



Electromobility in Europe – Rotterdam – 7th June 2017

ZeEUS: the deployment of electric buses in Europe

Pauline Bruge, UITP

~ 450 billion bus journeys per year worldwide

- Buses account for approximately 83% of the total PT journeys worldwide
- Buses are the **backbone** of any public transport system and are the only PT mode in many cities





ADVANCING
PUBLIC
TRANSPORT

The International Association of Public Transport is committed to make bus systems more attractive



COMPLETED



RUNNING



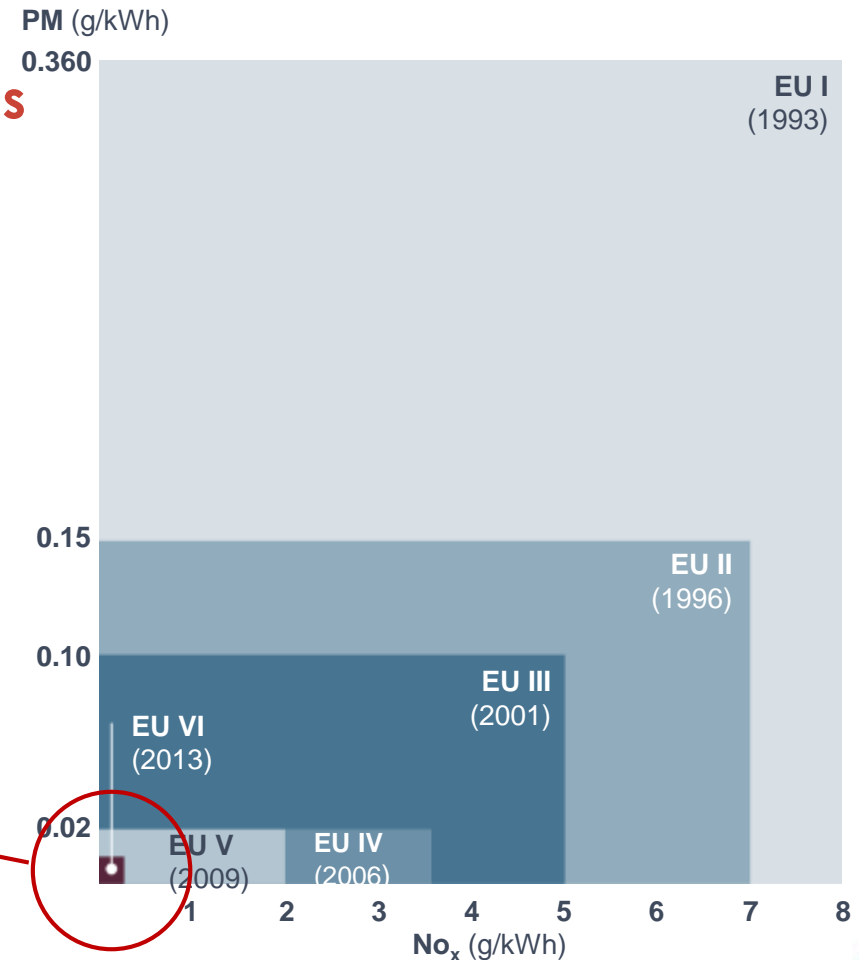
Clean fleet: what does it mean?

Euro vehicles standards & emissions

- PM & NO_x: **Hundredfold improvement** since 1993 from EURO I to EURO VI

Next “greening” step:

- (ultra) low / zero emission
- regulations on fuel consumption & CO₂ emissions

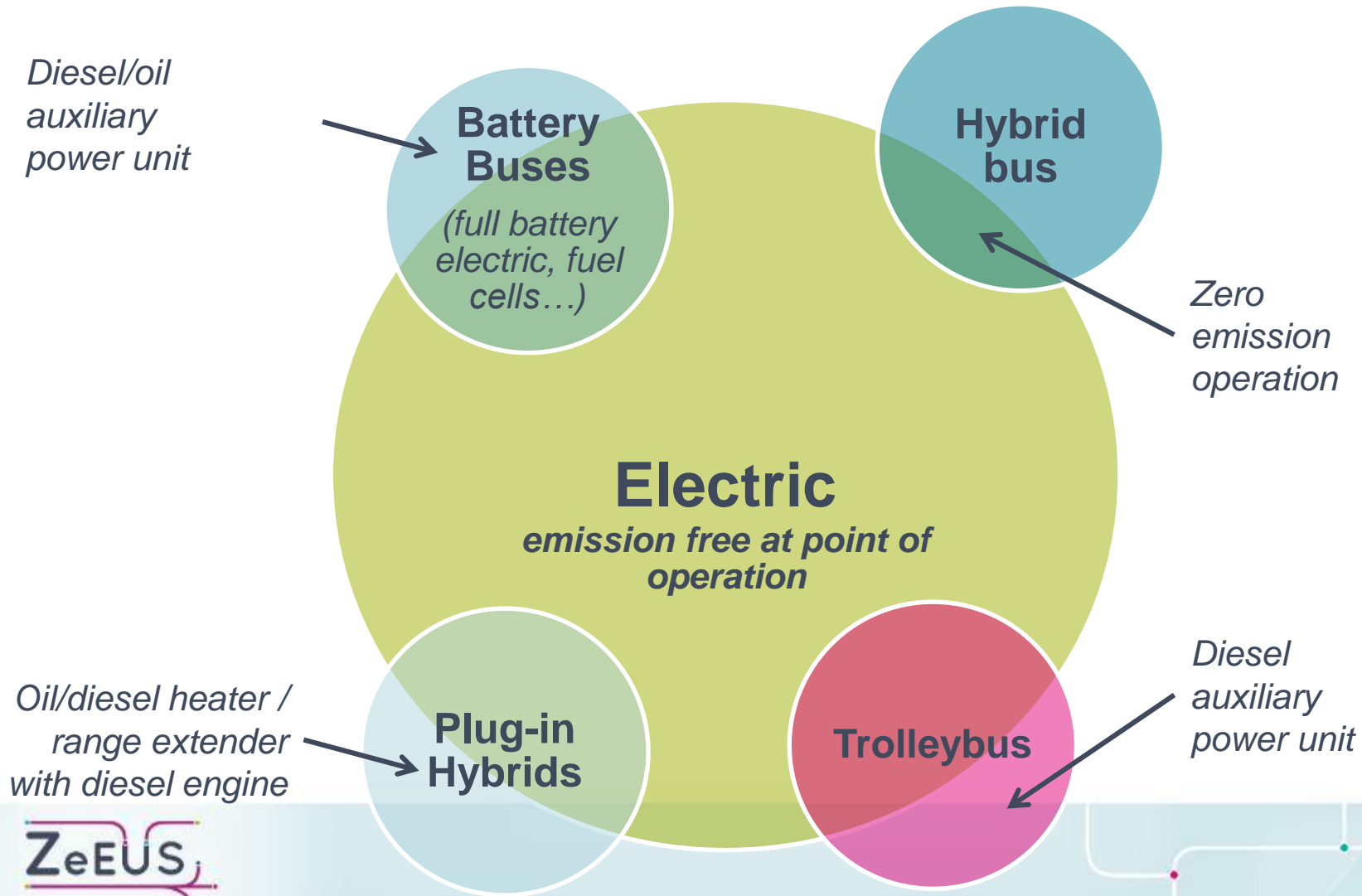


On road Plug-in
emissions

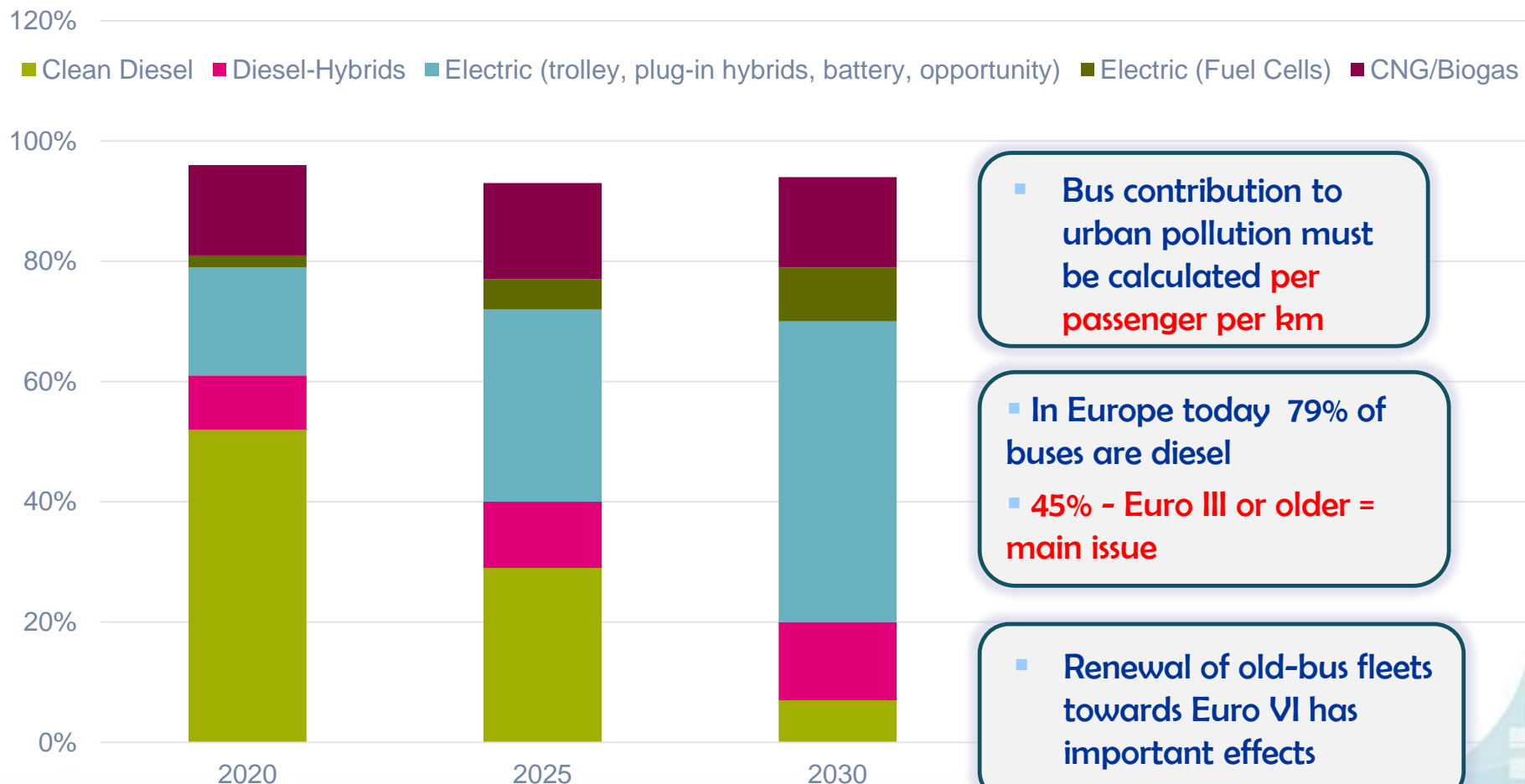
Source: VOLVO

UITP

Electric buses: what are we talking about?



Urban bus market share projections by propulsion technology



ZeEUS: a project to support electric bus deployment



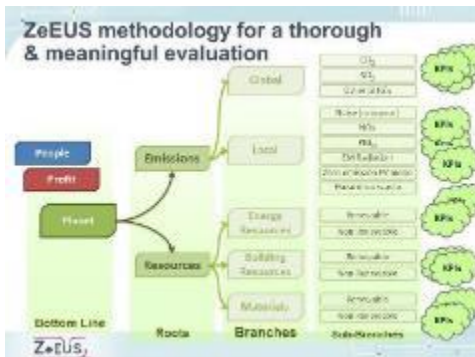
40 Consortium Partners
20 User Group Members
50 Observatory Members
Coordinator: UITP



22,5 million€
EU funding: 13,5
million €



10 cities
~70 electric buses



1 evaluation methodology

If?
When?
What?
How?



A set of tools and
guidelines to accompany
bus stakeholders in ebus
deployment

10 ZeEUS Demonstrations

~70 electric buses

- 12 meters, articulated, double-deckers
- Plug-in Hybrid, Full-electric, Battery Trolleys

Energy supply mode:

- plug-in, conductive, inductive, overhead

Charging strategies

- Overnight (depot)
- Opportunity (terminals, bus-stops)

Fast / Slow Charging



ZeEUS

Core Demo Cities

LONDON
3 plug-in hybrid
Double deck
Alexander Dennis

EINDHOVEN
43 full electric
VDL 18m

PARIS
10+ full electric
BOLLORE 12m

BARCELONA
2 full electric
IRIZAR 12 m
2 full electric
Solaris 18m

CAGLIARI
12 m Battery Trolleys
4 VOSSLOH /VAN HOOL
2 SOLARIS

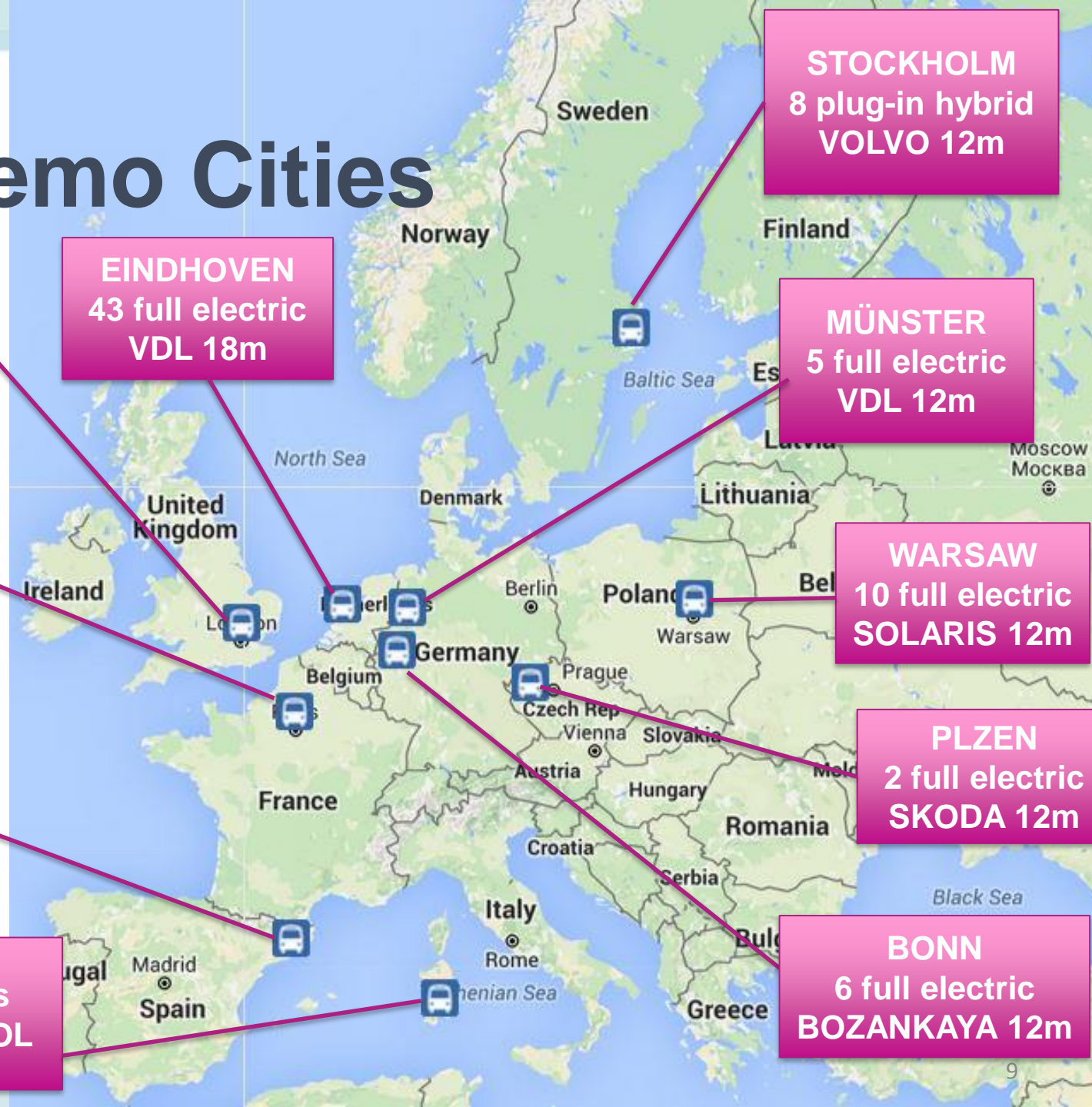
STOCKHOLM
8 plug-in hybrid
VOLVO 12m

MÜNSTER
5 full electric
VDL 12m

WARSAW
10 full electric
SOLARIS 12m

PLZEN
2 full electric
SKODA 12m

BONN
6 full electric
BOZANKAYA 12m



A two level evaluation methodology

Local / global level

Joint collaboration of stakeholders

Transferable to new cities / different alternative fuels



ZeEUS eBus Report

An overview of electric buses in Europe

- BEV, PHEV and battery trolleybuses
- 61 cities
- 27 manufacturers

Available online on:

www.zeeus.eu

Update foreseen in 2017, contact pauline.bruge@uitp.org for more info



City briefs & Industry fact sheets

MADRID (ES)

EMT DE MADRID



"We plan to renew our bus fleet with more CNG hybrid buses in order to improve air quality in Madrid."

Vehicles: 13 x 11.3m Castrusua Tempus

Charging: Slow-charging at the depot

Line: 41

Total operation time/day: 16h

Duration: Jan 2012-Jan 2014

Nature of experience: Pilot

Funding: Self-funded

DESCRIPTION

We are testing CNG hybrid buses; in our fleet we have 23 CNG hybrid buses, 13 of which are plug-in. The test aims to verify performance in real-world operations. Fuel consumption has been reduced by 30%, but the buses' reliability is not good. The buses have had a lot of breakdowns, especially in summer when the air conditioning is not powerful enough. However, the hybrid bus system has been good for air quality and passenger comfort.

VEHICLE SPECIFICATIONS

Vehicle Brand	13 x Castrusua
Vehicle Model	Tempus
Vehicle Length	11.3m
Total passenger capacity	64
Air Conditioning	Yes
Heating	Yes
Overnight charging	Plug at the depot (4h)
Energy storage system power	72kWh

LINE SPECIFICATIONS

Route number	41
Type of line	Metropolitan area
Topography of the line	Moderate
Length of the bus line	6km
Average commercial speed	13km/h
Total daily hours of operation	16h
Total daily hours operated in full electric	4.8h-6.4h
Total km driven/vehicle/day	210km



Castrusua Tempus

CLIMATE

The climate is warm and temperate in Madrid. The average annual temperature is 13.7°C. Rainfall averages 450mm annually. The warmest month of the year is July, with an average temperature of 24.0°C. The lowest average temperatures in the year occur in January, when it is around 5.0°C.

OTOKAR OTOMOTIV VE SAVUNMA SANAYI A. S.

COMPANY PROFILE

Being one of the major automotive manufacturers in Turkey, Otokar has been providing solutions specifically answering to the needs of its customers with its own technology, design and applications both in commercial and military range since 1963. It is operating with over 2,000 employees at the factory built on a land of 552,000m² in Sakarya. Otokar has been manufacturing buses for public transportation, semi-trailers for transportation and logistics industry and tracked the armored vehicles and tactical armored vehicles for the defense industry. With a hundred percent Turkish capital, Otokar is today present in the automotive and defense industries with products of which intellectual property rights are owned by it. Being a leader in the bus industry and the land vehicles in the defense industry in Turkey, Otokar is the main contractor in the Design and Prototype Development Project of ALTAY, the national battle tank of Turkey and is one of the companies of Koç Group.



Otokar Electra

Otokar

CONTACT

Company website:
www.otokar.com

Contact: Berkan Saglam
bsaglam@otokar.com

ELECTRIC BUS SPECIFICATIONS - GENERAL INFORMATION

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

ELECTRIC MOTOR

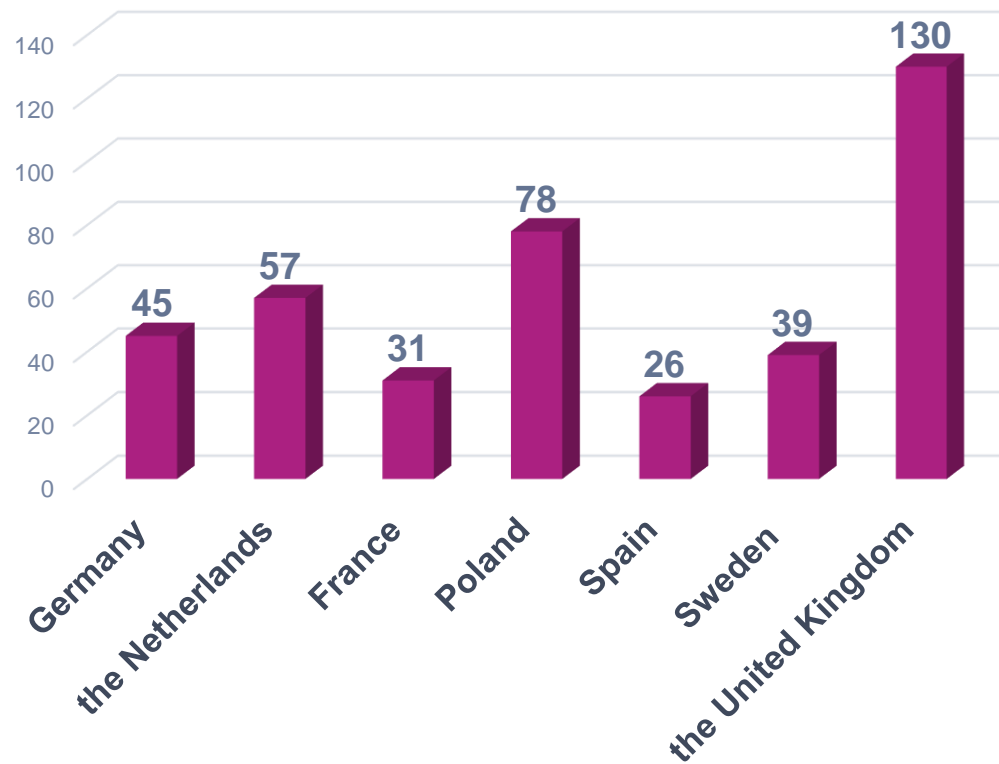
Suppliers	-
Type	asynchronous
Power peak	10.3kW
Torque	380Nm

BATTERY

Suppliers	Valence
Total energy	170kWh
Type	LFP
Warranty	-

ZeEUS eBus Report - overview

E-BUSES IN EUROPE - TOP COUNTRIES



- Coverage of > 500 E-buses in Europe

5 challenges to address for eBus deployment in Europe



High upfront cost

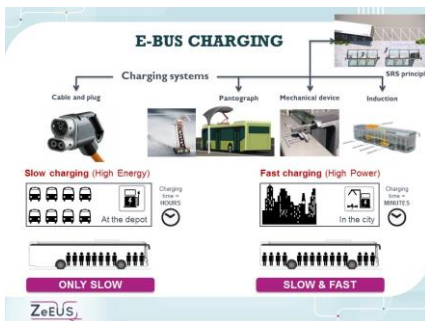


More challenging operation



New ways to procure:

- Vehicles & Equipments
- Operation services



Standardisation / Interoperability



Reinforcing cooperation energy/bus

How to procure an eBus?

- (Even more) complex tendering process?
 - Vehicles & equipment:
 - No longer business as usual!
 - Strike the right balance between technical specifications & required system functions
 - Embrace system approach: vehicle, operations, infrastructure
- Define a risk-sharing scheme as mitigation



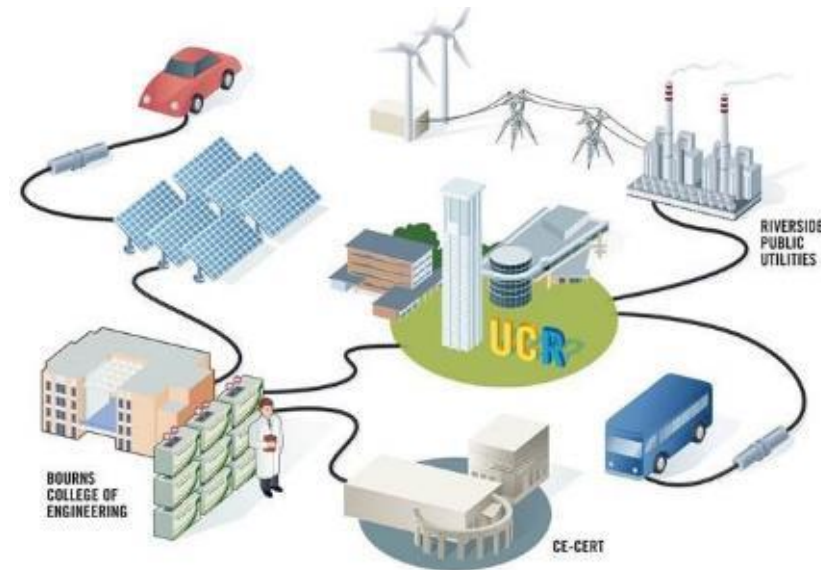
How to procure the eBus service?

- Adapt contract length between the authority and the operator
 - Take the technological risk into account (higher upfront cost/amortisation)
 - Define who pays & at what cost
 - Define who owns rolling stock/infra and what shall happen at the end of the contract



Ensuring good cooperation between the energy & bus sectors

- Different models in different cities
- Urban location of charging point
 - Cabling
 - Quality of the electricity distribution network
- Stability of electricity cost
- Exploring Opportunities
 - Use of PT power network (trams, metro)



UITP Training on ebuses Barcelona 19-21 June 2017



<http://www.uitp.org/events/electric-buses>

UITP International Bus Conference in conjunction with:

busworld.

EUROPE KORTRIJK
20-25 OCT 2017



<http://www.uitpxbusworld.uitp.org>

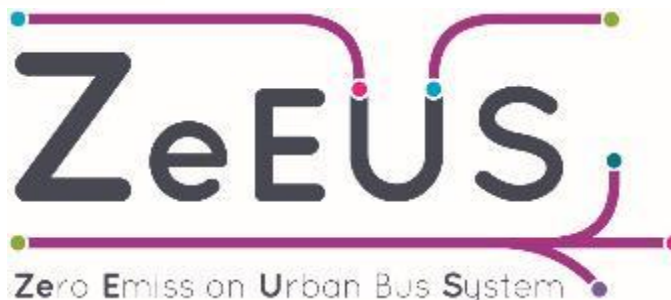
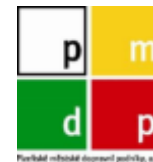
ZeEUS – Want to know more?

www.zeeus.eu



@zeeusproject





Key Performance Indicators (1)

PEOPLE	
Employment	Amount of workforce
	Qualitification of workforce
Quality of work	Safety
	Health
	Perception of technology
Quality of service	Safety
	Security
	Perception of technology

Key Performance Indicators (2)

PROFIT (1)

Capital costs (CAPEX)	Vehicles
	Depot facilities
	Recharging infrastructure
	Adjustments to current practices
	Assumed depreciation period
	Decommissioning costs
Operational costs (OPEX)	Personnel costs
	Spare parts
	Maintenance & Repairs
	Energy

PROFIT (2)

Revenue	Service fees
	Incentives
Financial sustainability	Leverage/gearing
	Access to capital (public/private)
	New financial mechanisms

Key Performance Indicators (3)

PLANET	
Emissions	Local
	Global
Resources	Building resources
	Energy resources
	Material