Urban Pathways

MAJOR BUS MANUFACTURERS - AN OVERVIEW OF THEIR FLAGSHIP MODELS

Source: (Land Transport guru 2020) (BNEF 2018, p. 6)

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The Urban Pathways project helps delivering on the Paris Agreement and the NDCs in the context of the New Urban Agenda and the Sustainable Development Goals. It has established a facility in close cooperation with other organisations and networks active in this area to support national and local governments to develop action plans and concrete implementation measures to boost low-carbon urban development. This builds on UN-Habitat's role as "a focal point on sustainable urbanisation and human settlements including in the implementation and follow-up and review of the New Urban Agenda". The project develops national action plans and local implementation concepts in key emerging economies with a high mitigation potential. The local implementation concepts are being developed into bankable projects, focusing on the access to urban basic services to create a direct link between climate change mitigation and sustainable development goals.

Project concept

The project follows a structured approach to boost Low Carbon Plans for urban mobility, energy and waste management services that deliver on the Paris Agreement and the New Urban Agenda. The project works on concrete steps towards a maximum impact with regards to the contribution of urban basic services (mobility, energy and waste management) in cities to global climate change mitigation efforts and sustainable and inclusive urban development. This project makes an active contribution to achieve global climate change targets to a 1.5°C stabilisation pathway by unlocking the global emission reduction potential of urban energy, transport and resource sectors. The project will contribute to a direct emission reduction in the pilot and outreach countries, which will trigger a longer term emission reduction with the aim to replicate this regionally and globally to make a substantial contribution to the overall emission reduction potential.

Project aims

This project implements integrated urban services solutions as proposed in the New Urban Agenda providing access to jobs and public services in urban areas, contributing to equality and social coherence and deliver on the Paris Agreement and the Sustainable Development Goals.This is the first dedicated implementation action oriented project, led by UN-Habitat to deliver on inclusive, low-carbon urban services. Securing sustainability and multiplier effect, the project aims to leverage domestic and international funding for the implementation projects that will follow from this initiative

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INTRODUCTION

The Paris Agreement, adopted at the United Nations Climate Change Conference (COP 21/UNFCCC) in Paris speaks of measures to reduce GHG emissions to limit global warming. The Agreement reinforces the need for an international response to global warming by maintaining the world temperature below to 1.5 degrees Celsius, compared to pre-industrial levels. That indicates accelerating transformations in favor of maintaining adequate living conditions on Earth.

The transportation sector is largely responsible for energy-related CO2 emissions. In 2017, the sector accounted for about a quarter of total global CO2 emissions, intensifying the effects of global warming. The reduction of these emissions, particularly that of CO2, is fundamental for the fulfillment of the goals related to climate change outlined in the Paris Agreement. (Barassa 2021, p. 14). Electromobility in the transport sector is one of the ways to reach these challenging targets. The introduction of fuel cell buses, battery electric buses and hybrid buses is part of this technological mix to meet the world´s growing demands.

According to the World Health Organization (WHO), deaths associated with exposure to Particulate Matter (PM10, PM5 and PM2,5) and other local air pollutants correspond to one of the main risk factors for premature deaths in the world, killing an estimated seven million people worldwide every year. Furthermore, according to WHO, respiratory diseases make up two of the ten most common causes of death in the world. The problem is even more serious in urban areas. More than half the world's urban population is exposed to levels exceeding at least 2.5 times WHO guidelines. Adopting e-mobility can be one of the keys to mitigating said levels, resulting in better quality of air for the urban population (Barassa 2021, p. 16).

In developing countries, especially in the mid-twentieth century, increasing urban development resulted in rural to urban migration, and consequently in higher demands of urban services. But advance and innovation in public transportation did not happen at same speed and intensity. As a result, inefficient, low quality and polluting public transport services became a reality. Within this context, electrification can be a means to modernize public transportation.

Battery Electric Vehicles (BEVs) are electric propulsion vehicles with an external electric power supply. They have an electric battery, with no gas engine parts, that allows the vehicle to run with different autonomy ranges depending on the battery size, driving cycles, slope, air conditioning or heating systems use. The battery pack is recharged from the grid, either by slow charging at depot, fast charging

at terminals or opportunity charging with ultrafast charging systems like pantographs or induction.

This document is intended for the determination of technical specifications for electric buses acquired and/or converted in the context of the SolutionsPlus project. Buses of twelve meters and larger are included in this factsheet with its main technical parameters and requirements.

12 M ELECTRIC BUSES

Asian manufacturers

BYD CK6121LGEV – also known as BYD K9 - China

Technical characteristics

Source: (Auto-Che 2015a)

Size (mm)	≤ 12,000 (length) ≤ 2,500 (width) ≤ 3,200 (height)
Interior Height (mm)	≥ 2,200
Front / Rear Overhang (mm)	≤ 2,800 / 3,500
Wheelbase, Front / Rear (mm)	≤ 6,200
Minimum ground clearance (mm)	160
Distance Between Axles (mm)	6,000
Maximum speed	70 km/h
Turning radius	< 23°
Curb weight	13,800 kg
GVWR	19,000 kg
Passenger Capacity	87 (sitting and standing)

Motor	
Motor Type	AC Synchronous
Max power	150 kW x2
Max Torque	550 Nm x 2
Battery Pack & charger	
Battery type	Lithium-ion battery (min energy density: 130 kWh/kg)
Battery capacity	324 kWh
Battery power rating	Up to 324 kW
Battery warranty	5 years
Charging system	Pantograph or plug-in CCS2 standard connector
Charging power	80 kW
Charging time	2 hours 80% SOC
Chassis	
Front axle load	Independent shaft, 8000 kg
Rear axle load	Independent shaft, 13000 kg
Floor type	Low floor in door 1 and 2, 3rd door with stair
Brake	Dual Circuit Air Disc Brake, Air Dryer, WABCO ABS, HALDEX Arm Double Action Air Disc Brake, Spring Power Parking Brake, Air Dryer, Condenser, EBS
Suspension	Hydraulic shock absorber from SACHS, ECAS with tilt function
Direction system	Integral Steering System with Electric Power Assist
Wheels	295 / 80 R 22.5

Two doors layout:

Three doors layout:

Source: (BYD 2019, p. 6)

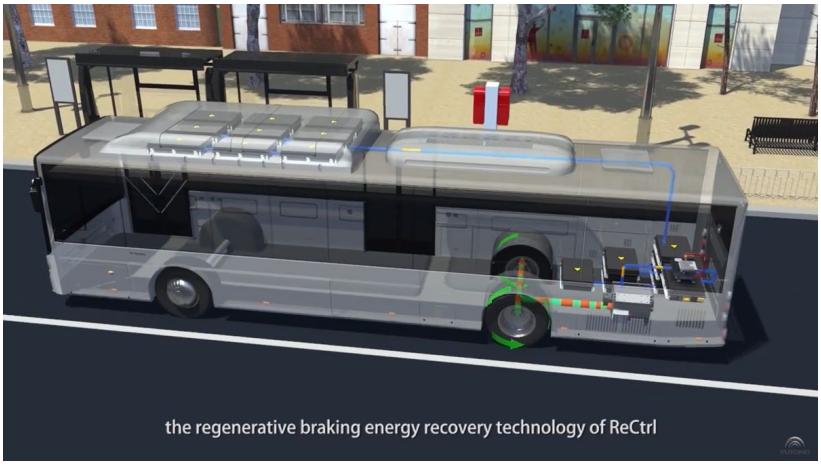
YUTONG ZK6128BEVG (E12) - China

Technical characteristics	

Source: (Yutong Buses 2021)

Size (mm)	≤ 12,170 (length) ≤ 2,550 (width) ≤ 3,300 (height)
Minimum ground clearance (mm)	160
Distance Between Axles (mm)	6,000
Maximum speed	90 Km / h
Approach/departure angle	7°/7°
Curb weight	13,100 kg
GVWR	18,500 kg
Passenger Capacity	90 (33 sitting and 57 standing)
Front/rear overhang (mm)	2,700/3,425
Motor	
Maximum power	240 kW
Nominal torque	2850 Nm
Battery Pack & charger	
Battery type	LiFePO4
Battery capacity	375 kWh
Battery power rating	375 kW
Charging power	≥ 60 kW ≤ 150 kW with plug-in at depot
Charging time	4 - 5 hours
Passenger Capacity	87 (sitting and standing)

Power Train graphics:



Source: (Land Transport guru 2020) (BNEF 2018, p. 6)

Zhongtong Bus LCK6122EVG - China

Technical characteristics	

Source: (Auto-Che 2015b)

Size (mm)	≤ 11,990 (length) ≤ 2,540 (width) ≤ 3,280 /3510 (height)
Interior Height (mm)	2450
Wheelbase, Front / Rear (mm)	6100
Maximum speed (km/h)	69
Approach/departure angle	7°/7°
Curb weight	13,450 kg
GVWR	18,000 kg
Passenger capacity	70
Front/rear track (mm)	2050, 2100/1860,1830
Motor	
Nominal/Maximum power	80/160 kW
Nominal / maximum torque	477/1000 Nm
Motor rated voltage	540 V (DC)
Battery Pack & charger	
Battery type	LiFePO4
Battery capacity	230 kWh
Battery power rating	80/160 kw
Charging power	120 kw with plug – in only
Charging time	4 – 5 h, depending on internal layout
Chassis	
Front axle load	7,000 kg, disc brake
Rear axle load	13,000 kg, drum brake
Suspension	Air suspension 2/4
Brake	Electric air pumper; dual-circuit air brake; front disc and rear drum brake; air drier; ABS; and rear automatic adjustment arm
Tires	275/70R22.5

Ankai 12M electric city bus - HFF6124G03EV32 - China

Technical characteristics	

Source: (Anhui Ankai Automobile Co., Ltd. 2021)

Size (mm)	≤ 12,000 (length) ≤ 2,550 (width) ≤ 3,250 (height)
Front / Rear Overhang (mm)	≤ 2,570 / 3,330
Wheelbase, Front / Rear (mm)	≤ 6,100
Maximum speed	70 km/h
Vehicle empty weight	13,500 kg
GVWR	18,000 kg
Passenger Capacity	93
Motor	
Rated power	200 kW
Battery Pack & charger	
Battery type	Lithium-ion battery
Battery capacity	≥ 326,73 kWh
Charging system	plug-in only
Charging power	≥ 50 kW ≤ 150 kW
Charging time	4 – 5 hrs
Chassis	
Front Axle load	Independent shaft, capacity 6,500 kg/Disc Brake
Rear axle load	Independent shaft, capacity 11,500 kg/Drum Brake
Brake	Dual Circuit Air Disc Brake, Self-adjusting arm, ABS
Direction system	Electro-hydraulic steering
Wheels	295 / 80 R 22.5

Tata Starbus 4/12 Electric - India

Technical characteristics	
	
Source: (Tata motors 2021)	
Size (mm)	11,985 (length) 2,537 (width) ≤ 3,600 (height)
Front / Rear Overhang (mm)	≤ 2,690 / 3,360
Wheelbase, Front / Rear (mm)	5,930
Maximum speed	65 km / h
GVWR	19,500 kg
Passenger Capacity	87 (31 seats)
Motor	
Maximum power	200 kW
Battery Pack & charger	
Battery type	Lithium-ion battery
Battery capacity	250 kWh
Charging power	60 – 120 kW, with plug in only
Charging time	2 – 3 hrs
Chassis	
Doors	2 in-swing double wing doors
Body structure	Monocoque Low-entry/Low-floor

Foton C10/C12 EV – China

Technical characteristics	

Source: (Foton 2020)

Size (mm)	12,000 (length) 2,550 (width) 3,100 (height)
Front / Rear Overhang (mm)	≤ 2,690 / 3,360
Wheelbase, Front / Rear (mm)	5,900
Curb Weight	12,900 kg
GVWR	18,000 kg
Passenger Capacity	82 (43 seats – 39 standing)
Battery Pack & charger	
Battery type	Lithium-ion battery
Battery capacity	423 kWh
Charging time	70 min (SOC 0 -100%)

JBM ECOLIFE ELECTRIC BUS - India

Technical characteristics	

Source: (JBM Group 2021)

Size (mm)	≤ 12,000 (length) ≤ 2,550 (width) ≤ 3,354 (height)
Front / Rear Overhang (mm)	≤ 2,560 / 3,120
Wheelbase (Distance Between Axles) (mm)	6,320
GVWR	18,000 kg
Passenger Capacity	87 (40 + 2 folding + Driver (CMVR) sitting and 43 standing)
Doors	2
Floor height (mm)	380
Motor	
Rated/Maximum power (kW)	150 kW/200 kW
Battery Pack & charger	
Battery type	chemistry Lithium-ion Liquid cooled battery system
Charging system	Pantograph or plug-in CCS2 standard connector
Charging time	Slow charging: 6 – 8 hours, 65 A (Plug-in) Fast charging: 15 min to 2 hours, 250 A (Plug-in/Pantograph) Opportunity charging: 5-30 min, 500 A (Pantograph)
Chassis	
Front Axle	Low Floor
Rear axle	Inverted Portal / Banjo Type
Brake	EBS Electronic (dual circuit) braking system incorporating the anti-blocking system (ABS) and the traction control system (ASR), parking (hand) brake with emergency release function from the driver's seat, bus stop brake
Suspension	Electronically controlled air suspension system (ECAS)
Wheels	295/80 R 22.5 Radial Tubeless

Golden Dragon Pivot-E12 Electric Bus - China

Technical characteristics	

Source: (Golden Dragon 2017)

Size (mm)	≤ 12,110 (length) ≤ 2,550 (width) ≤ 3,300 (height)
Front / Rear Overhang (mm)	2,750 / 3,430
Wheelbase (mm)	5,930
Approach/Departure Angle	7°/7°
Curb weight	13,550 kg
GVWR	19,000 kg
Passenger Capacity	79 (35 sitting and 44 standing)
Motor	
Maximum power	258 kW
Maximum torque	3500 Nm
Battery Pack & charger	
Battery type	LiFePO4
Battery capacity	≥ 345 kWh
Charging system	Plug-in CCS2 standard connector/Battery-swap
Chassis	
Front axle load	ZF RL82EC, 7,500 kg
Rear axle load	ZF AV132, 13,000 kg
Brake	WABCO EBS3
Wheels	275 / 70 R 22.5
Wheels	295/80 R 22.5 Radial Tubeless

European manufacturers

Citea SLF - 120 Electric (VDL Bus & Coach) – The Netherlands

Technical characteristics	

Source: https://www.sustainable-bus.com/news/north-germany-vdl-electric-buses/ Source: (VDL Bus & Coach 2019, p. 20)

Size (mm)	≤ 12,200 (length) ≤ 2,550 (width) ≤ 3,290 (height)
Interior Height (mm)	2,416
Front / Rear Overhang (mm)	2,750/3,400
Wheelbase, Front / Rear (mm)	5,850
Maximum speed	80 km/h
Curb weight	12,715 – 13,200 kg, depending on battery size
GVWR	+/- 19,500 kg
Passenger Capacity	110 (45 seating + 65 standing)
Motor	
Rated power	116 kW
Maximum power	160 kW
Nominal / maximum torque	973 – 1,337 Nm
Battery Pack & charger	
Battery type	Lithium – ion battery, NMC
Battery capacity	up to 215 kWh – 420 kWh
Charging system	Plug – in; pantograph
Charging power	Plug-in: 320 kW /optional: 450 kW in combination with a 800 A pantograph
Charging time	depending on charging power

A VDL Citea SLF-120 Bus with pantograph charging in Helsinki, Finland (2019):

Solaris Urbino 12 electric - Poland

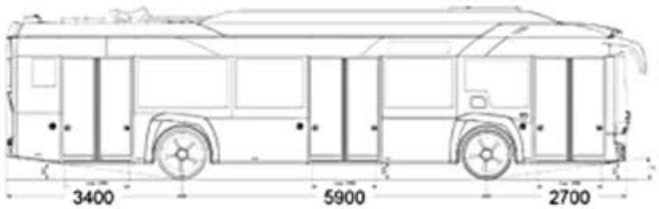
Technical characteristics	

Source: (Solaris 2021)

Size (mm)	≤12,000 (length) ≤ 2,550 (width) ≤ 3,650 (height incl. pantograph)
Wheelbase, Front / Rear (mm)	5,900
Distance to the road (mm)	320
Maximum speed	80 km/h
Curb weight	Approx. 13,200 kg, depending on battery type and size
Passenger Capacity	65 (sitting 39 + 4, depending on door arrangement and batteries)
Motor	
Rated power	220 kW; wheel hub engines ZF AVE 130 2x125 kW
Maximum power	300 kW
Battery Pack & charger	
Battery type	LiFePO4
Battery capacity	300 kWh
Battery power rating	450 kW/200 kW; plug-in at depot (i.e. 80 kW)
Battery warranty	Up to 10 years
Charging system	Plug-in at depot or pantograph
Charging power	80 kW /450 kW / 200 kW with automated contact system
Charging time	2 – 6 hrs
Chassis	
Front Axle	ZF RL 82 EC independent suspension
Rear axle	ZF AVE 130 portal axle with integrated electric motors
Brake	EBS (Electronic Braking System), ABS (Anti-Lock Braking System), ASR (Acceleration Slip Regulation)
Suspension	ECAS air suspension with leveling and kneeling function
Direction system	RB Servocom

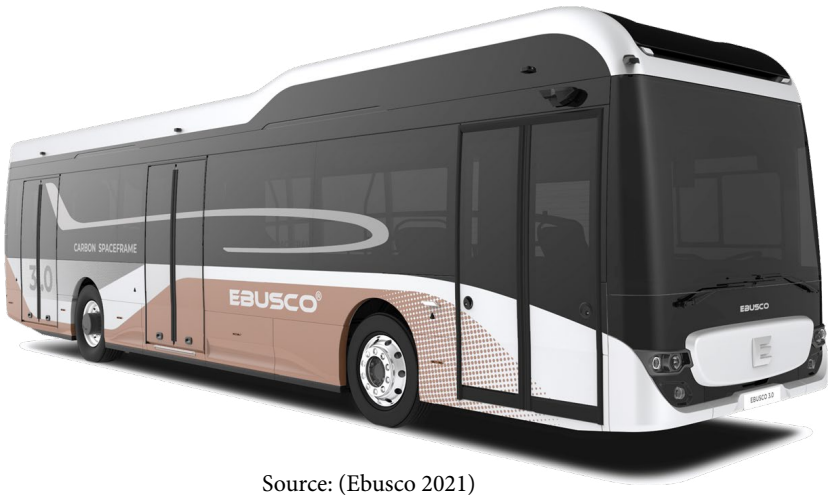
Dimensions graphics:

› Urbino 12 electric



Ebusco Electric citybus 3.0 – The Netherlands

(EBUSCO is a company in the Netherlands, which co-operates with Chinese bus manufacturers)

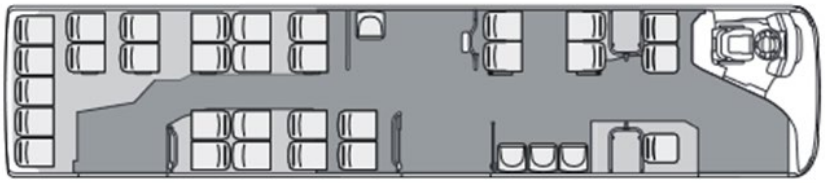
Technical characteristics	
	
Source: (Ebusco 2021)	
Size (mm)	≤ 12,000 (length) ≤ 2,500 (width) ≤ 3,200 (height)
Front / Rear Overhang (mm)	≤ 2,650 / 3,100
Wheelbase, Front / Rear (mm)	6,750
Interior height (mm)	2,350
Curb weight	8,530 kg
GVWR	18,000 kg
Passenger Capacity	95
Motor	
Rated power	220 kW
Peak power	250 kW
Maximum torque	18,000 Nm
Electric voltage	AC 3φ 400V
Battery Pack & charger	
Battery type	LiFePO4
Battery capacity	363 kWh / 423 kWh
Pack nominal voltage	576 Vdc
Cell capacity and voltage	105 Ah, 3.2 V
Charging power	75 kW, depot charging/optional: opportunity charging – Inverted or Pantograph up
Charging time	5 hours
Chassis	
Front Axle	ZF RL 82 EC
Rear axle	ZF AV 132
Floor type	Gerflor
Brake	KNORR-BREMSE
Suspension	WABCO Air suspension / brake support
Wheels	Michelin

Volvo 7900 Electric - Sweden

Technical characteristics	
 Source: (Volvo Buses Global 2021)	
Size (mm)	≤ 12,000 (length) ≤ 2,550 (width) ≤ 3,300 (height)
Front / Rear Overhang (mm)	≤ 2,700 / 3,300
Wheelbase, Front / Rear (mm)	≤ 6,000
Maximum speed	80 km/h
Approach/Departure angle	7°/7°
Turning radius (mm)	11,000
Vehicle empty weight	12,000 kg
GVWR	19,500 kg
Passenger Capacity	98 (sitting and standing)
Motor	
Maximum power	200 kW
Maximum torque	19,000 Nm
Motor rated voltage	400 V
Battery Pack & charger	
Battery type	Lithium-ion battery (Automatically temperature controlled)
Battery capacity (kWh)	Up to 470 kWh
Charging power (kW)	250 kW: CCS max charge power 300 kW: Roof charging: panto up (roof-mounted pantograph), max charge power
Charging time	depending on charging power
Chassis	
Front Axle	Volvo rigid low beam axle
Rear axle	ZF AV133
Brake	Volvo disc brakes; Electronic Braking System (EBS5); Anti-lock Braking System (ABS); Acceleration Slip Regulator (ASR); Brake blending; Hill start aid; Electronic Stability Program (ESP) as option on 12.0 m

Direction system	Electrically powered hydraulic steering Volvo Dynamic Steering as option
Wheels	275/70 R22.5

Three doors layout:



Source: (Volvo Buses Global 2021)

Sileo S12 (Sileo GmbH) – Deutsch – türkischer Omnibushersteller

Technical characteristics	

Source: (Sileo GmbH 2021)

Size (mm)	≤ 12,200 (length) ≤ 2,550 (width) ≤ 3,213 (height)
Maximum speed	79 Km / h
Vehicle empty weight	13,380 kg
GVWR	19,000 kg
Passenger Capacity	90 (39 sitting and 51 standing)
Doors	2 (or on request 3) electric twin doors
Motor	
Rated power (kW)	2 x 120 kW, ZF AVE 130
Maximum torque (Nm)	21,000
Working voltage range (v)	400 VAC
Battery Pack & charger	
Battery type	LiFePo4
Battery capacity	225 kWh
Battery voltage	500 to 700 V
Charging power	40 - 80 kW – plug in at depot
Charging time	3 – 7 hours depending on battery capacity and type of charging
Chassis	
Front Axle	Independent shaft, ZF RL 82 EC
Rear axle	ZF AVE 130 (Electric portal axle, max 2 x 125 kW)
Brake	WABCO ABS, regenerative braking
Direction system	ZF 8090 Servocom
Wheels	275 / 70 R 22.5

IRIZAR i2e - Spain

Technical characteristics	

Source:: (Irizar 2021)

Size (mm)	≤ 12,160 (length) ≤ 2,550 (width) ≤ 3,300 (height)
Front / Rear Overhang (mm)	≤ 2,805 / 3,400
Wheelbase, Front / Rear (mm)	≤ 5,955
Minimum ground clearance (mm)	320
Maximum speed	85 Km / h
Approach/Departure angle	7°/7,5°
Turning radius	21,374 mm
Vehicle empty weight	13,500 kg
GVWR	19,000 kg
Passenger Capacity	105 (sitting and standing)
Door Width (mm)	1100
Inlet height (mm)	First door: 320/2nd – 3rd Doors: 340
Motor	
Rated power	180 kW
Maximum power	375 kW
Nominal torque	1500 Nm
Engine	Siemens ELFA
Battery Pack & charger	
Battery type	Lithium-ion battery
Battery capacity	350 kWh
Battery power rating	100 kW at depot; 450 kW panto – 150 kW Combo 2; ultrafast charging 450
Charging system	Pantograph or plug-in CCS2 standard connector
Charging power	≥ 50 kW ≤ 600 kW
Charging time	3 hrs; fast charging 5 min

Chassis	
Front axle load	Independent shaft, capacity 8,200 kg
Rear axle load	Independent shaft, capacity 13,000 kg

Two doors layout:

N° de puertas	2
Zona silla de ruedas/cochecito	2
N° de butacas	33
N° de personas de pie*	47
N° total de pasajeros : Máximo	80

Three doors layout:

N° de puertas	3
Zona silla de ruedas	1
N° de butacas	30
N° de personas de pie*	49
N° total de pasajeros : Máximo	80

Avenue Electron – TEMSA – Turkey

Technical characteristics	

Source: (Temsa 2021)

Size (mm)	≤ 12,095 (length) ≤ 2,550 (width) ≤ 3,237 (height)
Interior Height (mm)	≥ 2,424
Front / Rear Overhang (mm)	2,757 / 3,533
Wheelbase, Front / Rear (mm)	5,805
Turning diameter (mm)	20,950
Approach angle	7°
GVWR	19,000 kg
Motor	
Type	TM4, 3 Phase x 3, High Efficient permanent Magnet Motor
Maximum power	250 kW
maximum torque	2700 Nm
Battery Pack & charger	
Battery type	Lithium-ion NMC
Battery capacity	240 kWh – 360 kWh
Battery position	Roof
Charging system	plug-in CCS2 standard connector
Charging time	3 hours with 150 kWh DC charger/ 4,5 hrs with 90 kWh DC Charger
Chassis	
Front axle load	Independent shaft, capacity 8,200 kg
Rear axle load	Rigid, capacity 13,000 kg
Brake	ASR (Anti-Slip regulation), EBS (Electronic Braking System)
Suspension	Hydraulic shock absorber from SACHS, ECAS with tilt function
Direction system	Electrohydraulic Steering
Wheels	275 / 70 R 22.5

Scania Citywide LFE

Technical characteristics	

Source: (Scania 2021)

Size (mm)	≤ 12,100 (length) ≤ 2,550 (width) ≤ 3,300 (height)
Interior Height (mm)	3,300 mm
Front / Rear Overhang (mm)	2,780 mm/3,415 mm
Wheelbase, Front / Rear (mm)	5,200 mm
Turning diameter (mm)	11,498 mm
GVWR	20,000 kg
Approach angle	7°
Maximum speed	100 km/h
Passenger capacity	100 (35 seats – 65 standing)
Motor	
Nominal power	250 kW
Maximum power	300 kW
Nominal torque	2.100 Nm
Battery Pack & charger	
Battery type	Lithium-ion NMC
Battery capacity	240 kWh/330 kWh (8/10 Battery packs)
Battery position	Roof
Voltage	650 V
Charging system	150 kW with plug-in CCS2 standard connector/with pantograph 300 kW
Chassis	
Front axle load	Independent shaft, capacity 8,200 kg
Rear axle load	Rigid, capacity 12,000 kg
Brake	ASR (Anti-Slip regulation), EBS (Electronic Braking System)
Suspension	Hydraulic shock absorber from SACHS, ECAS with tilt function
Direction system	Electrohydraulic Steering
Wheels	275 / 70 R 22.5

e-Citaro – EvoBus GmbH – Germany

EvoBus GmbH is a filial company of Daimler Mercedes Benz

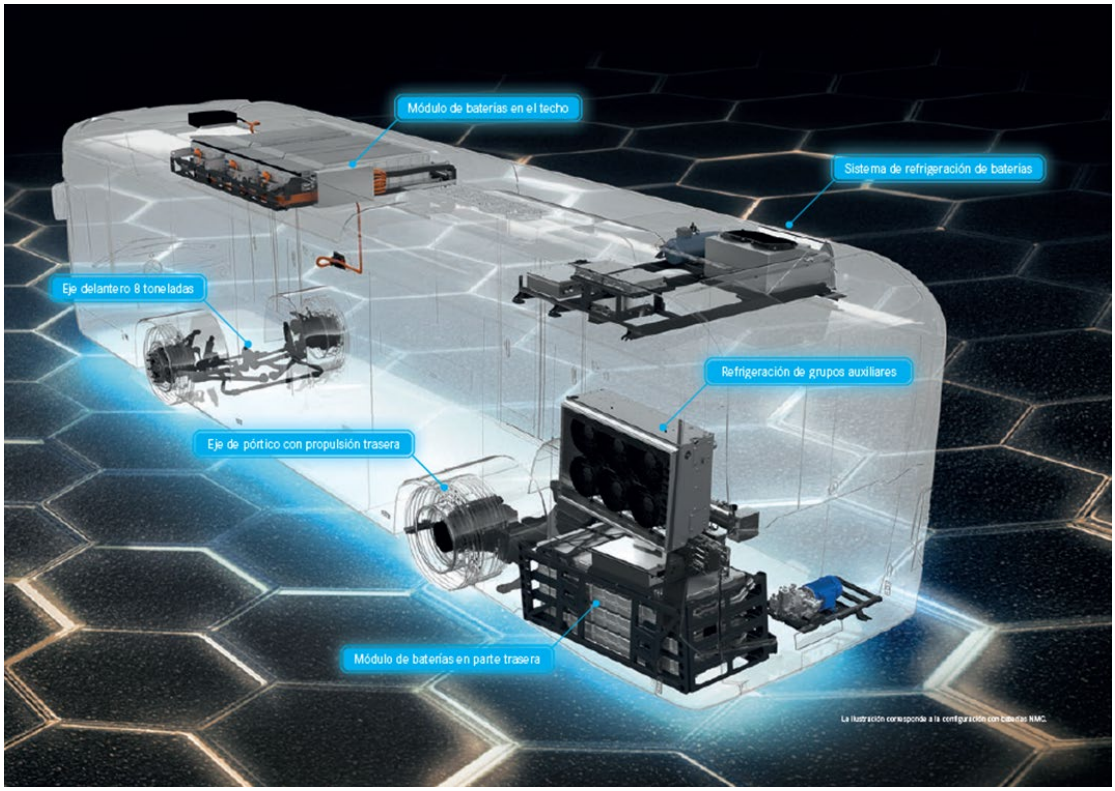
Technical characteristics	

Source: (Mercedes Benz 2020)

Size (mm)	≤ 12,135 (length) ≤ 2,550 (width) ≤ 3,400 (height)
Interior Height (mm)	≥ 2,200
Front / Rear Overhang (mm)	≤ 2,805 / 3,430
Wheelbase (mm)	5,900
Approach angle front/rear	7°/7°
Vehicle empty weight	13,250 kg
GVWR	20,000 kg
Passenger Capacity	With 6 batteries: 85, 8 batteries: 74; 10 batteries: 71; 12 batteries: 70
Inlet height (mm)	370
Motor	
Rated power	125 kW
Maximum power	250 kW
Nominal / maximum torque	2 * 485 Nm/2*11,000 Nm
Motor rated voltage	400 V
Battery Pack & charger	
Battery type	NMC or solid electrolyte
Battery capacity NMC1 (6/8/10/12 units) NMC2 (6/8/10/12 units)	146/194/243/292 kWh; 198/264/330/396 kWh
Battery power capacity	441 kWh/NMC1: 292 kWh/396 kWh (NMC2)
Charging system	plug-in CCS2 standard connector, Pantograph optional por NMC
Charging power	Plug-in up to 80 kW; optional Pantograph 243 kWh/260 kW

Chassis	
Front axle load	Independent shaft, capacity 7,500 kg
Rear axle load	Independent shaft, capacity 13,000 kg
Floor type	Low floor in all doors
Brake	Acceleration Slip Regulation (ASR), Anti-lock Braking System (ABS), Articulation Turntable Controller, Electronic Stability Program (ESP®)
Steering system	intelligent eco steering (electrohydraulic steering)
Wheels	275/70 R 22,5

Source: (Mercedes Benz 2020)



Source: (Mercedes Benz 2020)

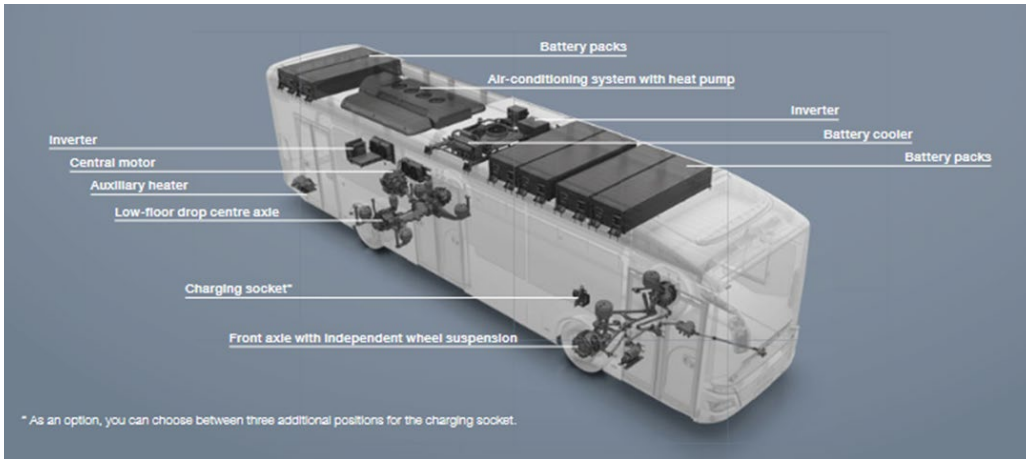
Man Lion´s City 12 E – Germany

Technical characteristics	

Source: https://www.urban-transport-magazine.com/en/hamburg-the-first-man-lions-city-12-e/

Size (mm)	≤ 12,200 (length) ≤ 2,250 (width) ≤ 3,320 (height)
Front / Rear Overhang (mm)	2,775/3,405
Wheelbase, Front / Rear (mm)	6.005
GVWR	19.500 kg
Passenger Capacity	88 (25 sitting and 63 standing)
Motor	
Type	Electric central motor
Rated power	160 kW
Maximum power	240 kW
Nominal / maximum torque	2.100 Nm
Battery Pack & charger	
Battery type	Lithium-ion battery; NMC
Battery capacity	480 kWh
Battery position	Roof
Charging system	Plug – in charging (CCS)
Charging power	> 40 kW < 150 kW (DC)
Charging time	< 3 h

Chassis	
Front Axle	Independent shaft
Rear axle	Independent shaft
Internal layout:	

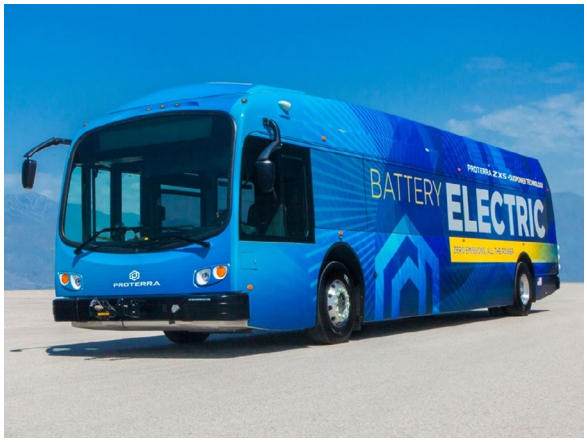


Source: (MAN Truck and Bus 2020)

U.S. manufacturers

Proterra ZX5
(ZX5; ZX5+; ZX5 Max)

Technical characteristics	



Source: (Proterra 2016)

Size (mm)	≤12,950 (length) ≤ 2,590 (width) ≤ 3,250 (height)
Wheelbase, Front / Rear (mm)	7,520
Maximum speed	104 km/h
Approach/departure angle	9,3°
Curb weight	12,870 kg; 13,540 kg; 15,037 kg
GVWR	19,800 kg
Passenger Capacity	80
Motor	
Rated power (kW)	220
Battery Pack & charger	
Battery type	LiFePO4
Battery capacity	225; 450; 675 kWh
Battery power rating	133; 135; 135 in depot/ 177; 355; 407 overhead charging kW
Charging power	133 - 135 kW with plug-in / 177; 355; 407 kW with max overhead charge
Charging time	1.8 – 4,2 hrs
Chassis	
Brake	Regenerative braking; Front & rear air disk brakes
Suspension	Multi-Link Air Ride rear suspension
Wheels	Michelin 305/80R22.5

New Flyer Xcelsior CHARGE NG

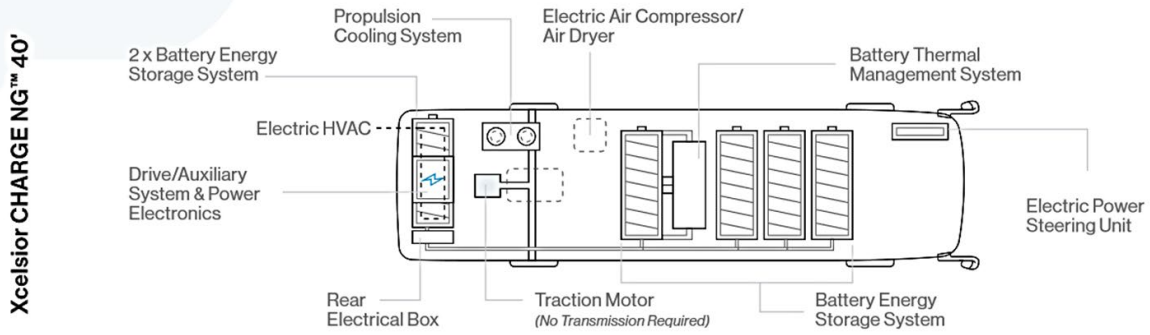
Technical characteristics	

Source: (New Flyer 2021)

Size (mm)	≤ 12,500 (length) ≤ 2,590 (width) ≤ 3,380 (height)
Interior Height (mm)	2,000 over front and rear axle; 2,400 mid-coach
Wheelbase (mm)	7,200
Approach Angle: Approach/	9°/9°/9°
Departure/Breakover angles	6,000
Distance Between Axles (mm)	70 km / h
Maximum speed	13,3 m
Turning radius	Up to 13,800 kg, depending on battery size
Vehicle empty weight	Up to 19,000 kg, depending on battery size
GVWR	84 (40 sitting and 44 standing)
Motor	
Rated power	160 kW
Nominal / maximum torque	1400 Nm
Battery Pack & charger	
Battery type	LiFePO4
Battery capacity	350/440/525 kWh
Battery power rating	375 kW
Battery position	Depends on bus layout & arrangement
Charging system	Pantograph or plug-in CCS2 standard connector
Charging power	450 kW pantograph charging ≤ 150 kW plug-in at depot
Charging time	3,5 – 4,5 hours

Chassis	
Floor type	Marine grade plywood floor; Optional composite floor; Composite rear interior step;
Wheels	305 / 70 R 22.5

Power Train layout:



18 M ELECTRIC BUSES

New Flyer Xcelsior CHARGE NG

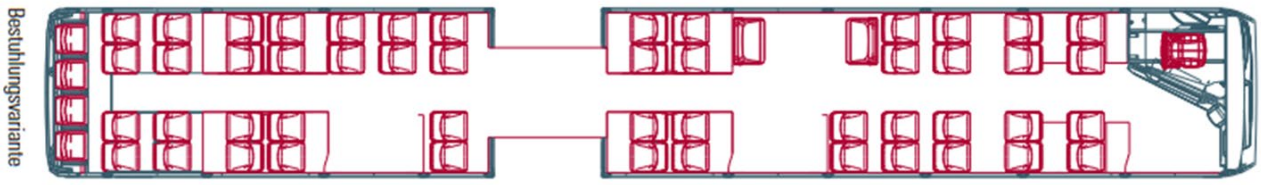
Technical characteristics

Source: (Sileo GmbH 2018, p. 1)

Size (mm)	≤ 18,300 (length) ≤ 2,550 (width) ≤ 3,213 (height)
Distance Between Axles (mm)	5881 / 5997 mm

GVWR	29,000 kg
Passenger Capacity	Approx. 130 (55 seats + 81 standing)
Motor	
Rated power (kW)	480 kW (4 x 120 kW)
Nominal / maximum torque (Nm)	21.000
Battery Pack & charger	
Battery type	LiFePO4
Battery capacity	337 kWh
Battery power rating	Up to 80 kW (standard mobile charging technology) Up to 180 kW (dynamic charging matrix, DLM)
Battery position	Batteries and power electronics on the vehicle roof
Charging system	plug-in CCS2 standard connector
Battery Voltage	500 bis 700 V
Charging time	4 – 10 hours depending on battery capacity and charging power
Chassis	
Front axle	ZF RL 82 EC (Independent wheel suspension)
Rear axle (2. and 3. Axle)	ZF AVE 130 (electric portal axle, max. 2 x 125 kW)
Brake	WABCO EBS3, regenerative braking
Wheels	275/70 R22.5

Internal Layout:



Hess light Tram 18 - Switzerland

Technical characteristics	

Source: https://energeiaplus.com/2016/07/15/le-bus-du-futur-arrive-a-geneve/

Size (mm)	≤ 18,000 (length) ≤ 2,550 (width) ≤ 3,500 (height)
Passenger Capacity	134 (sitting and standing) (6p/m2)
Battery Pack & charger	
Battery type	Lithium-ion battery
Battery capacity	≥ 312 kWh – 546 kWh
Charging system	plug-in CCS2 standard connector, Conductive pantograph, at 600kW
Charging power	CCS2, 150kW, 200A DC
Chassis	
Structure	Aluminium system CO-BOLT
Direction system	Electrohydraulic
Accessibility for the disabled	Yes, passenger platform door 2 and 3

Irizar ie bus 18 m

Technical characteristics	

Source: (Irizar 2021)

Size (mm)	≤ 18,730 (length) ≤ 2,550 (width) ≤ 3,300 (height)
Interior Height (mm)	≥ 2,400
Front / Rear Overhang (mm)	≤ 2,805 / 3,400
Wheelbase, Front / Rear (mm)	5,980/6,540
Maximum speed	80 km / h
Approach/departure angle	7°/7,5°
Turning radius	23,780 mm
Passenger Capacity	145 (sitting and standing)
Door Width (mm)	1,4: 1,100; 2,3: 1,200
Inlet height (mm)	320
Motor	
Rated power	240 kW
Nominal torque	2,300 Nm
Chassis	
Front axle load	Independent shaft, capacity 8,200 kg
Rear axle load (2 and 3)	capacity 10,000 kg – 13,000 kg
Floor type	stainless steel

Van Hool Exqui.city 18 Electric – Belgium

Technical characteristics	

Source: (Van Hool 2021)

Size (mm)	18,610 (length) 2,550 (width) 3,300 (height)
Interior Height (mm)	2,280
Front / Rear Overhang (mm)	1,900 / 3,400
Wheelbase, 1 – 2/ 2 - 3 axles (mm)	6,600/4,910
Passenger Capacity	107 (sitting and standing)
Doors	3/4
Inlet height (mm)	330
Motor	
Rated power	2 x 160 kW Siemens PEM-1DB2016/Electric drive on axle 2 and 3
Battery Pack & charger	
Battery type	Lithium-ion battery
Battery capacity	215 kWh
Battery position	On the roof
Charging system	Pantograph or plug-in CCS2 standard connector
Charging power	250 kW – fast charging inverted pantograph 80 kW – plug in
Charging time	4 hours – slow charging at depot 10 min – fast charging pantograph

eCitaro G – EvoBus GmbH – Germany (a subsidiary company of Mercedes Benz)

Technical characteristics	

Source: (Mercedes Benz 2020)

Size (mm)	≤ 18,125 (length) ≤ 2,550 (width 3 doors); 2950 mm (width 4 doors) ≤ 3,400 (height)
Interior Height (mm)	≥ 2,200
Wheelbase, Front axle-centre axle (mm)	5,900
Wheelbase, centre axle-drive axle (mm)	5,990
Minimum ground clearance (mm)	160
Front/rear overhang (mm)	2,805/3,430
Angle of approach/departure	7°/7°
GVWR	20,000 kg
Passenger Capacity with NMC1 batteries	(Standard) 1/151; with 10 bat: 143; with 12 bat: 135
Height of floor above road surface (mm)	370
Motor	
Rated power	125 kW
Maximum power	250 kW
Nominal / maximum torque (Nm)	2 * 485 Nm/2*11,000 Nm
Motor rated voltage	400 V
Battery Pack & charger	
Battery type	Lithium-ion battery (min energy density: 130 Wh/kg)
Battery capacity (NMC1 8/10/12 pcs) (NMC2 8/10/12 pcs) Solid state battery, 6/7 pcs.	194/243/292 kWh 264/330/396 kWh 378/441 kWh
Battery power capacity	441 kWh/NMC1: 292 kWh/396 kWh (NMC2)
Charging system	plug-in CCS2 standard connector up to 150 kW, opt Pantograph

Chassis	
Front Axle load	7,500 kg
Centre axle load	10,000 kg
Rear axle load	10,000 kg
Brake	Electropneumatic brake system with disc brakes; Anti-lock Braking System (ABS)/ Acceleration Slip Regulation (ASR)/ Electronic Stability Program (ESP®)/Anti-jackknife ATC (Articulation Turntable Controller); Wear-free brakes thanks to recuperation
Wheels	275/70 R 22.5

Three and four doors layout:

eCitaro G - 3 puertas
Longitud: 18 m - Capacidad de pasajeros: 146 con el equipamiento de serie del vehículo

eCitaro G - 4 puertas
Longitud: 18 m - Capacidad de pasajeros: 146 con el equipamiento de serie del vehículo

Solaris Urbino 18 electric - Poland

Technical characteristics	

Source: (Solaris 2021)

Size (mm)	≤ 18,000 (length) ≤ 2,550 (width) ≤ 3,300 (height)
Interior Height (mm)	≥ 2,200
Wheelbase, Front axle-centre axle (mm)	5,900
Wheelbase, centre axle-drive axle (mm)	6,000
Front/rear overhang (mm)	2,700/3,400
Angle of approach/departure	7°/7°
Passenger Capacity	120, depending on the seat arrangement
Height of floor above road surface (mm)	320
Motor	
Motor type	Asynchronous motor
Maximum power	240 kW
Nominal / maximum torque (Nm)	2 * 485 Nm/2*11,000 Nm
Motor rated voltage	600 V
Battery Pack & charger	
Battery type	LTO
Battery capacity	550 kWh (new model with seven packs, each of 79 kWh)
Battery power rating	Up to 450 kW
Charging system	plug-in CCS2 standard connector between 20 and 150 kW
Chassis	
Front Axle load	ZF independent suspension
Centre axle load	ZF neutral axle
Rear axle load	ZF portal axle
Brake	Electropneumatic brake system with disc brakes; Anti-lock Braking System (ABS)/ Acceleration Slip Regulation (ASR)

Doors	3 or 4 doors 1- 2-2-0 2-2-2-0 1-2-2-2 2-2-2-2 Ramp at 2nd door, manual

Three and four doors layout:

eCitaro G · 3 puertas

Longitud: 18 m - Capacidad de pasajeros: 146 con el equipamiento de serie del vehículo

eCitaro G · 4 puertas

Longitud: 18 m - Capacidad de pasajeros: 146 con el equipamiento de serie del vehículo

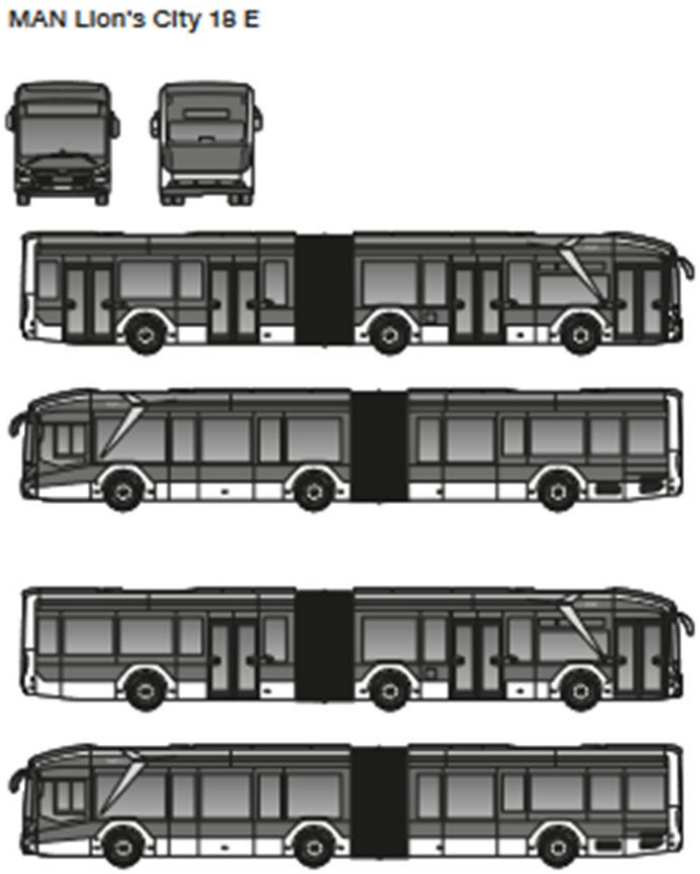
MAN Lion´s City 18 E – Germany

Technical characteristics	

Source: (Solaris 2021)

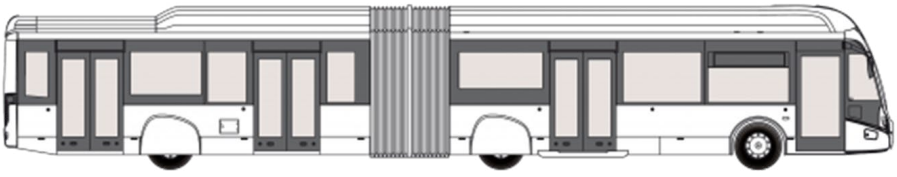
Size (mm)	≤ 18,100 (length) ≤ 2,550 (width) ≤ 3,320 (height)
Interior Height (mm)	≥ 2,200
Front / Rear Overhang (mm)	≤ 2,775 / 3,405
Wheelbase, Front / Rear (mm)	5,200/6,680
GVWR	29,900 kg
Passenger Capacity	120 (45 seats/75 standing)
Motor	
Engine	Two driven axles, two electric central motors
Rated power	320 kW
Maximum power	480 kW
Maximum torque	2,100 Nm
Battery Pack & charger	
Battery type	Lithium-ion battery; NMC
Battery capacity	640 kWh
Battery position	Roof
Charging system	Plug -in CCS
Charging power	>40 kW <150 kW (DC)
Charging time	< 4h

Three and four doors layout:



Source: (MAN Truck and Bus 2020)

CITEA SLFA 181 Electric BRT – VDL – The Netherlands

Technical characteristics	
	
Source: (VDL Bus & Coach 2019, p. 21)	
Size (mm)	≤ 18,150 (length) ≤ 2,550 (width) ≤ 3,290 (height)
Front / Rear Overhang (mm)	≤ 2,750 / 3,400
Wheelbase, Front /2nd and 3rd axle Rear (mm)	5,250/6,750
Turning circle (mm)	23,360
Vehicle empty weight	19,650 kg
GVWR	29,000 kg
Passenger Capacity	+/- 130
Interior saloon height (mm)	2,416
Motor	
Maximum power	240 kW
Rated/Maximum torque	1,337 Nm/3,600 Nm
Battery Pack & charger	
Battery type	Lithium-ion battery
Battery capacity	216 kWh 288 kWh (8 packs) 420 kWh (10 packs)
Battery position	roof
Charging system	plug-in CCS2 standard connector
Charging power	320 kW
Charging time	75 min
Citea SLFA – 181:	
	
Source: https://www.vdlbuscoach.com/en/products/citea/citea-slf-slfa-electric	

Heulliez GX 437 E City Bus - France

Technical characteristics	

Source: (VDL Bus & Coach 2019, p. 21)

Size (mm)	≤ 18,000 (length) ≤ 2,550 (width) ≤ 3,300 (height)
Passenger Capacity	140
Inlet height (mm)	320
Motor	
Rated power	160 kW
Maximum power	200 kW
Nominal / maximum torque (Nm)	2,405 Nm/2,100 Nm
Battery Pack & charger	
Battery type	Lithium-ion battery
Battery capacity	280 up to 385 kWh
Charging system	plug-in CCS2 standard connector; Pantograph optional
Charging power	Up to 150 kW

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