Electric Mobility and Urban Development

Source: Alstom

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

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

Urban Development and Sustainable Urban Mobility (2/2)

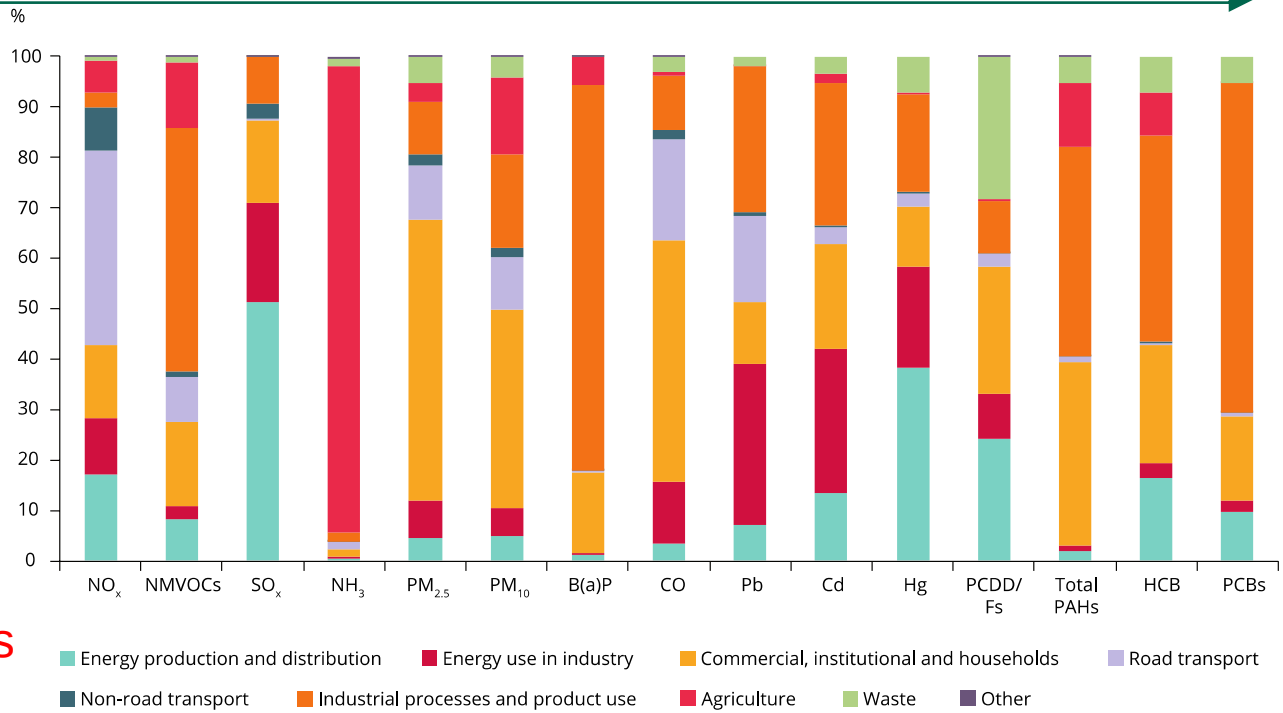
Percentage of the urban population in the EU-28 exposed to air pollutant concentrations above certain EU and WHO reference concentrations (minimum and maximum observed between 2013 and 2015)

Pollutant	EU reference value (a)	Exposure estimate (%)	WHO AQG (a)	Exposure estimate (%)
$PM_{2.5}$	Year (25)	7-8	Year (10)	82-85
PM_{10}	Day (50)	16-20	Year (20)	50-62
O_3	8-hour (120)	7-30	8-hour (100)	95-98
NO_2	Year (40)	7-9	Year (40)	7-9
BaP	Year (1)	20-25	Year (0.12) RL	85-91
SO_2	Day (125)	< 1	Day (20)	20-38

Key: < 5 % | 5-50 % | 50-75 % | > 75 %

Source: *** - ***Air quality in Europe — 2017 report***, European Environment Agency, 2017

Pollution associated to urban mobility solutions (1/3)

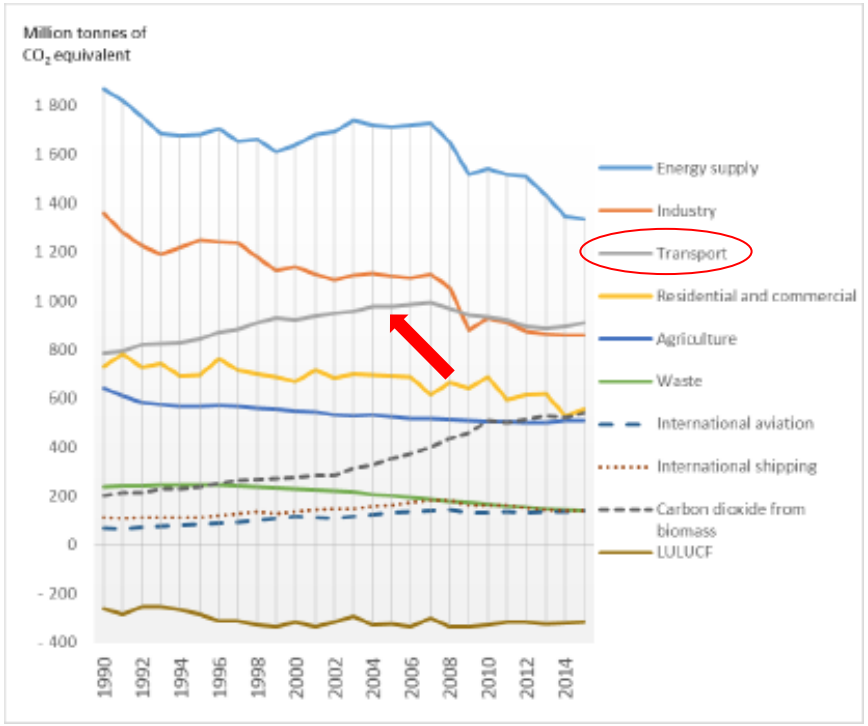


Share of EU emissions of the main pollutants, by sector group in 2016

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)

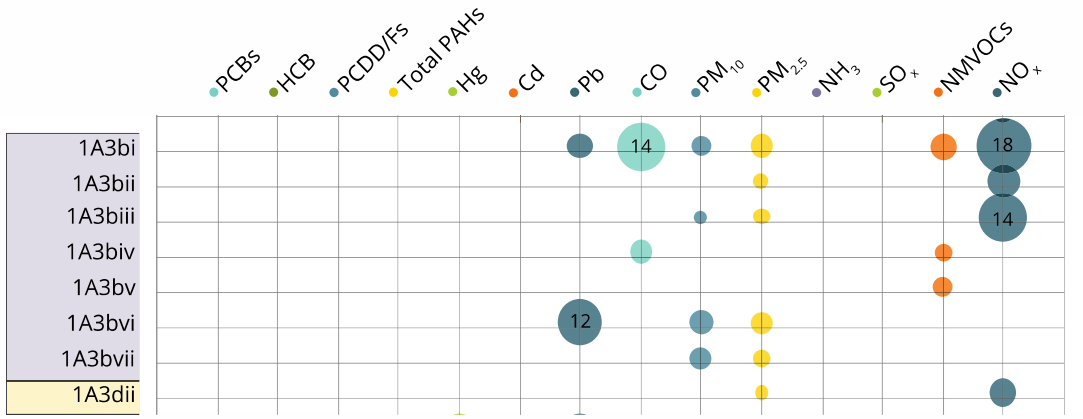
Greenhouse gases emissions by sector in the EU-28



Source: *** - ***EU greenhouse gas inventory. Trends and drivers in greenhouse gas emissions in the EU in 2016*** , European Environment Agency, 2018

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
1A3bvii - 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

Why electric public transport systems? (1/3)

"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."

Joseph L. Schofer. "Mass transit". Encyclopædia Britannica
https://www.britannica.com/topic/mass-transit

Why electric public transport systems? (2/3)

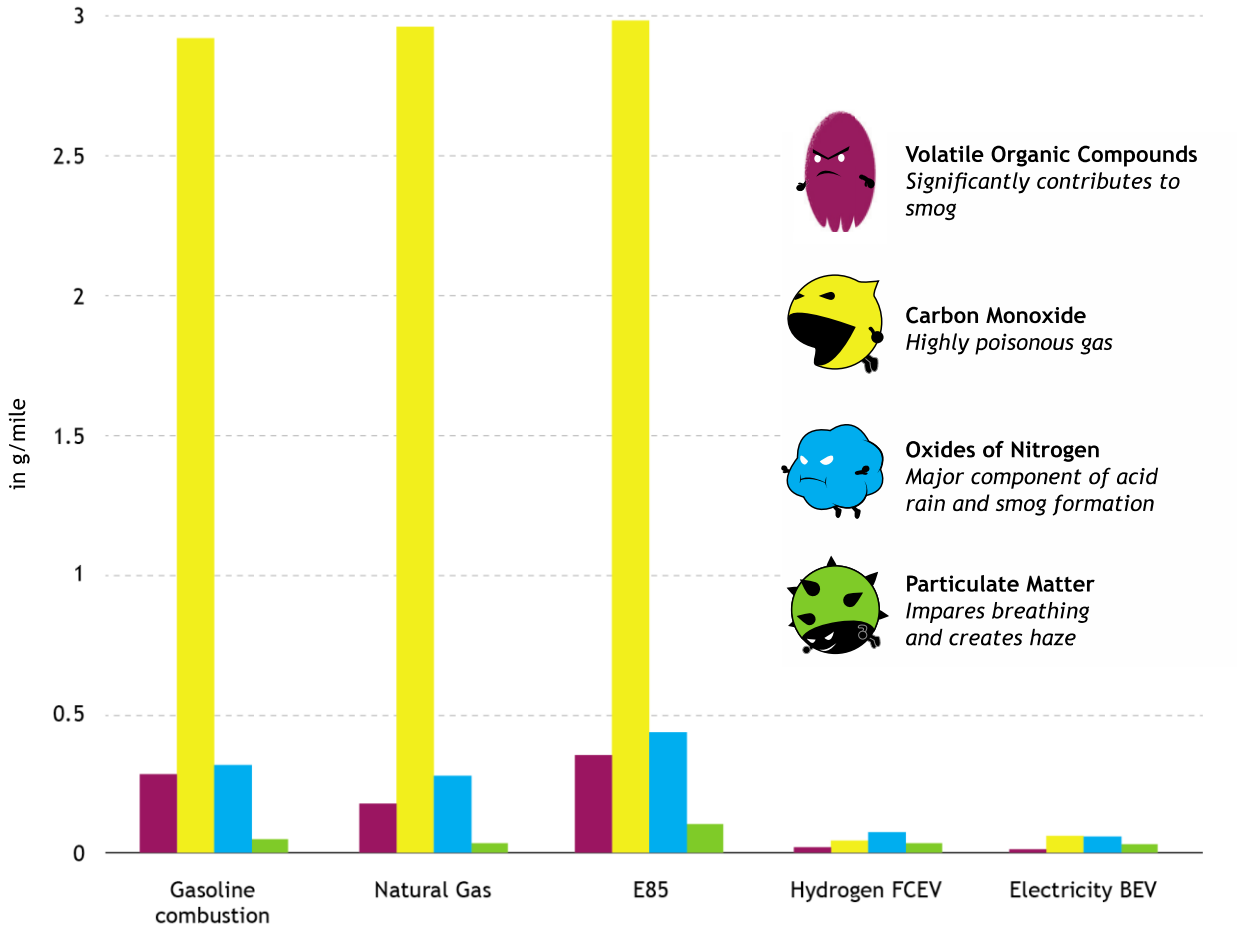
Clean (alternatively fuelled) buses in urban areas can offer considerable **advantages**.

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**.

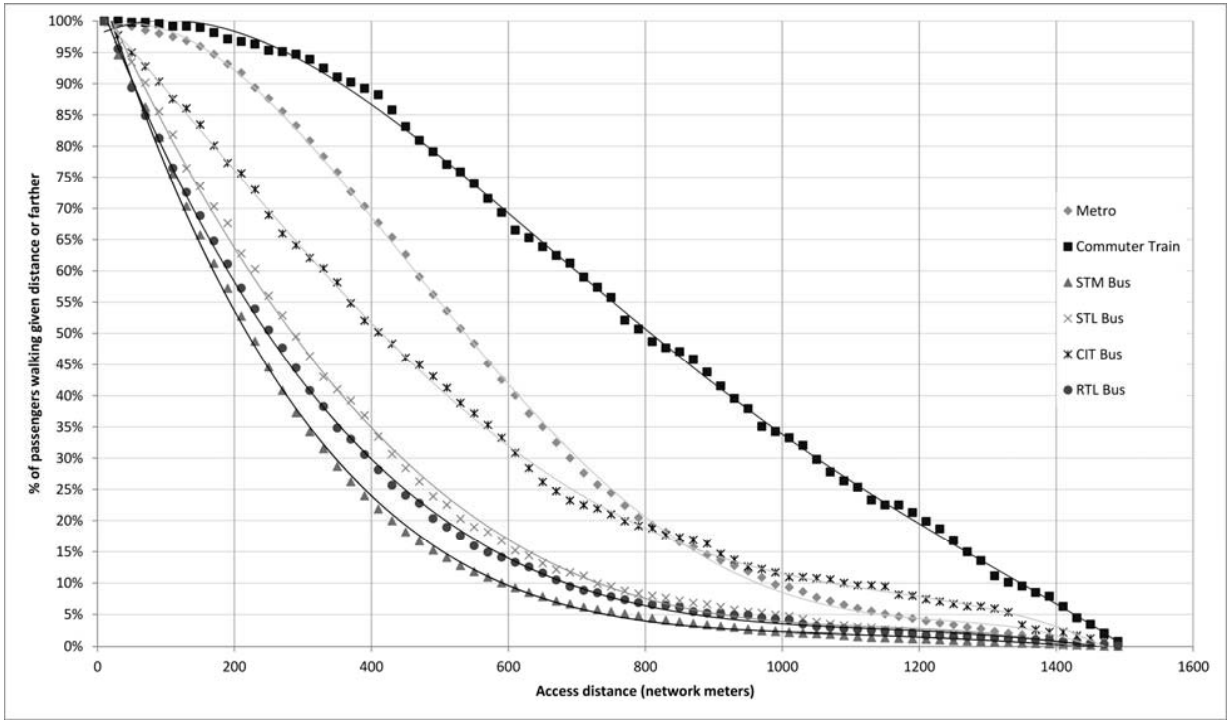
URBAN AGENDA FOR THE EU.
Partnership for Urban Mobility. Final Draft Action Plan
https://ec.europa.eu/futurium/en/system/files/ged/pum_draft_action_plan.pdf

Why electric public transport systems? (3/3)



Source: ****** - Air Climate Energy Water Security***, Frontier Energy, Inc., 2016

Route Planning for Electric Vehicles (1/3)



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

Source: Ahmed El-Geneidy, et. al - ***New evidence on walking distances to transit stops: Identifying redundancies and gaps using variable service areas***, Oct. 2013, Montreal

Route Planning for Electric Vehicles (2/3)

"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

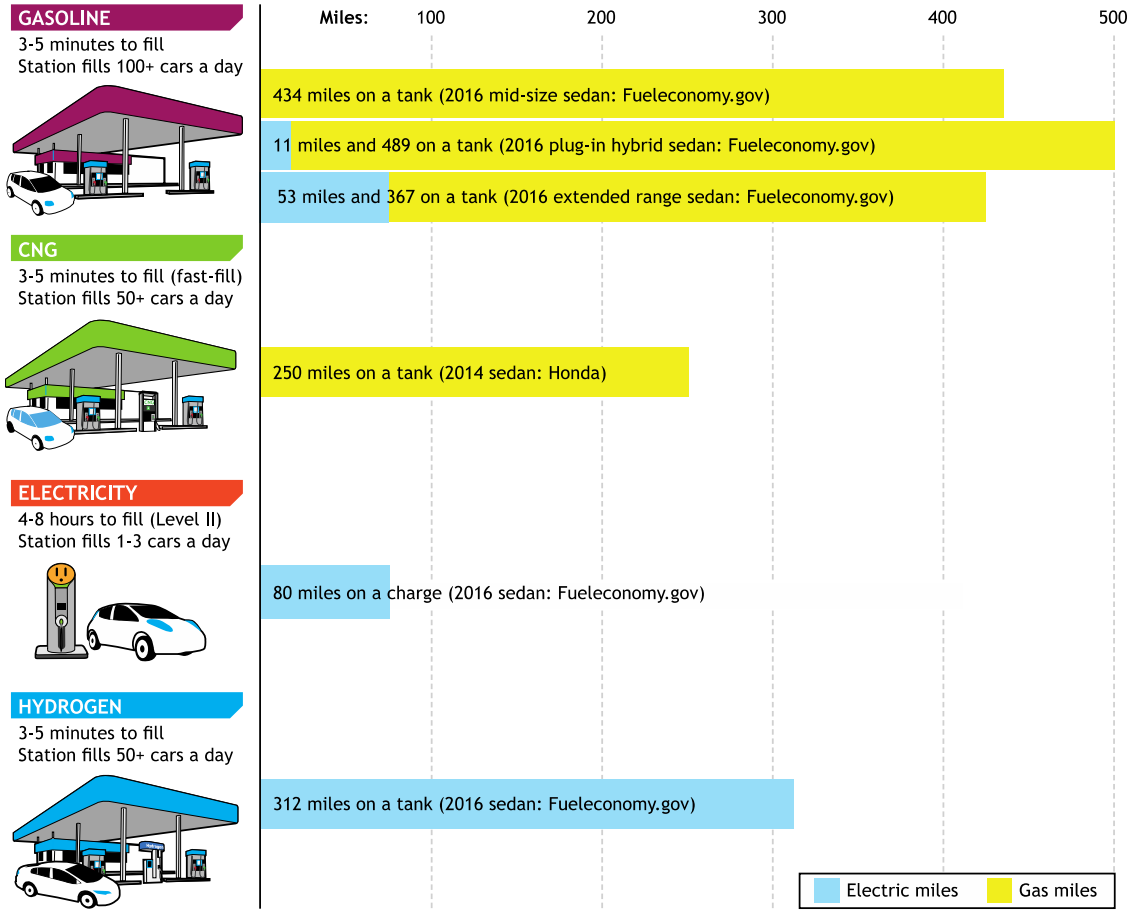
Source: Branden Klayko - ***TARC now operates the largest electric bus fleet east of the Mississippi***, Broken Sidewalk, August 4, 2016, https://brokensidewalk.com/2016/tarc-electric-route4/

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

Source: Erik Bigelow - ***Battery-Electric Buses 101***, Broken Sidewalk, APTA 2017 Sustainability Workshop Minneapolis, http://www.apta.com/mc/sustainability/previous/2017sustainability/presentations/Presentations/Battery-Electric%20Buses%20101%20-%20Erik%20Bigelow.pdf

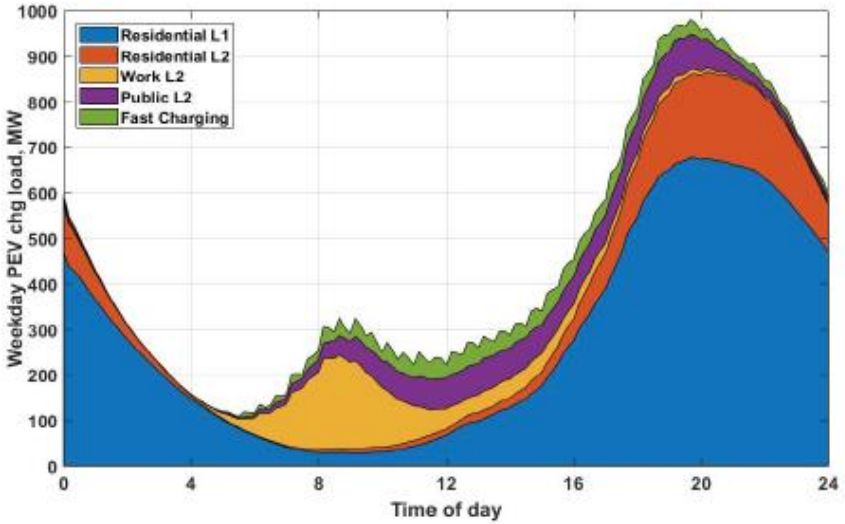
Challenges to the urban centre (1/4)

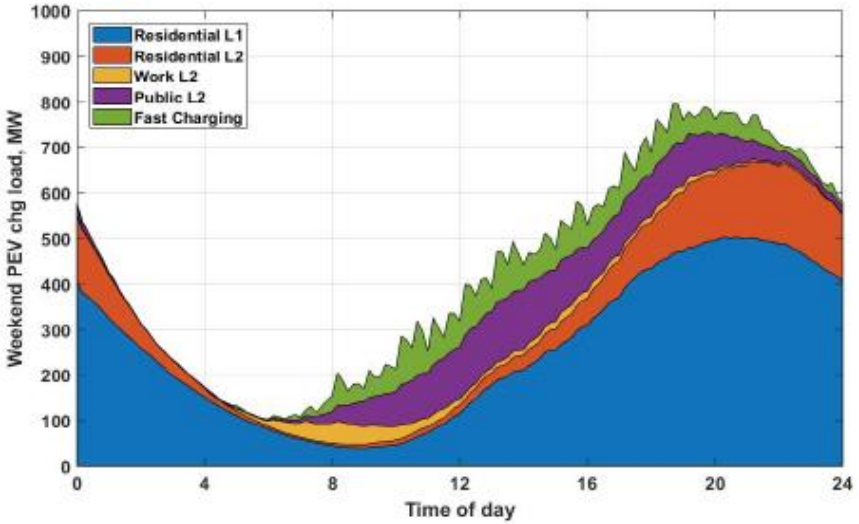


Range provided by a refill Gasoline and CNG provide the convenience of fast refill, while Battery Electric Vehicles require long periods of inactivity

Source: **** - *Air Climate Energy Water Security***, Frontier Energy, Inc., 2016

Challenges to the urban centre (2/4)



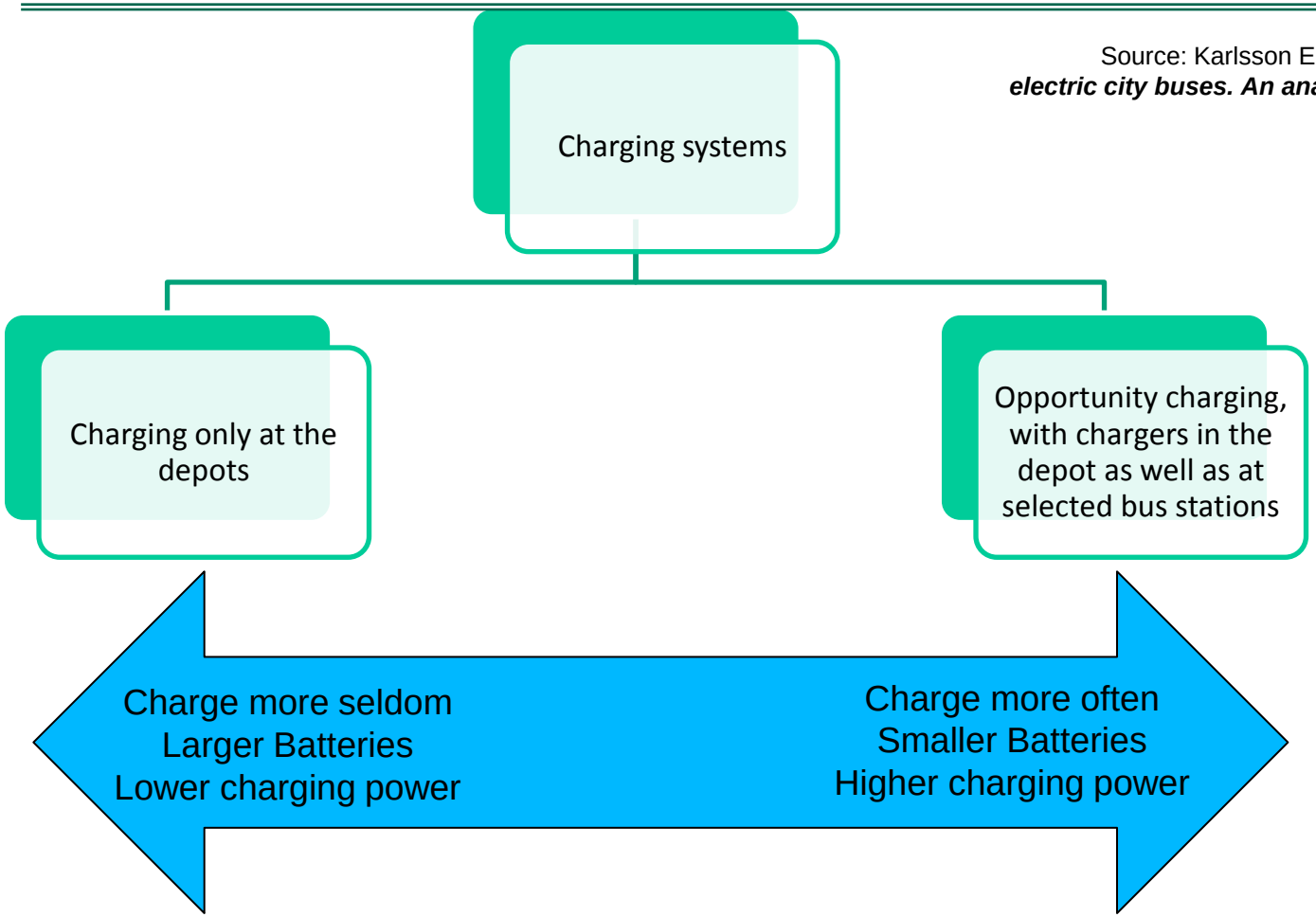


Plug-in Electric Vehicles Charging Load Profiles in 2025 in California, USA according to California Energy Commission and NREL

Source: Abdulkadir Bedir et.al. ***- California Plug- In Electric Vehicle Infrastructure Projections: 2017-2025. Future Infrastructure Needs for Reaching the State's Zero-Emission-Vehicle Deployment Goals***, California Energy Commission, 2018

Challenges to the urban center (3/4)

Source: Karlsson Elin - ***Charging infrastructure for electric city buses. An analysis of grid impact and costs***, Stockholm, 2016



Challenges to the urban center (4/4)

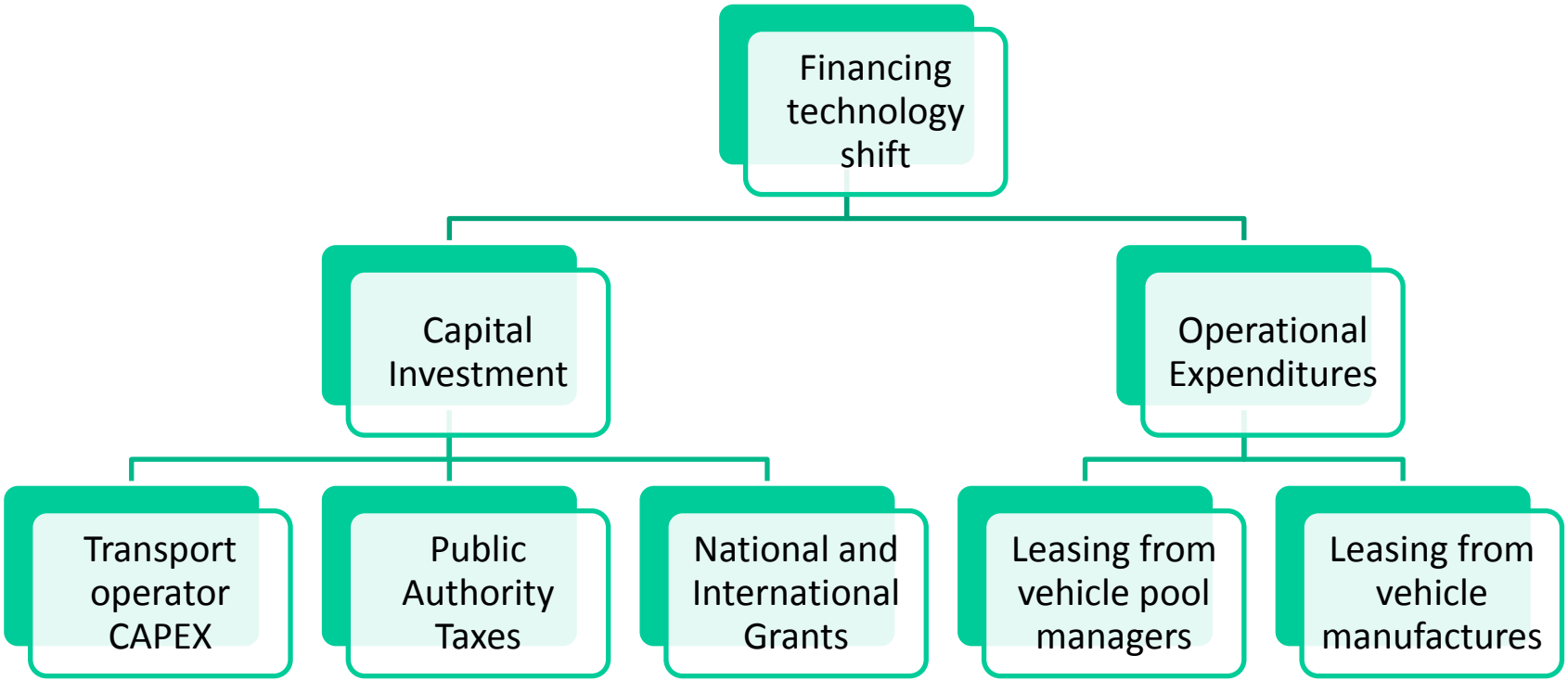
Source: https://www.electrive.com/

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

Source: https://chargedevs.com/features/the-inevitability-of-electric-buses/

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

Planning and financing the technology shift



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'.

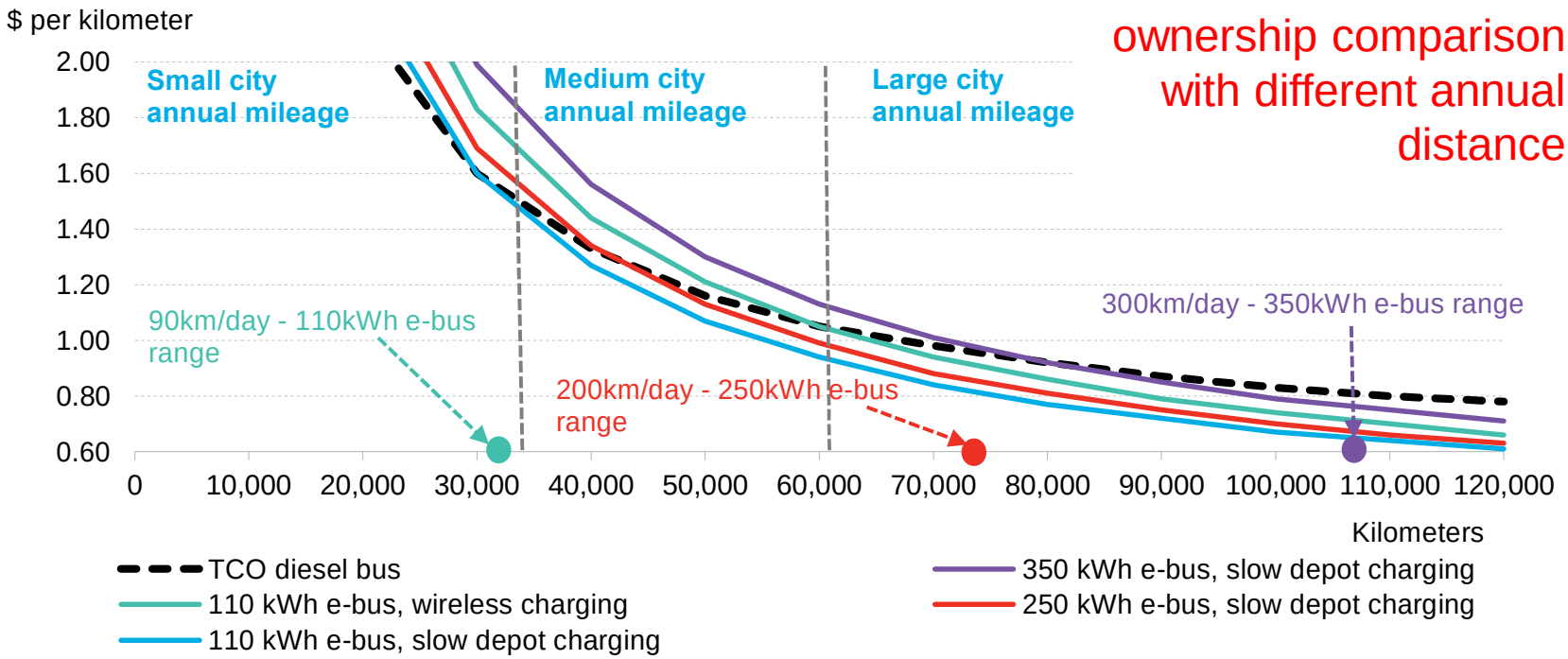
Cost structure for a passenger transport vehicle:

Costs	Locomotive for passenger service*	Electric bus with 250 kWh on-board
Purchase	22,7 %	43%
Energy consumption	46,2 %	12%
Maintenance	31,0 %	46%
	Source: Trümpi 1998[1]	Source: Bloomberg Finance 2018[2]

[1] http://www.railway-energy.org/static/LCC_driven_procurement_87.php
[2] Aleksandra O'Donovan et al., Electric buses in cities. Driving Towrds Cleaner Air and lower CO2, Bloomberg Finance 2018

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

Total cost of bus ownership comparison with different annual distance



Source: *** - ***Electric Buses in Cities. Driving Towards Cleaner Air and Lower CO2***, March 2018, Bloomberg Finance

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 Goverment
- 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 there 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

Source: Volvo Group

Thank you

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