

# Module 4

## Unit 2. Implementing e-bus operation

# E-bus network design and adaptation, a look into eBRT

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# THE INTERNATIONAL ASSOCIATION OF PUBLIC TRANSPORT



# Key elements for a successful e-bus planning and operation

- Customer-oriented bus service
- IT management and optimization tools
- Smart use of energy
- Fleet renewal plans
- Staff support
- Know-how exchange



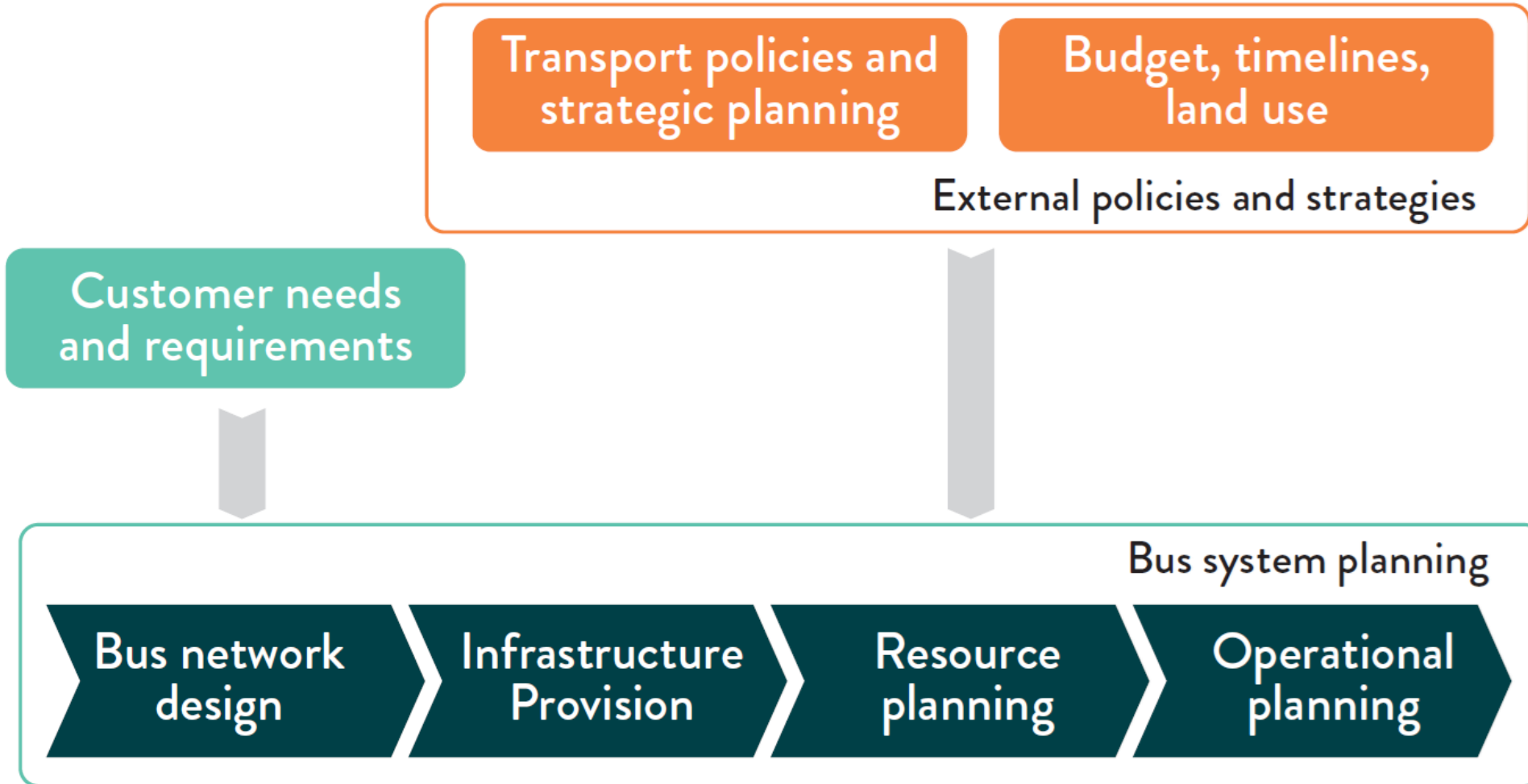


## UITP Report

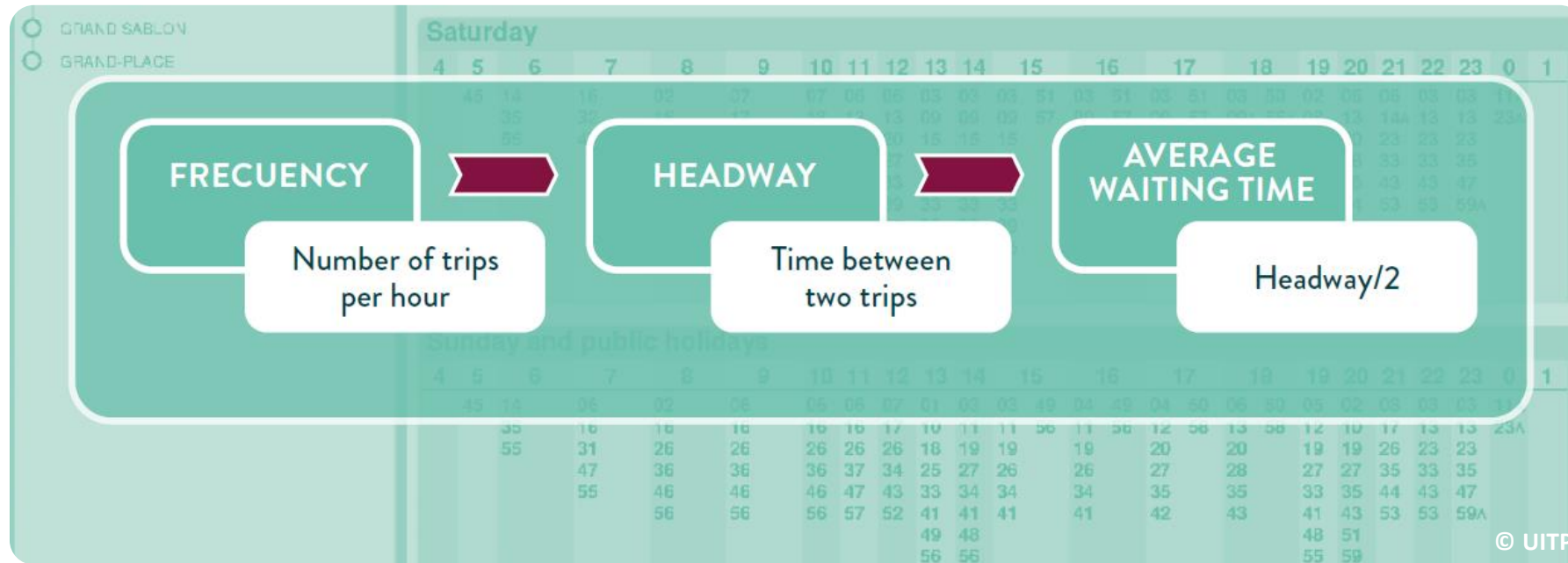
# Bus Network Planning from the operators' perspective October 2022

<https://www.uitp.org/news/clearer-streets-smoother-journeys-paving-the-road-with-bus-network-planning/>

# Bus system planning



# Planning basics



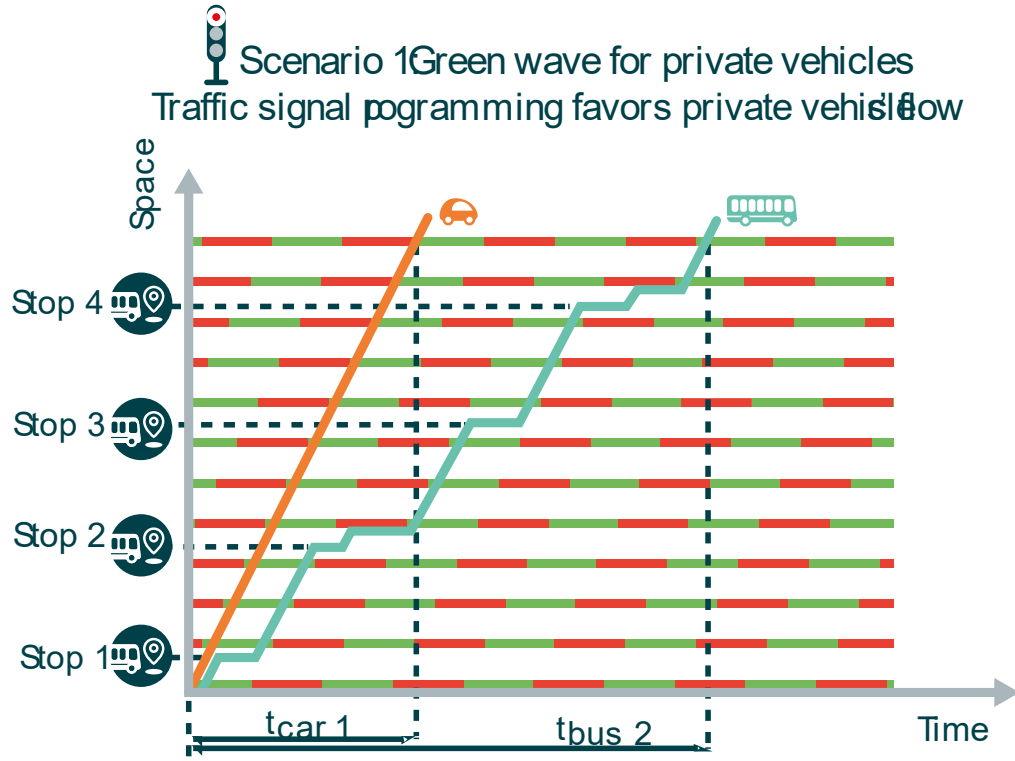
$$\text{Average Waiting Time} = \frac{H}{2} \times (1 + C_{v,h}^2)$$

# Pave the road for e-buses

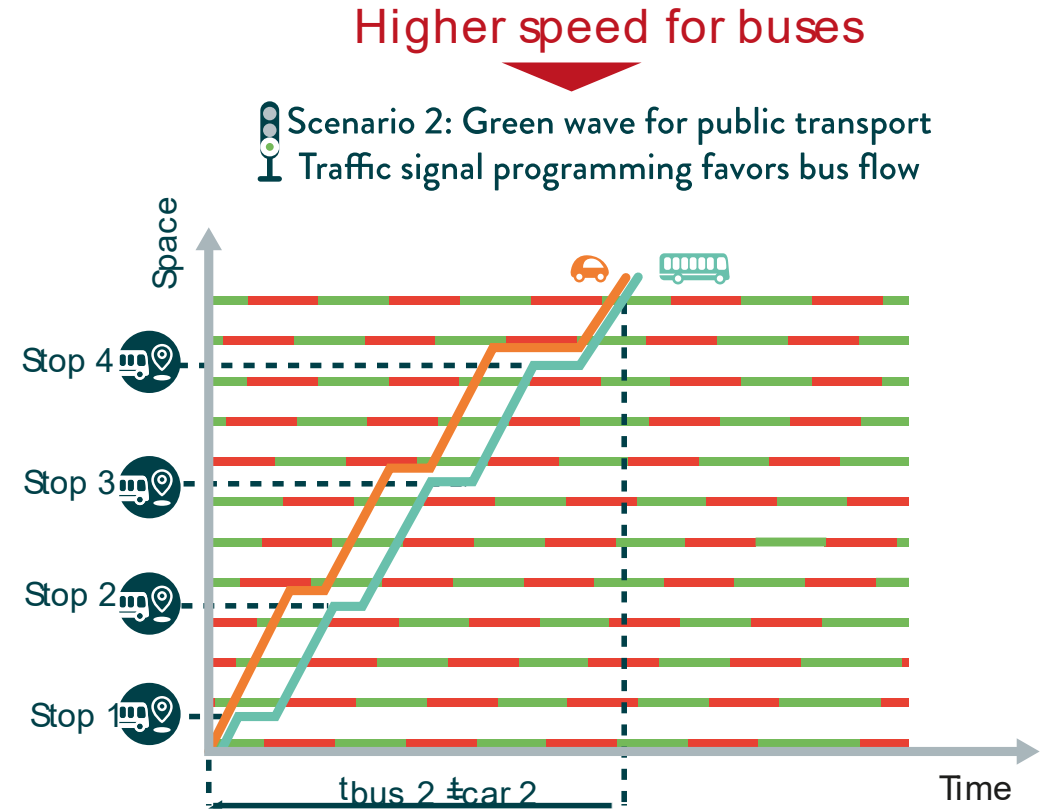
- Bus lanes
- Traffic signal priority
- Passenger-oriented bus stops. Bus-stop balancing.
- Multiple-bus stops
- All-doors boarding
- Guideline documents



# Speed-up buses!

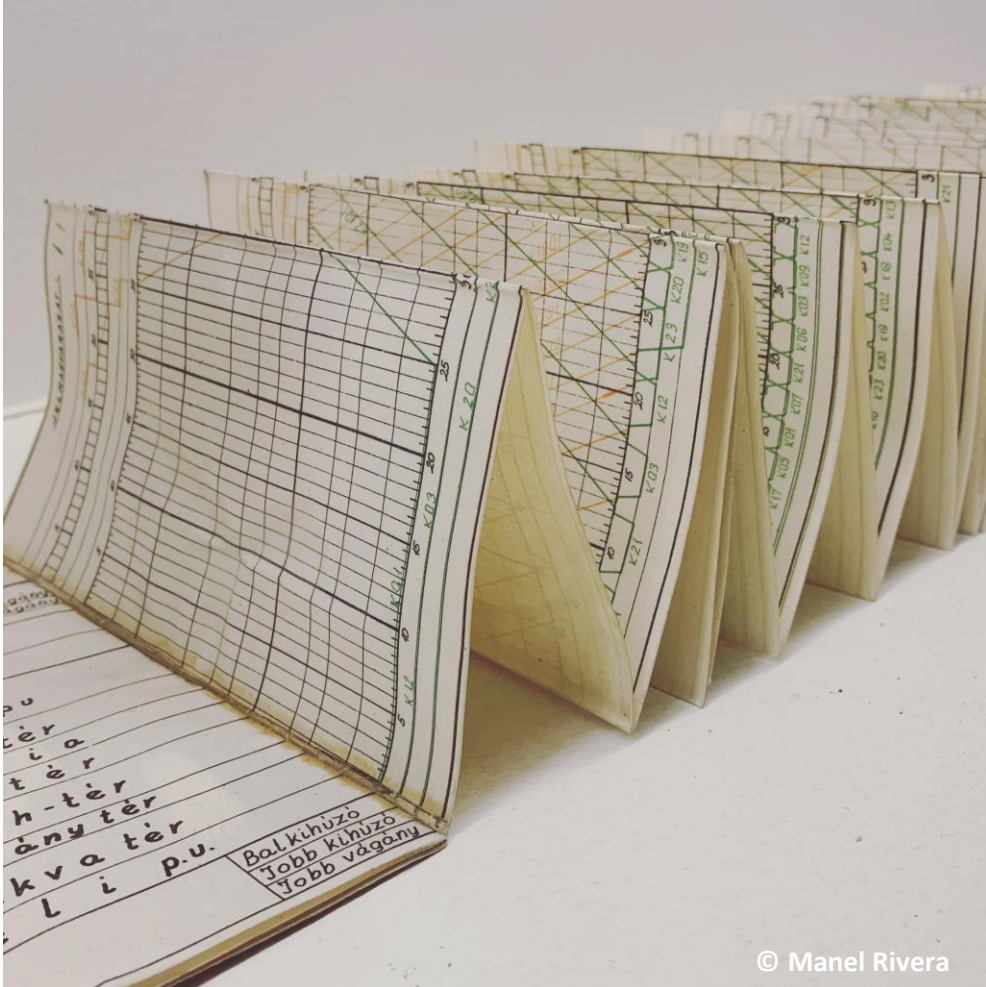


$$t_{bus\ 2} > t_{bus\ 1}$$



In scenario 2, the bus spends less time travelling the same distance as a private car at a stop and traffic lights

# E-buses main impact on planning



- Route selection/route design
  - **Routes must fit a purpose, not a technology**
  - Length, topography, load...
  - Charging strategy
  - Access to the grid
- Vehicle blocks
  - Define the needed vehicle type to absorb the demand
  - For a given battery pack, do the buses have enough autonomy?

**Operators need today  
the data from yesterday  
to plan the service for tomorrow**

# IT tools for scheduling, rostering and dispatching

Use advanced IT tools for bus scheduling and dispatching, considering e-bus specifications.

- the battery characteristics of the vehicles
- the state of health of the battery
- the availability of charging infrastructure defined in strategic and system deployment plans
- charging strategies
- passenger loads and line profile.

Integrate and monitor key e-bus telemetries along with AV

Monitor the service in a command-and-control center with a centralized and data-oriented decision process.



# Smart charging strategies & energy storage systems



Depot upgrade and adapted to electrical energy supply (access to the grid, charging infrastructure...)

The use of smart charging strategies allows for reducing energy cost and maximum power need, and privileges renewable sources consumption

In-depot energy storage systems also allow shaving the energy demand peak

# Bus planners

## Don't forget the people!

Specific training on e-bus characteristics at all levels of the company:

- Bus drivers
- Customer support staff
- **Planners and dispatchers**
- Fleet management staff



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# Key elements for a successful e-bus operation

## Integrated planning in higher order plans

- It is all about planning!
- Integrate the fleet renewal plans in Urban Mobility Plans and Energy Plans at a city or regional level ensure the right framework to help all the stakeholders to meet the overall goals

**Operational & Staff**

This series collects the main aspects related to the future operation of the new fleet. It includes operational service parameters. It also considers activities related to the coordination and management of the new depot and its adaptation to a new technology. Finally, it includes aspects related to the optimisation of fleet operation and how to monitor the success of the renewal exercise, both from the perspective of the staff and end-user (passengers).

<input type="checkbox"/>	4.1	Increased service demand
<input type="checkbox"/>	4.2	Vehicle availability level and reliability
<input type="checkbox"/>	4.3	Optimisation of service through dynamic fleet monitoring (predictive maintenance, reduced auxiliaries' energy consumption, etc.). For instance, predictive maintenance is key when it comes to zero-emission technologies, monitoring both vehicle and infrastructure ecosystems.
<input type="checkbox"/>	4.4	Energy and charging management strategies for cost reduction
<input type="checkbox"/>	4.5	Management of changes in organisation and design of depot, computer structure and roles, new equipment, tools, and tools for daily operation, all relative safety aspects.
<input type="checkbox"/>	4.6	Consider specific staff trainings, e.g. new technological profiles for finance staff, including training on the necessary electronics requirements. Training should be run at early stages. For instance, the introduction of new procedures, as specialised teams, supplies of tools and individual equipment aspects.
<input type="checkbox"/>	4.7	In multi-brand fleets, harmonisation of different technical factors: needs for spare parts (taking into account res. (regional/national/nets), costs related, workshop specialisation, etc.), EU energy suppliers, grid owner, operators, other modes, customers, etc.)
<input type="checkbox"/>	4.8	Consider aspects due to problems with modes, etc.
<input type="checkbox"/>	4.9	Develop new timetables for both
<input type="checkbox"/>	4.10	Evaluate the disruptive effects

**Flowchart Diagram:**

- GLOBAL THEORETICAL (Market knowledge of vehicles, infrastructure and energy supply)
- TECHNOLOGICAL AND COMMERCIAL MATURITY
- LEGAL / MANDATORY DEADLINES AND CONSTRAINTS
- NOISE
- AIR QUALITY
- GLOBAL WARMING
- PUBLIC PROCUREMENT
- OTHERS...
- Monitoring of (coming) legal conditions (environmental, quality certification, etc.)

## Know-how & best practice exchange with peer cities

- Interdepartmental Knowledge-exchange
- Knowledge sharing activities with peer cities and regions.
- Enlarge your global networks and engage in capacity building and know-how activities in your regions and across the world.



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**eBRT2030**



# ELECTRIC BUS RAPID TRANSIT 2030 IN EUROPE



# eBRT2030

- Project overall duration: 48 months
- Start date: 1/1/2023
- Total Budget: € 23 026 221 €
- Management:
  - Strategic and overall operational Coordinator: **UITP**
  - Technical Manager: VUB (MOBI LAB)
  - Financial and admin Manager: RINA Consulting

**PTOs, PTAs**

TMB, semitan, SITP, Dopravní podnik hlavního města Prahy, asstra, OSA, transdev, ARRIVA, START ROMAGNA, SW/M, IET

**OEMs, Suppliers and Technology Providers**

*OEMs*: Irizar, EBUSCO, SCANIA, IVECO, VOLVO, TEMSA, ŠKODA

*Suppliers*: ALSTOM, enel x, heliox, Elektroline, etra I+D

*Technology Providers*: AVL, factual, SYSTRA, Trivector, RUPPRECHT CONSULT

**Research and Infrastructure**

VUB VRIJE UNIVERSITEIT BRUSSEL, Universita Pardubice, KENEX nederland, UPC, VTT, ICCS, Applus IDIADA, CRM, Fraunhofer IVI, CERTH CENTRE FOR RESEARCH & TECHNOLOGY HELLAS

**Network, Consultancy and Regulatory and domain Knowledge**

UITP ADVANCING PUBLIC TRANSPORT, POLIS CITIES AND REGIONS FOR TRANSPORT INNOVATION, trolley:motion urban e-mobility, ERTICO, UEMI, RINA

# Objectives of eBRT2030



Create a New Generation of advanced full electric, urban and peri-urban European BRT enhanced with novel automation and connectivity functionalities.

The eBRT2030 project is developed through three main lines:

- 1) EBRT2030 project is developed around **operations-focused demos**: 6+1 demos of BRT system innovative solutions in real-operation, both city-&operator-led and BRT system-focused, or focused on specific tech developments at system or subsystem level that are ready for BRT operations, in Europe and outside Europe (in Latin America and East-Africa), and fully integrated in the whole urban mobility scenario
- 2) The development of **technology-focused key innovative solutions** for BRT, both at system and subsystem level, at level of vehicle, infrastructure, operation, and IoT connectivity
- 3) the definition a **new European concept of BRT for year 2030**, benefitting of evaluation, multiplication and replication of the real-operation test of innovations, that improve the performance of the whole European urban bus system. All cities in eBRT2030 have BRT lines already in operation or launched within 2023, and strongly committed to innovate with electrification, automation, connectivity technology tailored to the characteristics of European bus operations.



# ¡Gracias!

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