Customer Magazine

SOLARIS

A CAF GROUP COMPANY

www.solarisbus.com

1/2021 (26)

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„Cities of the future are cities for people”
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As an introduction

Dear Readers, dear Friends,

It was exactly 25 years ago in March that the factory in Bolechowo close to Poznań launched operations. Today Solaris stands for innovation and quality in all of Europe as well as beyond its borders. We have been a leader of e-mobility for several years now, whereas our products are recognised in 32 countries in over 750 cities. It looks much like this pace of achievements will pick up further.

All of that is owed to the wonderful team work and our staff whom I would like to say thanks to and congratulate, wishing them more successes yet, using this opportunity.

Unfortunately none of us was able to foresee that this magnificent anniversary would be celebrated by us in very peculiar, pandemic circumstances. In spite of many challenges we closed last year with record results. This would not have been possible without the commitment of our employees, nor without the trust of our clients or the support of our suppliers.

In Solaris we feel part of a greater, important whole. That is precisely why Solaris continuously does its work so that others may do theirs.

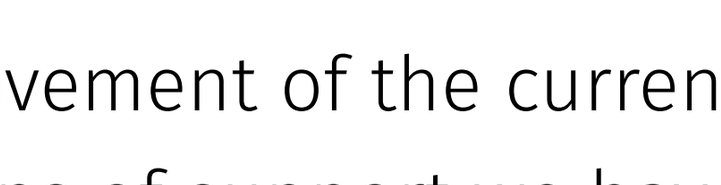
By the effort of our whole staff we have reorganised operations in such a manner as to protect the health of our employees first, while concurrently also maintain continuity of business and relations with clients and suppliers.

We want to continue following on the growth path in 2021 despite the pandemic. And even though many business events and fairs are still called off, I am full of hope that we are nearing the end of the current crisis, and that we will soon be able to once again enjoy the possibilities of face to face meetings. As it is, we try to use the opportunities provided to us by online technology to our best advantage. That is how we will showcase our new midi-range bus model this year and how we will hold a series of presentations, also known as #SolarisTalks, on sharing know-how about electromobility.

We warmly invite you to read this latest issue of our magazine in which we present our successes from last year and we lay out examples of the transition towards sustainable transport of the future - which we hope will become an inspiration for cities and operators.

I wish you persistence and faith in the improvement of the current situation. I cordially reciprocate all expressions of support we have received from various parties. Let us take care of ourselves and our next of kin, let us keep safety precautions.

Happy reading and best regards to all of you,



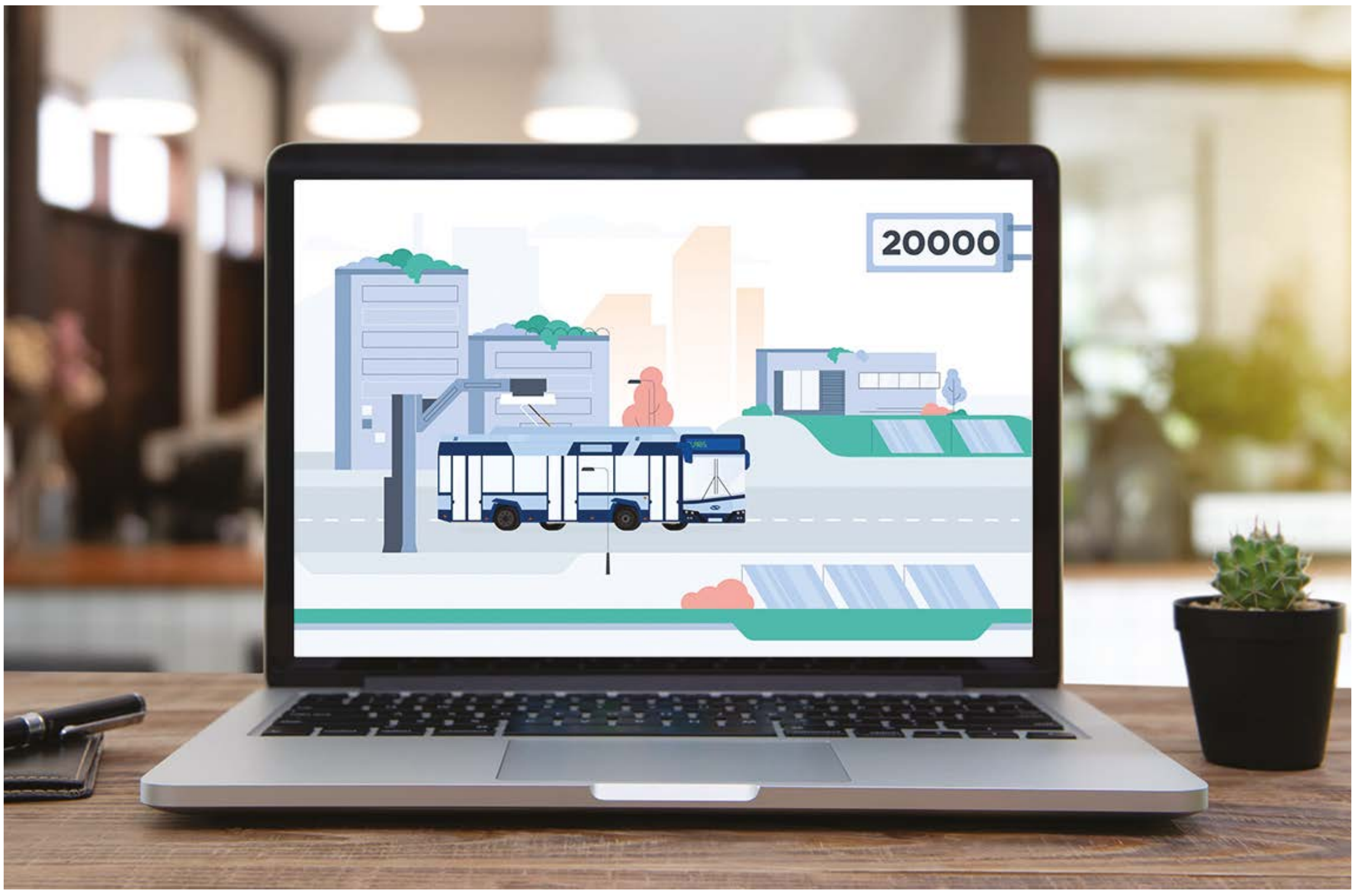
Javier Calleja
CEO of Solaris

We've hit **20,000 buses already!**

› The 20,000th bus has just rolled out of the Solaris factory gates. The jubilee vehicle is an articulated Urbino electric bus that has made its way to Warsaw operator MZA. And with it, deliveries have been completed for the large order placed by the capital of Poland for 130 electric buses.

Solaris has been manufacturing innovative and environmentally friendly buses since 1996. The producer had recognised the future prospects of electric drives long before the launch of its first electric bus by marketing its zero-emission trolleybuses and its first hybrid bus in 2006. Today, almost half of the Solaris buses produced each year are fitted with hybrid or purely electric drives. Hence, the jubilee electric Urbino bus is a symbol of the progress that has taken place in public transport as well as of a brand that, with each passing year, has been solidifying its position as an e-mobility leader in Europe.

Click & watch the jubilee animation created especially for this occasion [VIDEO]



Deliveries **to Barcelona**

› In March 2020, the municipal operator – Transports Metropolitans de Barcelona, TMB – placed an order for 14 Solaris Urbino 18 electric buses. The delivery of the vehicles, worth in total about €10m, have now been completed exactly a year later.

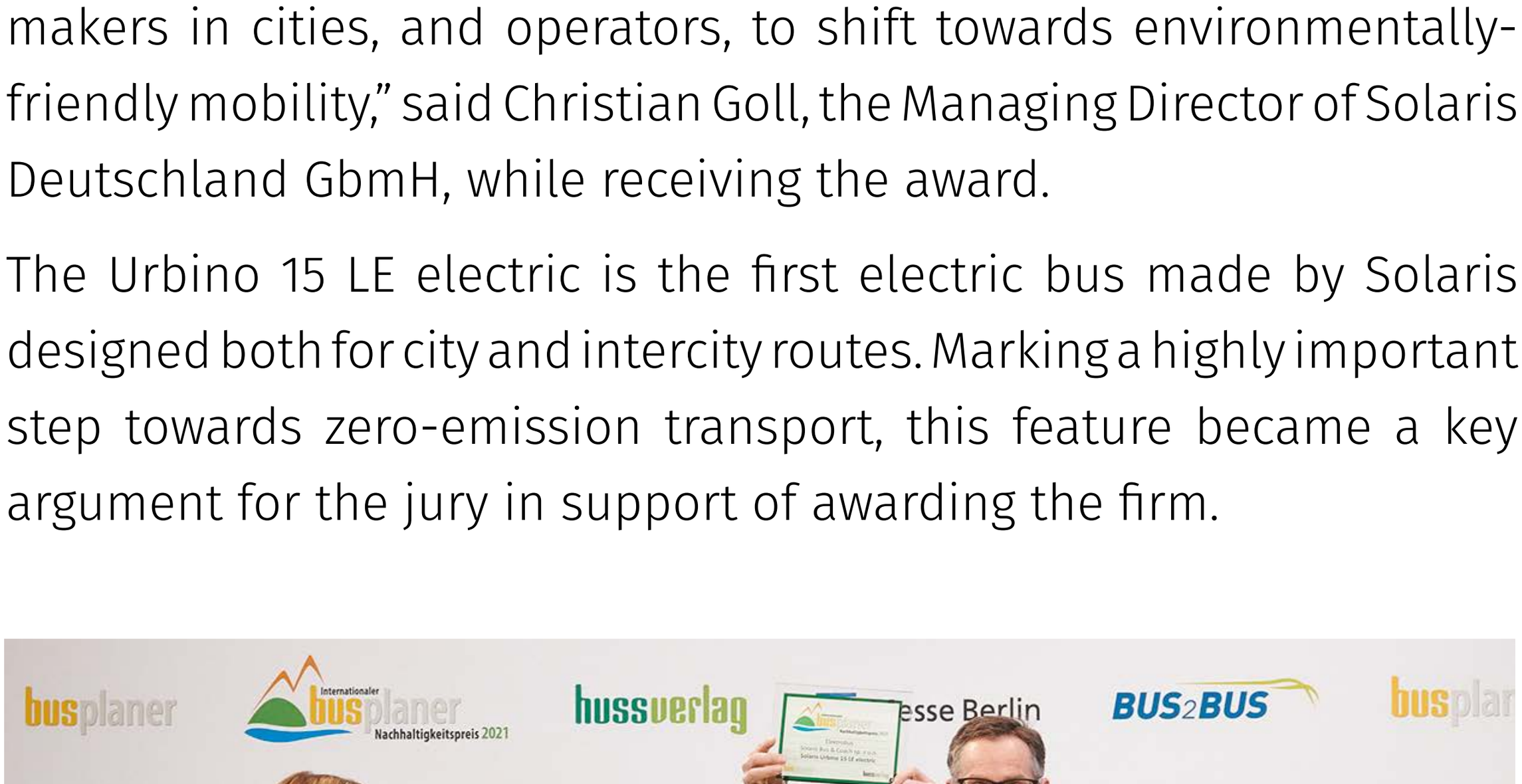
The fourteen 18-metre Urbino electric buses, delivered to Barcelona, have joined five articulated Solaris e-buses that have been carrying the residents of the capital of Catalonia since 2015. The vehicles are fitted with Solaris High Power batteries and they are recharged by means of a 500 kW pantograph. An interesting solution applied in the new buses is an extended Mobileye Shield+ system, i. e. a system with intelligent cameras monitoring the close surroundings of the vehicle. At the request of the carrier, the system will additionally be fitted with Geotab, a software which identifies potential road impediments, informs the client about them and archives recorded information. Moreover, this year Catalonia will see the delivery of thirty low-emission hybrid buses. Since 2014, Solaris has supplied Barcelona with nearly 100 vehicles with either hybrid or electric drives.

“busplaner” names Solaris Urbino 15 LE electric **best electric bus**

› The Urbino 15 LE electric has won the “Sustainability Award 2021”, handed out by German trade magazine “busplaner”. This is the first award for Solaris’s electric intercity bus model, which was launched at the end of last year.

“We are very happy that Solaris’s contribution to sustainable transport in Europe has been recognised. The expansion of emission-free technologies is crucial to reaching climate neutrality. Our latest electric bus model marks yet another step towards helping decision-makers in cities, and operators, to shift towards environmentally-friendly mobility,” said Christian Goll, the Managing Director of Solaris Deutschland GbmH, while receiving the award.

The Urbino 15 LE electric is the first electric bus made by Solaris designed both for city and intercity routes. Marking a highly important step towards zero-emission transport, this feature became a key argument for the jury in support of awarding the firm.



Best-of BUS2BUS Special Edition 2021 [VIDEO]

Big win:
123 e-buses for Romania

› Solaris is strengthening its position in the Romanian public transport market. In a tender run by the Romanian Ministry for Public Works, Development, and Administration, with seven local towns and cities benefitting, Solaris has been awarded a huge order for 123 of 131 e-buses. The total value of the contract stands at nearly €65m.

The tender for 131 modern, zero-emission e-buses was launched by seven Romanian towns and cities. Out of this pool, Solaris has been awarded an order for 123 12-metre vehicles destined for six locations: the towns and cities of Iași, Sibiu, Sighetu Marmației, Suceava, Târgu Mureș and Pitești. All orders are to be delivered by the end of 2022.

“We were very glad to hear the results of the tender announced by the Ministry for Public Works, Development, and Administration in Romania. Seeing more and more municipalities take such farsighted and eco-friendly decisions to extend their fleets via the addition of modern, zero-emission buses, is great news not only for us, but also for future generations”, said Petros Spinaris, member of the Management Board of Solaris Bus & Coach sp. z o.o. for Sales, Marketing and Customer Service.

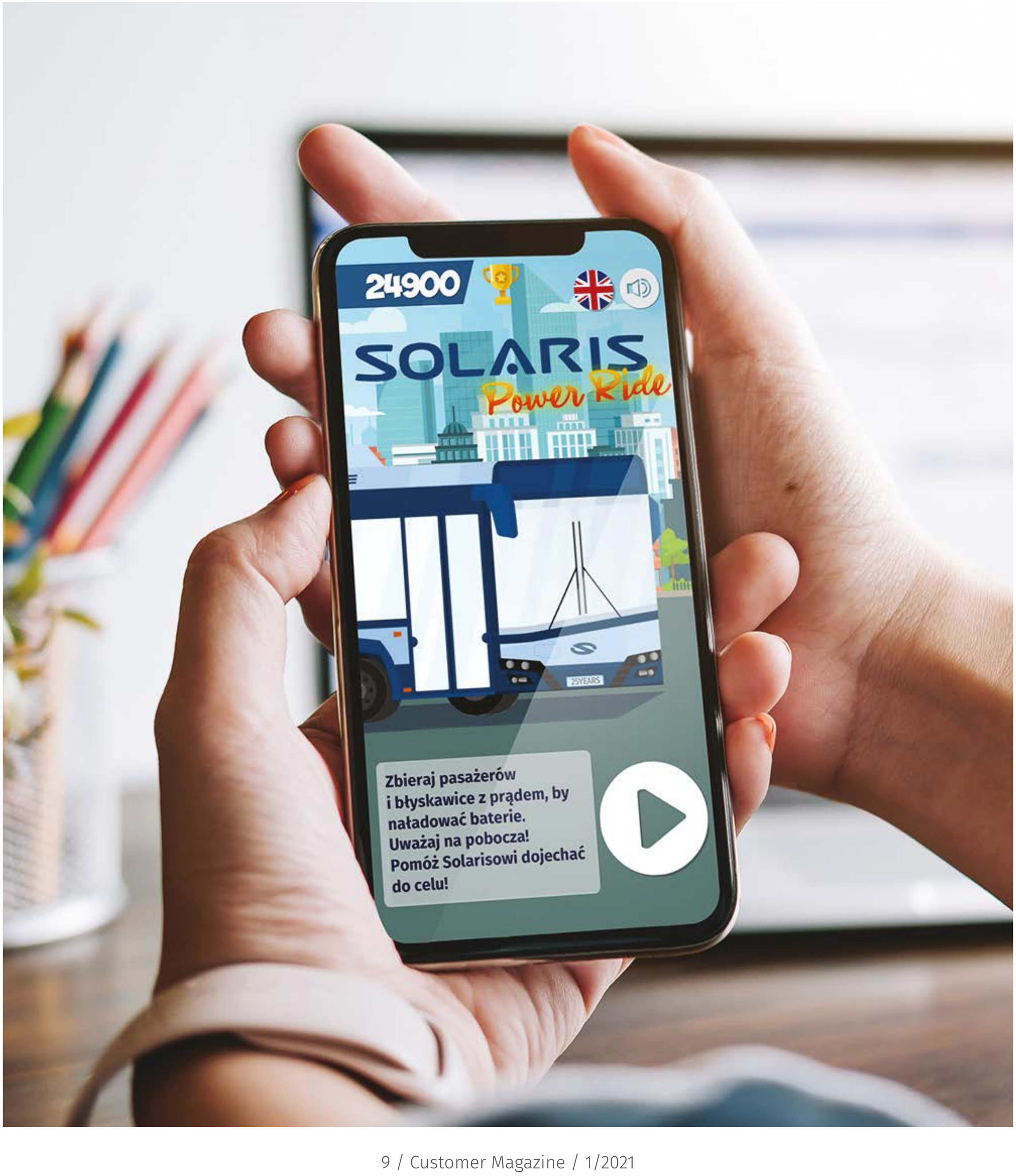
This tender, launched by Romania, has been one of the biggest for e-buses in Europe.

Playing games for a **worthy cause**

› To celebrate the 25 year anniversary of the company, a game was developed to allow employees raise money for a worthy cause while riding an electric bus made by Solaris.

The ‘Solaris Power Ride’ game was created not only to provide company staffers and their children with some unique entertainment, but also to enable them to join efforts to do some good. The points collected by employees were then converted into złoty which the company donated to charities. The employees managed to raise a total of PLN 25,000.

The “Solaris Power Ride” is already available to all fans of the brand – you are welcome to give it a go! [LINK]



First hydrogen Urbino arrives in Cologne

› In March 2020, in a tender launched by German operator Regionalverkehr Köln GmbH (RVK), Solaris was selected to supply 15 state-of-the-art Solaris Urbino 12 hydrogen buses. The first of the hydrogen vehicles has already been delivered and is being tested in the RVK branch in Wermelskirchen in the Rheinisch-Bergisches Kreis district. The remaining 14 units will make their way to Germany by the end of the year. This will be the début of the manufacturer's hydrogen model in the German market.

The hydrogen-powered buses have been purchased as part of an EU project called JIVE 2, with the support of "The Fuel Cells and Hydrogen Joint Undertaking", the Federal Ministry of Transport and Digital Infrastructure (BMVI), and thanks to the NIP2 programme (National Innovation Programme Hydrogen and Fuel Cell Technology) and the support of the Ministry of Transport of North Rhine-Westphalia.

The order placed by Cologne is not the first contract for buses fitted with this innovative solution. At around the same time, German operator WSW Mobil GmbH from Wuppertal placed an order for 10 vehicles of the same type. What is more, Solaris will deliver 12 hydrogen buses to Italian operator SASA Bolzano and 20 such units to Dutch operator Connexxion, providing transport services for the province of South Holland, by the end of 2021.

A second lease of life for batteries

› A consortium comprised of Solaris Bus & Coach Sp. z o.o., Impact Clean Power Technology S.A. and TAURON Polska Energia will implement a project titled “Second Life ESS”. Its aim is to create a prototype system to store electric energy based on retired bus batteries.

Batteries that, over time and as a result of their operation, have run down their capacity can still serve as an excellent form of electrical energy storage in stationary applications. This is the inspiration behind the idea for the second-life battery project, which Solaris will implement in cooperation with TAURON and Impact.

The aim of the project is to utilise lithium-ion cells whose parameters are no longer optimal when it comes to supplying power to vehicles in energy storage systems. Thus, the life cycle of batteries that are not disposed of, but reused, is prolonged. Storage systems made of such cells will constitute an important part of the intelligent grid infrastructure, and they also will contribute to grid stability, with a steadily increasing share of renewable energy sources.

As part of the project Solaris will provide batteries with a nominal capacity of 160 kWh that previously had been used in an electric bus operated by public carrier PKM Jaworzno. The project is being co-financed by the National Centre for Research and Development [NCBiR] and the work, aimed at developing an energy storage prototype system, is due to be completed in 2022.

First tests of Solaris Urbino 15 LE electric in Norway

› An intercity electric Urbino bus model was demonstrated to, among other carriers, ones from the cities of Oslo and Kristiansand. A particularly invaluable part of the trials was testing the buses while operating on lines with the participation of drivers and passengers. Solaris was thus able to gather direct feedback from target groups that were actual bus users.

It is not without reason that Norway has been selected as a test site. The first two Urbino 15 LE electric units were made mainly with Scandinavian operators in mind. The bus features special solutions compliant with "Busnordic" norms and the so-called Scandinavian package. With the tough climate conditions in mind, the designers have made sure that both thermal, and travel, comfort are ensured during operation. Vehicles of this type may boast other features that facilitate their operation in difficult conditions - for instance extra high beams, a sanding system, or a compartment for snow chains.

Solaris in 2020

Click & watch Solaris Press Conference summarizing company's achievements in 2020 [VIDEO]

Ranked first

in Europe when it comes to the number of delivered electric buses

PLN 3.2 billion

18,5%

company's revenues in 2020, which means a growth of 18.5%

22,2 km

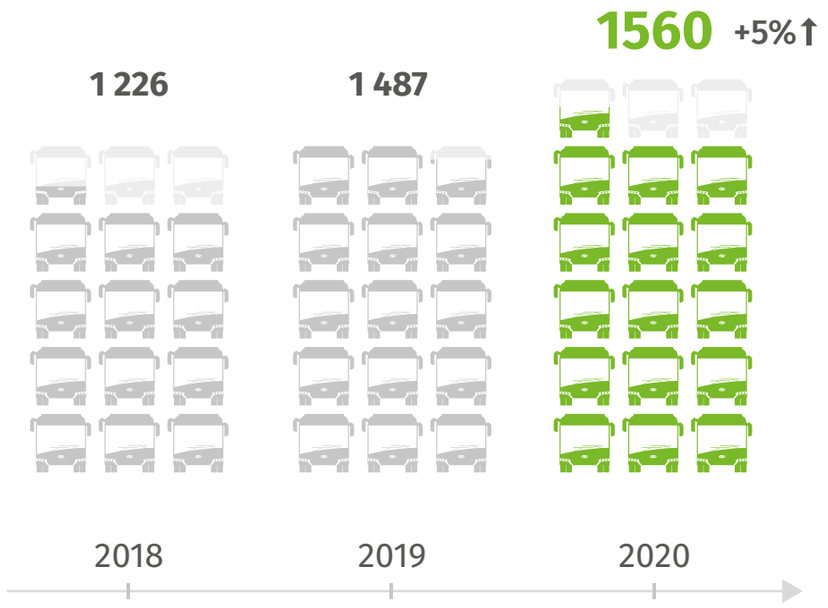
this is the total length of all the vehicles produced by Solaris in 2020, laid end to end, and they could carry

176,100 passengers

in total

1. SALES:

- **Tecord sales of vehicles in 2020 – 1560 units!**
- Compared to 2019, this represents a rise of nearly 5%
- The largest markets in 2020 were **Poland, Germany, Italy, Estonia, Czech Republic, Israel, Spain**



POLAND

18th year in a row

Solaris was ranked first in the segment of low-floor city buses in Poland, claiming a market share of **53%**

The lion's share of Solaris buses sold in Poland in 2020 were electric buses (194 out of 365 units sold in total) – **52%!**

90%

Urbino electric buses make up 90% of all e-buses in the country supplying

27 towns and cities

GERMANY

Record sales were seen in the Gtan market. The company supplied a total

329 vehicles

of which nearly **40%** were electric buses

Biggest tenders:

- **50 articulated Urbino electric buses** for Cracow operator MPK
- **37 electric buses** for Poznań operator MPK
- **16 zero-emission buses** for the Romanian city of Craiova
- Solaris has been shortlisted for the supply of **up to 530 electric buses** for German operator Hamburger Hochbahn. The carrier from Hamburg placed its first order for **10 electric buses** only in 2020.

Moreover, for 2021 the company landed orders, for the delivery of electric buses, from clients in France, Spain, the Netherlands, Latvia, Italy and Switzerland.

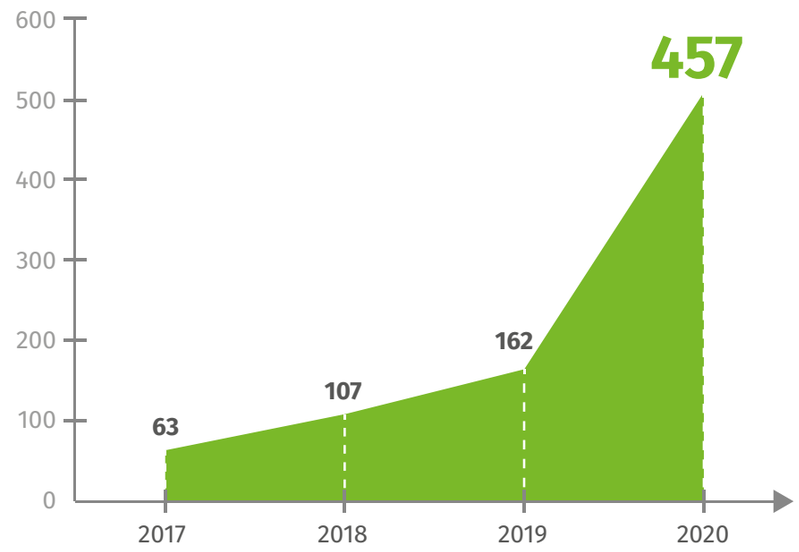
2. E-MOBILITY

In 2020, Solaris was the **largest manufacturer of city e-buses in Europe,** claiming a market share of

20%

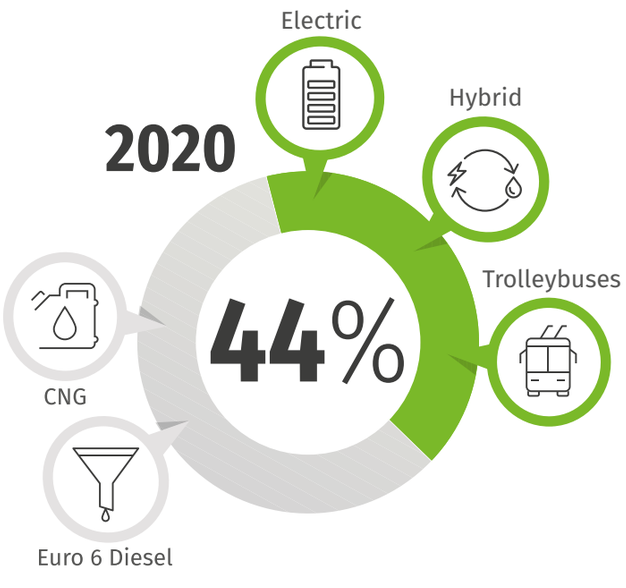
457
electric buses

the manufacturer delivered. This was nearly **three times more** than in the previous year.



44%

of our output in 2020 was made up of vehicles with alternative drives: electric, hybrid vehicles, and trolleybuses.



Largest deliveries

- **130 articulated Solaris Urbino electrics** for operator MZA in Warsaw
  * This includes the jubilee Urbino bus, i.e. our 20,000th vehicle produced since 1996
- **90 Solaris Urbino electrics** for operator ATM in Milan
- **106 battery-powered buses** for BVG in Berlin.

35 ton
of CO_2 emissions saved

by one Urbino 12 electric running in Cracow over one year.

Electric buses made by Solaris already ply routes in **18 countries** and are operated by almost European carriers. **100**

Hydrogen buses

The bus maker secured orders for the supply of hydrogen buses from operators in the Netherlands, Germany, Sweden and Italy.

Awards:

Global e-Mobility Leader 2020

3. NEW SOLUTIONS

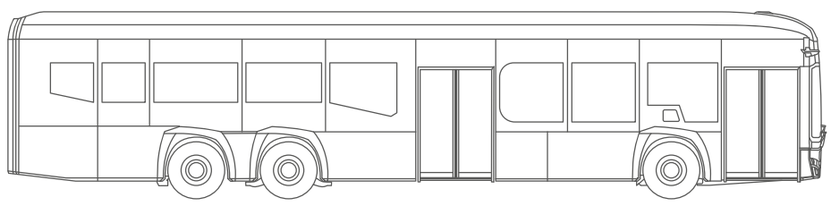
A new model in our portfolio:

[Click & watch the world premiere of Solaris Urbino 15 LE electric [VIDEO]]

the first Solaris electric intercity bus

274,000 views

of the launch of the Solaris Urbino 15 LE electric bus were racked up by our YouTube channel



[Urbino mild hybrid - click & learn more about the vehicle [LINK]]

4. CHALLENGES OF THE PANDEMIC

The company has introduced special anti-COVID solutions to enhance safety in public transport vehicles:

- Hands-free opening and closing of doors for passengers
- Disinfectors
- Intercom
- Passenger counting systems
- Closed driver's cabins

Good morning, is that the future?

Trends in modern public transport

Clean air. Silent streets, no tiresome noise. Safe, generally accessible, easy to operate and sustainable transport. Being able to buy a ticket within a few seconds using your own phone. Fast access to transportation timetables, transport information in real time. Stops that are nearby, and well-connected interchange hubs. Are these just pipe dreams, a utopia, unrealistic visions of the future? No, not at all. This is already the reality of many contemporary cities. Cities that are modern, and both people-friendly and environmentally-friendly. Cities where emission-free buses running on green energy are in operation. Cities which we can plan and design right now. These are our cities.

We need synergy

According to Eurostat, ca. 40 percent of the population of EU member states live in cities. In line with projections, over the next few years the percentage of people residing in urban areas will increase steadily. Being a city dweller entails just as many advantages as challenges. The future we desire is cities that offer equal opportunities for everyone. This means cities that offer cutting edge services, housing stock, and transport resources, because mobility is one of the basic needs of humanity. We travel every day to work, kindergarten, school, shops, public offices and coffee shops.

The rise in passenger car density is extremely fast. This is counter-productive to global efforts aimed at reducing the release of CO_2 into the atmosphere. The profusion of cars in large conurbations generates capacity issues for thoroughfares. Reducing traffic in cities is necessary to effectively implement the concept of sustainable cities.

In order for that to happen, what is necessary is a coherent vision for the development of two components: urban solutions and public transport provided as a part of the former. Procedures related to the designing of urban space must take into consideration the mobility needs of residents. For instance, suburbanisation has been noticeable in large agglomerations over the past decades. These suburbs are often poorly connected to the centre, which generates even more car traffic. The elimination of transport barriers of this kind is a priority for modern metropolises.

Promoting public transport means fewer cars in city centres, as well as less noise and exhaust gases, unobstructed pavements and roadsides, and instead of vast, congested parking lots – more space for parks, playgrounds and public utility areas.

However, freeing public space for city residents requires that systemic solutions be introduced which will support the transport of the future in the long run. That was exactly the reasoning of the Parisian authorities when a few months ago they announced that the city would eliminate half of all its 140,000 parking spaces. Residents will be consulted about the changes, and the space reclaimed will be turned into wider pavements, roadside gardens or picnic spots. Car transportation already constitutes a mere 13% of all city travel of Parisians! In order for such measures to work, residents first need to have access to a wide range of possibilities with regard to public transport, including micro-mobility solutions.

Hamburg is another excellent example of how a city of the future can be managed. By 2030, the city wants to increase the share of routes serviced by public transport vehicles from 22 to 30%. A hike of just 8 percentage points will mark a climb in passenger numbers of... a whopping 50%! In order to reach this goal, Hamburg intends to expand its bus network (the city has been testing hydrogen-powered Solaris vehicles since 2014, for instance), its underground train network, as well as the support of so-called shared mobility services. The latter are managed using bespoke applications and can cover, among other things, the rental of vehicles by the minute, of scooters, electric scooters, bicycles, or facilitate sharing a taxi. The goal is for every citizen of Hamburg to have access to some kind of public transport within a 5-minute walk, regardless of where they are at that moment. Should this plan succeed, driving a car will become quite unappealing, and owning a car will be unnecessary.

Modern cities boast many ideas for promoting personal modes of travel that are not passenger cars.

Copenhagen is one such city which may serve as a benchmark with regard to promoting zero-emission transport. According to measurements taken there regularly, in 2016 for the first time ever

the number of bicycles entering the city centre exceeded the number of cars entering it. The city continues to build new bike paths, footbridges and bridges, and already over 60 percent of residents go to work or school by bike every day.

Green zone

Clean transport zones may serve as another significant solution to help legitimise the privileges of public transport. There are currently over 230 such low-emission zones in Europe. They are a means to reduce vehicle traffic in city centres, and at the same time they spur a change in the character of these areas, making them more resident-friendly. Berlin is one of the cities that have succeeded in introducing a clean transport zone. Established in 2008 and spanning nearly 90 square kilometres, the zone is closed to trucks and passenger cars which do not meet emission standards equal to or above Euro 4. Cars without a “green sticker” are not allowed into the city centre. In 2019, further restrictions were introduced for some streets, which only vehicles meeting Euro 6 standards can use. As a result Berlin has seen a drastic decrease in the number of vehicle registrations per 1000 inhabitants, whereas public transport across the city – not only by bus (including a fleet of 123 electric Solaris ones), but also tram, underground train (U-Bahn), rapid transit railway (S-Bahn) and even water buses - has become much simpler and more comfortable.

Flying vehicles

Transport planners have taken note of the growing need for improving travel. Passengers want, in particular, shorter waiting times when changing their mode of transport, and this can be achieved thanks to the development of platforms that enable ticket-free transport and thanks to the establishment of mobility hubs that enable multi-modal transport offering a range of travel options.

Public transport is adapting to the needs of passengers and is more and more boldly reaching out for solutions of the future, whereas we are witnessing an electromobility revolution. Residents of a growing number of cities can avail themselves of a wide range of technologies that facilitate everyday mobility while at the same time showing that they care about the environment and the surroundings we live in. We can already ride on electric and hydrogen buses in cities, while car, scooter and bike sharing services are within close reach, too. Notably, the range of transport options is changing swiftly and adapting to the needs of drivers and passengers.

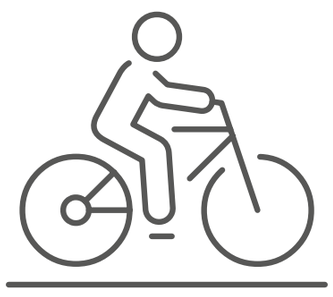
One of the ultra-modern potential additions to contemporary transport options is being devised by firms which are attempting to create autonomous electric flying vehicles that could serve as taxis and provide ride-sharing services.

The solutions of the future can be discerned, even today, among the equipment of some city buses. Advanced Driver Assistance Systems help drivers thanks to, among other things, the use of a smart brake assistance system or cameras that can detect pedestrians or cyclists situated in the blind spot of a vehicle.

In order to make it even easier to benefit from the range of options available, cities such as Gdynia plan (together with startup Vooom) to integrate all options of city transport and make them available as one service. British firm Urban Things, on the other hand, will soon launch its pilot programme “Be-in / Be-Out”. This particular system involves a travel app that communicates via Bluetooth and allows the whole journey of a passenger to be tracked and all payments managed, without the passenger having to take out their phone. This means not only saving time. The system will allow the unlimited use of all the advantages of travelling.

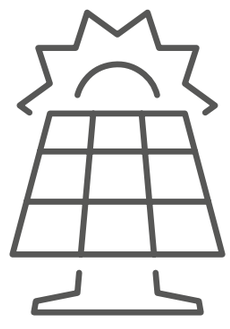
Public transport that responds to the needs of city dwellers is almost upon us. It operates practically unmanned and it is intuitive to use. We are clearly bearing witness to the establishment of a new transport model.

The last mile



Services on demand are one of the more eye-catching trends in public transport predicted to emerge in the next few years. One idea to broaden the range of modern public transport options is so-called last mile transport. This particular solution allows travellers to cover the last stretch of their journey by using, usually, micromobile solutions: bicycles or scooters. This is a great opportunity to make the offering for passengers more appealing and to propose a “door-to-door” service ready for use. This will allow to shorten travel times, lower the total cost of transit for the whole journey, and to accurately respond to the needs of residents. In Cracow the Tele-bus service has been operating since 2007. It entails ordering a minibus by phone and the service is available to anyone. It can be requested up to 30 minute before the planned ride, and will set you back just the current price of public transport tickets.

Exemplary electricity



In order to make public transport less dependent on other suppliers, it will have to pay more attention to renewable energy sources. We can already see how carriers are also turning into producers of energy. Public transport operator MZA in Warsaw is investing in photovoltaic panels that will ensure the operator has an additional power supply of its own both for buses and bus depots. There is already one solar power plant located on the depot building at Woronicza street in Warsaw. Under favourable weather conditions, the facility can supply electricity for the whole depot. Warsaw's Solaris buses are fitted with roof-mounted photovoltaic panels that power the electrical devices of the vehicles, such as ticket vending machines, air conditioning, CCTV cameras and passenger information screens.

In the past few months, Warsaw has received 130 state-of-the-art articulated electric buses: Solaris Urbino 18 electric buses. In line with the prerequisites of the Warsaw Climate Plan, only low- and zero-emission buses are to be deployed on the Royal Route in the city. The choice of environmentally friendly solutions by Warsaw operator MZA bolsters the city's daily battle against smog.

Intuitive transport

Urban transport is increasingly of a high standard and ensures comfortable travel in modern conditions. Nowadays public transport is opening up completely new possibilities to us. More and more agglomerations are electrifying their fleet, and hydrogen-fuelled buses are already hitting various cities' streets. Thanks to advanced zero-emission technologies, bus stops can be set up in places that were hitherto inaccessible. An electric bus could even drive into a shopping centre or a railway station!

Hydrogen acceleration

Zero-emission public transport based on hydrogen technology

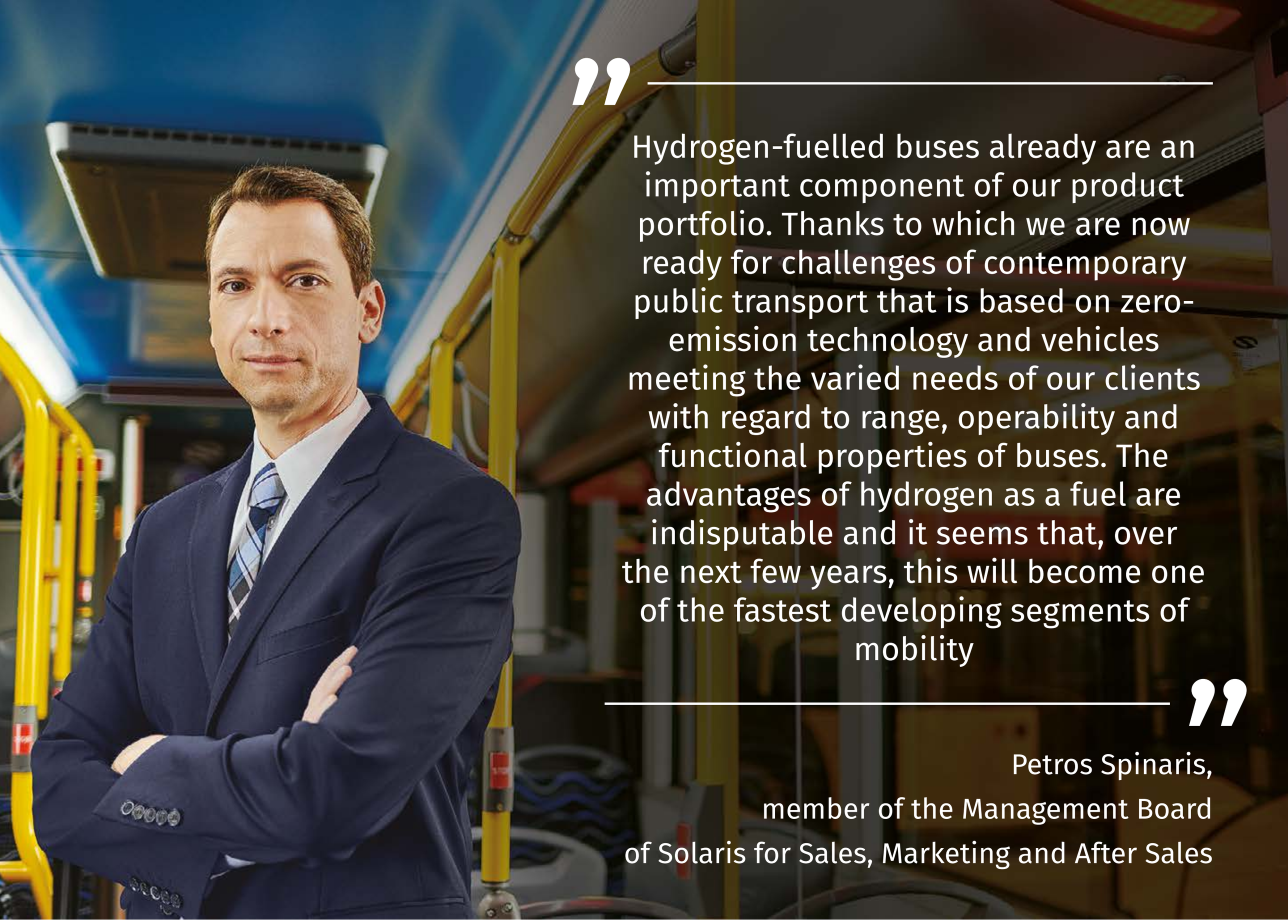
Exactly a decade ago Solaris was one of the first European producers to turn towards electric buses. Today, the company is a leader of that particular market segment, whereas the zero-emission battery-powered buses are conquering new markets and are deployed in passenger transport both in huge urban centres as well as in towns. In barely ten years these vehicles have become a staple of city bus transport in Europe. Are we to witness a similar development for vehicles with hydrogen drives? Looking at how fast this technology is progressing, and how interest of transport operators is growing, it seems that hydrogen used as fuel will soon become one of the key factors in transport systems. And so will hydrogen buses.

Solaris Urbino 12 hydrogen is fitted with a cutting-edge fuel cell that acts as a miniature hydrogen power plant on board of the vehicle. Thanks to the use of advanced technology, the bus will be capable of covering up to 350 km on a single refill.

The first vehicles using hydrogen fuel cells were presented by Solaris in 2014. These were two Solaris Urbino buses of 18.75 metres, supplied to a carrier in Hamburg. The concept for these buses was based on using traction batteries as main energy storage. Hydrogen fuel cells served only as an additional source of energy on board of the bus. The trolleybuses Solaris Trollino 18,75, supplied to Riga between 2018 and 2019, work on a similar principle. These unique vehicles are fed power from three energy sources: from an overhead wire network, batteries and, additionally, a range-extending hydrogen fuel cell.

Then, in 2019, Solaris supplemented its zero-emission portfolio with a hydrogen bus, i.e. the new-generation Urbino 12 hydrogen. For that vehicle, hydrogen is the main source of energy. At the heart of the bus sits a cutting-edge fuel cell that acts as a miniature hydrogen power plant on board of the vehicle. Thanks to the advanced technology applied in it, the bus is capable of covering at least 350 km on a single refill. In a hydrogen fuel cell, electric power is generated in the process of reverse electrolysis and then transferred directly to the driveline. **The sole products of the chemical reaction occurring in the fuel cell are heat and steam. Consequently, the vehicle does not generate any noxious substances whatsoever.**

A set of 70 kW fuel cells is used in the Solaris hydrogen buses. As a whole, the hydrogen system contains also auxiliary devices,



> Hydrogen-fuelled buses already are an important component of our product portfolio. Thanks to which we are now ready for challenges of contemporary public transport that is based on zero-emission technology and vehicles meeting the varied needs of our clients with regard to range, operability and functional properties of buses. The advantages of hydrogen as a fuel are indisputable and it seems that, over the next few years, this will become one of the fastest developing segments of mobility
>
> Petros Spinaris,
> member of the Management Board
> of Solaris for Sales, Marketing and After Sales

responsible for instance for the supply of hydrogen and air at an adequate pressure, for the recirculation of the resource that has not been used up, and also for maintaining a proper and stable temperature of the fuel cells during operation.

The hydrogen bus of Solaris is equipped with a small Solaris High Power traction battery whose role it is to support the fuel cell in moments of increased demand for electric power. The battery is recharged using energy derived from hydrogen and energy recovered during the braking process. It can be also recharged using a plug-in socket. Complementing the driveline is an axle with integrated electric motors.

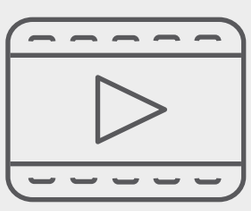
As for the hydrogen storing technology, the Urbino 12 hydrogen features cutting-edge solutions. The element is accumulated in gaseous form at a pressure of 350 atmospheres in 5 new-generation tanks on the bus roof. Thanks to the use of type 4 hydrogen tanks, engineers of the Solaris Technical Office managed to reduce their weight by ca. 20% compared to the parameters of the previous model. A multifunctional valve is installed at the end of each tank; this valve includes a range of safety measures: a solenoid valve, an emergency

valve actuated by high temperature and an overload valve cutting off the flow of hydrogen in case of the loss of containment.

The Solaris Urbino 12 hydrogen is the result of consistent investments of the producer in zero-emission public transport means. **The hydrogen bus with a hydrogen fuel cell offers all the benefits of an electric drive, such as reduced noise emission and reduced vibrations, but above all a complete lack of emission of noxious substances at the site of operation.** Vehicles featuring hydrogen technology also stand out thanks to their extensive driving range and the short time needed to refill.

The latest contracts for the supply of hydrogen buses, landed by the firm, serve as the best confirmation of these words. The Solaris Urbino hydrogen have already been or will soon be deployed in Cologne, Wuppertal, Bolzano, Gävle, and by Dutch operators Conexxion and Arriva. Solaris has also signed a framework contract with Austria's ÖBB Postbus which envisions the commissioning of up to 40 hydrogen buses.

The list of cities that are testing or planning to buy hydrogen vehicles is even longer. In the past weeks alone the hydrogen Urbino had trial runs among others in Poland - in Poznań, Jaworzno, Konin, Włocławek; in Germany - in Munich, Essen and Güstrow; in Latvia - in Riga, Jelgava; in France - in Paris and Chamonix; as well as in Spain - in Barcelona and Madrid.



[Five days, five cities: summing up the presentation of the Solaris 12 hydrogen in Poland [VIDEO]]

In those and in many other cities, operators have already advanced purchase plans with regard to the hydrogen technology. The best example is Poznań; its application for the purchase of over 80 hydrogen buses including refuelling infrastructure - all to be acquired

under a programme of support for zero-emission transport - has passed a positive preliminary verification. The project involves the purchase of hydrogen buses of 12 and 18 metres over the years 2023-2025.

The fast pace of new projects emerging to promote hydrogen as a fuel of the future is evident also on a general European level.

In 2020, the European Clean Hydrogen Alliance was born, following an initiative of the European Commission. The goal of that project was to scale-up, by 2030, the production and deployment of hydrogen as a fuel produced by means of low-emission technologies and renewable energy sources. The European Clean Hydrogen Alliance is one of the many measures taken by the European Union to bolster its position as a world leader in the production and deployment of hydrogen in industry and the energy grid. It is also an important step on the path to reaching carbon neutrality by 2050, which is an objective of the EU. As a member of the Alliance, Solaris is actively contributing to the work of the mobility roundtable. In collaboration with other organisations promoting the deployment of hydrogen as an energy source, the manufacturer seeks to develop optimal solutions regarding the EU's energy transition to a climate-neutral economy.

The project dubbed StasHH is an example of another initiative in which Solaris participates and the objective of which is the popularisation and standardisation of solutions in the area of hydrogen technologies. It is a European consortium consisting of 25 leading entities of the hydrogen sector. The organisations have started cooperation to define, develop and test the first European standard for fuel cell modules for heavy-duty applications, i.e. for commercial vehicles including buses and trucks. This standard for fuel cell modules may be the game changer that the fuel cell industry requires to enhance market competitiveness, reduce costs and enable mass production. 11 suppliers of fuel cell modules, 9

manufacturers of vehicles or equipment parts, as well as 5 research institutions are part of the consortium.

StasHH is working on standards regarding physical dimensions, digital interfaces, test protocols and safety requirements of the fuel cell modules that can be stacked and integrated in vehicles designed for “special tasks”.

In the European Union, the number of registered hydrogen-fuelled buses is rising with each passing year. Equally important, the refuelling infrastructure is following suit. Even though the number of 300 hydrogen refuelling stations set up in Europe may not be very impressive, one may certainly expect this sector to pick up pace in the years to come.

Solaris has already announced the launch of an articulated version of its hydrogen bus. **In line with the manufacturer’s vision, the battery technology and the hydrogen technology are complementary. Solaris keeps investing in the development of both types of drives, in the belief that they will become the foundation of the public transport of the future.**

Today, the decade-old declaration of the manufacturer according to which “Diesel has died, long live electricity!” no longer sounds as revolutionary as it once did, it simply has become our reality. Will hydrogen buses witness a similar boom? Everything points to it.

Interview with Paweł Mańkowski

Hydrogen Technologies Team Leader, R&D Department, Solaris Bus & Coach

Solaris Magazine:

What is the concept of safe transformation of hydrogen into electric power based on?

Paweł Mańkowski:

Hydrogen reacts with oxygen provided the right conditions are met and the proportions of both elements are adequate. In supply systems, hydrogen remains separated from oxygen (air), and this is also the case, to some extent, in the fuel cell which the chemical reaction occurs in. Hydrogen and air are delivered to the fuel cell to separate systems, whereas the proton-exchange membrane (PEM), made of a special composite, acts as a kind of separator which, at the same time enables the whole process. Its purpose is to let through only hydrogen protons to the other system.

Hydrogen used in that reaction is accumulated in a very pure form. Hydrogen constitutes a minimum of 99.97% of the gas compressed to ca. 350 bar and sealed in the tank. Such a high pressure is necessary to aggregate the sufficient amount of the gas and, consequently, to ensure the relevant driving range of the vehicle. The energy supply system of the 12-metre hydrogen bus contains five tanks with a total volume of 1560 l, which can hold ca. 37.5 kg of

hydrogen. Such an amount allows to cover a distance equalling the range of buses with conventional drives, namely ca. 350 km.

SM: Hydrogen molecules have penetrating properties that allow them to permeate the metal walls of tanks and pipes. Are losses of hydrogen in tanks noticeable under normal conditions of use?

PM: The hydrogen we use in research on the propulsion system is kept in tanks under a pressure of 350 bar which remains unchanged for many days, even when the vehicle is not in use. In the course of regular exploitation the hydrogen permeability is one hundredth in a month's time. That is actually much below the admissible permeability standard. What is more, the amount of hydrogen stored in the bus tanks is usually enough for a full day's run, after which the tanks get refilled. Currently, the type 4 tanks are used that are made solely from composite materials which are characterised by extreme durability and small permeability of hydrogen molecules. These are much lighter than the type 3 tanks in which one of the wall layers is made of metal. For both types, the permeability of hydrogen has to meet the same standards. Of course, this does not change the fact that hydrogen, on account of its properties, may permeate from the installation into the surroundings, which is why strict provisions apply to the parking of hydrogen-fuelled vehicles. If these are observed, parking them is completely safe.

SM: The products of the conversion of hydrogen in a fuel cell are electric energy, steam and heat. How can you use the heat?

PM: The energy efficiency of a fuel cell ranges between 46 and 53 percent, which means that heat makes up ca. half of the energy obtained through the conversion of hydrogen.

The efficiency of the fuel cell is one of its chief advantages, giving it an edge over diesel engines whose efficiency is lower. The fuel cell chosen by us works at a temperature range of 60-80 °C, so the heat released by it can be used for **the purpose of warming the passenger compartment.**

For that purpose we have designed an exchanger which connects the fuel cell cooling system to the bus heating system. The heat released from the fuel cell in summer is partially used for the cooling of the whole vehicle interior, using a heat pump.

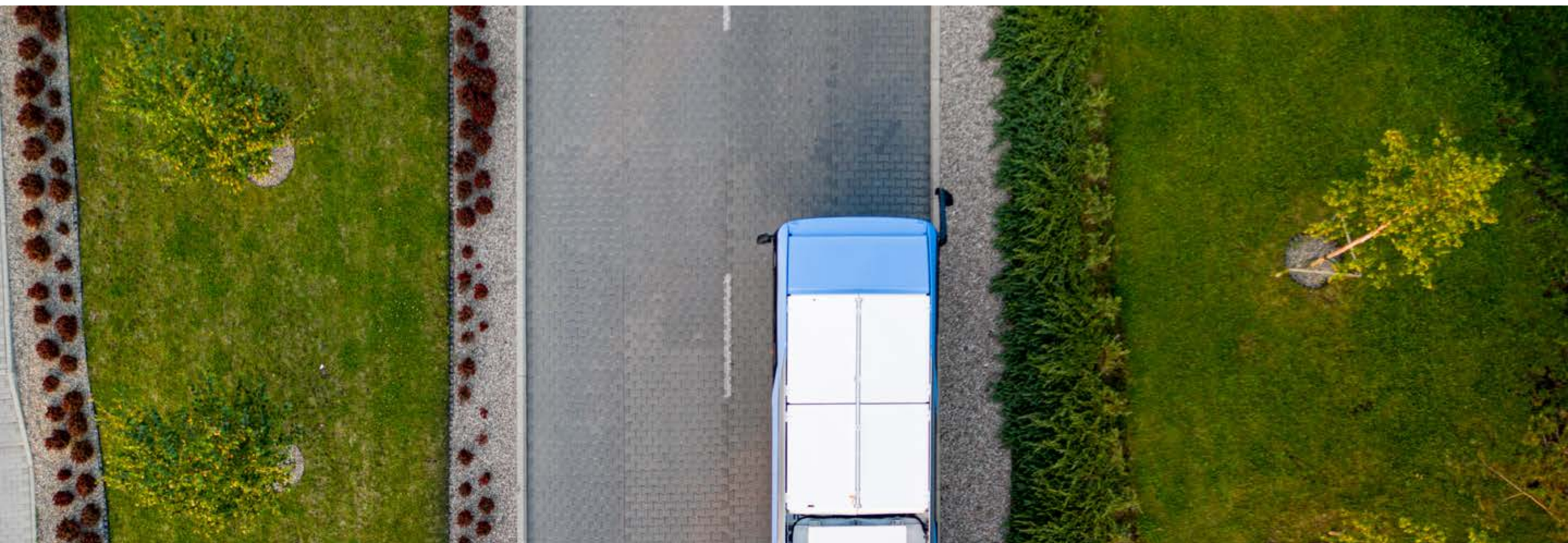
SM: The PEM membrane plays a crucial role in how the fuel cell works. What does it do?

PM: The PEM membrane is the chief component of the so-called Membrane Electrode Assembly. This is a device that captures electrons but allows protons to pass through; these

protons are released as a result of the decomposition of the hydrogen molecule on the surface of a special catalyst. This set contains an electric system that “transfers captured electrons” to the electric circuit of the fuel cell. The membrane is made of plastics, composites or a mixture of the two. For decades various makers of fuel cells have been fine-tuning membrane production technologies, which is why many of the “young” producers of fuel cells do not concern with making it themselves, but rather they buy it from subcontractors. We are using the tried and tested solution of Ballard.

SM: How is the exhaust system of the fuel cell built?

PM: One of the products of the chemical reaction is steam which, depending on the performance, emerges from the fuel cell with changing intensity. While no sounds are produced in the process, a white plume of steam can sometimes be seen above the bus roof where the fuel cell is stacked. Steam condenses to water which is drained via tubing and released underneath the bus. So you can say that the whole process is completely environmentally neutral.



Refueling stations with hydrogen

One of the most frequently made arguments against hydrogen buses and other hydrogen vehicles is the lack of appropriate refuelling infrastructure. Fortunately, this situation is changing rapidly. Currently, there are over 200 hydrogen fuelling stations in Europe and another 100 under construction.

The rate of technological development can sometimes be really impressive. A few years ago, hydrogen-fuelled vehicles were mostly prototypes implemented as test concepts. At present, mass-produced Urbino hydrogen buses carry passengers and more and more cities are making plans to put vehicles of this type into operation.

Advances in vehicles and transport must go hand in hand with setting up the necessary infrastructure. A few years ago when the first cities decided to add electric buses to their fleets, changes were needed to facilitate charging. However, while in the case of e-buses a plug-in charging station is a widely available device that may be used even in a small town, a hydrogen fuelling station is a much more ambitious undertaking. Yet, more and more cities are taking up this challenge as they wish to provide their residents with modern and sustainable public transport.

At the beginning we would like to note that the numbers mentioned herein encompass all hydrogen fuelling stations of which only a certain percentage have been adapted to fill buses. However, this shouldn't prevent us from having a look at the whole ecosystem from the perspective of bus transportation. **Growing demand, increasing production capacities, EU policy, and maturing technologies are all driving the hydrogen vehicle market to grow faster than ever.**

As regards the availability of hydrogen stations, Germany is far out in front. Currently, there are 99 stations in operation throughout the country and more are under construction. Thanks to this high number, it has been possible to deploy hydrogen vehicles in Cologne and Wuppertal, where a total of 25 Solaris Urbino hydrogen buses will be in use shortly. Interestingly, the project is of particular environmental relevance as the hydrogen used to fuel the buses is a by-product from a chemical plant in Hürth. Previously, it was simply disposed of; today, thanks to the deployment of hydrogen buses, it is put to use in sustainable public transport.

France can also boast a substantial number, i. e. 34 hydrogen refuelling stations. Many are also available in the UK (16 stations) and Switzerland (7 stations). However, even a relatively small number of stations doesn't prevent the deployment of hydrogen bus fleets. Although there are only 6 such stations in the Netherlands, 20 Solaris hydrogen buses will soon ply routes in the province of South Holland and another 10 units will make their way to the region of Achterhoek and to the towns of Zutphen and Apeldoorn. Italy can boast only 3

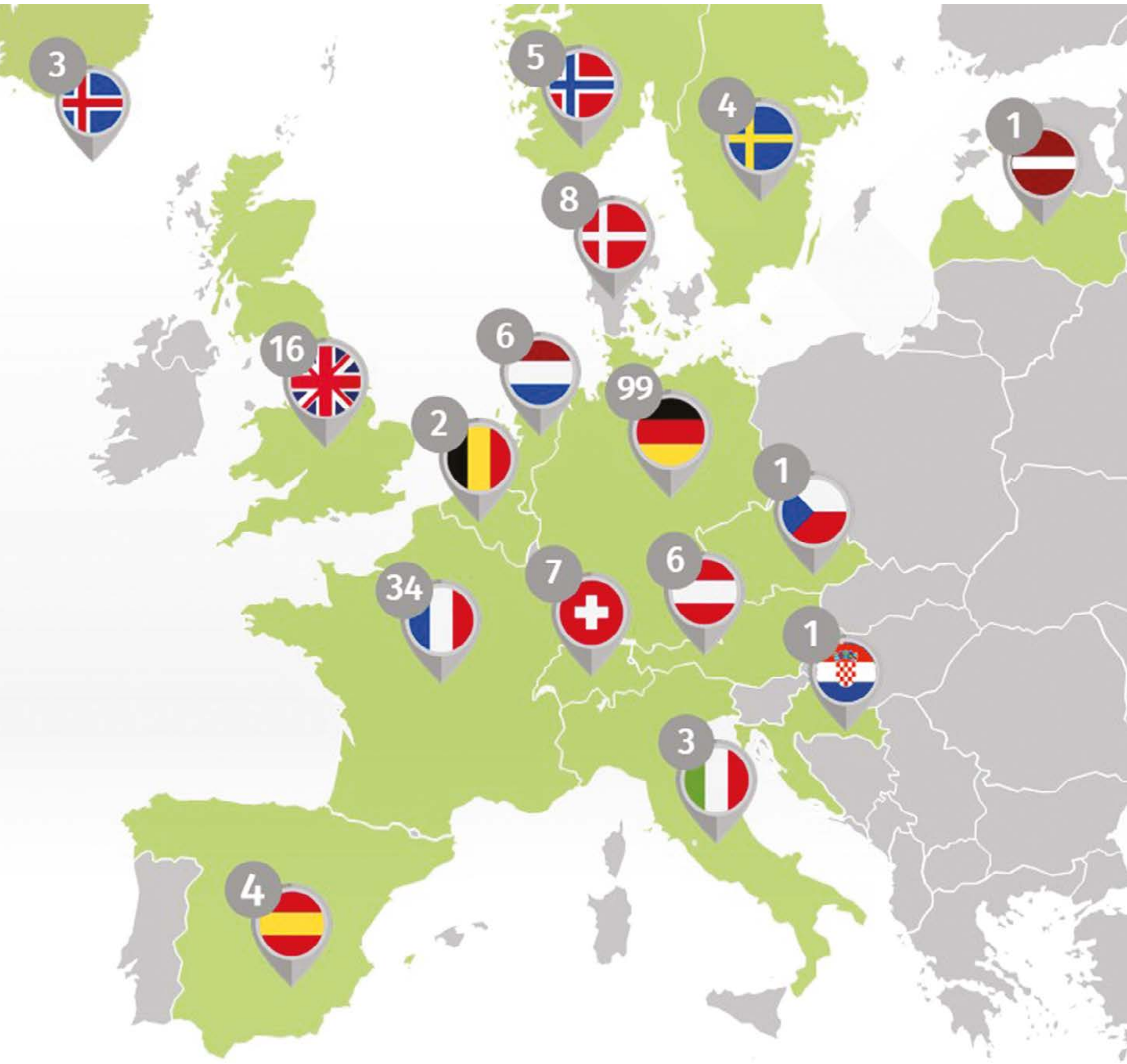
hydrogen refuelling stations, but the one in Bolzano is sufficient to serve 12 hydrogen buses made by Solaris.

Hydrogen-based transport is also being developed in Scandinavia. In Denmark there are 8 , in Norway there are 5, and Sweden boasts 4 stations in operation. Even distant Iceland, despite its sparse population, can boast 3 such stations. The first stations are now also available in Latvia, the Czech Republic and Croatia.
What is the situation in Poland? Unfortunately, no station has been put into operation yet. But this is going to change shortly. By the end of the year, two stations will have been built in Gdańsk and Warsaw. Other locations in the pipeline are Gdynia and Poznań, and more are only a matter of time.

Last year, the European Union adopted a new strategy on hydrogen, divided into three phases. One vital element is to build infrastructure to produce hydrogen at a large scale.

Plans are afoot to generate up to 10 million tonnes of renewable hydrogen by 2030. What is more, there will be subsidy schemes to boost the further development of the production and deployment of green fuel in many sectors.

What is also worth bearing in mind is economies of scale. **By increasing supply and thanks to subsidies, the availability of hydrogen as a fuel will surge.** At the same time, costs will fall: of the gas itself, the necessary infrastructure and of vehicles. That is why it is worth considering opting for hydrogen buses right now, without perceiving the scarce infrastructure of today as a major constraint for the future. Solaris will continue to supply state-of-the-art and environmentally friendly hydrogen buses and support its clients in transforming their fleets.



Hydrogen **filling stations** in Europe

200 working stations
(marked on the map)

107 stations in progress

source: https://www.h2stations.org/; as of 03.02.2021

Cities of the future are cities for people

Public transport provides a better life for all of us in our cities, and cities must be for the people before anything else. The COVID-19 pandemic has had a profound impact on our way of life, and with that numerous sectors have faced great change. With this, public transport has a unique opportunity to see through this crisis to a different end result. We do not have to go back to the ways of before, we can instead build better mobility for everyone. We can build back better.

We talk to **Mohamed Mezghani**, UITP Secretary General, about challenges related to the pandemic, its impact on the industry and the vision of the future, developed with city dwellers in mind

Solaris Magazine:

The coronavirus pandemic has affected the business of every sector, including public transport. All kinds of studies indicate that the possibility of contracting the virus while riding on a tram or trolleybus are very slim, producers, operators and carriers show continued concern for the safety of passengers. Have you noticed some particular trends regarding the proposed anti-COVID solutions?

Mohamed Mezghani:

When the coronavirus pandemic began, we knew that an immediate response would be needed to counter the impact on the public transport sector. This was of course not only concentrated around operational issues, ridership, finances and more, we knew that this crisis would have a reputational impact. Our UITP members around the world were also very quick to respond to impacts of Covid-19, and have continued to work very closely with UITP on responding to the pandemic from the beginning, by sharing information, data, and research.

Public transport has shown again the importance of public services and during this crisis, public and private sector stakeholders have adopted all the necessary measures to guarantee service continuity, ensuring the mobility of essential workers, while protecting staff and passengers.

This has come at a great financial cost and at UITP we´re proud of our members in the many ways they have stepped up to respond - they continue to be our Guardians of Mobility.

What the research tells us about the impact of Covid-19 on the sector, is exactly how you frame your question: the risk of spread and infection within public transport is extremely low.

In fact, public transport has been cited as one of the safest places to be during the pandemic.

One of our key publications released during the pandemic was focused on how public transport is Covid-safe.

What we have seen is that despite the lack of scientific evidence, many governments, relayed too often by the media, have called for people to avoid using public transport and to travel instead by car, bike or walk. This has impacted people´s behaviour and the public perception of feeling at risk in public spaces, including public transport.

Today, there is enough evidence to demonstrate that, when measures recommended by the health authorities are implemented, public transport is very safe.

The work carried out by operators and authorities during the pandemic has been exemplary. The extra measures implemented with cleaning and disinfecting have kept passengers safe and reassured. These measures have of course cost the sector financially, as new infrastructure also became necessary, on board and at stations. With ridership falling so dramatically during the initial stages of the pandemic, and with extra financial output, the sector must receive the vital attention in national recovery plans it truly deserves.

SM: Speaking of which... how does UITP intend to support the strive of the public transport sector to secure as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much EU-funding for rebuilding the sector after the pandemic? Have concrete measures been undertaken to that end yet?

MM: UITP has been very active to showcase the financial impact on public transport during Covid-19 and beyond. Our European department works closely with the European Union institutions and all relevant stakeholders to collaborate and offer input on the relevant developments. As early into the pandemic as last March, we began issuing a series of Open Letters addressed to the European institutions with the objectives to explain how much the sector is impacted and why we need financial support from the EU. We also organised high-level meetings with the Commission and public transport CEOs, who joined in our outreach by signing one of our Open Letters to call for serious financial support for the sector.

This has been a lot of necessary work, but in order to be recognised, the sector must speak up.

Our main focus is now on the national recovery and resilience plans and European Union member states have already submitted their national recovery and resilience plans setting out their reform and investment agendas until 2026. We continue to do a lot around advocacy action towards the EU. We have also encouraged members to lobby their national ministries and prepared a kind of toolkit to help them.

SM: Currently European cities are implementing various strategies to encourage citizens to use public transport. For instance, in Amsterdam or Vienna this is done first and foremost through education. By way of a range of campaigns, residents are informed about rules applying during the pandemic and about the fact that thanks to complying with these rules a train, metro or bus

ride is safe. Some cities have increased the frequency of buses running on particular routes. Which path seems most efficient to you?

MM: At UITP we would encourage any posi-tive messaging and imaging for promoting the safety and usage of public transport. Image and information are vital to this, and making it clear to people not only how safe using public transport is, but how present it has remained for city life. We want to remind of the benefits of using public transport for the climate, economy, jobs, social cohesion, urban space and health.

The economic benefits of public transport are five times higher than the money invested in it and public transport unlocks positive effects in the wider economy by connecting people across all walks of life. It is the sustainable option for city living and improves our health and reduces health expenditures, as well as helping to address the ongoing climate crisis across the globe.

These objectives are rooted in science, research and data and the positive communication of this is so very important. Public transport plays a crucial role in local development, offering mobility to all and maintaining territorial and social cohesion, leaving no one and no place behind after the crisis.

SM: What are the expectations of city residents regarding public transport? Did the past year see major changes to those, or are they essentially unchanged?

MM: What the coronavirus pandemic has shown us is how essential public transport is to guarantee access and continuity of basic services. During the lockdown, all over the world, the public transport supply was maintained to ensure the mobility of essential front-line workers. In fact, this reliability may have increased during the pandemic, as people could take their local tram, metro, bus, or train to get to medical appointments, to purchase their groceries, visit family in need. I think this is exactly the expectation of public transport – to provide the best service possible for moving around our cities.

It cannot be about simply moving from one point to the other. We must offer multiple mobility solutions for our city residents so public transport is always the most logical choice to move around.

SM: According to estimates of the United Nations, by 2050 some 68 percent of the world population will live in cities. The pandemic has not pushed inhabitants out of cities. This means that the already existing problems related to air pollution,

congestion or shortage of parking space may be exacerbated in the future. So, what will the future of transport in cities look like?

MM: With more half of the world's population already living in urban areas we must make sure that our cities adapt to population grow and become as liveable, accessible, and healthy as possible: public transport plays a huge part in this.

What we also know is that the existing problems you refer to, such as air pollution and congestion, need to be tackled, regardless of population growth. Although with less movement on our roads the air in our cities has become cleaner, a more permanent solution to this in a post-pandemic world is to move more people on to public transport from singular vehicle journeys.

Public transport helps to contribute to making the air in our cities cleaner, by lowering emissions, and as population numbers grow, we must continue to address this.

The future of transport in our cities is there for us to determine together. If we go back to the same ways as before, then this will not result in any form of successfully building back better.

SM: What role does UITP want to play in the shaping of “cities of the future” and what tasks, in terms of public transport as a whole, would you put on the agendas of vehicle manufacturers?

MM: Cities of the future are cities for people. For a century, cities have been built for cars, to facilitate their movement and parking. It has been done by dedicating a large part of the urban space to cars. This crisis, and in particular during the lockdown, has shown the huge space spoiled to move cars.

It’s time to change this paradigm of mobility and start moving people instead of moving cars. This will only be possible by giving the priority to walking, cycling, and public transport.

And by public transport I don’t just mean mass transit by also shared and on-demand mobility solutions.

We must redefine public transport beyond mass transit. That’s the only way to control car use, not to say car ownership. In doing so, we will be in a position to offer citizens the right mode at the right time according to the purpose of the trip. It will be possible for them to combine the various mobility options for an optimal planning of their trip wherever they are and at any time. In this context, vehicle manufacturers will have a key role to play because they are the ones supplying this variety of modes from the shared car, bike or scooter to the on-demand van and of course the conventional public transport modes.

Vehicles will have to be user-friendly, zero-emissions and flexible in use in crowded city streets but in low density peripherical areas too.

This pandemic crisis has also taught us about the importance of the internal layout of vehicles in a way to optimise occupancy while keeping some distancing between people. Also the progress made in the field of maintenance and flexibility of operation will be very important. But vehicle suppliers will not be just manufacturers but partners with the transport operators and authorities in developing new services and user-friendly solutions. Their capacity to tailor-make industrial solutions to the diversity of the demand will be key in the cities of the future.

Drivers

– our everyday heroes

Marked by the ongoing epidemic, the past year has generated many new challenges, also in the field of transport; however, it has also shown us which industries are crucial to ensure the stable functioning of the society. The coronavirus has made us realise what we should have known before: Without the work of public transport drivers we would run the risk of social and economic paralysis.

Public transport remains one of the most efficient means of travelling through the city for residents. This is true now more than ever. Fully aware of the importance of this, organisations responsible for the organisation of collective transport have worked out special solutions increasing the safety of passengers and drivers alike. For that purpose operators have introduced the daily disinfection of vehicles, while reducing the number of passengers onboard and deploying additional vehicles on the most frequented bus routes.

Bus, trolleybus and tram drivers can count on the support, such as being provided personal protective equipment and the exclusion from use for passengers of the zone around the driver's cabin and the first bus door.

Measures taken in Wuhan at the beginning of 2020 went to show how important and indispensable the job of public transport drivers is during a pandemic. It was, to a large extent, thanks to the tenacious work of drivers that the spread of the pandemic in China was stemmed effectively. Buses and other means of public transport ensured transit for medical personnel and cured patients. The city of Wuhan had set up a fleet of 623 buses that were dispatched to 15 districts for the purpose of providing emergency support. The buses also enabled easy commutes to work for medical personnel of 100 hospitals. Over 520 buses were used to cater to the daily transport needs of citizens, connecting 165 supermarkets and e-commerce outlets. These solutions ensured the orderly progress of medical efforts and the timely transport of daily necessities.

Of course, examples of the efficient use of public transport in the battle against the pandemic can be found much closer to home. In Warsaw, two buses of the operator MZA were converted into ambulances that relieved the burden of regular ambulances in the struggle against the coronavirus. Vehicles have been adapted to the transport of sick persons, by installing a tightly closed partition wall separating the driver's cabin from the passenger compartment, and by installing steel structures appropriate for the transport of oxygen cylinders in the front of the bus, in lieu of seats. What is more, radiotelephones were installed in the vehicles to ensure

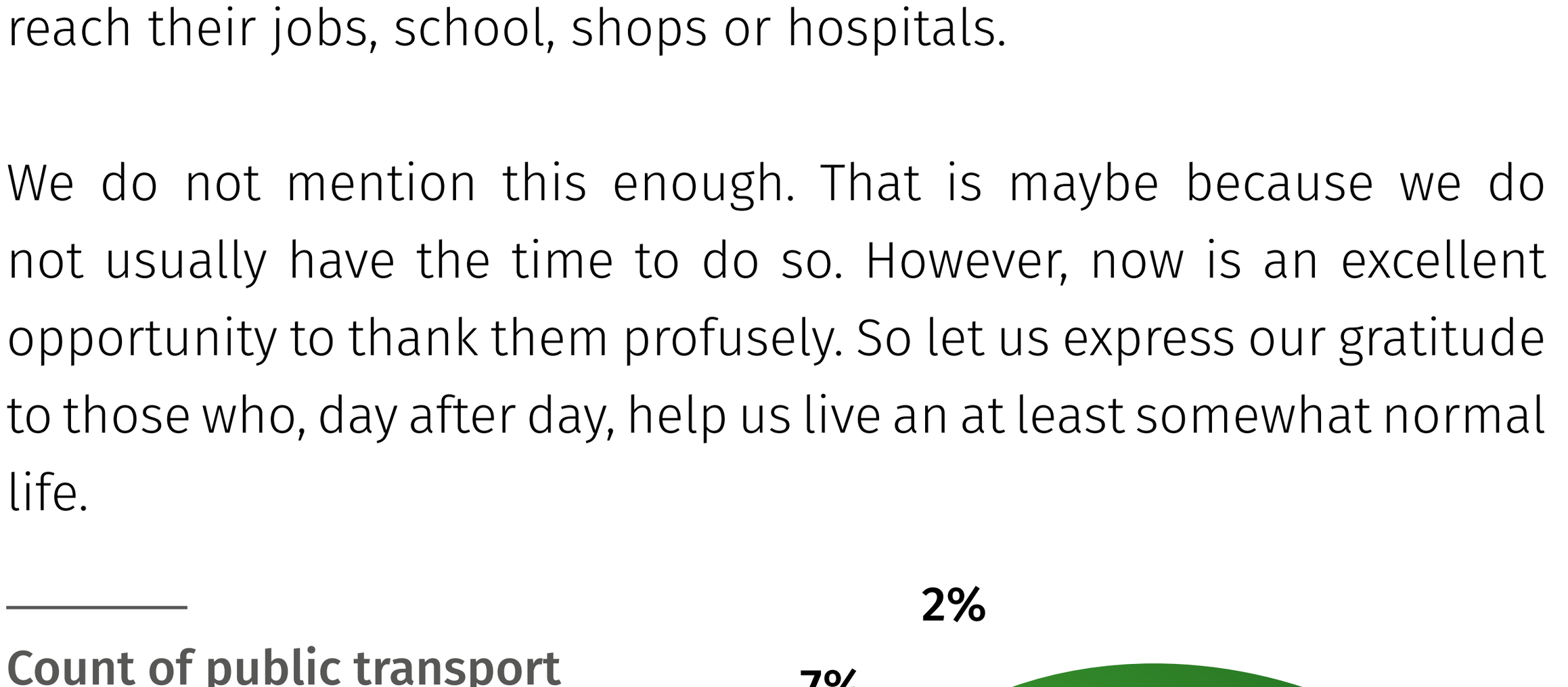
contact between the driver and medical personnel. Meanwhile, following reports of hospital directors about commute problems of healthcare workers, Cracow launched 10 special bus lines for medical professionals. The drivers provided easy passage for doctors and nurses from Cracow suburbs to their work places, ensuring thus more safety not only for them but also for their families and the patients.

Even though we may not always see this, a driver's job is a bond that makes the smooth operation possible for other industries. It is hard to imagine where we would stand now were it not for the daily effort of drivers, and for the assurance that other indispensable workers arrive wherever they are needed.

Drivers are the underestimated, silent heroes of the pandemic. They are not awarded the freedom of working from home. For over a year now drivers have been making it possible for countless people to reach their jobs, school, shops or hospitals.

We do not mention this enough. That is maybe because we do not usually have the time to do so. However, now is an excellent opportunity to thank them profusely. So let us express our gratitude to those who, day after day, help us live an at least somewhat normal life.

Count of public transport vehicles requisitioned for the support of vital areas using the example of Wuhan (Chen et al. 2020)



#25reasonstobeproud

It was clear, for 25 years, that this day would come. However, no-one could have foreseen the circumstances of this event. Even though this may not be the best of times to celebrate, our firm cannot, and will not, gloss over its great anniversary: 25 years of Solaris!

Click & watch all the 25 reasons Solaris can be proud of [VIDEO]

The first bus manufactured by the Bolechowo factory was handed over to a customer exactly on 22 March 1996. It has been 9125 days and 20,000 Solaris buses for us by this day, 22 March 2021. Almost everything has changed at our company in those 25 years. One thing remains unchanged though: the pride we take in our achievements and successes. So we celebrate this anniversary under the motto: 25 Reasons To Be Proud (#25reasonstobeproud), showing everything that was best during those 25 years.

The beginnings may have been modest but they were shaped by ambitions and the desire for more. Solaris started off with a group of 36 employees who worked on a contract for 72 buses for the municipal transport operator MPK in Poznań. The company which initially could not match its competitors in the industry with its size and capital, soon surprised them with its innovative approach and go-getting energy, for instance by being ahead of European trends regarding zero-emission vehicles by nearly a decade. **That is how Solaris works: we create our own future instead of waiting for it.**

Solaris headed into its jubilee year with a staff of over 2500 and having delivered 1560 buses and trolleybuses in 2020. The output of electric drives increased to 44 percent in the firm's total production. That is the way the producer has gone in those 25 years.

Celebrating 25 years of business, Solaris is focusing mostly on the people who create the brand. Among them are 60 employees of the Solaris crew who have been with the company for 25 years. "**Our company is the result of the actions and efforts of all people who came before us, who cooperated with us at different stages. Starting with the company founder and the group of the first 36 employees of course. We are all one Solaris family**," declares Javier Calleja, CEO of Solaris. In those 25 years of work and business Solaris has amassed countless reasons in which it can take pride and satisfaction. These are common achievements and successes. A set of accomplishments that says much about the firm and the people shaping it; a set reflecting who they are and what they can do. These are 25 years spent together. It is a source of pride for all.

"This would not have been possible without you, our clients, suppliers and all business partners, either. That is why I would like to thank you, above all. Thank you for your trust, the close co-operation and all the wonderful things we have created together. As much as we are proud of our past, we should also look boldly and confidently ahead. Together we have achieved so much but I believe that the greatest moments lie still ahead of us," Calleja adds.

1996

The first bus rolls out of the Bolechowo factory – the symbolic beginning of Solaris (Neoplan Polska at that time)

1999

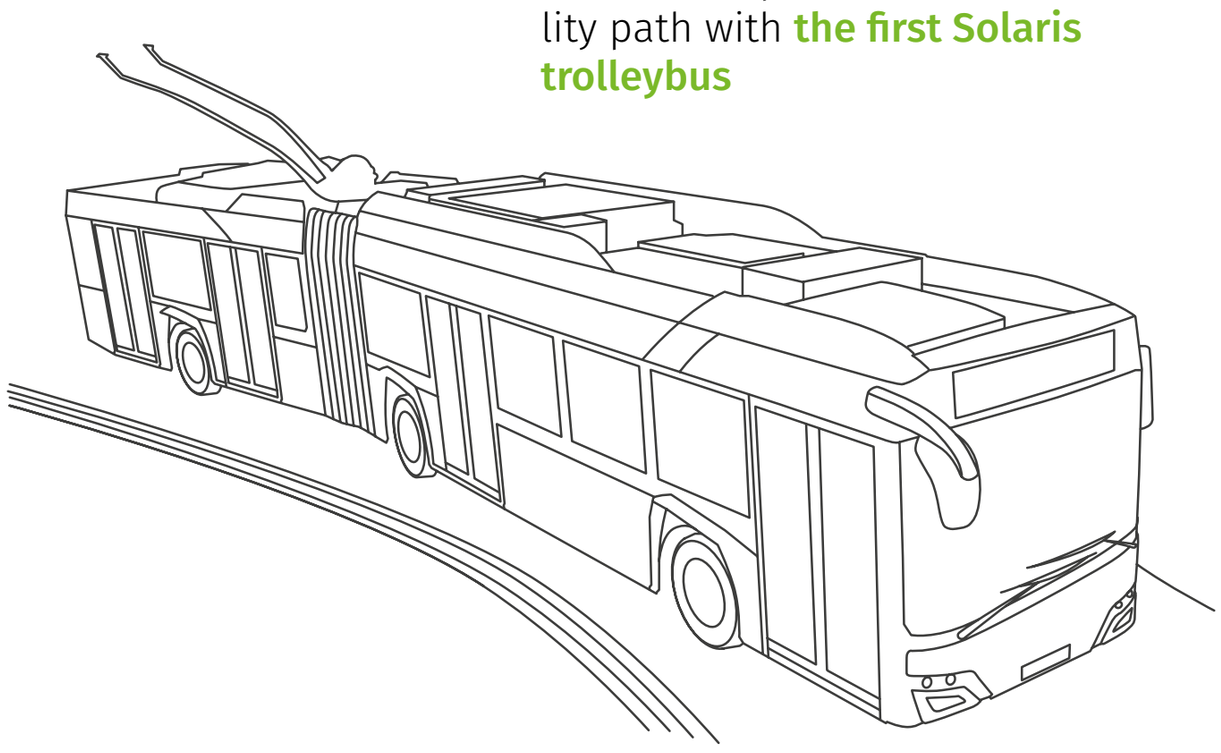
Launch of the first Urbino family vehicle, i. e. the low-floor **Solaris Urbino 12**

2000

The first export contract – Solaris buses roll onto the streets of Ostrava in the Czech Republic

2001

First footsteps on the e-mobility path with **the first Solaris trolleybus**

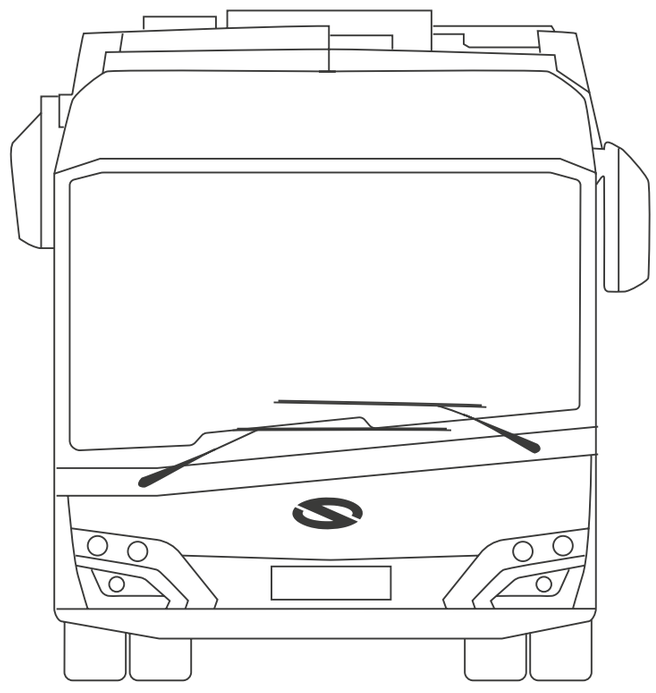


2003

ISO 9001 certification

2006

Solaris Urbino 18 hybrid – the first bus with a hybrid drive in Europe goes into series production



2005

- **Solaris launch the “Safe Driver” project** – over 1000 drivers to date
- **Integrated System Management, ISO certificate 14001.**

2007

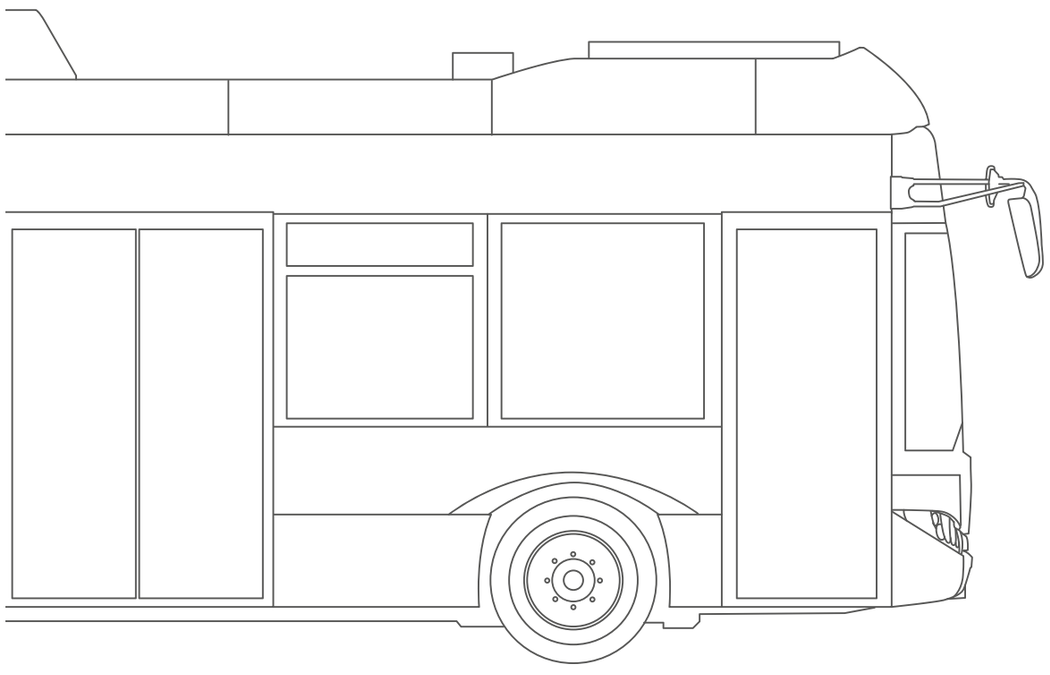
Launch of the vocational training programme – 200 students have participated in the programme to date and 76 graduates have taken up employment with the company

2012

- Opening of the in-house nursery: “**At the Green Dachshund**”
- The establishment of “**Green Dachshund Foundation - for the rescue of the defenceless**” – so far it has designated almost million Polish zlotys to help those most in need

2011

The first Solaris electric bus – Urbino 8,9 electric

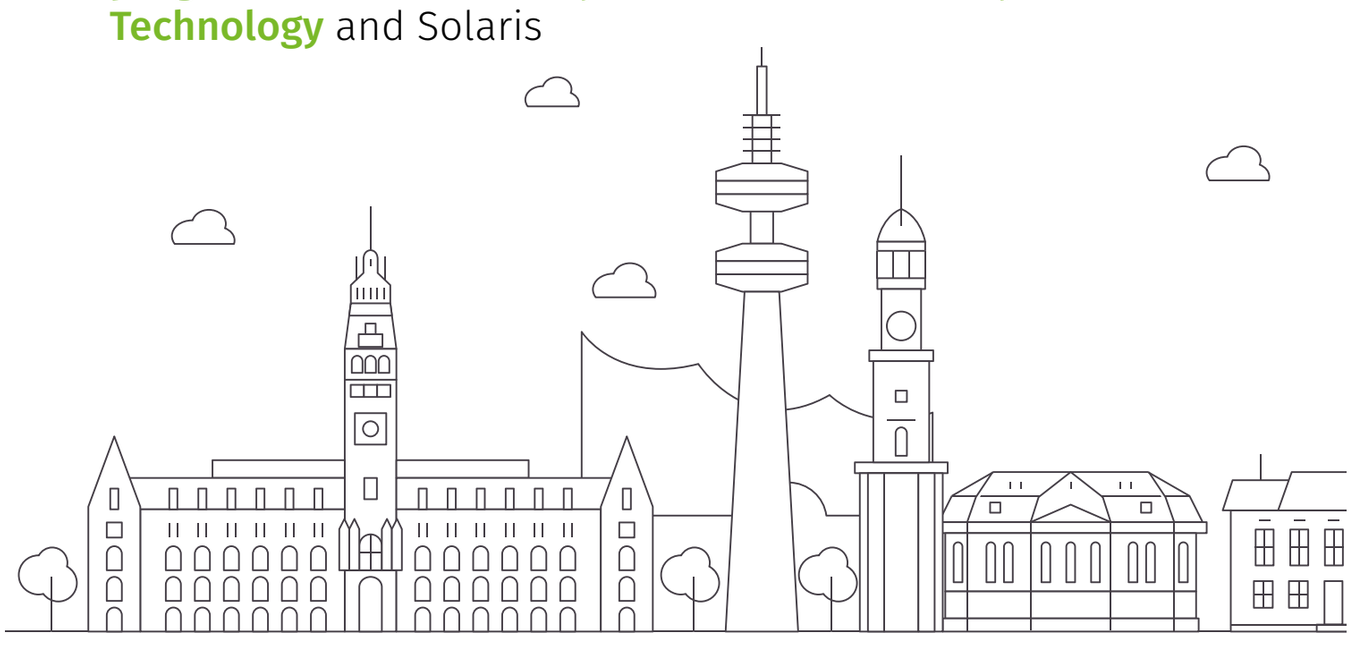


2016

- The Solaris Urbino 12 electric wins the “**Bus of the Year 2017**” title for the best city bus – as the first electric bus ever in the history of the contest
- **Solaris expand production buildings** and increase production capacity by adapting factory operation to series production of emission-free buses

2014

- The new generation of buses and trolleybuses – **a new Solaris bus has its premiere**
- **Delivery of the first bus fitted with a hydrogen fuel cell** to Hamburg
- The first student starts the dual study course **under a programme carried out by the Poznań University of Technology** and Solaris

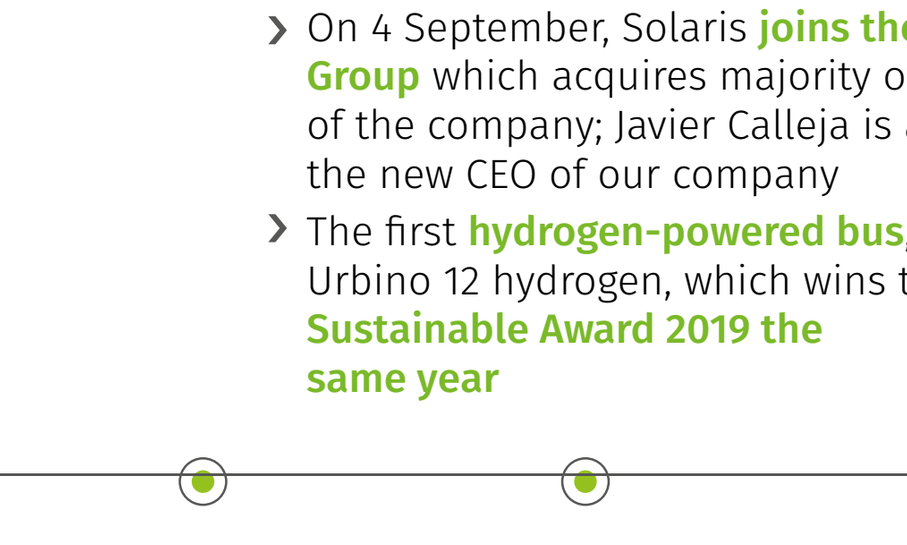


2018

- On 4 September, Solaris **joins the CAF Group** which acquires majority ownership of the company; Javier Calleja is appointed the new CEO of our company
- The first **hydrogen-powered bus**, i. e. the Urbino 12 hydrogen, which wins the **Sustainable Award 2019 the same year**

2017

- **Solaris sign the “Declaration on deployment of clean buses in Europe”**
- The 100th electric bus leaves the factory



2020

- Another electric model, i. e. the **Solaris Urbino 15 LE electric**, to portfolio; it is the first Solaris intercity e-bus
- The bus numbered **20,000 rolls off the production line of the factory in Bolechowo – it is the Urbino 18 electric** bus running on the streets of Warsaw

Solaris Urbino 15 LE electric - tested to the limits [VIDEO]

In its element

It is a frosty February morning. We’re in Bednary, located in the central part of the Greater Poland province, in the buffer zone surrounding the Puszcza Zielonka forest. A Solaris Urbino 15 LE electric bus drives onto the test track. The road surface is slippery, the road conditions difficult. These are the circumstances in which the latest model from the Solaris zero-emission range underwent trials.

The test track in Bednary is the largest driver training centre in Poland. This is the place where we invited five professional drivers with their vast experience to test our brand's latest electric bus in difficult winter conditions. During numerous trials, such parameters as energy consumption, noise levels inside and outside the bus, slalom driving, traction control, acceleration, braking and hill starts were investigated.

The Urbino 15 LE electric bus was designed to feel equally at home in urban surroundings and on intercity routes that are often exposed to changing weather conditions.

This all-electric bus fulfils the requirements for type-approval for both I and II vehicle classes. The test team was able to test the vehicle in conditions for which the model was specifically designed. The Urbino 15 LE electric bus was developed mainly with Scandinavian operators in mind, and such solutions as a built-in sanding system, hybrid heating based on a heat pump, and ADAS or ESC systems help to ensure maximum efficiency and safety.

The drivers who were given the opportunity to test the latest zero-emission Solaris vehicle on the Bednary test track were quickly convinced of its unique qualities. The Urbino 15 LE electric guarantees a comfortable ride due to the quiet and smooth operation of its engine. Use of the third axle to steer provides more stability, better grip, and improved manoeuvrability for the vehicle. A unique, almost luxurious interior, with passenger seats designed for intercity transport, special lighting and armrests, ensures a comfortable ride for passengers.

Drawing on experience acquired by Solaris in the course of manufacturing over 1,000 battery-powered buses, we have designed, tested and perfected an exceptional zero-emission bus - the Solaris Urbino 15 LE.

New Optiline product

Solaris buses cover thousands of kilometres every day on European roads with different types of surfaces and in varying climate conditions. Intensive use of some of the vehicle’s components requires them to be replaced after a certain period of time. One of these components is tie rod ends that are now available as part of the Optiline product range.

Due to tie rod ends’ high exposure to weather conditions and mechanical factors, the quality of materials used to produce them is particularly critical. Indirectly, they need to bear the weight of the whole vehicle and at the same time to react swiftly to the movements of the steering wheel and to ensure safe manoeuvring.

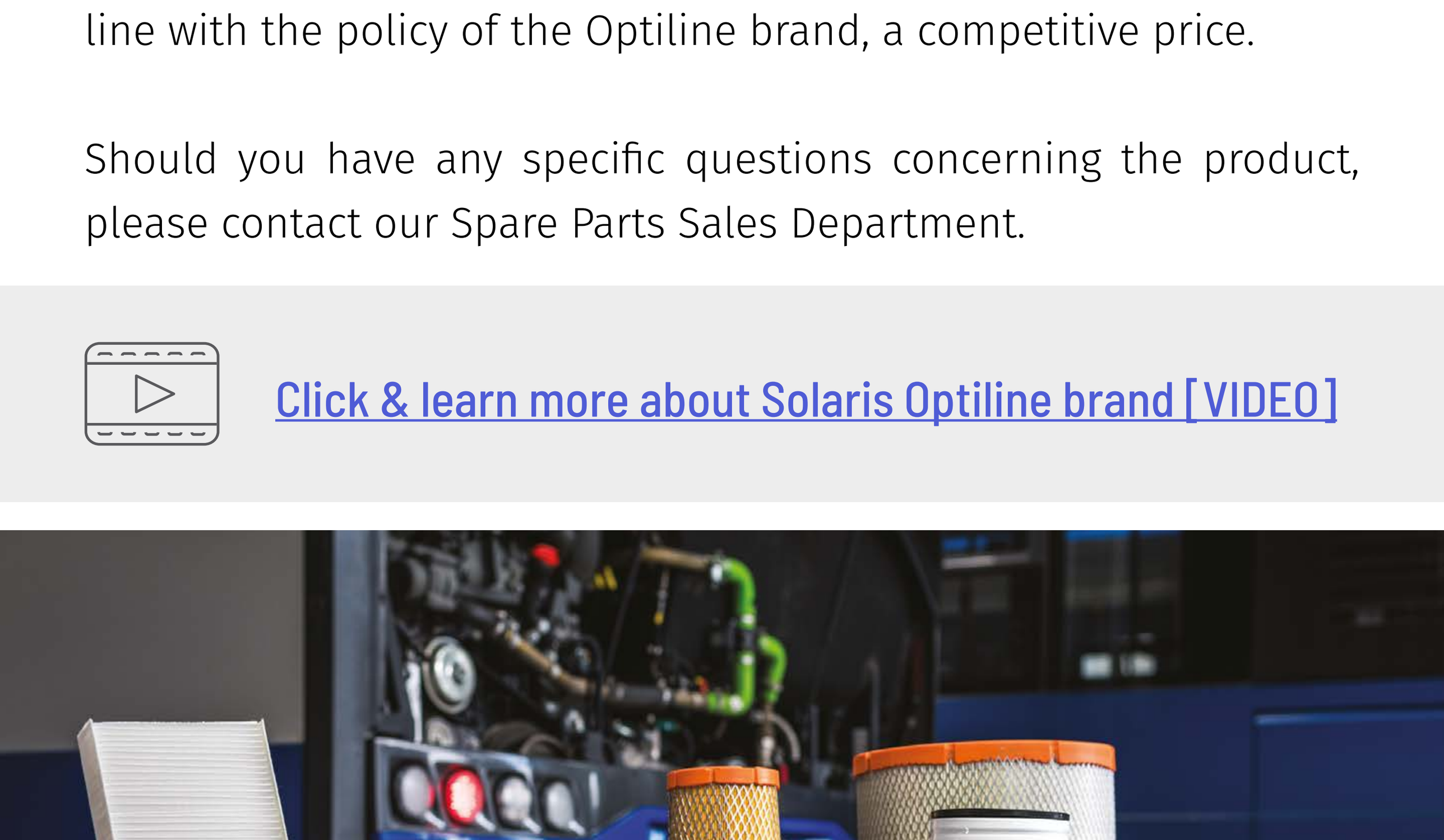
Materials used for the production of Optiline tie rod ends provide not just theoretical high resistance against wear and tear. The finished product has undergone demanding tests during trials on a test track with different types of surfaces. 800,000 km of simulated driving has delivered results showing that the product will provide incredible safety and high resistance levels even with intensive use.

Optiline tie rod ends are equivalents to those most commonly available on the market, no. 0820-352-212 and 0820-352-213. That is why they can be used to repair ZF axles. Thanks to their high quality, proven in practice, they have been accepted by the Technical Office to be used in Solaris vehicles including during the warranty period.

Apart from their high quality and perfect compatibility with the design characteristics of Solaris vehicles, the new product also boasts, in line with the policy of the Optiline brand, a competitive price.

Should you have any specific questions concerning the product, please contact our Spare Parts Sales Department.

Click & learn more about Solaris Optiline brand [VIDEO]



SOLARIS
A CAF GROUP COMPANY

DIRECTION ›
Optiline

Optiline
SOLARIS

Designed by those who brought your bus to life.

Optiline
SOLARIS
OPTI-030-400
E9 90R - 01.943/591
1083851

CAF GROUP

Spare parts

– how do they work at Solaris?

Operational availability is not just a provision included in tenders for the purchase of city buses. It is also a challenge that Solaris addresses every day in order to guarantee its clients Urbino buses that operate in various road conditions and at the highest efficiency in their daily work. One vital element therefore is the availability of spare parts. Below you will find a few words about how we ensure this and how ordered spare parts reach clients.

Atypical configuration? An ageing vehicle?

Identifying parts needed for a repair is often the key to performing a quick repair. There are no secrets here for Solaris's clients. They can easily find all the parts in the documentation placed on the Magbus. global web portal (link) available 24 hours a day. All carriers with Urbino buses in their fleets have access to it. With this knowledge, clients can easily place an order or else they can contact an account manager responsible for their region.

Time is of the essence

We know how important it is. Therefore, Solaris' logistics network has been organised so as to reduce the lead time to a minimum. At its heart is the Solaris Logistics Center, located in Jasin near Poznań. This is the central warehouse from which not only are the most frequently requested parts dispatched, but so too are those that are not that commonly required. The accumulated stock in the SLC warehouse allows us to process orders for rare parts as well as parts needed for older vehicles and ones with unusual configurations. In addition, the SLC supplies regional warehouses with high rotation items and those that meet the specifications of the vehicles deployed in a given region. Thus, parts that may be crucial for the operational

availability of a vehicle can be delivered quickly and directly from the nearest local warehouse. This two-stage model substantially shortens the lead time, resulting in a quicker repair for the client.

Why is it worth buying at SBC

There are a few reasons. But the most important is our profound knowledge of the vehicles we manufacture. We know the ins and outs of our buses so we can help you find the correct part you need at a particular time. At Solaris, we provide you with the whole range of spare parts used in our Urbino and Trollino vehicles. Last but not least, we do our utmost to offer our customers original parts of the highest quality. Thus, we guarantee additional protection, a high level of safety and a long service life for the vehicles.

Need more information?

Contact data for Key Account Managers working in your region is available on the Magbus.global platform. Do not hesitate to contact us.

Click & watch the process of product supply in Solaris Logistics Center, based in Jasin, Poland [VIDEO]

Solaris and representative warehouses

VALUES

our foundation, basis, and guiding principle

At the end of last year Solaris presented an updated set of aspirations, motivations and values binding for the company. On the one hand, these are requirements imposed on employees by the organisation, but on the other, requirements that employees should set for their employer. This is a kind of mutual obligation that defines what Solaris wants to be, how it wants to act, what it is driven by and what the motives behind its decisions are.

“If we want to grow together and be successful, we need to head in a clear and precise direction. We need to agree on what we all, as a company, manufacturer, supplier, employer and as an employee, want to be for ourselves, our surroundings, and especially for our customers. The set of values defining what we do and how we work should become our guiding principle, our roadmap for the years to come. These values should form the basis on which our professional decisions will be taken. What we do in our work, how we do it, what we would like to achieve and in what manner, must result from the

company values we profess", said Javier Calleja, CEO of Solaris, when presenting the new values.

The idea of five values to pervade the organisation constitutes merely the beginning of this path. Another step will be to embed these values in the functioning of the company so that they are discernable at all levels and in every area of its activities every day. They are to become an obvious beacon that we follow in our everyday work as well as features that make up our image and are instantly associated with the Solaris brand.

ASPIRATION

We are changing the image of public transport.

MOTIVATION

Solid and long-lasting relations with our customers and team work. We are proud of our products and innovative technical solutions.

VALUES

Customer orientation
Innovation
Cooperation
Long-term orientation
Agility

First Solaris Sustainability Report

44-percent share of alternative drives in traded vehicles in 2020, close on 700 delivered zero-emission buses, carbon footprint reduction of 51%, energy savings, new values introduced by the company, environmental and social policy, sustainable development vision and goals for the future are only some facts and pieces of information about Solaris activities in 2020 in the field of ESG (Environmental Social Governance). The first Solaris Sustainability Report is available.

> We interpret the mission of implementing the sustainable development idea at Solaris as the systematic expansion of the range of zero-emission vehicles and active support for the cities interested in green change to urban transport. This constitutes the basis for continuous improvements in the production process, as well as in the management of the company and creating a value chain. Solaris shapes its relations with the surrounding world by improving eco-awareness among the company employees, customers and Solaris vehicle users.

Javier Calleja, CEO

“Sustainability Report 2020” is the first publication by Solaris to provide such a comprehensive summary of the company’s activities in the ESG field. The report reflects Solaris’s awareness and shows that its activities don’t stop at the gates of its factory and that all decisions taken and projects implemented or its final products have a tremendous impact on the world around. The report contains a comprehensive description of the organisation’s impact on the economy, environment and communities. The objective of the report is to show the current position of Solaris as an organisation, employer and partner. Moreover, the report has placed the company’s activities in a broader context, but first and foremost it should spark a number of new ESG initiatives and projects in the future.

In its first report the company takes stock of 2020, the anniversary year in which Solaris celebrated 25 years of its market presence. The choice of topics to be covered in the report was not a mere coincidence – it resulted from internal workshops during which key topics for the company were selected and the contributions of our stakeholders who voiced their opinions on the matter. A survey among the stakeholders enabled us to map the most important topics in the field of sustainable development. The content was divided into three main chapters aligned with the main pillars of company’s operations: “Responsibility at every value chain stage”, “People - the greatest value” and “Zero-emission future”.

The report contains many examples of Solaris's activities which reflect the company's commitment to being an accountable partner to our customers and suppliers, as well as an excellent employer, socially responsible company and good neighbour to local communities. Sustainable supply chain, innovative and energy-efficient production solutions, driving CO2 reduction in the company, but also charitable activities and educational programmes are only a part of the challenges the company mentions in the report. A lot of space is also devoted to zero-emission modes of transport, which results from Solaris's conviction that modern cities with accessible, flexible and comfortable public transport may play a key role in the sustainable development of the world.

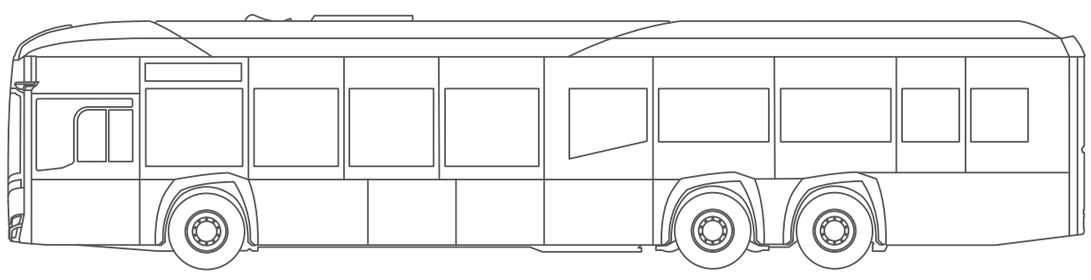
The report was drafted following the GRI Standards, which is an international benchmark for reporting on responsible business and sustainability issues. The report is available at: www.solarisbus.com. To protect the environment the report is available in an online version only.

Since the beginning Solaris has been investing in the research and development of green solutions.

2700 **zero-emission vehicles** in cities

1000 **electric buses** and close on

1700 **trolleybuses**



Caring for the health and safety of our employees is our priority.

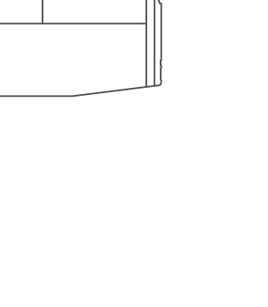
33% **fewer accidents**

(in 2020 as compared to 2019)

We are currently implementing a health and safety management system compliant with

ISO 450001

standard



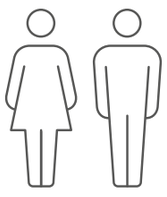
Solaris creates friendly jobs, ensuring the best working conditions to its employees.

2451

headcount in 2021

12% ↑ average annual headcount growth since 1996

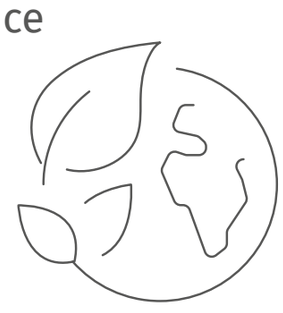
4% employee turnover rate



The company operates in compliance with environmental regulations.

Certified environmental management system based on

ISO 14001



Solaris is aware of the risks stemming from the climate crisis and therefore it is proactive in reducing its carbon footprint.

83% **reduction in emissions**

from electricity in the period 2017-2019

51% **carbon footprint reduction**

(scope 1 & 2) from 2017 to 2019

What we are proud of

0 emission

from our products – is our long-term objective we have pursued consistently by increasing emission-free buses share in our production and sales, thereby having a real impact on **improving the quality of life for citizens.**

For 25 years

we have been **changing the image of public transport** and looking after the comfort of everyday urban trips of millions of passengers across Europe

We have supplied over

20 000 buses

and their **innovation as well as modern and friendly design** has become an inherent part of the landscape of hundreds of European cities and metropolises.

We believe in

electric vehicles

as a **path to the transport of the future** and therefore we have been continuously developing technologies to reduce environmental impact for 20 years.

We build our company together –

2700 people

– in Poland and abroad

Innovative

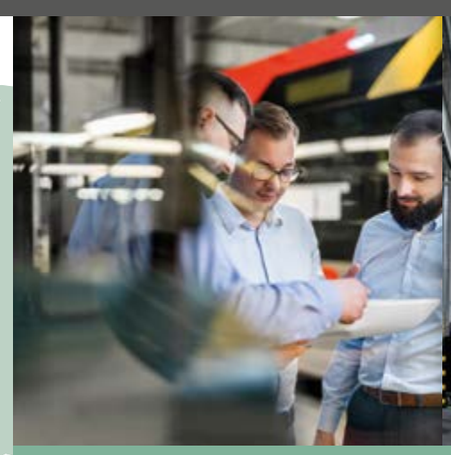
capacity has been our company's trademark and the key to its market success right from the start. Modern public transport is, in our opinion, **the foundation of sustainable cities where the quality of residents' life is the first priority.**

Our buses carry passengers in 32 countries

GRI 201-1

We affect the quality of urban transport by carrying passengers in hundreds of towns and cities across Europe every day.

Over 20,000 buses delivered to 750 cities



Head Office: Bolechowo

GRI 201-1

All our vehicles, from the idea through design to execution, are created in the sites located near Poznań, which makes us one of the largest employers in the region.

In 2020, the total headcount was 2,668, including 217 employees at the subsidiaries based in 13 countries. The two new subsidiaries – in Belgium and the Netherlands – were established in 2021. Our company also has representation offices. **We are present, in total, in 22 countries in Europe and in Israel.**

Subsidiaries

217

Murowana Goślina
Central Workshop
Customer Service Centre
101

Jasin
Solaris Logistics Center
65

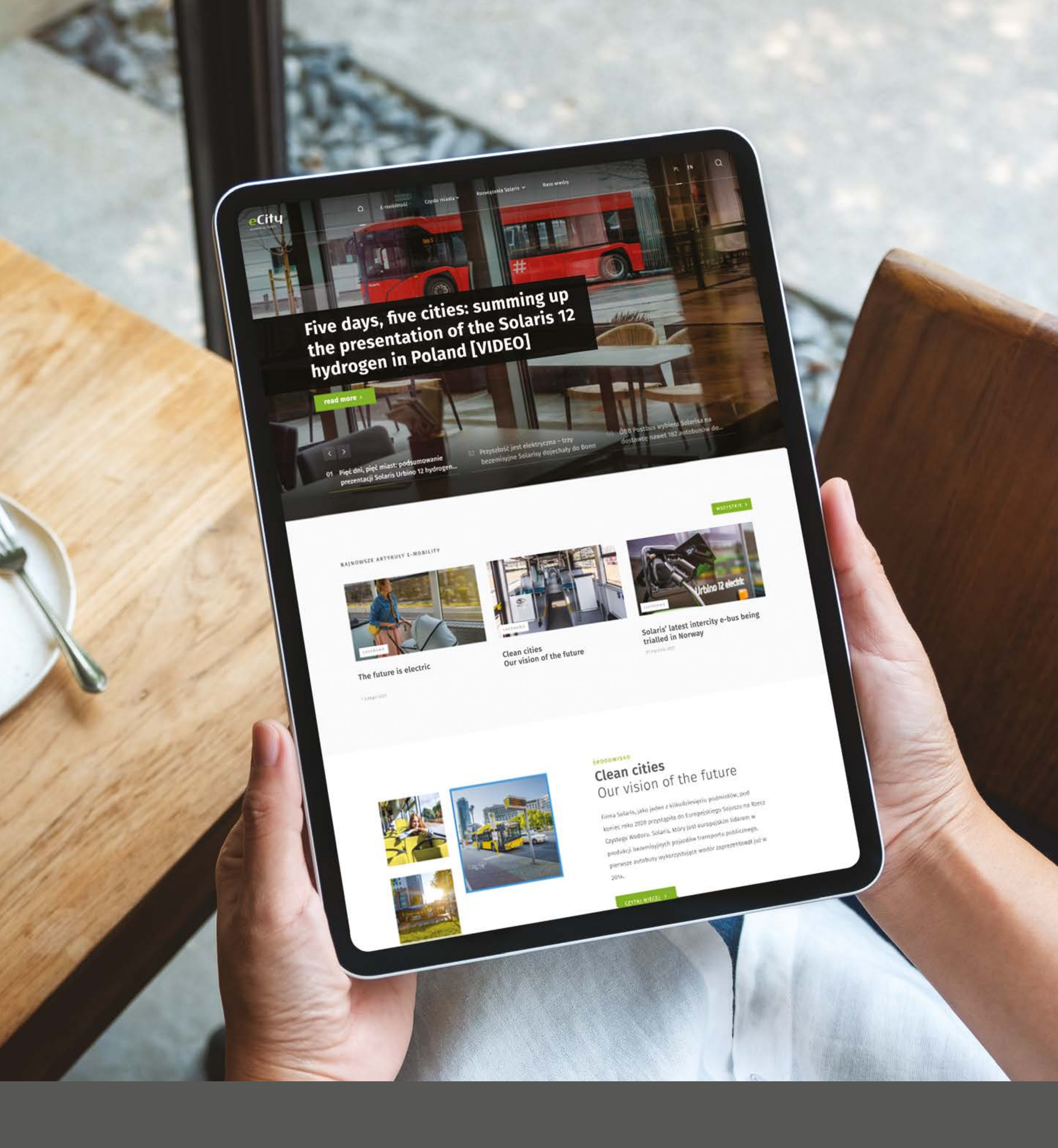
Środa Wlkp./Kijewo
Production of Steel Body Frames
345

BOLECHOWO
Head Office
Bus Production
1847

Poznań
Production Support
93

The Sustainability Report summarising Solaris activities in 2020 in the field of ESG was prepared in Polish and English.

Click & read Solaris Sustainability Report [LINK]



eCity
powered by Solaris

Responding to numerous requests relating to the need for a place that will give an insight into all issues related to e-mobility, in the broadest sense, we have created a unique space: eCity powered by Solaris. This is a web portal entirely dedicated to zero-emission public transport.

Who is the portal for?

For our clients, sector representatives, local governments, journalists, drivers, and all enthusiasts of modern urban transport.

eCity powered by Solaris is an expert web portal, dedicated to all e-mobility issues and promoting the belief that the development of zero-emission technologies is crucial to reaching climate neutrality. Creating eCity, a unique space on the Internet, will allow our company to share with you our extensive experience gained steadily over the past decades in this area, which is particularly important to us all.

What kind of content can you find on eCity powered by Solaris?

The web portal constitutes a comprehensive knowledge database for e-mobility, i.e. the future (and increasingly the present day!) of the automotive industry. The website provides the latest news from the public transport world. We introduce you to terms related to electric and hydrogen buses, trolleybuses, and modern charging infrastructure. We report on the transport of the future and on challenges that decision makers are confronted with while trying to create sustainable towns and cities. We present experiences of carriers that have for years now been benefitting from the advantages of zero-emission fleets. We observe the dynamic changes that are taking place in urban mobility before our very eyes: the last mile concept, transport on demand, micromobility, car-sharing, and autonomous vehicles. We share our competence in what we are best at: in the area of environmentally- and resident-friendly zero-emission vehicles.

E-mobility is a colourful world changing literally from one day to another, and one that we - with great pleasure - would like to gradually introduce you to. eCity will be updated on an ongoing basis, which is why we invite you to visit the website regularly. Sign up to the newsletter available directly on the website and stay up to date with all the new articles and developments.

Click & visit the website [LINK]

SOLARIS

A CAF GROUP COMPANY

Our experience, your safety

Thank you for your trust

CAF GROUP