have developed the first ever ultracapacitors electric bus (Chariot e-bus) to be used for commercial operation in Europe. Chariot e-bus is a silent, zero-emissions vehicle, which complies with the European homologation certifications, the strict market requirements in EU, including the ECE R100 standard for energy storage devices. We have ongoing projects in several European countries and Israel and more than 110 electric buses currently in operation or under production.

Clean bus specifications

Bus Model name	Chariot e-bus 8	Chariot e-bus 12	Chariot e-bus 18
Vehicle type	BEV ultracapacitors	BEV ultracapacitors	BEV ultracapacitors
Bus size	Mini/ Midi (<12 m)	Solo (12-15 m)	Articulated (≥18 m)
Total Passengers capacity	58	80	135
Gross vehicle weight (kg)	12700	18600	29000
Top speed (km/h)	80	80	80
Airconditioning system	yes	yes	yes
Heating system	yes	yes	yes
Range (km)	20-30	35-40	40
Year of EU introduction	2020	2014	2022

Electric Motor	Supplier	Dana	Siemens	Dana
	Type	synchronous electric motor	synchronous electric motor	synchronous electric motor
Battery and fuel cell stack	Supplier	Aowei	Aowei	Aowei
	Total energy (kWh)	36 kWh	72 kWh	108 kWh
Charging system	Charging solution	pantograph or CCS2	pantograph or CCS2	pantograph or CCS2
	Charging power (kW)	150 - 450	150 - 450	150 - 450
	Charging time (min)	8	10	15

EBUSCO

Ebusco is dedicated to the development, production, and bringing to market of fully electric city and regional buses and the associated ecosystem. Our goal is to contribute to a better and healthier living environment by making sustainable, emission-free transport of people the standard. Ebusco is originally a Dutch company, with its head office in Deurne. At the moment more than 350 Ebusco buses are operating in seven countries across Europe, including major cities such as Amsterdam, Frankfurt and Munich. Together we work on creating clean cities.

Clean bus specifications

Bus Model name	Ebusco 2.2	Ebusco 3.0
Vehicle type	BEV	BEV
Bus size	Solo (12-15 m) Articulated (≥18 m)	Solo (12-15 m) Articulated (≥18 m)
Total Passengers capacity	90 150	90 150
Gross vehicle weight (kg)	12,850 19,000	8,530 14,500
Top speed (km/h)	80	80
Airconditioning system	Thermoking	Thermoking
Heating system	Thermoking	Thermoking
Range (km)	450	575
Year of EU introduction	2017	2021

Electric Motor	Supplier	ZF	ZF
	Type	ZF	ZF
Battery and fuel cell stack	Supplier	n.a.	n.a.
	Total energy (kWh)	n.a.	n.a.
Charging system	Charging solution	Ebusco	Ebusco
	Charging power (kW)	150	150
	Charging time (h/min)	n.a.	n.a.

EVOBUS GMBH

DAIMLER TRUCK
Daimler Buses

EvoBus GmbH is Daimler Truck AG's largest European subsidiary. With our brands Mercedes-Benz, Setra, OMNIplus and BusStore, we are the leading full-line provider in the European bus market and have a global presence, as well. We have continued to develop and have positioned ourselves viably for the future. As part of the Daimler Truck Buses business unit, we are not only Europe's largest bus manufacturer but also one of the leading bus manufacturers worldwide.

Clean bus specifications

Bus Model name	eCitaro	eCitaro Artic
Vehicle type	BEV	BEV
Bus size	12	18
Total Passengers capacity	79	147
Gross vehicle weight (kg)	20.000	30.000
Top speed (km/h)	80	80
Airconditioning system	Air conditioning with heat pump	Air conditioning with heat pump
Heating system	Air conditioning with heat pump	Air conditioning with heat pump
Range (km)	Up to 270	Up to 180
Year of EU introduction	2018	2020

Electric Motor	Supplier	ZF	ZF
	Type	Drive axle with two wheel hub motors	Drive axle with two wheel hub motors
Battery and fuel cell stack	Supplier	Akasol	Akasol
	Total energy (kWh)	396	396
Charging system	Charging solution	Charging Plug / Pantograph or Charging rails	Charging Plug / Pantograph or Charging rails
	Charging power (kW)	150 – 300	150 – 300
	Charging time (h)	Up to 2.5 (Depending on battery configuration and charging power)	Up to 2.5 (Depending on battery configuration and charging power)

IRIZAR

Irizar e-mobility
for a better life

Clean bus specifications

Bus Model name	Irizar ie bus	Irizar ie tram
Vehicle type	BEV	BEV
Bus size	Mini/ Midi (<12 m) Solo (12-15 m) Articulated (≥18 m)	Solo (12-15 m) Articulated (≥18 m)
Total Passengers capacity	145	145
Gross vehicle weight (kg)	n.a.	n.a.
Top speed (km/h)	85	85
Airconditioning system	Electric	Electric
Heating system	Electric	Electric
Range (km)	n.a.	n.a.
Year of EU introduction	2014	2017

Electric Motor	Supplier	n.a.	n.a.
	Type	n.a.	n.a.
Battery and fuel cell stack	Supplier	n.a.	n.a.
	Total energy (kWh)	n.a.	n.a.
Charging system	Charging solution	CCS 2 plug, roof-mounted pantograph, infra-structure-mounted pantograph	CCS 2 plug, roof-mounted pantograph, infra-structure-mounted pantograph
	Charging power	600	600
	Charging time (h/ min)	Variable	Variable

At Irizar e-mobility, we offer comprehensive electromobility solutions for cities, both in terms of manufacturing zero emissions 100% electric vehicles, and in terms of manufacturing and installing the major infrastructure systems necessary for charging, traction, and energy storage, all with the application of the Group's completely European technology and with Irizar's warranty and service quality. The operator therefore has the added benefit of having a single point of contact at every stage of the project, including detailed consultation, comprehensive vehicle care and an after-sales, maintenance and repair service which are tailored to the customer's needs. Our vehicle range currently includes three models: Irizar ie bus, Irizar ie tram and Irizar ie truck.

IVECO GROUP

IVECO GROUP

Iveco Group is the house of eight unique, yet unified Brands: IVECO, a pioneering champion that designs, manufactures and commercializes heavy, medium and light duty commercial vehicles; FPT Industrial, a global leader in advanced powertrain technologies for agriculture, construction, marine, power generation and commercial vehicle applications; IVECO BUS and HEULIEZ, premium and mass transit bus and coach brands; Iveco Defense Vehicles, highly-specialised defense and civil protection equipment; ASTRA, a global expert in large-scale, heavy-duty quarry and construction vehicles; Magirus, the highly reputed firefighting vehicle and equipment manufacturer; IVECO CAPITAL, the financing arm which supports them all, serving as the cornerstone of Iveco Group's new business models.

Clean bus specifications

Bus Model name	GX EWAY Electric 12m Night Charge & Opportunity Charge	GX EWAY Electric 10m Night Charge	GX EWAY Electric 18m Opportunity charge	CROSSWAY Electric 12 / 13m Night Charge & opportunity Charge	EWAY Trolley IMC 18m
Vehicle type	BEV	BEV	BEV	BEV	In-motion charging
Bus size	Solo (12-15 m)	Mini/ Midi (<12 m)	Articulated (≥18 m)	Solo (12-15 m)	Articulated (≥18 m)
Total Passengers capacity	95	80	150	73	130
Gross vehicle weight (kg)	20,000	17,500	30,000	19,500	30,000
Top speed (km/h)	80	80	80	100	70
Aircon-ditioning system	Standard Electric AC	Standard Electric AC	Standard Electric AC	Standard Electric AC	Standard Electric AC
Heating system	Electric boiler or bi-mode heater	Electric boiler or bi-mode heater	Electric boiler or bi-mode heater	Electric boiler or bi-mode heater	Electric boiler
Range (km)	250	250	60	300	20
Year of EU introduction	2018	2021	2019	2023	2020

Electric Motor	Supplier	Siemens	Sie-mens	BAE – Siemens	Siemens	Skoda
	Type	PSM	PSM	PSM	PSM	ASM
Battery and fuel cell stack	Supplier	Forsee	Forsee	Forsee	Forsee	Skoda - ALTERNA-NO
	Total energy (kWh)	420	420	120	499	51
Charging system	Charging solution	Night charge or opportunity charge in-frastructure mounted pantograph	Night charge	Oppor-tunity charge with roof mounted or infra-structure mounted panto-graph	Night charge or with roof mounted or infra-structure mounted panto-graph	Over-head wires or Night Charge CCS
	Charging power (kW)	150 or 450	150	450	150	120
	Charging time (h/ min)	4 h	4 h	5-10 min	4 h	15 min

MAN TRUCK & BUS SE

MAN Truck & Bus is one of Europe's leading commercial vehicle manufacturers. It provides transport solutions: its portfolio includes vans, trucks, buses, diesel and gas engines and a range of services relating to the transport of passengers and goods. MAN Truck & Bus is a TRATON SE company.

Clean bus specifications

Bus Model name	MAN Lion's City G EfficientHybrid	MAN Lion's City E
Vehicle type	CNG	BEV
Bus size	Solo (12-15 m) Articulated (≥18 m)	Solo (12-15 m) Articulated (≥18 m)
Total Passengers capacity	n.a. n.a.	130
Gross vehicle weight (kg)	28,000	29,500
Top speed (km/h)	100	83
Airconditioning system	Yes	Heat pump
Heating system	Yes	Heat pump, electric heaters and fuel-based auxiliary heater in option
Range (km)	500	350
Year of EU introduction	2018	2020

Electric Motor	Supplier	VW group	VW group
	Type		Permanent magnet synchronous
	Power Peak (Kw)		
Battery and fuel cell stack	Supplier		Various
	Total energy (kWh)		480 – 640
Charging system	Charging solution		CCS, up to 150 kW
	Charging power (kW)		150
	Charging time (h)		4 – 5
HRS refueling system	Refuelling system	Depending on pressure	
	Refuelling time (min)	n.a.	
Natural gas refueling system	Refuelling system	NGV1/NGV2	
	Refuelling time (min)	n.a.	

OTOKAR OTOMOTIV VE SAVUNMA SANAYI A.S.

Otokar

Otokar, a Koç Group company and the leading Turkish bus brand, offers solutions tailored to the needs of its customers using its own technology, design and applications. With lengths ranging from 6.6 meters to 21 meters, Otokar offers a complete range of urban vehicles to optimize the fleets of public transport operators. Otokar has introduced Turkey's first hybrid bus (2007) and first electric bus (2012) to the market, continues to work on alternative fuel buses. More than 32,000 Otokar coaches and buses are currently used in over 50 countries.

Clean bus specifications

Bus Model name	e-Kent C	e-Centro C	Kent C CNG	Territo U CNG
Vehicle type	BEV	BEV	CNG	CNG
Bus size	Mini/ Midi (<12 m) Solo (12-15 m) Articulated (≥18 m)	Mini/ Midi (<12 m)	Mini/ Midi (<12 m) Solo (12-15 m) Articulated (≥18 m)	Solo (12-15 m)
Total Passengers capacity	95 108 151	33	94 107 154	63
Gross vehicle weight (kg)	20500 20500 30000	7000	20000 20000 29000	20000
Top speed (km/h)	85 85 75	100	85 85 75	100
Airconditioning system	Roof Top - 39kW	Roof Top - 17.4kW	Roof Top - 39kW	Roof Top - 36kW
Heating system	Roof Top - 19kW & Cabin heating through coolant circulation available	Roof Top - 16.2kW	Roof Top - 39kW & Cabin heating through coolant circulation available	Roof Top - 39kW & Cabin heating through coolant circulation available
Range (km)	300 300 300	230	575 575 530	675
Year of EU introduction	2021	2022	2019	2021

Electric Motor	Supplier	Voith	DANA-TM4		
	Type	Permanent Magnet	Asynchronous		
	Power Peak (Kw)				
Battery and fuel cell stack	Supplier	Webasto	Svolt Modules - Otokar Battery		
	Total energy	350 kWh (mini / midi) 350 kWh (solo) 560 kWh (articulated)	110 kWh		
Charging system	Charging solution	Plug-in	Plug-in		
	Charging power (kW)	150	82		
	Charging time (h)	4	3		
Natural gas refueling system	Refuelling system			NGV-1 and/or NGV-2	NGV-1 and/or NGV-2
	Refuelling time (min)			n.a.	n.a.

SAFRA

SAFRA is a historic player in the renovation of passenger transport equipment, but also in clean and sustainable mobility. SAFRA's strategy is based on environmental and social issues, through its different activities: the construction and marketing of hydrogen buses under the Businova® brand, the retrofit of coaches with hydrogen, the renovation and heavy maintenance of passenger transport vehicles, as well as customer service.

Clean bus specifications

Bus Model name	Businova 12-H2
Vehicle type	FCHEV
Bus size	Solo (12-15 m)
Total Passengers capacity	88
Gross vehicle weight (kg)	19,000
Top speed (km/h)	70
Airconditioning system	n.a.
Heating system	n.a.
Range (km)	400
Year of EU introduction	2018

Electric Motor	Supplier	n.a.
	Type	n.a.
	Power Peak (Kw)	250
Battery and fuel cell stack	Supplier	n.a.
	Total energy	132 kWh (battery) / 35 kWh (fuell cell stack)
HRS refueling system	Refuelling system	n.a.
	Refuelling time (min)	15

SCANIA CV AB

Scania is a world-leading provider of transport solutions, including trucks and buses for heavy transport applications combined with an extensive product-related service offering. Scania's purpose is to drive the shift towards a sustainable transport system, creating a world of mobility that is better for business, society and the environment.

Clean bus specifications

Bus Model name	Scania Citywide LF	Scania Citywide LE	Scania Irizar i4	Scania Irizar i6s (Class III)	Scania Interlink LD (Class III)
Vehicle type	BEV CNG Full-hybrid	CNG Full-hybrid	CNG LNG Full-Hybrid	LNG Full-Hybrid	CNG LNG Full-Hybrid
Bus size	Solo (12-15 m) Articulated (≥18 m)	Solo (12-15 m) Articulated (≥18 m)	Solo (12-15 m)	Solo (12-15 m)	Solo (12-15 m)
Total Passengers capacity	90	130	60	60	70
Gross vehicle weight (kg)	19,000	24,000	24,000	24,000	24,000
Top speed (km/h)	80	100	100	100	100
Aircon-ditioning system	BEV HVAC	AC	AC	AC	AC
Heating system	BEV HVAC	Engine	Engine	Engine	Engine
Range (km)	250	500	1000	1000	500
Year of EU introduc-tion	2018	2021	2021	2021	2021

Electric Motor	Supplier	Scania				
	Type	Central				
	Power Peak (Kw)					
Battery and fuel cell stack	Supplier	Samsung				
	Total ener-gy (kWh)	300				
Charging system	Charging solution	Panto-graph and CCS type 2				
	Charging power (kW)	300 - 150				
	Charging time (h/ min)	Depends on charger				
Natural gas refueling system	Refuelling system	CNG type 1 and 2	CNG type 1 and 2	CNG type 1 and 2 or LNG	LNG	CNG type 1 and 2 or LNG
	Refuelling time (min)	CNG: 5 – 10	CNG: 5 – 10	CNG: 5 – 10 LNG: 20	CNG: 5 – 10 LNG: 20	CNG: 5 – 10 LNG: 20

SOLARIS BUS & COACH SP. Z O.O.

Solaris Bus & Coach sp. z o.o. is one of the leading European bus and trolleybus manufacturers. Benefiting from 25 years of experience and having manufactured more than 20,000 vehicles, Solaris affects the quality of city transport in hundreds of cities across Europe every day. Thinking of the future, the firm is setting new standards by dynamically developing its products, in particular in the electromobility sector. Solaris products have been repeatedly awarded for quality and innovation in Poland, as well as in other countries. The Solaris Urbino 12 electric won the prestigious European "Bus of the Year 2017" competition. In September 2018 Solaris Bus & Coach sp. z o.o. joined CAF Group, which acquired 100% of the shares of company.

Clean bus specifications

Bus Model name	Solaris Urbino 9 electric	Solaris Urbino 12 electric	Solaris Urbino 15 electric	Solaris Urbino 18 electric
Vehicle type	BEV	BEV	BEV	BEV
Bus size	Mini/ Midi (<12 m)	Solo (12-15 m)	Solo (12-15 m)	Articulated (≥18 m)
Total Passengers capacity	73	74	90	120
Gross vehicle weight (kg)	16,000	19,000	25,000	28,000
Top speed (km/h)	70 - 90	70 - 90	70 - 90	70 - 90
Airconditioning system	Electric or heat pump	Electric or heat pump	Electric or heat pump	Electric or heat pump
Heating system	Electric, hybrid or heat pump	Electric, hybrid or heat pump	Electric, hybrid or heat pump	Electric, hybrid or heat pump
Range (km)	n.a.	n.a.	n.a.	n.a.
Year of EU introduction	2021	2013	2020	2014

Electric Motor	Supplier	Siemens	ZF or TSA	ZF	ZF or TSA
	Type	Central	Central or axle	Central	Central or axle
Battery and fuel cell stack	Supplier	Depends on battery type	Depends on battery type	Depends on battery type	Depends on battery type
	Total energy (kWh)	317	475	554	554
Charging system	Charging solution	Plug-in, roof-mounted pantograph or infrastructure-mounted pantograph	Plug-in, roof-mounted pantograph or infrastructure-mounted pantograph	Plug-in, roof-mounted pantograph or infrastructure-mounted pantograph	Plug-in, roof-mounted pantograph or infrastructure-mounted pantograph
	Charging power (kW)	Plug in up to 260 kW, pantograph up to 450 kW	Plug in up to 260 kW, pantograph up to 560 kW	Plug in up to 260 kW, pantograph up to 450 kW	Plug in up to 260 kW, pantograph up to 560 kW
	Charging time (h/ min)	Depends on battery capacity	Depends on battery capacity	Depends on battery capacity	Depends on battery capacity

TEMSA

TEMSA is a midibus manufacturer providing a diversity of transportation solutions for our customers building on our 50 years of experience. TEMSA 's mission is to be the human-centered technology company which provides smart and sustainable mobility solutions to the world for more pleasant journeys.

Clean bus specifications

Bus Model name	Avenue Electron	MD9 Electicity	Avenue EV	Avenue CNG
Vehicle type	BEV	BEV	BEV	CNG
Bus size	Solo (12-15 m)	Mini/Midi (<12 m)	Solo (12-15 m)	Solo (12-15 m)
Total Passen-gers capacity	92	63	92	102
Gross vehicle weight (kg)	19,145	14,440	19,145	19,145
Top speed (km/h)	80	80	80	80
Aircondition-ing system	Valeo 37kW	Cling 27kW	Valeo 37kW	Safkar 42kW
Heating system	Valeo 22kW / Heat pump	Valeo 22kW / Heat pump	Valeo 22kW / Heat pump	
Range (km)	433	300	84	n.a.
Year of EU introduction	2019	2018	2020	2022

Electric Motor	Supplier	TM4	TM4	Aselsan	
	Type	Synchro-nous Permanent Magnet Type	Synchro-nous Permanent Magnet Type	Synchro-nous Permanent Magnet Type	
Battery and fuel cell stack	Supplier	TEMSA	TEMSA	ALTINAY	
	Total energy (kWh)	390	240	101	
Charging system	Charging solution	CCS2 plug	CCS2 plug	CCS2 plug / Panto-graph	
	Charging power (kW)	150	150	450	
	Charging time (h/ min)	3 h	2 h	15 min	
Natural gas refueling system	Refueling system				NGV2
	Refueling time (min)				20 - 25

VAN HOOL NV

Van Hool is an independent bus, coach and industrial vehicles manufacturer. The company, founded in 1947, is based in Koningshooikt (Belgium). The vast majority of units produced are destined for Europe and the US. Van Hool has around 3,300 staff worldwide, the majority of whom work at the production facilities in Koningshooikt (Belgium) and Skopje (North Macedonia). As a major bus manufacturer in Europe, Van Hool offers a complete range of 100% zero-emission buses (battery, fuel cell and trolley) for public transport purposes (city and inter-city) for international markets, ranging from a 10m city-bus to a 24m double articulated low floor bus.

Clean bus specifications

Bus Model name	XQC18 FC	XQC24 E	XQC18 T	A12 E	A12 FC
Vehicle type	FCHEV	BEV	In-motion charging	BEV	FCHEV
Bus size	Articulated (≥18 m)	Articulated (≥18 m)	Articulated (≥18 m)	Solo (12-15 m)	Solo (12-15 m)
Total Passengers capacity	145	134	134	85	81
Gross vehicle weight (kg)	29,000	39,000	30,000	19,500	19,500
Top speed (km/h)	70	67	70	80	83
Airconditioning system	AC136AE	2xAC136AECA + V520CA	AC230	Heavac Borealis	Heavac Borealis
Heating system	integrated in AC-system	integrated in AC-system	integrated in AC-system	integrated in AC-system	integrated in AC-system
Range (km)	350	220	20 (on battery only)	330	350
Year of EU introduction	Currently available	Currently available	Currently available	Currently available	Currently available

Electric Motor	Supplier	Siemens	Siemens	VEM	ZF	Siemens
	Type	PEM 210 kW	2 x PEM 160 kW	2 x 160 kW (asynchronous motor)	2 x 125 kW	PEM 210 kW
Battery and fuel cell stack	Supplier	Ballard	n.a.	n.a.	n.a.	Ballard
	Total energy (kWh)	100	n.a.	n.a.	n.a.	70
Charging system	Charging solution		CCS plug in	IMC	CCS plug in	
	Charging power (kW)	n.a.	150	n.a.	185	n.a.
	Charging time (h/min)	n.a.	depending on charging infrastructure	depending on charging infrastructure	depending on charging infrastructure	n.a.
HRS refueling system	Refuelling system	H2 refueling station				H2 refueling station
	Refuelling time (min)	10				10

VDL BUS & COACH

VDL Bus & Coach introduced the first electric bus (Citea) to the market in 2013. Since then, over 1000 electric buses have been delivered and more than 150 million electric kilometres have been driven. The core activities of VDL Bus & Coach consist of the development, manufacturing, sales and after-sales of a wide range of buses and coaches, the conversion or extension of mini & midi buses and the purchase and sales of used buses. VDL Bus & Coach consists of multiple bus companies that operate cooperatively in the global market. VDL Bus & Coach is a solid partner in developing and transitioning to smart and sustainable transport solutions which add value for people. Now and in the future.

Clean bus specifications

Bus Model name	New Generation Citea LF-122	New Generation Citea LF-181	New Generation Citea LE-122	New Generation Citea LE-135	New Generation Citea LE-149
Vehicle type	BEV	BEV	BEV	BEV	BEV
Bus size	Solo (12-15 m)	Articulated (≥18 m)	Solo (12-15 m)	Solo (12-15 m)	Solo (12-15 m)
Total Passengers capacity	110	150	105	90	140
Gross vehicle weight (kg)	19,500	29,000	19,500	19,500	25,250
Top speed (km/h)	80	80	100	100	100
Aircon-ditioning system	Electric heat pump	Electric heat pump	Electric heat pump	Electric heat pump	Electric heat pump
Heating system	Electric heat pump and possible HV and/or die-sel heater	Electric heat pump and possible HV and/or die-sel heater	Electric heat pump and possible HV and/or die-sel heater	Electric heat pump and possible HV and/or die-sel heater	Electric heat pump and possible HV and/or die-sel heater
Range (km)	900	950	900	950	1050
Year of EU introduction	2022	2023	2022	2023	2023
Electric Motor – Supplier	ZF	ZF	ZF	ZF	ZF
Electric Motor – Type	AxTrax AVE Electric portal axle	AxTrax AVE Electric portal axle	CeTrax Electrical Central Drive	CeTrax Electrical Central Drive	CeTrax Electrical Central Drive
Battery and fuel cell stack – Supplier	VDL High Energy battery	VDL High Energy battery	VDL High Energy battery	VDL High Energy battery	VDL High Energy battery
Battery and fuel cell stack – Total energy (kWh)	490	674	490	552	674
Charg-ing system – Charging solution	CCS2, infrastruc-ture-mount-ed panto-graph	CCS2, infrastruc-ture-mount-ed panto-graph	CCS2, infrastruc-ture-mount-ed panto-graph	CCS2, infrastruc-ture-mount-ed panto-graph	CCS2, infrastruc-ture-mount-ed panto-graph
Charg-ing system – Charging power (kW)	429	530	429	530	520
Charg-ing system – Charging time (h/min)	5 min – 3 h	5 min – 4 h	5 min - 3.15 h	5 min - 3.15 h	5 min – 4 h

VOLVO BUSES

VOLVO

Clean bus specifications

Bus Model name	7900E	7900EA
Vehicle type	BEV	BEV
Length in m	Solo (12-15 m)	Articulated (≥18 m)
Total Passengers capacity	95	150
Gross vehicle weight (kg)	19,500	30,000
Top speed (km/h)	80	80
Airconditioning system	600V electric HVAC system	600V electric HVAC system
Heating system	600V heat pump and Diesel/electric aux. heater	600V heat pump and Diesel/electric aux. heater
Fuel economy (kW/km)	SORT2 0.78	SORT2 1.0
Year of EU introduction	2015	2018

Volvo Buses is one of the world's leading providers of sustainable people transport solutions. We offer premium city- and intercity buses, coaches, and bus chassis as well as a wide range of services for increased productivity, uptime and safety. Volvo Buses has sales in 85 countries and a global service network with more than 1,500 dealerships and workshops. Care and respect for people and nature are fundamental for us. This explains why Volvo Buses has a strong reputation for social responsibility and ethical behaviour. We are passionate and human-centric, with a clear focus on a premium experience for our customers, partners, users and employees.

Electric Motor	Supplier	Volvo	Volvo
	Type	Permanent magnet synchronous motor	Permanent magnet synchronous motor
Battery and fuel cell stack	Supplier	Volvo	Volvo
	Total energy (kWh)	Volvo 94 (3,4 or 5 batteries)	Volvo 94(3,4 or 5 batteries)
Charging system	Charging solution	High Power, Low Power	High Power, Low Power
	Charging power (kW)	Up to 300	Up to 450
	Charging time (h/min)	Depends on battery configuration in combination with charging type	Depends on battery configuration in combination with charging type

YUTONG BUS CO.,LTD

As the world's major bus and coach supplier, Yutong is a large-scale enterprise mainly specialized in bus business and also covers areas of construction machinery, real estate and other investment business. Yutong has four manufacturing bases for conventional buses, new energy buses, special vehicles and parts & components. Up to now, Yutong has formed a complete 5m-18m product lineup consisting of buses and coaches and covering various segment markets. The sales performance take a lead in the world. Yutong has realized a sizable sales volume in over 30 countries and regions such as France, UK, Australia, Russia, Saudi Arabia, Kazakhstan, Mexico , Norway and so on with a market share of over 35% in China and over 13% in the world. In the main target markets, Yutong has become one of the world's major bus and coach suppliers.

Clean bus specifications

Bus Model name	E15	E12	E10	T12E	E9
Vehicle type	BEV	BEV	BEV	BEV	BEV
Length in m	Solo (12-15 m)	Solo (12-15 m)	Mini/Midi (<12 m)	Solo (12-15 m)	
Total Passengers capacity	90	75	70	61	62
Gross vehicle weight (kg)	24600	18500	18300	19500	14300
Top speed (km/h)	80	80	70	100	80
Air-conditioning system	Standard configuration: Pure electric A/C, both heating and cooling Option configuration: CO_2 A/C	Standard configuration: Pure electric A/C, both heating and cooling Option configuration: CO_2 A/C	Standard configuration: Pure electric A/C, both heating and cooling Option configuration: CO_2 A/C	Standard configuration: Pure electric A/C, both heating and cooling Option configuration: CO_2 A/C	Pure electric A/C
Heating system	Electric heating radiator	Standard configuration: Electric heating radiator Option Standard configuration: Electric heating radiator	Electric heating radiator	Standard configuration: Electric heating radiator Option Standard configuration: Electric heating radiator	Electric heating radiator
Fuel economy (kW/km)	1.2	0.85	0.85	0.95	0.586
Year of EU introduction	2020	2015	2021	2021	2021

Electric Motor	Supplier	Yutong Bus	Yutong Bus	Yutong Bus	Yutong Bus	Yutong Bus
	Type	TZ400XSYTB26	TZ368XSYTB38	TZ368XSYTB38	TZ368XSYTB38	TZ400XSYTB44
	Power Peak (Kw)					
Battery and fuel cell stack	Supplier	CATL	CATL	CATL	CATL	CATL
	Total energy	563.8 kWh	422.87 kWh	422.87 kWh	422.87 kWh	255.48 kWh
Charging system	Charging solution	Double charging ports (Chinese Standard)	Standard configuration: Single charging port (European Standard) Option configuration: Double charging ports (European Standard)	Standard configuration: Single charging port (European Standard) Option configuration: Double charging ports (European Standard)	Standard configuration: Single charging port (European Standard) Option configuration: Double charging ports (European Standard)	Single charging port (European Standard)
	Charging power (kW)	300	Standard configuration: 120 Option configuration: 240	Standard configuration: 120 Option configuration: 240	Standard configuration: 120 Option configuration: 240	120kW
	Charging time (h/min)	1.9 h (25˚C, 20%-100%)	Single charging: 2.8 h (25˚C, 20%-100%) Double charging: 1.5 h (25˚C, 20%-100%)	Single charging: 2.8 h (25˚C, 20%-100%) Double charging: 1.8 h (25˚C, 20%-100%)	Single charging: 2.8 h (25˚C, 20%-100%) Double charging: 1.8 h (25˚C, 20%-100%)	2.1 h (25˚C, 20%-100%)

Chapter 4
System Suppliers

ABB GROUP

We are the global leader in EV charging technology with the highest uptime and largest installed base of DC fast chargers in the market. Using critical cloud-based connectivity, we remotely diagnose, cure infrastructure and update in-house developed software. With more than 13 years of experience in DC fast charging and commercial products introduced since May 2010, we have an unparalleled reach with sales of more than 440,000 electric vehicle chargers across more than 88 markets, including more than 21,000 fast chargers and 420,000 AC chargers.

Charging Systems	Depot box combined with HVC 160 power cabinet.	Control box/ Cable reel combined with HVC 160 power cabinet	HVC Pantograph down	HVC Pantograph up	Pantograph Down Depot set
Product description	The HVC depot box with single or double outlet can be mounted on a wall or on a pedestal and are especially designed to charge larger fleets of electric vehicles in its most optimized way with limited footprint. Capable of sequential charging up to 4 outlets.	The HVC control box is specifically developed for overhead constructions like a roof, canopy or truss structure. Several cable management systems are available like an automated cable reel or a simple cable balancer. With this small and light design control box it is possible to mount the control box on any structure and have the cable hanging down close to the vehicle inlet.	Fully automated pantograph charging solution following the OppCharge protocol. With typical charge times of 3 to 6 minutes the pantograph system can easily be integrated in existing operations, ensuring zero-emission public transit during the day without impacting on the normal operation of the route.	Pantograph solution equipped with a roof-mounted pantograph. This allows to charge larger fleets of e-buses overnight in a range of 50-150 kW per vehicle and during the day with 150 kW up to 600 kW for opportunity charging.	ABB offers an ideal solution to charge electric buses fully automated following the OppCharge protocol. The panto down depot set charging solution can easily be integrated in existing operations and bus depots, ensuring zero emission public transport.

Suitable for	Depot charging	Depot overhead charging	Opportunity charging at bus stops	Opportunity charging at bus stops	Depot charging
Charging technology and connection device	Conductive, CCS plug		Conductive, Infrastructure-mounted pantograph	Conductive, Roof-mounted pantograph	Conductive, Infrastructure-mounted pantograph
Max. output power range	160 kW (max 250A), output power depending on vehicle voltage level. Voltage range from 150-850VDC		150-300-450-600 kW		160 kW
Charging Standard	ISO 15118 / DIN 70121 / IEC 61851-23 & -24	ISO 15118 / DIN 70121 / IEC 61851-23 & -24	OppCharge, ISO 15118 / DIN 70121 / IEC 61851-23 & -24	ISO 15118 / DIN 70121 / IEC 61851-23 & -24	OppCharge, ISO 15118 / DIN 70121 / IEC 61851-23 & -24
Indoor and/or Outdoor use:	Indoor /Outdoor. ABB products are designed for the harshest environment. Products have for ex. been proven in Qatar to withstanding extreme heat, sand, salt, and moisture.				
Connectivity level	OCPP based cloud platform. Enabling your charging operation through intelligent connectivity, and Connected Services and Web Tools Charger connectivity enables remote service and support. Through ABB's robust platform resulting in very short response times and substantially reducing downtime. Connectivity allows remote software updates including charging protocols, user interface enhancements and back-end solutions for minimal field intervention as well as future proofing software.				
Examples of implementation in Europe	Jönköping (Sweden) Namur & Charleroi (Belgium), TEC The Netherlands, Q-buzz				

ALSTOM

A global leader in the transportation sector, in the digital age. Leading the way to greener and smarter mobility worldwide, Alstom develops and markets integrated systems that provide the sustainable foundations for the future of transportation. Alstom offers a complete range of equipment and services, from high-speed trains, metros and trams to integrated systems, customised services, infrastructure, signalling and digital mobility solutions.

Charging Systems	SRS: Innovative, safe and automatic charging for trams and e-buses
Product description	Alstom's SRS for e-buses offers numerous advantages to cities and bus operators. SRS is a completely safe, ground-level, conductive, static recharge system allowing the charging of on-board equipment automatically, in "top-up" mode in a few minutes on a bus line, or within the depots, when off duty. As a ground-based solution, it eliminates the need for overhead infrastructure in cities, preserving the aesthetics of the urban landscape. In depots, SRS avoids the infrastructure costs associated with overhead charging systems and maximises ease of operation & maintenance. SRS is scalable, interoperable and non-proprietary, meaning it can be used for fleets of various bus types, regardless of manufacturer or changes in battery technology.
Suitable for	Depot charging and Opportunity charging along the route (terminals, selected stops)
Charging technology and connection device	Conductive, ground-based system
Max. output power range	1 MW DC
Indoor and/or Outdoor use:	Indoor / Outdoor
Connectivity level	On premises server connected to charging system through OCPP Protocol
Number of chargers installed/planned in Europe (up 2025)	28 chargers
Examples of implementation in Europe	Malaga (Spain) hosts the world premiere of the SRS solution, where Alstom installed for the first time its SRS System to power the e-buses within the EU co-funded PALOMA project. The SRS is equipped with a 200 kW charger and powers 12-m electric bus manufactured by Finnish company Linkker. In Paris (France), Île-de-France Mobilités have chosen the Alstom SRS solution to power two lines, T Zen4 and T Zen5, the high service bus lines in the south of Paris. The bus line will be serviced with 24-m long, bi-articulated Van Hool e-buses, powered by Kiepe Electric's high-power fast-charging batteries, and charged with Alstom's conductive ground-based static charging system.

FURRER+FREY AG

Furrer+Frey
Opbrid charging systems

Furrer+Frey AG – founded in 1923 – is a pioneer in e-mobility. We have been building DC charging stations for e-buses since2011. Our charging stations provide fast opportunity charging during operations, as well as charging in depots and garages when vehicles are not in service. To reduce energy demand peaks, fleet operators also need smart charging management for their systems. Building on our long experience as an engineering firm, we offer products and services that make an important contribution to transport companies' success. We therefore produce pioneering solutions that incorporate solar PV installations and energy storage devices. Our charging stations operate throughout Europe, providing safe charging for vehicles produced by leading manufacturers.

Charging Systems	All-In-One Fast Charging Station (AIO)	Zero-Foot-Print Depot Charging Station (ZFP)
Product description	Furrer+Frey AG's AIO All-In-One Fast Charging Stations– available off-the-shelf with 150, 300 and 450 kW outputs – are considered by industry specialists an essential infrastructure component for efficient electric bus systems. Our All-In-One charging stations meet the OppCharge standard and exceed our clients' expectations: the simplicity of the design provides the durability required, since all components are neatly integrated in the charging station. This does not just save the operator construction and maintenance costs. It also facilitates integration of the charging station into the urban environment, as there is no need to install a separate box of electronics to provide power. A mobile version of the AIO can also be rented for temporary operation and test projects.	Our ZFP Zero-Foot-Print Depot Charging Stations, available off the shelf with outputs ranging from 60 to240 kW, provide vehicles with electric charge while they are parked in the depot between operations. The ZFP are fitted on the roof of the depot, meaning they don't take up any vehicle space on the ground. Buses can manoeuvre freely in the depot without the inconvenience of charge boxes or the risk of collisions. The ZFP also meet the OppCharge standard, making them an elegant, cost effective and user friendly. The ZFP enable very easy charging for e-buses via the standardised contact rails on the roof. Unlike wired plug-in solutions, the automated pantograph can also provide depot charging for the semi-autonomous buses.
Suitable for	Opportunity charging along the bus route (selected stops)	Depot charging Opportunity charging along the bus route (terminals)
Max. output power range	450 kW DC	240 kW DC
Charging Standard	OppCharge	OppCharge
Indoor and /or Outdoor use:	Indoor / Outdoor	Indoor / Outdoor
Connectivity level	Via sim card - into fleet and charging management system.	Via sim card - into fleet and charging management system.
Number of chargers installed/planned for e-buses in Europe (up 2025)	280	112
Examples of implementation in Europe	Solutions implemented around Europe including Switzerland, Spain, Luxembourg, Netherlands, UK, Sweden	

HELIOX

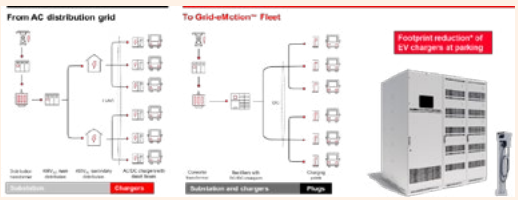
Heliox provides world class smart energy management solutions that are tailored and scalable within a fast-changing e-mobility landscape. We are working towards a sustainable world where a seamless charging experience is the standard for every electric vehicle, and this transforms the way we power our everyday. Founded in 2009, Heliox is the market leader in fast charging systems within public transport, e-trucks, marine, mining and port equipment. In 2017, the company installed one of Europe's first and largest rapid charging networks for the e-bus fleet in Eindhoven, The Netherlands; and over the past two years, has created 'model city' energy ecosystems around the world in Den Bosch, Netherlands, Glasgow, Scotland and Montgomery County, (USA).

Charging Systems	Mobile 25kW/40k-W/50kW	Flex 180kW	Flex 360kW	Ultra Fast 450/600kW
Description	The Heliox Mobile charger (plug connector) is available in three power ranges, 25 kW-40kW-50kW. Its durable yet lightweight design charger makes it an ideal solution for a range of environments. Its tough frame is designed specifically for service and maintenance personnel. Its easy manoeuvrability and the fact it connects to a standardised wall-socket makes it our easiest charger to use.	The Heliox Flex 180 is Heliox's most versatile charging solution. Whether you need overnight or opportunity charging, dynamic or static charging, to charge one vehicle or up to three, the Flex 180 can do it all. It's the most flexible charging solution available, anywhere.	The Heliox Flex 360 kW is a fast and efficient solution for a single vehicle, or a dual vehicle fleet. Boasting one of the industry's highest component efficiency ratings the Flex 360 will always have your fleet ready to go.	Heliox' unique "Power Curve" technology means the 450kW can optimally charge a bus in just 2-5 min, allowing your fleet buses to run all day, achieving significant passenger capacity increase and cost reduction. Straightforward implementation meets future-proof as the Ultra-Fast 450 kW is ready for V2G and smart charging functionality.
Suitable for	Depot charging	Depot charging Opportunity charging along the bus route (terminals, selected stops)	Opportunity charging along the bus route (terminals, selected stops)	Opportunity charging along the bus route (terminals, selected stops)
Charging technology and connection device	Conductive, CCS plug	Conductive, CCS plug	Conductive: Roof-mounted pantograph Infrastructure-mounted pantograph	Conductive: Ground-based system Mega Charger System (MCS)

Max. output power range	25 kW DC / 40 kW DC / 50 kW DC	180 kW DC	360 kW DC	600 kW DC
Charging Standard	CCS	CCS, OppCharge, Panto Up	CCS, OppCharge, Panto Up	CCS, OppCharge, Panto Up, QCC3
Indoor and/ or Outdoor use:	Outdoor	Outdoor	Outdoor	Outdoor
Connectivity level	Open Charge Point Protocol (OCPP)	Open Charge Point Protocol (OCPP)	Open Charge Point Protocol (OCPP)	Open Charge Point Protocol (OCPP)
Number of chargers installed/ planned for e-buses in Europe (up 2025)	>10,000	>10,000	>10,000	>10,000
Examples of implementation in Europe	YouTube Link	Web link	Web link	Web link

HITACHI ENERGY

Hitachi Energy is a global technology leader that is advancing a sustainable energy future for all. We serve customers in the utility, industry and infrastructure sectors with innovative solutions and services across the value chain. Together with customers and partners, we pioneer technologies and enable the digital transformation required to accelerate the energy transition towards a carbon-neutral future. We are advancing the world's energy system to become more sustainable, flexible, and secure whilst balancing social, environmental and economic value. Hitachi Energy has a proven track record and unparalleled installed base in more than 140 countries. Headquartered in Switzerland, we employ around 38,000 people in 90 countries and generate business volumes of approximately $10 billion USD.

GRID-eMOTION™ FLEET/FLASH	Fleet	Flash
Description	Grid-eMotion™ Fleet: Grid-eMotion™(GeM) Fleet is a grid-code compliant and space-saving grid-to-plug charging solution that can be installed in existing depots or at line ends and scaled flexibly as the fleet gets greener. It charges e-buses according to the ISO 15118 standards.  Instead of using a conventional AC to DC charging system requiring standalone AC-DC chargers all fed from LV Switchboards with one-to-one connections, Hitachi Energy uses a bulk rectifier and down-stream distribution on a common DC Bus. Approaching charging in this way yields the following advantages: • Reduced footprint compared to AC chargers as power components are kept separate from interface points. • Lower DC cabling costs then AC cabling. • Easy integration of solar panels and battery storage to DC bus. • Integration into existing power supply system in case of combined Trolleybus/Tram/Metro depot.	Grid-eMotion™ Flash: The Grid eMotion™ (GeM) Flash charging system is a complete electric bus system consisting, at line level, of a fleet of fully e-buses equipped with a small on-board battery and an infrastructure deployed along the route to automatically transfer energy to the e-buses seamlessly during operation. This infrastructure includes a set of high-power "Flash" Feeding Stations (FFS) at selected bus stops along the route (if needed), high power Terminal Feeding Stations (TFS) and high-power Depot Feeding Station (DFS) at depot or low power Depot Chargers (DCh) using GeM Fleet technology at depot: • DCh (Depot Chargers): 15-60 min slow charging or • DFS (Depot Feeding Station): 1-5 min fast charging at entry or exit of the depot with automatic redundant system to switch charging pole in event of a charger failure. • TFS (Terminal Feeding Station): 1-6 minutes fast charging at each terminal stop) with automatic redundant system to switch charging pole in event of a charger failure. • FFS (Flash Feeding Station): 10 to 40 seconds flash charging at a dedicated bus stop, if needed.

Description	• Reduced site activities. • Reduced interfaces and complexity. • Futureproof (centralized grid connection for multiple charging points) • Extension of charging Infrastructure made easy with modular approach. • Easy maintenance with fast replacement using withdrawable DCDC modules • Mature DC technology used over several decades with many references from Trolleybus, Tram and Train Traction Depot.	
Suitable for	Chargers may be used at depot or at terminals of the lines (if needed). Charging interfaces located near the bus (pedestal, wall box, cable reel, panto-down or panto-up). Rectifier and Power Modules are centralised in a separate location, either an enclosure, prefabricated building or integrated to an existing structure on site.	At depot and terminals of the lines (if needed). If needed also along the line. Pantograph at bus stop and/or entry/exit of the depot. Plug CCS-2 at depot.
Charging technology and connection device	Compatible with ISO 15118 standards. Bulk AC/DC rectification using modular DCDC chargers. Connection by cable (pedestal or wall box) with or without cable reel, infrastructure-mounted and/or roof-mounted pantograph.	Panto-up with ETS (Energy Transfer System) pantograph Plug CCS-2 at depot
Max. output power range	600 kW (set of 75 kW DC/DC chargers and/or 100 kW DC/DC chargers)	750 kW along the line 600 kW at terminal
Charging Standard	CCS1 / CCS2	CCS2 at depot
Indoor and/or Outdoor use:	Indoor /Outdoor	Indoor /Outdoor
Connectivity level	ISO 15118, VDV 2.6.1, VDV 4.6.3, OCPP 2.0.1, IEC 60870-5-104	ISO 15118 at depot No communication needed along the line
Number of chargers installed/planned for e-buses in Europe (up 2025)	Already installed: 50 Ongoing: 56	Already installed: 32
Examples of implementation in Europe	Milan, Italy; London, United-Kingdom; Västerås, Sweden; Berlin, Germany	Geneva, Switzerland; Nantes, France

JEMA ENERGY

Jema is a leading technology company that is writing the future of energy innovation. For more than six decades, we've been on the cutting edge because of our innovation in designing and manufacturing personalised power conversions systems. Every day, we promote efficiency, top performance, reliability and productivity in public services, industry, transport and infrastructures around the world. With a legacy that surpasses 65 years, Jema is present in more than 90 countries. More than 60% of staff at Jema works in research and developing new products.

Charging Systems	ECI 600	ECI 150	ECID 75	ECI 100	ECID 50
Product description	Interoperable and conform with ISO 15118 [-1,-2,-3] and IEC 61851 [-1,-23,-24] standards. The main characteristics of the chargers are: IGBT topology, bi-directional power flow, specific design for high temperatures, minimal harmonic distortion and power management capability (OCPP 1.6j). Useful life of the device more than 20 years.	Interoperable and conform with ISO 15118 [-1,-2,-3] and IEC 61851 [-1,-23,-24] standards. The main characteristics of the chargers are: IGBT topology, galvanic isolation, bi-directional power flow, specific design for high temperatures, minimal harmonic distortion and power management capability (OCPP1.6j). Useful life of the device more than 20 years.	Interoperable and conform with ISO 15118 [-1,-2,-3] and IEC 61851 [-1,-23,-24] standards. The main characteristics of the chargers are: IGBT topology, galvanic isolation, bi-directional power flow, specific design for high temperatures, minimal harmonic distortion and power management capability (OCPP1.6j). Useful life of the device more than 20 years.	Interoperable and conform with ISO 15118 [-1,-2,-3] and IEC 61851 [-1,-23,-24] standards. The main characteristics of the chargers are: IGBT topology, galvanic isolation, bi-directional power flow, specific design for high temperatures, minimal harmonic distortion and power management capability (OCPP1.6j). Useful life of the device more than 20 years.	Interoperable and conform with ISO 15118 [-1,-2,-3] and IEC 61851 [-1,-23,-24] standards. The main characteristics of the chargers are: IGBT topology, galvanic isolation, bi-directional power flow, specific design for high temperatures, minimal harmonic distortion and power management capability (OCPP1.6j). Useful life of the device more than 20 years.

Suitable for	Opportunity charging along the bus route (terminals, selected stops)	Depot charging	Depot charging	Depot charging	Depot charging
Charging technology and connection device	Conductive: Roof-mounted pantograph Infrastructure-mounted pantograph	Conductive, CCS plug	Conductive, CCS plug	Conductive, CCS plug	Conductive, CCS plug
Max. output power range	600 kW DC	150 kW DC	2x75 kW (each) DC	100 kW DC	2x50 kW (each) DC
Charging Standard	CCS, OppCharge	CCS, OppCharge	CCS, OppCharge	CCS, OppCharge	CCS, OppCharge
Indoor and/or Outdoor use:	Indoor /Outdoor	Outdoor	Outdoor	Outdoor	Outdoor
Connectivity level	OCPP 1.6j	OCPP 1.6j	OCPP 1.6j	OCPP 1.6j	OCPP 1.6j
Number of chargers installed/ planned for e-buses in Europe (up 2025)	100	200	200	400	400
Examples of implementation in Europe	Charging infrastructure in Schaffhausen, Switzerland. The project consists of 12 units of 600 kW opportunity charging stations along the route, and 16 units of 50 kW chargers in depot for slow charging. The energy supply for the charging stations will be generated by the force of the waters of the Rhine River as it passes through Schaffhausen.	38 units for new depot in Zaragoza, Spain	8 units (16 chargers) for new depot in Guimaraes, Portugal	70 units for new depot in Madrid, Spain	22 units (44 chargers) in Amiens, France

Schunk Transit Systems GmbH

Schunk Transit Systems is one of the world's leading providers in the field of automated, safe and reliable current transmission. Our developments set technological milestones and constantly push the boundaries of the possible. Benefit from our decades of experience and use our know-how as a development partner. Schunk Transit Systems's products are already setting new standards worldwide in all areas of mobility and wherever power needs to be transmitted safely and reliably. On the road, our innovative SchunkSmart Charging system opens completely new possibilities in terms of economy, performance, and flexibility. It charges battery-driven vehicles safely, reliably, and within seconds in the depot or even during operation.

Charging Systems	Roof-mounted Pantograph SLS 102	Roof-mounted Pantograph SLS 103	Inverted Pantograph SLS 201	Depot Charger SLS 301
Product description	SLS 102 roof-mounted pantographs have already proven themselves in many projects all over the world. The compact pantographs are mounted on the roof of the E-bus or battery-powered industrial vehicle and function according to the bus-up principle: The vehicle stop sunder the charging station where the roof charging pantograph extends, connects to the charging station and charges the batteries. Charging can take place both in the depot and during operation at a charging station within the route network - without any delay to regular driving operations. This is guaranteed by the extremely fast contacting and the very high current transmission.	SLS 103 roof-mounted pantographs have already proven themselves in many projects all over the world. The compact pantographs are mounted on the roof of the E-bus or battery-powered industrial vehicle and function according to the bus-up principle: The vehicle stops under the charging station where the roof charging pantograph extends, connects to the charging station and charges the batteries. Charging can take place both in the depot and during operation at a charging station within the route network - without any delay to regular driving operations. This is guaranteed by the extremely fast contacting and the very high current transmission.	Inverted pantograph SLS 201 is the worldwide proven standard for flexible, fast and safe charging of e-buses and battery-powered industrial vehicles. Our patented contact systems can also be adapted to other vehicles and specific customer requirements. The inverted pantograph is integrated on the infrastructure side at a central location where its contacting functions according to the top-down principle: The vehicle parks underneath the inverted pantograph, the latter drives down, connects to its compact counterpart on the vehicle roof and charges the batteries.	Schunk's latest automatic charging device enables vehicles of different heights to be docked in the depot in seconds. In addition, overnight charging in the depot has the advantage that there is no need for fast and large amounts of electricity to flow along the track in the shortest possible time. The devices can also be made simpler, lighter and more compact - and are therefore particularly economical

Product description	Our patented contact systems can be adapted to a variety of vehicles and specific customer requirements.	Our patented contact systems can be adapted to a variety of vehicles and specific customer requirements	This system guarantees a safe current transmission of up to 1,000 Avia a multipole concept and maintains a defined contact sequence during contacting.	
Suitable for	Depot charging Opportunity charging at terminal and selected bus stops. The pantographs are also already used in different kind of applications, such as harbour and mining	Depot charging Opportunity charging at terminal and selected bus stops. The pantographs are also already used in different kind of applications, such as harbour and mining	Depot charging Opportunity charging at terminal and selected bus stops. The pantographs are also already used in different kind of applications, such as harbour and mining	Depot charging Opportunity charging at terminal
Charging technology and connection device	Conductive: roof mounted pantograph.	Conductive: roof mounted pantograph.	Conductive: infrastructure-mounted pantograph. Infrastructure-mounted pantograph: System 3 + 4	Infrastructure-mounted pantograph: System 3 + 4
Max. output power range	1 MW DC	1 MW DC	1 MW DC	600 kW DC
Charging Standard	EN50696 / SAEJ3105	EN50696 / SAEJ3105	EN50696 / SAEJ3105 / OppCharge	-
Indoor and/ or Outdoor use:	Indoor / Outdoor	Indoor / Outdoor	Indoor / Outdoor	Indoor / Outdoor
Connectivity level	All systems can be used with fleet charging management system.	All systems can be used with fleet charging management system.	All systems can be used with fleet charging management system.	
Number of chargers installed/ planned for e-buses in Europe (up 2025)	5,000-6,000	200-300	400-600	800-1,000
Examples of implementation in Europe	Amsterdam (Schiphol), Eindhoven, Moscow, Barcelona, Osnabruck, Jaworzno, Cracow, Warsaw, Amiens, Helsinki, Oslo	Den Bosch	Milan, Luxembourg, Turku, Gottingen, Ostrava, Gliwice, Rzeszow, Grudziadz	-

WABTEC

Railway, transit and industry products including charging applications for on- and off road as well as mining and maritime.

Charging Systems	ChargingPANTO	DepotPANTO	ChargingREEL
Product description	Opportunity charging solution for on route charging (Oppcharge)	Oppcharge charging solution for overnight charging in depots	Motorized cable reel for depot charging
Suitable for	Opportunity charging along the bus route (terminals, selected stops)	Depot charging	Depot charging
Charging technology and connection device	Conductive, infrastructure-mounted pantograph	Conductive, infrastructure-mounted pantograph	Conductive, CCS plug
Max. output power range	4500 kW DC	3000 kW DC	200 kW DC
Charging Standard	OppCharge	OppCharge	CCS
Indoor and/or Outdoor use:	Indoor / Outdoor	Indoor / Outdoor	Indoor / Outdoor
Connectivity level	Yes	Yes	Yes
Number of chargers installed/planned for e-buses in Europe (up 2025)	1,500	1,000	2,000
Examples of implementation in Europe	Hamburg, Berlin, Luxembourg, Switzerland, Poland, Spain	-	Düsseldorf, Munich, Paris

WABTEC STEMANN-TECHNIK

Wabtec accelerates the future of transportation by building the safest, most reliable and sustainable freight, transit, signaling and logistics systems and services. Wabtec offers charging solutions for electric vehicles and vessels, using innovative and reliable STEMMANN-TECHNIK technology drawing on our 100 years of engineering and practical experience. As the world's leadingmanufacturer we deliver widest portfolio for electrical buses High Power Charging systems, fastest on the market OppCharge solution– ChargingPANTO, and overnight depot charging options – DepotPANTO and ChargingREEL.

Charging Systems	ChargingPANTO	DepotPANTO	ChargingREEL
Product description	ChargingPANTO® is the fastest OppCharge e-bus charging solution currently available. It does not put additional weight on your bus and extends the net service time of your municipal e-bus fleet. The dependable system consists of an inverted, top-down pantograph installed on a charging station and a set of roof rails mounted to the vehicle roof. By choosing ChargingPANTO® you decide the first application to fully meet the on-route bus charging standard and the best way to sustainable urban mobility. Key functions: Reliable high-current DC charging; Easy connection due to durable fixed-mount light-weight charging rail; Fully automatic and secured by two-way Wifi; Start of charging sequence by simply activating the parking brake	DepotPANTO is newest solution for depot infrastructure, offering automated charging from the top. It does not require additional weight on the bus and prevents from hanging cables at the depot. Easy to install, light weight and compact design makes it attractive alternative toother solutions. It also complies with OppCharge standard, therefore, is great choice when considering charging at depot with on route.	Motorized cable reel for depot charging
Suitable for	Depot charging Opportunity charging along the bus route (terminals, selected stops)	Depot charging Opportunity charging along the bus route (terminals, selected stops)	Depot charging Opportunity charging along the bus route (terminals, selected stops)

Charging technology and connection device	Conductive, infrastructure-mounted pantograph	Mega Charger System 5MCS) DepotPANTO is also conductive: infrastructure mounted pantograph	Conductive, CCS plug Ground-based system
Max. output power range	1500kW DC &AC (100% duty cycle)	400 kW DC & AC	200 kW DC & AC
Charging Standard	OppCharge	OppCharge	CCS, Type 1, Type 2, others
Indoor and/or Out-door use:	Indoor / Outdoor	Indoor / Outdoor	Indoor / Outdoor
Connectivity level	All systems can be used with fleet charging management system.	All systems can be used with fleet charging management system.	All systems can be used with fleet charging management system.
Number of chargers installed/planned for e-buses in Europe (up 2025)	2,000	3,000	5,000
Examples of implementation in Europe	Hamburg, Jaworzno, Berlin, Luxembourg, Gothenburg, Zurich, Nice, Jonkoping	Porto, Wroclaw, Montreal	Paris, Munich, Nice, Marseille, Zug, Bonn, Oslo

ASSURED, JIVE/JIVE2 & CBEP AT A GLANCE

The Clean Bus Report is a collaboration between three EU co-funded initiatives.

ASSURED

Coordinated by VUB (Vrije Universiteit Brussel), ASSURED aims to boost the electrification of urban commercial vehicles and their integration with high power fast charging infrastructure. The project develops and tests high-power solutions for full-size, urban, heavy-duty applications. The fundamental aim is that each of these solutions will be able to charge various types of vehicles, enabling operators to mix and match different brands of vehicles and chargers.

During the project, electric buses, trucks, and vans test different types of charging solutions. They are first tested in controlled conditions and later operated in real cities. Another element which ASSURED has investigated is the stability of the energy supply, essential for future uses when a larger number of vehicles will rely on the charging infrastructure.

JIVE

The H2020 project JIVE (Joint Initiative for hydrogen Vehicles across Europe) project seeks to advance the commercialisation of fuel cell buses through large-scale deployment of vehicles and infrastructure. While the first JIVE initiative launched in 2017, JIVE2 started in parallel in January 2018. Both initiatives are coordinated by Element Energy Limited.

The aim of the JIVE projects is to ensure fuel cell buses are commercially viable for bus operators to include in their fleets without subsidy, and that local and national governments feel empowered to regulate for zero emission propulsion for their public transport systems. Combined, the JIVE projects will deploy nearly 300 fuel cell buses in 22 cities across Europe by the early 2020s – the largest deployment in Europe to date.

The Clean Bus Europe Platform

The Clean Bus Europe Platform is an initiative under the European Commission's Clean Bus Deployment Initiative that aims to support the deployment of clean bus technologies across Europe. Led by UITP, the Platform brings together European cities, transport authorities and operators, together with relevant stakeholders like social dialogue partners, industry, financing and funding institutions, associations, etc. to boost and support the exchange of knowledge and expertise on clean bus deployment.

The Clean Bus Deployment Initiative was launched by the European Commission in 2017 to support the transition to cleaner transport. Through their combined efforts, signatories of the Initiative are committed to make this transition happen.

The Platform will make sure that a critical mass of cities and operators start and continue investing in clean bus technologies, thus creating a powerful momentum for a wider and unstoppable clean bus deployment across Europe.

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Acknowledgments

The ASSURED Clean Bus Report is a collective effort.

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Disclaimer

Data shown for city bus operations, and bus model or system suppliers characteristics are based on the information received directly from the contributors on the survey performed in February 2022.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 769850.