State of the European Battery Electric Buses

ASSURED UsG-1
18th September 2018, Berlin

Umberto Guida
Director Research & Innovation, UITP
FLEET RENEWAL IS A PRIORITY

In Europe, 45% - Euro III or older

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

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

NMHC
- Today: 50.3%
- Only Euro III: 24.5%
- Only Euro VI: 13.2%

NOx
- Today: 34.2%
- Only Euro III: 11.6%
- Only Euro VI: 13.2%

PM
- Today: 24.6%
- Only Euro III: 13.2%
- Only Euro VI: 11.6%

Estimated emissions reduction by renewing the fleet

Source: www.3ibs.eu
BEYOND CLEAN FLEETS, TOWARDS LIVEABLE CITIES

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

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

AVOID SHIFT IMPROVE
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 approach, BUT more a vehicle replacement philosophy**
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)
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
**ZEEUS REPORT**

**Type of Bus**
- BEV: 67%
- PHEV: 12%
- Battery-trolley: 19%
- Supercaps: 2%

**Number of eBus**
- 0 to 5 Buses: 54
- 5 to 10 Buses: 15
- More than 10 Buses: 8

**Charging Strategy**
- Opportunity Charging: 42%
- Panto: 22%
- Plug: 15%
- Induction: 5%
- Articulated Arm: 0.2%

**Daily Km of Operation**
- Over 300Km/day: 75%
- Between 200 and 300km/day: 23%
- Less than 200km/day: 2%
E-Bus Deployment in Europe

Growing “line by line”
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

1 or 2 buses / pilots | Small lines / simple operations | More lines / large service

2013  →  2018
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
- Schiphol (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](http://www.zeeus.eu) and UITP VEI Committee - 2017
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.

1 or 2 buses / pilots  
Small lines / simple operations  
More lines / large service

2013  
2018
# European Standards for Charging

**Charging options**

<table>
<thead>
<tr>
<th>Manual connection</th>
<th>Automatic connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (connector)</td>
<td>B (roof mounted pantograph)</td>
</tr>
<tr>
<td></td>
<td>C (infrastructure mounted pantograph)</td>
</tr>
<tr>
<td></td>
<td>D (under floor mounted ACD)</td>
</tr>
</tbody>
</table>

**Communication**

<table>
<thead>
<tr>
<th>ISO 15118-2 Ed1</th>
<th>ISO 15118-2 Ed2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 15118-3</td>
<td>ISO 15118-8</td>
</tr>
</tbody>
</table>

**Electrical**

<table>
<thead>
<tr>
<th>IEC 61851-1</th>
<th>IEC 61851-21-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61851-23</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ISO 17409 Ed1</th>
<th>IEC 61851-23-1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ISO 17409 Ed2</td>
</tr>
</tbody>
</table>

**Mechanical**

<table>
<thead>
<tr>
<th>IEC 62196-3</th>
<th>prEN50696</th>
<th>prEN50696</th>
<th>prEN50696</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration FF</td>
<td>Configuration xx</td>
<td>Configuration yy</td>
<td>Configuration zz</td>
</tr>
</tbody>
</table>
Design Principles for eBus as a new urban object

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

Available E-SORT for battery and plug-in hybrids

COMING SOON

Measures with Auxiliaries
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!

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

ASSURED

- 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.

e-LOBSTER

- smart management of power distribution networks, electrified public transport networks (metro, trams...) and charging stations for EVs.
ASSURED User Group
ASSURED User Group objectives

In line with the ASSURED Innovations, the challenges of the large deployment of electric buses are suggested as topics for the UsG work:

• Road charging infrastructure
  • Planning, permissions, interoperability…

• Depot transformation
  • Including safety, training…

• Operational excellence
  • Energy vs operation efficiency

• IT tools for fleet management and diagnostic
  • Including data standardisation…

The objective is to look these topics from the operational point of view, even beyond ASSURED, and bringing your direct experience
THANK YOU!

QUESTIONS?

Umberto Guida, Director R&I, UITP

@UITPNews

UITP

www.uitp.org