ZeEUS eBus Report
An overview of electric buses in Europe
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-Carbon 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
### CHAPTER 1: INTRODUCTION

ZeEUS CITIES MAP

### CHAPTER 2: CITY

<table>
<thead>
<tr>
<th>Country</th>
<th>City</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Graz</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Klagenfurt</td>
<td>16</td>
</tr>
<tr>
<td>Belgium</td>
<td>Bruges</td>
<td>17</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>Sofia</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Příbram</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Prague</td>
<td>20</td>
</tr>
<tr>
<td>Denmark</td>
<td>Copenhagen</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deutschland</td>
<td>Berlin</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Bad Langensalza</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Bonn</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Braunschweig</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Bremen</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>Cologne</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Eberswalde</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Hamburg</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Mannheim</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Münster</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>Oberhausen</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>Stuttgart Airport</td>
<td>33</td>
</tr>
<tr>
<td>Estonia</td>
<td>Tallinn</td>
<td>34</td>
</tr>
<tr>
<td>Finland</td>
<td>Turku</td>
<td>35</td>
</tr>
<tr>
<td>France</td>
<td>Gaillac</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>Marseille</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Nice Airport</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>Paris</td>
<td>39</td>
</tr>
<tr>
<td>Hungary</td>
<td>Budapest</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Szeged</td>
<td>41</td>
</tr>
<tr>
<td>Italy</td>
<td>Cagliari</td>
<td>42</td>
</tr>
<tr>
<td>Israel</td>
<td>Tel Aviv</td>
<td>43</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Rotterdam</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Schiedam</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Schiphol Airport</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>’s-Heerenberg</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>Utrecht</td>
<td>48</td>
</tr>
<tr>
<td>Poland</td>
<td>Inowroclaw</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>Jaworzno</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Krakow</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>Lodz</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>Lublin</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>Rzeszow</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>Warsaw</td>
<td>56</td>
</tr>
</tbody>
</table>

### CHAPTER 3: INDUSTRY

<table>
<thead>
<tr>
<th>Company</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALEXANDER DENNIS LIMITED</td>
<td>80</td>
</tr>
<tr>
<td>BLUEBUS</td>
<td>81</td>
</tr>
<tr>
<td>BOZANKAYA A.S.</td>
<td>82</td>
</tr>
<tr>
<td>BYD AUTO INDUSTRY COMPANY LIMITED</td>
<td>83</td>
</tr>
<tr>
<td>CAETANOBUS - FABRICO DE AUTOCARROS</td>
<td>85</td>
</tr>
<tr>
<td>E CARROCCARIANS, S. A.</td>
<td>86</td>
</tr>
<tr>
<td>CHARIOT MOTORS</td>
<td>87</td>
</tr>
<tr>
<td>EBUSCO B.V.</td>
<td>88</td>
</tr>
<tr>
<td>EVOPRO BUS KFT.</td>
<td>88</td>
</tr>
<tr>
<td>CARROSSERIE HESS AG</td>
<td>89</td>
</tr>
<tr>
<td>HEULIEZ BUS</td>
<td>90</td>
</tr>
<tr>
<td>HUNAN CRRC TIMES ELECTRIC VEHICLE CO., LTD</td>
<td>91</td>
</tr>
<tr>
<td>HYBRICON BUS SYSTEM AB</td>
<td>92</td>
</tr>
<tr>
<td>IRIZAR S. COOP</td>
<td>94</td>
</tr>
<tr>
<td>OPTARE</td>
<td>96</td>
</tr>
<tr>
<td>OTOKAR OTOMOTIV VE SAVUNMA SANAYI A. S.</td>
<td>98</td>
</tr>
<tr>
<td>RAMPINI CARLO SPA</td>
<td>99</td>
</tr>
<tr>
<td>SAFRA</td>
<td>100</td>
</tr>
<tr>
<td>ŠKODA ELECTRIC A.S.</td>
<td>101</td>
</tr>
<tr>
<td>SOLARIS</td>
<td>102</td>
</tr>
<tr>
<td>SOR LIBCHAY, SPOL. S.R.O.</td>
<td>104</td>
</tr>
<tr>
<td>TEMSA GLOBAL SANAYI VE TICARET A.S.</td>
<td>105</td>
</tr>
<tr>
<td>URSUS BUS S.A.</td>
<td>107</td>
</tr>
<tr>
<td>VAN HOOL</td>
<td>109</td>
</tr>
<tr>
<td>VDL BUS &amp; COACH</td>
<td>111</td>
</tr>
<tr>
<td>VECTIA MOBILITY S.L.</td>
<td>112</td>
</tr>
<tr>
<td>VOLVO BUS CORPORATION</td>
<td>113</td>
</tr>
</tbody>
</table>

ZeEUS AT A GLANCE

ACKNOWLEDGMENTS
CHAPTER 1: INTRODUCTION
What is an electric bus?

While the electric bus (or ‘ebus’) 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.

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), 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. 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’, 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. 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.etrac.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


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 University

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.

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.

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 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.

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.

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. 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.

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.

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.

---

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. In Belarus, the Minsktrans public transport operator has also confirmed an order for charging stations and ebuses, in accordance with their 2017 plan.

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.

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. 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.

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.

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. 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. The City of Cape Town, meanwhile, has awarded the tender announced in February 2016 for the procurement of battery-powered electric buses.
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.

In Latin America, development has also been quite modest. There are pilot projects ongoing in both Campinas (Brazil) and Montevideo (Uruguay). Itajai Transportes Colelivos, 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 statewide transit bus fleet by 2040.21

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.

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 (3); San Jose, CA (5); Stockton, CA (17); Reno, NV (4); Lakewood, WA (2); Seattle, WA (17); 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/rspprog/bus/bus.htm
In terms of scale, Europe follows Asia with over 1,300 electric buses delivered or on order. This figure includes battery buses (overnight and opportunity charged), plug-in hybrid buses and trolleybuses with batteries for off-wire operation.

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 France, Germany, Italy and the UK 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 Energy Support (MOVEA).

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. İzmir 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.
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 ebuses, 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.
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. 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 ebuses in an urban context.

The ZeEUS eBus Report is a collective effort, produced thanks to the authors and contributors listed in the acknowledgements.
CHAPTER 2: CITY
VEHICLE SPECIFICATIONS

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

LINE SPECIFICATIONS

<table>
<thead>
<tr>
<th></th>
<th>Route number</th>
<th>Type of line</th>
<th>Topography of the line</th>
<th>Length of the bus line</th>
<th>Average commercial speed</th>
<th>Total daily hours of operation</th>
<th>Total km driven/vehicle/day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50</td>
<td>City centre</td>
<td>Flat</td>
<td>3.5km</td>
<td>20km/h</td>
<td>15h</td>
<td>203km</td>
</tr>
<tr>
<td></td>
<td>34E</td>
<td></td>
<td></td>
<td>3.5km</td>
<td>20km/h</td>
<td>13h</td>
<td>188km</td>
</tr>
</tbody>
</table>

**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.

**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.
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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>1 x Solaris</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>Urbino 8.9 LE electric</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>8.9m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>51</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (4h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>120 kWh</td>
</tr>
</tbody>
</table>

LINE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>43</td>
</tr>
<tr>
<td>Type of line</td>
<td>City centre</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Flat</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>7.5km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>19km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>8h</td>
</tr>
<tr>
<td>Total daily hours operated</td>
<td>4-4.8h</td>
</tr>
<tr>
<td>in full electric</td>
<td></td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>110km</td>
</tr>
</tbody>
</table>

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.
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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>3 x Van Hool</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>A308 citybus</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>9.65m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>55</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Opportunity charging</td>
<td>Induction at the terminal (12min)</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (2.5h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>36.4kWh</td>
</tr>
</tbody>
</table>

LINE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>12</td>
</tr>
<tr>
<td>Type of line</td>
<td>City centre</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Flat</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>5.5km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>14km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>10h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>10h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>50-60km</td>
</tr>
</tbody>
</table>

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.”

**DESCRIPTION**

Sofia plans to promote ebuses in 2016-2017. A Higer Chariot ebus, 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 ebus 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**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>1 x Higer</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>Chariot e-bus</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>91</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Opportunity charging</td>
<td>Pantograph at the terminal (5-6min) and at the depot (5-6min)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>21kWh-32kWh</td>
</tr>
</tbody>
</table>

**LINE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>11</td>
</tr>
<tr>
<td>Type of line</td>
<td>City centre, suburban area</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Flat including a hilly section</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>11.2km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>16.3km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>8.5h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>8.5h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>88km</td>
</tr>
</tbody>
</table>

**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.
**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**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>2 x Škoda</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>PERUN HP</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>82</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Opportunity charging</td>
<td>Articulated arm at the terminal (7min)</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (5h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>75kWh</td>
</tr>
</tbody>
</table>

**LINE SPECIFICATIONS**

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

**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.
**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).

**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).
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 ebuses 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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>2 x BYD</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>K9 (Variant of BYD 12m Overseas)</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>61</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (5h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>324kWh</td>
</tr>
</tbody>
</table>

LINE SPECIFICATIONS

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

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.
“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 ebuses will contribute to a wider strategy regarding overall environmental decarbonisation and nitrogen oxides reduction.

**VEHICLE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>4 x Solaris</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>Urbino 12 electric</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>87</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Opportunity charging</td>
<td>Induction at terminal and selected bus stops (5min)</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (4h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>230kWh</td>
</tr>
</tbody>
</table>

**LINE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>204</td>
</tr>
<tr>
<td>Type of line</td>
<td>City centre</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Flat</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>6km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>12km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>22h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>22h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>168km</td>
</tr>
</tbody>
</table>

**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 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.
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

<table>
<thead>
<tr>
<th>Vehicle Brand</th>
<th>6 x Bozankaya Sileo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Model</td>
<td>S12</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>80</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (5.5h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>230kWh</td>
</tr>
</tbody>
</table>

LINE SPECIFICATIONS

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

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**

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

**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.
**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**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>1 x Bozankaya Sileo</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>S12</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>79</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (2h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>230 kWh</td>
</tr>
</tbody>
</table>

**LINE SPECIFICATIONS**

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

**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.
**DESCRIPTION**

As part of the ‘Kölner 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**

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

**LINE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>133</td>
</tr>
<tr>
<td>Type of line</td>
<td>City centre to suburban areas</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Flat</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>6.7-7.0km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>16-18km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>18h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>18h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>120km</td>
</tr>
</tbody>
</table>

**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.
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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>1 x Solaris</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>Trollino 18</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>18m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>146</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Opportunity charging</td>
<td>Articulated arm at the depot (22min) and overhead wires via connecting poles en route</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>120 kWh</td>
</tr>
</tbody>
</table>

LINE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>4</td>
</tr>
<tr>
<td>Type of line</td>
<td>Suburban area</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Moderate</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>18km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>24km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>18h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>18h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>250km</td>
</tr>
</tbody>
</table>

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.
**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**

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

**LINE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>109 Innovation-Line</td>
</tr>
<tr>
<td>Type of line</td>
<td>City centre</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Flat</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>13.4km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>18km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>20h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>20h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>40-250km</td>
</tr>
</tbody>
</table>

**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.
**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**

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

**LINE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>63</td>
</tr>
<tr>
<td>Type of line</td>
<td>City centre</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Moderate</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>4.5km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>13.4km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>15h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>15h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>190km</td>
</tr>
</tbody>
</table>

**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.
“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.”

**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**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>4 x VDL</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>Citea SLF-120 Electric</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>80</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Opportunity charging</td>
<td>Pantograph at the terminal (5min)</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (3h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>62.5kWh</td>
</tr>
</tbody>
</table>

**LINE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>14</td>
</tr>
<tr>
<td>Type of line</td>
<td>City centre</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Flat</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>10km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>15km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>14h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>14h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>200km</td>
</tr>
</tbody>
</table>

**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.
**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**

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

**LINE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>962</td>
</tr>
<tr>
<td>Type of line</td>
<td>City centre</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Flat</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>15.6km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>21km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>18.25h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>18.25h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>300km</td>
</tr>
</tbody>
</table>

**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.
**STUTTGART AIRPORT (DE)**

**STUTTGART 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.

**LINE SPECIFICATIONS**

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

**VEHICLE SPECIFICATIONS**

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

**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.
DESCRIPTION

After initial tests with hybrid buses and fully electric buses, Tallinna Linnavoimalastute AS purchased Volvo 7900 ebuses 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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>24 x Volvo</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>7900 Electric Hybrid</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12.1m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>84</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (6.5h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>1.2kWh</td>
</tr>
</tbody>
</table>

LINE SPECIFICATIONS

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

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, 5.6°C.
**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**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vehicle Brand</strong></td>
<td>6 x Linkker</td>
</tr>
<tr>
<td><strong>Vehicle Model</strong></td>
<td>13 LE-D</td>
</tr>
<tr>
<td><strong>Vehicle Length</strong></td>
<td>12.8m</td>
</tr>
<tr>
<td><strong>Total passenger capacity</strong></td>
<td>68</td>
</tr>
<tr>
<td><strong>Air Conditioning</strong></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Heating</strong></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Opportunity charging</strong></td>
<td>Pantograph at the terminal (3min)</td>
</tr>
<tr>
<td>** Overnight charging**</td>
<td>Plug at the depot (3h)</td>
</tr>
<tr>
<td><strong>Energy storage system power</strong></td>
<td>55kWh</td>
</tr>
</tbody>
</table>

**LINE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Route number</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Type of line</strong></td>
<td>City centre, suburban area</td>
</tr>
<tr>
<td><strong>Topography of the line</strong></td>
<td>Flat</td>
</tr>
<tr>
<td><strong>Length of the bus line</strong></td>
<td>12.6km</td>
</tr>
<tr>
<td><strong>Average commercial speed</strong></td>
<td>19km/h</td>
</tr>
<tr>
<td><strong>Total daily hours of operation</strong></td>
<td>18h</td>
</tr>
<tr>
<td><strong>Total daily hours operated in full electric</strong></td>
<td>18h</td>
</tr>
<tr>
<td><strong>Total km driven/vehicle/day</strong></td>
<td>350km</td>
</tr>
</tbody>
</table>

**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

“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.”

**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**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>1 x Safra</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>Businova Midibus</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>10.5m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>53</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (5–6h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>135kWh</td>
</tr>
</tbody>
</table>

**LINE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>D988</td>
</tr>
<tr>
<td>Type of line</td>
<td>City centre, suburban area</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Moderate</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>10km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>12km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>8.5h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>6h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>100km</td>
</tr>
</tbody>
</table>

**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)

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

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

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.
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

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

LINE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>Airport shuttle</td>
</tr>
<tr>
<td>Type of line</td>
<td>Airport shuttle</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Flat</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>3.9km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>18km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>9h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>9h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>200km</td>
</tr>
</tbody>
</table>

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.
**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**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>23 x Bolloré</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>Bluebus 12m</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>90</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>No</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (5h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>240kWh</td>
</tr>
</tbody>
</table>

**LINE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>341</td>
</tr>
<tr>
<td>Type of line</td>
<td>Mixed</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Moderate</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>10km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>10km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>14h</td>
</tr>
<tr>
<td>Total daily hours operated in</td>
<td></td>
</tr>
<tr>
<td>full electric</td>
<td>14h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>180km</td>
</tr>
</tbody>
</table>

**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.
“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.”

**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**

<table>
<thead>
<tr>
<th>Route number</th>
<th>Type of line</th>
<th>Topography of the line</th>
<th>Length of the bus line (one direction)</th>
<th>Average commercial speed</th>
<th>Total daily hours of operation</th>
<th>Total daily hours operated in full electric</th>
<th>Total km driven/vehicle/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>City centre</td>
<td>Flat</td>
<td>6.1km</td>
<td>13km/h</td>
<td>12.3h</td>
<td>12.3h</td>
<td>128km</td>
</tr>
<tr>
<td>16A</td>
<td>City centre</td>
<td>Hilly</td>
<td>1.5km</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>City centre</td>
<td>Hilly</td>
<td>3.4km</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>102</td>
<td>City centre</td>
<td>Hilly</td>
<td>3.9km</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>116</td>
<td>City centre</td>
<td>Hilly</td>
<td>1.6km</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>191</td>
<td>City centre</td>
<td>Hilly</td>
<td>3.4km</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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.

**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.
**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**

<table>
<thead>
<tr>
<th>Route number</th>
<th>77A (with a section without overhead wires)</th>
<th>10</th>
<th>19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of line</td>
<td>City centre – residential area</td>
<td>City centre and suburban area</td>
<td>City centre and suburban area</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Flat</td>
<td>Flat</td>
<td>Flat</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>13.2km</td>
<td>9.2km</td>
<td>15.8km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>18km/h</td>
<td>15km/h</td>
<td>17km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>18h</td>
<td>19h</td>
<td>18h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>16h</td>
<td>19h</td>
<td>18h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>237km</td>
<td>117km</td>
<td>176km</td>
</tr>
</tbody>
</table>

**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.
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

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

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.
\[\text{Vehicle: 1 x 12m BYD K9A (Variant of BYD 12m Overseas)}\]

\[\text{Charging: Slow-charging at the depot}\]

\[\text{Lines: 5, 61, 279}\]

\[\text{Total operation time/day: 14h}\]

\[\text{Duration: Aug 2013-Dec 2014}\]

\[\text{Nature of experience: Pilot}\]

\[\text{Funding: Self-funded, national}\]

---

\[\text{DESCRIPTION}\]

DAN’s policy is to operate an alternative energy public transport system in collaboration with the Ministry of Environment and local authorities. The electric bus operated mainly in crowded areas and was successfully integrated into the Tel Aviv metropolis. The electric bus 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.

---

\[\text{VEHICLE SPECIFICATIONS}\]

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>1 x BYD</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>K9A (Variant of BYD 12m Overseas)</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>58</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>No</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (5h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>324kWh</td>
</tr>
</tbody>
</table>

---

\[\text{LINE SPECIFICATIONS}\]

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>5, 61, 279</td>
</tr>
<tr>
<td>Type of line</td>
<td>Crowded urban area</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Flat</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>18km, 38km, 23km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>12km/h, 12km/h, 12km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>14h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>14h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>160km</td>
</tr>
</tbody>
</table>

---

\[\text{CLIMATE}\]

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.
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

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

LINE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>70</td>
</tr>
<tr>
<td>Type of line</td>
<td>Mixed metropolitan area</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Flat</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>12km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>16.25km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>19h</td>
</tr>
<tr>
<td>Total daily hours operated in</td>
<td>2.8h</td>
</tr>
<tr>
<td>full electric</td>
<td></td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>200km</td>
</tr>
</tbody>
</table>

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.”

**DESCRIPTION**

Schermonnikoog 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**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>6 x BYD</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>K9 (Variant of BYD 12m Overseas)</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>70</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (5h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>220kWh</td>
</tr>
</tbody>
</table>

**LINE SPECIFICATIONS**

Schermonnikoog 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.
**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

**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**

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

**LINE SPECIFICATIONS**

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

**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)

“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

DESCRIPTION

As a part of the ‘Zero emission city transport’ and ‘Climate neutral 2050’ programmes, this demonstration aims to test using a series of ebuses 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

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

LINE SPECIFICATIONS

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

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.
**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 60 kW, thus allowing an unlimited range. The charging system is equipped with a monitoring system and has an availability of > 99.5%.

---

**CLIMATE**

The climate is warm and temperate in Utrecht. There is a great deal of rainfall, with an annual average of 804 mm. 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.

---

**VEHICLE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>3 x Optare</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>Solo EV</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>10m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>55</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Opportunity charging</td>
<td>Induction at the terminal (3-5min)</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (2h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>86kWh</td>
</tr>
</tbody>
</table>

---

**LINE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>2</td>
</tr>
<tr>
<td>Type of line</td>
<td>City centre</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Flat</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>5km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>20 km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>18h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>18h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>140km</td>
</tr>
</tbody>
</table>
**DESCRIPTION**

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

**VEHICLE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>2 x Solaris</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>Urbino 12 electric</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>70</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Opportunity charging</td>
<td>Plug at the depot (2h)</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (5h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>201kWh</td>
</tr>
</tbody>
</table>

**LINE SPECIFICATIONS**

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

**CLIMATE**

In this area, the climate is temperate and cold. Inowroclaw is a city with significant rainfall, averaging 531mm annually. The average annual temperature is 7.9°C. The average temperature of 18.3°C makes July the warmest month of the year. January is the coldest month, with temperatures around -3.4°C.
### 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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>1 x Solaris</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>Urbino 12 electric</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>80</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Opportunity charging</td>
<td>Pantograph at selected bus stops (1h)</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (1.5h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>160kWh</td>
</tr>
</tbody>
</table>

### LINE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>313</td>
</tr>
<tr>
<td>Type of line</td>
<td>City centre, suburban area</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Moderate</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>16km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>30km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>18h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>18h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>250km</td>
</tr>
</tbody>
</table>

### 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 ebuses 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."

---

**DESCRIPTION**

Following a two-year test phase, MPK decided to purchase five ebuses 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**

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

**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.
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

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

### LINE SPECIFICATIONS

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

### 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.
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

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

LINE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Route number</th>
<th>152</th>
<th>159</th>
<th>160</th>
<th>161</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of line</td>
<td>Residential areas</td>
<td>City centre</td>
<td>City centre</td>
<td>Residential areas</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Flat</td>
<td>Moderate</td>
<td>Flat</td>
<td>Flat</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>11km</td>
<td>12km</td>
<td>15km</td>
<td>15km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>19km/h</td>
<td>19km/h</td>
<td>19km/h</td>
<td>21km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>16h</td>
<td>7h (Ursus E70110)</td>
<td>18h (Solaris Trollino 18 and Ursus T70116)</td>
<td>18h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>16h</td>
<td>7h</td>
<td>18h</td>
<td>18h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>188km (9.5km using batteries)</td>
<td>110km</td>
<td>223km (50km using batteries)</td>
<td>215km (35km using batteries)</td>
</tr>
</tbody>
</table>
**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.
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

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

LINE SPECIFICATIONS

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

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.
**DESCRIPTION**

MZA purchased 10 Solaris Urbino U12 ebuses 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 ebuses. 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**

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

**LINE SPECIFICATIONS**

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

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

LINE SPECIFICATIONS

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

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.
“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.”

**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 ebuses.

**VEHICLE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>5 x Higer</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>KLQ6125GEV3</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>81</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Opportunity charging</td>
<td>Pantograph at the terminal (5-10min), pantograph at the depot (30-40min)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>20kWh</td>
</tr>
</tbody>
</table>

**LINE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>1 EKO</td>
</tr>
<tr>
<td>Type of line</td>
<td>City centre</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Moderate</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>8km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>14.5km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>18h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>18h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>185km</td>
</tr>
</tbody>
</table>

**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.
DESCRIPTION

We introduced ebuses 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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>9 x SOR</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>EBN 10.5</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>10.5m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>80</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>No</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Opportunity charging</td>
<td>Plug at the terminal (3h)</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (3h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>120 kWh</td>
</tr>
</tbody>
</table>

LINE SPECIFICATIONS

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

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.
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

<table>
<thead>
<tr>
<th>Vehicle Brand</th>
<th>2 x Irizar</th>
<th>1 x BYD</th>
<th>2 x Solaris</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Model</td>
<td>i2e</td>
<td>K9</td>
<td>Urbino 18</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12m</td>
<td>12m</td>
<td>18m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>75</td>
<td>75</td>
<td>115</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Opportunity charging</td>
<td>No</td>
<td>No</td>
<td>Pantograph at the terminal (6-8min)</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (5-6h)</td>
<td>Plug at the depot (5-6h)</td>
<td>Plug at the depot (2.5h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>352kWh</td>
<td>324kWh</td>
<td>125kWh</td>
</tr>
</tbody>
</table>

LINE SPECIFICATIONS

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

**Vehicle:** 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)

**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.
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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>3 x Irizar</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>i2e</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>75</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (7h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>340kWh</td>
</tr>
</tbody>
</table>

LINE SPECIFICATIONS

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

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.
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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>13 x Castrosua</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>Tempus</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>11.3m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>64</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (4h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>72kWh</td>
</tr>
</tbody>
</table>

LINE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>41</td>
</tr>
<tr>
<td>Type of line</td>
<td>Metropolitan area</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Moderate</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>6km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>13km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>16h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>4.8h-6.4h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>210km</td>
</tr>
</tbody>
</table>

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.
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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>5 x Vectia</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>Veris.12 Hybrid+</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>85</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Opportunity charging</td>
<td>Pantograph at the terminal (3-5min)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>24kWh</td>
</tr>
</tbody>
</table>

LINE SPECIFICATIONS

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

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.
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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>1 x Optare</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>Solo EV</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>9.2m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>49</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Opportunity charging</td>
<td>Plug at the terminal (3h)</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (6h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>150kWh</td>
</tr>
</tbody>
</table>

LINE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>Älvan</td>
</tr>
<tr>
<td>Type of line</td>
<td>Suburban area</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Hilly</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>5km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>20km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>10h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>10h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>80km</td>
</tr>
</tbody>
</table>

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.
**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.

**LINE SPECIFICATIONS**

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

**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.

**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 |
**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**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>2 x BYD</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>Variant of BYD 12m Overseas</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>72</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (3h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>260-330kWh</td>
</tr>
</tbody>
</table>

**LINE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>Several different lines</td>
</tr>
<tr>
<td>Type of line</td>
<td>City centre</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Moderate</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>N/A</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>25km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>11h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>11h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>250km</td>
</tr>
</tbody>
</table>

**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.
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

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

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.
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 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**

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

**LINE SPECIFICATIONS**

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

**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.
**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**

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

**LINE SPECIFICATIONS**

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

**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.
**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.

**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.

---

**VEHICLE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Brand</td>
<td>1 x Solaris</td>
</tr>
<tr>
<td>Vehicle Model</td>
<td>Urbino 12 electric</td>
</tr>
<tr>
<td>Vehicle Length</td>
<td>12m</td>
</tr>
<tr>
<td>Total passenger capacity</td>
<td>65</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating</td>
<td>Yes</td>
</tr>
<tr>
<td>Opportunity charging</td>
<td>Plug at the terminal (1h)</td>
</tr>
<tr>
<td>Overnight charging</td>
<td>Plug at the depot (2h)</td>
</tr>
<tr>
<td>Energy storage system power</td>
<td>160kWh</td>
</tr>
</tbody>
</table>

**LINE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>4</td>
</tr>
<tr>
<td>Type of line</td>
<td>Urban area</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Flat</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>12.3km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>25km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>9h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>9h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>100km</td>
</tr>
</tbody>
</table>
**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

---

**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

---

**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.

---

**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**

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

---

**LINE SPECIFICATIONS**

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

---

**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**

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

---

**LINE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route number</td>
<td>7</td>
</tr>
<tr>
<td>Type of line</td>
<td>City centre</td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Moderate</td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>39km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>N/A</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>10-12h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>10-12h</td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>160km</td>
</tr>
</tbody>
</table>

---

**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.
**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**

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

**LINE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Route number</th>
<th>507/521</th>
<th>312</th>
<th>H98</th>
<th>98</th>
<th>69</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of line</td>
<td>City urban</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Topography of the line</td>
<td>Flat</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of the bus line</td>
<td>11km</td>
<td>9km</td>
<td>13km</td>
<td>11km</td>
<td>11km</td>
</tr>
<tr>
<td>Average commercial speed</td>
<td>12km/h</td>
<td>12km/h</td>
<td>12km/h</td>
<td>12km/h</td>
<td>12km/h</td>
</tr>
<tr>
<td>Total daily hours of operation</td>
<td>16h</td>
<td>16h</td>
<td>16h</td>
<td>16h</td>
<td>16h</td>
</tr>
<tr>
<td>Total daily hours operated in full electric</td>
<td>11.2h-12.8h</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total km driven/vehicle/day</td>
<td>150-250km</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
LONDON (UK)

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

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

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

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

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

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

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.
**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**

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

**LINE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Route MS1</th>
<th>Route MS2</th>
<th>Route MS3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Route number</strong></td>
<td>MS1</td>
<td>MS2</td>
<td>MS3</td>
</tr>
<tr>
<td><strong>Type of line</strong></td>
<td>City centre</td>
<td>City centre</td>
<td>City centre</td>
</tr>
<tr>
<td><strong>Topography of the line</strong></td>
<td>Flat</td>
<td>Flat</td>
<td>Flat</td>
</tr>
<tr>
<td><strong>Length of the bus line</strong></td>
<td>6km</td>
<td>6km</td>
<td>6km</td>
</tr>
<tr>
<td><strong>Average commercial speed</strong></td>
<td>18km/h</td>
<td>18km/h</td>
<td>18km/h</td>
</tr>
<tr>
<td><strong>Total daily hours of operation</strong></td>
<td>12h</td>
<td>12h</td>
<td>12h</td>
</tr>
<tr>
<td><strong>Total daily hours operated in full electric</strong></td>
<td>12h</td>
<td>12h</td>
<td>12h</td>
</tr>
<tr>
<td><strong>Total km driven/vehicle/day</strong></td>
<td>150km</td>
<td>150km</td>
<td>150km</td>
</tr>
</tbody>
</table>

**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 17.6°C, July is the hottest month of the year. January has the lowest average temperature of the year, at 4.3°C.
**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**

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

**LINE SPECIFICATIONS**

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

**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.

**CONTACT**

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

---

**ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION**

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

---

**ELECTRIC MOTOR**

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>BAE Systems</th>
<th>BYD</th>
<th>BYD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Central motor</td>
<td>Integrated in axle</td>
<td>Integrated in axle</td>
</tr>
<tr>
<td><strong>Power peak</strong></td>
<td>175kW</td>
<td>180kW</td>
<td>180kW</td>
</tr>
<tr>
<td><strong>Torque</strong></td>
<td>870Nm</td>
<td>700Nm</td>
<td>700Nm</td>
</tr>
</tbody>
</table>

---

**BATTERY**

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Akasol</th>
<th>BYD</th>
<th>BYD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total energy</strong></td>
<td>61kWh</td>
<td>324kWh</td>
<td>324kWh</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>Nickel manganese cobalt</td>
<td>Lithium iron phosphate</td>
<td>Lithium iron phosphate</td>
</tr>
<tr>
<td><strong>Warranty</strong></td>
<td>Depending on contract</td>
<td>Depending on contract</td>
<td>Depending on contract</td>
</tr>
</tbody>
</table>

---

**CHARGING SYSTEM**

<table>
<thead>
<tr>
<th><strong>Charging System</strong></th>
<th>Inductive</th>
<th>Manual</th>
<th>Manual</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Charge Rate</strong></td>
<td>100kW</td>
<td>80kW</td>
<td>80kW</td>
</tr>
<tr>
<td><strong>Charge Time</strong></td>
<td>5min</td>
<td>4h</td>
<td>4h</td>
</tr>
</tbody>
</table>
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.

**Electric bus model name**

<table>
<thead>
<tr>
<th></th>
<th>12m</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vehicle type</strong></td>
<td>BEV</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td>12m</td>
</tr>
<tr>
<td><strong>Total passengers capacity</strong></td>
<td>97</td>
</tr>
<tr>
<td><strong>Gross vehicle weight</strong></td>
<td>20,000kg</td>
</tr>
<tr>
<td><strong>Top speed</strong></td>
<td>70km/h</td>
</tr>
<tr>
<td><strong>Airco</strong></td>
<td>No</td>
</tr>
<tr>
<td><strong>Heating</strong></td>
<td>Webasto and electric</td>
</tr>
<tr>
<td><strong>Fuel economy or range</strong></td>
<td>180km measured on Line 21 RATP</td>
</tr>
<tr>
<td><strong>European Market introduction</strong></td>
<td>May 2016</td>
</tr>
</tbody>
</table>

**Electric Motor**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Suppliers</strong></td>
<td>Siemens</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>Permanent magnet</td>
</tr>
<tr>
<td><strong>Power peak</strong></td>
<td>160kW</td>
</tr>
<tr>
<td><strong>Torque</strong></td>
<td>2,500Nm</td>
</tr>
</tbody>
</table>

**Battery**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Suppliers</strong></td>
<td>BlueSolutions</td>
</tr>
<tr>
<td><strong>Total energy</strong></td>
<td>240kWh</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>Lithium metal polymer</td>
</tr>
<tr>
<td><strong>Warranty</strong></td>
<td>7 years</td>
</tr>
</tbody>
</table>

**Charging System**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Charging System</strong></td>
<td>Manual</td>
</tr>
<tr>
<td><strong>Charge Rate</strong></td>
<td>50kW</td>
</tr>
<tr>
<td><strong>Charge Time</strong></td>
<td>5h</td>
</tr>
</tbody>
</table>

Contact:

Company website: www.bluebus.fr
Contact: Yves Labesse
yves.labesse@blue-solutions.com
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.

**Contact**


Contact:
Emrah Dal
emrahdal@bozankaya.com
Frank Goldacker
goldacker@sileo-ebus.com

### ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

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

### ELECTRIC MOTOR

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>ZF/Siemens</th>
<th>ZF/Siemens</th>
<th>ZF/Siemens</th>
<th>ZF/Siemens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>AC asynchronous</td>
<td>AC asynchronous</td>
<td>AC asynchronous</td>
<td>AC asynchronous</td>
</tr>
<tr>
<td>Power peak</td>
<td>2 x 120 = 240kW</td>
<td>2 x 120 = 240kW</td>
<td>4 x 120 = 480kW</td>
<td>4 x 120 = 480kW</td>
</tr>
<tr>
<td>Torque</td>
<td>21,000Nm</td>
<td>21,000Nm</td>
<td>42,000Nm</td>
<td>42,000Nm</td>
</tr>
</tbody>
</table>

### BATTERY

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Bozankaya BC&amp;C</th>
<th>Bozankaya BC&amp;C</th>
<th>Bozankaya BC&amp;C</th>
<th>Bozankaya BC&amp;C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy</td>
<td>200kWh</td>
<td>200 or 230kWh</td>
<td>300kWh</td>
<td>380kWh</td>
</tr>
<tr>
<td>Type</td>
<td>Lithium iron phosphate</td>
<td>Lithium iron phosphate</td>
<td>Lithium iron phosphate</td>
<td>Lithium iron phosphate</td>
</tr>
<tr>
<td>Warranty</td>
<td>4 years</td>
<td>4 years</td>
<td>4 years</td>
<td>4 years</td>
</tr>
</tbody>
</table>

### CHARGING SYSTEM

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge Rate</td>
<td>4-100kW</td>
<td>4-100kW</td>
<td>4-200kW</td>
<td>Undefined</td>
</tr>
<tr>
<td>Charge Time</td>
<td>2-7h</td>
<td>2-8h</td>
<td>3-8h</td>
<td>Undefined</td>
</tr>
</tbody>
</table>
BYD AUTO INDUSTRY COMPANY LIMITED

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.

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

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

ELECTRIC MOTOR

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>BYD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Wheel-hub motor (PNSM)</td>
</tr>
<tr>
<td>Power peak</td>
<td>2x90kW</td>
</tr>
<tr>
<td>Torque</td>
<td>2x350Nm</td>
</tr>
<tr>
<td>Electric bus model name</td>
<td>BYD 12m China</td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Suppliers</td>
<td>BYD</td>
</tr>
<tr>
<td>Type</td>
<td>Iron-Phosphate battery</td>
</tr>
<tr>
<td>Warranty</td>
<td>5 years</td>
</tr>
</tbody>
</table>

### CHARGING SYSTEM

<table>
<thead>
<tr>
<th>Charging System</th>
<th>BYD 12m China</th>
<th>BYD 12m Overseas</th>
<th>BYD midi bus</th>
<th>BYD 10.8m Variants</th>
<th>BYD Double Decker</th>
<th>BYD 18m Articulated</th>
<th>BYD 12m coach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charging System</td>
<td>Plug-in</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charge Rate</td>
<td>2x40kW</td>
<td></td>
<td></td>
<td></td>
<td>Plug-in 2x40kW</td>
<td>2x40kW</td>
<td></td>
</tr>
<tr>
<td>Charge Time</td>
<td>4 - 4.5h</td>
<td>2h</td>
<td>4 - 4.5h</td>
<td>4.5h</td>
<td>Up to 3h</td>
<td>3h</td>
<td></td>
</tr>
</tbody>
</table>
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.

CONTACT

Company website: www.caetanobus.pt/pt
Contact: Rui Miguel Rodrigues Pinto
rui.pinto@salvadorcaetano.pt

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

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

Suppliers
- Siemens

Type
- Synchronous motor

Power peak
- 160kW

Torque
- 1,500Nm

Suppliers
- Actia

Total energy
- 50-250kWh

Type
- Lithium titanate or Nickel Manganese Cobalt Power

Warranty
- 5 years

CHARGING SYSTEM

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

**Electric Bus Specifications - General Information**

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

**Electric Motor**

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Siemens</th>
<th>Siemens</th>
<th>ZF Ave 130</th>
<th>Siemens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Asynchronous</td>
<td>Synchronous (permanent magnet)</td>
<td>Synchronous</td>
<td>Synchronous (permanent magnet)</td>
</tr>
<tr>
<td>Power peak</td>
<td>67 x 2kW</td>
<td>180kW</td>
<td>76 x 2kW</td>
<td>180kW</td>
</tr>
<tr>
<td>Torque</td>
<td>430 x 2Nm</td>
<td>2,500Nm</td>
<td>11,000 x 2Nm</td>
<td>2,500Nm</td>
</tr>
</tbody>
</table>

**Battery**

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Ultracapacitors by Aowei</th>
<th>Ultracapacitors by Aowei</th>
<th>Ultracapacitors by Aowei</th>
<th>Ultracapacitors by Aowei</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy</td>
<td>21kWh</td>
<td>21kWh</td>
<td>32kWh</td>
<td>32kWh</td>
</tr>
<tr>
<td>Type</td>
<td>Graphene ultracapacitors</td>
<td>Graphene ultracapacitors</td>
<td>Graphene ultracapacitors</td>
<td>Graphene ultracapacitors</td>
</tr>
<tr>
<td>Warranty</td>
<td>8 years’ full warranty</td>
<td>8 years’ full warranty</td>
<td>8 years’ full warranty</td>
<td>8 years’ full warranty</td>
</tr>
</tbody>
</table>

**Charging System**

<table>
<thead>
<tr>
<th>Charging System</th>
<th>Overhead fast-charging pantograph system</th>
<th>Overhead fast-charging pantograph system</th>
<th>Overhead fast-charging pantograph system</th>
<th>Overhead fast-charging pantograph system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge Rate</td>
<td>150kW</td>
<td>150kW</td>
<td>340kW</td>
<td>340kW</td>
</tr>
<tr>
<td>Charge Time</td>
<td>Charged up to 85% in 5min</td>
<td>Charged up to 85% in 5min</td>
<td>Charged up to 85% in 3min</td>
<td>Charged up to 85% in 3min</td>
</tr>
</tbody>
</table>
EBUSCO B.V.

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.

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

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

ELECTRIC MOTOR

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Ebusco</th>
<th>ZF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Asynchronous</td>
<td>Asynchronous</td>
</tr>
<tr>
<td>Power peak</td>
<td>220kW</td>
<td>2 x 125kW</td>
</tr>
<tr>
<td>Torque</td>
<td>3,000Nm</td>
<td>2 x 11,000Nm (including gear)</td>
</tr>
</tbody>
</table>

BATTERY

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Ebusco</th>
<th>Ebusco</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy</td>
<td>311kWh</td>
<td>414kWh</td>
</tr>
<tr>
<td>Type</td>
<td>Lithium iron phosphate</td>
<td>Lithium iron phosphate</td>
</tr>
</tbody>
</table>

CHARGING SYSTEM

<table>
<thead>
<tr>
<th>Charging System</th>
<th>Plug-in</th>
<th>Plug-in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge Rate</td>
<td>75kW/120kW</td>
<td>75kW/120kW</td>
</tr>
<tr>
<td>Charge Time</td>
<td>4.5/3h</td>
<td>6/4h</td>
</tr>
</tbody>
</table>

CONTACT

Company website: www.ebusco.eu
Contact: Patrick Heuts
patrick@ebusco.eu
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**

<table>
<thead>
<tr>
<th>Electric bus model name</th>
<th>Modulo C66e</th>
<th>Modulo C88e</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle type</td>
<td>BEV</td>
<td>BEV</td>
</tr>
<tr>
<td>Length</td>
<td>7.982m</td>
<td>9.457m</td>
</tr>
<tr>
<td>Total Passengers capacity</td>
<td>55 (8 person/m²)</td>
<td>74 (8 person/m²)</td>
</tr>
<tr>
<td>Gross vehicle weight</td>
<td>10,350kg</td>
<td>11,050kg</td>
</tr>
<tr>
<td>Top speed</td>
<td>65km/h</td>
<td>65km/h</td>
</tr>
<tr>
<td>Airco</td>
<td>Eberspächer Hydronic M12 (diesel heating, optional electric heating)</td>
<td>Eberspächer Hydronic M12 (diesel heating, optional electric heating)</td>
</tr>
<tr>
<td>Heating</td>
<td>Thermoking and optional Spheros</td>
<td>Thermoking and optional Spheros</td>
</tr>
<tr>
<td>Fuel economy or range</td>
<td>0.62kWh/km; Range (SORT 2 cycle): 200-230km</td>
<td>0.7kWh/km; Range (SORT 2 cycle): 120-140km</td>
</tr>
<tr>
<td>European Market introduction</td>
<td>May 2016</td>
<td>May 2016</td>
</tr>
</tbody>
</table>

**Electric Motor**

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Siemens</th>
<th>Siemens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>1DB2016 – 1NB06 synchron motor</td>
<td>1DB2016 – 1NB06 synchron motor</td>
</tr>
<tr>
<td>Power peak</td>
<td>Max. 160kW</td>
<td>Max. 160kW</td>
</tr>
<tr>
<td>Torque</td>
<td>1,019Nm</td>
<td>1,019Nm</td>
</tr>
</tbody>
</table>

**Battery**

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Valence</th>
<th>Valence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy</td>
<td>144kWh</td>
<td>84kWh</td>
</tr>
<tr>
<td>Type</td>
<td>Lithium iron phosphate</td>
<td>Lithium iron phosphate</td>
</tr>
<tr>
<td>Warranty</td>
<td>5 years</td>
<td>5 years</td>
</tr>
</tbody>
</table>

**Charging System**

<table>
<thead>
<tr>
<th>Charging System</th>
<th>Conductive</th>
<th>Conductive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge Rate</td>
<td>60kW</td>
<td>60kW</td>
</tr>
<tr>
<td>Charge Time</td>
<td>5h</td>
<td>5h</td>
</tr>
</tbody>
</table>
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.

**Electric Bus Specifications - General Information**

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

**Electric Motor**

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>ABB</th>
<th>TSA</th>
<th>TSA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>PEM</td>
<td>Asynchronous</td>
<td>Asynchronous</td>
</tr>
<tr>
<td><strong>Power peak</strong></td>
<td>240kW</td>
<td>240kW</td>
<td>320kW</td>
</tr>
<tr>
<td><strong>Torque</strong></td>
<td>1,520Nm</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Battery**

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>ABB</th>
<th>VKD</th>
<th>VKD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total energy</strong></td>
<td>70kWh</td>
<td>20kWh</td>
<td>32kWh</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>Lithium titanate</td>
<td>Lithium iron phosphate</td>
<td>Lithium iron phosphate</td>
</tr>
<tr>
<td><strong>Warranty</strong></td>
<td>&gt; 5 years</td>
<td>&gt; 2 years</td>
<td>&gt; 2 years</td>
</tr>
</tbody>
</table>

**Charging System**

<table>
<thead>
<tr>
<th>Charging System</th>
<th>Conductive pantograph</th>
<th>Overhead in-motion charging</th>
<th>Overhead in-motion charging</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Charge Rate</strong></td>
<td>600kW</td>
<td>&gt; 600kW</td>
<td>&gt; 600kW</td>
</tr>
<tr>
<td><strong>Charge Time</strong></td>
<td>Flash, 15s; terminus, 3min</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Contact**

Company website: www.hess-ag.ch
Contact: Hans-Jörg Gisler hans-joerg.gisler@hess-ag.ch
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.

### Electric Bus Specifications - General Information

<table>
<thead>
<tr>
<th>Electric bus model name</th>
<th>HEULIEZ BUS GX 337 ELEC</th>
<th>HEULIEZ BUS GX437 ELEC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vehicle type</strong></td>
<td>BEV</td>
<td>Electric Opportunity Charge</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td>12 m</td>
<td>18 m</td>
</tr>
<tr>
<td><strong>Total Passengers capacity</strong></td>
<td>94</td>
<td>155</td>
</tr>
<tr>
<td><strong>Gross vehicle weight</strong></td>
<td>20,000 kg</td>
<td>30,000 kg</td>
</tr>
<tr>
<td><strong>Top speed</strong></td>
<td>80 km/h</td>
<td>80 km/h</td>
</tr>
<tr>
<td><strong>Airco</strong></td>
<td>electric</td>
<td>electric</td>
</tr>
<tr>
<td><strong>Heating</strong></td>
<td>water circuit heater by boiler, electric or with diesel or biofuel</td>
<td>electric</td>
</tr>
<tr>
<td><strong>Fuel economy or range</strong></td>
<td>200 km in typical heavy-duty bus routes, such as in Paris/RATP</td>
<td>No limitation of range, thanks to opportunity charge</td>
</tr>
<tr>
<td><strong>European Market introduction</strong></td>
<td>June 2017</td>
<td>November 2017</td>
</tr>
</tbody>
</table>

### Electric Motor

- **Suppliers**: BAE Systems
- **Type**: Permanent Magnet
- **Power peak**: 120/190kW
- **Torque**: 1,610/3,300Nm

### Battery

- **Suppliers**: Foresee
- **Total energy**: 349kWh
- **Type**: NMC
- **Warranty**: depending on contract

### Charging System

- **Charging System**: manual plug Combo 2, CCS protocol
- **Charge Rate**: 50 to 100kW (overnight slow charge), 150kW (mid-day faster charge)
- **Charge Time**: 3 to 5 hours

---

**Company website:**
www.heuliezbus.com  
**Contact:**  
Jean-Marc Boucheret  
jeanmarc.boucheret@cnhind.com  
Rémy Foyer  
remy.foyer@heuliezbus.com
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.

**Electric Bus Specifications - General Information**

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

European Market introduction: Ready for European market

**Electric Motor**

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Hunan CRRC Times Electric Vehicle Co., Ltd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Permanent magnet synchronous motor</td>
</tr>
<tr>
<td>Power peak</td>
<td>150kW</td>
</tr>
<tr>
<td>Torque</td>
<td>2,500Nm</td>
</tr>
</tbody>
</table>

**Battery**

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Offenbach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy</td>
<td>20kWh</td>
</tr>
<tr>
<td>Type</td>
<td>Nickel manganese cobalt ternary batteries</td>
</tr>
<tr>
<td>Warranty</td>
<td>Battery Warranty (years or km) : TBD</td>
</tr>
</tbody>
</table>

**Charging System**

<table>
<thead>
<tr>
<th>Charging System</th>
<th>Manual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge Rate</td>
<td>99-137kw</td>
</tr>
<tr>
<td>Charge Time</td>
<td>2h (100kW charger)</td>
</tr>
</tbody>
</table>

**Contact**

Company website: www.tev.crcczic.cc
Contact: Yuan Xiaoxing (Cherry Yuan)
        yuanxx@csrzic.com; crrctev@csrzic.com

Hunan CRRC Times Electric Vehicle Co., Ltd

Company website: www.tev.crcczic.cc
Contact: Yuan Xiaoxing (Cherry Yuan)
yuanxx@csrzic.com; crrctev@csrzic.com
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.

### CONTACT

Company website:  
www.hybricon.se

Contact:  
info@hybricon.se

### ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

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

### ELECTRIC MOTOR

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Ziehl-Abegg</th>
<th>Ziehl-Abegg</th>
<th>Ziehl-Abegg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>SM530.60AL-30 direct drive</td>
<td>SM530.60AL-30 direct drive</td>
<td>SM530.60AL-30 direct drive</td>
</tr>
<tr>
<td>Power peak</td>
<td>4x157kW (628kW)</td>
<td>2 x 157kW (314kW)</td>
<td>2 x 157kW (314kW)</td>
</tr>
<tr>
<td>Torque</td>
<td>6,000Nm max per wheel, 2,100Nm nominal</td>
<td>6,000Nm max per wheel, 2,100Nm nominal</td>
<td>6,000Nm max per wheel, 2,100Nm nominal</td>
</tr>
</tbody>
</table>
### Electric bus model name

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

### Battery

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Altair-Nano</th>
<th>BMZ</th>
<th>BMZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy</td>
<td>40-120kWh</td>
<td>38-265kWh</td>
<td>38-265kWh</td>
</tr>
<tr>
<td>Type</td>
<td>Lithium titanate</td>
<td>Nickel manganese cobalt</td>
<td>Nickel manganese cobalt</td>
</tr>
<tr>
<td>Warranty</td>
<td>3 years, extendable to 10 years</td>
<td>2 years, extendable to 10 years</td>
<td>2 years, extendable to 10 years</td>
</tr>
</tbody>
</table>

### Charging System

<table>
<thead>
<tr>
<th>Charging System</th>
<th>Overhead/depot manual</th>
<th>Overhead/depot manual</th>
<th>Overhead/depot manual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge Rate</td>
<td>20-650kW</td>
<td>20-200kW</td>
<td>20-200kW</td>
</tr>
</tbody>
</table>

**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
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.

### Electric Bus Specifications - General Information

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

### Electric Motor

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Siemens</th>
<th>–</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Synchronous motor</td>
<td>Synchronous motor</td>
</tr>
<tr>
<td>Power peak</td>
<td>180 kW</td>
<td>230 kW</td>
</tr>
<tr>
<td>Torque</td>
<td>1,800Nm</td>
<td>2,350Nm</td>
</tr>
<tr>
<td>Electric bus model name</td>
<td>Irizar i2e</td>
<td>Irizar i2e 18m</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------</td>
<td>---------------</td>
</tr>
<tr>
<td><strong>BATTERY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suppliers</td>
<td>FIAMM</td>
<td>-</td>
</tr>
<tr>
<td>Total energy</td>
<td>376kWh</td>
<td>from 120-180kWh</td>
</tr>
<tr>
<td>Type</td>
<td>ZEBRA</td>
<td>Lithium ion</td>
</tr>
<tr>
<td>Warranty</td>
<td>2,000 cycles</td>
<td>-</td>
</tr>
<tr>
<td><strong>CHARGING SYSTEM</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 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.

---

**ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION**

<table>
<thead>
<tr>
<th>Electric bus model name</th>
<th>Optare Solo EV</th>
<th>Optare Metrocity EV</th>
<th>Optare Versa EV</th>
<th>Optare Metrodecker EV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle type</td>
<td>BEV</td>
<td>BEV</td>
<td>BEV</td>
<td>BEV</td>
</tr>
<tr>
<td>Length</td>
<td>9.2m and 9.9m</td>
<td>10.5m</td>
<td>10.4m and 11.1m</td>
<td>10.5m</td>
</tr>
<tr>
<td>Total Passengers capacity</td>
<td>55</td>
<td>58</td>
<td>58</td>
<td>96</td>
</tr>
<tr>
<td>Gross vehicle weight</td>
<td>11,300kg</td>
<td>12,960kg</td>
<td>12,480kg</td>
<td>TBC</td>
</tr>
<tr>
<td>Top speed</td>
<td>80km/h</td>
<td>80km/h</td>
<td>80km/h</td>
<td>80km/h</td>
</tr>
<tr>
<td>Airco</td>
<td>Not currently available</td>
<td>Not currently available</td>
<td>Not currently available</td>
<td>Chiller system</td>
</tr>
<tr>
<td>Heating</td>
<td>Diesel combustion heater/electric heating</td>
<td>Diesel combustion heater/electric heating</td>
<td>Diesel combustion heater/electric heating</td>
<td>Electric heating</td>
</tr>
<tr>
<td>Fuel economy or range</td>
<td>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)</td>
<td>0.67kWh/km based on the London City route, UK</td>
<td>0.67kWh/km based on in-service data from the park and ride service in York, UK</td>
<td>TBC</td>
</tr>
<tr>
<td>European Market introduction</td>
<td>August 2012</td>
<td>March 2014</td>
<td>October 2013</td>
<td>Imminent Launch</td>
</tr>
</tbody>
</table>

---

**ELECTRIC MOTOR**

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Magtec</th>
<th>Magtec</th>
<th>Magtec</th>
<th>Magtec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Power peak</td>
<td>150kW</td>
<td>150kW</td>
<td>150kW</td>
<td>200kW</td>
</tr>
<tr>
<td>Torque</td>
<td>2,000Nm</td>
<td>2,000Nm</td>
<td>2,000Nm</td>
<td>3,570Nm</td>
</tr>
<tr>
<td>Electric bus model name</td>
<td>Optare Solo EV</td>
<td>Optare Metrocity EV</td>
<td>Optare Versa EV</td>
<td>Optare Metrodecker EV</td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------------</td>
<td>--------------------</td>
<td>----------------</td>
<td>----------------------</td>
</tr>
<tr>
<td><strong>BATTERY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suppliers</td>
<td>Valence</td>
<td>Valence</td>
<td>Valence</td>
<td>TBC</td>
</tr>
<tr>
<td>Total energy</td>
<td>138 kWh</td>
<td>138 kWh</td>
<td>138 kWh</td>
<td>200 kWh</td>
</tr>
<tr>
<td>Type</td>
<td>Lithium iron magnesium phosphate</td>
<td>Lithium iron magnesium phosphate</td>
<td>Lithium iron magnesium phosphate</td>
<td>Lithium iron magnesium phosphate</td>
</tr>
<tr>
<td>Warranty</td>
<td>5 years</td>
<td>5 years</td>
<td>5 years</td>
<td>TBC</td>
</tr>
<tr>
<td><strong>CHARGING SYSTEM</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charging System</td>
<td>Plug-in</td>
<td>Plug-in</td>
<td>Plug-in</td>
<td>Plug-in</td>
</tr>
<tr>
<td>Charge Rate</td>
<td>42 kW</td>
<td>42 kW</td>
<td>42 kW</td>
<td>40 kW</td>
</tr>
<tr>
<td>Charge Time</td>
<td>2.5h</td>
<td>2.5h</td>
<td>2.5h</td>
<td>6h</td>
</tr>
</tbody>
</table>
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.

CONTACT

Company website:
www.otokar.com
Contact: Berkan Saglam
bsaglam@otokar.com

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

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

ELECTRIC MOTOR

| Suppliers                | -              |
|                        |                |
| Type                    | asynchronous   |
| Power peak              | 103kW          |
| Torque                  | 380Nm          |

BATTERY

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Valence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy</td>
<td>170kWh</td>
</tr>
<tr>
<td>Type</td>
<td>LFP</td>
</tr>
<tr>
<td>Warranty</td>
<td>-</td>
</tr>
</tbody>
</table>

CHARGING SYSTEM

<table>
<thead>
<tr>
<th>Charging System</th>
<th>manual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge Rate</td>
<td>32kW</td>
</tr>
<tr>
<td>Charge Time</td>
<td>8h</td>
</tr>
</tbody>
</table>
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: chassises intended for special uses, OB vehicles, vehicles for satellite broadcasts, special equipments for the armed forces, levelling systems, and much more.

**Electric Bus Specifications - General Information**

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

**Electric Motor**

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Siemens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>A/C</td>
</tr>
<tr>
<td>Power peak</td>
<td>150 - 160kW</td>
</tr>
<tr>
<td>Torque</td>
<td>980 - 2,180Nm</td>
</tr>
</tbody>
</table>

**Battery**

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>winston battery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy</td>
<td>180kWh</td>
</tr>
<tr>
<td>Type</td>
<td>LFP</td>
</tr>
<tr>
<td>Warranty</td>
<td>2 years</td>
</tr>
</tbody>
</table>

**Charging System**

<table>
<thead>
<tr>
<th>Charging System</th>
<th>manual (plug) / pantograph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge Rate</td>
<td>15 - 30kW</td>
</tr>
<tr>
<td>Charge Time</td>
<td>3 - 6h</td>
</tr>
</tbody>
</table>
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.

### Electric Bus Specifications - General Information

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

### Electric Motor

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>TM4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>LSM200 – permanent magnet</td>
</tr>
<tr>
<td>Power peak</td>
<td>200kW</td>
</tr>
<tr>
<td>Torque</td>
<td>2,105Nm</td>
</tr>
</tbody>
</table>

### Battery

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>EVE System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy</td>
<td>132kWh</td>
</tr>
<tr>
<td>Type</td>
<td>Lithium iron phosphate</td>
</tr>
<tr>
<td>Warranty</td>
<td>5 years</td>
</tr>
</tbody>
</table>

### Charging System

<table>
<thead>
<tr>
<th>Charging System</th>
<th>On board</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge Rate</td>
<td>18-22kW</td>
</tr>
<tr>
<td>Charge Time</td>
<td>4-6h</td>
</tr>
</tbody>
</table>
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 Plzen, 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.

### Electric Bus Specifications - General Information

<table>
<thead>
<tr>
<th>Electric bus model name</th>
<th>Skoda Perun HE</th>
<th>Skoda Perun HP</th>
<th>Skoda 26Tr</th>
<th>Skoda 27Tr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle type</td>
<td>BEV</td>
<td>BEV</td>
<td>Trolleybus</td>
<td>Trolleybus</td>
</tr>
<tr>
<td>Length</td>
<td>12m</td>
<td>12m</td>
<td>12m</td>
<td>18m</td>
</tr>
<tr>
<td>Total Passengers capacity</td>
<td>62</td>
<td>62</td>
<td>85</td>
<td>125</td>
</tr>
<tr>
<td>Gross vehicle weight</td>
<td>18,600kg</td>
<td>18,600kg</td>
<td>18,000kg</td>
<td>29,000kg</td>
</tr>
<tr>
<td>Top speed</td>
<td>70km/h</td>
<td>70km/h</td>
<td>70km/h</td>
<td>70km/h</td>
</tr>
<tr>
<td>Airco</td>
<td>Electric</td>
<td>Electric</td>
<td>Electric</td>
<td>Electric</td>
</tr>
<tr>
<td>Heating</td>
<td>Electric water boiler</td>
<td>Electric water boiler</td>
<td>Electric water boiler</td>
<td>Electric water boiler</td>
</tr>
<tr>
<td>Fuel economy or range</td>
<td>1.4kWh/km</td>
<td>1.4kWh/km</td>
<td>1.5kWh/km</td>
<td>2.4kWh/km</td>
</tr>
<tr>
<td>European Market introduction</td>
<td>2013</td>
<td>2014</td>
<td>2013</td>
<td>2014</td>
</tr>
</tbody>
</table>

### Electric Motor

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Skoda</th>
<th>Skoda</th>
<th>Skoda</th>
<th>Skoda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Asynchronous</td>
<td>Asynchronous</td>
<td>Asynchronous</td>
<td>Asynchronous</td>
</tr>
<tr>
<td>Power peak</td>
<td>160kW</td>
<td>160kW</td>
<td>160kW</td>
<td>250kW</td>
</tr>
<tr>
<td>Torque</td>
<td>1800Nm</td>
<td>1800Nm</td>
<td>1800Nm</td>
<td>2500Nm</td>
</tr>
</tbody>
</table>

### Battery

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Various</th>
<th>Various</th>
<th>Various</th>
<th>Various</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy</td>
<td>230kWh</td>
<td>80kWh</td>
<td>50kWh</td>
<td>80kWh</td>
</tr>
<tr>
<td>Type</td>
<td>Lithium iron phosphate</td>
<td>Lithium titanate</td>
<td>Lithium titanate</td>
<td>Nickel manganese cobalt</td>
</tr>
<tr>
<td>Warranty</td>
<td>4 years</td>
<td>4 years</td>
<td>4 years</td>
<td>4 years</td>
</tr>
</tbody>
</table>

### Charging System

<table>
<thead>
<tr>
<th>Charging System</th>
<th>Plug-in</th>
<th>Overhead automatic</th>
<th>Overhead trolley</th>
<th>Overhead trolley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge Rate</td>
<td>Up to 100kW</td>
<td>Up to 600kW</td>
<td>Up to 200kW</td>
<td>Up to 200kW</td>
</tr>
<tr>
<td>Charge Time</td>
<td>4-6h</td>
<td>Up to 10min</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
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.

Contact

Company website: www.solarisbus.com
Contact: Anna Kordylas
anna.kordylas@solarisbus.com

Electric Bus Specifications - General Information

<table>
<thead>
<tr>
<th>Electric bus model name</th>
<th>Solaris Urbino 8.9 LE electric</th>
<th>Solaris Urbino 12 electric</th>
<th>Solaris Urbino 18 electric</th>
<th>Solaris Trollino 12</th>
<th>Solaris Trollino 18/18,75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle type</td>
<td>BEV</td>
<td>BEV</td>
<td>BEV</td>
<td>Trolley</td>
<td>Trolley</td>
</tr>
<tr>
<td>Length</td>
<td>8.95m</td>
<td>12m</td>
<td>18m</td>
<td>12m</td>
<td>18m/18.75m</td>
</tr>
<tr>
<td>Total Passengers capacity</td>
<td>Up to 65 depending on specifications</td>
<td>Up to 90</td>
<td>Up to 129</td>
<td>Up to 83</td>
<td>Up to 139</td>
</tr>
<tr>
<td>Gross vehicle weight</td>
<td>14,500-16,000kg</td>
<td>18,000-19,000kg</td>
<td>28,000-30,000kg</td>
<td>18,000-19,000kg</td>
<td>28,000-30,000kg</td>
</tr>
<tr>
<td>Top speed</td>
<td>Up to 80km/h</td>
<td>Up to 80km/h</td>
<td>Up to 80km/h</td>
<td>Up to 70km/h</td>
<td>Up to 70km/h</td>
</tr>
<tr>
<td>Airco</td>
<td>AC with electric compressor (3 x 400V)</td>
<td>AC with electric compressor (3 x 400V)</td>
<td>AC with electric compressor (3 x 400V)</td>
<td>AC with electric compressor (3 x 400V)</td>
<td>AC with electric compressor (3 x 400V)</td>
</tr>
<tr>
<td>Heating</td>
<td>Electric boiler and/or diesel heater</td>
<td>Electric boiler and/or diesel heater</td>
<td>Electric boiler and/or diesel heater</td>
<td>Electric boiler</td>
<td>Electric boiler</td>
</tr>
<tr>
<td>Fuel economy or range</td>
<td>0.8kWh/km according to test procedure PB-23, based on SORT 2</td>
<td>0.9kWh/km according to test procedure PB-23, based on SORT 2</td>
<td>1.3kWh/km according to test procedure PB-23, based on SORT 2</td>
<td>Range on battery mode: up to 50% of the length of line</td>
<td>Range on battery mode: up to 50% of the length of line</td>
</tr>
</tbody>
</table>
### ELECTRIC MOTOR

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>TSA</th>
<th>TSA, ZF</th>
<th>TSA, ZF</th>
<th>Škoda/TSA/EMIT</th>
<th>Škoda/TSA/EMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Asynchronous motor 160kW</td>
<td>Asynchronous motor 160kW; asynchronous 2 x 60kW nominal</td>
<td>Asynchronous motor 240kW</td>
<td>Asynchronous motor 160kW/160kW/175kW</td>
<td>Asynchronous motor 250kW/25kW/240kW</td>
</tr>
<tr>
<td><strong>Power peak</strong></td>
<td>170kW</td>
<td>2 x 125kW</td>
<td>270kW</td>
<td>280kW/215kW</td>
<td>280kW/296kW</td>
</tr>
<tr>
<td><strong>Torque</strong></td>
<td>903Nm (nominal)</td>
<td>2x1,000Nm (axle output torque max.)</td>
<td>1,304Nm</td>
<td>1,800Nm/2,266Nm (max.)</td>
<td>3,750Nm/4,200Nm (max.)</td>
</tr>
</tbody>
</table>

### BATTERY

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Solaris</th>
<th>Solaris</th>
<th>Solaris</th>
<th>Solaris Škoda</th>
<th>Solaris Škoda</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total energy</strong></td>
<td>Up to 160kWh depending on technology</td>
<td>Up to 240kWh depending on technology</td>
<td>Up to 240kWh depending on technology</td>
<td>Up to 69kWh depending on technology</td>
<td>Up to 69kWh depending on technology</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>Lithium iron phosphate/Lithium titanate</td>
<td>Lithium iron phosphate/Lithium titanate</td>
<td>Lithium iron phosphate/Lithium titanate</td>
<td>Lithium iron phosphate/Lithium titanate</td>
<td>Lithium iron phosphate/Lithium titanate</td>
</tr>
<tr>
<td><strong>Warranty</strong></td>
<td>Up to 5-10 years</td>
<td>Up to 5-10 years</td>
<td>Up to 5-10 years</td>
<td>Up to 10 years</td>
<td>Up to 10 years</td>
</tr>
</tbody>
</table>

### CHARGING SYSTEM

<table>
<thead>
<tr>
<th>Charging system</th>
<th>Plug-in/pantograph</th>
<th>Plug-in/pantograph/pantograph</th>
<th>Plug-in/pantograph/pantograph/induction</th>
<th>In-motion charging</th>
<th>In-motion charging</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Charge rate</strong></td>
<td>Plug-in, up to 80kW; pantograph, up to 300kW</td>
<td>Plug-in, up to 80kW; pantograph, up to 450kW; induction, 200kW</td>
<td>Plug-in, up to 80kW; pantograph, up to 450kW; induction, 200kW</td>
<td>50-60kW</td>
<td>50-60kW</td>
</tr>
<tr>
<td><strong>Charge time</strong></td>
<td>Plug-in, 1,33kWh/min; pantograph, 5kWh/min</td>
<td>Plug-in, 1,33kWh/min; pantograph, 7,5kWh/min; induction, 3,33kWh/min</td>
<td>Plug-in, 1,33kWh/min; pantograph, 7,5kWh/min; induction, 3,33kWh/min</td>
<td>Approx. 1kWh/min</td>
<td>Approx. 1kWh/min</td>
</tr>
<tr>
<td><strong>Warranty</strong></td>
<td>Up to 5-10 years</td>
<td>Up to 5-10 years</td>
<td>Up to 5-10 years</td>
<td>Up to 10 years</td>
<td>Up to 10 years</td>
</tr>
</tbody>
</table>
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.

### Electric Bus Specifications - General Information

<table>
<thead>
<tr>
<th>Electric bus model name</th>
<th>SOR EBN 11</th>
<th>SOR EBN 10.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle type</td>
<td>BEV</td>
<td>BEV</td>
</tr>
<tr>
<td>Length</td>
<td>11.1m</td>
<td>10.37m</td>
</tr>
<tr>
<td>Total Passengers capacity</td>
<td>90</td>
<td>82</td>
</tr>
<tr>
<td>Gross vehicle weight</td>
<td>16,500kg</td>
<td>16,500kg</td>
</tr>
<tr>
<td>Top speed</td>
<td>80km/h</td>
<td>80km/h</td>
</tr>
<tr>
<td>Airco</td>
<td>Heating pump</td>
<td>Driver</td>
</tr>
<tr>
<td>Heating</td>
<td>Heating pump and electric heating</td>
<td>Independent diesel heating</td>
</tr>
<tr>
<td>Fuel economy or range</td>
<td>1.1kW/h (on average)</td>
<td>0.9-1kW/h (on average)</td>
</tr>
<tr>
<td>European Market introduction</td>
<td>September 2015</td>
<td>October 2014</td>
</tr>
</tbody>
</table>

### Electric Motor

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Pragoimex</th>
<th>Pragoimex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Asynchronous</td>
<td>Asynchronous</td>
</tr>
<tr>
<td>Power peak</td>
<td>120kW</td>
<td>120kW</td>
</tr>
<tr>
<td>Torque</td>
<td>968Nm</td>
<td>968Nm</td>
</tr>
</tbody>
</table>

### Battery

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Winston Battery</th>
<th>Winston Battery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy</td>
<td>172kW</td>
<td>172kW</td>
</tr>
<tr>
<td>Type</td>
<td>Lithium ion</td>
<td>Lithium ion</td>
</tr>
<tr>
<td>Warranty</td>
<td>Depending on contract</td>
<td>Depending on contract</td>
</tr>
</tbody>
</table>

### Charging System

<table>
<thead>
<tr>
<th>Charging System</th>
<th>Overhead, manual</th>
<th>Manual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge Rate</td>
<td>100-150kW</td>
<td>22kW</td>
</tr>
<tr>
<td>Charge Time</td>
<td>1-2h (fully charged)</td>
<td>7h (fully charged)</td>
</tr>
</tbody>
</table>
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.

CONTACT

Company website: www.temsa.com
Contact:
Burak Onur
burak.onur@temsa.com
Mert Özkan
mert.ozkan@temsa.com

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

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

ELECTRIC MOTOR

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>TM4</th>
<th>TM4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>PEM</td>
<td>PEM</td>
</tr>
<tr>
<td>Power peak</td>
<td>200kW</td>
<td>270kW</td>
</tr>
<tr>
<td>Torque</td>
<td>2,200Nm</td>
<td>2,700Nm</td>
</tr>
<tr>
<td>Electric bus model name</td>
<td>Temsa MD9 electricity</td>
<td>Temsa Avenue EV</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td><strong>BATTERY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suppliers</td>
<td>Mitsubishi</td>
<td>Microvast</td>
</tr>
<tr>
<td>Total energy</td>
<td>200kWh</td>
<td>75kWh</td>
</tr>
<tr>
<td>Type</td>
<td>Nickel manganese cobalt</td>
<td>Lithium titanate</td>
</tr>
<tr>
<td>Warranty</td>
<td>2 years</td>
<td>2 years</td>
</tr>
<tr>
<td><strong>CHARGING SYSTEM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charging System</td>
<td>Manual plug</td>
<td>Overhead/manual plug</td>
</tr>
<tr>
<td>Charge Rate</td>
<td>120kW</td>
<td>450kW</td>
</tr>
<tr>
<td>Charge Time</td>
<td>2.5h</td>
<td>7min</td>
</tr>
</tbody>
</table>
## Electric Bus Specifications - General Information

<table>
<thead>
<tr>
<th>Electric bus model name</th>
<th>Ursus Bus Ekovolt</th>
<th>Ursus Bus City Smile 8.5m</th>
<th>Ursus Bus City Smile 9.95m</th>
<th>Ursus Bus City Smile 12m</th>
<th>Ursus Bus City Smile 12m</th>
<th>Ursus Bus City Smile 18m</th>
<th>Ursus Bus City Smile 12m with ZIEHL-ABEGG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle type</td>
<td>BEV</td>
<td>BEV</td>
<td>BEV</td>
<td>BEV</td>
<td>BEV</td>
<td>BEV</td>
<td>FCEB</td>
</tr>
<tr>
<td>Length</td>
<td>11.96m</td>
<td>8.5m</td>
<td>9.95m</td>
<td>12m</td>
<td>12m</td>
<td>18m</td>
<td>12m</td>
</tr>
<tr>
<td>Total Passengers capacity</td>
<td>61</td>
<td>61</td>
<td>64</td>
<td>62</td>
<td>62</td>
<td>104</td>
<td>76</td>
</tr>
<tr>
<td>Gross vehicle weight</td>
<td>18,000kg</td>
<td>16,000kg</td>
<td>18,000kg</td>
<td>18,000kg</td>
<td>18,000kg</td>
<td>28,000kg</td>
<td>18,000kg</td>
</tr>
<tr>
<td>Top speed</td>
<td>70km/h</td>
<td>70km/h</td>
<td>70km/h</td>
<td>100km/h</td>
<td>100km/h</td>
<td>70km/h</td>
<td>70km/h</td>
</tr>
<tr>
<td>Heating</td>
<td>Saffar DKE-26-KSO17</td>
<td>No</td>
<td>Saffar DKE-26-KSO17</td>
<td>Thermo King Athena</td>
<td>Thermo King Athena</td>
<td>Thermo King E700</td>
<td>Thermo King E700</td>
</tr>
<tr>
<td>Fuel economy or range</td>
<td>0.97kWh/km SORT 2</td>
<td>Not tested</td>
<td>Not tested</td>
<td>0.8kWh/km SORT 2</td>
<td>Not tested</td>
<td>Not tested</td>
<td>Not tested</td>
</tr>
</tbody>
</table>

## Electric Motor

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>TM4</th>
<th>TM4</th>
<th>TAM</th>
<th>TM4</th>
<th>Ziehl-Abegg</th>
<th>Ziehl-Abegg</th>
<th>Ziehl-Abegg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>LSM280AHV-3400-AI</td>
<td>LSM280AHV-3400-AI</td>
<td>1052C6B</td>
<td>LSM280AHV-3400-AI</td>
<td>SM 530.60AL-30</td>
<td>SM 530.60AL-30</td>
<td>SM 530.60AL-30</td>
</tr>
<tr>
<td>Power peak</td>
<td>170kW</td>
<td>170kW</td>
<td>120kW</td>
<td>170kW</td>
<td>226kW</td>
<td>452kW</td>
<td>226kW</td>
</tr>
<tr>
<td>Torque</td>
<td>1,100Nm</td>
<td>1,100Nm</td>
<td>835Nm</td>
<td>1,100Nm</td>
<td>5,400Nm</td>
<td>10,800Nm</td>
<td>5,400Nm</td>
</tr>
<tr>
<td>Electric bus model name</td>
<td>Ursus Bus EkoVest</td>
<td>Ursus Bus City Smile</td>
<td>Ursus Bus City Smile</td>
<td>Ursus Bus City Smile</td>
<td>Ursus Bus City Smile</td>
<td>Ursus Bus City Smile</td>
<td>Ursus Bus City Smile</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------------</td>
<td>---------------------</td>
<td>---------------------</td>
<td>---------------------</td>
<td>---------------------</td>
<td>---------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>BATTERY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suppliers</td>
<td>Impact</td>
<td>BMZ</td>
<td>EVC</td>
<td>Impact</td>
<td>Hybricon Bus Systems</td>
<td>Hybricon Bus Systems</td>
<td>BMZ</td>
</tr>
<tr>
<td>Total energy</td>
<td>120kWh</td>
<td>175kWh</td>
<td>210kWh</td>
<td>175kWh</td>
<td>105kWh</td>
<td>105kWh</td>
<td>70kWh</td>
</tr>
<tr>
<td>Type</td>
<td>Lithium iron phosphate</td>
<td>Nickel manganese cobalt</td>
<td>Lithium iron phosphate</td>
<td>Lithium iron phosphate</td>
<td>Lithium titanate</td>
<td>Lithium titanate</td>
<td>Nickel manganese cobalt</td>
</tr>
<tr>
<td>Warranty</td>
<td>5 years</td>
<td>6 years</td>
<td>5 years</td>
<td>5 years</td>
<td>15 years</td>
<td>15 years</td>
<td>6 years</td>
</tr>
<tr>
<td>CHARGING SYSTEM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charge Rate</td>
<td>150kW</td>
<td>30kW</td>
<td>240kW</td>
<td>30kW</td>
<td>625kW</td>
<td>625kW</td>
<td>60kW</td>
</tr>
<tr>
<td>Charge Time</td>
<td>1h</td>
<td>7h</td>
<td>1h</td>
<td>7h</td>
<td>10min</td>
<td>10min</td>
<td>Constant charging during driving</td>
</tr>
</tbody>
</table>
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.

**COMPANY PROFILE**

**CONTACT**

Company website: [www.vanhool.be](http://www.vanhool.be)

Contact: Dirk Snauwaert
dirk.snauwaert@vanhool.be

**ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION**

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

**ELECTRIC MOTOR**

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Siemens</th>
<th>Kiepe</th>
<th>Kiepe/TSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>PEM 2016</td>
<td>Skoda, Asynchronous 3-phase</td>
<td>TMF 37-21-4</td>
</tr>
<tr>
<td>Power peak</td>
<td>2 x 160kW</td>
<td>120kW</td>
<td>2 x 160kW</td>
</tr>
<tr>
<td>Torque</td>
<td>1,500Nm</td>
<td>–</td>
<td>1,250Nm</td>
</tr>
</tbody>
</table>
### BATTERY

<table>
<thead>
<tr>
<th>Electric bus model name</th>
<th>Van Hool Exqui.City 18m 100% Battery</th>
<th>Van Hool Exqui.City 18m Trolley</th>
<th>Van Hool Exqui.City 24m Trolley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suppliers</td>
<td>BFFT</td>
<td>Kiepe</td>
<td>Kiepe</td>
</tr>
<tr>
<td>Total energy</td>
<td>215kWh</td>
<td>35kWh</td>
<td>20kWh</td>
</tr>
<tr>
<td>Type</td>
<td>Lithium ion</td>
<td>Lithium titanate</td>
<td>Lithium ion</td>
</tr>
<tr>
<td>Warranty</td>
<td>5 years</td>
<td>-</td>
<td>5 years</td>
</tr>
</tbody>
</table>

### CHARGING SYSTEM

<table>
<thead>
<tr>
<th>Charging System</th>
<th>Van Hool Exqui.City 18m 100% Battery</th>
<th>Van Hool Exqui.City 18m Trolley</th>
<th>Van Hool Exqui.City 24m Trolley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charging System</td>
<td>Conductive in two ways: connector and inverted pantograph</td>
<td>Overhead catenary (trolleybus)</td>
<td>Overhead</td>
</tr>
<tr>
<td>Charge Rate</td>
<td>Connector, 80kW; pantograph, 250kW</td>
<td>-</td>
<td>Pantograph, 75kW</td>
</tr>
<tr>
<td>Charge Time</td>
<td>Connector, 4h; pantograph, 10min</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
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.

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

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

SUPPLIERS

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Siemens</th>
<th>Siemens/Ziehl-Abegg</th>
<th>Siemens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Central mounted, permanent magnet</td>
<td>Central mounted, permanent magnet/ wheel hub, permanent magnet</td>
<td>Central mounted, permanent magnet</td>
</tr>
<tr>
<td>Power peak</td>
<td>153kW</td>
<td>153kW/2 x 162kW</td>
<td>210kW</td>
</tr>
<tr>
<td>Torque</td>
<td>2,500Nm</td>
<td>2,500Nm/2 x 6,000Nm</td>
<td>3,800Nm</td>
</tr>
</tbody>
</table>

BATTERY

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Multiple</th>
<th>Multiple</th>
<th>Multiple</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy</td>
<td>180kWh</td>
<td>63kWh-240kWh</td>
<td>63kWh-180kWh</td>
</tr>
<tr>
<td>Type</td>
<td>Nickel manganese cobalt</td>
<td>LpTO, Nickel manganese cobalt</td>
<td>LpTO, Nickel manganese cobalt</td>
</tr>
<tr>
<td>Warranty</td>
<td>Depending on contract/ operation</td>
<td>Depending on contract/ operation</td>
<td>Depending on contract/ operation</td>
</tr>
</tbody>
</table>

CHARGING SYSTEM

<table>
<thead>
<tr>
<th>Charging System</th>
<th>Combo 2, pantograph</th>
<th>Combo 2, pantograph</th>
<th>Combo 2, pantograph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge Rate</td>
<td>Up to 270kW</td>
<td>Up to 350kW</td>
<td>Up to 270kW</td>
</tr>
<tr>
<td>Charge Time</td>
<td>40min-4.5h</td>
<td>15min-4.5h</td>
<td>15min-4.5h</td>
</tr>
</tbody>
</table>
**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.

**CONTACT**

Company website: www.vectia.es/en/
Contact: Javier Ramos
javier.ramos@vectia.es

---

### ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

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

---

### ELECTRIC MOTOR

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>PMSM</td>
</tr>
<tr>
<td>Power peak</td>
<td>210kW (180kW cont.)</td>
</tr>
<tr>
<td>Torque</td>
<td>1,500Nm</td>
</tr>
</tbody>
</table>

---

### BATTERY

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy</td>
<td>24kWh</td>
</tr>
<tr>
<td>Type</td>
<td>Lithium titanate</td>
</tr>
<tr>
<td>Warranty</td>
<td>5 years</td>
</tr>
</tbody>
</table>

---

### CHARGING SYSTEM

<table>
<thead>
<tr>
<th>Charging System</th>
<th>Overhead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge Rate</td>
<td>150kW</td>
</tr>
<tr>
<td>Charge Time</td>
<td>3-5min</td>
</tr>
</tbody>
</table>
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.

**Electric Bus Specifications - General Information**

<table>
<thead>
<tr>
<th>Electric bus model name</th>
<th>Volvo 7900 Electric Hybrid</th>
<th>Volvo 7900 Electric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle type</td>
<td>PHEV</td>
<td>BEV</td>
</tr>
<tr>
<td>Length</td>
<td>12m</td>
<td>12m</td>
</tr>
<tr>
<td>Total passengers capacity</td>
<td>71-96 depending on specifications</td>
<td>80-105 depending on specifications</td>
</tr>
<tr>
<td>Gross vehicle weight</td>
<td>12,100-12,900kg depending on specifications</td>
<td>11,400-12,000kg depending on specifications</td>
</tr>
<tr>
<td>Top speed</td>
<td>70km/h (software controlled)</td>
<td>80km/h (software controlled)</td>
</tr>
<tr>
<td>Airco</td>
<td>Spheros Revo E</td>
<td>Spheros Revo E</td>
</tr>
<tr>
<td>Heating</td>
<td>Auxiliary heater: fuel (diesel/HVO)</td>
<td>Auxiliary heater: fuel (diesel/HVO) and electric; heat pump</td>
</tr>
<tr>
<td>Fuel economy or range</td>
<td>LUB average (13,706kg): 10.24lit/100km + 0.53kWh/km Zero-emission operating range: 8.1km</td>
<td>LUB (13,162kg), 0.68/0.67kWh/km Braunschweig (15,040kg), 0.83/0.80kWh/km - SORT 2 (14,700kg), 0.79kWh/km</td>
</tr>
<tr>
<td>European Market introduction</td>
<td>June 2016</td>
<td>June 2017</td>
</tr>
</tbody>
</table>

**Electric Motor**

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>In motion</th>
<th>In motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Permanent magnet</td>
<td>Permanent magnet</td>
</tr>
<tr>
<td>Power peak</td>
<td>150kW</td>
<td>155kW</td>
</tr>
<tr>
<td>Torque</td>
<td>400Nm</td>
<td>1,200Nm</td>
</tr>
</tbody>
</table>

**Contact**

Company website: [www.volvobuses.com](http://www.volvobuses.com)
Contact: Magnus Broback
magnus.broback@volvo.com
<table>
<thead>
<tr>
<th>Electric bus model name</th>
<th>Volvo 7900 Electric Hybrid</th>
<th>Volvo 7900 Electric</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BATTERY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suppliers</td>
<td>SAFT</td>
<td>SAFT</td>
</tr>
<tr>
<td>Total energy</td>
<td>19kWh</td>
<td>76kWh</td>
</tr>
<tr>
<td>Type</td>
<td>Lithium iron phosphate</td>
<td>Lithium iron phosphate</td>
</tr>
<tr>
<td>Warranty</td>
<td>Volvo offers a battery contract including performance monitoring over an agreed timeframe.</td>
<td>Volvo offers a battery contract including performance monitoring over an agreed timeframe.</td>
</tr>
<tr>
<td><strong>CHARGING SYSTEM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charging System</td>
<td>Opportunity charging, overhead, conductive, pantograph on pole</td>
<td>Opportunity charging, overhead, conductive, pantograph on pole</td>
</tr>
<tr>
<td>Charge Rate</td>
<td>150kWh</td>
<td>300kW</td>
</tr>
<tr>
<td>Charge Time</td>
<td>3-6min</td>
<td>3-6min</td>
</tr>
</tbody>
</table>
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 spared

519 tons
of CO2 emissions spared

1 assuming 381/100km
2 assuming ISO 16258 factor for Diesel and GaBi factor for EU electricity grid mix (2014)
ZeEUS eBus Report is a collective effort.

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

Authors and contributors:

Advisors:
Carlo Mol (Vito/EnergyVille), Stefan Baguette (Alexander Dennis), Arno Kerkhof (UITP)

English proofreading:
Brussels Writing Bureau

Layout:
Agencja Kreatywna „Buika z Masiem”, agencjabzm.pl

Printing:
Boarding Concept

Climate data:
en.climate-data.org, Wikipedia, weather-and-climate.com

ACKNOWLEDGEMENTS
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

ZeEUS
Zero Emission Urban Bus System

Partners

www.zeeus.eu

The ZeEUS project is coordinated by UITP. ZeEUS is co-funded by the European Commission under the 7th Research & Innovation Framework Programme, Mobility & Transport Directorate General under grant agreement n° 605485. The ZeEUS project has been launched by the European Commission in the frame of the European Green Vehicle and Smart Cities & Communities.