State of the European Battery Electric Buses

US ZEB Conference 2018
11th - 12th September 2018, Los Angeles

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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

- Today
- Only > Euro III
- Only Euro VI

Estimated emissions reduction by renewing the fleet

<table>
<thead>
<tr>
<th></th>
<th>NMHC</th>
<th>NOx</th>
<th>PM</th>
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</thead>
<tbody>
<tr>
<td>Today</td>
<td>50.3%</td>
<td>34.2%</td>
<td>24.6%</td>
</tr>
<tr>
<td>Only &gt; Euro III</td>
<td>24.5%</td>
<td>11.6%</td>
<td>13.2%</td>
</tr>
<tr>
<td>Only Euro VI</td>
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</tbody>
</table>

Source: www.3ibs.eu

THE BUS IS CLEAN!
In Europe Urban Bus contribution to city transport pollution (25%) is 8% calculated per passenger per km

In Europe, 45% - Euro III or older

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

The changes leading to a clean bus fleets shall improve and never put at risk the quality of service to passengers
GROW KNOWLEDGE BY EXPERIENCE

- Short routes.
- Low capacity.
- Low energy consumption
- Enough time to charge batteries.
- Back up of conventional buses.
- Not a system approach, BUT a vehicle replacement philosophy

- Selection of line(s)
- Early stage of urban strategy for mobility
- Feasibility studies with all stakeholders
- IT fleet monitoring tools to optimise operation.

Paradigm shift: from vehicle procurement to system procurement

- Replace a fleet (no back up)
- High passengers demand
- Demanding operations 20 h/day / 300km
- Limited time to charge
- Interoperability is a must

A completely new transport system deployed.

1 or 2 buses / pilots
Selected lines / simple operations
Large service

2013 2018
E-Bus Deployment in Europe

The “first steps”
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)
GROWING PERFORMANCES

ZERO EMISSION URBAN BUS SYSTEM (ZeEUS) PROJECT
For the period Aug 2015 – Jan 2018

Figures coming from 10 cities across Europe

- **5.661.126 km**
  The distance travelled by ZeEUS buses running in pure electric mode

- **2.151.228 litres**
  The amount of diesel fuel saved by the ZeEUS bus project

- **3.273 tons**
  The amount of carbon dioxide emissions prevented by the ZeEUS bus project

Charging infrastructure Availability

- **Availability - 4 BEV fleets**
- **Downtime - non-electric/hybrid drive train related 11%**
- **Downtime - electric/hybrid drive train related 7%**
- **Time for scheduled maintenance 3%**

Total operating hours 79%
E-BUS SYSTEMS OPERATING IN EUROPE

ZeEUS eBus Report #2
An updated overview of electric buses in Europe

- 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!

DOWNLOAD YOUR DIGITAL COPY AT:
www.zeeus.eu
E-Bus Deployment in Europe

Growing “line by line”
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.**
E-Bus Deployment in Europe

“BIG and Different”
ELECTRIC BUS ORDERS GROWING FAST!

Large capacity e-Bus orders in Europe per year: (battery, plug-in hybrids, battery trolleys)

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
INDUSTRY VIEW: MARKET SHARE PROJECTIONS

Source: www.zeeus.eu and UITP VEI Committee - 2017
## European Standards for Charging

### Charging Options

<table>
<thead>
<tr>
<th>Charging options</th>
<th>Manual connection</th>
<th>Automatic connection</th>
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<tbody>
<tr>
<td></td>
<td>A (connector)</td>
<td>B (roof mounted pantograph)</td>
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<tr>
<td>Communication</td>
<td>ISO 15118-2 Ed1</td>
<td>ISO 15118-2 Ed2</td>
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<td>IEC 62196-3</td>
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<tr>
<td></td>
<td>Configuration FF</td>
<td>Configuration xx</td>
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</table>
Available E-SORT for battery and plug-in hybrids

COMING SOON Measures with Auxiliaries

Design Principles for eBus as a new urban object

Third edition including tendering for e-buses released (Oct ‘18)
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!
PROJECTS SUPPORTING THE UPSCALE

• **Modular high power charging systems up to 600 kW and high transfer efficiency.**

• **Charger-vehicle interoperability and standardisation** test protocols.

• **Energy storage systems & charging management strategies:** smart charging for large fleets.

• **Smart management** of power distribution networks, electrified public transport networks (metro, trams...) and charging stations for EVs.
BEYOND CLEAN FLEETS, TOWARDS LIVEABLE CITIES

- Fleet Renewal towards Clean Technologies
- Policies fostering Modal Shift towards clean & multimodal PT
- Shared Public Transport Charging Infrastructure

Multiplier effect on improved air quality, urban mobility, citizens’ well-being

AVOID SHIFT IMPROVE
THANK YOU!

QUESTIONS?

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