



# Analysis of Urban Transportation **Madrid, Spain**

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# Madrid's Transportation System

- **3,25 million people** in the city (up to 6 million inhabitants in the metropolitan area)
- **8,4 million trips** everyday (working day)
- **3,415 km of roads** (938 km are high capacity, 790 km of which are free highways).  
Radial structure, 2 ring roads and 2 semi-ring roads
- Metro system has **338 stations, 2,157 trains** and **339 km** network
- **13 transport interchange** stations
- **4 Car-sharing** companies
- Pedestrian areas, 30-zones, etc.

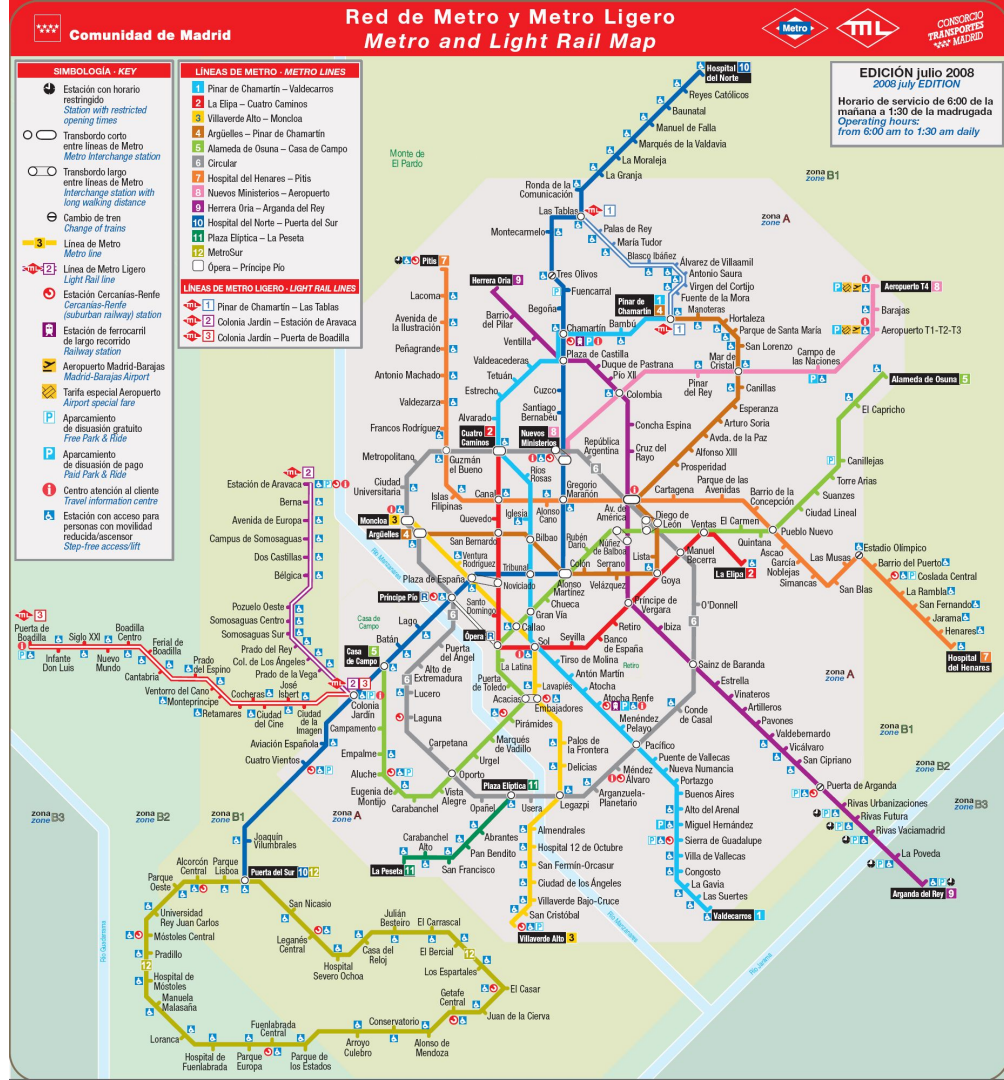


# Madrid's Transportation Network

Highly efficient and accessible, Madrid's Metro and Light Rail transportation system consists of:

- 12 metro routes
- 3 tram routes

It operates between the hours of 6 AM and 1:30 AM, running every 1-3 minutes during peak hours.







# Suburban Transportation Network

(Cercanías)

There are also ten suburban routes that connect city centers to other neighborhoods. While these trains run every 10-30 minutes, with less frequency during the weekends.



# Madrid's Bus Network

The EMT, manages the 200 routes that are sprawled throughout Madrid. This network ...

- serves over two million people per day
- ~ 42% of ridership on an average weekday
- bus system also services the community at nighttime, making it the only mode of transportation available at night.



# Eurail Network in Madrid & Europe

The Eurail network connects Madrid to other parts of Spain as well as other countries in Europe.

- high-speed & energy-efficient trains
- integration with local transportation
- minimizes your carbon footprint
- promotes the use of renewable energy sources



# Ridership and Operational Stats

	Metro	Bus	Suburban (Cercanias)	Light Rail
Ridership #	2,248,100	2,144,900	690,100	69,800
Ridership %	43.63%	41.63%	13.39%	1.35%
Average Wait Time	2.5 minutes	8 minutes	4 minutes	6 minutes

# 69%

of trips in the metro area don't involve cars!



# Flows

Flows in Madrid's transportation system describe the movements of commuters and vehicles, linking metro, bus, and light rail journeys. These flows highlight the efficiency of the transportation network, facilitating seamless travel across the city.

# Different Transport Flows

**Metro Madrid:** Over 300 stations, 13 lines linking residential and business districts. One of Europe's largest underground systems.

**Cercanías:** Commuter rail connecting suburbs to central Madrid, essential for commuters who live outside city but work in Madrid.

**Buses:** Extensive network including standard, express and night routes, help manage surface-level flows.

**Taxis and Ridesharing:** Common throughout the city, alternative transport especially at night.

**Private Vehicles:** High usage causes major congestion, especially on the M-30 ring road (pictured).

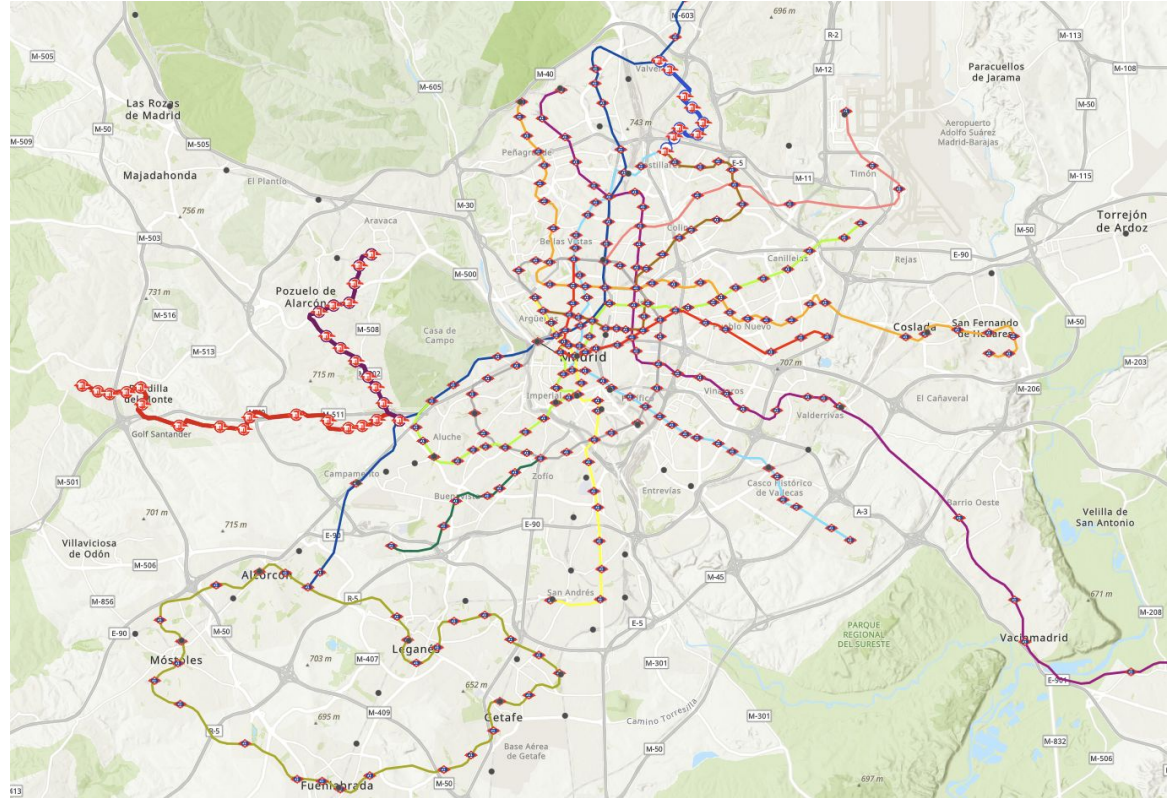
**Bicycle and Scooter Sharing:** Expanded cycling infrastructure with programs like BiciMAD for sustainable travel.

**Pedestrian:** Walkable city center, popular for short trips in dense areas.



# Flow Visualization

- This map highlights the Metro, Cercanías (Commuter Rail), and Light Rail systems that interconnect Madrid, providing city-wide accessibility and connecting the capital with outlying suburbs and regions.



# 5,152,900

Average Daily Ridership in Madrid



# Nodes

With Madrid's transportation system, there are many nodes, including the metro stations, bus stops, suburban terminals, and light rail stations. Every point in which a person can interact with any of these modes of transportation is a node in the network.

# Nodes

- Bus stops
- Bike-share hubs
- Parking structures
- Metro stops
- Cercanias stops
- Light rail stops
- Airport terminals (external)
- Pedestrian zones
- EV Charging Stations



# Node Visualization



**BiciMAD**

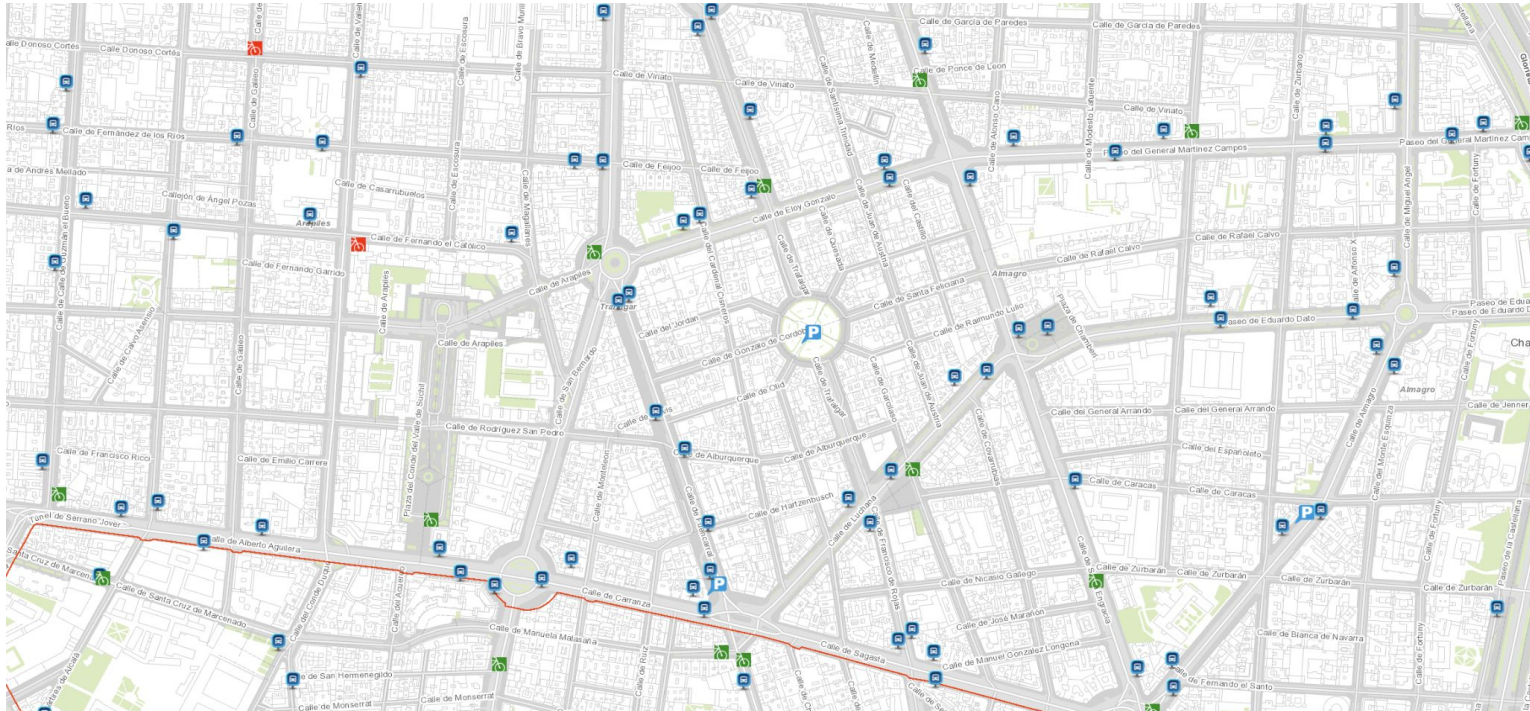
\*A bike-sharing scheme with 7,500 electric bikes and 611 docking stations across the city



**Public Parking**



**Bus stop**



# Critical Nodes

We can define some “critical nodes” to the system which experience a larger influx of users and flows than others:

- Major hubs like **Atocha** and **Nuevos Ministerios** transport hundreds of thousands and exemplify successful intermodal integration for both commuter rail (Cercanias) and Metro subway system, enabling seamless travel across different transit modes in the city
  - Atocha has 15 platforms for high-speed trains and 10 underground through platforms for suburban and some mainline trains
  - Nuevos Ministerios has 12 platforms and 9 underground
  - Madrid's Atocha train station serves over 20 million passengers per year, with Nuevos Ministerios serving over 18 million per year



# Agents

- Public Sector
- Private Sector
- Non-Governmental Organizations (NGOs) and Community Initiatives

Agents in Madrid are starting to use technology and smart mobility:

- Introduction of contactless and mobile payment solutions by CRTM (MTA of Madrid) to enhance user convenience and system efficiency
- Use of AI and IoT technologies by municipal authorities to optimize traffic flow and reduce congestion, particularly during peak hours



## Public Sector Agents in Madrid's Transport Ecosystem

**Madrid Regional Transport Consortium (Consorcio Regional de Transportes de Madrid - CRTM):** Acts as the main coordinating body for public transport in Madrid. It integrates bus, metro, and light rail services ensuring seamless connectivity and fare management across different modes.

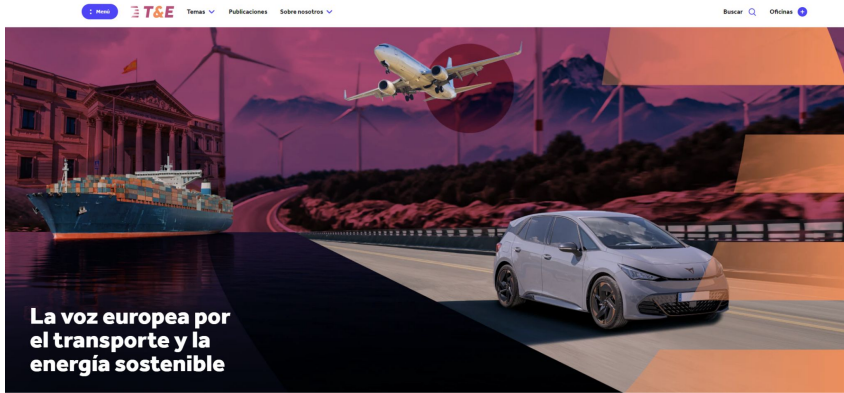
**Municipal Transport Company (Empresa Municipal de Transportes - EMT):** Manages the extensive bus network in Madrid, including regular, express, and night bus services, playing a crucial role in daily commuter movement.



## Private Sector Contributions and Innovations

**ALSA and Avanza Group:** Operate long-distance bus services that connect Madrid with other regions, supplementing the public transport system.

**Cabify (Madrid-based) and other ride-sharing services:** Enhance last-mile connectivity and provide flexible transport options that integrate with public transit systems via mobile app technologies.



## Community Impact and Advocacy

**Transport & Environment (T&E) and Ecologists in Action:** These NGOs advocate for sustainable transport solutions in Madrid, influencing policies towards reduced emissions and increased use of renewable energy in public transport.

\*Image on right shows Ecologistas en Accion, holding a sign saying "Tourism kills the neighborhoods", protesting how mass tourism is leading to rising living costs and the loss of community culture.



# Madrid Nuevo Norte

- Madrid Nuevo Norte is one of the largest urban regeneration project in Europe, with plans for new business districts, residential areas, and green spaces
- This project is similar to London's Canary Wharf or Paris' La Défense, but designed to be a more mixed-use environment that integrates residential and commercial spaces to remain vibrant throughout the day and night
- Aims to avoid the pitfalls of other large business districts that can become deserted outside office hours



# Madrid Nuevo Norte

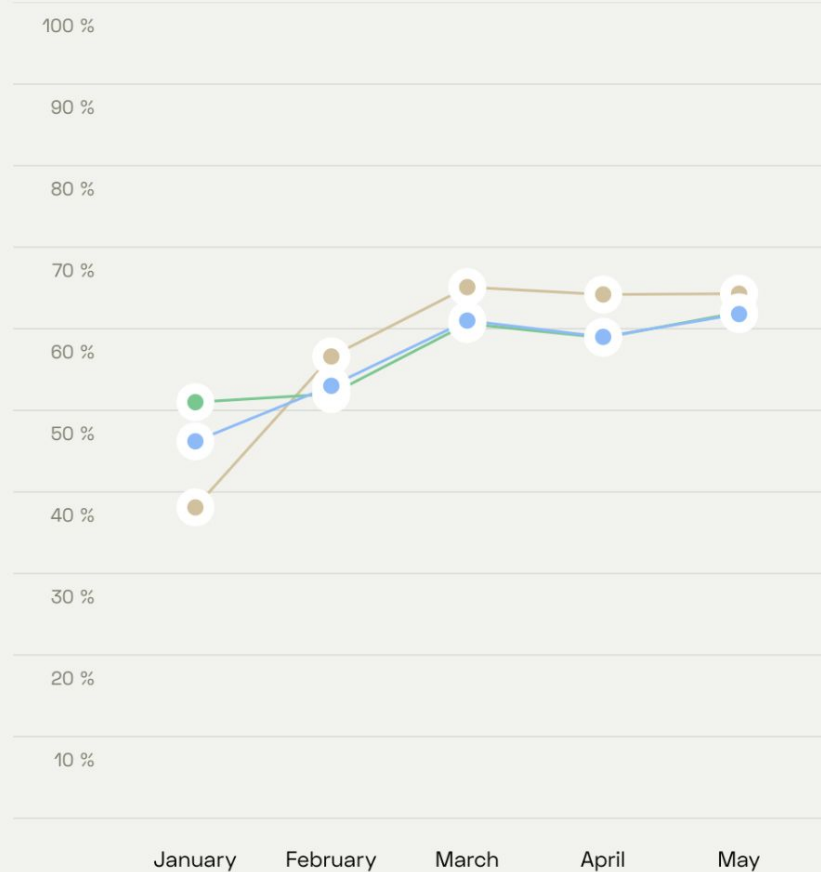
- Sustainable mobility that reduces carbon emissions and promotes renewable energy usage
  - 145,000 square meter urban forest built over the covered rail tracks (similar to NYC's High Line)
- Emphasize pedestrian-friendly urban planning
- Energy efficiency and smart city technologies

## • Covid-19 ridership adjustment

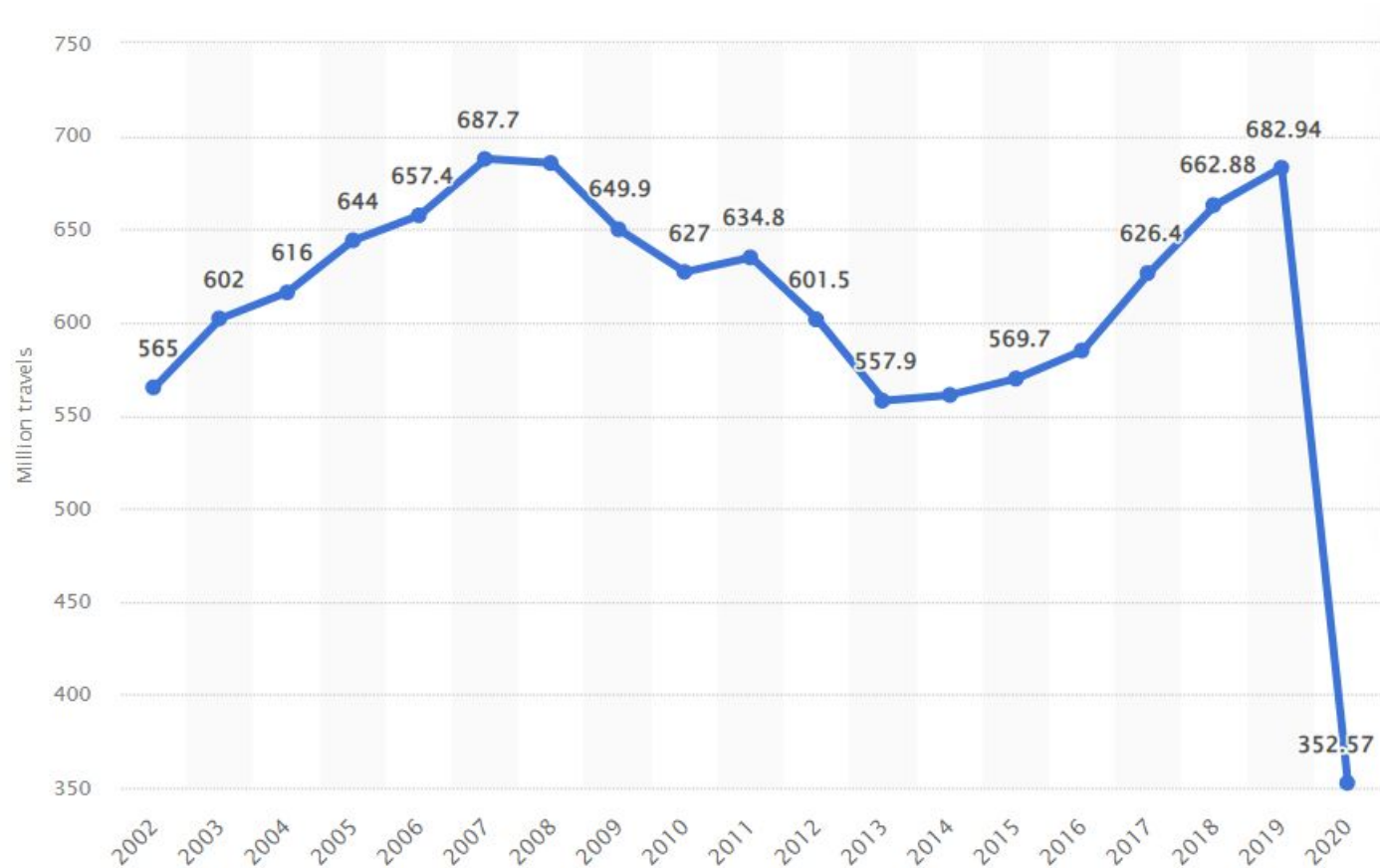
This indicator is recording the impact of the Covid-19 pandemic and public health crisis on the level of public transport use in the city. The ridership level recorded is compared with the one for the most relevant period pre-pandemic and before any restriction had been imposed restricting movement or activities.

Values are shown in percentage of the normal ridership expected without any restrictions in place.

 Bus	64.3 %	>
 Metro	62 %	>
 Suburban rail	61.8 %	>
 Tram-/LRT	--	>



## Annual number of travels by metro in Madrid from 2002 to 2020 (in millions)



Source: Statista Research Department, May 19, 2024



# Links/Notes

<https://creamadridnuevonorte.com/en/>

[Why Madrid is Designed Insanely Well](#)

[https://www.esmadrid.com/sites/default/files/plano\\_metro\\_madrid\\_junio\\_2024.pdf](https://www.esmadrid.com/sites/default/files/plano_metro_madrid_junio_2024.pdf)

<https://citytransit.uitp.org/madrid>

<https://www.ecologistasenaccion.org/>

<https://www.transportenvironment.org/te-espana>

[https://en.wikipedia.org/wiki/Empresa\\_Municipal\\_de\\_Transportes\\_de\\_Madrid](https://en.wikipedia.org/wiki/Empresa_Municipal_de_Transportes_de_Madrid)

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Sensato. "Why Madrid is Insanely Well Designed" *YouTube*, June 16, 2024, <https://www.youtube.com/watch?v=46gpQddyFFg&t=159s>. Accessed 25 Sept. 2024.

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