Electric Mobility and Urban Development

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Workshop on: Integrated Transport and Urban Development including environmental, health and quality of life perspective

Source: Alstom
Agenda

• Urban Development and Sustainable Urban Mobility
• Pollution associated to urban mobility solutions
• Why electric public transport solutions?
• Route Planning for Electric Vehicles
• Challenges to the urban centre
• Planning and financing the technology shift
• Innovative procurement processes to support electric mobility
• Steps taken in Romania
• Lessons learnt
Urban Development and Sustainable Urban Mobility (1/2)

Green, compact and energy-efficient cities make a key contribution to sustainable growth.

The fast urbanisation pace in Europe bring about a number of unprecedented challenges related inter alia to the prevention and management of urban sprawl, the promotion of sustainable land-use, the prioritisation of renewal, regeneration and retrofitting of urban areas and the redevelopment of brownfields, the provision of high-quality buildings, public space and mobility policies, and the protection of urban green areas and promotion of nature-based solutions.

Urban Agenda for the EU
https://ec.europa.eu/futurium/en/urban-agenda
Percentage of the urban population in the EU-28 exposed to air pollutant concentrations above certain EU and WHO reference concentrations (minimum and maximum observed between 2013 and 2015)

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>EU reference value (*)</th>
<th>Exposure estimate (%)</th>
<th>WHO AQG (*)</th>
<th>Exposure estimate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM$_{2.5}$</td>
<td>Year (25)</td>
<td>7-8</td>
<td>Year (10)</td>
<td>82-85</td>
</tr>
<tr>
<td>PM$_{10}$</td>
<td>Day (50)</td>
<td>16-20</td>
<td>Year (20)</td>
<td>50-62</td>
</tr>
<tr>
<td>O$_3$</td>
<td>8-hour (120)</td>
<td>7-30</td>
<td>8-hour (100)</td>
<td>95-98</td>
</tr>
<tr>
<td>NO$_2$</td>
<td>Year (40)</td>
<td>7-9</td>
<td>Year (40)</td>
<td>7-9</td>
</tr>
<tr>
<td>BaP</td>
<td>Year (1)</td>
<td>20-25</td>
<td>Year (0.12) RL</td>
<td>85-91</td>
</tr>
<tr>
<td>SO$_2$</td>
<td>Day (125)</td>
<td>&lt; 1</td>
<td>Day (20)</td>
<td>20-38</td>
</tr>
</tbody>
</table>

**Key**
- < 5 %
- 5-50 %
- 50-75 %
- > 75 %

Pollution associated to urban mobility solutions (1/3)

Share of EU emissions of the main pollutants, by sector group in 2016

Source: *** - European Union emission inventory report 1990-2016 under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP), European Environment Agency, 2018
Pollution associated to urban mobility solutions (2/3)

Greenhouse gases emissions by sector in the EU-28

Pollution associated to urban mobility solutions (3/3)

EU key category analysis results for 2016: bubble size indicates amount of emissions

Key category source sector abbreviations:
Road transport:
1A3bi - Passenger cars
1A3bii - Light duty vehicles
1A3biii - Heavy duty vehicles and buses
1A3biv - Mopeds and motorcycles
1A3bv - Gasoline evaporation
1A3bvi - Automobile tyre and brake wear
1A3bvi - Automobile road abrasion
Non-road transport:
1A3dii - National navigation (shipping)

Source: *** - European Union emission inventory report 1990-2016 under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP), European Environment Agency, 2018
“Mass transit, also called mass transportation, or public transportation, the movement of people within urban areas using

**group travel technologies**

such as buses and trains.
The essential feature of mass transportation is that many people are carried in the same vehicle (e.g., buses) or collection of attached vehicles (trains).
This makes it possible to move people in the same travel corridor with

**greater efficiency**, which can lead to

**lower costs to carry each person**
or—because the costs are shared by many people—the opportunity to spend more money to provide better service, or both.”

https://www.britannica.com/topic/mass-transit*
Clean (alternatively fuelled) buses in urban areas can offer considerable advantages.

Reductions in emissions of greenhouse gases, air pollutants and noise bring about considerable public health benefits. Moreover, moving around quietly and smoothly means greater passenger comfort and new opportunities for routes, making public transport more attractive.

However, the potential of these innovative technologies is far from being fully utilised in the EU, owing also to ongoing wide-spread concerns over technical maturity and high costs, particularly of battery-electric and fuel-cell electric buses.

**URBAN AGENDA FOR THE EU.**

*Partnership for Urban Mobility. Final Draft Action Plan*

Why electric public transport systems? (3/3)

Volatile Organic Compounds
Significantly contributes to smog

Carbon Monoxide
Highly poisonous gas

Oxides of Nitrogen
Major component of acid rain and smog formation

Particulate Matter
Impairs breathing and creates haze

Route Planning for Electric Vehicles (1/3)

Optimum distance for walking to/from public transport station is worth about 5 minutes.

"For electric bus route design, the **consideration of wider objectives and more operational constraints** (in comparison to the traditional vehicle routing problem) pose new routing models and application scenarios which consequently leading to more complicated optimization problem."

Lay Eng Teoh et.al

**Scenario-based electric bus operation: A case study of Putrajaya, Malaysia**

![Route Map](image)

Route Planning for Electric Vehicles (3/3)

- Route Logistics
  - Length
  - Duration
  - Schedule
  - Frequency
- Duty Cycle
  - Speed
  - Acceleration/Deceleration
  - Grades
  - Passenger Load
  - Auxiliary Load
  - Deadhead
- Operating Environment
  - Traffic Congestion
  - Climate
Challenges to the urban centre (1/4)

Range provided by a refill
Gasoline and CNG provide the convenience of fast refill, while Battery Electric Vehicles require long periods of inactivity

Challenges to the urban centre (2/4)

Plug-in Electric Vehicles Charging Load Profiles in 2025 in California, USA according to California Energy Commission and NREL

Challenges to the urban center (3/4)

Charging systems

- Charging only at the depots
  - Charge more seldom
  - Larger Batteries
  - Lower charging power

- Opportunity charging, with chargers in the depot as well as at selected bus stations
  - Charge more often
  - Smaller Batteries
  - Higher charging power

Challenges to the urban center (4/4)

Opportunity charging requires access to power infrastructure in different areas of the urban area and raises design challenges to integrate the station in urban environment.

Charging at the depots may require large areas for charging simultaneously the fleet.

Source: https://www.electrive.com/

Source: https://chargedevs.com/features/the-inevitability-of-electric-buses/
Planning and financing the technology shift

Financing technology shift

Capital Investment
- Transport operator CAPEX
- Public Authority Taxes
- National and International Grants

Operational Expenditures
- Leasing from vehicle pool managers
- Leasing from vehicle manufactures
Innovative procurement process to support electric mobility (1/2)

Directive 2009/33/CE, on the promotion of clean and energy-efficient road transport vehicles
- Art. 16 – ‘The biggest impact on the market, together with the best cost/benefit result, is obtained through mandatory inclusion of lifetime costs for energy consumption, CO2 emissions, and pollutant emissions as award criteria in the procurement of vehicles for public transport services.’
- Art. 20. Including the above mentioned award criteria ‘does not impose higher total costs but rather anticipates operational lifetime costs in the procurement decision’.

Cost structure for a passenger transport vehicle:

<table>
<thead>
<tr>
<th>Costs</th>
<th>Locomotive for passenger service*</th>
<th>Electric bus with 250 kWh on-board</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase</td>
<td>22,7 %</td>
<td>43%</td>
</tr>
<tr>
<td>Energy consumption</td>
<td>46,2 %</td>
<td>12%</td>
</tr>
<tr>
<td>Maintenance</td>
<td>31,0 %</td>
<td>46%</td>
</tr>
<tr>
<td>Source: Trümpi 1998¹</td>
<td>Source: Bloomberg Finance 2018²</td>
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</tbody>
</table>

Innovative procurement process to support electric mobility (2/2)

Steps taken in Romania (1/3)

- **Sustainable Urban Mobility Plans** are mandatory official documents for all cities above 100k inhabitants and those cities looking for EU and Romania Government grants.
- During the implementation period of EU MFF 2014-2020 Romanian urban centres are subsidised by EU and RO public budgets to invest in enhanced environmental friendly buses, in tramways and in trolleybuses:
  - 80%/85% of funds are provided by EU
  - 18%/13% of the funds are provided by RO central Government
- Since 2017 RO Government subsidise individuals to buy electric vehicles.
- Starting with 2019 all municipalities and state-owned operators should use at least a 30% investment option in environmental friendly public transport vehicles out when buying new vehicles (based on a new 2018 RO Law)
Steps taken in Romania (2/3)

- Some Romanian cities have invested in **bike-rental systems and integrated the system in the public transport offer** (i.e. Timisoara, Cluj)
- Bucharest Municipality (RO capital city) has started to issue (2017) individual subsidies to **buy classic and electric bikes as well as electric scooters**
- Smaller and larger cities are investing in **e-buses vehicles and infrastructures**
  - This is **not yet a clear trend**
  - Non-plugin hybrid buses are still an investment option for conservative technical influencers (i.e. Targoviste, Zalau)
  - Cities with tradition in trolleybus operations are investing in autonomous (diesel or electric) trolleys too (i.e. Cluj Napoca, Ploiesti)
- **New financial sources are identified to invest in electric PT vehicles** (i.e. environment protection funds)
- RO Government and cities are preparing the **first centralized acquisition** process of **electric PT vehicles** with the support of JASPERS (EC+EIB Joint Assistance to Support Projects in European Regions)
Lessons learnt

• Some **challenges** are raised, in RO, on the road to developing sustainable public transport networks and investing in EEVs in functional urban areas:
  1. Each municipality has the right to spend **public funds only for their own administrative area**;
  2. There is a **limited knowledge** about how to prepare **long term investments**;
  3. **Confusing messages** around operation new technologies;
• **Bus and PT vehicles pooling** may be an option to lower risks to running high quality services
  • similar option is already available based on **modified Regulation EC 1370/2007**, art 5a for railway undertakings
Thank you

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