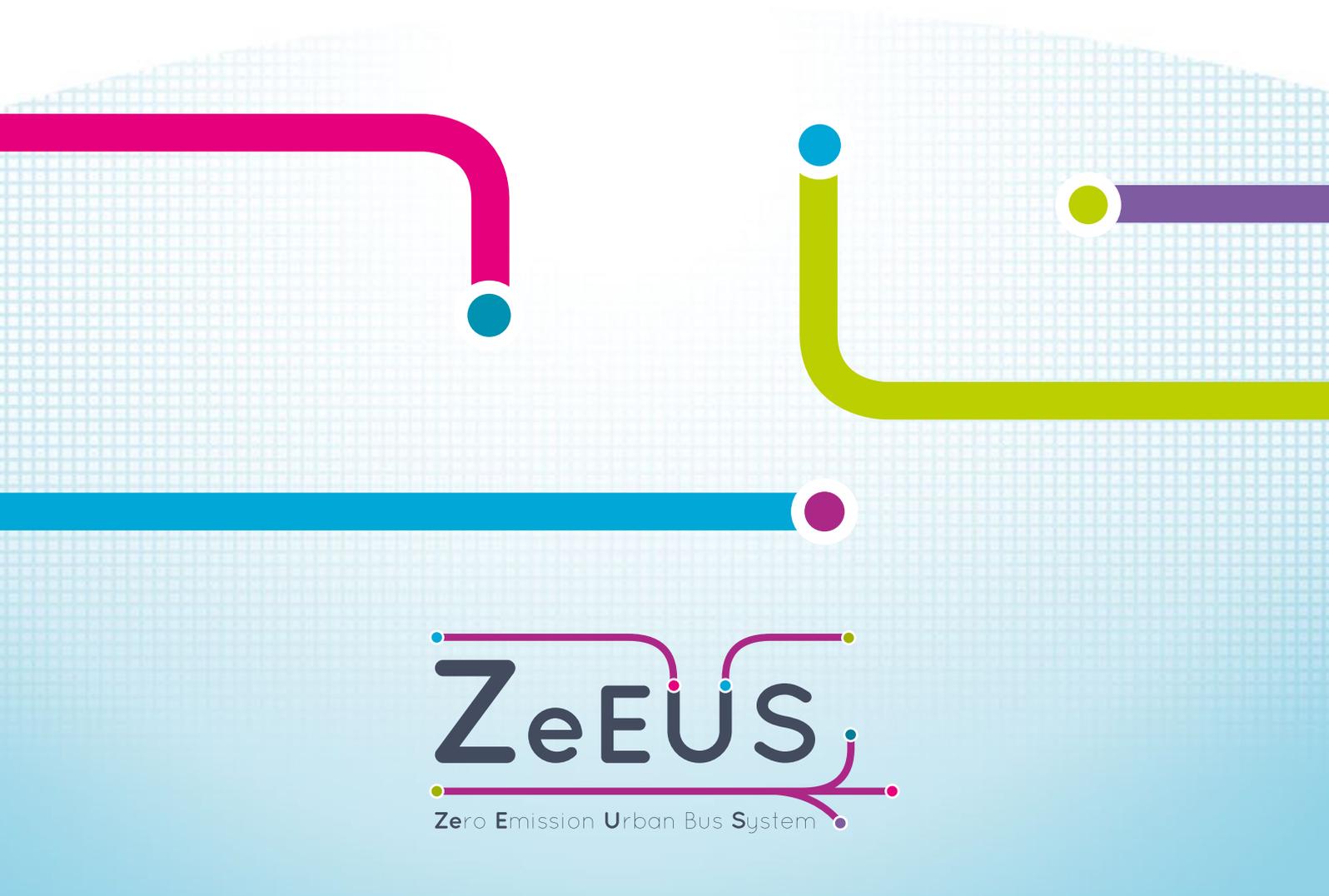


ZeEUS eBus Report

An overview of electric
buses in Europe



ZeEUS

Zero Emission Urban Bus System



FOREWORD TO ZEEUS REPORT 2016

ZeEUS is an impressive project with over 40 consortium participants and a budget in excess of 22 million euros of which the European Commission co-finances 13.5 million. Put simply, ZeEUS is the most important European project focusing on electric buses.

In the light of the Paris Agreement reached at the COP 21 to limit global warming to 2 degrees Celsius, the transport sector has an important contribution to make to the achievement of the climate goals. Our common efforts to reduce greenhouse gas emissions are becoming even more of a priority as they are already. Transport contributes to about a quarter of total GHG emissions in the European Union. That is why the Energy Union strategy, adopted last year by the European Commission as one of the political priorities of President Juncker, includes as an objective the decarbonisation of transport.

According to the Commission's Communication "A European Strategy for Low-Emission Mobility", by mid-century, GHG emissions from transport will need to be at least 60% lower than in 1990 and be firmly on the path towards zero concerning both GHG and pollutant emissions in order to meet the EU's emissions targets.

Alternative fuels are part of the policy mix to achieve this decarbonisation, and electrification of transport is a promising means to reach this goal. Alternative Fuels will help us meet our goals for reducing CO₂, but also to diversify our energy sources and to improve air quality, two benefits we tend to overlook.

But let me mention a last benefit of alternative fuels, which is the competitiveness of the European economy. With cities all over the world facing similar challenges, markets for clean, smart mobility and transport solutions are expected to strongly grow. Alternative fuels technologies are huge opportunity for our industry.

Let me underline that, until now, most talk about electro-mobility has been on passenger cars. A lot of progress is indeed being made regarding electric cars and manufacturers are in the process of bringing to the market an increasing offer of such cars.

But public transport has to green its credentials as well; public transport needs to contribute its share to reaching the overarching objectives outlined above.

It is therefore very timely and important that the ZeEUS project deals with buses, as this will contribute to closing the link between electro-mobility and public transport.

We need to demonstrate the economic, environmental and societal feasibility of electric urban bus systems. I am convinced that there will be uptake of electro-mobility solutions for buses. The experience gained from ZeEUS, for instance, will most certainly feed into the development of series products for market deployment. This contribution will allow public transport to move towards more economic and environmental sustainability with innovative solutions.

Violeta Bulc
European Commissioner for Transport



MOVING TOWARDS CLEAN AND SPACE-SAVING BUSES IN CITIES... AND AWAY FROM POLLUTING AND CONGESTION-CAUSING CARS

Low-carbon mobility in cities requires us to embrace a range of strategies based on a mix of policy, technology and behavioural changes: the well-known avoid/shift/improve concept. In this holistic scenario, public transport plays a major role being one of the obvious solutions contributing to the fight against global warming, congestion and pollution. In this context and at the 2014 UN Climate Summit, UITP members pledged to double the global public transport market share by the year 2025 and scale up efforts on public transport, optimising infrastructure, vehicles and fuel efficiency, including the deployment of electric bus systems around the world.

With around 450 billion bus journeys per year worldwide, buses are a significant part of any public transport system and are the only public transport mode in many cities. However, the bus still suffers from an image problem, partly due to the fact that almost 50% of buses across the EU are still of Euro III standard or older. As such, bus fleet renewal should remain on top of the political agenda for better urban mobility. Electrification of buses together with the numerous alternative fuels' solutions are a promising path to reduce the (already low) public transport carbon footprint.

UITP members' growing interest in e-buses has evolved from pilot testing of one or two vehicles and rapidly moved towards the deployment of fully-electrified bus lines. This analysis made it clear for our Association to lead the way by coordinating the ZeEUS project. The work achieved thus far to accelerate an optimal deployment of e-buses demonstrates that lots of work still need to be carried out from the operational point of view. The ZeEUS project and UITP are accompanying the public transport stakeholders in this learning curve, through the production of the necessary supporting guidelines.

The ambition of this ZeEUS e-bus Report is to provide you with a comprehensive overview of the European market for electric buses. We wish to deeply thank all the public transport operators, authorities and manufacturers for taking up the e-bus challenge and for their contribution to making this quite unique report.

We invite you to explore European cities' ongoing experiences with e-buses, as well as the portfolio of e-buses available on the European market, as defined within the scope of the ground-breaking and lighthouse ZeEUS project.

Alain Flausch
UITP Secretary General

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CHAPTER 1: INTRODUCTION

What is an electric bus?

“Electric buses are like sex for teenagers: everyone talks about it, nobody really knows how to do it, everyone thinks everyone else is doing it, so everyone claims they are doing it.”¹

While the electric bus (or ‘e-bus’) can come in different forms, the name always refers to a motor road vehicle that is emission free at the point of operation. They are usually seen as ‘clean’ and ‘green’, because they are battery-driven and have a lower environmental impact than an internal combustion engine bus.²

For the purpose of this publication, we understand an electric bus as defined in the scope of the ZeEUS project:

(1) The ZeEUS project focuses on:

a. Plug-in hybrid buses (PHEV) is a hybrid electric vehicle that uses rechargeable batteries, or another energy storage device, which can be recharged by connecting it to an external source of electric power. A PHEV shares the characteristics of a conventional hybrid electric vehicle, with an electric motor and an internal combustion engine (ICE), of and an all-electric vehicle, with a plug or other device to connect to the electrical grid. Diesel hybrids (as they exist in today’s bus market) are excluded from the scope of the project and from this publication.

b. Full battery electric buses (BEV), an all-electric or purely electric vehicle, is a bus with an electric propulsion system that uses chemical energy stored in rechargeable battery packs. BEVs use electric motors and motor controllers instead of internal combustion engines (ICEs) for propulsion. They derive all power from battery packs and have no internal combustion engine, fuel cell or fuel tank. Battery buses are charged statically, using mechanical and electrical equipment.

c. Battery trolleybuses: also referred to as dual-mode trolleybuses (China) or hybrid trolleybuses (Germany). They are bus-type vehicles propelled by a motor, drawing power from overhead wires via connecting poles called trolleys. Power is supplied from a central power source that is not on board the vehicle, or via on-board rechargeable batteries. This enables the vehicle to run electrically and independently of the overhead wires for part of its route, while maintaining full operational capability. Battery trolleybuses are charged dynamically using the existing trolleybus catenary or in a static position with a device to connect to the electrical grid. Trolleybuses with auxiliary-only batteries are considered a proven technology and are therefore excluded from the project’s scope and from this publication.

(2) The ZeEUS project focuses its activities on high-capacity buses for which no legal definition currently exists. The UITP Secretariat’s definition of ‘high capacity’ is a bus that can carry at least 55 passengers both standing and sitting.³ Proven commercial solutions for smaller electric buses (minibuses and midibuses) do exist in the market and are hence excluded from this publication.

(3) Vehicles included are in full revenue operation today or ready for exploitation by December 2017, the latest.

Towards a more efficient and equitable use of scarce resources

As a minimum requirement, the deployment of alternatively fuelled or electric buses should not hamper overall service quality, reliability, passenger comfort, etc.

To reduce CO₂ emissions in cities, the key strategy of ‘avoid/shift/improve’⁴, involves encouraging people to shift from individual transport to public transport and ‘soft transport modes’, in part by enhancing the attractiveness of urban buses, which are the backbone of public transport.⁵ In this regard, supporting fleet renewal with clean vehicles, as well as policies in favour of a shift towards public transport, should help to achieve cleaner cities and improved urban mobility. In other words, moving away from polluting and congestion-causing cars to clean and space-saving buses is highly desirable.

¹ Paraphrasing Dan Ariely, Professor of Psychology and Behavioural Economics at Duke University, on big data: <http://danariely.com/>

² “We define ‘Green Vehicles’ as vehicles with ‘new’ technologies, seen as ‘green’. Technologies as fuel cell electric vehicles (FCEV) or hydrogen driven vehicles, hybrid electric vehicles (HEV) or fully electric vehicles (EV) with or without plug-in devices, vehicles powered by gas, bio-fuels or dedicated new Internal Combustion Engines (ICE) with a strong reduction on environmental impact.” European Road Transport Research Advisory Council, European Roadmap: Infrastructure for Green Vehicles (October 2012), p. 5: http://www.ertrac.org/uploads/documents_publications/Roadmap/infrastructure-for-green-vehicles_final-october-2012_65.pdf

³ UITP is the International Association for Public Transport and coordinates the ZeEUS project: www.uitp.org

⁴ <http://www.uitp.org/sites/default/files/Decarbonisation%20-%20the%20public%20transport%20contribution.pdf>

⁵ http://www.uitp.org/sites/default/files/cck-focus-papers-files/UITP_PositionPaper_Bus%20Systems%202015.pdf

Looking back to move forward

In an increasingly volatile oil market, the deployment of electric buses has accelerated very quickly in the past five to ten years, influenced by national energy policies and driven more by environmental requirements than by commercial considerations. In Europe, the starting point for the current development trajectory was the introduction, in the late 1990s, of the first small electric vehicles dedicated to public transport. Pioneered in Italy, these vehicles were mainly operated on inner-cities routes. Deployment of minibuses and midibuses was followed by the full-scale operation of 12m full battery electric buses at the 2008 Beijing Olympic Games.

“A chosen technology performs well only if put in its ‘best operational’ conditions”
Dr Ralph Pütz, Landshut University⁶

Today, the propulsion technologies used in the bus sector are highly diversified. Every few years since the 1990s, a new EU standard sets mandatory emission limits for certain pollutants, including nitrogen oxides (NOx) and particulate matter (PM). Despite the outstanding results achieved to date, diesel buses still carry a negative reputation and local politicians increasingly call for ‘clean fleets’ of electric and alternatively-fuelled buses. This negative perception of diesel buses is partly due to the fact that almost 50% of buses across the EU are of Euro III standard or older.⁷

Buses powered by alternative fuels have been available for more than ten years and have recently gained popularity, due to their reduced CO₂ emissions. UITP members have supported the development and testing of such alternative technologies. On one hand, there are proven and reliable technologies such as hybrids, biofuels – including biodiesel, biogas and bioethanol – and natural gas (CNG). On the other, new experimental technologies are emerging, such as hydrogen, new generation biofuels, biowaste, etc.

UITP considers that new propulsion technologies should be developed continuously and tested under local, real-life conditions in order to increase their availability and reliability. Furthermore, UITP also encourages the exchange of test results and the examination of their transferability.



Full battery electric buses were used during the 2008 Beijing Olympic Games
Source: *power-technology, Kable 2016*

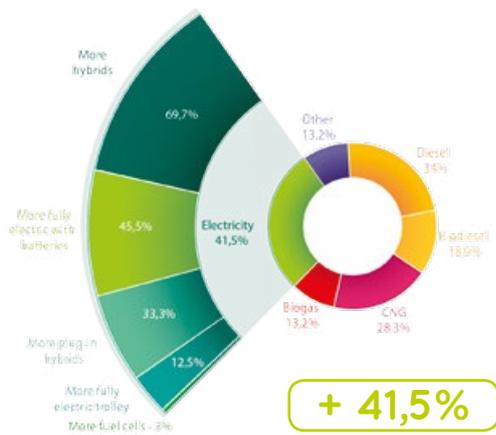
small-scale tests, involving one or two vehicles, have grown into larger schemes and shifted entire bus lines from internal combustion engine to electrical power. In recent months, cities such as London, Paris and Warsaw have placed larger orders for this type of vehicle. It is expected that they will be rapidly followed by other cities, heralding a ramp-up in production to answer increased demand.

In the context of a previous EU-funded project, UITP recorded strong interest from public transport authorities and operators in the future deployment of electric buses. In 2013, electric buses represented only 1.2% of European buses. On examining operators’ and authorities’ future plans, a dynamic pattern emerges, with more than 40% of respondents eager to switch to electric traction options and, within that category, mainly to hybrid and fully electric with batteries.

The technology proved to be reliable, although vehicles with a 75km range needed to be plugged in two to three times a day for recharging. Building on this initial success, a 12m full battery electric bus was launched in China in 2010, with a promising range of 250-300km. This new step opened the way for numerous other Chinese manufacturers to enter the electric bus market. However, demand remained below expected levels despite the strong incentives offered by the Chinese government. American and European bus manufacturers have also rapidly developed electric bus models, although these are currently operated at a smaller scale through numerous pilots and local projects. Since 2013 these

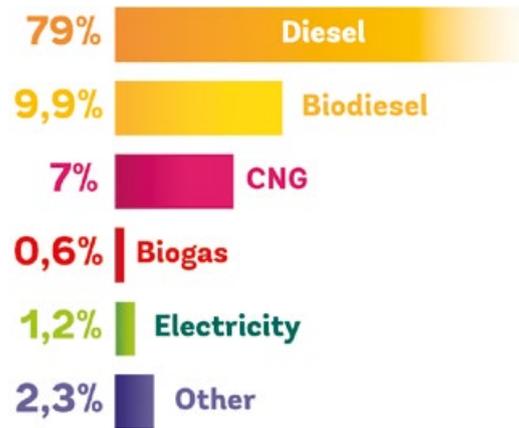
⁶ European Bus System of the Future project co-funded by European Commission Directorate-General for Research and Innovation: <http://www.uitp.org/ebsf-european-bus-system-future>; study by Verband Deutscher Verkehrsunternehmen (VDV: Association of German Transport Companies) and Prof. Dr. Ralph Pütz, Landshut University.

⁷ <http://www.3ibs.eu/uploads/fichiers/publications/priority-actions-for-the-fast-development-of-innovative-bus-systems-in-european-cities.pdf>



European fleet renewal intention according to future plans to change propulsion system ratio

Source: 3iBS project co-funded by the European Commission under the 7th Research and Technological Development Framework Programme (FP7), Research and Innovation Directorate-General, www.3ibs.eu, 2013



2013 European bus fleet breakdown, by fuel or energy used

Source: 3iBS project co-funded by the European Commission under the 7th Research and Technological Development Framework Programme (FP7), Research and Innovation Directorate-General, www.3ibs.eu, 2013

Worldwide market trends

The worldwide electric bus fleet is estimated to have reached approximately 173,000 in 2015. **China** is leading this global mass deployment, with more than 170,000 buses (98.3% of the global total) operating in **Beijing, Changsha, Dalian, Hangzhou, Hebei, Nanjing, Shanghai, Shaoguan, Shenzhen, Tianjin, Xi'an and other cities**.⁸ These developments are strongly endorsed by Chinese government policy, which includes an official programme for 'new energy buses', aiming to produce 1.67 million EVs (including ebuses), and to create 1.2 million jobs annually for the period 2010-2020.⁹

As an example, Shenzhen City currently has 4,887 purely electric buses in operation. By the end of 2017, all of the city's buses will be fully electrified, in accordance with municipal government requirements, reaching a total of 16,493 ebuses.¹⁰



Part of the Shenzhen ebus fleet
Source: Shenzhen Bus Group Co., Ltd.

While the European market is one of the leading regions for electric bus research and development (R&D) – including vehicle technology – the **Asia-Pacific region** is home to some of the biggest producers of both buses and batteries. In fact, the region contributes over two-thirds of the global output of buses and coaches for domestic markets, and leads the global electric bus market with substantial government initiatives in countries including China, Japan and, to a lesser extent, India. The dominance of the Asia-Pacific market is driven primarily by the increasing output of Chinese original equipment manufacturers (OEMs). With the introduction of technologically advanced 5th-generation electric buses in the regional market, and an increased emphasis on innovation and OEM investments in R&D, the government is planning to continue supporting the electric bus market over the next five years.

Government initiatives are playing a pivotal role in facilitating the growth of the electric bus market. In China, for example, the Ministry of Transport (MOT) provides subsidies and tax benefits to manufacturers of low-emission buses, including subsidies of \$81,600 per bus for the purchase of electric buses in 2016. China has been one of the few developing economies worldwide to take initiatives to curb vehicular pollution with the introduction of electric buses. However, the infrastructure for charging electric buses is currently weak in many countries, restricting the growth of the electric bus market.¹¹

⁸ Organisation for Economic Co-operation and Development/International Energy Agency, Global EV Outlook 2016: Beyond One Million Electric Cars (2016), p. 5: http://www.iea.org/publications/freepublications/publication/Global_EV_Outlook_2016.pdf; Global Green Growth Institute (GGGI) and Center for Study of Science, Technology and Policy (CSTEP), Electric Buses in India: Technology, Policy and Benefits (GGGI, Seoul, Republic of Korea, 2015) pp. 65-66.

⁹ H. Pan and M. Zhang, 2011, quoted in GGGI and CSTEP, Electric Buses in India: Technology, Policy and Benefits (GGGI, Seoul, Republic of Korea, 2015) p. 56.

¹⁰ Speech by a leader of Shenzhen's public transport authority, the Municipal Commission of Transport.

¹¹ However, China has taken important steps to support the electric vehicle charging infrastructure. For instance, the State Grid Corporation of China has announced plans for handing over the country's distributed power grid and EV charging equipment (which were previously state-run) to private investors, to increase the construction rate of charging stations. In addition, plans are in place to introduce more rapid charging stations, charging piles, power-exchange centres and power-distribution centres, which would help to boost electric bus infrastructure in China.

The demand for wirelessly-charged buses should also help to drive the demand for high-performance batteries. Alongside China, **South Korea** has also launched a wirelessly charged electric bus called 'on-line electric vehicle' (onlev bus) to test induction charging for buses. The Korea Advanced Institute of Science and Technology has developed this technology back in 2014 and the bus is in operation in Se-jong City since June 2015. The market has also seen increased investments from the Chinese government to develop plug-in hybrid electric bus infrastructure, the latter will require a certain degree of expertise and capital to develop. Therefore government contributions are crucial to augment the market.

Trials of ebuses are planned to start in late 2016 in **Singapore**, where a close examination of the available technologies to be implemented locally will help shape strategy towards the introduction of clean buses.

Trolleybuses with an autonomous off-wire stand-alone course, equipped with batteries – also known as dual-mode trolleybuses – have been tested on the streets of more than 40 cities in **Russia, Belarus, Moldova, Kyrgyzstan and Serbia**. A dual-mode trolleybus is able to run up to 15km without its connecting poles and was operationally tested, for example, in Saint Petersburg in 2014. New trolleybuses with extended autonomous run are expected to appear on routes to the residential areas of Saint Petersburg in 2017, while ebus tests in the city's specific climate conditions are planned to continue.¹² In Belarus, the Minsktrans public transport operator has also confirmed an order for charging stations and ebuses, in accordance with their 2017 plan.



▲ Electric bus in Bangalore
Source: Ramesh NG, Bangalore

There is currently no fully electric buses in commercial operation in **India**, although pilots took place in Bangalore (2014) and Delhi (2016) to demonstrate electric bus technology. Having test-launched India's first electric bus in February 2014 with a vehicle imported from a company based in China, the Bangalore Metropolitan Transport Corporation's (BMTC's) board has given its in-principle clearance to invest in 150 electric buses. Bengaluru is likely to be the first city in the country to launch city bus transport operations using such a large fleet of electric buses. The Indian government has initiated the 'Faster Adoption and Manufacturing of Hybrid and Electric Vehicles' (FAME) scheme to promote adoption of electric buses. BMTC will approach the Department of Heavy Industry for subsidy under this funding scheme.

A joint venture between a Chinese and an Indian-based OEM has been set up to ensure a manufacturing base in India for the production of electric buses. However, the company has not yet encountered the expected levels of demand from the Indian market. One European OEM has also entered into a joint venture with an Indian-based company for the production of electric buses for the Indian market. They plan to invest \$50m in establishing a manufacturing base. The first of these fully electric products will reach the market by March-April 2017.

In **Australia**, a free solar-electric bus service has been set up in Adelaide, where buses have 18 hours to charge and 6 hours of operation per day.¹³ Transport Canberra will also trial three ebuses across the ACTION bus network of school, suburban and rapid services. These vehicles are expected to be delivered in time for a trial that should start around January 2017 and last 12 months. The trial will quantify the economic, environmental and operational performance of electric buses in the network, compared to diesel buses.



▲ Solar electric bus service in Adelaide
Source: Market Quarter



▲ Electric bus line at the University of Yaoundé
Source: Bolloré

Contrasting with the other continents, the electric bus sector is not highly developed in **Africa**, reflecting the current state of the public transport sector. However, some operational experiences are ongoing on the continent, including a French-based company that has used electric buses for student transport in Cameroon and Ivory Coast since 2014.¹⁴ There are three buses in use at the University of Yaoundé (Cameroon) and three in use at Felix Houphouët Boigny University of Abidjan (Ivory Coast). In Uganda, engineers have built a solar-powered electric bus, the 'Kayoola', a 35-seater that can run for up to 80km on two power banks. These power banks can also be recharged by solar panels installed on the roof of the bus.¹⁵ The City of Cape Town, meanwhile, has awarded the tender announced in February 2016 for the procurement of battery-powered electric buses

¹² <http://www.eurasia.uitp.org/sankt-peterburg-trolleybus-tests>

¹³ <http://ecolocalizer.com/2013/09/04/adelaide-has-worlds-first-solar-powered-public-transport-system/>

¹⁴ <http://www.bolloré-africa-logistics.com/en/media/press-releases/bluebus-in-cameroon.html>

¹⁵ <http://www.bbc.com/news/world-africa-35458465>

and ancillary equipment for the MyCiTi service. With a service planned to start in June 2017, Cape Town will be the first municipality in South Africa to benefit from using electricity as an alternative fuel technology for its bus fleet.¹⁶

In the **North African region**, the Morocco's Energy Investment Company (SIE) will launch production of its locally made electric buses in 2017, for local and international markets. Marrakech has also announced the deployment of 30 ebuses in 2016-2017, half of them to be fully operational at the occasion of the COP22 climate change conference in November 2016. These buses will be operating on the four Bus à Haut Niveau de Service (BHNS)¹⁷ lines with dedicated lanes and high frequency.



Electric bus line at the University of Yaoundé
Source: Bolloré



Electric bus in Campinas
Source: BYD

In **Latin America**, development has also been quite modest. There are pilot projects ongoing in both Campinas (Brazil) and Montevideo (Uruguay). Itajaí Transportes Coletivos, a private bus operator in Campinas, has been testing a 70-passenger vehicle since November 2015. Following this, the plan is to introduce ten buses of this type. The local bus operator in Montevideo has been conducting a similar test since May 2016.

In parallel, a municipal law introduced in **Sao Paulo** in 2009 aims to fight air pollution and provides for the replacement of 100% of fossil fuels vehicles with alternative fuels and less polluting vehicles by 2020. Among the available technologies, the electric drive is presented as one of the

most advantageous solutions and Sao Paulo, which already has a large fleet of bus rapid transit (BRT)¹⁸ trolleybuses in operation, is currently considering investment in battery trolleybuses.

Approximately 200 full battery electric buses were delivered in the **USA** within 2016, with the largest number currently operated by Foothill Transit in the Los Angeles region (California).¹⁹ The North American market is also characterised by the presence of both an American and a Chinese OEMs. Last year, the US Department of Transportation announced \$55m in competitive grants to deploy more zero-emission buses across the country.²⁰ In **California**, the Fleet Rule for Transit Agencies requires reductions in both pollutant emissions and exposure to air contaminants from urban buses and transit fleet vehicles. The transit fleet rule also established a demonstration and purchase requirement for zero-emission technologies for large transit agencies. As operators gain experience with zero-emission bus technology, and as that technology evolves, purchase requirements are expected to increase, with the goal of transforming the state-wide transit bus fleet by 2040.²¹



Electric bus in the Los Angeles Region
Source: CHARGED

In **Canada**, the Société de Transport de Laval (STL) purchased an electric bus in 2012 and tested it during 2013-14 before putting it into service in 2015. The main goal of this project was to test the bus in closed-circuit rather than real-life conditions, so that STL could make informed choices when the time comes to electrify its fleet. This project is part of a wider strategy to promote 'green' energy in the province of **Quebec**, which has abundant hydroelectricity. Similarly and as part of the 'Cité Mobilité' project, the operator Société de transport de Montréal (STM) is purchasing three full electric buses and installing four rapid charging points in order to test the technology in a real-life operating context between 2016-2019.

¹⁶ Transport for Cape Town: <http://www.tct.gov.za/en/news/general/myciti-service-to-go-green-with-electric-powered-buses-and-new-job-opportunities/page-1/>
¹⁷ BHNS: Bus à Haut Niveau de Service, inspired by bus rapid transit in urban contexts outside Latin America, for example in Europe.

¹⁸ BRT: bus rapid transit, a type of limited-stop service developed in the 1970s in South America and enjoying popularity elsewhere since the 1990s. It is operated on exclusive lanes that are physically separated from other road traffic, except at junctions. A BRT line combines intelligent transportation systems technology, priority at junctions, and rapid and convenient fare collection, and is integrated with land-use policy in order to substantially upgrade bus system performance.

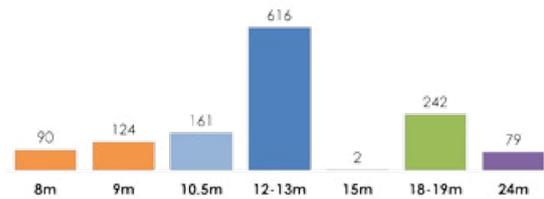
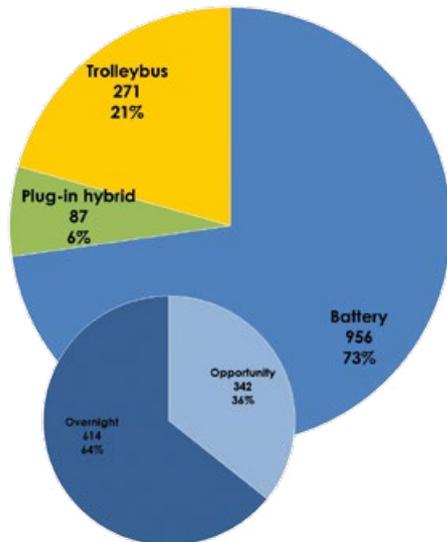
¹⁹ List of cities/regions operating full battery electric buses in the USA:

Worcester, MA (7); Philadelphia, PA (25); Delaware (6); City of Seneca, SC (7); Tallahassee, FL (5); Nashville, TN (9); Louisville, KY (16); Lexington, KY (6); Moline, IL (2); Shreveport, LA (5); Port Arthur, TX, (6); San Antonio, TX (3); Dallas, TX (7); Duluth, MN (7); Missoula, MT (2); Park City, UT (6); Pomona, CA (31); San Jose, CA (5); Stockton, CA (17); Reno, NV (4); Lakewood, WA (2); Seattle, WA (11); Everett, WA (4). Source: <https://www.proterra.com/our-story/our-customers/>

²⁰ A list of all funded projects is available at <https://www.transit.dot.gov/funding/grants/low-or-no-emission-vehicle-deployment-program-project-selections>

²¹ <https://www.arb.ca.gov/msprog/bus/bus.htm>

In terms of scale, Europe follows Asia with over 1,300 electric buses delivered or on order.²² This figure includes battery buses (overnight and opportunity charged), plug-in hybrid buses and trolleybuses with batteries for off-wire operation.



European urban electric bus operation, by vehicle length

Source: Alexander Dennis Limited

Electric bus technologies in Europe

Source: Alexander Dennis Limited

The greatest number of electric buses of the above types can be seen in the **United Kingdom**, with over **18%** of the total European fleet, followed by the **Netherlands, Switzerland, Poland and Germany**, with around **10%** each.

In order to accelerate deployment, countries such as **France²³, Germany²⁴, Italy²⁵ and the UK²⁶** have set up, or are setting up, national legal frameworks to promote vehicles with reduced environmental impact and energy consumption. Local initiatives, including the establishment of low and ultra-low-emission zones, can also encourage the deployment of electric buses. Some funding and financing schemes have been identified as supporting this trend. In the UK, the Air Quality Grant scheme runs alongside the Green Bus Fund, Clean Bus Technology Fund, Low Emission Bus Scheme and Bus Service Operators Grant (BSOG)/Low Carbon Emission Bus (LCEB) incentives. In southern Europe, Spain has developed two similar schemes, the Integral Strategy for Electric Vehicle Support (MOVELE) and the Integral Strategy for Alternative Energies Vehicle Support (MOVEA).²⁷

Further east, **Istanbul's** operator IETT has experience with hybrid BRT and has tested electric buses in the past. It is clear that deploying electric buses is part of their agenda. Izmir Metropolitan Municipality tendered and ordered 20 full battery electric buses. MOTAS, which operates in Malatya, introduced a new trolleybus system in 2014 and has bought ten 24-metre battery trolleybuses following a successful test of three fully electric trolleybuses. MOTAS's fleet will have 13 fully electric, high-capacity vehicles by the summer of 2017.

Ebus in Malatya, Source: MOTAS



²²Vehicles > 8t GVW and > 8m in length. Small numbers of trial vehicles have been withdrawn.

²³Article 37 of Transition énergétique pour la croissance verte, published 17/08/2015.

https://www.legifrance.gouv.fr/affichTexteArticle.do;jsessionid=51B1B679AA96A41956077488B7AD621C.tpdila12v_1?idArticle=JORFARTI000031044848&cid-Texte=JORFTEXT000031044385&dateTexte=29990101&categorieLien=id

²⁴Paragraphs 1-8 of the E Mobility Law, published in 2013.

²⁵Article 7 of D.Lgs. 03-mar-2011 n.24, Attuazione della direttiva 2009/33/CE relativa alla promozione di veicoli a ridotto impatto ambientale e a basso consumo energetico nel trasporto su strada, published on 24/03/2011, <http://www.gazzettaufficiale.it/gunewsletter/dettaglio.jsp?service=10&data-gu=2011-03-24&task=dettaglio&numgu=68&redaz=011G0063&tmstp=1301302373955>; Article 9 of D.M. 19-dic-2011 n.735, published on 05/06/2012; Article 70 of D.L. 83/2012 Testo del decreto-legge 22 giugno 2012, n. 83 (in supplemento ordinario n. 129/L alla Gazzetta Ufficiale serie generale - n. 147 del 26 giugno 2012), coordinato con la legge di conversione 7 agosto 2012, n. 134 (in questo stesso supplemento ordinario alla pag. 1), recante: "Misure urgenti per la crescita del Paese", published on 11/08/2012, <http://www.minambiente.it/normative/decreto-ministeriale-19-dicembre-2011-n-735-che-istituisce-un-programma-di-finanziamenti>; Article 9 of D. M. 1 dicembre 2015, n. 219 - Regolamento recante sistema di riqualificazione elettrica destinato ad equipaggiare autovetture M e N1, published on 11/01/2016, http://www.gazzettaufficiale.it/atto/serie_generale/caricaDettaglioAtto/originario?atto.dataPubblicazioneGazzetta=2016-01-11&atto.codiceRedazionale=15G00232&elenco30giorni=false; Article 79 of EGGE 28 dicembre 2015, n. 221 Disposizioni in materia ambientale per promuovere misure di green economy e per il contenimento dell'uso eccessivo di risorse naturali, published on 18/01/2016, <http://www.gazzettaufficiale.it/eli/id/2016/1/18/16G00006/sg>.

²⁶Part II Paragraph 142 of the Transport Act published in 2000.

²⁷Analysis of existing legislative frameworks in the European Union conducted by the ZeEUS National Observatory composed of: UITP, ASSTRA, VDV, UTP, TRL, TMB and EURELECTRIC.

What does the future hold? —

As part of the ZeEUS project, UITP has compiled the strategies of various European cities for the introduction of electric buses over the coming years. It reveals that 19 public transport operators and authorities, covering around 25 cities, have a published strategy up to 2020. By this cut-off date, there should be more than 2,500 electric buses operating in the relevant cities, representing 6% of their total fleet of 40,000.

Over 13 public transport operators and authorities in some 18 cities have a strategy up to 2025; by then, they are expected to have more than 6,100 electric buses in service, representing 43% of their total fleet of 14,000.

A more qualitative market analysis was conducted among bus manufacturers. This shows that a European series production of electric buses should reach full maturity by 2018-2020.

These latest developments bode well for the uptake of fully electric buses in the near future, since demand and supply are converging. In a context of transition however, the various transport providers are on a learning curve. The ZeEUS project partners have identified five challenges that must be tackled to ensure an increase in the use of electric buses in the years to come:

- (1) The higher upfront cost of electric buses and their charging infrastructure compared to conventional vehicles
- (2) The importance of identifying suitable technology solutions for specific local operational contexts
- (3) The necessity to review current procurement and contractual frameworks
- (4) The requisite to standardise charging interfaces to ensure the interoperability of e buses, allowing multi-brands fleets to recharge with multi-brands infrastructures
- (5) The need to develop trust and cooperation with the electricity power generation and distribution sector, as well as grid owners and energy regulators.

Public transport stakeholders are confident that, by working hand-in-hand with everyone involved, most of these hurdles can be overcome by 2020.

Some electric bus rapid transit (BRT) systems have recently been developed in **Malatya** (2014) and **Kuala Lumpur** (2015). Other cities such as **Indianapolis**, **Lausanne**, **Lucerne**, **Nantes** and **Stavanger** have launched similar projects, while **Donostia/San Sebastian** and **Barcelona** are considering adopting a full electric BRT system.

The future will see an expansion of electrified bus rapid transit, as well as the growing role of autonomous driving in speeding up the deployment of electric buses; fully automated vehicles and electrified BRT solutions are mutually reinforcing.



Bus Rapid Transit in Kuala Lumpur
Source: *Prasarana Malaysia Berhad*



Autonomous shuttle in Sion, Switzerland, Source: *Carpostal*

IMPORTANT NOTE TO THE READER

The ZeEUS eBus Report gives an extensive overview of the electric buses in operation in Europe today, along the different solutions available on the markets today.²⁸ It is obvious that the electrification of public transport is high on the priority list of cities and public transport agencies and operators.

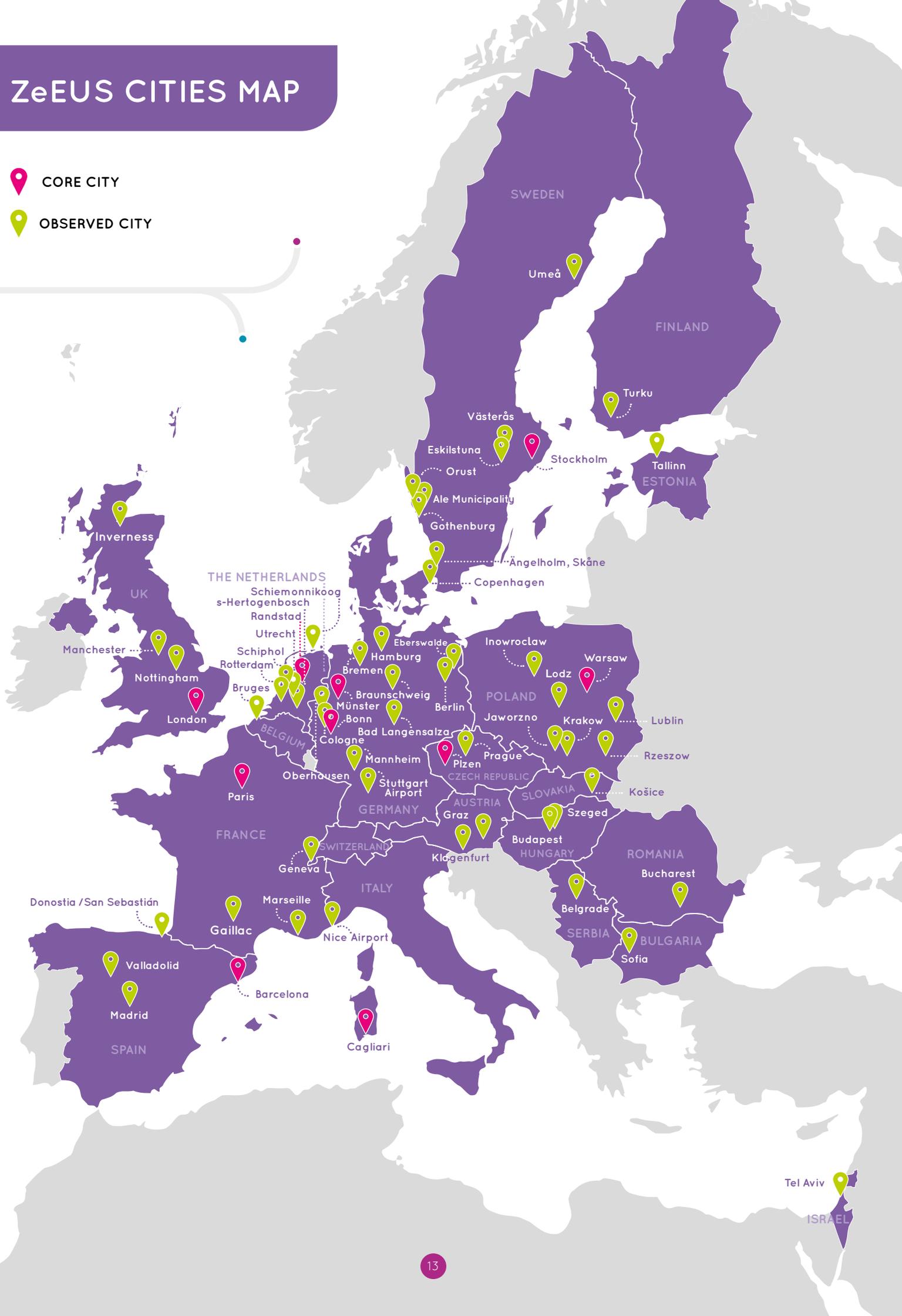
Many vehicle specifications are collected and shown in this report, but we want to emphasise that **some of the specifications are meant to give an indication only, and can vary depending on local conditions and local contexts of operation.** An example is the 'range' of an electric bus, which is theoretically the maximum distance that can be driven on a fully charged battery. The actual range of a fully charged battery can depend on many different parameters, including vehicle efficiency, weight/number of passengers, weather conditions, route characteristics and driving style. Moreover, different charging strategies can change the way we have to look at the definition of range. For instance, a broad network of high-power opportunity charging infrastructure can provide almost infinite range, even with a smaller battery on board.

A wide range of technological solutions exist for the electrification of public transport, but every choice is dependent on the local situation and can result in a different total cost of ownership. Therefore, this report aims to provide the reader with an overview of experiences from various cities, and to demonstrate the feasibility of implementing e buses in an urban context.

²⁸ The ZeEUS eBus Report is a collective effort, produced thanks to the authors and contributors listed in the acknowledgements.

ZeEUS CITIES MAP

-  CORE CITY
-  OBSERVED CITY



CHAPTER 2: CITY

GRAZ (AT)

HOLDING GRAZ – KOMMUNALE DIENSTLEISTUNGEN
GMBH

“Holding Graz has a focus on next-generation energy/ power storage technologies and systemic, open and more sustainable solutions. We do not repeat electric bus tests already made in other cities, but try to capitalise on those experiences to provide the best possible solution for Graz.”

Vehicles: 2 x 12m Chariot Motors ebus

Charging: Fast-charging at the terminal and selected bus stops

Line: 50

Total operation time/day: 15h

Duration: Oct 2016 – Nov 2017

Nature of experience: Testing different technologies

Funding: City, industry



Chariot Motors e-bus

Vehicles: 2 x 18m CRRC articulated bus

Charging: Fast-charging at the terminal and selected bus stops, slow-charging at the depot

Line: 34E

Total operation time/day: 13h

Duration: Oct 2016 – Nov 2017

Nature of experience: Testing different technologies

Funding: City, industry



CRRC articulated bus
Source: CRRC

DESCRIPTION

As a part of the E-mobility Graz strategy, Holding Graz operates two different brands of electric bus, Chariot Motors and CRRC, with supercapacitors. The tests aim to demonstrate the utility of electric buses as a replacement for diesel buses, without changing operational setup, as well as to gain acceptance with the relevant public and the staff of Holding Graz. The implementation of different technologies and validation of the test results will inform the strategy process of Holding Graz, as it seeks to decarbonise its bus fleet and the inner city of Graz.

VEHICLE SPECIFICATIONS

Vehicle Brand	2 x Chariot Motors	2 x CRRC
Vehicle Model	Ebus	Articulated bus
Vehicle Length	12m	18m
Total passenger capacity	90	135
Air Conditioning	Yes	Yes
Heating	Yes	Yes
Opportunity charging	Pantograph at the terminal and selected bus stops (0.5-2min)	
Overnight charging	No	Plug at the depot (0-120min)
Energy storage system power	32kWh (supercapacitors)	24kWh (supercapacitors) + 25kWh (batteries)

LINE SPECIFICATIONS

Route number	50	34E
Type of line	City centre	
Topography of the line	Flat	
Length of the bus line	3.5km	3.5km
Average commercial speed	20km/h	20km/h
Total daily hours of operation	15h	13h
Total daily hours operated in full electric	15h	13h
Total km driven/vehicle/day	203km	188km

CLIMATE

The climate in Graz is moderate. There is significant rainfall, with an annual average of 819mm. The average annual temperature in Graz is 10.8°C. Temperatures are highest on average in July, at around 21.5°C. January is the coldest month, with temperatures averaging -0.5°C.

KLAGENFURT (AT)

STADTWERKE KLAGENFURT



Vehicle: 1 x 8,9m Solaris Urbino 8.9 LE electric

Charging: Slow-charging at the depot

Line: 43

Total operation time/day: 8h

Duration: July 2013 – Aug 2018

Nature of experience: Test different technologies

Funding: Self-funded, EU



Solaris Urbino 8.9 LE electric

DESCRIPTION

Stock Company purchased a Solaris Urbino 8.9 LE electric prototype in order to test its suitability for everyday operation. At the end of the trial, the bus will operate on a different route. The test is also a part of a CO2 reduction policy.

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x Solaris
Vehicle Model	Urbino 8.9 LE electric
Vehicle Length	8.9m
Total passenger capacity	51
Air Conditioning	Yes
Heating	Yes
Overnight charging	Plug at the depot (4h)
Energy storage system power	120kWh

LINE SPECIFICATIONS

Route number	43
Type of line	City centre
Topography of the line	Flat
Length of the bus line	7.5km
Average commercial speed	19km/h
Total daily hours of operation	8h
Total daily hours operated in full electric	4-4.8h
Total km driven/vehicle/day	110km

CLIMATE

Klagenfurt has a continental climate with cold winters. The average temperature is 9.3°C. The daily mean temperature in January is -4.0°C and 18.8°C in July. The heaviest precipitation is during the period from June to September.

BRUGES (BE)

DE LIJN



"The biggest challenge to overcome was power availability, mainly because we use fast-charging at 170kW at both stations. For that reason we had to install a transformer station. We have to take into account that buses and infrastructure are closely related and should be seen as a concept rather than as individual items."

Vehicles: 3 x 9.65m Van Hool A308 citybus

Charging: fast charging at the terminal, slow charging at the depot

Line: 12

Total operation time/day: 10h

Duration: Oct 2015 – March 2016

Nature of experience:
Demonstration

Funding: Regional, EU (EVTecLab)

DESCRIPTION

Within the Flemish Government's EVTecLab demonstration project, De Lijn purchased and operated three A308 Citybuses manufactured by Van Hool. Energy supply is via an inductive fast charging system provided by Bombardier. At the end of the test, the buses will continue to operate on the same route.

VEHICLE SPECIFICATIONS

Vehicle Brand	3 x Van Hool
Vehicle Model	A308 citybus
Vehicle Length	9.65m
Total passenger capacity	55
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Induction at the terminal (12min)
Overnight charging	Plug at the depot (2.5h)
Energy storage system power	36.4kWh

LINE SPECIFICATIONS

Route number	12
Type of line	City centre
Topography of the line	Flat
Length of the bus line	5.5km
Average commercial speed	14km/h
Total daily hours of operation	10h
Total daily hours operated in full electric	10h
Total km driven/vehicle/day	50-60km



Van Hool A308 citybus

CLIMATE

The climate is mild and generally warm. Rainfall in Bruges is significant, with precipitation averaging 925mm. The average temperature is 12.7°C. With an average temperature of 19.9°C, July is the hottest month of the year. At 5.6°C on average, January is the coldest month of the year.

SOFIA (BG)

CHARIOT MOTORS



"Sofia has implemented a unique ultracapacitor ebus pilot, a technology that had not yet been tested in any other European city at that time. The biggest challenge was the correct operation of the electric bus ultracapacitor. The bus itself was well-accepted by passengers and staff."

Vehicle: 1 x 12m Higer Chariot e-bus

Charging: Fast-charging at both the terminal and depot

Line: 1

Total operation time/day: 8.5h

Duration: May 2014 – Sept 2015

Nature of experience: Pilot

Funding: Self-funded



Higer Chariot e-bus

DESCRIPTION

Sofia plans to promote e buses in 2016-2017. A Higer Chariot e bus, purchased from Chariot Motors, has been in operation on line 1 (11.2km). The line has two charging stations at terminals, each with capacity of 150kW. The Chariot e bus has accumulated around 25,000km to date, as a result of 8-hour daily shift operations, excluding national holidays and weekends. The charging time at each terminal is within the range of 6min, with the possibility of even faster charging if a more powerful charging station is installed.

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x Higer
Vehicle Model	Chariot e-bus
Vehicle Length	12m
Total passenger capacity	91
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Pantograph at the terminal (5-6min) and at the depot (5-6min)
Energy storage system power	21kWh-32kWh

LINE SPECIFICATIONS

Route number	11
Type of line	City centre, suburban area
Topography of the line	Flat including a hilly section
Length of the bus line	11.2km
Average commercial speed	16.1km/h
Total daily hours of operation	8.5h
Total daily hours operated in full electric	8.5h
Total km driven/vehicle/day	88km

CLIMATE

Sofia has a humid, continental climate, with an average annual temperature of 10.6°C. Winters are cold and snowy. In January, the daily average temperature is -0.5°C. On average, there are annually 58 days of snow cover. Summers are warm and sunny but Sofia is slightly cooler than other parts of Bulgaria. The average daily temperature in July is 21.2°C. The city receives average precipitation of 581mm a year, reaching its peak in late spring and early summer.

PLZEN (CZ)

ŠKODA



"The biggest complication was the implementation of the charging infrastructure. Due to the necessary administration, permissions, licences, construction works, etc., the whole process took longer than expected."

Vehicles: 2 x 12m Škoda PERUN HP

Charging: Fast-charging at the terminal, slow charging at the depot

Lines: 27

Total operation time/day: 7.5-18.5h

Duration: Since May 2015 and ongoing

Nature of experience: Demonstration

Funding: City, regional, EU

DESCRIPTION

Demonstration of the use of electricity as an alternative to diesel for urban buses in a wide range of real-life operating conditions – operation on standard line with passengers, including the implementation of charging infrastructure. It will be implemented into the city initiative 'Green Plzen'.

VEHICLE SPECIFICATIONS

Vehicle Brand	2 x Škoda
Vehicle Model	PERUN HP
Vehicle Length	12m
Total passenger capacity	82
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Articulated arm at the terminal (7min)
Overnight charging	Plug at the depot (5h)
Energy storage system power	75kWh

LINE SPECIFICATIONS

Route number	27
Type of line	City centre, suburban area
Topography of the line	Hilly
Length of the bus line	6km
Average commercial speed	25km/h
Total daily hours of operation	7.5-18.5h
Total daily hours operated in full electric	7.5-18.5h
Total km driven/vehicle/day	80-200km



ŠKODA PERUN HP

CLIMATE

Plzen's climate is classified as warm and temperate. There is a significant amount of rainfall during the year, with an annual average of 604mm. The average annual temperature is 8.0°C. The temperatures are highest on average in July, at around 27.7°C. January has the lowest average temperatures of the year, sometimes as low as -20°C.

PRAGUE (CZ)

DOPRAVNÍ PODNIK HL.M. PRAHY



Dopravní podnik
hlavního města Prahy

"With no opportunity for subsidies, we had to fund the project ourselves, which led to a simple and cost-efficient solution. The key part of the project has been synergy and close cooperation between the bus and tram departments of our public transport company. As the next step, we plan to fully electrify line 207 by 2018, which will involve 12-14 12m ebuses."

Vehicle: 1 x 11.1m SOR EBN 11

Charging: Fast-charging at the terminal, slow charging at the depot

Lines: 124, 163, 188, 213

Total operation time/day: 18h

Duration: Sept 2015 – Aug 2017

Nature of experience: Pilot

Funding: Self-funded



SOR EBN 11

DESCRIPTION

As a part of the Czech National Action Plan for Clean Mobility, the Prague area Sustainable Mobility Plan and DPP company strategy, DPP (the operator), SOR (the vehicle producer) and Cegelec (an electrical equipment supplier) are cooperating in this pilot project to test the SOR EBN 11 vehicle. The bus and charging stations have been leased by DPP for one year, with the possibility of an extension. The pilot project has already been extended for a further 12 months, because of positive results during the first year of operation (65,000km in regular passenger service).

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x SOR
Vehicle Model	EBN 11
Vehicle Length	11.1m
Total passenger capacity	93
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Pantograph at the terminal, using energy from the tram supply network (10-30min)
Overnight charging	Plug at the depot (1-6h)
Energy storage system power	172kWh

LINE SPECIFICATIONS

Route number	124	163	188	213
Type of line	Metropolitan area			
Topography of the line	hilly	flat	medium	medium
Length of the bus line	27km	35km	28km	22km
Average commercial speed	14.3km/h	19.4km/h	16.6km/h	14.9km/h
Total daily hours of operation	18h			
Total daily hours operated in full electric	18h			
Total km driven/vehicle/day	265km	340km	265km	265km

CLIMATE

Prague's climate is somewhere between maritime and humid continental. The winters are relatively cold, with average temperatures at about freezing point and with very little sunshine. Snow cover can be common between mid November and late March. Summers usually bring plenty of sunshine and an average temperature high of 24°C. Precipitation in Prague is rather low (just over 500mm per year).

COPENHAGEN (DK)

TRAFIKSELSKABET MOVIA



"The biggest challenge for us is the high Danish tax on electricity (200 times higher for electric buses than trains). This has not yet been overcome, and renders electric bus operation significantly more expensive than diesel bus operation."

Vehicles: 2 x 12m BYD K9 (Variant of BYD 12m Overseas)

Charging: Slow-charging at the depot

Lines: 3A, 141/149

Total operation time/day: 3A, 10-12h; 141, 7-12h

Duration: Jan 2014 – Dec 2015

Nature of experience: Pilot

Funding: Danish Transport Authority's test scheme for clean vehicles



BYD K9 (Variant of BYD 12m Overseas)

DESCRIPTION

The Danish Transport Authority has supported a number of projects to test new technology using alternative fuels in order to reduce CO2 emissions. As a part of this strategy, Movia has leased two 12m electric buses from BYD (model K9). The buses were used in regular service on two routes and under two different bus operators. The purpose of the trial was to test overnight charging for e-buses in regular service and to collect data on energy consumption, reliability, functionality (for example range, noise level and comfort), battery performance and driver and customer satisfaction.

VEHICLE SPECIFICATIONS

Vehicle Brand	2 x BYD
Vehicle Model	K9 (Variant of BYD 12m Overseas)
Vehicle Length	12m
Total passenger capacity	61
Air Conditioning	Yes
Heating	Yes
Overnight charging	Plug at the depot (5h)
Energy storage system power	324kWh

LINE SPECIFICATIONS

Route number	141/149	3A
Type of line	Suburban area	Urban area
Topography of the line	Flat	Flat
Length of the bus line	10.8km/9.1km	9.4km
Average commercial speed	22.3km/h	15.7km/h
Total daily hours of operation	7-12h	10-12h
Total daily hours operated in full electric	7-12h	10-12h
Total km driven/vehicle/day	210-260km	210-260km

CLIMATE

The climate is cool and temperate. Rainfall in Copenhagen is significant, with an annual average of 613mm. The average annual temperature is 8°C. July is the warmest month of the year, with the temperature averaging 20.4°C. At an average of -0.1°C, February is the coldest month of the year.

BERLIN (DE)

BERLINER VERKEHRSBETRIEBE

BVG

"We are proud to have successfully electrified a full line with inductive charging. The fully functioning system was a challenge, but we have delivered."

Vehicles: 4 x 12m Solaris Urbino 12 electric

Charging: Fast-charging at the terminal and at selected bus stops, slow-charging at the depot

Line: 204

Total operation time/day: 22h

Duration: Oct 2015-Oct 2018

Nature of experience: Pilot

Funding: Local authority, regional, EU

DESCRIPTION

The 'E-Bus Berlin' project is one of about 30 core projects funded by the Federal Ministry of Transport and Digital Infrastructure. It is the first fully electric line in Germany, operating with four electric buses and inductive opportunity charging at the terminals. The conclusions obtained on the suitability and marketability of e-buses will contribute to a wider strategy regarding overall environmental decarbonisation and nitrogen oxides reduction.

VEHICLE SPECIFICATIONS

Vehicle Brand	4 x Solaris
Vehicle Model	Urbino 12 electric
Vehicle Length	12m
Total passenger capacity	87
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Induction at terminal and selected bus stops (5min)
Overnight charging	Plug at the depot (4h)
Energy storage system power	230kWh

LINE SPECIFICATIONS

Route number	204
Type of line	City centre
Topography of the line	Flat
Length of the bus line	6km
Average commercial speed	12km/h
Total daily hours of operation	22h
Total daily hours operated in full electric	22h
Total km driven/vehicle/day	168km



Solaris Urbino 12 electric

CLIMATE

Berlin has a maritime temperate climate. Summers are warm and sometimes humid, with average daily temperatures of 17-19°C. Winters are cool, with average daily temperatures of 0-2°C. Annual precipitation is 570mm, with moderate rainfall throughout the year.

Vehicle: 1 x 10.7m Bozankaya
Sileo S10

Charging: Fast-charging at the
terminal, slow-charging at the
depot

Line: 16

Total operation time/day: 12h

Duration: June 2016-June 2020

Nature of experience: Pilot

Funding: City, local authority,
regional

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x Bozankaya
Vehicle Model	Sileo S10
Vehicle Length	10.7m
Total passenger capacity	66
Air Conditioning	Yes
Heating	Yes
Overnight charging	Plug at the depot (8h)
Energy storage system power	230KWh

LINE SPECIFICATIONS

Route number	16
Type of line	Urban
Topography of the line	Moderate
Length of the bus line	4.6km
Average commercial speed	28km/h
Total daily hours of operation	12h
Total daily hours operated in full electric	12h
Total km driven/vehicle/day	200km

CLIMATE

The climate is mild, and generally warm. There is significant rainfall throughout the year, with precipitation averaging 547mm. The average annual temperature is 8.4°C. With an average temperature of 17.3°C, July is the hottest month of the year. In January, the average temperature is -0.6°C, which is the lowest average temperature of the year.

BONN (DE)

STADTWERKE BONN VERKEHRS GmbH



"We strive for overnight charging. In terms of the efficacy of this procedure, we are far ahead of other cities."

Vehicles: 6 x 12m Bozankaya Sileo S12

Charging: Slow-charging at the depot

Line: 607

Total operation time/day: 13h

Duration: Feb 2016-Feb 2028

Nature of experience: Demonstration

Funding: Self-funded

DESCRIPTION

The demonstration in the city of Bonn focuses on 12m battery buses, which operate on different lines in order to gain a comprehensive overview of the operational possibilities. The overall objective of the demonstration is to evaluate both the feasibility of the operation of 12m battery buses and their technical suitability, not least in combination with the charging infrastructure. Recharging takes place at the Bonn-Friesdorf bus depot. We will use the experience of the project to take a decision in 2017 on adopting e-buses across the entire bus network, particularly against the background of sustainability in Bonn and the wider region.

VEHICLE SPECIFICATIONS

Vehicle Brand	6 x Bozankaya Sileo
Vehicle Model	S12
Vehicle Length	12m
Total passenger capacity	80
Air Conditioning	Yes
Heating	Yes
Overnight charging	Plug at the depot (5.5h)
Energy storage system power	230kWh

LINE SPECIFICATIONS

Route number	607
Type of line	City centre
Topography of the line	Moderate
Length of the bus line	17.2km
Average commercial speed	15km/h
Total daily hours of operation	13h
Total daily hours operated in full electric	13h
Total km driven/vehicle/day	200km



Bozankaya Sileo S12

CLIMATE

Bonn's climate is classified as warm and temperate. The city has significant rainfall, with an annual average of 742mm. The average annual temperature in Bonn is 10.0°C. The temperatures are highest on average in July, at around 18.1°C. January is the coldest month, with temperatures averaging 2.0°C.

Vehicles: 4 x 12m Solaris Urbino 12 electric; 2 x 18m Solaris Urbino 18 electric

Charging: Fast-charging at the terminal and at selected bus stops, slow-charging at the depot

Line: 1

Total operation time/day: 18h

Duration: Since March 2014 and ongoing

Nature of experience: Research project

Funding: Self-funded, city, local authority, regional, national

DESCRIPTION

Within an EMIL (electro mobility by inductive charging) project, an electric powered 12m bus runs with passengers on the 12km M19 bus route. The vehicles use high-power wireless (inductive) charging. The daily service runs with virtually no disturbance or problems. Articulated buses are the next step in this project and have replaced most of the diesel-powered buses on this specific line.

VEHICLE SPECIFICATIONS

Vehicle Brand	4 x Solaris	2 x Solaris
Vehicle Model	Urbino 12 electric	Urbino 18 electric
Vehicle Length	12m	18m
Total passenger capacity	78	123
Air Conditioning	Yes	Yes
Heating	Yes	Yes
Opportunity charging	Induction at the terminal and selected bus stops (6-8min)	
Overnight charging	Plug at the depot (4-6h)	
Energy storage system power	200kWh	

LINE SPECIFICATIONS

Route number	1
Type of line	City centre
Topography of the line	Moderate
Length of the bus line	12km
Average commercial speed	23km/h
Total daily hours of operation	18h
Total daily hours operated in full electric	18h
Total km driven/vehicle/day	250km

CLIMATE

Braunschweig falls climatically into the north temperate zone of central Europe. The average annual temperature is 8°C. The warmest month is August, with an average temperature of 19.5°C. The coolest month is January, with an average temperature of 0°C.

BREMEN (DE)

BREMER STRAßENBAHN AG



Vehicle: 1 x 12m Bozankaya Sileo S12

Charging: Slow-charging at the depot

Line: 29/52 (two combined full lines)

Total operation time/day: 10.5h

Duration: Aug 2016-Aug 2019

Nature of experience: Pilot

Funding: Self-funded, local authority, EU (H2020 project ELIPTIC)



Bozankaya Sileo S12

DESCRIPTION

The Bremer Straßenbahn AG (BSAG) is testing (over a period of three years) one standard 12m bus in regular operation. It is equipped with low-floor technology, ticket vending machines and air conditioning to maintain the usual standard for urban buses operated by BSAG.

An overall dissemination strategy is under way, in which the electromobility strategy of BSAG will be conveyed to the citizens and stakeholders of Bremen.

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x Bozankaya Sileo
Vehicle Model	S12
Vehicle Length	12m
Total passenger capacity	79
Air Conditioning	Yes
Heating	Yes
Overnight charging	Plug at the depot (2h)
Energy storage system power	230kWh

LINE SPECIFICATIONS

Route number	Combination of two lines 29 and 52
Type of line	City area, outside the city centre
Topography of the line	Flat
Length of the bus line	30km
Average commercial speed	21km/h
Total daily hours of operation	10.5h/day
Total daily hours operated in full electric	10.5h/day
Total km driven/vehicle/day	300km

CLIMATE

Bremen has a moderate maritime climate. The annual average temperature is 9.2°C, with an average of 17.4°C in July and 1.4° C in January. The city receives on average 671.3mm of precipitation per year.

COLOGNE (DE)

KOELNER VERKEHRS - BETRIEBE



"Electromobility is still in the early stages of its development. Many technical specifications of the data sheet had to be developed during our one-year test phase. Additionally, employees had to learn how to use the new technology. The challenge of this project was to ensure successful ebus operation in Cologne by using a new technology, with the target of achieving customer service quality on a par with that of conventional diesel buses."

Vehicles: 8 x 18.1m VDL Citea SLF-180 Electric

Charging: Fast-charging at the terminal and at selected bus stops; slow-charging at the depot

Line: 133

Total operation time/day: 18h

Duration: Oct 2015-Dec 2016

Nature of experience: Test

Funding: Self-funded, regional

DESCRIPTION

As a part of the 'Köln mobil 2025' strategy, KVB purchased eight VDL Citea SLF electric buses and is currently testing the vehicles on a route from the city centre to suburban areas. Following the test, the buses will continue to operate on the same route.

VEHICLE SPECIFICATIONS

Vehicle Brand	8 x VDL
Vehicle Model	Citea SLF-180 Electric
Vehicle Length	18.1m
Total passenger capacity	139
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Pantograph at the terminal and selected bus stops (8-15min)
Overnight charging	Pantograph at the depot (5-7h)
Energy storage system power	123kWh

LINE SPECIFICATIONS

Route number	133
Type of line	City centre to suburban areas
Topography of the line	Flat
Length of the bus line	6.7-7.0km
Average commercial speed	16-18km/h
Total daily hours of operation	18h
Total daily hours operated in full electric	18h
Total km driven/vehicle/day	120km



VDL Citea SLF-180 Electric

CLIMATE

Cologne is one of the warmest cities in Germany, with relatively mild winters and warm summers. Its average annual temperature is 10.3°C. In January, the mean temperature is 2.6°C, while the mean temperature in July is 18.8°C. Precipitation is spread evenly throughout the year.

Vehicle: 1 x 18m Solaris Trollino 18

Charging: Fast-charging at the terminal/depot and en route

Line: 4

Total operation time/day: 18h

Duration: Since May 2014 and ongoing

Nature of experience: Test

Funding: Self-funded, national, EU (ELIPTIC)

DESCRIPTION

The battery trolleybus operating in Eberswalde is the first vehicle of its kind in Europe. The target for the operator is to expand the wireless operation area in the city. The plan is then to acquire the next generation of battery trolleybus.

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x Solaris
Vehicle Model	Trollino 18
Vehicle Length	18m
Total passenger capacity	146
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Articulated arm at the depot (22min) and overhead wires via connecting poles en route
Energy storage system power	120kWh

LINE SPECIFICATIONS

Route number	4
Type of line	Suburban area
Topography of the line	Moderate
Length of the bus line	18km
Average commercial speed	24km/h
Total daily hours of operation	18h
Total daily hours operated in full electric	18h
Total km driven/vehicle/day	250km



Solaris Trollino 18

CLIMATE

The climate is mild, and generally warm and temperate. Eberswalde is a city with significant rainfall, and the annual average is 546mm. The average annual temperature is 8.9°C. With an average temperature of 18.4°C, July is the hottest month of the year. January is the coldest month, with temperatures averaging -1.1°C.

Vehicles: 4 x 18m Volvo 7900 electric

Charging: Fast-charging at the terminal and at selected bus stops, slow-charging at the depot

Line: 109 Innovation-Line

Total operation time/day: April 2012-Jan 2020

Nature of experience: Testing different technologies

Funding: City, local authority, national, EU



Volvo 7900 electric

DESCRIPTION

In order to find the best operational concept for the harbour city of Hamburg, we are currently testing different technologies. The trial of the buses described forms a part of an e-mobility strategy implemented in 2000. The main objective is to buy only electric buses by 2020.

VEHICLE SPECIFICATIONS

Vehicle Brand	4 x Volvo
Vehicle Model	7900 electric
Vehicle Length	12m
Total passenger capacity	73
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Pantograph at the terminal and selected bus stops (8min)
Overnight charging	Plug at the depot (3-6h)
Energy storage system power	100kWh

LINE SPECIFICATIONS

Route number	109 Innovation-Line
Type of line	City centre
Topography of the line	Flat
Length of the bus line	13.4km
Average commercial speed	18km/h
Total daily hours of operation	20h
Total daily hours operated in full electric	20h
Total km driven/vehicle/day	40-250km

CLIMATE

The climate is mild and generally warm. Rainfall in Hamburg is significant, with an annual average of 738mm. The average annual temperature is 8.5°C. With an average temperature of 17.3°C, July is the hottest month of the year. At -0.2°C on average, January is the coldest month of the year.

MANNHEIM (DE)

RHEIN-NECKAR-VERKEHR



"The biggest achievement was the successful integration of the charging infrastructure in a sensitive area of the city. In particular, underground facilities had to be installed for various supply lines (pipes for gas, water and electricity)."

Vehicles: 2 x 12m Hess Swisstrolley

Charging: Fast-charging at the terminal, selected bus stops and at the depot

Line: 63

Total operation time/day: 15h

Duration: May 2015-May 2016

Nature of experience: Pilot

Funding: National (Leuchttürme der Elektromobilität)



Hess Swisstrolley

DESCRIPTION

By operating a line with two fully electric buses and an inductive charging system, RNV is testing their suitability for everyday passenger services. The service on inner-city bus line 63 will enable RNV to determine the conditions under which electric buses can replace the entire diesel bus service on a line. Based on the results of this pilot project, RNV will consider the installation of further electric bus lines. After the end of the trial, the buses will continue to operate on the same route.

VEHICLE SPECIFICATIONS

Vehicle Brand	2 x Hess
Vehicle Model	Swisstrolley (prototype)
Vehicle Length	12m
Total passenger capacity	80
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Induction at the terminals and selected bus stops (30sec-4min)
Overnight charging	Induction using energy from tram supply network (14min)
Energy storage system power	60kWh

LINE SPECIFICATIONS

Route number	63
Type of line	City centre
Topography of the line	Moderate
Length of the bus line	4.5km
Average commercial speed	13.4km/h
Total daily hours of operation	15h
Total daily hours operated in full electric	15h
Total km driven/vehicle/day	190km

CLIMATE

Mannheim's climate is classified as warm and temperate. The city has significant rainfall and the annual average is 644mm. The average annual temperature is 10.1°C. The temperatures are highest on average in July, at around 19.1°C. January is the coldest month, with temperatures averaging 1.0°C.

MÜNSTER (DE)

RHEINISCH-WESTFÄLISCHE TECHNISCHE HOCHSCHULE
AACHEN

"Introducing electric buses in the city brings positive long-term effects for the environment. Reductions in noise and exhaust gas offer significant improvements for quality of life in Münster."

Vehicles: 4 x 12m VDL Citea SLF-120 electric

Charging: Fast-charging at the terminal, slow-charging at the depot

Line: 1

Total operation time/day: 14h

Duration: Sept 2015-April 2017

Nature of experience:
Demonstration

Funding: EU (FP7 ZeEUS project)



VDL Citea SLF-120 Electric

DESCRIPTION

In Münster, five fast-charging electric buses were used to electrify one bus line. Four vehicles are being tested within the ZeEUS project and one complements the electrification of the line. True fast-charging of up to 500kW is a key technology for achieving all-day bus operation. Following the demonstration, the buses will continue to operate on the same line.

VEHICLE SPECIFICATIONS

Vehicle Brand	4 x VDL
Vehicle Model	Citea SLF-120 Electric
Vehicle Length	12m
Total passenger capacity	80
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Pantograph at the terminal (5min)
Overnight charging	Plug at the depot (3h)
Energy storage system power	62.5kWh

LINE SPECIFICATIONS

Route number	14
Type of line	City centre
Topography of the line	Flat
Length of the bus line	10km
Average commercial speed	15km/h
Total daily hours of operation	14h
Total daily hours operated in full electric	14h
Total km driven/vehicle/day	200km

CLIMATE

In Münster, the climate is warm and temperate. There is a great deal of rainfall, with an annual average of 802mm. The average temperature is 9.2°C. With an average of 17.1°C, July is the warmest month. The lowest average temperatures in the year occur in January, when it is around 1.3°C.

OBERHAUSEN (DE)

STADTWERKE OBERHAUSEN

STOAG
Stadtwerke Oberhausen GmbH

"The objective of the test has been charging an ebus using tram infrastructure, while bearing in mind the most important aspect – a safe and reliable ebus operation."

Vehicles: 2 x 12m Solaris Urbino 12 electric

Charging: Fast-charging at selected bus stops, slow-charging at the depot

Lines: 962, 966

Total operation time/day: 18.25h and 11.5h respectively

Duration: Since Oct 2015 and ongoing

Nature of experience: Demonstration

Funding: Self-funded, regional, EU (ELIPTIC), industry (Energieversorgung Oberhausen)



SOLARIS Urbino 12 electric

DESCRIPTION

In order to reduce dependency on fossil fuels and reduce levels of nitrogen oxide and noise pollution in urban areas, the public transport operator Stadtwerke Oberhausen GmbH (STOAG) electrified two urban lines, 962 and 966. For fast-charging, the existing DC tram infrastructure is used to charge the battery buses in operation. The required charging stations have been built at Oberhausen-Sterkrade train station (line 962) and Neumarkt station (line 966). In Sterkrade the charging energy is taken from the tram catenary and at Neumarkt station the energy is taken from the tram sub-station. Currently, studies are being undertaken to examine the conversion of additional bus lines to electric operation, which can be fed from existing charging stations.

VEHICLE SPECIFICATIONS

Vehicle Brand	2 x Solaris
Vehicle Model	Urbino 12 electric
Vehicle Length	12m
Total passenger capacity	70
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Pantograph at selected bus stops, using energy from tram supply network (10min)
Overnight charging	Plug at the depot (5h)
Energy storage system power	200kWh

LINE SPECIFICATIONS

Route number	962	966
Type of line	City centre	City centre
Topography of the line	Flat	Flat
Length of the bus line	15.6km	13.3km
Average commercial speed	21km/h	21km/h
Total daily hours of operation	18.25h	11.5h
Total daily hours operated in full electric	18.25h	11.5h
Total km driven/vehicle/day	300km	170km

CLIMATE

The climate is warm and temperate. There is a great deal of rainfall in Oberhausen, with an annual average of 813mm. The average annual temperature is 10.0°C. July is the warmest month of the year, averaging 18.1°C. The lowest average temperatures in the year occur in January, when it is around 1.9°C.

STUTT GART AIRPORT (DE)

STUTT GART AIRPORT



Vehicles: 6 x 14m Cobus Industries eCobus 3000

Charging: Fast-charging at the depot

Lines: Airport area

Total operation time/day: 17h

Duration: Oct 2015-Dec 2016

Nature of experience: Pilot

Funding: EU

DESCRIPTION

Stuttgart Airport deployed the first six electric airport buses, type eCobus 3000. Forty percent of its bus fleet has become electric with this step. A full service contract has been signed for eight years. Stuttgart Airport's goal is to fully electrify the bus fleet by 2017, as the results in availability and energy efficiency are very encouraging.

VEHICLE SPECIFICATIONS

Vehicle Brand	6 x Cobus Industries
Vehicle Model	eCobus 3000
Vehicle Length	14m
Total passenger capacity	120
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Plug at the depot (1.5h)
Energy storage system power	85kWh



CobusIndustries eCobus 3000

LINE SPECIFICATIONS

Route number	Airport area, airside
Type of line	Airport
Topography of the line	Flat
Length of the bus line	Different routes
Average commercial speed	35km/h
Total daily hours of operation	17h
Total daily hours operated in full electric	17h
Total km driven/vehicle/day	90km

CLIMATE

Stuttgart's climate is classified as warm and temperate. The city has significant rainfall, and the annual average is 674mm. The average annual temperature in Stuttgart is 9.3°C. The temperatures are highest on average in July at around 18.0°C. January is the coldest month with temperatures averaging 0.1°C.

"Currently, we are modernising our tram and trolleybus infrastructure and, in connection with the reconstruction works, we are preparing to build a 'charging on demand system' for ebus."

Vehicles: 24 x 12.1m Volvo 7900 Electric Hybrid

Charging: Slow-charging at the depot

Lines: 42, 43

Total operation time/day: 8-19h

Duration: Since Jan 2016 and ongoing

Nature of experience: Procurement

Funding: City

DESCRIPTION

After initial tests with hybrid buses and fully electric buses, Tallinna Linnatranspordi purchased Volvo 7900 ebus for regular operation in real-world conditions with passengers. The new hybrid buses operate on the previous trolleybus routes. The buses are much more comfortable than the old trolleybuses and the passengers are very satisfied.

VEHICLE SPECIFICATIONS

Vehicle Brand	24 x Volvo
Vehicle Model	7900 Electric Hybrid
Vehicle Length	12.1m
Total passenger capacity	84
Air Conditioning	Yes
Heating	Yes
Overnight charging	Plug at the depot (6.5h)
Energy storage system power	1.2kWh

LINE SPECIFICATIONS

Route number	42	43
Type of line	City centre	City centre
Topography of the line	Flat	Flat
Length of the bus line	19.7km	18.1km
Average commercial speed	17.1km/h	17.8km/h
Total daily hours of operation	13.9h	14.9h
Total daily hours operated in full electric	1.1h	1.2h
Total km driven/vehicle/day	221km	249km



VOLVO 7900 Electric Hybrid

CLIMATE

The climate is cold and temperate. Tallinn has a significant amount of rainfall during the year, with an annual average of 671mm. The average temperature is 5.3°C. July is the warmest month of the year with an average temperature of 16.9°C. February has the lowest average temperature of the year, 5.8°C.

TURKU (FI)

TURKU REGION TRAFFIC FÖLI

"Turku is the only Finnish city that has converted a whole bus line to electric. The aim is to be carbon neutral by 2040."

Vehicles: 6 x 12.8m Linkker 13 LE-D

Charging: Fast-charging at the terminal, slow-charging at the depot

Line: 1

Total operation time/day: 18h

Duration: Since Oct 2016 until 2023 or later

Nature of experience:
Procurement

Funding: Self-funded, city, national



Linkker 13 LE-D

DESCRIPTION

With the city council's decision to electrify transport and become carbon neutral by 2040, this is a pilot of six electric buses to gain experience of electric buses, with the aim of procuring electric buses in future tenders for bus operation. At the same time, this is a real procurement for the operation of bus line 1 and the buses will be operating the whole line for the whole contract period (7+3 years).

VEHICLE SPECIFICATIONS

Vehicle Brand	6 x Linkker
Vehicle Model	13 LE-D
Vehicle Length	12.8m
Total passenger capacity	68
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Pantograph at the terminal (3min)
Overnight charging	Plug at the depot (3h)
Energy storage system power	55kWh

LINE SPECIFICATIONS

Route number	1
Type of line	City centre, suburban area
Topography of the line	Flat
Length of the bus line	12.6km
Average commercial speed	19km/h
Total daily hours of operation	18h
Total daily hours operated in full electric	18h
Total km driven/vehicle/day	350km

CLIMATE

In Turku, the climate is cold and temperate. The city has significant rainfall; the annual average is 670mm. The average annual temperature in Turku is 5.2°C. The warmest month of the year is July, with an average temperature of 17.0°C. February is the coldest month, with temperatures averaging -5.7°C.

GAILLAC (FR)

SAFRA

Safra

"Given the potential of the area, we believe that the area of Gaillac will be increasing and therefore the presence of the public transport is crucial. We want it to be sustainable to respect the surrounding vineyards."

Vehicles: 1 x 10.5m Safra Businova Midibus

Charging: Slow-charging at the depot

Line: D988

Total operation time/day: 8.5h

Duration: April 2016 – Dec 2017

Nature of experience: Demonstration

Funding: City level funded, local authority (other than city) funding

DESCRIPTION

Gaillac is a small town where Businova is used in a commercial operation as a Bus with a High Level of Services (BHLS). The demonstration period was used for the development of the bus, as of April 2017 the bus will be part of the public transport fleet.

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x Safra
Vehicle Model	Businova Midibus
Vehicle Length	10.5m
Total passenger capacity	53
Air Conditioning	Yes
Heating	Yes
Overnight charging	Plug at the depot (5-6h)
Energy storage system power	135kWh

LINE SPECIFICATIONS

Route number	D988
Type of line	City centre, suburban area
Topography of the line	Moderate
Length of the bus line	10km
Average commercial speed	12km/h
Total daily hours of operation	8.5h
Total daily hours operated in full electric	6h
Total km driven/vehicle/day	100km



Safra Businova Midibus

CLIMATE

Gaillac's climate is classified as warm and temperate. The rainfall is significant, with the annual average of 732mm. The temperature here averages 13.1°C. The temperatures are highest on average in July, at around 21.2 °C. At 5.0°C on average, January is the coldest month of the year.

MARSEILLE (FR)

Régie des Transports de Marseille



"Our biggest challenges were to adapt the power supply at the depot and to respond to the commercial environment. The outcome is a fully electric line, thanks to which we can see the behaviour of the vehicle during real commercial conditions as well as the behaviour of the electrical grid when we connect the whole fleet for charging."

Vehicles: 6 x 12m Irizar i2e

Charging: Slow-charging at the depot

Line: 82

Total operation time/day: 14-16h

Duration: Dec 2015 – Dec 2016

Nature of experience: Pilot

Funding: Self-funded

DESCRIPTION

With the city council's decision to electrify transport and become carbon neutral by 2040, this is a pilot of six electric buses to gain experience of electric buses, with the aim of procuring electric buses in future tenders for bus operation. At the same time, this is a real procurement for the operation of bus line 1 and the buses will be operating the whole line for the whole contract period (7+3 years).

VEHICLE SPECIFICATIONS

Vehicle Brand	6 x Irizar
Vehicle Model	i2e
Vehicle Length	12m
Total passenger capacity	64
Air Conditioning	Yes
Heating	Yes
Overnight charging	Slow plug-in charging at the depot (5-7h)
Energy storage system power	339kWh



IRIZAR i2e

LINE SPECIFICATIONS

Route number	82
Type of line	City centre
Topography of the line	Moderate
Length of the bus line	5.5km
Average commercial speed	10km
Total daily hours of operation	14-16h
Total daily hours operated in full electric	14-16h
Total km driven/vehicle/day	141km

CLIMATE

Marseille has a Mediterranean climate with mild, humid winters and warm, mostly dry summers. In January, the average temperature is around 12°C; in July, it is around 29°C. Marseille is also one of the driest major cities in Europe, with only 512mm of precipitation annually.

NICE AIRPORT (FR)

TRANSDEV FRANCE



Vehicle: 1 x 12m Heuliez Bus GX 337 ELEC

Charging: Fast-charging at the bus stops, slow-charging at the depot

Line: Airport shuttle

Total operation time/day: 9h

Duration: Nov 2014-May 2016

Nature of experience: Test

Funding: National (ADEME)



Heuliez BUS GX 337 ELEC

DESCRIPTION

Nice Airport is testing one electric bus in normal operation alongside conventional buses. The aim is to validate the feasibility of an ultra-fast charging system.

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x Heuliez
Vehicle Model	Bus GX 337 ELEC
Vehicle Length	12m
Total passenger capacity	107
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Articulated arm at bus stops (20sec)
Overnight charging	Onboard charger (2h)
Energy storage system power	1.2kWh supercapacitor on board

LINE SPECIFICATIONS

Route number	Airport shuttle
Type of line	Airport shuttle
Topography of the line	Flat
Length of the bus line	3.9km
Average commercial speed	18km/h
Total daily hours of operation	9h
Total daily hours operated in full electric	9h
Total km driven/vehicle/day	200km

CLIMATE

Nice's climate is classified as warm and temperate. The average annual rainfall is 811mm. The average annual temperature is 14.8°C. Temperatures are highest on average in July, at around 22.3°C. The lowest average temperatures in the year occur in January, when it is around 8.0°C.

PARIS (FR)

RÉGIE AUTONOME DES TRANSPORTS PARISIENS



"By 2025, RATP wants to roll out a 100% eco-friendly bus fleet, including electric and biogas buses, in the Île-de-France region. With the bus2025 programme, RATP will completely transform its facilities (bus depots) and fully engage in the energy transition phase for its bus fleet."

Vehicles: 23 x 12m Bolloré Bluebus 12m

Charging: Slow-charging at the depot

Line: 341

Total operation time/day: 14h

Duration: Since May 2016 and ongoing

Nature of experience: Demonstration

Funding: Self-funded, local authority

DESCRIPTION

The buses were purchased as part of the 'bus2025' programme, which promises a complete transformation of the bus fleet in the Paris region to electric and biogas buses. The buses operate in the north-west of Paris all year round, Monday to Friday, from 07:00 to 20:30. The line carries more than 8,800 passengers per day. The early feedback from passengers and drivers is very positive.

VEHICLE SPECIFICATIONS

Vehicle Brand	23 x Bolloré
Vehicle Model	Bluebus 12m
Vehicle Length	12m
Total passenger capacity	90
Air Conditioning	No
Heating	Yes
Overnight charging	Plug at the depot (5h)
Energy storage system power	240kWh



Bolloré Bluebus 12m

LINE SPECIFICATIONS

Route number	341
Type of line	Mixed
Topography of the line	Moderate
Length of the bus line	10km
Average commercial speed	10km/h
Total daily hours of operation	14h
Total daily hours operated in full electric	14h
Total km driven/vehicle/day	180km

CLIMATE

The climate is mild, and generally warm and temperate. Rainfall in Paris is significant, with an annual average of 637mm. The average annual temperature is 11.3°C. With an average temperature of 19.4°C, July is the hottest month of the year. At 3.3°C on average, January is the coldest month of the year.

BUDAPEST (HU)

BUDAPESTI KÖZLEKEDÉSI VÁLLALAT ZRT.



"We started with a relatively large fleet of 20 ebuses from a Hungarian manufacturer. We are replacing our old diesel fleet (Euro 0, Euro 1 or without Euro classification) with environmentally friendly buses and we have been following this policy since 2011."

Vehicles: 20 x 7.98m evopro Modulo C68e

Charging: Slow-charging at the depot

Lines: 15, 16A, 39, 102, 116, 191

Total operation time/day: 12.3h

Duration: Since April 2016 and ongoing

Nature of experience: Procurement

Funding: Self-funded, national

DESCRIPTION

BKV bought 20 ebuses in December 2015, financed by the Hungarian Government and put into operation in April 2016. The MABI-BUS ebus is a new Hungarian product and the prototype was made for BKV, the municipally-owned urban public transport operator. Thanks to the funding, the operator was able to develop a relatively large fleet from the outset. Charging takes place only at the depot.

VEHICLE SPECIFICATIONS

Vehicle Brand	20 x evopro
Vehicle Model	Modulo C68e
Vehicle Length	7.98m
Total passenger capacity	53
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Plug at the depot (1.5h-5h)
Energy storage system power	141kWh

LINE SPECIFICATIONS

Route number	15	16A	39	102	116	191
Type of line	City centre					
Topography of the line	Flat	Hilly	Hilly	Hilly	Hilly	Hilly
Length of the bus line (one direction)	6.1km	1.5km	3.4km	3.9km	1.8km	3.4km
Average commercial speed	13km/h					
Total daily hours of operation	12.3h					
Total daily hours operated in full electric	12.3h					
Total km driven/vehicle/day	128km					



evopro Modulo C68e

CLIMATE

Budapest has a maritime climate, with cold winters and warm summers. During winter, there is regular snowfall and the daily mean temperature is 1.5°C. Budapest's long summer – lasting from May until mid-September – is warm or very warm. The daily mean temperature is 23°C. Mean annual precipitation amounts to 596.9mm.

SZEGED (HU)

SZEGEDI KÖZLEKEDÉSI KFT.



"As the next step, we would like to lead the provision of clean public transport in Szeged. We can set a good example for citizens and decision-makers, which would inform future expectations for Szeged transportation."

Vehicles: 13 x 18.75m Ikarus-Skoda Tr187.2

Charging: Fast-charging en route

Lines: 77A

Total operation time/day: 17h

Duration: April 2016-Sept/Oct 2016

Nature of experience:

Demonstration

Funding: EU



Ikarus-Skoda Tr187.2

DESCRIPTION

In Szeged, we are demonstrating the replacement of diesel bus lines by extending the trolley bus network with trolley-hybrids, without the need for additional infrastructure. In 2013, SZKT purchased battery-equipped trolleybuses for the demonstration. The charging came from the existing catenary network and the battery trolleybuses ran in accumulator mode inbetween the existing and extended network.

VEHICLE SPECIFICATIONS

Vehicle Brand	13 x Ikarus-Skoda
Vehicle Model	Tr187.2
Vehicle Length	18.75m
Total passenger capacity	125
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Overhead wires via connecting poles en route, plug charging is possible (not used)
Energy storage system power	81kWh

LINE SPECIFICATIONS

Route number	77A (with a section without overhead wires)	10	19
Type of line	City centre - residential area	City centre and suburban area	City centre and suburban area
Topography of the line	Flat	Flat	Flat
Length of the bus line	13.2km	9.2km	15.8km
Average commercial speed	18km/h	15km/h	17km/h
Total daily hours of operation	18h	19h	18h
Total daily hours operated in full electric	18h	19h	18h
Total km driven/vehicle/day	237km	117km	176km

CLIMATE

Szeged's climate is classified as warm and temperate. The city has significant rainfall and the annual average is 518mm. The average annual temperature is 10.8°C. Temperatures are highest on average in July, at around 20.8°C. January is the coldest month, with temperatures averaging -1.4°C.

CAGLIARI (IT)

CTM SpA



"Thanks to the existence of a vast and consolidated trolley wire network (39km, three lines), between 2012 and 2016 CTM renewed its entire trolleybus fleet with 32 latest generation vehicles. Six of these have an auxiliary battery system."

Vehicles: 2 x 12m Solaris T12; 4 x 12m Kiepe Van Hool A330T

Charging: Fast-charging at the terminal and en route

Line: 5 ZeEUS

Total operation time/day: 15-18h

Duration: July 2014-April 2017

Nature of experience:
Demonstration

Funding: EU (Jessica, ZeEUS project), Ministry of Environment



Solaris Trollino T12



Van Hool A330T

DESCRIPTION

CTM was tasked with evaluating the efficiency, reliability and performance of six fully electric ZEV trolleybus during a scheduled service. Additionally, the performance of these vehicles in the stretches without catenary will be compared with those of another ten trolleybuses, equipped with diesel engines and two traditional buses equipped with internal combustion engines. All 18 vehicles travel the line simultaneously under the same operational conditions.

VEHICLE SPECIFICATIONS

Vehicle Brand	2 x Solaris	4 x Kiepe Van Hool
Vehicle Model	T12	A330T
Vehicle Length	12m	12m
Total passenger capacity	82	86
Air Conditioning	Yes	Yes
Heating	Yes	Yes
Opportunity charging	Pantograph at the terminal (8-10min) and overhead wires via connecting poles en route	
Energy storage system power	37kWh	23kWh

LINE SPECIFICATIONS

Route number	5 ZeEUS
Type of line	Urban area (city centre) and seafront road
Topography of the line	Moderate
Length of the bus line	17.1km (winter configuration) 25.6km (summer configuration)
Average commercial speed	13.3km/h
Total daily hours of operation	15-18h
Total daily hours operated in full electric	2-3h (winter configuration) 7-9h (summer configuration)
Total km driven/vehicle/day	180-220km

CLIMATE

The climate in Cagliari is warm and temperate. The winter months are much wetter than the summer months, with around 419mm of precipitation annually. The average annual temperature is 16.2°C. August is the warmest month of the year, with an average temperature of 24.2°C. January is the coldest month, with temperatures averaging 9.8°C.

TEL AVIV (IL)

DAN BUS



חברה לחברה ציבורית בע"מ

"Our next step will be to purchase additional electrical buses, as directed and instructed by the Israel Transportation Regulator."

Vehicle: 1 x 12m BYD K9A (Variant of BYD 12m Overseas)

Charging: Slow-charging at the depot

Lines: 5, 61, 279

Total operation time/day: 14h

Duration: Aug 2013-Dec 2014

Nature of experience: Pilot

Funding: Self-funded, national

DESCRIPTION

DAN's policy is to operate an alternative energy public transport system in collaboration with the Ministry of Environment and local authorities. The ebus operated mainly in crowded areas and was successfully integrated into the Tel Aviv metropolis. The ebus has a 160km range limit, so the greatest achievement was to find lines that suit that limitation, in order to operate successfully for the entire day.

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x BYD
Vehicle Model	K9A (Variant of BYD 12m Overseas)
Vehicle Length	12m
Total passenger capacity	58
Air Conditioning	Yes
Heating	No
Overnight charging	Plug at the depot (5h)
Energy storage system power	324kWh



BYD K9A (Variant of BYD 12m Overseas)

LINE SPECIFICATIONS

Route number	5	61	279
Type of line	Crowded urban area		
Topography of the line	Flat		
Length of the bus line	18km	38km	23km
Average commercial speed	12km/h	12km/h	12km/h
Total daily hours of operation	14h		
Total daily hours operated in full electric	14h		
Total km driven/vehicle/day	160km		

CLIMATE

The climate here is mild, and generally warm and temperate. Average annual rainfall amounts to 562mm. The average annual temperature is 20.2°C. With an average temperature of 27.0°C, August is the hottest month of the year. January has the lowest average temperature of the year, at 13.5°C.

ROTTERDAM (NL)

ROTTERDAMSE ELEKTRISCHE TRAM



"Clean buses need electric infrastructure. The greatest achievement was to develop a cooperative setting and to work together with people from various disciplines and sectors that were not yet familiar with each other."

Vehicles: 2 x 12m VDL/e-Traction Citea

Charging: Slow-charging at the depot

Line: 70

Total operation time/day: 19h

Duration: Jan 2015-Dec 2019

Nature of experience: Pilot

Funding: Self-funded, city, regional, national



VDL/e-Traction Citea

DESCRIPTION

RET wants to contribute to the goals of regional authorities in Rotterdam and The Hague on reduction of CO2 and improvement of air quality. The two electric buses operate services on line 70. This is a frequently-used bus route of 12km on the Rotterdam's South Bank, a high-density area with local problems of air quality. The aim is to transition to a fully zero-emission bus fleet (250 vehicles) within the next 10-15 years.

VEHICLE SPECIFICATIONS

Vehicle Brand	2 x VDL/e-Traction
Vehicle Model	Citea
Vehicle Length	12m
Total passenger capacity	59
Air Conditioning	Yes
Heating	Yes
Opportunity charging	None
Overnight charging	Plug at the depot (8h)
Energy storage system power	100kWh

LINE SPECIFICATIONS

Route number	70
Type of line	Mixed metropolitan area
Topography of the line	Flat
Length of the bus line	12km
Average commercial speed	16.25km/h
Total daily hours of operation	19h
Total daily hours operated in full electric	2.8h
Total km driven/vehicle/day	200km

CLIMATE

The climate of Rotterdam is mild and relatively warm. Significant rainfall is recorded throughout the year, with an annual average of 782mm. The annual average temperature is 9.6°C. With an average temperature of 16.9°C, August is the hottest month. The coldest month of the year is January, with an average temperature of 2.5°C.

SCHIERMONNIKOOG (NL)

ARRIVA NEDERLAND

"When we received the six BYD buses, they all were equipped with a large battery, which meant that we could not carry many passengers. We realised that we did not need the extra battery capacity, so we removed one of the three packs from five of the six buses. We can now transport sufficient passenger numbers."

Vehicles: 6 x 12m BYD K9
(Variant of BYD 12m Overseas)

Charging: Slow-charging at the depot

Line: N/A

Total operation time/day: N/A

Duration: Feb 2013–Dec 2020

Nature of experience:
Full operation

Funding: Regional

DESCRIPTION

Schiermonnikoog is a tourist island, coming to life only during the summer season. Arriva operates electric BYD buses purchased by the local authority and is satisfied regarding the driveline of the bus. Passengers also provide positive feedback about the vehicles.

VEHICLE SPECIFICATIONS

Vehicle Brand	6 x BYD
Vehicle Model	K9 (Variant of BYD 12m Overseas)
Vehicle Length	12m
Total passenger capacity	70
Air Conditioning	Yes
Heating	Yes
Overnight charging	Plug at the depot (5h)
Energy storage system power	220kWh



BYD K9 (Variant of BYD 12m Overseas)

LINE SPECIFICATIONS

Schiermonnikoog is a flat island with rural topography. The buses operate on different lines without a fixed timetable, which does not allow for operational data.

CLIMATE

The climate is warm and temperate. Schiermonnikoog is an island with significant rainfall, and an annual average of 806mm. The average temperature is 8.6°C. The warmest month of the year is August, with an average temperature of 16.2°C. January is the coldest month, with temperatures averaging 1.6°C.

SCHIPHOL AIRPORT (NL)

SCHIPHOL AMSTERDAM AIRPORT

Vehicles: 35 x 12m BYD (Variant of BYD 12m Overseas)

Charging: Slow-charging at the depot

Line: Airport area

Total operation time/day: 19h

Duration: Jan 2015-April 2016

Nature of experience:
Demonstration

Funding: Self-funded



12m BYD (Variant of BYD 12m overseas)

DESCRIPTION

RET wants to contribute to the goals of regional authorities in Rotterdam and The Hague on reduction of CO2 and improvement of air quality. The two electric buses operate services on line 70. This is a frequently-used bus route of 12km on the Rotterdam's South Bank, a high-density area with local problems of air quality. The aim is to transition to a fully zero-emission bus fleet (250 vehicles) within the next 10-15 years.

VEHICLE SPECIFICATIONS

Vehicle Brand	35 x BYD
Vehicle Model	Variant of BYD 12m Overseas
Vehicle Length	12m
Total passenger capacity	65
Air Conditioning	Yes
Heating	Yes
Overnight charging	Plug at the depot (3.5h)
Energy storage system power	216kWh

LINE SPECIFICATIONS

Route number	Airport area
Type of line	Airport
Topography of the line	Flat
Length of the bus line	0.9km
Average commercial speed	17km/h
Total daily hours of operation	19h
Total daily hours operated in full electric	19h
Total km driven/vehicle/day	120km

CLIMATE

The climate in Schiphol is warm and temperate. There is significant rainfall throughout the year, even in the driest month, with an annual average of 808mm. The average annual temperature is 9.3°C. August is the warmest month of the year, with an average temperature of 16.8°C. In January, the average temperature is 2.5°C, the lowest average temperature of the year.

CITY OF 'S-HERTOGENBOSCH (NL)

CITY OF 'S-HERTOGENBOSCH



"Our greatest achievement in the implementation phase is that we organised a consortium based on mutual trust rather than on contracts. This is what was needed at the start of an innovation curve."

Vehicle: 1 x 12m Volvo 7700 (customised model)

Charging: Fast-charging at selected bus stops, slow-charging at the depot

Line: 80

Total operation time/day: 12h

Duration: From Dec 2010 and ongoing

Nature of experience: Scaling-up phase

Funding: EU (European Local Energy Assistance – ELENA), regional, local authority, city



VOLVO 7700 (customised model)

Vehicles: 10 x 12m VDL Citea SLF-120 Electric

Charging: Fast-charging at the terminal and selected bus stops, slow-charging at the depot

Line: 70

Total operation time/day: 12h

Duration: From June 2016 and ongoing

Nature of experience: Scaling-up phase

Funding: EU (ELENA), regional, city



VDL Citea SLF-120 Electric

DESCRIPTION

As a part of the 'Zero emission city transport' and 'Climate neutral 2050' programmes, this demonstration aims to test using a series of e-buses within a regular bus timetable. Following the end of the trial, the buses will continue to operate on the same line, as the city of 's-Hertogenbosch plans to replace its full fleet with zero-emission buses before 2025

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x Volvo	10 x VDL
Vehicle Model	7700 (customised model)	Citea SLF-120 Electric
Vehicle Length	12m	12m
Total passenger capacity	86	79
Air Conditioning	No	Yes
Heating	Yes	Yes
Opportunity charging	Induction at selected bus stops (2min)	Pantograph at selected bus stops (2min)
Overnight charging	Plug at the depot (6h)	Plug at the depot (6h)
Energy storage system power	120kWh	120kWh

LINE SPECIFICATIONS

Route number	80	70
Type of line	Urban area	Urban area
Topography of the line	Flat	Flat
Length of the bus line	5.32km	5km
Average commercial speed	20km/h	20km/h
Total daily hours of operation	12h	12h
Total daily hours operated in full electric	12h	12h
Total km driven/vehicle/day	280km	100-150km

CLIMATE

The climate is mild and generally warm. 's-Hertogenbosch has a significant amount of rainfall during the year, with an annual average of 786mm. The average annual temperature is 9.4°C. With an average temperature of 16.8°C, July is the hottest month of the year. January has the lowest average temperature of the year, at 2.0°C.

UTRECHT (NL)

PROOV



"With good project management, documentation and selection of subcontractors, we had the complete infrastructure working in 16 weeks. We were able to limit civil works in public spaces to three days, so disturbance to the existing bus services was very low."

Vehicles: 3 x 10m Optare Solo EV

Charging: Fast-charging at the terminal, slow-charging at the depot

Line: 2

Total operation time/day: 18h

Duration: Dec 2013-Dec 2023

Nature of experience:
Procurement

Funding: Self-funded

DESCRIPTION

The electric Optare buses are used on a bus line through the inner city of Utrecht. At the bus terminal at Centraal Station, an inductive charging system was installed for opportunity charging (IPT 2.0), delivering 60kW, thus allowing an unlimited range. The charging system is equipped with a monitoring system and has an availability of > 99.5%.

VEHICLE SPECIFICATIONS

Vehicle Brand	3 x Optare
Vehicle Model	Solo EV
Vehicle Length	10m
Total passenger capacity	55
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Induction at the terminal (3-5min)
Overnight charging	Plug at the depot (2h)
Energy storage system power	86kWh

LINE SPECIFICATIONS

Route number	2
Type of line	City centre
Topography of the line	Flat
Length of the bus line	5km
Average commercial speed	20km/h
Total daily hours of operation	18h
Total daily hours operated in full electric	18h
Total km driven/vehicle/day	140km



Optare Solo EV

CLIMATE

The climate is warm and temperate in Utrecht. There is a great deal of rainfall, with an annual average of 804mm. The average annual temperature is 9.3°C. The warmest month of the year is July, with an average temperature of 16.6°C. The lowest average temperatures in the year occur in January, when it is around 2.2°C.

INOWROCLAW (PL)

MIEJSKIE PRZEDSIĘBIORSTWO KOMUNIKACYJNE
SP. Z O.O. W INOWROCLAWIU



"Our passengers love the buses because they offer a quiet and comfortable ride. WiFi, air-conditioning, phone chargers, real-time information and ergonomic seats are additional incentives to hop on an ebus"

Vehicles: 2 x 12m Solaris Urbino 12 electric

Charging: Fast- and slow-charging at the depot

Lines: 3, 10, 16

Total operation time/day: 13h

Duration: Since Aug 2015 and ongoing

Nature of experience:
Normal operation

Funding: EU, city, self-funded



SOLARIS Urbino 12 electric

DESCRIPTION

The buses are in regular service carrying passengers and receive positive feedback from users and staff. As Inowrocław is a health resort, only low-emission buses are allowed to enter the city.

VEHICLE SPECIFICATIONS

Vehicle Brand	2 x Solaris
Vehicle Model	Urbino 12 electric
Vehicle Length	12m
Total passenger capacity	70
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Plug at the depot (2h)
Overnight charging	Plug at the depot (5h)
Energy storage system power	201kWh

LINE SPECIFICATIONS

Route number	3	10	16
Type of line	City centre, mixed traffic		
Topography of the line	Flat		
Length of the bus line	7km	14.2km	9.6km
Average commercial speed	13km/h	13km/h	13km/h
Total daily hours of operation	23h	23h	23h
Total daily hours operated in full electric	23h	23h	23h
Total km driven/vehicle/day	84km	168km	90km

CLIMATE

In this area, the climate is temperate and cold. Inowrocław is a city with significant rainfall, averaging 531mm annually. The average annual temperature is 7.9°C. The average temperature of 18.1°C makes July the warmest month of the year. January is the coldest month, with temperatures around -3.4°C.

JAWORZNO (PL)

PRZEDSIĘBIORSTWO KOMUNIKACJI MIEJSKIEJ SP. Z O. O.



"In October 2016, our company signed an agreement for delivery of 16 ebuses with Solaris Bus & Coach. Delivery is expected by the end of September 2017. We are also finalising a tender procedure for the delivery of a further six ebuses – the new agreement with Solaris will be signed by the end of 2016."

Vehicle: 1 x 12m Solaris Urbino 12 electric

Charging: Fast-charging at the terminal, slow-charging at the depot

Line: 313

Total operation time/day: 18h

Duration: Since March 2015 and ongoing

Nature of experience: Pilot

Funding: Self-funded



Solaris Urbino 12 electric

DESCRIPTION

We have been operating our first electric bus since March 2015. If the experience is satisfactory, we plan to buy a further 22 buses within the next two years. One third of our fleet will then consist of ebuses.

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x Solaris
Vehicle Model	Urbino 12 electric
Vehicle Length	12m
Total passenger capacity	80
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Pantograph at selected bus stops (1h)
Overnight charging	Plug at the depot (1.5h)
Energy storage system power	160kWh

LINE SPECIFICATIONS

Route number	313
Type of line	City centre, suburban area
Topography of the line	Moderate
Length of the bus line	16km
Average commercial speed	30km/h
Total daily hours of operation	18h
Total daily hours operated in full electric	18h
Total km driven/vehicle/day	250km

CLIMATE

The climate in Jaworzno is cold and temperate. The city has significant rainfall – the annual average is 707mm. The average temperature is 8.2°C. With an average of 18.4°C, July is the warmest month. January is the coldest month, with temperatures averaging -3.6°C.

KRAKOW (PL)

MIEJSKIE PRZEDSIĘBIORSTWO KOMUNIKACYJNE S.A.
W KRAKOWIE



"We decided to introduce e buses into our fleet mainly in order to reduce pollution in the city. We are happy to declare that line 154 is now fully electric. Regarding the noise aspect, funnily enough, our passengers commented that the bus is too quiet. In their opinion, a bus should be heard."

Vehicle: 1 x 12m Solaris Urbino 12 electric

Charging: Slow-charging at the depot

Line: 169

Total operation time/day: 13h

Duration: Since April 2014 and ongoing

Nature of experience: Regular service

Funding: Self-funded



Solaris Urbino 12 electric

Vehicles: 4 x 8.9m Solaris Urbino 8.9 LE electric

Charging: Fast-charging at the terminal, slow-charging at the depot

Line: 154

Total operation time/day: 11h

Duration: Since September 2016 and ongoing

Nature of experience: Regular service

Funding: Self-funded



Solaris Urbino 8.9 LE electric

DESCRIPTION

Following a two-year test phase, MPK decided to purchase five e buses to contribute to the sustainable plan for environmental protection and public transport development in the city. The buses run in regular service and their operation is planned until the end of the battery lifetime.

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x Solaris	4 x Solaris
Vehicle Model	Urbino 12 electric	Urbino 8.9 LE electric
Vehicle Length	12m	8.9m
Total passenger capacity	71	49
Air Conditioning	Yes	Yes
Heating	Yes	Yes
Opportunity charging	N/A	Pantograph at the terminal (20 min)
Overnight charging	Plug at the depot (4h)	
Energy storage system power	210kWh	80kWh

LINE SPECIFICATIONS

Route number	169 (Solaris Urbino 12 electric)	154 (Solaris Urbino 8.9 LE electric)
Type of line	City centre	City centre
Topography of the line	Flat	Flat
Length of the bus line	12.41km	11.82km
Average commercial speed	17km/h	17km/h
Total daily hours of operation	13h	11h
Total daily hours operated in full electric	13h	11h
Total km driven/vehicle/day	192km	146km

CLIMATE

In Krakow, the climate is cold and temperate. There is a great deal of rainfall, with an annual average of 678mm. The average temperature in Krakow is 8.2°C. The warmest month of the year is July, with an average temperature of 17.9°C. The lowest average temperatures in the year occur in January, when it is around -3.6°C.

LODZ (PL)

MIEJSKIE PRZEDSIĘBIORSTWO KOMUNIKACYJNE
- LODZ SP. Z O.O.

Vehicle: 1 x 12m Solaris Urbino 12 electric

Charging: Fast-charging at the terminal, slow-charging at the depot

Lines: 79, 14

Total operation time/day: 6.5h

Duration: Since Oct 2015 and ongoing

Nature of experience: Short test

Funding: City

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x Solaris
Vehicle Model	Urbino 12 electric
Vehicle Length	12m
Total passenger capacity	70
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Plug at the terminal (2h)
Overnight charging	Plug at the depot (4h)
Energy storage system power	120kWh

LINE SPECIFICATIONS

Route number	79	14
Type of line	City centre	City centre
Topography of the line	Flat	Flat
Length of the bus line	9.9km	7.3km
Average commercial speed	20.1km/h	19.7km/h
Total daily hours of operation	6.5h	6.5h
Total daily hours operated in full electric	6.5h	6.5h
Total km driven/vehicle/day	100km	100km

CLIMATE

Generally, the climate in Lodz is cold and temperate. There is a great deal of rainfall, with an annual average of 564mm. The average annual temperature is 7.9°C. Temperatures are highest on average in July, at around 18.7°C. The lowest average temperatures occur in January, when it is around -4.8°C.

LUBLIN (PL)

MIEJSKIE PRZEDSIĘBIORSTWO KOMUNIKACYJNE W LUBLINIE SP. Z O.O.
AND ZARZĄD TRANSPORTU MIEJSKIEGO W LUBLINIE



DESCRIPTION

MPK Lublin is the biggest operator in the city, providing 80% of public transport journeys. MPK owns 226 buses and 110 trolleybuses. Among these are one electric bus and 50 trolleybuses equipped with batteries to operate up to 5km independently of the wires. The electric bus operates mainly at peak hours on trolleybus route 159. The levels of comfort are similar on trolleybuses and on the electric bus; both are quiet and have a good rate of acceleration. The city transport authority (ZTM Lublin) is planning to purchase up to 70 electric buses and 40 trolleybuses equipped with batteries.

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x Ursus Ekovolt	38 x Ursus	12 x Solaris
Vehicle Model	E70110	T70116	Trollino 18
Vehicle Length	12m	12m	18m
Total passenger capacity	80	75	125
Air Conditioning	Yes	Yes	Yes
Heating	Yes	Yes	Yes
Opportunity charging	Pantograph at the depot (1h)	While running on electric power from overhead wires	While running on electric power from overhead wires
Overnight charging	Plug at the depot (6h)	No	No
Energy storage system power	120kWh	13.6kWh	38kWh

LINE SPECIFICATIONS

Route number	152	159	160	161	
Type of line	Residential areas	City centre	City centre	Residential areas	
Topography of the line	Flat	Moderate	Flat	flat	
Length of the bus line	11km	12km	15km	15km	
Average commercial speed	19km/h	19km/h	19km/h	21km/h	
Total daily hours of operation	18h	7h (Ursus E70110)	18h (Solaris Trollino 18 and Ursus T70116)	18h	
Total daily hours operated in full electric	18h	7h	18h	18h	
Total km driven/vehicle/day	188km (9.5km using batteries)	110km	223km (50km using batteries)	215km (35km using batteries)	280km (15km using batteries)

LUBLIN (PL)

MIEJSKIE PRZEDSIĘBIORSTWO KOMUNIKACYJNE W LUBLINIE SP. Z O.O.
AND ZARZĄD TRANSPORTU MIEJSKIEGO W LUBLINIE



Vehicle: 1 x 12m Ursus Ekovolt E70110

Charging: Fast- and slow-charging
at the depot

Line: 159

Total operation time/day: 7h

Duration: Since July 2015 and ongoing

Funding: Self-funded



Ursus E70110

Vehicles: 38 x 12m Ursus T70116

Charging: While running on electric
power from overhead wires

Lines: 152, 159, 160, 161

Total operation time/day: 18h

Duration: Since Dec 2013 and ongoing

Funding: EU, city



Ursus T70116

Vehicles: 12 x 18m Solaris Trollino 18

Charging: While running on electric
power from overhead wires

Lines: 159, 161

Total operation time/day: 18h

Duration: Since Dec 2013 and
ongoing

Funding: EU, city



Solaris Trollino 18

CLIMATE

The climate in Lublin is cold and temperate. There is a great deal of rainfall, with an annual average of 540mm. In Lublin, the average annual temperature is 7.6°C. With an average of 18.5°C, July is the warmest month. The lowest average temperatures occur in January, when it is around -5.6°C.

RZESZOW (PL)

MIEJSKIE PRZEDSIĘBIORSTWO KOMUNIKACYJNE
- RZESZOW SP Z O.O.



Vehicle: 1 x 12m Ursus Ekovolt E70110; 1 x 12m Solaris Urbino E12 Medcom

Charging: Slow-charging at the depott

Lines: 0

Total operation time/day: 8-9h

Duration: February 2016 (2 weeks), May 2016-June 2016 (2 weeks)

Nature of experience: Test

Funding: City, EU

DESCRIPTION

MPK Rzeszow tested the buses to gain initial experience in this domain. Following this test phase, in April 2016, it was decided to announce a tender to purchase ten ebuses in order to fully electrify line 0, which runs through the city centre. The buses received positive feedback from both drivers and passengers.

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x Ursus Ekovolt	1 x Solaris
Vehicle Model	E70110	E12 Solaris Urbino-Medcom (Variant of Solaris Urbino 12 electric)
Vehicle Length	12m	12m
Total passenger capacity	80	80
Air Conditioning	Yes	Yes
Heating	Yes	Yes
Overnight charging	Plug-in (3h)	Plug at the depot (5h)
Energy storage system power	170kWh	210kWh

LINE SPECIFICATIONS

Route number	0
Type of line	City centre
Topography of the line	Flat
Length of the bus line	9.5km
Average commercial speed	16.5km/h
Total daily hours of operation	8-9h
Total daily hours operated in full electric	8-9h
Total km driven/vehicle/day	120km

CLIMATE

In Rzeszow, the climate is cold and temperate. There is significant rainfall throughout the year, with an average of 615mm of precipitation annually. The average annual temperature is 7.5°C. The warmest month of the year is July, with an average temperature of 18.6°C. In January, the average temperature is -5.9°C, which is the lowest average temperature of the year.

WARSAW (PL)

WARSAW MUNICIPAL BUS CO. LTD



Vehicles: 10 x 12m Solaris Urbino 12 electric

Charging: Fast-charging at the terminal, slow-charging at the depot

Line: 222

Total operation time/day: 16h

Duration: Since June 2015 and ongoing

Nature of experience: Pilot

Funding: Self-funded, city



Solaris Urbino 12 electric

Vehicles: 6 x 12m BYD K9 (Variant of BYD 12m Overseas)

Charging: Fast-charging at the terminal, slow-charging at the depot

Lines: 222 and others

Total operation time/day: 13h

Duration: Nov 2014-June 2015 (4 vehicles, line 222); March 2016-Dec 2016 (2 vehicles, different lines)

Nature of experience:

Exploitation test

Funding: Self-funded, city



BYD K9 (Variant of BYD 12m Overseas)

DESCRIPTION

MZA purchased 10 Solaris Urbino U12 e buses as the first step toward the electrification of the city centre. The buses today operate on line 222, which goes through the congested centre and the historic part of the city. The whole line is operated solely with e buses. Passengers appreciate the comfort and driving dynamics, even although it is sometimes crowded inside (for obvious reasons). An efficient HVAC system completes the positive overall opinion of the vehicle.

MZA also tests leased BYD K9 buses that operate on line 222. By the end of 2016, these will have been tested on different lines in the city centre.

VEHICLE SPECIFICATIONS

Vehicle Brand	10 x Solaris	6 x BYD
Vehicle Model	Urbino 12 electric	K9 (Variant of BYD 12m Overseas)
Vehicle Length	12m	12m
Total passenger capacity	70	60
Air Conditioning	Yes	Yes
Heating	Yes	Yes
Opportunity charging	Plug at the depot (2-3h), Pantograph at the terminal (planned for Dec 2016/Jan 2017)	Plug at the depot (2-3h) (overnight charging only in summer)
Overnight charging	Plug at the depot (5h)	Plug at the depot (5h)
Energy storage system power	208kWh	324kWh

LINE SPECIFICATIONS

Route number	222	
Type of line	City centre	
Topography of the line	Moderate	
Length of the bus line	10km	
Average commercial speed	12km/h	
Total daily hours of operation	16h (Solaris)	17h (BYD)
Total daily hours operated in full electric	16h	15-17h
Total km driven/vehicle/day	160km	170-200km

BUCHAREST (RO)

REGIA AUTONOMA DE TRANSPORT BUCURESTI



"Bucharest's electric surface public transport consists of trams and trolleybuses, which are based on mature technologies. As well as this, we need flexibility to adapt to passengers' travel needs and to new developments in the city. From this perspective, the fully electric buses, combined with existing trolleybuses and trams, can offer a practical alternative."

Vehicle: 1 x 10.5m SOR EBN 10.5,
2 x 12m BYD K9 (Variant of BYD
12m Overseas)

Charging: Slow-charging at the
depot

Lines: 381, 104

Total operation time/day: 7-12h

Duration: March 2015-June 2015

Nature of experience:
Short test

Funding: City



SOR EBN 10.5



BYD K9 (Variant of BYD 12m Overseas)

DESCRIPTION

From March 2015 to the end of June 2015, two types of electric bus – SOR EBN 10.5m and BYD EBUS K9 12m – were tested in Bucharest's transport system.

The comfort of these buses and their environmental benefits were appreciated by users. These buses operate on two high-demand public transport lines in an urban area, alongside normal diesel Euro IV buses. Time-keeping is satisfactory but the operational range and transport capacity is lower than those of existing buses.

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x SOR	2 x BYD
Vehicle Model	EBN 10.5	K9 (Variant of BYD 12m Overseas)
Vehicle Length	10.5m	12m
Total passenger capacity	85	85
Air Conditioning	No	No
Heating	No	No
Overnight charging	Plug at the depot (7h)	Plug at the depot (6h)
Energy storage system power	172kWh	324KWh

LINE SPECIFICATIONS

Route number	381	104
Type of line	City centre	City centre
Topography of the line	Flat	Flat
Length of the bus line	22.4km	23.5km
Average commercial speed	15.10km/h	14.29km/h
Total daily hours of operation	7-12h	7-12h
Total daily hours operated in full electric	7-12h	7-12h
Total km driven/vehicle/day	114-187km	114-187km

CLIMATE

Bucharest has a humid continental climate. Winter temperatures often dip below 0°C, sometimes even to -20°C. In the summer, the average temperature is 23°C. Temperatures frequently reach 35-40°C in midsummer. The average annual precipitation is 595mm.

BELGRADE (SR)

CITY PUBLIC TRANSPORT COMPANY – BELGRADE



"The biggest challenge for the company (JKP GSP Belgrade) was the professional advocacy of our ebus team, which was crucial to enabling the Mayor of Belgrade to introduce the first electric line in Belgrade."

Vehicles: 5 x 12m Higer KLQ6125GEV3

Charging: Fast-charging at the terminal and at the depot

Line: 1 EKO

Total operation time/day: 16h

Duration: Since Sept 2016 and ongoing

Nature of experience:
Regular operation of the new ebus line

Funding: City, EU (EBRD)

DESCRIPTION

Regular operation of the new ebus line 1 'EKO' is the first step towards wider ebus use. Once the city has gained operational experience, Belgrade plans to open further lines operated by e buses.

VEHICLE SPECIFICATIONS

Vehicle Brand	5 x Higer
Vehicle Model	KLQ6125GEV3
Vehicle Length	12m
Total passenger capacity	81
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Pantograph at the terminal (5-10min), pantograph at the depot (30-40min)
Energy storage system power	20kWh



Higer KLQ6125GEV3

LINE SPECIFICATIONS

Route number	1 EKO
Type of line	City centre
Topography of the line	Moderate
Length of the bus line	8km
Average commercial speed	14.5km/h
Total daily hours of operation	18h
Total daily hours operated in full electric	18h
Total km driven/vehicle/day	185km

CLIMATE

Belgrade is in a continuous zone of humid subtropical and humid continental climate. It receives uniformly spread precipitation. Monthly average temperatures range from 1.4°C in January to 23.0°C in July, with an annual mean of 12.5°C. Belgrade receives an average of 690mm of precipitation a year.

Vehicles: 9 x 10.5m SOR EBN 10.5

Charging: Fast-charging at the terminal and at the depot

Line: I/50

Total operation time/day: 8h

Duration: Dec 2014-Dec 2020

Nature of experience: Pilot

Funding: Self-funded, national, EU



SOR EBN 10.5

DESCRIPTION

We introduced e buses in Košice and following almost one year of use, we are assessing their pros and cons. We are analysing how far they can travel with fully-charged batteries, how the terrain affects battery capacity (Košice has both flat and hilly terrain), the influence of the number of chargings on battery capacity, etc. This experience is a part of a wider project that aims to ensure the use of more electric vehicles in the future.

VEHICLE SPECIFICATIONS

Vehicle Brand	9 x SOR
Vehicle Model	EBN 10.5
Vehicle Length	10.5m
Total passenger capacity	80
Air Conditioning	No
Heating	Yes
Opportunity charging	Plug at the terminal (3h)
Overnight charging	Plug at the depot (3h)
Energy storage system power	120kWh

LINE SPECIFICATIONS

Route number	I/50
Type of line	Suburban area, city centre
Topography of the line	Moderate
Length of the bus line	35-30km
Average commercial speed	18km/h
Total daily hours of operation	8h
Total daily hours operated in full electric	8h
Total km driven/vehicle/day	120km

CLIMATE

The climate is cold and temperate. Rainfall in Košice is significant, with an annual average of 624mm. The average temperature in Košice is 8.6°C. With an average temperature of 19.1°C, July is the hottest month of the year. At -3.4°C on average, January is the coldest month of the year.

BARCELONA (ES)

TRANSPORTS METROPOLITANS DE BARCELONA (TMB)



"We believe that, regarding electric propulsion, communication must be robust between the bus, the charging station and the control centre, where we can monitor performance. Only in this way can we create a complete electric bus line."

Vehicles: 2 x 12m Irizar i2e

Charging: Slow-charging at the depot

Lines: L20, L34

Total operation time/day: 15-16h (winter), 12-13h (summer)

Duration: Sept 2014-April 2017

Nature of experience: Demonstration

Funding: EU (ZeEUS project)



IRIZAR i2e

DESCRIPTION

Within the ZeEUS project, we are evaluating 12m Irizar i2e purely electric buses (overnight charging) and 18m Solaris Urbino purely electric buses (overnight slow-charging, with opportunity charging at line terminals). Additionally, we operate a BYD K9 bus to test different lines. Following the test, we will evaluate results and make a decision on whether to buy the vehicles. Testing is the only way to experience and understand the operational characteristic of an electric bus, as it is a completely new technology.

VEHICLE SPECIFICATIONS

Vehicle Brand	2 x Irizar	1 x BYD	2 x Solaris
Vehicle Model	i2e	K9 (Variant of BYD 12m Overseas)	Urbino 18 electric
Vehicle Length	12m	12m	18m
Total passenger capacity	75	75	115
Air Conditioning	Yes	Yes	Yes
Heating	No	No	No
Opportunity charging	No	no	Pantograph at the terminal (6-8min)
Overnight charging	Plug at the depot (5-6h)	Plug at the depot (5-6h)	Plug at the depot (2.5h)
Energy storage system power	352kWh	324kWh	125kWh

LINE SPECIFICATIONS

Route number	L20	L34	L45	L47	H16
Type of line	City centre	City centre	City centre	City centre	City centre
Topography of the line	Flat and hilly	Flat and hilly	Flat and hilly	Flat and hilly	Flat
Length of the bus line	6.4km	10.9km	9.7km	9.3km	12.5km
Average commercial speed	12,5km/h	12.5km/h	12.5km/h	12.5km/h	12.5km/h
Total daily hours of operation	17h	16.75h	17h	17h	18h
Total daily hours operated in full electric	15-16h (winter) 12-13h (summer)	15-16h (winter) 12-13h (summer)	15h (winter) 12-13h (summer)	15-16h (winter) 12-13h (summer)	15-16h (winter) 12-13h (summer)
Total km driven/vehicle/day	Winter: 170km Summer: 138km	Winter: 180km Summer: 138km	Winter: 155km Summer: 130km	Winter: 155km Summer: 130km	-

BARCELONA (ES)

TRANSPORTS METROPOLITANS DE BARCELONA (TMB)



Vehicle: 1 x 12m BYD K9 (Variant of BYD 12m Overseas)

Charging: Slow-charging at the depot

Lines: L45, L47

Total operation time/day: 15-16h (winter), 12-13h (summer)

Duration: Since Jan 2014 and ongoing

Nature of experience:
Demonstration

Funding: Self-funded

Vehicles: 2 x 18m Solaris Urbino 18 electric

Charging: Fast-charging at the terminal, slow-charging at the depot

Line: H16

Total operation time/day: 15-16h (winter), 12-13h (summer)

Duration: May 2016–April 2017

Nature of experience:
Demonstration

Funding: EU (ZeEUS project)



BYD K9 (Variant of BYD 12m Overseas)



SOLARIS Urbino 18 electric

CLIMATE

The climate is warm and temperate in Barcelona. The rain falls mostly in winter, with relatively little rain in summer. The average annual rainfall is 612mm. The average annual temperature is 16.5°C. The warmest month of the year is July, with an average temperature of 24.1°C. At 9.8°C on average, January is the coldest month of the year.

DONOSTIA/SAN SEBASTIÁN (ES)

DBUS



"The introduction of the drivers to the vehicles has been successful. Following a proper communication and training strategy, all staff have adapted to the new vehicles. The participation of unions in the design of the driver's cockpit area has also helped in the acceptance of the vehicles among staff."

Vehicle: 3 x 12m IRIZAR i2e

Charging: Slow-charging at the depot

Lines: Different lines in the city centre (150-200km)

Total operation time/day: 14h

Duration: From July 2014 (1 vehicle) and March 2016 (2 vehicles) and ongoing

Nature of experience: Demonstration

Funding: Self-funded, national, EU

DESCRIPTION

Dbus is testing an Irizar I2E vehicle on various routes in the city centre (mainly line 26). The target is to adapt the vehicle to a line with no changes in the service, which would mean that the range of the vehicle was pushed to the limit every day. With this target in mind, the vehicle was designed in collaboration with Irizar and Dbus, setting the operational needs as a prerequisite. The bus will stay in operation until the end of its operational life (12 years).

VEHICLE SPECIFICATIONS

Vehicle Brand	3 x Irizar
Vehicle Model	i2e
Vehicle Length	12m
Total passenger capacity	75
Air Conditioning	Yes
Heating	Yes
Overnight charging	Plug at the depot (7h)
Energy storage system power	340kWh

LINE SPECIFICATIONS

Route number	26 (also 27, 17, 13)
Type of line	City centre
Topography of the line	Moderate
Length of the bus line	13.2km
Average commercial speed	17.2km/h
Total daily hours of operation	15h
Total daily hours operated in full electric	15h
Total km driven/vehicle/day	150-200km



IRIZAR i2e

CLIMATE

The city has a maritime climate with warm summers and cool, mild winters. The city averages 1650mm of precipitation annually. Average temperatures range from 8.4°C in January to 21.5°C in August.

MADRID (ES)

EMT DE MADRID



"We plan to renew our bus fleet with more CNG hybrid buses in order to improve air quality in Madrid."

Vehicles: 13 x 11.3m Castrosua Tempus

Charging: Slow-charging at the depot

Line: 41

Total operation time/day: 16h

Duration: Jan 2012-Jan 2014

Nature of experience: Pilot

Funding: Self-funded

DESCRIPTION

We are testing CNG hybrid buses; in our fleet we have 23 CNG hybrid buses, 13 of which are plug-in. The test aims to verify performance in real-world operations. Fuel consumption has been reduced by 30%, but the buses' reliability is not good. The buses have had a lot of breakdowns, especially in summer when the air conditioning is not powerful enough. However, the hybrid bus system has been good for air quality and passenger comfort.

VEHICLE SPECIFICATIONS

Vehicle Brand	13 x Castrosua
Vehicle Model	Tempus
Vehicle Length	11.3m
Total passenger capacity	64
Air Conditioning	Yes
Heating	Yes
Overnight charging	Plug at the depot (4h)
Energy storage system power	72kWh

LINE SPECIFICATIONS

Route number	41
Type of line	Metropolitan area
Topography of the line	Moderate
Length of the bus line	6km
Average commercial speed	13km/h
Total daily hours of operation	16h
Total daily hours operated in full electric	4.8h-6.4h
Total km driven/vehicle/day	210km



Castrosua Tempus

CLIMATE

The climate is warm and temperate in Madrid. The average annual temperature is 13.7°C. Rainfall averages 450mm annually. The warmest month of the year is July, with an average temperature of 24.0°C. The lowest average temperatures in the year occur in January, when it is around 5.0°C.

VALLADOLID (ES)

VECTIA MOBILITY S.L.



"VECTIA Plug-In Hybrid Technology allows a reduction in fossil fuel consumption of 30% and ensures zero-emission service at bus stops, the city centre, depots and the underground transport hub."

Vehicles: 5 x 12m Vectia Veris.12 Hybrid+

Charging: Fast-charging at the terminal

Line: 7

Total operation time/day: 16h

Duration: June 2016-July 2017

Nature of experience: Testing different technologies

Funding: City, EU (Lighthouse project - REMOURBAN)

DESCRIPTION

The test consists of three different modes of operation of a plug-in hybrid 12m urban bus; hybrid mode (diesel-electric hybrid), partially full electric mode (100% electric in the zones and the remainder in hybrid mode, fast-charge at both ends of route) and fully electric mode (100% electric operation, fast-charge at both ends of route). The test will look at performance, total cost of ownership and pollutant emissions.

VEHICLE SPECIFICATIONS

Vehicle Brand	5 x Vectia
Vehicle Model	Veris.12 Hybrid+
Vehicle Length	12m
Total passenger capacity	85
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Pantograph at the terminal (3-5min)
Energy storage system power	24kWh

LINE SPECIFICATIONS

Route number	7
Type of line	City centre, metropolitan area including old town
Topography of the line	Flat
Length of the bus line	6km
Average commercial speed	10km/h
Total daily hours of operation	16h
Total daily hours operated in full electric	5.3h
Total km driven/vehicle/day	160km



Vectia Veris.12 Hybrid+

CLIMATE

Valladolid has a Mediterranean climate with hot summers and cool, windy winters. The mean daytime temperature is 12.7°C. The July average temperature is 22.3°C. The January average temperature is 4.2°C. Average annual precipitation is 435mm.

ALE MUNICIPALITY (SE)

ALE KOMMUN MUNICIPALITY



"Ale Kommun will continue to work to improve its bus fleet. The Västra Götalands Region is in charge of public transport in our region and we, as a municipality, will continue to campaign for more electric vehicles on our roads. We are helping to electrify the general vehicle fleet by installing public charging stations and by providing an electric car pool for our inhabitants."

Vehicle: 1 x 9.2m Optare Solo EV

Charging: Fast-charging at the terminal, slow-charging at the depot

Line: Älvan

Total operation time/day: 10h

Duration: Since Dec 2014 and ongoing

Nature of experience: Demonstration

Funding: Regional

DESCRIPTION

The electric bus operates around a dense urban area in Ale called Älvängen. The objective is to contribute to more sustainable transport within the area and to reduce the number of cars at the train station, from where the bus ('Älvan') operates. The service has been very successful and received positive feedback from passengers.

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x Optare
Vehicle Model	Solo EV
Vehicle Length	9.2m
Total passenger capacity	49
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Plug at the terminal (3h)
Overnight charging	Plug at the depot (6h)
Energy storage system power	150kWh



Optare Solo EV

LINE SPECIFICATIONS

Route number	Älvan
Type of line	Suburban area
Topography of the line	Hilly
Length of the bus line	5km
Average commercial speed	20km/h
Total daily hours of operation	10h
Total daily hours operated in full electric	10h
Total km driven/vehicle/day	80km

CLIMATE

The climate in Ale is cold and temperate. Rainfall is significant, with precipitation averaging 631mm, March being the driest month and August the wettest. The average annual temperature is 4.4°C. The temperatures are highest on average in July, at around 16.0°C. At -7.0°C on average, January is the coldest month of the year.

ÄNGELHOLM (SE)

NOBINA EUROPE



Vehicles: 5 x 12m BYD K9-13C
(Variant of BYD 12m Overseas)

Charging: Fast-charging at the depot

Lines: 1, 2 and 3

Total operation time/day: 9-13h

Duration: Jan 2016-Dec 2019

Nature of experience: Pilot

Funding: Regional



BYD K9-13C (Variant of BYD 12 m Overseas)

DESCRIPTION

This pilot is part of the environmental strategy of Skånetrafiken (the local PTA), in order to evaluate the use of depot-charged battery buses in traffic systems in terms of total system efficiency, vehicle performance and customer appreciation. Eight urban buses are being tested, of which five are full battery electric buses leased by Nobina Fleet. Three remaining compressed natural gas (CNG) buses operate for reference. Following completion of the trial, the buses will continue to operate on the same route.

VEHICLE SPECIFICATIONS

Vehicle Brand	5 x BYD
Vehicle Model	K9-13C (Variant of BYD 12m Overseas)
Vehicle Length	12m
Total passenger capacity	70
Air Conditioning	Yes
Heating	Yes
Overnight charging	Plug at the depot (4.5h)
Energy storage system power	292kWh

LINE SPECIFICATIONS

Route number	1	2	3
Type of line	City centre/ suburban area	City centre/ suburban area	City centre/ suburban area
Topography of the line	Flat	Flat	Flat
Length of the bus line	7.1km	14.2km	9.7km
Average commercial speed	18.5km/h	18.5km/h	18.5km/h
Total daily hours of operation	3h	3h	3h
Total daily hours operated in full electric	13h	13h	13h
Total km driven/vehicle/day	250km	250km	250km

CLIMATE

In Ängelholm, the climate is warm and temperate. There is significant rainfall throughout the year. The average temperature is 7.8°C and average annual rainfall is 703mm. With an average of 17.0°C, July is the warmest month. In February, the average temperature is -0.6°C, which is the lowest average temperature for the whole year.

ESKILSTUNA (SE)

TRANSDEV SWEDEN AB



Vehicles: 2 x 12m BYD (Variant of BYD 12m Overseas)

Charging: Slow-charging at the depot

Line: different lines

Total operation time/day: 11h

Duration: Since Nov 2015 and ongoing

Nature of experience: Pilot to test the buses during different conditions

Funding: Self-funded, city, local authority



12m BYD (Variant of BYD 12m overseas)
Source: *bussmagazinet*

DESCRIPTION

Eskilstuna is one of the leading cities in developing a quiet, attractive and climate-friendly bus fleet. The drivers who drove the electric buses during the pilot were satisfied and the buses passed the test in both winter cold and summer heat. The results of this pilot are so successful that the municipality, Transdev and Sörmlands Public Transportation Authority decided to purchase another 10 vehicles, which should enter in service in mid-2017.

VEHICLE SPECIFICATIONS

Vehicle Brand	2 x BYD
Vehicle Model	Variant of BYD 12m Overseas
Vehicle Length	12m
Total passenger capacity	72
Air Conditioning	Yes
Heating	Yes
Overnight charging	Plug at the depot (3h)
Energy storage system power	280-330kWh

LINE SPECIFICATIONS

Route number	Several different lines
Type of line	City centre
Topography of the line	Moderate
Length of the bus line	N/A
Average commercial speed	25km/h
Total daily hours of operation	11h
Total daily hours operated in full electric	11h
Total km driven/vehicle/day	250km

CLIMATE

In Eskilstuna, the climate is cold and temperate. There is a great deal of rainfall with a year average of 574mm. The temperature here averages 6.2°C. The warmest month of the year is July, with an average temperature of 17.0°C. The lowest average temperatures in the year occur in February, when it is around -3.7°C.

GOTHENBURG (SE)

VÄSTTRAFIK AB



"Our project combines both electric hybrids and fully electric buses that run together on line 55. The biggest challenge for us was working together with 15 partners, as there were many different perspectives and focuses. We aim to create an electric bus line that can make a difference for our customers and the environment."

Vehicles: 3 x 10m Volvo (prototype); 7 x 12m Volvo 7900 Electric Hybrid

Charging: Fast-charging at the terminal and at selected bus stops, slow-charging at the depot

Line: 55

Total operation time/day: 13h

Duration: June 2015-June 2018

Nature of experience: Demonstration

Funding: Regional, EU (European Bus System of the Future 2)



Volvo 10m (prototype)



Volvo 7900 Electric Hybrid

DESCRIPTION

With the goal of reducing CO2 emissions by 80% by 2020, seven plug-in hybrids and three fully electric buses are used on route 55, which connects two university campuses in Gothenburg. The route is around 8km long and we have 100,000 passengers per month, with high satisfaction levels among drivers and customer satisfaction levels of 100%. The project is a collaboration between 15 partners, including Volvo, the University of Chalmers, Västtrafik and the Region of Västra Götaland.

VEHICLE SPECIFICATIONS

Vehicle Brand	3 x Volvo	7 x Volvo
Vehicle Model	10m (prototype)	7900 Electric Hybrid
Vehicle Length	10m	12m
Total passenger capacity	76	70
Air Conditioning	Yes	Yes
Heating	Yes	Yes
Opportunity charging	Pantograph at the terminal and selected stops (3-6min)	
Overnight charging	Plug at the depot (4h)	
Energy storage system power	76kWh	

LINE SPECIFICATIONS

Route number	55
Type of line	City centre
Topography of the line	Moderate
Length of the bus line	8km
Average commercial speed	18km/h
Total daily hours of operation	13h
Total daily hours operated in full electric	13h (Volvo Hybrid 12m) and 10h (Volvo 10m)
Total km driven/vehicle/day	156km

CLIMATE

Gothenburg has a maritime climate. Despite its northern latitude, temperatures are quite mild throughout the year and warmer than places of similar latitude. Summers are warm and pleasant, with average high temperatures of 19°C to 20°C, although temperatures of 25-30°C do occur. Winters are cold and windy, with temperatures of around 0°C, though it rarely drops below -15°C. The average annual precipitation is 791mm.

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x Optare	1 x Ebusco	1 x BYD
Vehicle Model	Solo SR EV	2.0	Variant of BYD 12m Overseas
Vehicle Length	9m	12m	12m
Total passenger capacity	49	90	87
Air Conditioning	Yes	Yes	Yes
Heating	Yes	Yes	Yes
Opportunity charging	15min	N/A	N/A
Overnight charging	Plug at the depot (8h)	N/A	N/A
Energy storage system power	92kWh	311kWh	220kWh

LINE SPECIFICATIONS

Route number	Göksäterlinjen
Type of line	Rural areas
Topography of the line	Moderate
Length of the bus line	50km
Average commercial speed	40km/h
Total daily hours of operation	9h
Total daily hours operated in full electric	9h
Total km driven/vehicle/day	150km (Optare Solo SR EV), 400km (Ebusco 2.0), 250km (BYD Overseas)

CLIMATE

The climate is mild and generally warm and temperate. Orust has a significant amount of rainfall during the year, with an annual average of 724mm. The average temperature is 7.2°C. With an average temperature of 16.3°C, July is the hottest month of the year. February has the lowest average temperature of the year, at -1.7°C.

STOCKHOLM (SE)

STOCKHOLMS LÄNS LANDSTING – TRAFFIC ADMINISTRATION



Stockholm
Public Transport

"Stockholm has set ambitious targets for climate gases and is therefore putting significant effort into transferring the bus fleet towards renewable fuel. Today more than 90% of the buses run on renewable fuel."

Vehicles: 8 x 12m Volvo 7900
Electric Hybrid

Charging: Fast-charging at selected bus stops, slow-charging at the depot

Line: 73

Total operation time/day: 14.75h

Duration: March 2015-Dec 2016

Nature of experience:
Demonstration

Funding: Self-funded, EU

DESCRIPTION

Within the framework of the ZeEUS project, SLL tests plug-in hybrid buses, with fast charging stations in terminals and overnight charging at the depot. The operation supports the objective of 87% of the bus fleet running on renewable fuel by the end of 2016. Following completion of the test, the buses will continue to operate in regular service.

VEHICLE SPECIFICATIONS

Vehicle Brand	8 x Volvo
Vehicle Model	7900 Electric Hybrid
Vehicle Length	12m
Total passenger capacity	71
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Pantograph at selected bus stops (6min)
Overnight charging	Plug at the depot (2h)
Energy storage system power	19kWh

LINE SPECIFICATIONS

Route number	73
Type of line	Metropolitan area
Topography of the line	Moderate
Length of the bus line	7km
Average commercial speed	13km/h
Total daily hours of operation	14.75h
Total daily hours operated in full electric	10.9-12.5h
Total km driven/vehicle/day	100km



Volvo 7900 Electric Hybrid

CLIMATE

The climate is warm and temperate. Stockholm has a significant amount of rainfall during the year, with an annual average of 527mm. The average annual temperature in Stockholm is 7.0°C. The warmest month of the year is July, with an average temperature of 17.9°C. February has the lowest average temperature of the year, at -2.6°C.

UMEÅ (SE)

UMEÅ KOMMUNFÖRETAG AB (PART OF UMEA MUNICIPALITY)

UMEÅ
KOMMUN

"Umeå Municipality plans to replace all diesel vehicles on our biggest routes with fully electric buses. This will require at least 24 additional electric buses, which will cover 80% of the services."

Vehicles: 6 x 12m Hybricon Artic Whisper HAW 12 LE;
3 x 18m Hybricon Artic Whisper HAW 18 LE 4WD

Charging: Fast-charging at selected bus stops, slow-charging at the depot

Lines: 6, 9, 80

Total operation time/day: 18h

Duration: Since Oct 2015 and ongoing

Nature of experience: Demonstration

Funding: Self-funded



Hybricon Artic Whisper HAW 12 LE



Hybricon Artic Whisper HAW 18 LE 4WD

DESCRIPTION

As long ago as 2010, Umeå Municipality recognised the positive impact of electrical technology and in particular fully electric buses. This has created opportunities for us in Umeå to solve growing environmental problems, at both local and global levels. For Umeå - which has been experiencing strong growth for several decades - the introduction of quickly rechargeable electric buses is an opportunity to solve local environmental and noise-related problems in the city centre.

VEHICLE SPECIFICATIONS

Vehicle Brand	6 x Hybricon Artic Whisper	3 x Hybricon Artic Whisper
Vehicle Model	HAW 12 LE	HAW 18 LE 4WD
Vehicle Length	12m	18m
Total passenger capacity	65	100
Air Conditioning	Yes	Yes
Heating	Yes	Yes
Opportunity charging	Pantograph at selected bus stops (3-5min)	Pantograph at selected bus stops (3-5min)
Overnight charging	Plug at the depot (4h)	Plug at the depot (4h)
Energy storage system power	80kWh	80kWh

LINE SPECIFICATIONS

Route number	6	9	80
Type of line	City centre, suburban area	City centre, suburban area	City centre, suburban area
Topography of the line	Moderate	Moderate	Moderate
Length of the bus line	15km	16km	14km
Average commercial speed	20km/h	20km/h	30km/h
Total daily hours of operation	18h	18h	18h
Total daily hours operated in full electric	18h	18h	18h
Total km driven/vehicle/day	250km	250km	260km

CLIMATE

The climate is cold and temperate. There is significant rainfall throughout the year in Umeå, with an annual average of 572mm. The average temperature is 2.7°C. Temperatures are highest on average in July, at around 15.9°C. The lowest average temperature of the year is in January, at -9.7°C.

VÄSTERÅS (SE)

VÄSTERÅS LOKALTRAFIK AB



"This step towards electrical operation was made without the infrastructure being ready, and we needed a bigger battery than normally required. However, the experience we gained will help us to develop an optimal infrastructure in the near future."

Vehicle: 1 x 12m Solaris Urbino 12 electric

Charging: Fast-charging at the terminal and the depot

Lines: 4

Total operation time/day: 9h

Duration: From Dec 2014 and ongoing

Nature of experience: Pilot

Funding: EU – Baltic biogas bus

DESCRIPTION

Västerås Lokaltrafik runs a fully electric bus with biogas heating. When ordered, this was the first of its kind; its operating range and function with biogas heating were theoretical, so the bus needed live testing in real-world traffic conditions and climate. The data obtained to date is satisfactory, even in winter. The pilot is a part of a sustainable strategy for the Region of Västmanland.

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x Solaris
Vehicle Model	Urbino 12 electric
Vehicle Length	12m
Total passenger capacity	65
Air Conditioning	Yes
Heating	Yes
Opportunity charging	Plug at the terminal (1h)
Overnight charging	Plug at the depot (2h)
Energy storage system power	160kWh

LINE SPECIFICATIONS

Route number	4
Type of line	Urban area
Topography of the line	Flat
Length of the bus line	12.3km
Average commercial speed	25km/h
Total daily hours of operation	9h
Total daily hours operated in full electric	9h
Total km driven/vehicle/day	100km



Solaris Urbino 12 electric

CLIMATE

The climate is cold and temperate. There is a great deal of rainfall in Västerås, with an annual average of 570mm. The average annual temperature is 6.0°C. July is the warmest month of the year, with an average temperature of 16.8°C. The lowest average temperatures occur in February, when it is around -4.1°C, with lowest temperatures reaching -25°C.

GENEVA (CH)

TRANSPORTS PUBLICS GENEVOIS



"The biggest challenge was to coordinate the various partners around an innovative idea – manufacturer, operator and authorities. Innovation success is based on human success stories."

Vehicle: 1 x 18.75m TOSA articulated bus

Charging: Fast-charging at the terminal and at selected bus stops, slow-charging at the depot

Line: Airport shuttle

Total operation time/day: 20h

Duration: May 2013-May 2016

Nature of experience: Pilot

Funding: Self-funded, local authority, national



TOSA articulated bus

Vehicles: 33 x 18.61m Van Hool/Vossloh Kiepe Exqui.City 18T

Charging: Overhead wires via connecting poles en route, slow-charging at the depot

Line: 7

Total operation time/day: 20h

Duration: April 2015-May 2016

Nature of experience: Daily operation

Funding: Self-funded



Van Hool/Vossloh Kiepe Exqui.City 18T

DESCRIPTION

As part of the electric mobility development strategy, TPG – a local operator in Geneva – purchased one articulated bus from TOSA and is conducting a pilot test. Following a three-year trial, TPG plans to continue to operate the vehicle and to introduce a 12km line with charging at stops and terminals.

VEHICLE SPECIFICATIONS

Vehicle Brand	1 x TOSA	33 x Van Hool/Vossloh Kiepe
Vehicle Model	Articulated bus	Exqui.City 18T
Vehicle Length	18.75m	18.61m
Total passenger capacity	133	131
Air Conditioning	Yes	Yes
Heating	Yes	Yes
Opportunity charging	Articulated arm at the terminal (5min) and selected bus stops (20s)	Overhead wires via connecting poles en route
Overnight charging	Articulated arm at the depot (30-40min)	On line at the depot with connection poles for batteries cells balancing (15-25min)
Energy storage system power	40kWh	28kWh

LINE SPECIFICATIONS

Route number	Shuttle between airport and exhibition centre	7
Type of line	City centre	City centre
Topography of the line	Moderate	Moderate
Length of the bus line	1km	10km
Average commercial speed	16.75km/h	16.75km/h
Total daily hours of operation	8h	20h
Total daily hours operated in full electric	8h	6h
Total km driven/vehicle/day	30km	10km

CLIMATE

Geneva's climate is classified as warm and temperate. Rainfall in the city is significant, with an annual average of 934mm. The average annual temperature is 10.3°C. The temperatures are highest on average in July, at around 19.7°C. At 1.1°C on average, January is the coldest month of the year.

INVERNESS (UK)

STAGECOACH NORTH SCOTLAND



Vehicles: 6 x 10.2m Optare Solo EV

Charging: Fast-charging at the terminal, slow-charging at the depot

Line: 7

Total operation time/day: 10-12h

Duration: June 2015-June 2018

Nature of experience: Testing different technologies

Funding: Self-funded, national



Optare Solo EV

DESCRIPTION

As a part of the 'Zero emissions within the city' strategy, Stagecoach North Scotland purchased six Solo EV buses, manufactured by Optare, to test whether the technology can deliver the required mileage and reliability in a challenging climate. Following the trial, the buses will continue to operate on the same route.

VEHICLE SPECIFICATIONS

Vehicle Brand	6 x Optare
Vehicle Model	Solo EV
Vehicle Length	10.2m
Total passenger capacity	49
Air Conditioning	N/A
Heating	Yes
Opportunity charging	Plug at the terminal (1h)
Overnight charging	Plug at the depot (6h)
Energy storage system power	150kWh

LINE SPECIFICATIONS

Route number	7
Type of line	City centre
Topography of the line	Moderate
Length of the bus line	39km
Average commercial speed	N/A
Total daily hours of operation	10-12h
Total daily hours operated in full electric	10-12h
Total km driven/vehicle/day	160km

CLIMATE

Inverness has a maritime climate, but it is one of the driest areas in Scotland. There are around 18.3 days of falling snow per year. In January, the average high temperature is 6.9°C and in July it is 18.9°C.

LONDON (UK)

TRANSPORT FOR LONDON



Transport
for London

"The next steps will be to introduce the first fully electric bus route – route 507/521. At the same time, we will continue to explore other low-emission technologies, such as pantograph charging and harnessing energy from existing grid power sources, such as the Underground network."

DESCRIPTION

London is exploring a number of different low-emission technology trials, including purely electric buses, plug-in electric hybrid range-extending solutions and hydrogen fuel. These technology trials are being conducted to better understand the technology in terms of performance, durability, cost and saleability. These tests will help to deliver the goal of the central ultra-low-emission zone by 2020. This zone will cover the area of the current congestion charge zone, in which all double-decker buses will have to be hybrid Euro VI and single-deckers will have to have zero tailpipe emissions (electric or hydrogen).

VEHICLE SPECIFICATIONS

Vehicle Brand	2 x BYD	51 x BYD/ADL	5 x BYD	13 x Optare	2 x Irizar	3 x ADL
Vehicle Model	K9A (Variant of BYD 12m Overseas)	Enviro200EV	K8SR (Variant of BYD Double Decker)	Metrocity EV	i2e	Enviro400VE
Vehicle Length	12m	12m	10.9m	10.6m	12m	10.3m
Total passenger capacity	60	86	87	60	60	83
Air Conditioning	No	No	No	No	No	No
Heating	Yes	Yes	Yes	Yes	Yes	Yes
Opportunity charging	No	No	No	No	No	Induction at the terminals (10min)
Overnight charging	Plug at the depot (6h)	Plug at the depot (6h)	Plug at the depot (6h)	Plug at the depot (8h)	Plug at the depot (6h)	Plug at the depot (8h)
Energy storage system power	324-350kWh	324kWh	324kWh	92kWh	282kWh	60kWh

LINE SPECIFICATIONS

Route number	507/521	312	H98	98	69
Type of line	City urban				
Topography of the line	Flat				
Length of the bus line	11km	9km	13km	11km	11km
Average commercial speed	12km/h	12km/h	12km/h	12km/h	12km/h
Total daily hours of operation	16h	16h	16h	16h	16h
Total daily hours operated in full electric	11.2h-12.8h				
Total km driven/vehicle/day	150-250km				

LONDON (UK)

TRANSPORT FOR LONDON



Transport
for London

Vehicles: 2 x 12m BYD K9A (Variant of BYD 12m Overseas)

Charging: Slow-charging at the depot

Line: 507/521

Total operation time/day: 16h

Duration: Dec 2013-Sept 2016

Nature of experience: Demonstration

Funding: Self-funded



BYD K9A (Variant of BYD 12m Overseas)

Vehicles: 51 x 12m BYD/ADL Enviro200EV

Charging: Slow-charging at the depot

Line: 507/521

Total operation time/day: 16h

Duration: Aug 2016-2030

Nature of experience: Regular service

Funding: Bus contract



BYD slash ADL Enviro200EV

Vehicles: 5 x 10.9m BYD K8SR (Variant of BYD Double Decker)

Charging: Slow-charging at the depot

Line: 98

Total operation time/day: 16h

Duration: Since April 2016 and ongoing

Nature of experience: Demonstration

Funding: Self-funded



BYD K8SR (Variant of BYD Double Decker)

Vehicles: 13 x 10.6m Optare Metrocity

Charging: Slow-charging at the depot

Lines: 312 and H98

Total operation time/day: 16h

Duration: Since April 2014, Dec 2014 and Sept 2015 and ongoing

Nature of experience: Demonstration

Funding: Self-funded



Optare Metrocity EV

Vehicles: 2 x 12m Irizar i2e

Charging: Slow-charging at the depot

Line: 507/521

Total operation time/day: 16h

Duration: Since Aug 2015 and ongoing

Nature of experience: Demonstration

Funding: Self-funded



Irizar i2e

Vehicles: 3 x 10.2m ADL E400H

Charging: Fast-charging at terminals, slow-charging at the depot

Line: 69

Total operation time/day: 16h

Duration: Nov 2015-March 2017

Nature of experience: Demonstration

Funding: Self-funded, EU



ADL E400H

CLIMATE

The climate is warm and temperate. London has a significant amount of rainfall during the year, with an annual average of 621mm. The average annual temperature is 11.1°C. The warmest month of the year is July, with an average temperature of 18.7°C. January has the lowest average temperature of the year, at 4.9°C.

MANCHESTER (UK)

TRANSPORT FOR GREATER MANCHESTER



Transport for
Greater Manchester

"The Greater Manchester Transport Strategy 2040 places a strong emphasis on low-emission growth and smart mobility. The Strategy includes the ambition that, by 2040, TfGM will deliver a low-emission transport system to meet the ambitious carbon reduction targets and to eradicate poor air quality caused by transport in Greater Manchester."

Vehicles: 3 x 9.5m Optare Versa EV

Charging: Fast-charging at the terminal, slow-charging at the depot

Lines: MS1, MS2, MS3

Total operation time/day: 12h

Duration: Since April 2003 and ongoing

Nature of experience: Regular city centre link service

Funding: Local authority, national funding

DESCRIPTION

TfGM provides a free Metro-shuttle bus service linking main rail stations, car parks, shopping areas and businesses in Manchester city centre. There are three circular routes, carrying a combined average of 30,000 passengers per week, and operated by 20 Optare low-carbon emission buses, three of which are fully electric.

VEHICLE SPECIFICATIONS

Vehicle Brand	3 x Optare
Vehicle Model	Versa EV
Vehicle Length	9.5m
Total passenger capacity	57
Air Conditioning	No
Heating	Yes
Opportunity charging	Plug at the terminal (2h)
Overnight charging	Plug at the depot (6h)
Energy storage system power	Two packs assembled in series, consisting of 26 lithium iron magnesium phosphate batteries per pack

LINE SPECIFICATIONS

Route number	MS1	MS2	MS3
Type of line	City centre	City centre	City centre
Topography of the line	Flat	Flat	Flat
Length of the bus line	6km	6km	6km
Average commercial speed	18km/h	18km/h	18km/h
Total daily hours of operation	12h	12h	12h
Total daily hours operated in full electric	12h	12h	12h
Total km driven/vehicle/day	150km	150km	150km



Optare Versa EV

CLIMATE

The climate here is mild, and generally warm and temperate. Manchester has a significant amount of rainfall during the year, with an annual average of 929mm. The average annual temperature is 10.5°C. With an average temperature of 17.8°C, July is the hottest month of the year. January has the lowest average temperature of the year, at 4.3°C.

NOTTINGHAM (UK)

NOTTINGHAM CITY COUNCIL



Nottingham
City Council

"Despite the government funding available for electric buses, this still leaves the problem of meeting the match-funding requirements. The cuts in government grants to local authorities have made this more difficult. We have found funding from the workplace parking levy (a type of congestion charge for companies), as well as using the low carbon emission bus grant provided by the government."

Vehicles: 35 x 9.5m Optare Solo EV; 10 x 10.5m Optare Versa EV

Charging: Fast-charging at the terminal and depot, slow-charging at the depot

Lines: Locallink L1, Medilink

Total operation time/day: 15h

Duration: Since June 2012 and ongoing

Nature of experience: Commercial operation

Funding: City, regional, national, EU

DESCRIPTION

We began purchasing our pure electric buses in 2010 and commenced operations with them in 2012. We currently have a fleet of 45 ebuses, run by one operator. Thirteen further long-range electric buses will be delivered shortly. We have worked closely with vehicle and charging equipment manufacturers to improve performance over the years.

VEHICLE SPECIFICATIONS

Vehicle Brand	35 x Optare	10 x Optare
Vehicle Model	Solo EV	Versa EV
Vehicle Length	9.5m	10.5m
Total passenger capacity	43	57
Air Conditioning	Driver only	Driver only
Heating	Yes	Yes
Opportunity charging	Plug at the terminal and depot (2h)	Plug at the terminal and depot (7h)
Overnight charging	Plug at the depot (6h)	Plug at the depot (6h)
Energy storage system power	95kWh	95kWh

LINE SPECIFICATIONS

Route number	Medilink	Localink L1
Type of line	Suburban, ring road	City centre, suburban
Topography of the line	Moderate	moderate
Length of the bus line	24km	19.7km
Average commercial speed	17.5km/h	No data
Total daily hours of operation	15h	8.16h
Total daily hours operated in full electric	15h	8.16h
Total km driven/vehicle/day	100km	100km



Optare Solo EV



Optare Versa EV

CLIMATE

In Nottingham, the climate is warm and temperate. Nottingham is a city with significant rainfall, with an annual average of 648mm. The average annual temperature is 9.8°C. With an average of 17.2°C, July is the warmest month. January is the coldest month, with temperatures averaging 2.9°C.

CHAPTER 3: INDUSTRY

COMPANY PROFILE

Alexander Dennis Limited (ADL) is the UK's leading bus and coach manufacturer, employing around 2,000 people at facilities in the UK, North America and Asia. One of the fastest-growing bus and coach builders in western Europe, ADL produces a wide range of innovative and fuel-efficient, low-floor single- and double-decker buses, including low- and zero-emission vehicles.



ADL Enviro400VE



BYD ADL Enviro200EV

CONTACT

Company website:
www.alexander-dennis.com

Contact: Stefan Baguette
stefan.baguette@alexander-dennis.com

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	ADL	BYD ADL	BYD ADL
Vehicle type	Enviro400VE	Enviro200EV	Enviro200EV
Length	10.3m	12m	10.8m
Total Passengers capacity	83	90	77
Gross vehicle weight	18,000kg	18,600kg	18,600kg
Top speed	70km/h	70km/h	70km/h
Airco	Electric air chill	Electric	Electric
Heating	Conventional or electric	Conventional or electric	Conventional or electric
Fuel economy or range	Up to 30km range in zero-emission electric mode without recharging	Over 250km range (London routes 507 and 521)	Over 250km range (London routes 507 and 521)
European Market introduction	December 2015	September 2016	June 2017

ELECTRIC MOTOR

Suppliers	BAE Systems	BYD	BYD
Type	Central motor	Integrated in axle	Integrated in axle
Power peak	175kW	180kW	180kW
Torque	870Nm	700Nm	700Nm

BATTERY

Suppliers	Akasol	BYD	BYD
Total energy	61kWh	324kWh	324kWh
Type	Nickel manganese cobalt	Lithium iron phosphate	Lithium iron phosphate
Warranty	Depending on contract	Depending on contract	Depending on contract

CHARGING SYSTEM

Charging System	Inductive	Manual	Manual
Charge Rate	100kW	80kW	80kW
Charge Time	5min	4h	4h

COMPANY PROFILE

Bluebus is a subsidiary of the Bolloré Group, best known for its Lithium Metal Polymer (LMP) battery technology. LMP batteries are used in mobile applications (cars, buses, trams and boats) and stationary applications.



Bluebus 12m, Source: RATP - Denis Sutton

CONTACT

Company website:
www.bluebus.fr

Contact: Yves Labesse
yves.labesse@blue-solutions.com

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	12m
Vehicle type	BEV
Length	12m
Total Passengers capacity	97
Gross vehicle weight	20,000kg
Top speed	70km/h
Airco	No
Heating	Webasto and electric
Fuel economy or range	180km measured on Line 21 RATP
European Market introduction	May 2016

ELECTRIC MOTOR

Suppliers	Siemens
Type	Permanent magnet
Power peak	160kW
Torque	2,500Nm

BATTERY

Suppliers	BlueSolutions
Total energy	240kWh
Type	Lithium metal polymer
Warranty	7 years

CHARGING SYSTEM

Charging System	Manual
Charge Rate	50kW
Charge Time	5h

COMPANY PROFILE

Bozankaya is a pioneer in the development of electric drive systems for buses. We are creating a future-oriented mobility alternative for public transport with our intelligent battery management systems and charging technologies that are tailored to individual fleet operations.



Sileo S10



Sileo S12



Sileo S18

CONTACT

Company website:
www.bozankaya.com.tr;
www.sileo-ebus.com

Contact:

Emrah Dal
 emrahdal@bozankaya.com

Frank Goldacker
 goldacker@sileo-ebus.com

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	Sileo S10	Sileo S12	Sileo S18	Sileo S24
Vehicle type	BEV	BEV	BEV	BEV
Length	10.7m	12m	18m	24m
Total Passengers capacity	78	79	137	-
Gross vehicle weight	18,000kg	18,000kg	28,000kg	-
Top speed	75km/h	75km/h	75km/h	-
Airco	Electric HVAC system, Spheros Citisphere			
Heating	Diesel/electric (opt.)	Diesel/electric (opt.)	Diesel/electric (opt.)	Diesel/electric (opt.)
Fuel economy or range	0.85kWh/km	0.88kWh/km	1.15kWh/km	Range: min. 250km/d
European Market introduction	2015	2015	September 2016	December 2016

ELECTRIC MOTOR

Suppliers	ZF/Siemens	ZF/Siemens	ZF/Siemens	ZF/Siemens
Type	AC asynchronous	AC asynchronous	AC asynchronous	AC asynchronous
Power peak	2 x 120 = 240kW	2 x 120 = 240kW	4 x 120 = 480kW	4 x 120 = 480kW
Torque	21,000Nm	21,000Nm	42,000Nm	42,000Nm

BATTERY

Suppliers	Bozankaya BC&C	Bozankaya BC&C	Bozankaya BC&C	Bozankaya BC&C
Total energy	200kWh	200 or 230kWh	300kWh	380kWh
Type	Lithium iron phosphate	Lithium iron phosphate	Lithium iron phosphate	Lithium iron phosphate
Warranty	4 years	4 years	4 years	4 years

CHARGING SYSTEM

Charging System	Manual (plug-in)	Manual (plug-in)	Manual (plug-in)	Manual (plug-in)
Charge Rate	4-100kW	4-100kW	4-200kW	Undefined
Charge Time	2-7h	2-8h	3-8h	Undefined

COMPANY PROFILE

BYD is the world's largest producer of full-size purely electric buses. It is also the world's largest manufacturer of rechargeable batteries. Its technology is fully proven and safe and delivers outstanding range. All BYD electric buses are designed to complete a full duty cycle on a single charge. BYD has 220,000 employees and a turnover of €11.2bn in 2015.



BYD 12m China



BYD 12m Overseas city bus



BYD 12m Overseas airport bus



BYD ADL Enviro200EV 12m



BYD Double Decker



BYD 18m Articulated



BYD 12m Coach

CONTACT

Company website:
www.byd.com

Contact: Hao Yin
edison.yin@byd.com

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	BYD 12m China	BYD 12m Overseas	BYD midi bus	BYD 10.8m Variants	BYD Double Decker	BYD 18m Articulated	BYD 12m coach
Vehicle type	BEV low entry/low floor						BEV
Length	12m		8.7m	9.6 - 11.5m	10.2-12m	18m	12m
Total Passengers capacity	75	Up to 95	Up to 54	Up to 90	Up to 95	Up to 150	Up to 59
Gross vehicle weight	18,000kg	19,000kg	13,000kg	Up to 19,000 kg	Up to 20,000kg	28,000kg	19,000kg
Top speed	70km/h	70/80km/h	70km/h	70/80km/h	70km/h	70km/h	90km/h
Airco available	Yes - BYD climate control system or other assigned suppliers						
Heating available	Yes- electric or diesel heating						
Fuel economy or range	300km under SORT	320km under SORT	200km under SORT	About 340km under SORT	About 330km under SORT	200km under SORT	200km under SORT
Market introduction	2013	2013	Introduction in 2017		2015	2016	2016

ELECTRIC MOTOR

Suppliers	BYD						
Type	Wheel-hub motor (PNSM)						
Power peak	2x90kW	2x 90/150kW	2x90kW	2x 90/150kW	2x150kW		2x180kW
Torque	2x350Nm	2x 350/550Nm	2x350Nm	2x 350/550Nm	2x350Nm		2x1,500Nm

Electric bus model name	BYD 12m China	BYD 12m Overseas	BYD midi bus	BYD 10.8m Variants	BYD Double Decker	BYD 18m Articulated	BYD 12m coach
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BATTERY

Suppliers	BYD
Type	Iron-Phosphate battery
Warranty	5 years

CHARGING SYSTEM

Charging System	Plug-in				Pantograph & Plug-in	Plug-in
Charge Rate	2x40kW				Plug-in 2x40kW	2x40kW
Charge Time	4 - 4.5h	2h	4 - 4.5h	4.5h	Up to 3h	3h

COMPANY PROFILE

CaetanoBus is the most important manufacturer of buses and coaches in Portugal. The majority of our products are intended for export and are now transporting people all over the world. It is a company that uses tradition, innovation and design to remain one step ahead, closer to the future. We manufacture buses and bodies mounted on chassis of various brands and with different specifications for urban, tourism and airport service, as well as other products that provide unique solutions for niche markets. We are world leaders in the airport bus sector with the Cobus brand. In this sector, we developed the first electric bus exclusive to airports.



e. City Gold



eCobus

CONTACT

Company website:
www.caetanobus.pt/pt

Contact: Rui Miguel Rodrigues Pinto
rui.pinto@salvadorcaetano.pt

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	e. City Gold	eCobus
Vehicle type	Fully electric	Fully electric
Length	11.995m	13.92m
Total Passengers capacity	88	112
Gross vehicle weight	19,000kg	20,000kg
Top speed	70km/h	Airport – 50km/h
Airco	Roof (27kW or 40kW cooling capacity)	Roof
Heating	Electric water heater	Electric water heater
Fuel economy or range	Up to 200km	Up to 70km
European Market introduction	June 2016	2013

ELECTRIC MOTOR

Suppliers	Siemens	Siemens
Type	Synchronous motor	Synchronous motor
Power peak	160kW	160kW
Torque	1,500Nm	1,500Nm

BATTERY

Suppliers	-	Actia
Total energy	50-250kWh	85kWh
Type	Lithium titanate or Nickel Manganese Cobalt Power	Lithium titanate
Warranty	5 years	8 years

CHARGING SYSTEM

Charging System	Manual/overhead	Manual
Charge Rate	50kW-150kW/350kW	60kW
Charge Time	Depends on the configuration of the batteries used in the vehicle. To manually charge a 100kWh vehicle, a full charge takes 40min	Manual charge: full charge in 1h 15min

CHARIOT MOTORS



COMPANY PROFILE

Chariot Motors was established in 2009 to design, develop and bring into commercial operation a unique ultracapacitor-based electric bus. The Chariot ebus is based on the world's most advanced ultracapacitor technology, developed by Aowei. As a result, Chariot Motors has developed ultracapacitor electric buses that comply with the Western markets' strict requirements and European mandatory homologation certification. The Chariot ebus is the only electric bus model in commercial operation in Europe powered solely by ultracapacitors, without employing any batteries.



Chariot ebus Belgrade



Chariot ebus Tel Aviv



Chariot ebus Sofia

CONTACT

Company website:
www.chariot-electricbus.com

Contact: Milen Milev
milen@chariot-electricbus.com

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	Chariot ebus	Chariot ebus	Chariot ebus	Chariot ebus
Vehicle type	Ultracapacitor electric bus	Ultracapacitor electric bus	Ultracapacitor electric bus	Ultracapacitor electric bus
Length	12m	12m	12m	-
Total Passengers capacity	91	91	91	91
Gross vehicle weight	19,000kg	19,000kg	19,000kg	19,000kg
Top speed	70km/h	70km/h	70km/h	70km/h
Airco	Thermoking	NTC	Spheros	NTC
Heating	Spheros	NTC	Spheros	NTC
Fuel economy or range	0.95kWh/km (SORT 2 conditions)	0.95kWh/km (SORT 2 conditions)	To be tested	0.95kWh/km (SORT 2 conditions)
European Market introduction	May 2014	August 2016	October 2016	July 2017

ELECTRIC MOTOR

Suppliers	Siemens	Siemens	ZF Ave 130	Siemens
Type	Asynchronous	Synchronous (permanent magnet)	Synchronous	Synchronous (permanent magnet)
Power peak	67 x 2kW	180kW	76 x 2kW	180kW
Torque	430 x 2Nm	2,500Nm	11,000 x 2Nm	2,500Nm

BATTERY

Suppliers	Ultracapacitors by Aowei	Ultracapacitors by Aowei	Ultracapacitors by Aowei	Ultracapacitors by Aowei
Total energy	21kWh	21kWh	32kWh	32kWh
Type	Graphene ultracapacitors	Graphene ultracapacitors	Graphene ultracapacitors	Graphene ultracapacitors
Warranty	8 years' full warranty	8 years' full warranty	8 years' full warranty	8 years' full warranty

CHARGING SYSTEM

Charging System	Overhead fast-charging pantograph system	Overhead fast-charging pantograph system	Overhead fast-charging pantograph system	Overhead fast-charging pantograph system
Charge Rate	150kW	150kW	340kW	340kW
Charge Time	Charged up to 85% in 5min	Charged up to 85% in 5min	Charged up to 85% in 3min	Charged up to 85% in 3min

COMPANY PROFILE

Ebusco is a Dutch bus manufacturer focused on the development, marketing and sales of fully electric buses for the European market. Ebusco is a pioneer in the development of electric bus transport and was the first European company to receive full European approval for a fully electric bus. Since 2012, Ebusco has gained extensive practical experience through following a normal timetable all day. All buses are equipped with live monitoring systems to support safe and economically optimal public transport.



CONTACT

Company website:
www.ebusco.eu

Contact: Patrick Heuts
patrick@ebusco.eu

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	Ebusco 2.1 HV LF-311-HV-2/3	Ebusco 18M HV LF-414-HV-3/4
Vehicle type	BEV	BEV
Length	12m	18m
Total Passengers capacity	90	125
Gross vehicle weight	12,000kg	19,500kg
Top speed	80km/h	80km/h
Airco	Thermoking	Thermoking
Heating	Thermoking and optional Spheros	Thermoking and optional Spheros
Fuel economy or range	0.85kWh/km	1.275kWh/km
European Market introduction	October 2014	November 2017

ELECTRIC MOTOR

Suppliers	Ebusco	ZF
Type	Asynchronous	Asynchronous
Power peak	220kW	2 x 125kW
Torque	3,000Nm	2 x 11.000Nm (including gear)

BATTERY

Suppliers	Ebusco	Ebusco
Total energy	311kWh	414kWh
Type	Lithium iron phosphate	Lithium iron phosphate

CHARGING SYSTEM

Charging System	Plug-in	Plug-in
Charge Rate	75kW/120kW	75kW/120kW
Charge Time	4.5/3h	6/4h

COMPANY PROFILE

evopro Bus LLC is the member of the evopro Group and was established in 2012, when it was separated from evopro LLC Engineering. Our focus is on research and development that advances both society and industry. Several innovative developments in transportation technology, embedded systems, high-performance computing and mobile informatics made by evopro are now available on the market as services or products. These include the dynamic railway diagnostic system and the composite structured electrical bus family for urban use. The unique solution of the composite structured modular electric bus family (Modulo) provides evopro Bus with the opportunity to revolutionise urban traffic.



CONTACT

Company website:

www.evopro-group.com

Contact: Donát Dékány

donat.dekany@evopro-group.com

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	Modulo C68e	Modulo C88e
Vehicle type	BEV	BEV
Length	7.982m	9.457m
Total Passengers capacity	55 (8 person/m ²)	74 (8 person/m ²)
Gross vehicle weight	10,350kg	11,050kg
Top speed	65km/h	65km/h
Airco	Eberspächer Hydronic M12 (diesel heating, optional electric heating)	Eberspächer Hydronic M12 (diesel heating, optional electric heating)
Heating	Thermoking and optional Spheros	Thermoking and optional Spheros
Fuel economy or range	0.62kWh/km; Range (SORT 2 cycle): 200-230km	0.7kWh/km; Range (SORT 2 cycle): 120-140km
European Market introduction	May 2016	May 2016

ELECTRIC MOTOR

Suppliers	Siemens	Siemens
Type	1DB2016 - 1NB06 synchron motor	1DB2016 - 1NB06 synchron motor
Power peak	Max. 160kW	Max. 160kW
Torque	1,019Nm	1,019Nm

BATTERY

Suppliers	Valence	Valence
Total energy	144kWh	84kWh
Type	Lithium iron phosphate	Lithium iron phosphate
Warranty	5 years	5 years

CHARGING SYSTEM

Charging System	Conductive	Conductive
Charge Rate	60kW	60kW
Charge Time	5h	5h

COMPANY PROFILE

Manufacturing vehicles is fascinating, because it calls for an ability to see the big picture - from individual components to highly sophisticated transport systems, as well as environmental and climate issues. Of course, we never lose sight of the most important aspect; people and their mobility needs. Hess transport solutions keep the world on the move. Therefore, we work closely with competent local partners and are always aware of specific local conditions. Our high-quality Co-Bolt modular system, originating in the public transport paradise of Switzerland, further guarantees dependable operation and advanced technology.



TOSA BGT-N2D



SwissTrolley BGT-N2D



lighTram Trolley BGGT-N2D

CONTACT

Company website:
www.hess-ag.ch

Contact: **Hans-Jörg Gisler**
hans-joerg.gisler@hess-ag.ch

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	TOSA BGT-N2D	SwissTrolley BGT-N2D	lighTram Trolley BGGT-N2D
Vehicle type	BEV	Trolley	-
Length	18.74m	18.74m	24.72m
Total Passengers capacity	142	147	221
Gross vehicle weight	29,000kg	29,500kg	39,400kg
Top speed	80km/h	65km/h	65km/h
Airco	Fully electric	Fully electric	Fully electric
Heating	Fully electric water heating	Fully electric water heating	Fully electric water heating
Fuel economy or range	2.4kW/h with AC and heating	2.5kW/h with AC and heating	2.9kW/h with AC and heating
European Market introduction	May 2013	November 2016	June 2014

ELECTRIC MOTOR

Suppliers	ABB	TSA	TSA
Type	PEM	Asynchronous	Asynchronous
Power peak	240kW	240kW	320kW
Torque	1,520Nm	-	-

BATTERY

Suppliers	ABB	VKD	VKD
Total energy	70kWh	20kWh	32kWh
Type	Lithium titanate	Lithium iron phosphate	Lithium iron phosphate
Warranty	> 5 years	> 2 years	> 2 years

CHARGING SYSTEM

Charging System	Conductive pantograph	Overhead in-motion charging	Overhead in-motion charging
Charge Rate	600kW	> 600kW	> 600kW
Charge Time	Flash, 15s; terminus, 3min	-	-

COMPANY PROFILE

Heuliez Bus is a French bus manufacturer manufacturing midibuses, standard and articulated buses. Powertrains available are Diesel Euro VI and hybrid. Heuliez Bus has been involved in developing and manufacturing at industrial scale alternative drive, since 2000 with trolleybuses, hybrid since 2011. Heuliez Bus electric buses are derived from the hybrid versions.

CONTACT

Company website:
www.heuliezbus.com

Contact:

Jean-Marc Boucheret
jeanmarc.boucheret@cnhind.com

Rémy Foyer
remy.foyer@heuliezbus.com



HEULIEZ BUS GX 337 ELEC



HEULIEZ BUS GX 337 ELEC

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	HEULIEZ BUS GX 337 ELEC	HEULIEZ BUS GX437 ELEC
Vehicle type	BEV	Electric Opportunity Charge
Length	12 m	18 m
Total Passengers capacity	94	155
Gross vehicle weight	20.000kg	30.000kg
Top speed	80km/h	80km/h
Airco	electric	electric
Heating	water circuit heater by boiler, electric or with diesel or biofuel	electric
Fuel economy or range	200 km in typical heavyduty bus routes, such as in Paris/RATP	No limitation of range, thanks to opportunity charge
European Market introduction	June 2017	November 2017

ELECTRIC MOTOR

Suppliers	BAE Systems	BAE Systems
Type	Permanent Magnet	Permanent Magnet
Power peak	120/190kW	160/200kW
Torque	1,610/3,300Nm	2,400/5,100Nm

BATTERY

Suppliers	Foresee	Foresee
Total energy	349kWh	106kWh
Type	NMC	LTO
Warranty	depending on contract	depending on contract

CHARGING SYSTEM

Charging System	manual plug Combo 2, CCS protocol	pantograph, CCS protocol
Charge Rate	50 to 100kW (overnight slow charge), 150kW (mid-day faster charge)	300 to 450kW
Charge Time	3 to 5 hours	few minutes depending on charging power

COMPANY PROFILE

Our company is the first major electric and energy-efficient bus manufacturer in China. Thanks to the proprietary rail transit equipment technologies (converting technology, electric drive and controlling technology) supported by our parent company, CRRC Corporation Limited, our company has successfully developed green buses, including hybrid extended-range plug-in, natural gas and purely electric. We have the capacity to manufacture 10,000 electric buses and 20,000 sets of drive trains and key components annually and we have already established a complete industrial chain. Over 14,000 buses and 20,000 drive trains have already left our factory. To date these have operated a total mileage of 1bn km, with 98% average reliability and fuel savings of greater than 20%. We have also supported many major events, including the Beijing Olympic Games in 2008.



CRRC C12

CONTACT

Company website:
www.tev.crrczie.com

**Contact: Yuan Xiaoxing
(Cherry Yuan)**
yuanxx@csrzic.com;
crrctev@csrzic.com

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	CRRC C12
Vehicle type	BEV
Length	11.95m
Total Passengers capacity	86
Gross vehicle weight	18,000kg
Top speed	70km/h
Airco	Electric air conditioning
Heating	HVAC, water heater is an option
Fuel economy or range	1kWh/km Max. range 200km (fully loaded, air-conditioned, city bus cycle)
European Market introduction	Ready for European market

ELECTRIC MOTOR

Suppliers	Hunan CRRC Times Electric Vehicle Co., Ltd
Type	Permanent magnet synchronous motor
Power peak	150kW
Torque	2,500Nm

BATTERY

Suppliers	Offnenbach
Total energy	201kWh
Type	Nickel manganese cobalt ternary batteries
Warranty	Battery Warranty (years or km) : TBD

CHARGING SYSTEM

Charging System	Manual
Charge Rate	99-137kw
Charge Time	2h (100kW charger)

HYBRICON BUS SYSTEM AB



COMPANY PROFILE

Hybricon Bus Systems AB (HYCO) develops and manufactures the world's most energy-efficient, clean and quiet system for public transport buses. Hybricon Ultrafast Charged® buses run around the clock on clean electric power. Hybricon's headquarters, where the company's production facility is also located, is in Holmsund, outside Umeå (Sweden). Given the relative proximity to the Arctic Circle, this provides a perfect environment for cold-testing the company's products. Energy efficiency, ultra-fast charging and modularised key components together constitute a set of unique features of the company's buses.



Hybricon Arctic Whisper HAW
18 LE 4WD



Hybricon Arctic Whisper HAW
18 LE 4WD

CONTACT

Company website:
www.hybricon.se

Contact:
info@hybricon.se

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	Hybricon Arctic Whisper HAW 18 LE 4WD	Hybricon City bus HCB 12 LF	-
Vehicle type	BEV, ultra-fast charge	BEV, fast charge	BEV, fast charge
Length	12m	12m	12m
Total Passengers capacity	79	62	N/A
Gross vehicle weight	28,000kg	18,000kg	18,000kg
Top speed	80km/h	80km/h	80km/h
Airco	ThermoKing	Yes	Yes
Heating	Electric, heat pump and diesel	Electric and diesel	Electric and diesel
Fuel economy or range	1.3 to 2.2kW/km based on practical experience in Umeå, northern Sweden, over one year	TBD	TBD
European Market introduction	June 2016	N/A	N/A

ELECTRIC MOTOR

Suppliers	Ziehl-Abegg	Ziehl-Abegg	Ziehl-Abegg
Type	SM530.60AL-30 direct drive	SM530.60AL-30 direct drive	SM530.60AL-30 direct drive
Power peak	4x157kW (628kW)	2 x 157kW (314kW)	2 x 157kW (314kW)
Torque	6,000Nm max per wheel, 2,100Nm nominal	6,000Nm max per wheel, 2,100Nm nominal	6,000Nm max per wheel, 2,100Nm nominal

Electric bus model name	Hybricon Arctic Whisper HAW 18 LE 4WD	Hybricon City bus HCB 12 LF	-
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BATTERY

Suppliers	Altair-Nano	BMZ	BMZ
Total energy	40-120kWh	38-265kWh	38-265kWh
Type	Lithium titanate	Nickel manganese cobalt	Nickel manganese cobalt
Warranty	3 years, extendable to 10 years	2 years, extendable to 10 years	2 years, extendable to 10 years

CHARGING SYSTEM

Charging System	Overhead/depot manual	Overhead/depot manual	Overhead/depot manual
Charge Rate	20-650kW	20-200kW	20-200kW
Charge Time	4.5min, 4h depot The shorter time given assumes 20km route consumption and maximum charging power (effective charging time). The longer time is the recommended depot charge time.	TBD	TBD

COMPANY PROFILE

Irizar e-mobility is the Irizar Group's new company, created in 2016. The business is focused on offering integral electromobility solutions for vehicles, as well as vehicle components and systems for cities. It combines the knowledge and experience of all the group's companies (buses and coaches, climate, door pneumatic systems, power electronics, intelligent information systems and electric engines) to create comprehensive urban mobility solutions. This means 100% electric buses and the major infrastructure systems required for charging, traction and energy storage, all of which are designed and manufactured with the group's 100% European technology and with Irizar's warranty and service quality.

The product range includes 10.8m and 12m city buses, which have been operating in various European cities since 2014, articulated (18m) or bi-articulated buses and other electric vehicles to serve cities. The Irizar Group promotes the use of clean and accessible transport and is committed to the environment, the health and well-being of people and to creating better urban environments. It is also committed to reducing noise pollution, to achieving low fuel consumption and to zero-emission vehicles. That is why 'For a better life' has become our motto. Thanks to our broad sectoral diversification, we at Irizar e-mobility offer a turnkey project that meets 100% of customer requirements.

CONTACT

Company website:
www.irizar.com

Contact: Hector
 Olabegogeoaskoetxea
holabe@irizar.com



Irizar i2e



Irizar i2e

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	Irizar i2e	Irizar i2e 18m
Vehicle type	BEV	BEV
Length	11.98m	18.73m
Total Passengers capacity	80	150 (up to client's request)
Gross vehicle weight	20,000kg	28,000kg
Top speed	85km/h	85km/h
Airco	Hispacold electric and fully automated air conditioning	Hispacold electric and fully automated air conditioning
Heating	Hispacold electric and fully automated heat ventilation system	Hispacold electric and fully automated heat ventilation system
Fuel economy or range	1.5kWh/km with air conditioning	-
European Market introduction	Q1 2014	Q1 2017

ELECTRIC MOTOR

Suppliers	Siemens	-
Type	Synchronous motor	Synchronous motor
Power peak	180kW	230kW
Torque	1,800Nm	2,350Nm

Electric bus model name

Irizar i2e

Irizar i2e 18m

BATTERY

Suppliers	FIAMM	-
Total energy	376kWh	from 120-180kWh
Type	ZEBRA	Lithium ion
Warranty	2,000 cycles	-

CHARGING SYSTEM

Charging System	Manual Combo 2	Opportunity charging: pantograph Depot charging: Combo 2
Charge Rate	80-100kW	Opportunity charging: up to 500kW Depot charging: 80-100kW
Charge Time	6-7h	Opportunity charging: 5-10min Depot charging: 2h

COMPANY PROFILE

Optare is a leading British manufacturer of urban buses employing around 350 people with a modern assembly facility near Leeds, Yorkshire. Its award-winning range of buses feature an integral design and efficient diesel engines, as well as an industry-leading choice of electric units using the latest low-carbon technology.



Optare Metrocity EV



Optare Versa EV



Optare Metrodecker EV

CONTACT

Company website:
www.optare.com

Contact: **Rebecca Green**
rebecca.green@optare.com

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	Optare Solo EV	Optare Metrocity EV	Optare Versa EV	Optare Metrodecker EV
Vehicle type	BEV	BEV	BEV	BEV
Length	9.2m and 9.9m	10.8m	10.4m and 11.1m	10.5m
Total Passengers capacity	55	58	58	96
Gross vehicle weight	11,300kg	12,960kg	12,480kg	TBC
Top speed	80km/h	80km/h	80km/h	80km/h
Airco	Not currently available	Not currently available	Not currently available	Chiller system
Heating	Diesel combustion heater/electric heating	Diesel combustion heater/electric heating	Diesel combustion heater/electric heating	Electric heating
Fuel economy or range	0.51kWh/km - from independent testing by the LowCVP in conjunction with DfT on the Millbrook London Transbus Bus cycle (MLTB - route 159) and LowCVP UK Bus drive cycle (LUB)	0.67kWh/km based on the London City route, UK	0.67kWh/km based on in-service data from the park and ride service in York, UK	TBC
European Market introduction	August 2012	March 2014	October 2013	Imminent Launch

ELECTRIC MOTOR

Suppliers	Magtec	Magtec	Magtec	Magtec
Type	-	-	-	-
Power peak	150kW	150kW	150kW	200kW
Torque	2,000Nm	2,000Nm	2,000Nm	3,570Nm

Electric bus model name	Optare Solo EV	Optare Metrocity EV	Optare Versa EV	Optare Metrodecker EV
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BATTERY

Suppliers	Valence	Valence	Valence	TBC
Total energy	138kWh	138kWh	138kWh	200kWh
Type	Lithium iron magnesium phosphate			
Warranty	5 years	5 years	5 years	TBC

CHARGING SYSTEM

Charging System	Plug-in	Plug-in	Plug-in	Plug-in
Charge Rate	42kW	42kW	42kW	40kW
Charge Time	2.5h	2.5h	2.5h	6h

COMPANY PROFILE

Being one of the major automotive manufacturers in Turkey, Otokar has been providing solutions specifically answering to the needs of its customers with its own technology, design and applications both in commercial and military range since 1963. It is operating with over 2,000 employees at the factory built on a land of 552,000m² in Sakarya. Otokar has been manufacturing buses for public transportation, semi-trailers for transportation and logistics industry and tracked armoured vehicles and tactical armoured vehicles for the defense industry. With a hundred percent Turkish capital, Otokar is today present in the automotive and defense industries with products of which intellectual property rights are owned by it. Being a leader in the bus industry and the land vehicles in the defense industry in Turkey, Otokar is the main contractor in the Design and Prototype Development Project of ALTAY, the national battle tank of Turkey and is one of the companies of Koç Group.



Otokar Electra

CONTACT

Company website:
www.otokar.com

Contact: Berkan Saglam
bsaglam@otokar.com

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	Otokar Electra
Vehicle type	BEV
Length	9m
Total Passengers capacity	55
Gross vehicle weight	13,500kg
Top speed	80km/h
Airco	yes
Heating	yes
Fuel economy or range	1kWh/km - 170km (city cycle)
European Market introduction	-

ELECTRIC MOTOR

Suppliers	-
Type	asynchronous
Power peak	103kW
Torque	380Nm

BATTERY

Suppliers	Valence
Total energy	170kWh
Type	LFP
Warranty	-

CHARGING SYSTEM

Charging System	manual
Charge Rate	32kW
Charge Time	8h

COMPANY PROFILE

Since 1945, Rampini is a leader in the design and manufacture of specialty vehicles and urban buses with special features built into them (diesel, electric and hydrogen). In addition, Rampini designs and manufactures highly technological vehicles for specific applications: chassis intended for special uses, OB vehicles, vehicles for satellite broadcasts, special equipments for the armed forces, levelling systems, and much more.



Rampini E12

CONTACT

Company website:
www.rampini.it/en/

Contact: Stefano Rampini
stefano@rampini.it

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	Rampini E12
Vehicle type	BEV
Length	12m
Total Passengers capacity	70
Gross vehicle weight	19,000kg
Top speed	70km/h
Airco	yes
Heating	yes
Fuel economy or range	120km/130km public urban service
European Market introduction	2016

ELECTRIC MOTOR

Suppliers	Siemens
Type	A/C
Power peak	150 - 160kW
Torque	980 - 2,180Nm

BATTERY

Suppliers	winston battery
Total energy	180kWh
Type	LFP
Warranty	2 years

CHARGING SYSTEM

Charging System	manual (plug) / pantograph
Charge Rate	15 - 30kW
Charge Time	3 - 6h

COMPANY PROFILE

The Safra commercial body shop specialises in the provision of equipment and the fitting out and heavy maintenance of urban passenger transport vehicles. Specialising in the renovation of standard and articulated buses, Safra has recently extended its expertise to the rail sector; trams, underground trains and rail carriages. Since 2010, Safra has also been a bus manufacturer, with an innovative programme, Businova, an urban transport vehicle that gives excellent results in terms of technical, economic and ecological performance.



Businova Midibus



Businova Standard

CONTACT

Company website:
www.safra.fr/en

Contact:
contact@businova.com

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	Businova Midibus	Businova Standard
Vehicle type	PHEV	PHEV
Length	10.5m	12m
Total Passengers capacity	70	100
Gross vehicle weight	19,000kg	20,000kg
Top speed	70km/h	70km/h
Airco	Reversible heat pump	Reversible heat pump
Heating	Reversible heat pump	Reversible heat pump
Fuel economy or range	120km fully electric and 200km with range extender on 2/3 SORT 1 and 1/3 SORT 2	120km fully electric and 200km with range extender on 2/3 SORT 1 and 1/3 SORT 2
European Market introduction	June 2017	June 2017

ELECTRIC MOTOR

Suppliers	TM4	TM4
Type	LSM200 - permanent magnet	LSM200 - permanent magnet
Power peak	200kW	200kW
Torque	2,105Nm	2,105Nm

BATTERY

Suppliers	EVE System	EVE System
Total energy	132kWh	132kWh
Type	Lithium iron phosphate	Lithium iron phosphate
Warranty	5 years	5 years

CHARGING SYSTEM

Charging System	On board	On board
Charge Rate	18-22kW	18-22kW
Charge Time	4-6h	4-6h

COMPANY PROFILE

Škoda Electric is a world-leading manufacturer of electric drives and traction motors for trolleybuses, tramways, locomotives, suburban train units, metro, mine cars, etc. The company continues a long-standing tradition of electrical engineering production at Škodové závody in Plzeň, which commenced in 1901. The high technical level of Škoda Electric products, our lengthy experience in manufacturing and the quality of our technology, along with the high productivity of our employees, offer effective conditions for successful production for both domestic and foreign markets. Škoda has been a traditional producer of complete trolleybuses since 1936, with more than 15,000 vehicles delivered to customers around the world. Škoda is now also focusing on the production of complete hybrid buses and electric buses including charging infrastructure.



SKODA PERUN HE



SKODA PERUN HP



SKODA 26TR



SKODA 27TR

CONTACT

Company website:
www.skoda.cz

Contact: Pavel Kuch
pavel.kuch1@skoda.cz

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	Skoda Perun HE	Skoda Perun HP	Skoda 26Tr	Skoda 27Tr
Vehicle type	BEV	BEV	Trolleybus	Trolleybus
Length	12m	12m	12m	18m
Total Passengers capacity	82	82	85	125
Gross vehicle weight	18,600kg	18,600kg	18,000kg	29,000kg
Top speed	70km/h	70km/h	70km/h	70km/h
Airco	Electric	Electric	Electric	Electric
Heating	Electric water boiler	Electric water boiler	Electric water boiler	Electric water boiler
Fuel economy or range	1.4kWh/km	1.4kWh/km	1.5kWh/km	2.4kWh/km
European Market introduction	2013	2014	2013	2014

ELECTRIC MOTOR

Suppliers	Skoda	Skoda	Skoda	Skoda
Type	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Power peak	160kW	160kW	160kW	250kW
Torque	1800Nm	1800Nm	1800Nm	2,500Nm

BATTERY

Suppliers	Various	Various	Various	Various
Total energy	230kWh	80kWh	50kWh	80kWh
Type	Lithium iron phosphate	Lithium titanate	Lithium titanate	Nickel manganese cobalt
Warranty	4 years	4 years	4 years	4 years

CHARGING SYSTEM

Charging System	Plug-in	Overhead automatic	Overhead trolley	Overhead trolley
Charge Rate	Up to 100kW	Up to 600kW	Up to 200kW	Up to 200kW
Charge Time	4-6h	Up to 10min	N/A	N/A

COMPANY PROFILE

Solaris Bus & Coach S.A. is a Europe-wide leading manufacturer of Solaris Urbino city buses, Solaris Trollino trolleybuses, InterUrbino intercity buses, special buses and Solaris Tramino trams. Since production commenced in 1996, the firm has manufactured over 14,000 vehicles supplied to over 600 cities in 30 countries all around the world. The company successfully launched low-floor buses onto the Polish market and quickly became the market leader in its sector, a position that it retains to this day. In 2011, Solaris introduced the electric version of the Urbino city bus, which has become one of the most successful products in the manufacturer's portfolio. The company employs 2,300 people in Poland and nearly 500 in overseas offices.



Solaris Urbino 8,9 LE electric



Solaris Urbino 12 electric



Solaris Urbino 18 electric
Source: Ylli Hajdaraj



Solaris Trollino 12



Solaris Trollino 18

CONTACT

Company website:
www.solarisbus.com

Contact: Anna Kordylas
anna.kordylas@solarisbus.com

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	Solaris Urbino 8,9 LE electric	Solaris Urbino 12 electric	Solaris Urbino 18 electric	Solaris Trollino 12	Solaris Trollino 18/18,75
Vehicle type	BEV	BEV	BEV	Trolley	Trolley
Length	8.95m	12m	18m	12m	18m/18.75m
Total Passengers capacity	Up to 65 depending on specifications	Up to 90	Up to 129	Up to 83	Up to 139
Gross vehicle weight	14,500-16,000kg	18,000-19,000kg	28,000-30,000kg	18,000- 19,000kg	28,000-30,000kg
Top speed	Up to 80km/h	Up to 80km/h	Up to 80km/h	Up to 70km/h	Up to 70km/h
Airco	AC with electric compressor (3 x 400V)	AC with electric compressor (3 x 400V)	AC with electric compressor (3 x 400V)	AC with electric compressor (3 x 400V)	AC with electric compressor (3 x 400V)
Heating	Electric boiler and/or diesel heater	Electric boiler and/or diesel heater	Electric boiler and/or diesel heater	Electric boiler	Electric boiler
Fuel economy or range	0.8kWh/km according to test procedure PB-23, based on SORT 2	0.9kWh/km according to test procedure PB-23, based on SORT 2	1.3kWh/km according to test procedure PB-23, based on SORT 2	Range on battery mode: up to 50% of the length of line	Range on battery mode: up to 50% of the length of line
European Market introduction	2011	2012	2013	2005	2005

Electric bus model name	Solaris Urbino 8.9 LE electric	Solaris Urbino 12 electric	Solaris Urbino 18 electric	Solaris Trollino 12	Solaris Trollino 18/18,75
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ELECTRIC MOTOR

Suppliers	TSA	TSA, ZF	TSA, ZF	Škoda/TSA/EMIT	Škoda/TSA/EMIT
Type	Asynchronous motor 160kW	Asynchronous motor 160kW, asynchronous 2 x 60kW nominal	Asynchronous motor 240kW	Asynchronous motor 160kW/ 160kW/ 175kW	Asynchronous motor 250kW/ 251kW/ 240kW
Power peak	170kW	2 x 125kW	270kW	280kW/215kW	280kW/ 296kW
Torque	903Nm (nominal)	2x11,000Nm (axle output torque max.)	1,304Nm	1,800Nm/ 2,266Nm (max.)	3,750Nm/ 4,200Nm (max.)

BATTERY

Suppliers	Solaris	Solaris	Solaris	Solaris, Škoda	Solaris, Škoda
Total energy	Up to 160kWh depending on technology	Up to 240kWh depending on technology	Up to 240kWh depending on technology	Up to 69kWh depending on technology	Up to 69kWh depending on technology
Type	Lithium iron phosphate/ Lithium titanate				
Warranty	Up to 5-10 years	Up to 5-10 years	Up to 5-10 years	Up to 10 years	Up to 10 years

CHARGING SYSTEM

Charging system	Plug-in/ pantograph	Plug-in/ pantograph/ induction	Plug-in/ pantograph/ induction	In-motion charging	In-motion charging
Charge rate	Plug-in, up to 80kW; pantograph, up to 300kW	Plug-in, up to 80kW; pantograph, up to 450kW; induction, 200kW	Plug-in, up to 80kW; pantograph, up to 450kW; induction, 200kW	50-60kW	50-60kW
Charge time	Plug-in, 1.33kWh/min; pantograph, 5kWh/min	Plug-in, 1.33kWh/min; pantograph, 7.5kWh/min; induction, 3.33kWh/min	Plug-in, 1.33kWh/min; pantograph, 7.5kWh/min; induction, 3.33kWh/min	Approx. 1kWh/min	Approx. 1kWh/min
Warranty	Up to 5-10 years	Up to 5-10 years	Up to 5-10 years	Up to 10 years	Up to 10 years

COMPANY PROFILE

SOR is a Czech bus producer. The company was founded in 1991. It produces all types of buses – city, intercity and coaches and manufactures buses for all types of engine – electric, diesel, CNG. Production of electric buses started in 2009. To date, SOR has manufactured 35 electric bus units, currently operating in the Czech Republic, Slovakia, Germany and Switzerland.



SOR EBN 11



SOR EBN 10,5

CONTACT

Company website:
www.sor.cz

Contact: Jirí Dansa
dansa@sor.cz

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	SOR EBN 11	SOR EBN 10,5
Vehicle type	BEV	BEV
Length	11.1m	10.37m
Total Passengers capacity	90	82
Gross vehicle weight	16,500kg	16,500kg
Top speed	80km/h	80km/h
Airco	Heating pump	Driver
Heating	Heating pump and electric heating	Independent diesel heating
Fuel economy or range	1.1kW/h (on average)	0.9-1kW/h (on average)
European Market introduction	September 2015	October 2014

ELECTRIC MOTOR

Suppliers	Pragoimex	Pragoimex
Type	Asynchronous	Asynchronous
Power peak	120kW	120kW
Torque	968Nm	968Nm

BATTERY

Suppliers	Winston Battery	Winston Battery
Total energy	172kW	172kW
Type	Lithium ion	Lithium ion
Warranty	Depending on contract	Depending on contract

CHARGING SYSTEM

Charging System	Overhead, manual	Manual
Charge Rate	100-150kW	22kW
Charge Time	1-2h (fully charged)	7h (fully charged)

COMPANY PROFILE

Temsa, one of Turkey's leading automotive companies, manufactures and distributes buses and coaches under its own brand in domestic and international markets. The company's manufacturing facility in Adana has a single-shift annual production capacity of 4,000 buses and coaches and 7,500 light trucks, totalling 11,500 vehicles per year. It offers a range of products that help customers navigate through changing environments and adapt their fleet to new passenger requirements and travel trends. Temsa vehicles, designed and manufactured with in-house expertise, are sold to the world's leading automotive markets as well as to the Turkish market, having expanded to 64 countries. Temsa's strategy is to develop products that respond to customers' changing needs, to introduce a modular approach to production and to deliver a well-designed line of buses of the highest quality. Although producing buses in the bus market it leads, Temsa retains its vision of becoming an innovative and entrepreneurial technology enterprise, producing smart transportation solutions and making a difference.

As a high-performance, successful venture, Temsa constantly pursues sustainable and profitable business growth and is proud of being an innovation-oriented organisation, focusing on creative ideas for high value products in order to always exceed customer expectation. The Temsa Innovation and Entrepreneurship programme sponsors and deploys projects to continuously enhance the safety, comfort, durability and operating performance of its products. Temsa's innovation efforts can be summarised in four dimensions: Safety, Environmental Awareness, Smart Mobility and Operational Excellence.



Temsa MD9 electriCITY



Temsa Avenue EV

CONTACT

Company website:
www.temsa.com

Contact:

Burak Onur
burak.onur@temsa.com

Mert Özkaynak
mert.ozkaynak@temsa.com

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	Temsa MD9 electriCITY	Temsa Avenue EV
Vehicle type	BEV	BEV
Length	9.3m	12m
Total Passengers capacity	65	90
Gross vehicle weight	14,000kg	19,000kg
Top speed	90km/h	90km/h
Airco	Electrical	Electrical
Heating	Electrical	Electrical
Fuel economy or range	1.1kwh/km - SORT 1	1.5kwh/km - SORT 1
European Market introduction	March 2017	March 2017

ELECTRIC MOTOR

Suppliers	TM4	TM4
Type	PEM	PEM
Power peak	200kW	270kW
Torque	2,200Nm	2,700Nm

Electric bus model name

Temsa MD9 electriCITY

Temsa Avenue EV

BATTERY

Suppliers	Mitsubishi	Microvast
Total energy	200kWh	75kWh
Type	Nickel manganese cobalt	Lithium titanate
Warranty	2 years	2 years

CHARGING SYSTEM

Charging System	Manual plug	Overhead/manual plug
Charge Rate	120kW	450kW
Charge Time	2.5h	7min



COMPANY PROFILE

Ursus Bus company was created one year ago as joint venture between Ursus S.A. and AMZ-Kutno S.A., drawing on the experiences of both companies in ebus production. Before joining forces, both organisations had acquired experience in manufacturing e buses. The purpose of joining forces was to create a company focused solely on e buses and to scale up production.



Ursus Bus Ekovolt



Ursus Bus City Smile 8,5m



Ursus Bus City Smile 10m



Ursus Bus City Smile 12m with ZIEHL-ABEGG



Ursus Bus City Smile 12m with TM4



Ursus Bus City Smile 18m

CONTACT

Company website:
www.ursusbus.com

Contact: Grzegorz Stawicki
grzegorz.stawicki@ursus.com

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	Ursus Bus Ekovolt	Ursus Bus City Smile					
Vehicle type	BEV	BEV	BEV	BEV	BEV	BEV	FCEB
Length	11.96m	8.5m	9.95m	12m	12m	18m	12m
Total Passengers capacity	81	61	84	82	62	104	76
Gross vehicle weight	18,000kg	16,000kg	18,000kg	18,000kg	18,000kg	28,000kg	18,000kg
Top speed	70km/h	70km/h	70km/h	70km/h	100km/h	100km/h	70km/h
Airco	Safkar DKE-26-KSO17	No	No	Safkar DKE-26-KSO17	Thermo King Athenia	Thermo King Athenia	Thermo King E700
Heating	Spheros Thermo 30kW	Spheros Thermo 30kW	Spheros Thermo 30kW	Strocco 35.02	Strocco 35.02	Strocco 35.02	Spheros Thermo 30kW
Fuel economy or range	0.97kWh/km SORT 2	Not tested	Not tested	0.8kWh/km SORT 2	Not tested	Not tested	Not tested
European Market introduction	March 2015	June 2014	July 2013	June 2016	October 2013	May 2015	September 2016

ELECTRIC MOTOR

Suppliers	TM4	TM4	TAM	TM4	Ziehl-Abegg	Ziehl-Abegg	Ziehl-Abegg
Type	LSM280AHV-3400-A1	LSM280AHV-3400-A1	1052C6B	LSM280AHV-3400-A1	SM 530.60AL-30	SM 530.60AL-30	SM 530.60AL-30
Power peak	170kW	170kW	120kW	170kW	226kW	452kW	226kW
Torque	1,100Nm	1,100Nm	835Nm	1,100Nm	5,400Nm	10,800Nm	5,400Nm

Electric bus model name	Ursus Bus Ekovolt	Ursus Bus City Smile					
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BATTERY

Suppliers	Impact	BMZ	EVC	Impact	Hybricon Bus Systems	Hybricon Bus Systems	BMZ
Total energy	120kWh	175kWh	210kWh	175kWh	105kWh	105kWh	70kWh
Type	Lithium iron phosphate	Nickel manganese cobalt	Lithium iron phosphate	Lithium iron phosphate	Lithium titanate	Lithium titanate	Nickel manganese cobalt
Warranty	5 years	6 years	5 years	5 years	15 years	15 years	6 years

CHARGING SYSTEM

Charging System	Manual	Manual	Manual	Manual	Overhead	Overhead	Fuel cell range extender
Charge Rate	150kW	30kW	240kW	30kW	625kW	625kW	60kW
Charge Time	1h	7h	1h	7h	10min	10min	Constant charging during driving

COMPANY PROFILE

Van Hool of Belgium manufactures approximately 1,400 buses and coaches and as many as 4,000 commercial vehicles annually, of which 80% are exported worldwide. With a workforce of over 4,000, Van Hool is a major European bus manufacturer, offering a complete range of buses for public transport for international markets, from a 9m midibus to a 25m double articulated low-floor bus. For over 65 years, Van Hool has developed a reputation for designing and building high-quality, state-of-the-art customised products.



Van Hool Exqui.City 18m
100% Battery



Van Hool A330T ZEV



Van Hool A308E

CONTACT

Company website:
www.vanhool.be

Contact: Dirk Snauwaert
dirk.snauwaert@vanhool.be

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	Van Hool Exqui.City 18m 100% Battery	Van Hool Exqui.City 18m Trolley	Van Hool Exqui.City 24m Trolley
Vehicle type	BEV	Trolley	Trolley
Length	18.610m	18.610m	23.820m
Total Passengers capacity	117	131	149
Gross vehicle weight	28,000kg	29,000kg	36,500kg
Top speed	70km/h	60km/h	65km/h
Airco	Heatpump Eberspächer-Sütrak Typ AC136HP	Eberspächer/Sütrak AC136AE	Eberspächer-Sütrak Typ AC136 AE CA
Heating	Integrated in air con system	Eberspächer/Sütrak AC136AE	Integrated in air con system
Fuel economy or range	Up to 120km at 10°C, half-load, 50% SORT 1 - 50% SORT 2	-	Load: 2/3 Frequency at 1.5km 350 days/year respectively 30 scheduled trips/day
European Market introduction	October 2016	2014	2017

ELECTRIC MOTOR

Suppliers	Siemens	Kiepe	Kiepe/TSA
Type	PEM 2016	Skoda, Asynchronous 3-phase	TMF 37-21-4
Power peak	2 x 160kW	120kW	2 x 160kW
Torque	1,500Nm	-	1,250Nm

Electric bus model name	Van Hool Exqui.City 18m 100% Battery	Van Hool Exqui.City 18m Trolley	Van Hool Exqui.City 24m Trolley
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BATTERY

Suppliers	BFFT	Kiepe	Kiepe
Total energy	215kWh	35kWh	20kWh
Type	Lithium ion	Lithium titanate	Lithium ion
Warranty	5 years	-	5 years

CHARGING SYSTEM

Charging System	Conductive in two ways: connector and inverted pantograph	Overhead catenary (trolleybus)	Overhead
Charge Rate	Connector, 80kW; pantograph, 250kW	-	Pantograph, 75kW
Charge Time	Connector, 4h; pantograph, 10min	-	-

VDL BUS & COACH



BUS & COACH

COMPANY PROFILE

The core activities of VDL Bus & Coach consist of the development, manufacturing, sales and after-sales of a wide range of buses, coaches and chassis modules, the conversion or extension of minibuses and midibuses, and the purchase and sales of second-hand buses. It consists of multiple bus companies that operate cooperatively in the global market. VDL Bus & Coach places a great emphasis on aspects such as quality, safety, durability, comfort, the environment, low fuel consumption and low maintenance costs. Manufacturing takes place in the Netherlands and Belgium. Sales of VDL Bus & Coach products are managed through a worldwide network consisting of corporate-owned sales offices, importers and agents in more than 30 countries.



VDL Citea LLE-99 Electric



VDL Citea SLF-120 Electric



VDL Citea SLFA-180 Electric

CONTACT

Company website:
www.vdlbuscoach.com

Contact: Michel Dekker
m.dekker@vdlbuscoach.com

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	VDL Citea LLE-99 Electric	VDL Citea SLF-120 Electric	VDL Citea SLFA-180 Electric
Vehicle type	BEV	BEV	BEV
Length	9.95m	12m	18m
Total Passengers capacity	60	92	145
Gross vehicle weight	14,440kg	19,500kg	29,000kg
Top speed	80km/h	80km/h	80km/h
Airco	Fully electric	Fully electric	Fully electric
Heating	Fully electric or (bio)diesel	Fully electric or (bio)diesel	Fully electric or (bio)diesel
Fuel economy or range	N/A	N/A	N/A
European Market introduction	August 2016	August 2014	August 2015

ELECTRIC MOTOR

Suppliers	Siemens	Siemens/Ziehl-Abegg	Siemens
Type	Central mounted, permanent magnet	Central mounted, permanent magnet/wheel hub, permanent magnet	Central mounted, permanent magnet
Power peak	153kW	153kW/2 x 182kW	210kW
Torque	2,500Nm	2,500Nm/2 x 6,000Nm	3,800Nm

BATTERY

Suppliers	Multiple	Multiple	Multiple
Total energy	180kWh	63kWh-240kWh	63kWh-180kWh
Type	Nickel manganese cobalt	LpTO, Nickel manganese cobalt	LpTO, Nickel manganese cobalt
Warranty	Depending on contract/operation	Depending on contract/operation	Depending on contract/operation

CHARGING SYSTEM

Charging System	Combo 2, pantograph	Combo 2, pantograph	Combo 2, pantograph
Charge Rate	Up to 270kW	Up to 350kW	Up to 270kW
Charge Time	40min-4.5h	15min-4.5h	15min- 4.5h

COMPANY PROFILE

Vectia is a brand that has emerged to offer global solutions for more sustainable urban transport. At Vectia, we are committed to new solutions for urban transport; configurable hybrid and electric buses that are competitive, reliable and safe. Our innovative range is designed for cities looking to the future and working towards a better quality of life for their inhabitants through modern and sustainable transport in harmony with the environment, minimising environmental impact and promoting a healthier life for all. This project is a forward-looking response to the mobility challenges faced by our towns and cities. Vectia seeks to become a reference company, committed to society and the environment through knowledge-intensive technological activity, providing significant added-value and excellent service.



VECTIA VERIS.12 Plug-In



VECTIA VERIS.12 Plug-In

CONTACT

Company website:
www.vectia.es/en/

Contact: Javier Ramos
javier.ramos@vectia.es

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	VECTIA VERIS.12 Plug-In
Vehicle type	PHEV
Length	12m
Total Passengers capacity	90
Gross vehicle weight	13,360kg
Top speed	80km/h
Airco	Reversible heat pump
Heating	Reversible heat pump
Fuel economy or range	TBD
European Market introduction	July 2017

ELECTRIC MOTOR

Suppliers	N/A
Type	PMSM
Power peak	210kW (180kW cont.)
Torque	1,500Nm

BATTERY

Suppliers	N/A
Total energy	24kWh
Type	Lithium titanate
Warranty	5 years

CHARGING SYSTEM

Charging System	Overhead
Charge Rate	150kW
Charge Time	3-5min



COMPANY PROFILE

Leading the way with sustainable transport solutions, Volvo Buses is one of the world's leading brands of buses and coaches, operating in more than 140 countries. We are driven by a passion to help create the cities of the future, free from congestion, emissions and noise. Our mission is to help operators and communities offer people safe, clean and efficient transportation to and from work, around the city or across the continent. We do so by striving to be the ultimate provider of sustainable transport solutions.



Volvo 7900 Electric



Volvo 7900 Electric Hybrid

CONTACT

Company website:
www.volvobuses.com

Contact: Magnus Broback
magnus.broback@volvo.com

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

Electric bus model name	Volvo 7900 Electric Hybrid	Volvo 7900 Electric
Vehicle type	PHEV	BEV
Length	12m	12m
Total Passengers capacity	71-98 depending on specifications	80-105 depending on specifications
Gross vehicle weight	12,100-12,900kg depending on specifications	11,400-12,000kg depending on specifications
Top speed	70km/h (software controlled)	80km/h (software controlled)
Airco	Spheros Revo E	Spheros Revo E
Heating	Auxiliary heater: fuel (diesel/HVO)	Auxiliary heater: fuel (diesel/HVO) and electric; heat pump
Fuel economy or range	LUB average (13,706kg): 10.24lit/100km + 0.53kWh/km Zero-emission operating range: 8.1km	LUB (13,182kg), 0.68/0.67kWh/km Braunschweig (15,040kg), 0.83/0.80kWh/km - SORT 2 (14,700kg), 0.79kWh/km
European Market introduction	June 2016	June 2017

ELECTRIC MOTOR

Suppliers	In motion	In motion
Type	Permanent magnet	Permanent magnet
Power peak	150kW	155kW
Torque	400Nm	1,200Nm

Electric bus model name	Volvo 7900 Electric Hybrid	Volvo 7900 Electric
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BATTERY

Suppliers	SAFT	SAFT
Total energy	19kWh	76kWh
Type	Lithium iron phosphate	Lithium iron phosphate
Warranty	Volvo offers a battery contract including performance monitoring over an agreed timeframe	Volvo offers a battery contract including performance monitoring over an agreed timeframe.

CHARGING SYSTEM

Charging System	Opportunity charging, overhead, conductive, pantograph on pole	Opportunity charging, overhead, conductive, pantograph on pole
Charge Rate	150kWh	300kW
Charge Time	3-6min	3-6min

ZeEUS AT A GLANCE

Within the ZeEUS project, 40 partners representing the whole eBus value chain and led by UITP are joining forces to extend the fully-electric solution to the core part of the urban bus network. ZeEUS demonstrates the feasibility of several electric solutions for high capacity buses in live operational scenarios across Europe. With around 60 series and pre-series vehicles taking part in the ZeEUS demonstrations, a meaningful evaluation of the real impact of the electric solution on the operations is being performed.

Aiming at facilitating the market uptake of electric buses, this analysis contributes to the development of tools to support decision makers on “if”, “how” and “when” to introduce electric buses in the core part of the bus network.

Together with the launch of local demonstrations, the performance of the vehicles has been carefully analysed. For the period of August 2015 – August 2016, the number of vehicles increased from 12 to 32 (21 BEV and 11 PHEV). The data from this period shows that the performance of the vehicle amounted to 597,161km, which spared 226,921l of diesel and 519 tons of CO2 emissions.

597,161 km

served in pure electric mode

226,921 litres

of diesel spared¹

519 tons

of CO2 emissions spared²

¹ assuming 38l/100km

² assuming ISO 16258 factor for Diesel and GaBi factor for EU electricity grid mix (2014)

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Management team:

Pauline Bruge (UITP), Umberto Guida (UITP), Marta Van den Bergh – Goralczyk (UITP)

Authors and contributors:

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CONTACT INFORMATION

Umberto Guida

ZeEUS Project Director
umberto.guida@uitp.org

Pauline Bruge

ZeEUS Project Manager
pauline.bruge@uitp.org

UITP

Rue Sainte-Marie 6
1080 Brussels

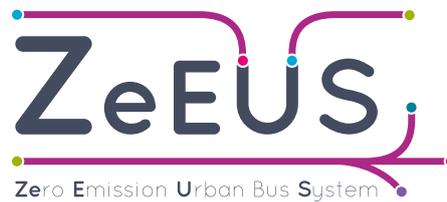
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www.zeeus.eu

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ZeEUS *in brief*

- Scope** Testing electrification solutions at the heart of the urban bus system network through live urban demonstrations and facilitating the market uptake of electric buses in Europe.
- Duration** Nov 2013 – April 2017 [42 Months]
- Budget** 22.5m EUR [13.5 EU Funding]
- Coordinator** UITP, the International Association of Public Transport



Partners



www.zeeus.eu



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