

# Planning procurement, and commissioning of electric buses and charging infrastructure: EMT MADRID example



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## EMT MADRID

**Created** in 1947.

**Company** 100% owned by Madrid City Council.

**Service** 24/7 all year round.

**Operates** and manages the whole network of public urban buses in Madrid city.

**EMT** also provides other public mobility services in the city of Madrid:

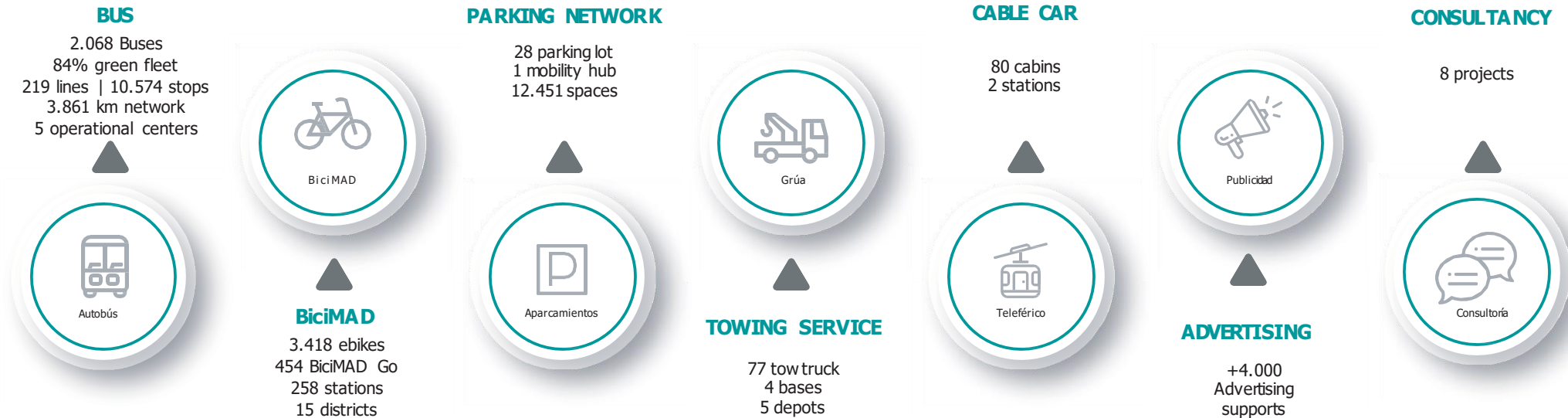
- **Since** 2014, managing parking facilities and tow trucks
- **Since** September 2016, the public e-bike sharing system BiciMAD
- **Since** January 2018, the cable car system

But also managing the segregated bus lanes, buses and bus shelters advertising exploitation, and Consultancy

# FIGURES EMT 2021



EMT is **the reference of surface mobility** in the city of Madrid. It count with **9.816 employees, 7 business lines y 5 Operational Centers** that enable the company to provide integrated, client-oriented services that foster a sustainable and efficient mobility.



# Electric Bus Deployments

## Fleet Renewal: Purchasing Procedure

### BID SPECIFICATIONS

EMT needs:  
Identification

Requirements:  
operational and  
test criterias

### CONTRACT AWARDING & TENDER

Prototypes:  
must verify  
specifications

### MANUFACTURING PROCESS MONITORING

Factory tour  
  
Due date control

### DELIVERY

All units must be  
validated and  
checked based on  
the specifications

### ACCEPTANCE CERTIFICATE AND WARRANTY

Batteries  
warranty  
  
Penalties

# Electric Bus Deployments

## E-buses operation structure

WHAT

WHO

SOME DETAILS...

Fleet supplier



Bus & Charger supplier  
Training  
Maintenance (during warranty period)

Energy supplier



Critical infrastructure: Power supply must be guaranteed

Operation & Maintenance



Bus operator  
Bus & Charger maintenance  
Training workforce

# Electric Bus Deployments

## Fleet renewal: Purchasing evolution

### FIRST STEPS

Vehicle + Charger  
 Zebra batteries  
 Plug-in charger

### LITHIUM BATTERIES

Vehicle + Charger  
 Lithium batteries  
 Plug-in charger  
 AC&DC chargers

### DC CHARGERS

Vehicle  


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 Charger  
 Lithium batteries  
 Plug-in charger  
 DC chargers

### INVERTED PANTOGRAPH

Vehicle  


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 Charger  
 Lithium batteries  
 Pantograph  
 charger  
 DC chargers

### SMART CHARGING & NEW DEPOT

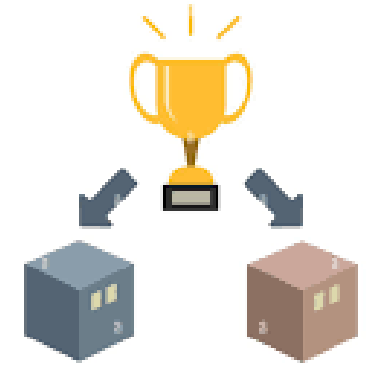
Vehicle  


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 Charger  
 Lithium batteries  
 Pantograph  
 charger  
 DC chargers

# What to consider in a tendering process? (UITP recommendations) :

- Main features (summary) of the tender. What for?
- Buyer and contact persons
- Procedure
- Timetable of the tender
- Legal requirements and standards
- List of legal documentation and company information
- Tender evaluation criteria, including LCC (Life Cycle Cost)
- Presentation of the tender
- Functional and technical specifications
- Maintenance documentation
- Consumables
- Training
- Financial conditions
- Vehicle warranty
- Vehicle availability
- Charging infrastructure



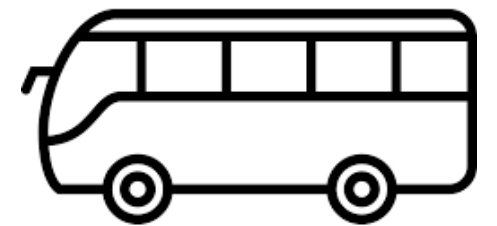
# E-bus...in which conditions and what for?

## City conditions

- Climate
- Topography
- Noise requirements
- Zero Emission Zone
- Traffic
- Other...

## Main characteristics of the bus line

- Length
- Timetable of the line
- Speed
- Number of stops
- Possible loading time
- Number of buses and drivers
- Other...



# May I use electricity?

## Charging strategy and network capacity

- Charging capacity for the entire infrastructure
- Charging positions with individual load capacity and grid power supply
- Substation capacity and installation
- Charging rate to be applied at each point
- Charging management (time and load profile)
- Charging technology (night, opportunity or combination)
- Bus specifications regarding battery technology and charging capacity.
- Charging type (pantograph, plug-in...)
- Energy supply
- Grid availability capacity
- Grid connection (high capacity)
- Lifetime system
- Amortization of buses
- Lifetime of chargers



**Acquisition and charging infrastructure costs for e-buses are higher than for other types of fuels. To mitigate these costs, the following measures can be taken:**

- **Longer contract periods** (in case of full line operation contract).
- Allow **phased introduction** of electric buses in operation.
- Allowing an **extension** of the period of use of electric buses.
- Allow **longer amortization** of buses and infrastructure (i.e. 15 years).
- Elaborate mandatory procedures in the tender documents for **handing over** the infrastructure to the next operator.
- Set **financial conditions** for transferring buses and infrastructure and network connection that have not been fully depreciated, including depreciation for renewal, transferring costs to the next operator.
- Maximize investment, taking into account ways to increase bus mileage, by taking measures that benefit the use of public transport.
- Include in tenders measures to **subsidize** green technologies and take advantage of subsidies at any level (local, national, etc.)



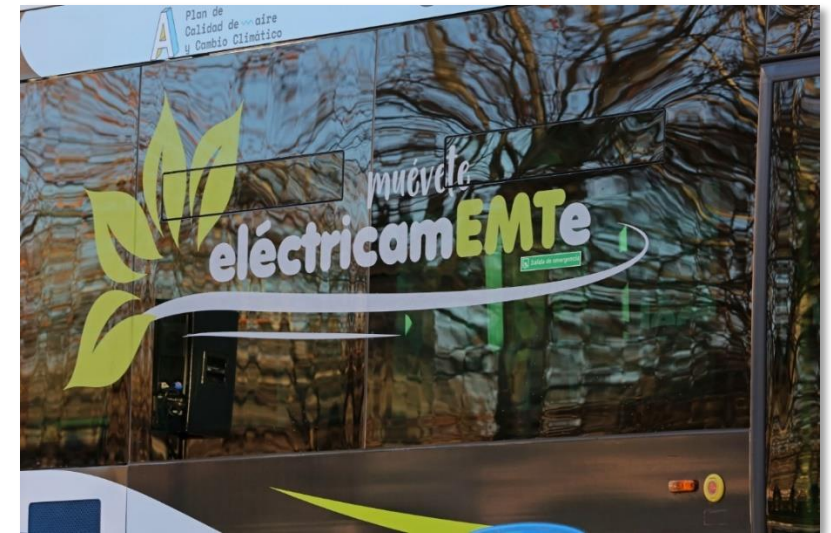
## What skills do we need?: Training

- Safety systems, specially high voltage systems.
- Economical driving
- Connection of buses for charging
- Points of attention
- How to check that charging is activated
- How to act in the event of faults
- Parking precision
- How to operate and tow buses
- Familiarizing yourself with the bus
- Checking bus functions
- Risks and hazards related to propulsion system identification



# CONCLUSIONS

- ✓ Electrification must be done in accordance with the **characteristics of the bus network**
- ✓ Choosing **Optimal charging model** considering local context: For us (EMT) charging by night at bus depot: inverted pantograph + conductive charging, with few exceptions
- ✓ Design and Adaptation of the bus depots to **guarantee the availability of energy** (efficient, reliable and redundant). More than one depot to provide energy in case of failure
- ✓ Key aspects to consider: **Maintenance** facilities and **Workforce skills (training)**
- ✓ Charging of buses must be guaranteed efficiently and reliably: A very high electrical power is required but by **planning charging processes**, the electrification of the fleet is feasible
- ✓ **Public-private collaboration**: Operator, Administration and electricity companies. Explore financing/funding possibilities



75 años  
EMT MADRID  
1947 - 2022



**EMT MADRID**

Thanks!

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