

Module 4

Unit 1. Why shifting to zero- emission public transport

Situation of e-bus deployment in Europe

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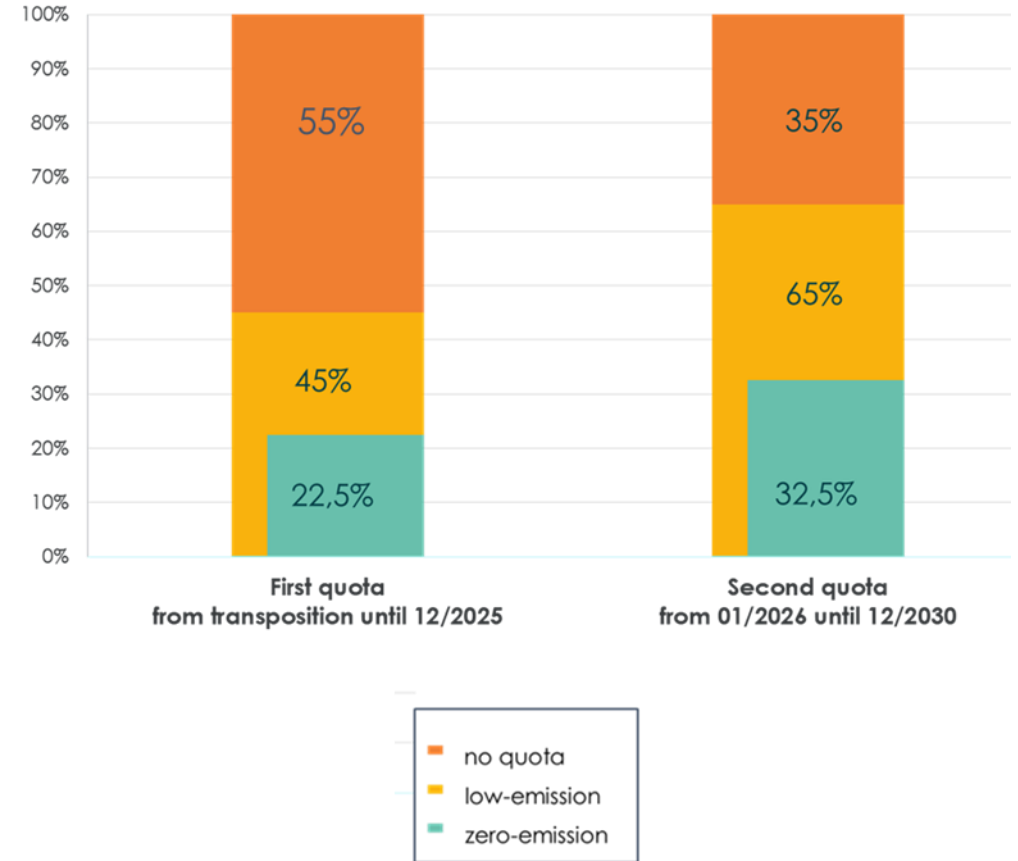
THE INTERNATIONAL ASSOCIATION OF PUBLIC TRANSPORT



EU policy framework

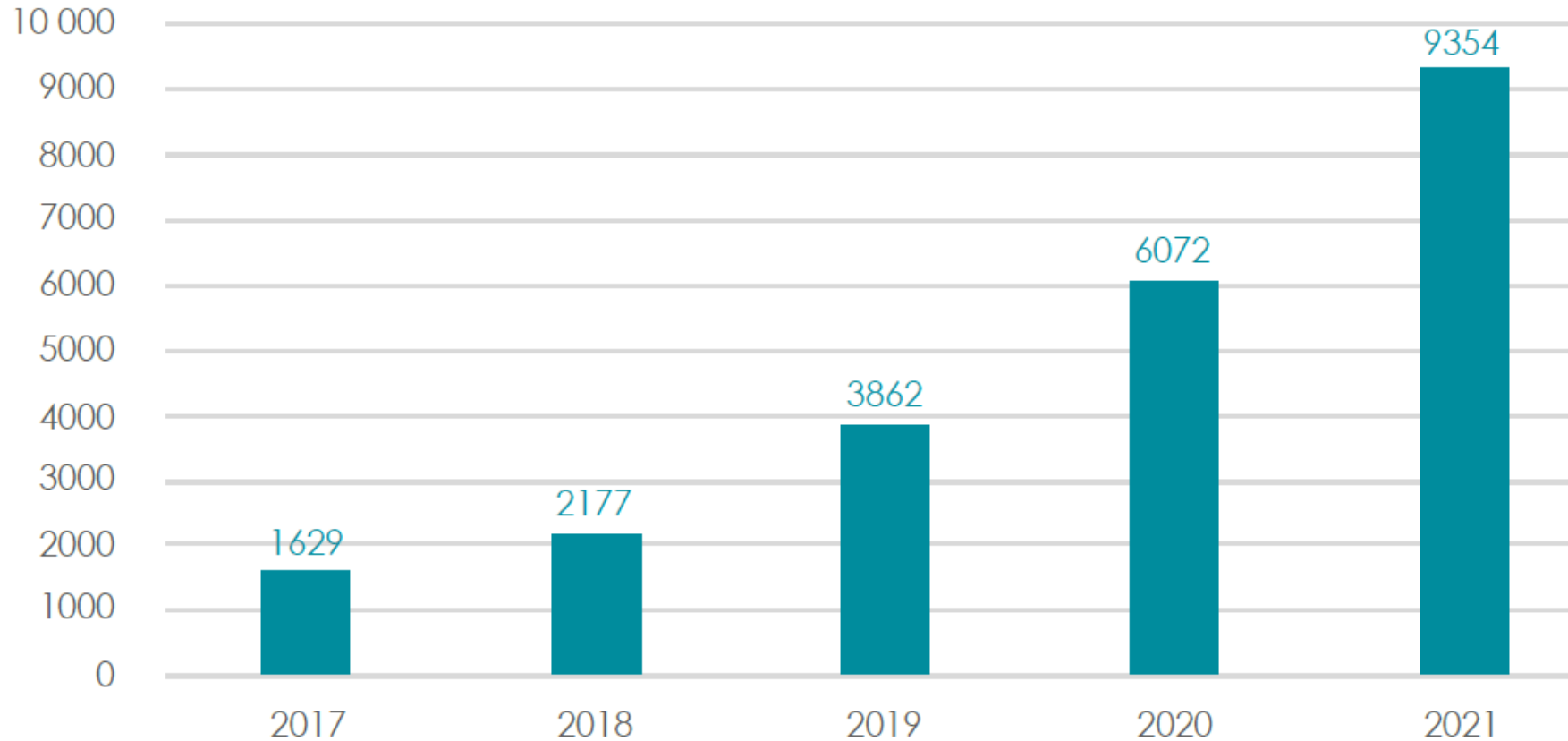
- Favourable policies for decarbonisation & clean technologies is driving market and cities towards clean buses
 - Fit for 55, Green Deal, CVD, AFID
- Strong leadership of Cities in decarbonisation strategies and zero-emissions PT bus fleets by 2025-2030
 - Some cities have more ambitious targets than the ones set by the current policy framework (CVD).

CVD Quotas and periods



Battery vehicle stock in Europe

Figures of December 2021



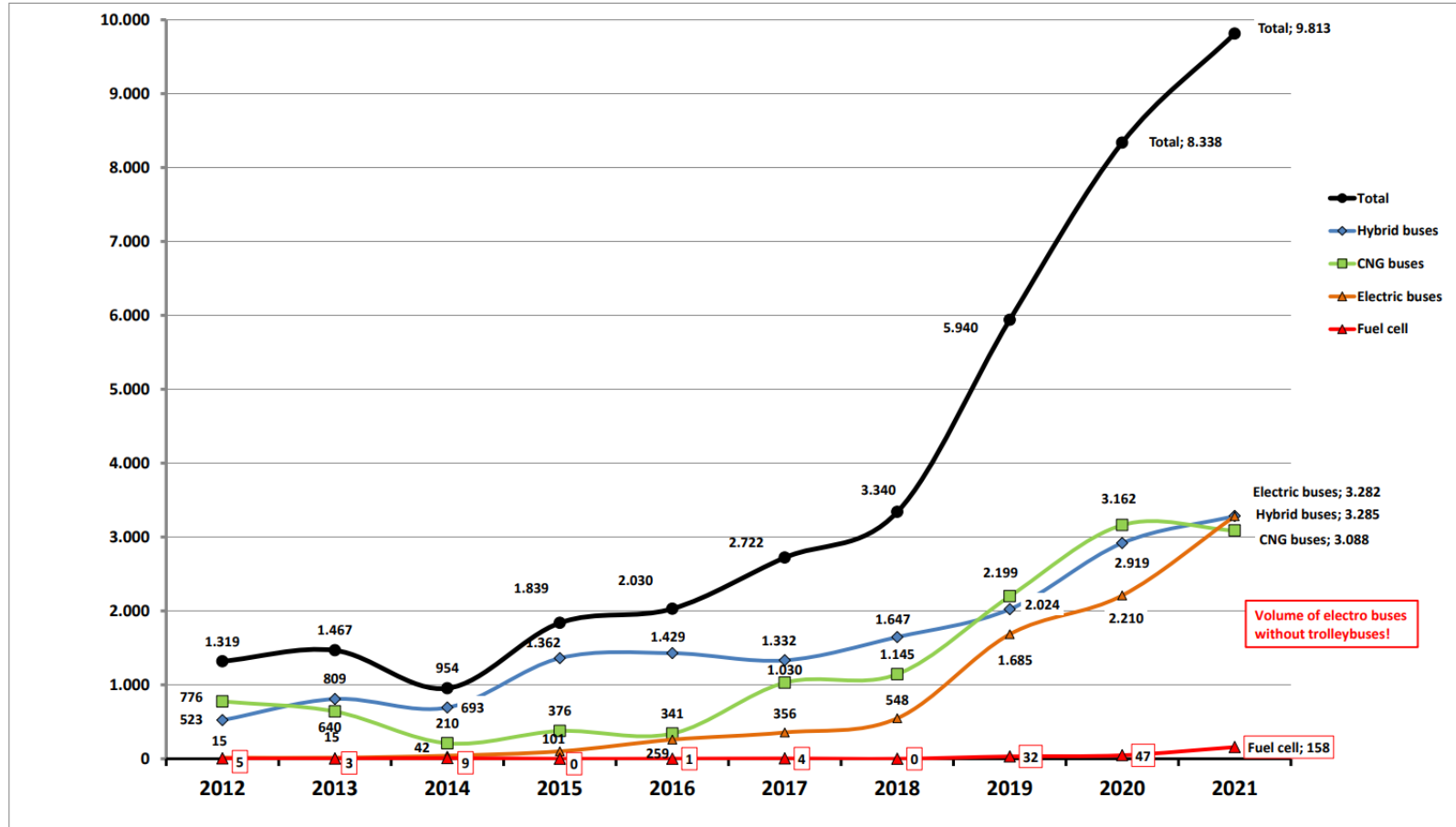
UITP elaboration on data by ZeEUS eBus Report #2 and Chatrou CME Solutions, Alternative Drivelines for City buses 2020/2021

Registrations 2021 city buses

Development of Alternative Drivelines, GVW >8t



Years 2012-2019: Western-Europe + Poland / Years 2020+2021: EU27+UK+ICE+NO+CH



e-Bus operation today



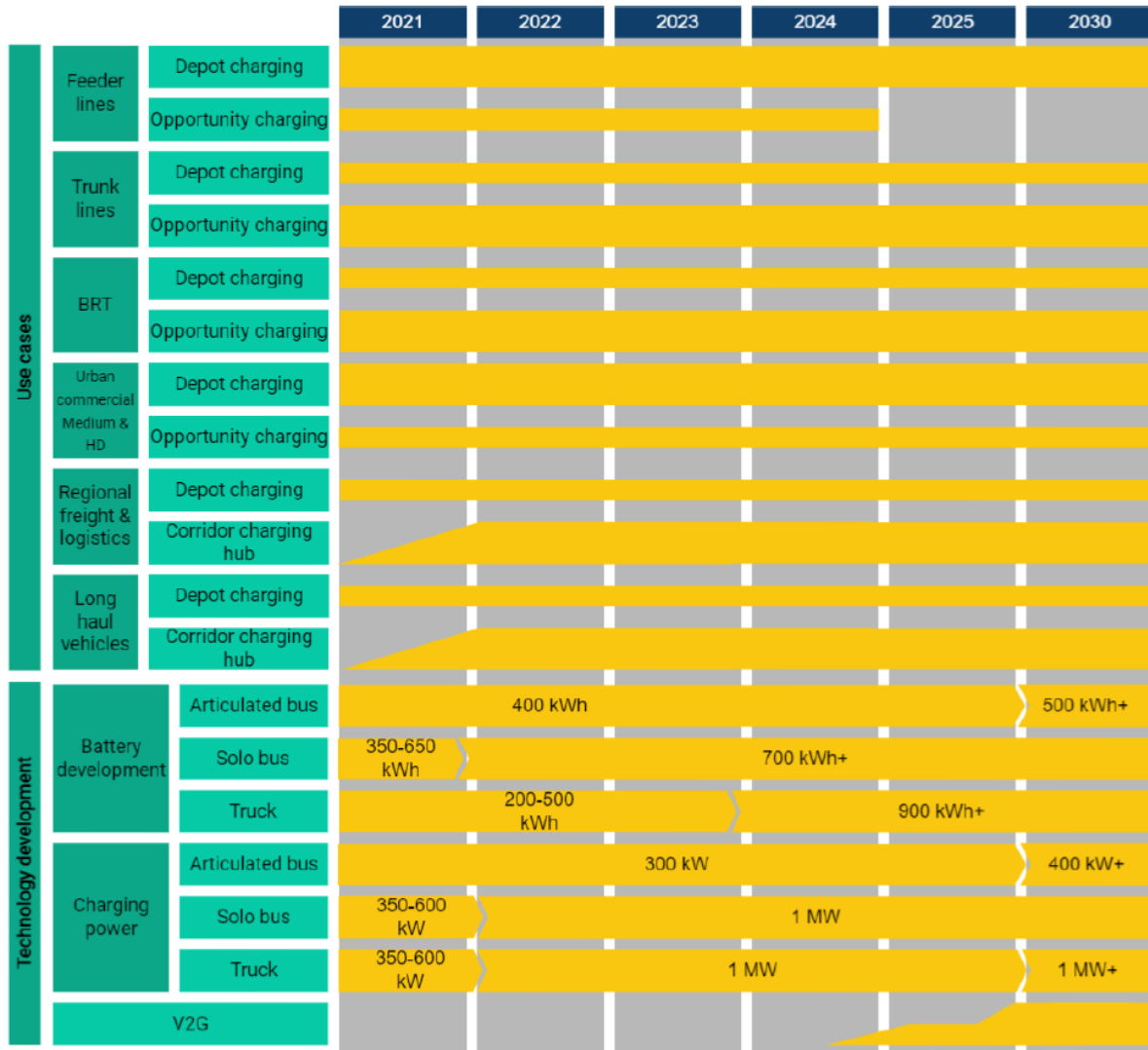
- Standardisation & interoperability of high-power fast charging
- IT intelligence for optimised fleet operation & integration into the data-driven system
 - Telematic diagnosis, scheduling and dispatching, eco-driving, real-time passenger information, etc.
- Smart charging strategies and energy storage systems
 - Considerable savings potential on energy bill by applying smart data-driven charging algorithms.
 - Depot upgrade involves increased energy needs and power capacity; assessment of new depot location and access to grid.
- Bus electrification requires strong cooperation among all stakeholders
 - Bus operators, the city, bus/charger OEMs, IT solutions companies, grid and energy utilities, etc.

The challenges ahead

- Access to the grid, peak shaving, self-production of energy
- E-bus fleet upscale for any bus service, including BRTs.



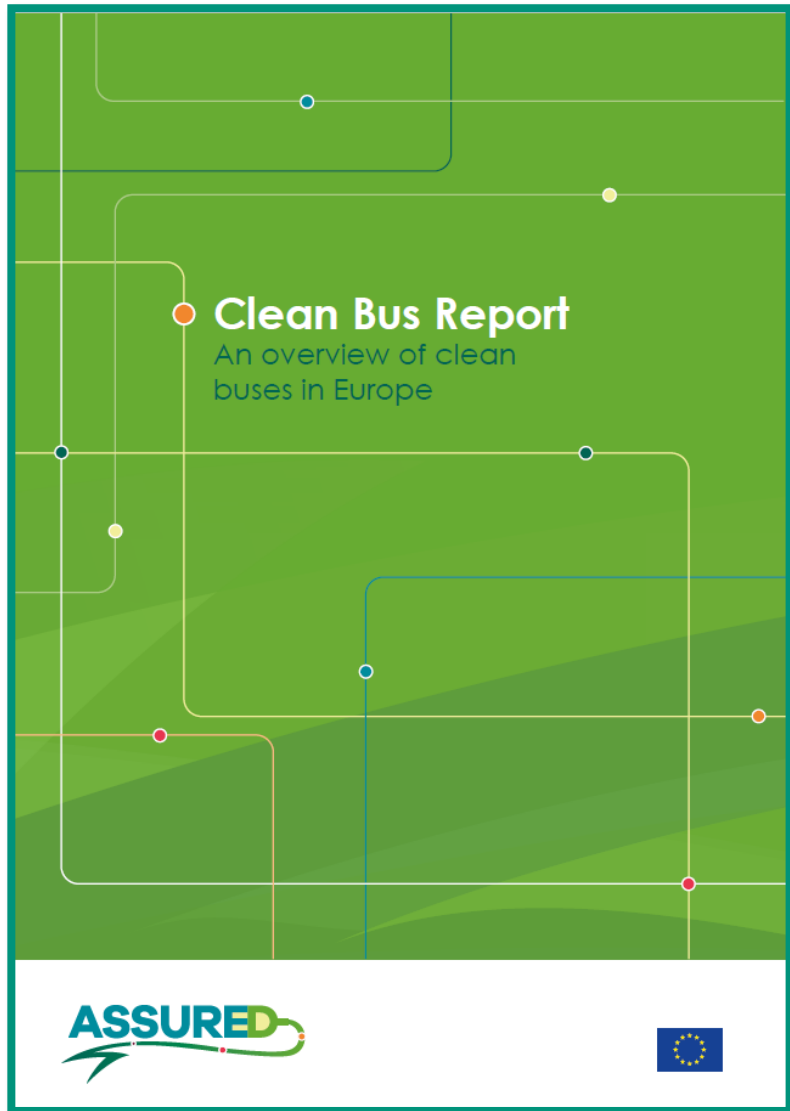
ASSURED charging technology roadmap



- Opportunity charging for trunk lines and BRT. Feeder lines will mostly rely on overnight charging.
- BRT buses will need smaller battery packs and rely more on opportunity charging, as opposed to solo buses with higher battery capacity charged overnight.
- Pantograph on the roof and plug-based charging are the most used.
- Static and conductive charging have higher potential than dynamic and wireless. Inductive charging can be the future charging solution for HD Evs, only if the current bottlenecks in the technology can be addressed.

<https://assured-project.eu/news-and-events/news/facilitating-future-standardisation-efforts-assured-releases-new-deliverable>

ASSURED Clean Bus Report



Produced in cooperation of the EC funded projects ASSURED, JIVE/JIVE 2 and CBEP.

<https://assured-project.eu/news-and-events/news/assured-project-concludes-and-launches-clean-bus-report>



ASSURED Clean Bus Report

Cities, bus OEMs, system suppliers

Klagenfurt am Wörthersee
Austria
Klagenfurt Mobil GmbH

Stage of deployment
Currently, one electric bus accounts for 1.4% of the fleet, but a tender is planned for the electrification of 2 lines.

Current fleet data

Total bus fleet	2017	2021
	46	71

Bus size	Total number of vehicles
Mini/ Mid (<12 m)	4
Solo (12-15 m)	33
Articulated (>18 m)	29

Vehicle propulsion type	Total number of vehicles
Battery Electric	1
Diesel	45

Charging & refuelling infrastructure

Charging technology	Depot	On route
Number of charging plugs (CCS)	1	-
Roof mounted pantograph	1	-

The plan is to incorporate a mix of depot charging and opportunity charging electric buses.

Total average weekday driven veh-km (km) n.a.

City topography flat

Total yearly driven fleet-km (km) 3.4 M

Total yearly transported passengers 15.1 M

Average fleet age (years) 9.1

Average commercial speed (km/h) n.a.

Clean over total number of driven kilometres, 2021

99.4%

Diesel

0.6%

Electric

Share of clean buses

2017

1.4%

2021

1.4%

VDL Bus & Coach

Clean bus specifications

Bus Model name	New Generation Citea LE-122	New Generation Citea LE-181	New Generation Citea LE-122	New Generation Citea LE-135	New Generation Citea LE-149
Vehicle type	BEV	BEV	BEV	BEV	BEV
Bus size	Solo (12-15 m)	Articulated (21.8 m)	Solo (12-15 m)	Solo (12-15 m)	Solo (12-15 m)
Total Passengers capacity	110	150	105	90	140
Gross vehicle weight (kg)	19,500	29,000	19,500	19,500	25,250
Top speed (km/h)	80	80	100	100	100
Air-conditioning system	Electric heat pump	Electric heat pump	Electric heat pump	Electric heat pump	Electric heat pump
Heating system	Electric heat pump and possible HV and/or diesel heater	Electric heat pump and possible HV and/or diesel heater	Electric heat pump and possible HV and/or diesel heater	Electric heat pump and possible HV and/or diesel heater	Electric heat pump and possible HV and/or diesel heater
Range (km)	900	950	900	950	1050
Year of EU introduction	2022	2023	2022	2023	2023

VDL Bus & Coach introduced the first electric bus (Citea) to the market in 2013. Since then, over 1,000 electric buses have been delivered and more than 150 million electric kilometres have been driven. The core activities of VDL Bus & Coach consist of the development, manufacturing, sales and after-sales of a wide range of buses and coaches, the conversion or extension of mini & mid buses and the purchase and sales of used buses. VDL Bus & Coach consists of multiple bus companies that operate cooperatively in the global market. VDL Bus & Coach is a solid partner in developing and transitioning to smart and sustainable transport solutions which add value for people. Now and in the future.

Electric Motor

Supplier	ZF	ZF	ZF	ZF	ZF
Type	Audax AVE Electric portal axle	Audax AVE Electric portal axle	Centrax Electrical Central Drive	Centrax Electrical Central Drive	Centrax Electrical Central Drive

Battery and fuel cell stack

Supplier	VDL High Energy battery	VDL High Energy battery	VDL High Energy battery	VDL High Energy battery	VDL High Energy battery
Total energy (kWh)	490	674	490	552	674

Charging solution

CCS Infrastructure-mounted pantograph	CCS Infrastructure-mounted pantograph	CCS Infrastructure-mounted pantograph	CCS Infrastructure-mounted pantograph	CCS Infrastructure-mounted pantograph	
Charging power (kW)	429	530	429	530	520
Charging time (hr:min)	5 min - 3 h	5 min - 4 h	5 min - 3:15 h	5 min - 3:15 h	5 min - 4 h

Heliox

Heliox provides world class smart energy management solutions that are tailored and scalable within a fast-changing mobility landscape. We are working towards a sustainable world where a seamless charging experience is the standard for every electric vehicle, and this transforms the way we power our everyday. Founded in 2009, Heliox is the market leader in fast charging systems within public transport, trucks, marine, mining and port equipment. In 2017, the company installed one of Europe's first and largest rapid charging networks for the e-bus fleet in Eindhoven, The Netherlands, and over the past two years, has created 'model city' energy ecosystems around the world in Den Bosch, Netherlands, Glasgow, Scotland and Montgomery County, USA.

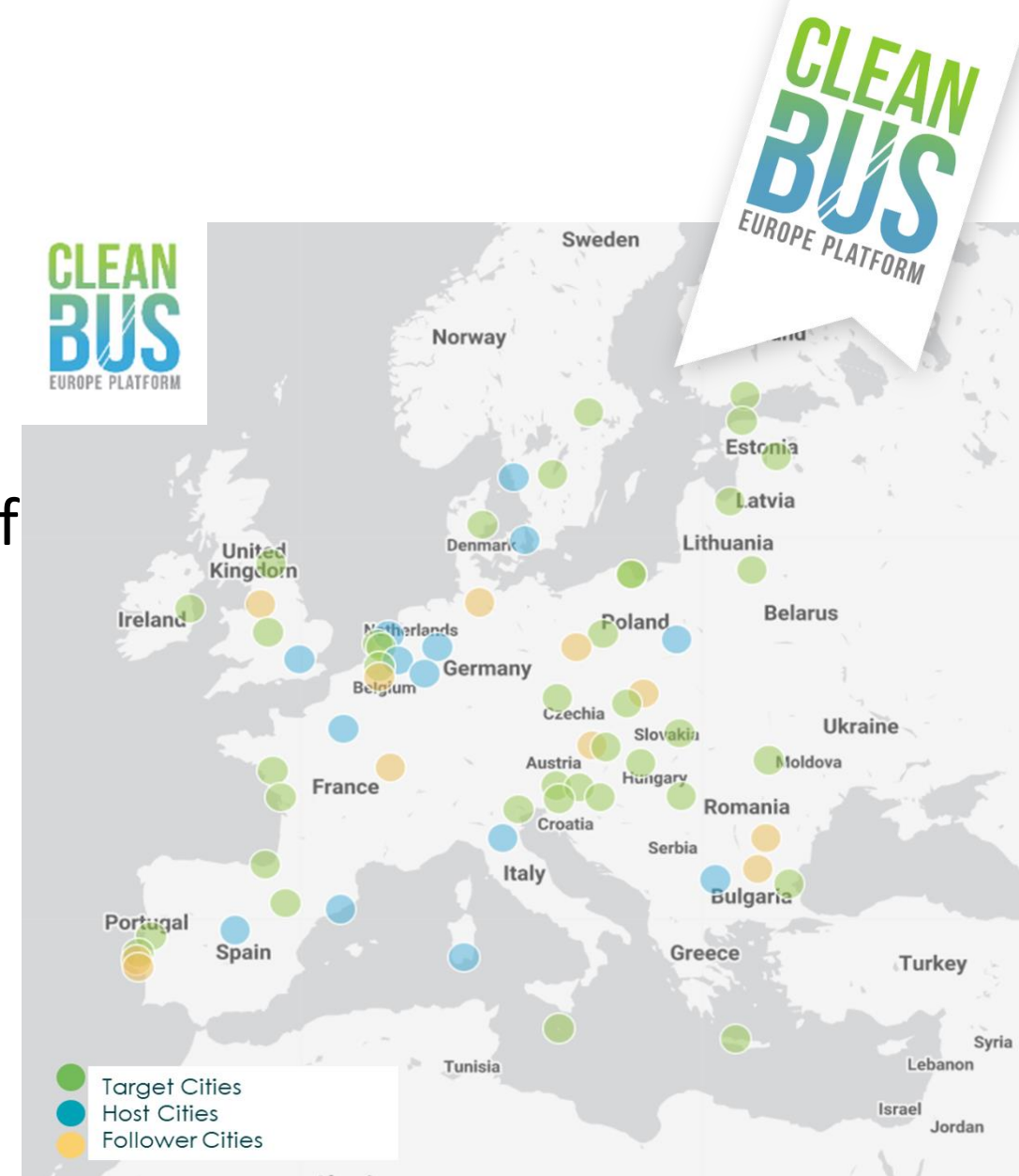
Charging Systems

Mobile 25kW/40kW/50kW	Rex 180kW	Rex 360kW	Ultra Fast 450/400kW
The Heliox Mobile charger (plug connector) is available in three power ranges, 25 kW-40kW-50kW.	The Heliox Flex 180 is Heliox's most versatile charging solution. Whether you need overnight or opportunity charging, dynamic or static charging, to charge one vehicle or up to three, the Flex 180 can do it all.	The Heliox Flex 360 kW is a fast and efficient solution for a single vehicle, or a dual vehicle fleet. Boasting one of the industry's highest component efficiency ratings the Flex 360 will always have your fleet ready to go.	Heliox' unique "Power Curve" technology means the 450kW can optimally charge a bus in just 2-5 min, allowing your fleet buses to run all day, achieving significant passenger capacity increase and cost reduction. Straightforward implementation meets future-proof as the Ultra-Fast 450 kW is ready for V2G and smart charging functionality.
Its durable yet lightweight design charger makes it an ideal solution for a range of environments. Its tough frame is designed specifically for service and maintenance personnel. Its easy manoeuvrability and the fact it connects to a standardised wall-socket makes it our easiest charger to use.	It's the most flexible charging solution available, anywhere.		
Suitable for Depot charging	Opportunity charging along the bus route (terminals, selected stops)	Opportunity charging along the bus route (terminals, selected stops)	Opportunity charging along the bus route (terminals, selected stops)
Charging technology and connection device	Conductive, CCS plug	Conductive, CCS plug	Conductive: Roof-mounted pantograph Infrastructure-mounted pantograph

Clean Bus Europe Platform Project

Supporting clean bus deployment

- Electrification involves strong partnerships and collaboration among key stakeholders
- CBEP brings together all players in the field of clean bus deployment
 - Exchange knowledge & expertise
 - Provision technical support
 - Match supply & demand
- Technologies
 - Battery electric, Plug-in hybrid, Natural gas, Fuel cells, IMC trolleybus





¡Gracias!

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