Deployment of electric buses in Europe

Urban Mobility India

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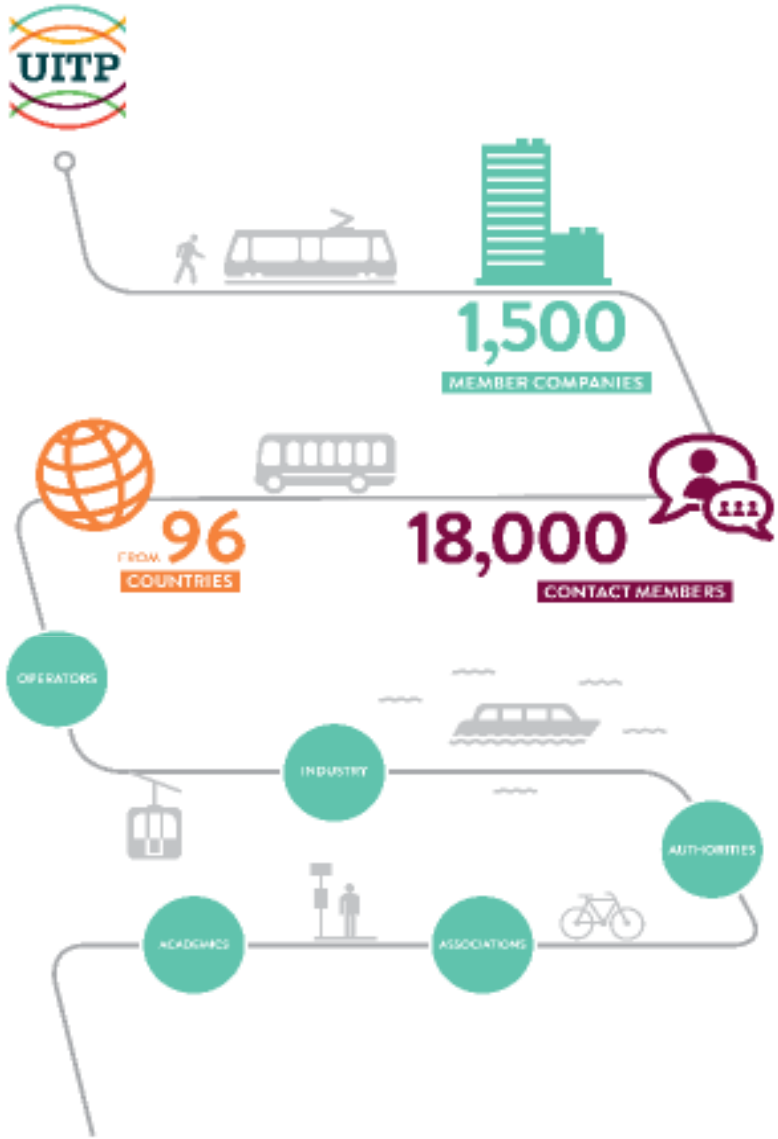
UITP AT A GLANCE

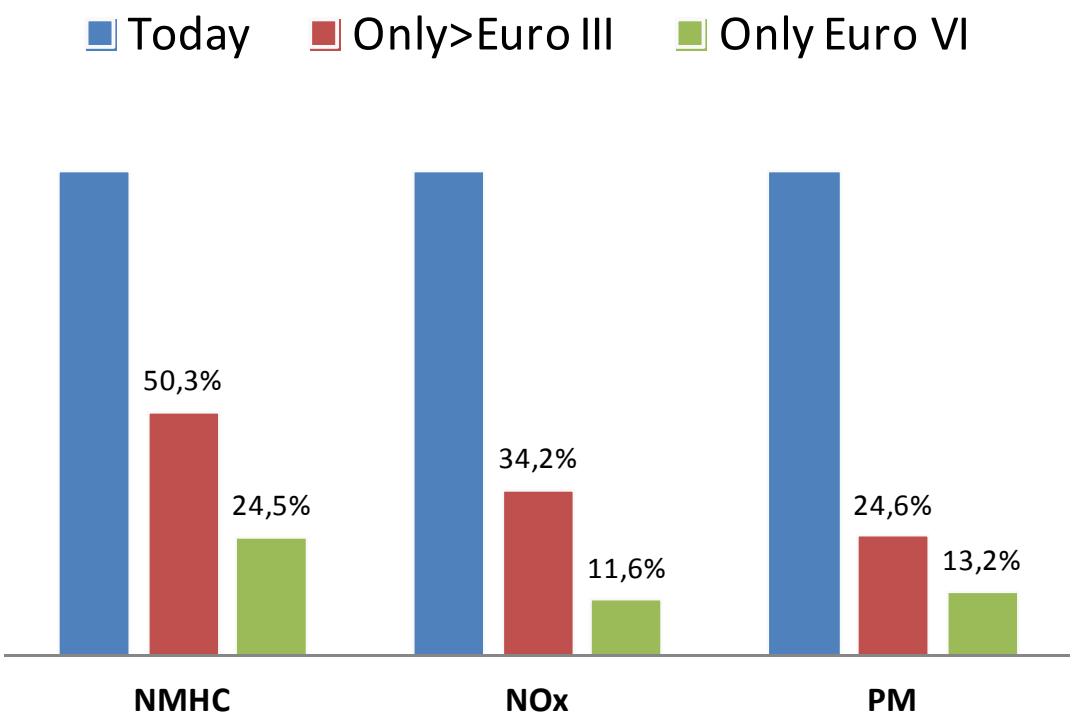
Mission: to enhance quality of life and economic well-being by supporting and promoting sustainable transport in urban areas worldwide.



FLEET RENEWAL IS A PRIORITY

In Europe, **45% - Euro III or older**

Renewal of old-bus fleets towards cleaner technologies is a priority for European Bus Stakeholders

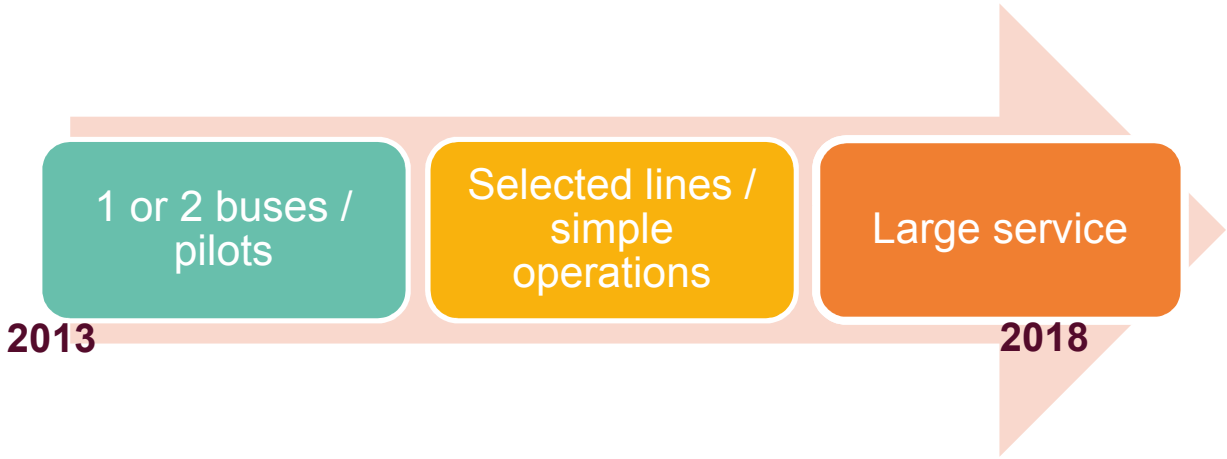


Estimated emissions reduction by renewing the fleet

Source:
www.3ibs.eu

ADVANCING PUBLIC TRANSPORT

GROW KNOWLEDGE BY EXPERIENCE



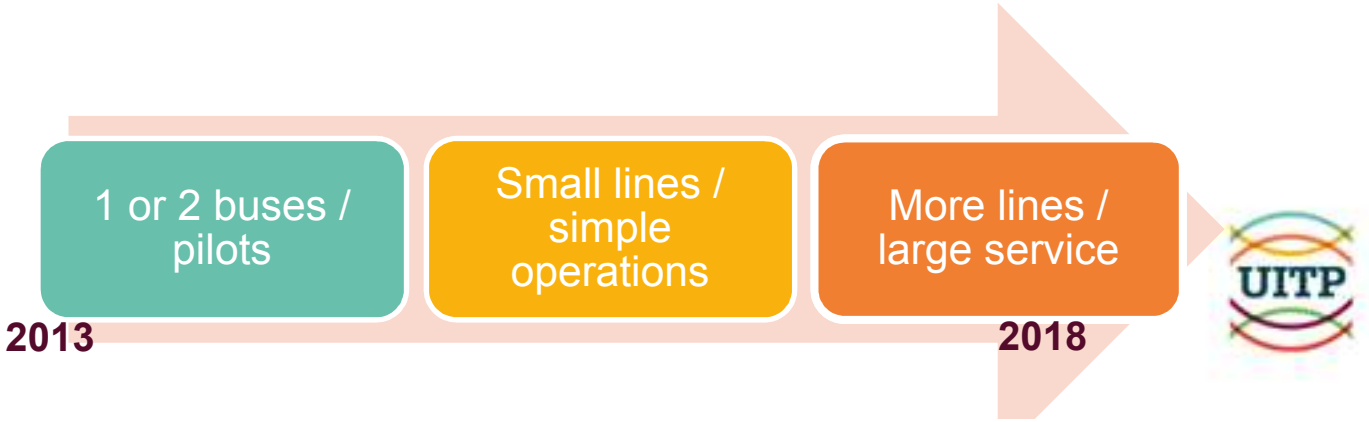
E-Bus Deployment in Europe

The “first steps”

PILOTS: BASIC OPERATIONS

- **Short route**: daily mileage load not too high.
- **Demands** on passenger's capacity low.
- **Energy consumption** not too high (no steep climbs, av. speed not too low).
- Enough time to **charge** the batteries in depot or at the terminal.
- There is the **back up** of conventional buses.

Not always necessary a system appoach, BUT more a *vehicle replacement* philosophy



BONN
6 full electric
12m Bozankaya

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

LONDON
3 Plug-in hybrid
(Induction)
Alexander Dennis

EINDHOVEN
43 full electric
(Opportunity)
18m VDL

CAGLIARI
12m Battery-Trolley
4 Voosloh/VanHool
2 Solaris

PARIS
23 full electric
12m Bolloré

WARSAW
10 full electric
12m Solaris

PILSEN
2 full electric
12m Skoda

MUNSTER
5 full electric
12m VDL

STOCKHOLM
8 Plug-in hybrid
12m Volvo

High capacity buses

- 12 meters,
- articulated,
- double-deckers

Different e-type

- Plug-in Hybrid,
- Full-electric,
- Battery Trolleys

Energy supply

- Plug-in,
- Inductive
- Conductive (pantograph)
- Overhead (trolley)

Fast and slow charging strategies

- Overnight (depot)
- Opportunity (terminals)
- On-route (trolley)

ZeEUS

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BARCELONA (ES) – TMB OVERNIGHT BUSES

Goal was to test the viability of 2 BEBs with overnight charging

Irizar i2e (BEB) 12 m – Overnight charging

- Line 20 H8, started operations 2014
- Battery capacity > 350 KWh
- More battery weight, less passenger capacity (75 pax)

Operational conditions

- Climate: Mediterranean
- Typology: City centre, flat
- Length: 12km
- Av. commercial speed: 11km/h
- Av. nr of passengers/day: 650 passengers

Key Figures

- Total daily hours of operation: 16 h
- Total km driven/vehicle/day: 180 km

Lessons learned:

- Key element: INFORMATION AT THE CONTROL CENTER: communication and monitoring to control the electric system.
- Automatic charging system at the depot (not manual).
- With the currently batteries:
- Overnight buses: not feasible because of the SERVICE TIME (16-18 h a day).
- Open questions:
  - Financing: How do we finance vehicles + infrastructure?
  - TCO: which technology (diesel/CNG/HY/ELECTRIC) is more expensive?

CAGLIARI (IT) - CTM

12m Battery-Trolley 4 Voosloh/VanHool and 2 Solaris Trollino T12

- Line 5 ZeEUS, stared operations

Operational conditions

- Typology: City centre – suburban (seafront road), moderate topography
- Length: 17.1km (winter configuration), 25.6km (summer configuration)
- Average commercial speed: 13.3km/h
- Total daily hours of operation: 15 - 18h
- Total km driven/vehicle/day: 180 - 220km
- Av. no. of passengers/day: 8,000 passengers

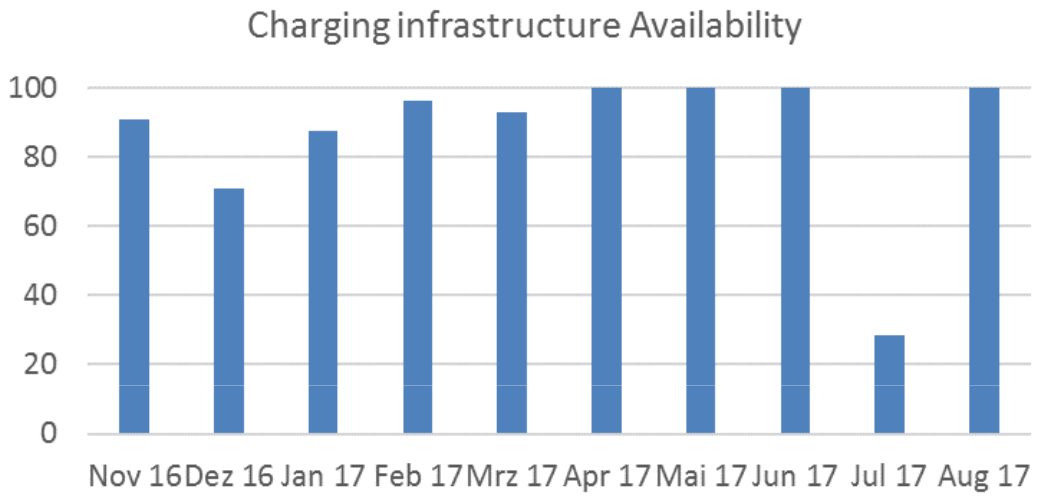
Key figures

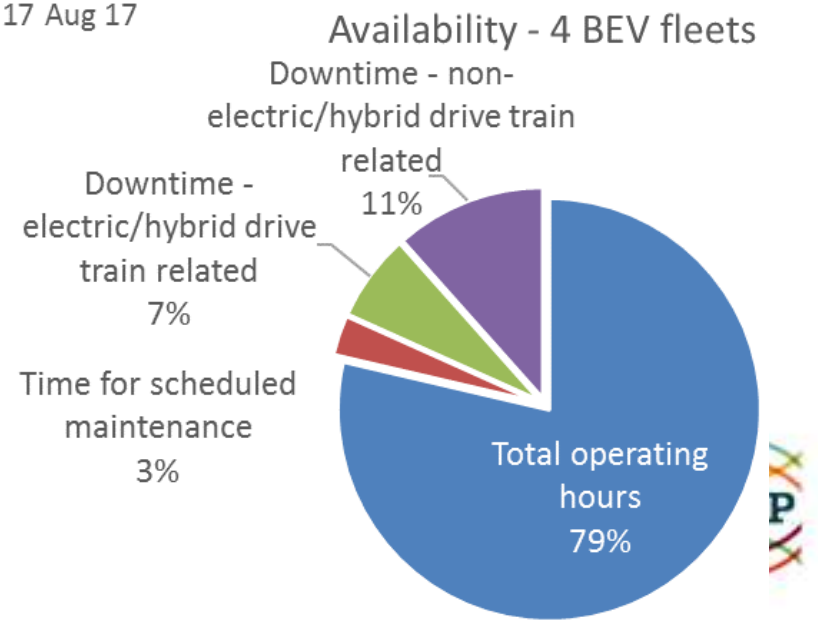
- Total travelled distance: 934,362 km (18 vehicles)
- 131,837 litres of diesel fuel saved
- Distance travelled by battery-trolleys: 346,944 km (95,865 km by battery)
- 105,100 kg of CO_2 emissions avoided

Lessons learned

- Using battery-trolley is possible to eliminate local emission and to reduce significantly global emissions and noise.
- The reliability of the battery trolleybuses is comparable to traditional vehicles (buses and trolleybuses) of CTM's fleet
- Energy consumption is considerably lower than diesel buses and traditional trolleybuses.
- Passengers appreciated the ZeEUS project and the battery-trolleybuses.

GROWING PERFORMANCES





E-BUS SYSTEMS OPERATING IN EUROPE

ZeEUS eBus Report #2

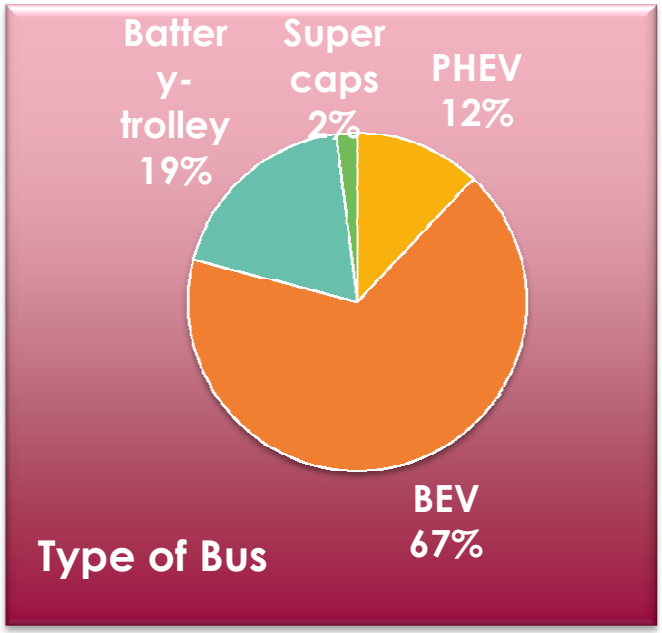
An updated overview of electric buses in Europe

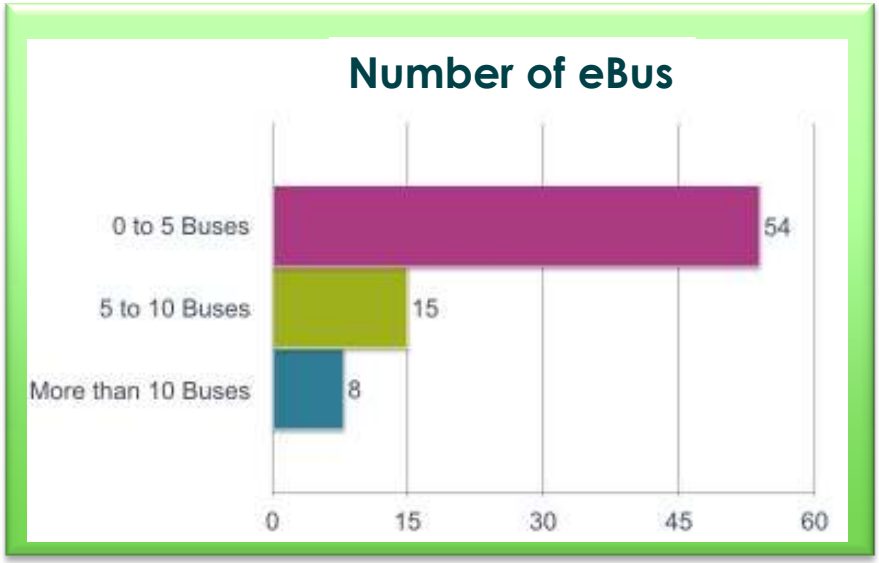
DOWNLOAD YOUR DIGITAL COPY AT:
www.zeeus.eu

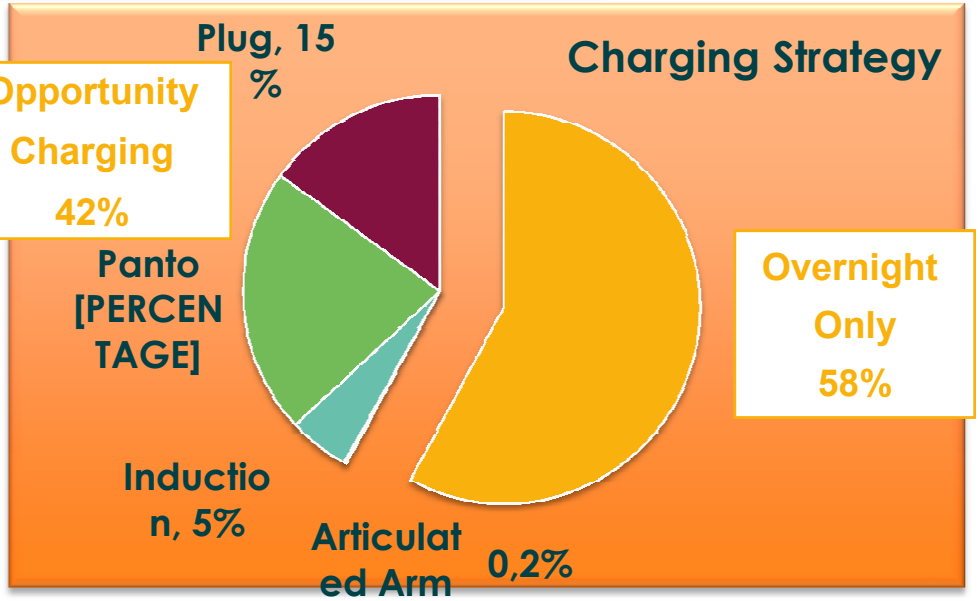
- 90 cities, over 800 vehicles and over 20 million km driven in pure electric mode
- 32 manufacturers
- 8 electric system suppliers

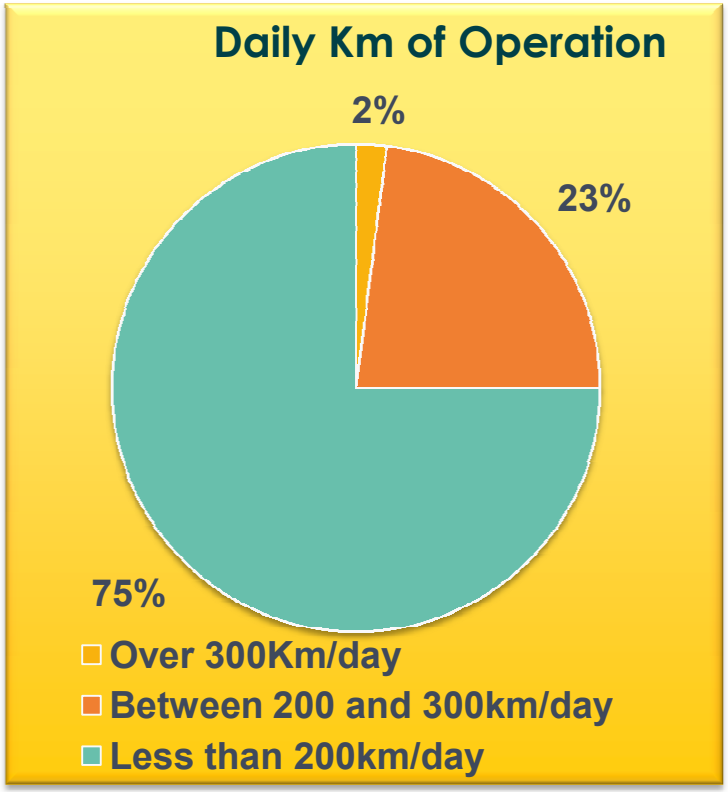
New release in preparation (init 2019)
Battery and Fuel Cells Electric Buses
Wider International Outlook
Stay Tuned!

ZEEUS REPORT









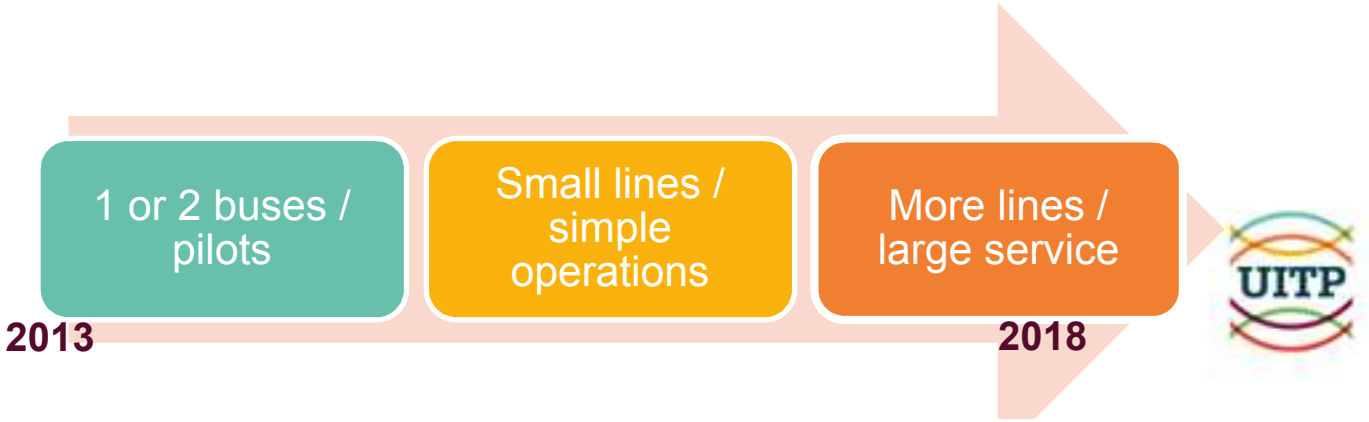
E-Bus Deployment in Europe

Growing “line by line”

LINE(S): SIMPLE OPERATIONAL CONDITIONS

- Selection of **more suitable line(s)** according to technical capabilities and operation requirements
- Early stage of new **urban strategy** for mobility and decarbonisation
- Early involvement of stakeholders from early planning stage: **joint feasibility studies**
- IT supporting fleet monitoring to optimise operation.

Paradigm shift: from vehicle procurement to system procurement



EINDHOVEN (NL) – HERMES-TRANSDEV 1/2

43 x 18m articulated e-buses VDL Citea SLFA-E181, on 8 lines since December 2016

- Roof-mounted pantograph
- Battery capacity: 180 kWh
- Range: 65-85 km
- Capacity: 136 passengers
- Buses in rush hour: 36 e-buses (+3 e-buses technical reserve, 6 add. e-buses).

Charging strategy: Opportunity (35-45 min) + Overnight at depot (4-5 h).

- Topography: flat.
- Length: 4.4-12.3 km.
- Total operation: 20 h/day.
- Total km driven/bus/day: av. 200 km; max. 300 km.

Improvements by experience reduced:

- Number of charging sessions during the day from 147 to 135.
- Number of charging operators from 5 to 3.

E-Fleet of 203 e-buses in 3 phases until 2024.

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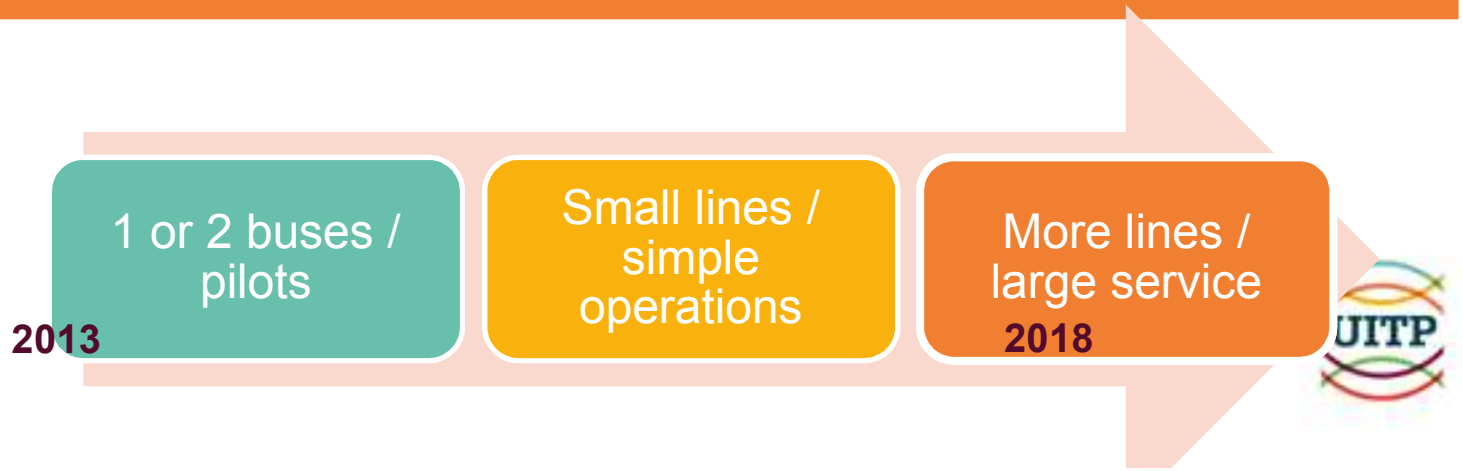
E-Bus Deployment in Europe

Large scale operation

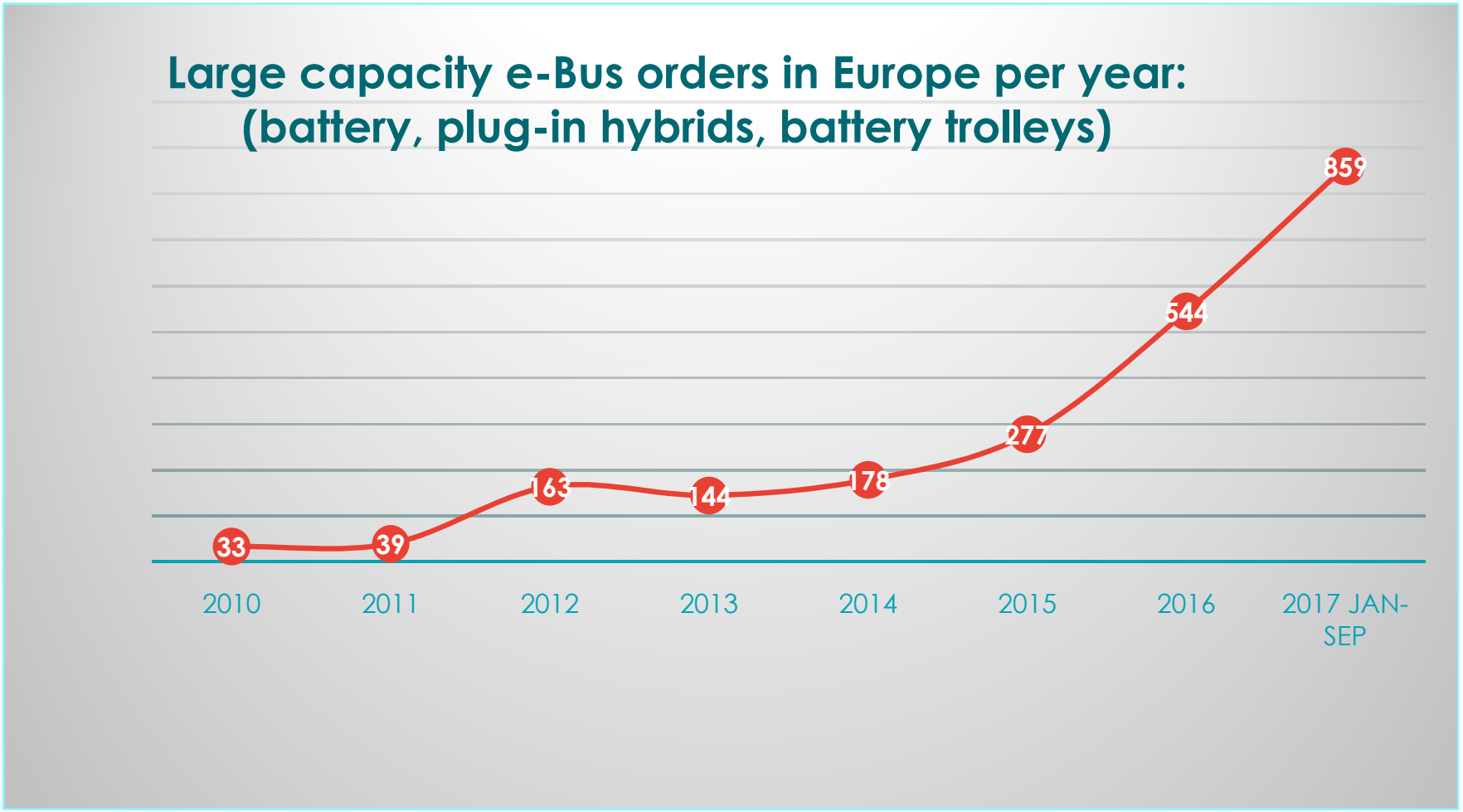
LARGE SCALE OPERATION

- **Replace a fleet** of conventional buses (no back up)
- Cover a **higher mileage** load on a daily basis
- The operation time is **20 hours/day** or more (>300km)
- Need to transport a **high capacity** of passengers
- The time available for **charging** is limited.
- **Interoperability** is a must

A new transport system to be deployed.



ELECTRIC BUS ORDERS GROWING FAST!



Source: www.zeeus.eu - 2017

LARGE OPERATION AND ORDERS IN PLACE

RECENT OPERATIONS
- **Schipol (NL) 100 BEV**
- **London (UK) 73 BEV**

ORDERS 2018
- **Paris (F) 80 + 250 BEV**
- **London (UK) 68 DD BEV**
- **Manchester (UK) 105 BEV**
- **Milan (I) 34 BEV**
- **Trondheim (N) 35 BEV**
- **Rotterdam (NL) 55 BEV**
- **Messina (I) 13 BEV**
- **Umeå (S) 25 BEV**
- **Goteborg (S) 30 BEV**
- **Leiden (NL) 23 BEV**
- **Oslo (N) 57 BEV**
- **Berlin (D) 30 BEV**
- **…**

- **More and more cities in Europe placing orders for Electric Buses**
- Driven by National or Local Policies
- European legislative framework in definition for **Infrastructure** and **Procurement** (numbers)
- Financial support by Europe only for **large projects**
- Most of financement comes from **local Governments**

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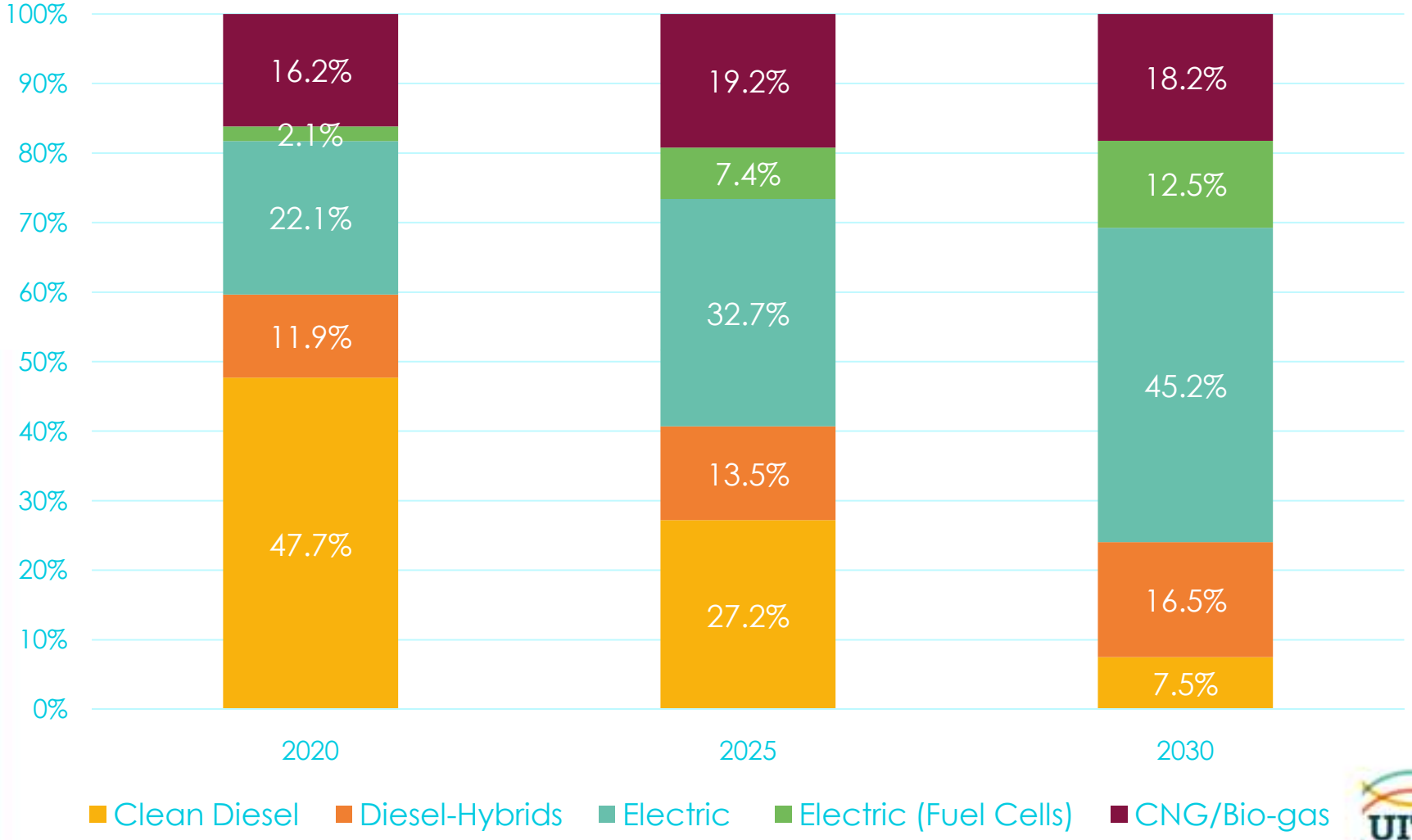
INDUSTRY VIEW: MARKET SHARE PROJECTIONS



Source: www.zeeus.eu **and UITP VEI Committee - 2017**

DEPLOYMENT SUPPORT

AVAILABLE
E-SORT for battery and plug-in hybrids

COMING SOON
Measures with Auxiliaries

Third edition including tendering for e-buses released (Oct '18)

Design Principles for eBus as a new urban object

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DEPLOYMENT RECOMMENDATIONS DOCUMENT (OCTOBER 2018)

IF – Know & Decide

- Clean-buses deployment strategy
- Exchange of experiences
- Understand own operation needs

Start from the needs, not the solution

WHEN – Plan & Regulate

- Joint collaboration
- Urban policies
- Funding & Financing mechanism
- Clear Project governance

Do the right plan!

WHAT – Select & Procure

- Standardised/ interoperable solutions
- Process for procuring innovation
- Risk sharing mechanism
- Relationship with energy providers

Expect the unexpected!

HOW – Operate & Maintain

- Training (new competencies, processes)
- Operations (including charging operations)
- Maintenance (new garage settings)
- Decommissioning (battery after-life)

Don't forget that is for the Passengers!

THANK YOU!

QUESTIONS?

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