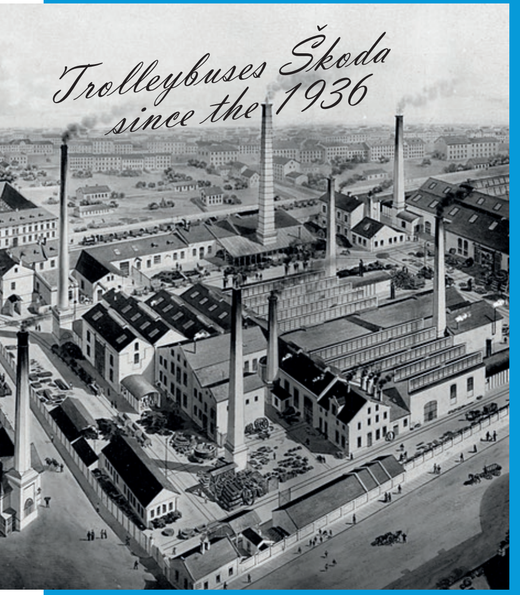

ŠKODA
TROLLEY | BATTERY
BUSES

FUTURE TECHNOLOGY



HISTORY OF TROLLEYBUS PRODUCTION

In 1936 the first trolleybus with the type designation Škoda 1Tr was designed and built in Plzeň. Efficient, comfortable and convenient, this new means of transport quickly became very popular, and so was followed two years later by another type, the Škoda 2Tr. One of the most successful types in the history of Czech trolleybuses is the Škoda 9Tr, which Škoda produced for a full 21 years and supplied a total of 7 400 vehicles to markets abroad, such as to Poland, East Germany, Afghanistan and the former USSR. Increasing demand for the capacity to carry large numbers of passengers led to the development of articulated trolleybuses, including the well-known Škoda 15Tr. In the early 90s Škoda produced the first Škoda 21Tr low-floor trolleybus, which since the end of the 90s has been capable of autonomous operation due to its auxiliary diesel aggregate.

Many changes took place throughout Škoda at the beginning of the new millennium. New customers are sought for trolleybuses and Škoda is hugely successful with American carriers in Dayton, San Francisco and Boston. The firm begins to collaborate with suppliers of bus bodies, the first being the Irisbus concern with Iveco. This led to the launch of the Škoda 24Tr in 2003 and the articulated 25Tr version a year later. Transport companies' diverse requirements led to Škoda Electric expanding its production portfolio to include other trolleybus types, and in 2008 the firm started to work with the Polish manufacturer Solaris Bus&Coach on the Škoda 26Tr, 27Tr and 28Tr; two years later it began to cooperate with the Czech bus manufacturer SOR Libchavy and added the Škoda 30Tr and the articulated Škoda 31Tr. The list certainly does not end here, however. Škoda electrical equipment can be installed on virtually any bus body, and in the modern era these buses have included Neoplan, Belkommunmaš, Ikarus, Breda Menarinibus and the Mexican DINA.

During their long and successful history Škoda trolleybuses have found their way into hundreds of cities on three continents and in 2014 Škoda Electric produced its jubilee 14 000th trolleybus as part of its record contract for the supply of 125 modern trolleybuses to the Latvian capital Riga. Other important foreign projects includes supplies to Bratislava, Budapest, Sofia, Žilina and Bologna. There is also a considerable interest in the modernization of existing Škoda trolleybuses, such as in the US city of Boston.

COMPANY PROFILE

There are few brands that have made the Czech Republic as famous throughout the world as Škoda in Plzeň. Škoda Electric, which is part of the Škoda Transportation group, is an experienced manufacturer of traction drives and traction motors for locomotives, trams, EMUs, metro trains and mining vehicles and is also a leading producer **of trolleybuses and battery-powered buses**. The company prioritises the use of cutting-edge technology for its modern urban public transport and rail vehicles. It invests an average of 5% of its annual turnover in the development of new products. The company employs around 800 people, more than 200 of whom are specialists in technical development, projects and construction.

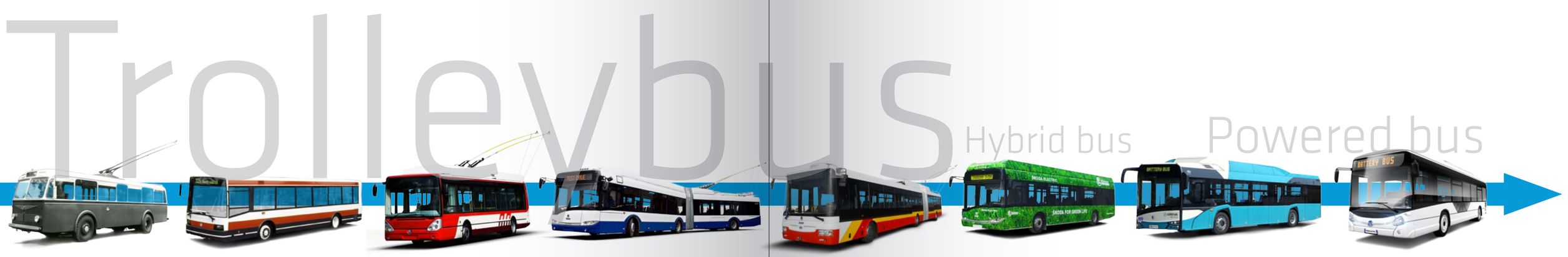
Škoda Electric is a stable, strong and experienced European company, which guarantees quality, reliability and long-term cooperation. It continues in the tradition of the Škoda Works in Plzeň, which dates back more than one hundred and fifty years.

150
let historie

75%
výroby je pro export

800
zaměstnanců

5%
obratu je investováno do vývoje



EVOLUTION

FROM THE TROLLEYBUS TO THE BATTERY-POWERED BUS

Škoda has been developing and manufacturing trolleybuses since the 1930s, when it refined its technology enough to enable **trolleybuses** to be put into operation in cities. Thanks to the skills and know-how of the technicians from the Škoda plant, the vehicle with the two characteristic 'feelers' on the roof soon proved that it was irreplaceable in public transport and became a popular form of transport for many decades.

The second phase in the evolution of urban transport is the **hybrid bus**, which uses a battery drive in addition to its diesel motor. It can run for several kilometres on the battery drive and is designed primarily for use in city centres. However, it still uses the diesel engine, and so is not a 100% environmentally-friendly vehicle.

The increasing demand for passenger comfort on public transport, environmental concerns and the expansion of individual transport routes led to the development of **partial trolleybuses**, which are equipped with an auxiliary drive, which allows them to travel several kilometres away from the overhead line. The first partial trolleybuses were equipped with a diesel generator or supercapacitors. The new trend is to fit trolleybuses with traction batteries, meaning the vehicles are entirely environmentally-friendly and emission-free.

Battery-powered buses represent the cutting edge of technological development. Škoda Electric offers three types in its portfolio: a battery bus with standard recharging, with a fast charging option using a Škoda charging station or a version with opportune recharging. Recharging technology can be combined and a specific solution can be completely adapted to suit the specific needs of the customer.

The advantage of battery-powered buses is that they are environmentally-friendly as they are quiet and emission-free. These properties make them ideal for use in historical city centres, suburban residential areas or the protected zones of national parks; basically, any place where ecology is more than a mere formality.

Škoda Electric successfully develops its electro-mobility projects in the Czech Republic and abroad. Cities with experience of Škoda Perun battery-powered buses include Hradec Králové, Plzeň, České Budějovice and Třinec, as well as Nové Zámky in Slovakia.

12m TROLLEYBUS

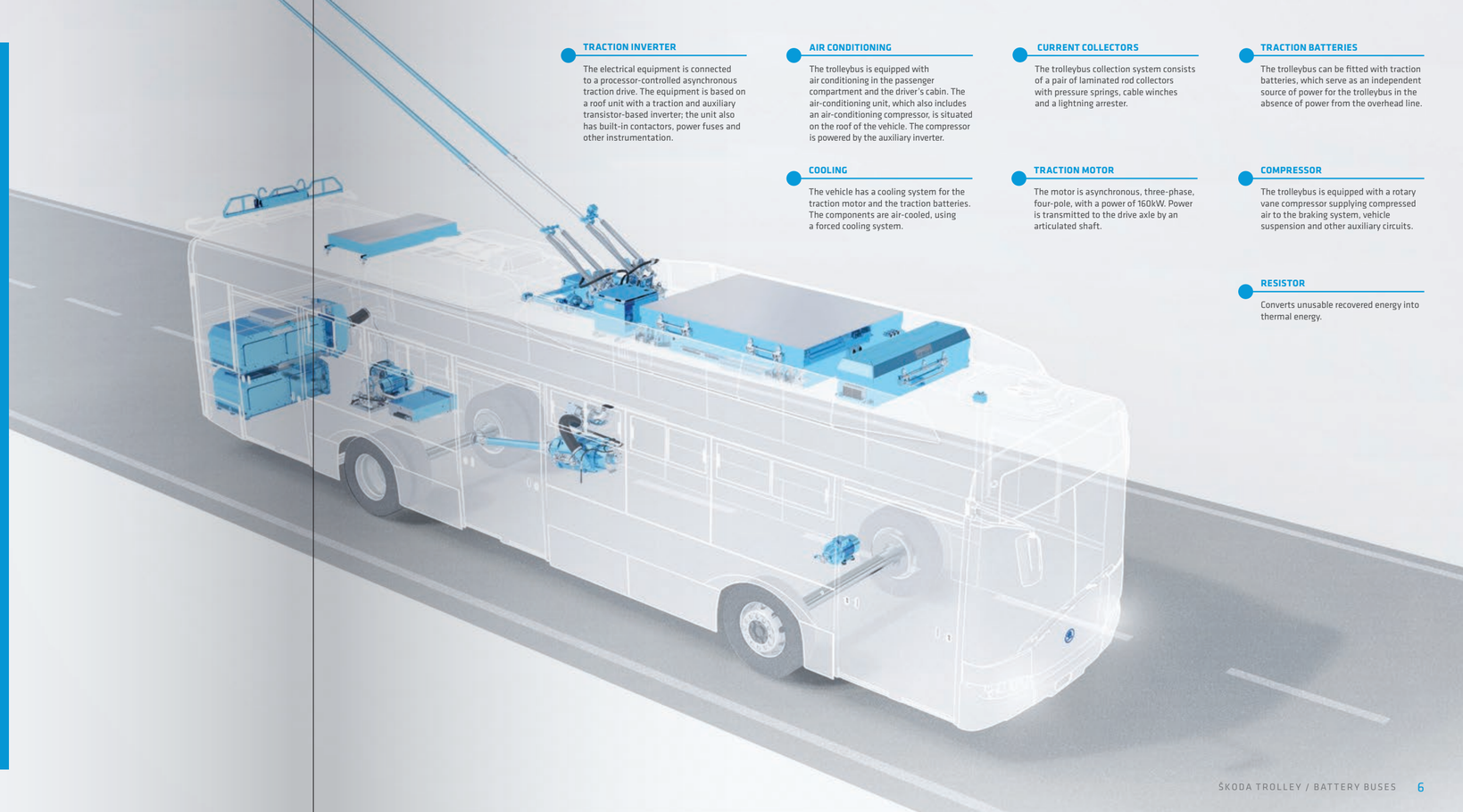
Škoda Electric Plzeň offers a standard twelve-metre fully low-floor trolleybus. This trolleybus can be three- or four-door and can be operated on lines with a voltage of 600 or 750 V DC. All the electrical equipment is housed in a single compact container on the roof of the vehicle. Passenger comfort is increased by the fact that the vehicle is fully low-floor, with wide aisles between the seats, a clear information system and a tilt-out platform for wheelchair users. The vehicle is also capable of recovering energy when braking and enables kneeling, making it easier to board and exit the vehicle. This type of trolleybus has proven very popular with customers and is in great demand both in this country and abroad.

OTHER TROLLEYBUS EQUIPMENT:
The trolleybus may also be fitted with traction batteries, which are housed in the rear of the vehicle and enable it to fully operate away from the overhead line. Riding the trolleybus is made even more comfortable by a powerful heating system, air conditioning in the driver's cabin and throughout the passenger compartment, a camera system and semi-automatic collectors.

REFERENCES:
Škoda's short trolleybuses are successful in hundreds of cities on three continents. Some of the firm's biggest contracts include the supply of 100 trolleybuses to four major cities in Bulgaria, contracts for Slovakia (e.g. for the cities of Bratislava, Žilina, Prešov and Banská Bystrica), and battery-drive projects for the Czech Republic (Ostrava, Plzeň, Zlín) and abroad (Castellon and Cagliari).a zahraničí (Castellon nebo Cagliari).

BASIC TECHNICAL DESCRIPTION:

Length	12 000 – 12 180 mm
Width	2 550 mm
Height	3 400 – 3 450 mm
Max. speed	65 km/h
No. of passengers	up to 102 (depending on vehicle specification)



TRACTION INVERTER
The electrical equipment is connected to a processor-controlled asynchronous traction drive. The equipment is based on a roof unit with a traction and auxiliary transistor-based inverter; the unit also has built-in contactors, power fuses and other instrumentation.

AIR CONDITIONING
The trolleybus is equipped with air conditioning in the passenger compartment and the driver's cabin. The air-conditioning unit, which also includes an air-conditioning compressor, is situated on the roof of the vehicle. The compressor is powered by the auxiliary inverter.

CURRENT COLLECTORS
The trolleybus collection system consists of a pair of laminated rod collectors with pressure springs, cable winches and a lightning arrester.

TRACTION BATTERIES
The trolleybus can be fitted with traction batteries, which serve as an independent source of power for the trolleybus in the absence of power from the overhead line.

COOLING
The vehicle has a cooling system for the traction motor and the traction batteries. The components are air-cooled, using a forced cooling system.

TRACTION MOTOR
The motor is asynchronous, three-phase, four-pole, with a power of 160kW. Power is transmitted to the drive axle by an articulated shaft.

COMPRESSOR
The trolleybus is equipped with a rotary vane compressor supplying compressed air to the braking system, vehicle suspension and other auxiliary circuits.

RESISTOR
Converts unusable recovered energy into thermal energy.

18m TROLLEYBUS

This is an eighteen-metre articulated trolleybus, designed for urban public transport and with the capacity to carry larger numbers of passengers. The articulated trolleybus can be four- or five-door for convenient boarding and exit and can be operated on lines with a voltage of 600 or 750 V DC. The Škoda electrical equipment is housed in a container on the roof of the vehicle, the roof unit. Passenger comfort is increased by the fact that the vehicle is fully low-floor, with wide aisles between the comfortable seats. The energy needed to power the vehicle and maintenance costs are significantly reduced by the Škoda asynchronous traction motor and microprocessor-controlled voltage inverter with recuperation capacity. The trolleybus also has a tilting platform for wheelchair users and a modern information system.

OTHER TROLLEYBUS EQUIPMENT:
The articulated trolleybus can be equipped with an auxiliary battery drive, enabling the vehicle to operate away from the overhead line. At the customer's request the trolleybus can also be fitted with a system for counting the number of passengers, air conditioning for the driver and passengers, a powerful heating system and an alcohol tester.

REFERENCES:
Škoda articulated trolleybuses have been a great success not only in Czech cities (České Budějovice, Ostrava, Ústí nad Labem and Brno), but also abroad. Škoda has supplied over 100 trolleybuses to Slovakia and new battery-powered trolleybuses are in operation both in cities in the Czech Republic (České Budějovice) and abroad (Szeged, Budapest).

BASIC TECHNICAL DESCRIPTION:

Length	18 000 – 18 750 mm
Width	2 550 mm
Height	3 400 – 3 450 mm
Max. speed	65 km/h
No. of passengers	up to 167 (depending on vehicle specification)

TRACTION INVERTER
The electrical equipment is connected to a processor-controlled asynchronous traction drive. The equipment is based on a roof unit with a traction and auxiliary transistor-based inverter; the unit also has built-in contactors, power fuses and other instrumentation.

AIR CONDITIONING
The trolleybus is equipped with air conditioning in the passenger compartment or the driver's cabin. The air-conditioning unit, which also includes an air-conditioning compressor, is situated on the roof of the vehicle. The compressor is powered by the inverter.

CURRENT COLLECTORS
The trolleybus collection system consists of a pair of laminated rod collectors with pressure springs, cable winches and a lightning arrester.

TRACTION BATTERIES
The trolleybus can be fitted with traction batteries, which serve as an independent source of power for the trolleybus in the absence of power from the overhead line.

COOLING
The vehicle has a cooling system for the traction motor and the traction batteries. The components are air-cooled, using a forced cooling system.

TRACTION MOTOR
The motor is asynchronous, three-phase, six-pole, with a power of 250kW. Power is transmitted to the drive axle by an articulated shaft.

COMPRESSOR
The trolleybus is equipped with a rotary vane compressor supplying compressed air to the braking system, vehicle suspension and other auxiliary circuits.

RESISTOR
Converts unusable recovered energy into thermal energy

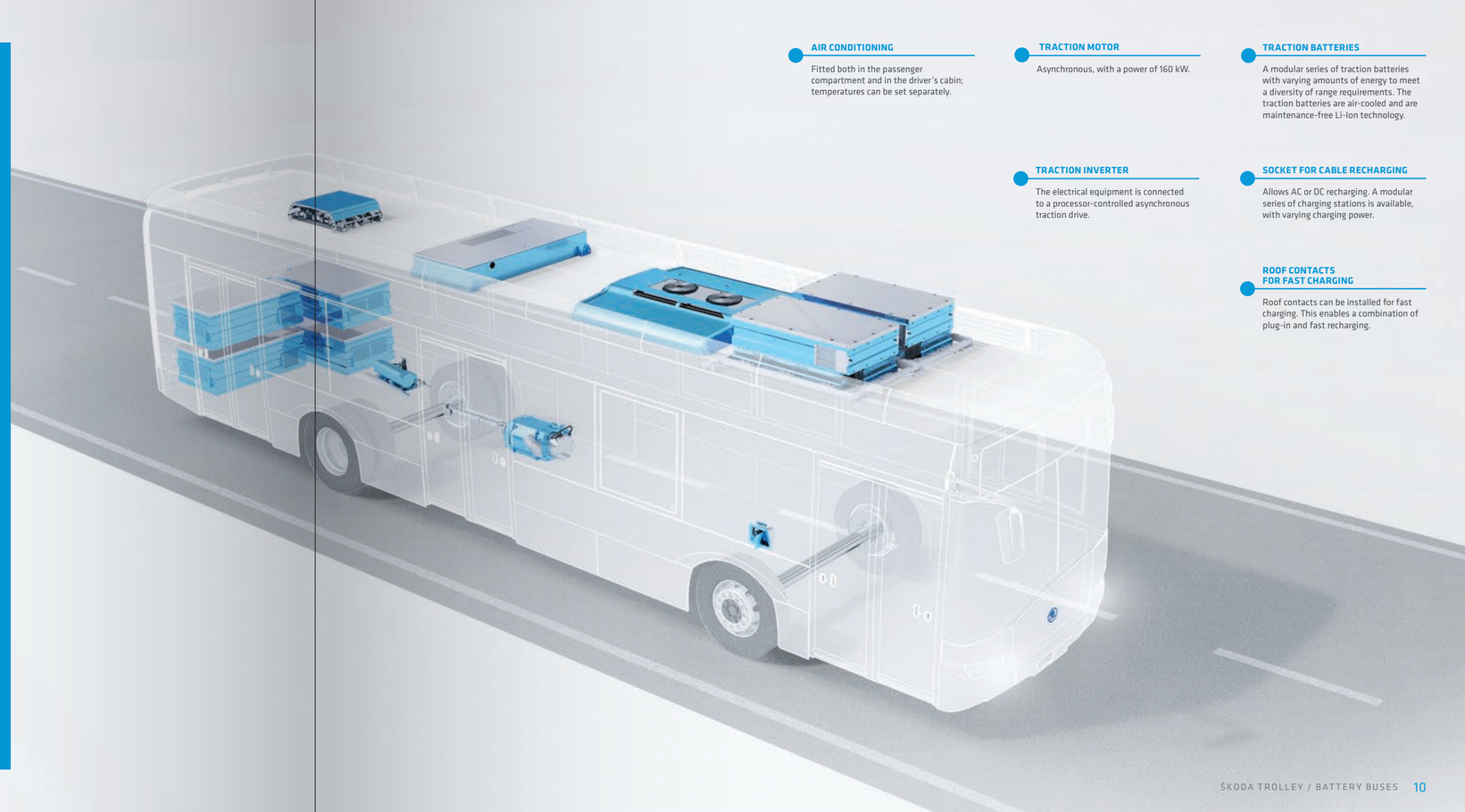
ELECTRIC BUS
PLUG-IN

The Škoda PERUN HE (High Energy) is a 12-metre modern battery-powered bus fitted with high-energy-density lithium-ion (Li-Ion) batteries to enable long journeys on a single charge. When fully charged the electric bus has a range of 150 – 200 km in cities and carrying passengers. The vehicle can be charged in the standard manner in the depot, while the vehicle is parked at night, for 6 – 8 hours, or in 70 minutes using a Škoda high-power fast-charging station.

This makes the Škoda PERUN HE suitable for longer-range lines, where the necessary fast-charging infrastructure is not available or when there is insufficient time for fast charging. The advantage of night-time recharging is that it balances the individual cells of the batteries to the same level of charge. The total vehicle capacity is 82 passengers, 27 seated.

BASIC TECHNICAL DESCRIPTION:

Length	12 000 mm
Width	2 550 mm
Height	3 250 mm
Power	160 kW
Max. speed	80 km/h
Range	up to 200 km
Batteries	maintenance-free Li-Ion
Night-time recharging	within 5 hours
Fast charging option	



AIR CONDITIONING

Fitted both in the passenger compartment and in the driver's cabin; temperatures can be set separately.

TRACTION MOTOR

Asynchronous, with a power of 160 kW.

TRACTION BATTERIES

A modular series of traction batteries with varying amounts of energy to meet a diversity of range requirements. The traction batteries are air-cooled and are maintenance-free Li-Ion technology.

TRACTION INVERTER

The electrical equipment is connected to a processor-controlled asynchronous traction drive.

SOCKET FOR CABLE RECHARGING

Allows AC or DC recharging. A modular series of charging stations is available, with varying charging power.

ROOF CONTACTS FOR FAST CHARGING

Roof contacts can be installed for fast charging. This enables a combination of plug-in and fast recharging.

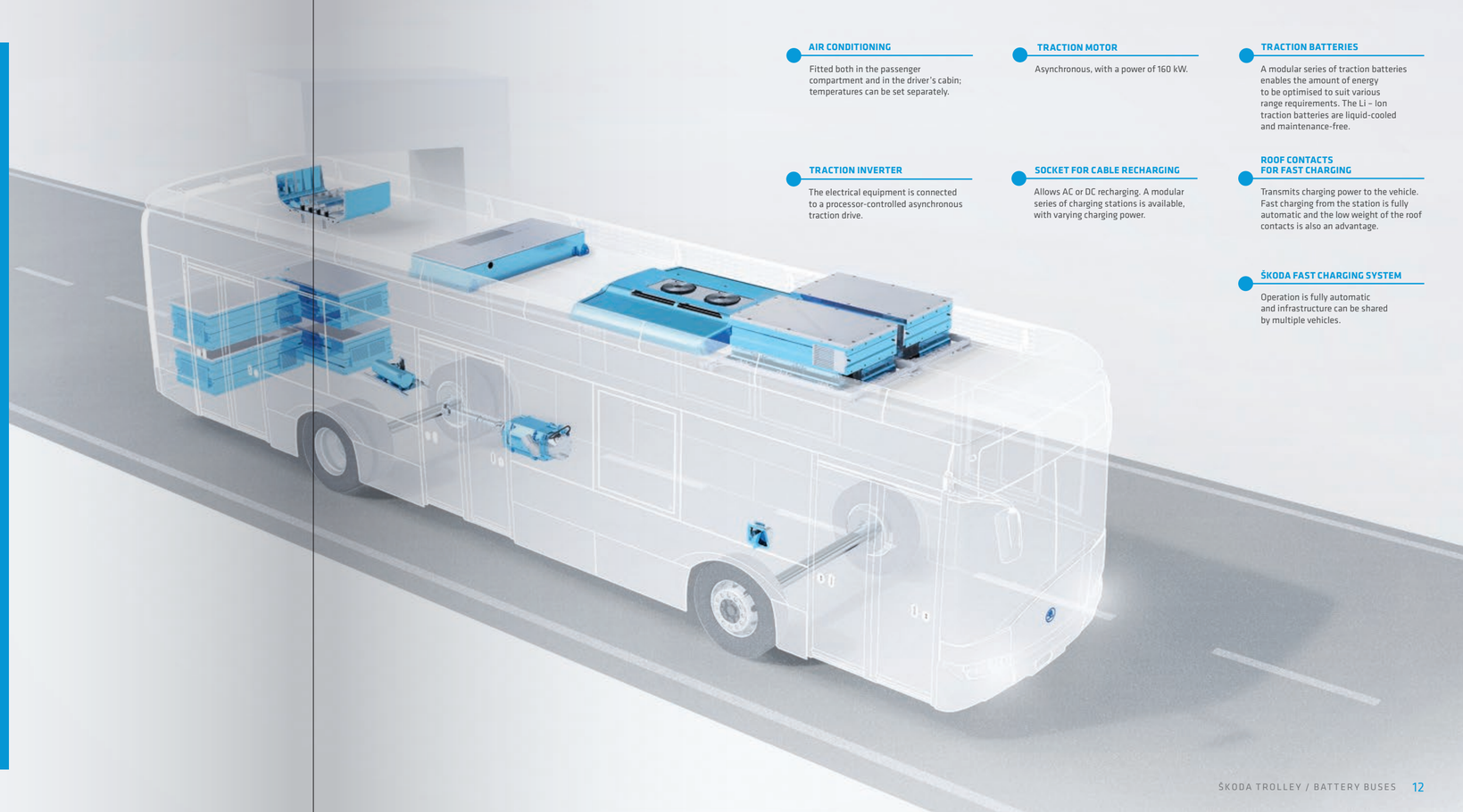
ELECTRIC BUS
FAST CHARGING

The Škoda PERUN HP (High Power) battery-powered bus is an advanced twelve-metre vehicle fitted with batteries using the very latest developments in nanotechnology. The high-density batteries enable the vehicle to be charged in 5-8 minutes using the Škoda "Ultra Fast Charger" fully automatic fast charging station. The battery bus has a range of approx. 35 km on a single charge, making it suitable for use on regular routes. As the batteries recharge quickly, there are practically no limitations on the operation of the electric bus. Recharging infrastructure is installed at intermediate or final stops. Škoda's sophisticated solution reduces the weight and the cost of the vehicle, as the recharging infrastructure is shared by multiple vehicles, maximising their workload. The waste heat generated as the batteries are water-cooled can be used to heat the passenger compartment. The Škoda PERUN HP battery-powered bus has capacity for 58 passengers standing and 27 seated.

The Škoda PERUN HP is the top-of-the-range solution for forward-thinking customers who are not afraid to move with the times. Together with the Škoda fully automatic fast charging station, this is an excellent alternative for demanding urban routes.

BASIC TECHNICAL DESCRIPTION:

Length	12 000 mm
Width	2 550 mm
Height	3 250 mm
Power	160 kW
Max. speed	80 km/h
Range	25-35 km
Batteries	Li-Ion
Fast charging	cyclical fast charging ≤ 8 minutes



AIR CONDITIONING

Fitted both in the passenger compartment and in the driver's cabin; temperatures can be set separately.

TRACTION MOTOR

Asynchronous, with a power of 160 kW.

TRACTION BATTERIES

A modular series of traction batteries enables the amount of energy to be optimised to suit various range requirements. The Li – Ion traction batteries are liquid-cooled and maintenance-free.

TRACTION INVERTER

The electrical equipment is connected to a processor-controlled asynchronous traction drive.

SOCKET FOR CABLE RECHARGING

Allows AC or DC recharging. A modular series of charging stations is available, with varying charging power.

ROOF CONTACTS FOR FAST CHARGING

Transmits charging power to the vehicle. Fast charging from the station is fully automatic and the low weight of the roof contacts is also an advantage.

ŠKODA FAST CHARGING SYSTEM

Operation is fully automatic and infrastructure can be shared by multiple vehicles.

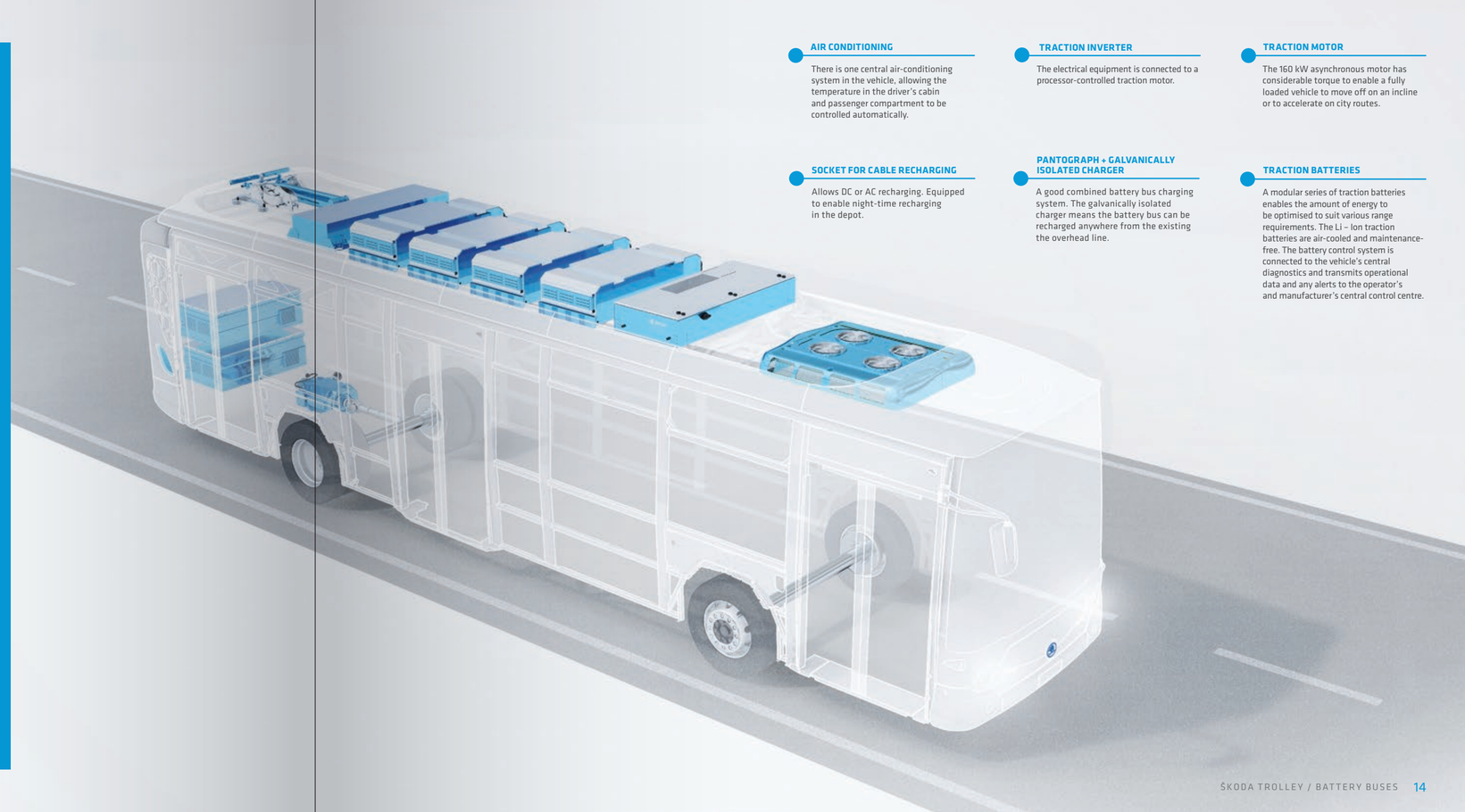
ELECTRIC BUS
OPPORTUNE RECHARGING

The electric bus featuring opportune recharging enables the vehicle's traction batteries to be recharged from the overhead line. This type of recharging is suitable wherever tram or trolleybus infrastructure is already installed. The batteries are charged by a pantograph on the roof of the vehicle. The great advantage of this solution is that the customer does not have to install any other unique charging infrastructure and can optimise operations for longer daily routes than would otherwise be possible on a single battery charge. The ŠKODA opportune electric bus recharging system is a unique solution, where the charger can be galvanically isolated either in the vehicle itself, enabling its batteries to be charged practically anywhere within reach of the overhead line, or alternatively outside the vehicle at a fixed charging point. The slow recharging essential for balancing the individual battery cells can be arranged in the same way or the charging system can be fitted with a socket to connect a PLUG IN DC charger of the general automotive standard (COMBO).

This solution is ideal for demanding customers seeking a way to run environmentally-friendly lines in cities on long routes or routes with complex profiles, or who want to increase transport capacity by reducing the size of the traction batteries.

BASIC TECHNICAL DESCRIPTION:

Length	12 000 mm
Width	2 550 mm
Height	3 250 mm
Motor power	160 kW
Max. speed	80 km/h
Range	150 - 300 km depending on configuration selected
Batteries	Li-Ion (55 kWh / pack)



AIR CONDITIONING

There is one central air-conditioning system in the vehicle, allowing the temperature in the driver's cabin and passenger compartment to be controlled automatically.

TRACTION INVERTER

The electrical equipment is connected to a processor-controlled traction motor.

TRACTION MOTOR

The 160 kW asynchronous motor has considerable torque to enable a fully loaded vehicle to move off on an incline or to accelerate on city routes.

SOCKET FOR CABLE RECHARGING

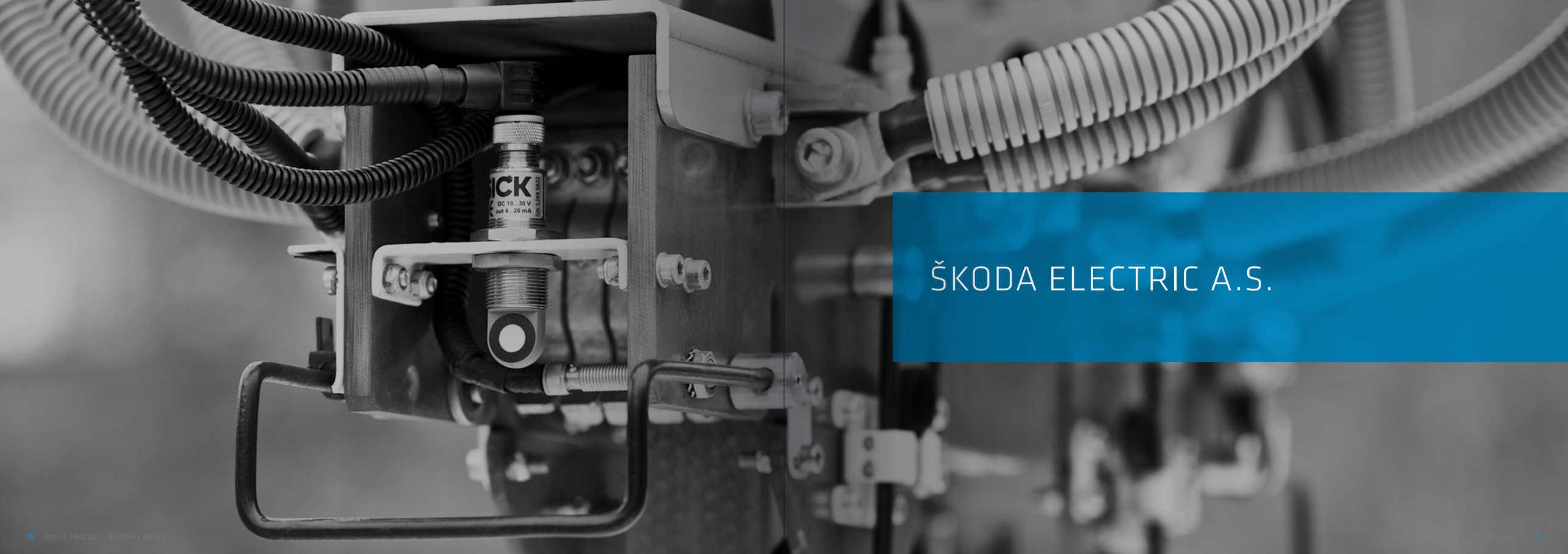
Allows DC or AC recharging. Equipped to enable night-time recharging in the depot.

PANTOGRAPH + GALVANICALLY ISOLATED CHARGER

A good combined battery bus charging system. The galvanically isolated charger means the battery bus can be recharged anywhere from the existing the overhead line.

TRACTION BATTERIES

A modular series of traction batteries enables the amount of energy to be optimised to suit various range requirements. The Li – Ion traction batteries are air-cooled and maintenance-free. The battery control system is connected to the vehicle's central diagnostics and transmits operational data and any alerts to the operator's and manufacturer's central control centre.



ŠKODA ELECTRIC A.S.

ŠKODA ELECTRIC a.s.
Tylova 1/57
301 28 Pilsen
Czech Republic

T +420 378 181 155
F +420 378 181 452
E electric@skoda.cz

www.skoda.cz