

Alberto Sánchez López

Metropolitano de Granada

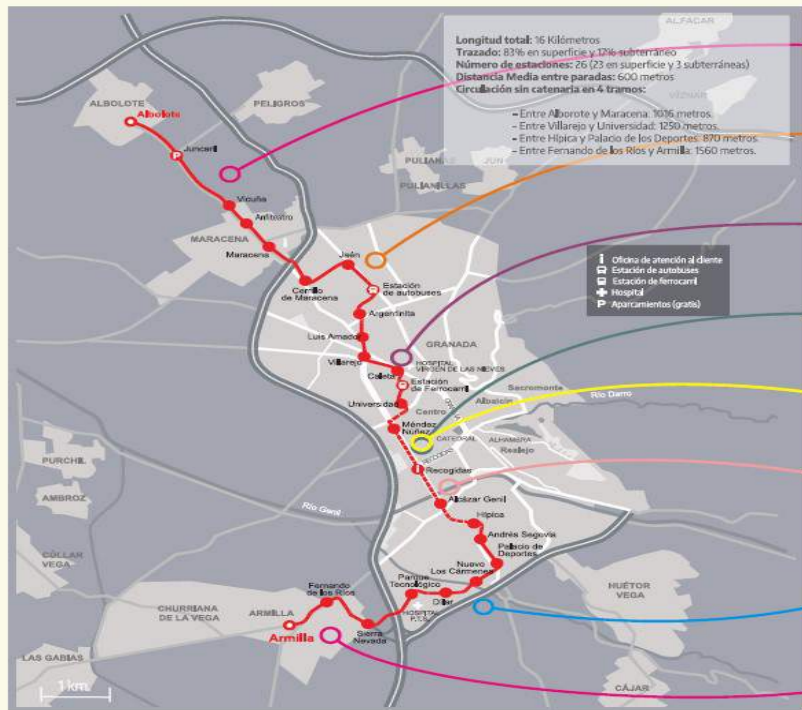
A Metro for People. Metropolitano de Granada, Present and Future

Alberto Sánchez López
Manager Engineer

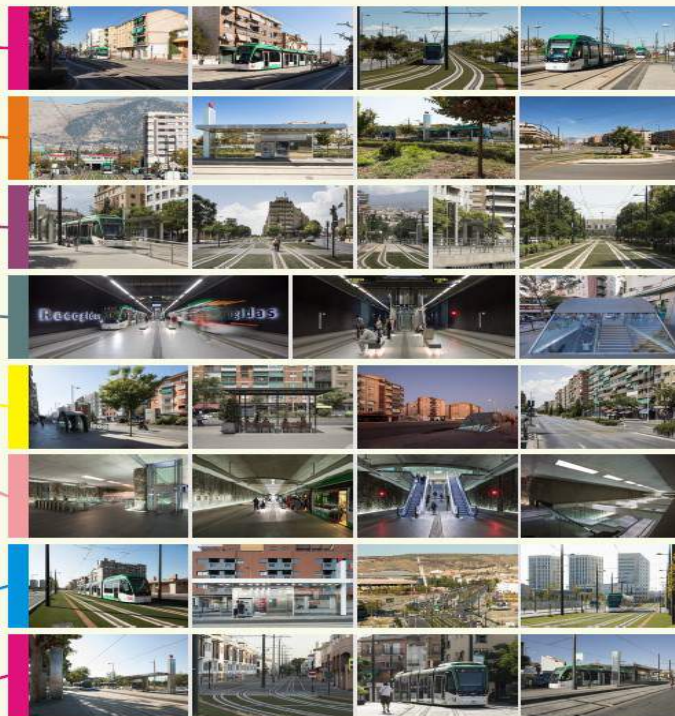
Agencia de Obra Pública de la Junta de Andalucía

13 -14 March 2024. Seville.

CONTEXTUALIZATION



— línea
 - - - - zona subterránea



Área metropolitana e industrial
 Áreas residenciales nuevas

Centro
 Zona subterránea

Zona subterránea (superficie)
 Integración con restos arqueológicos

Parque tecnológico de la salud y zona de centros deportivos

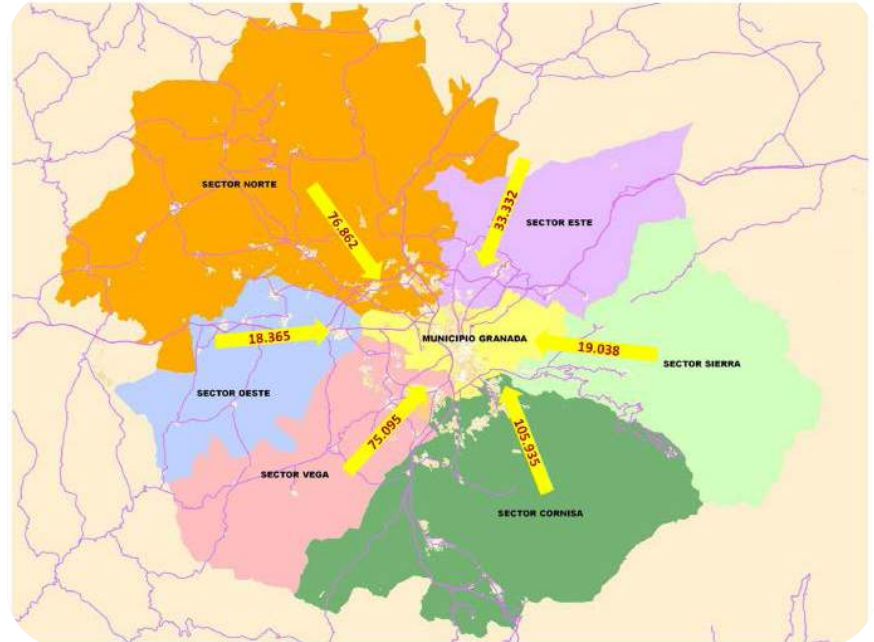
CONTEXTUALIZATION

THE PROBLEM

The city of Granada has a **powerful attraction on its metropolitan area**, because it is the Centre of economic and social activity.

High volume of commute to the city + internal displacements = Jams at the entrances to the city:

Domain of the private vehicle
Public Transport: Secondary character → Low Speed
Pedestrians and Cyclists

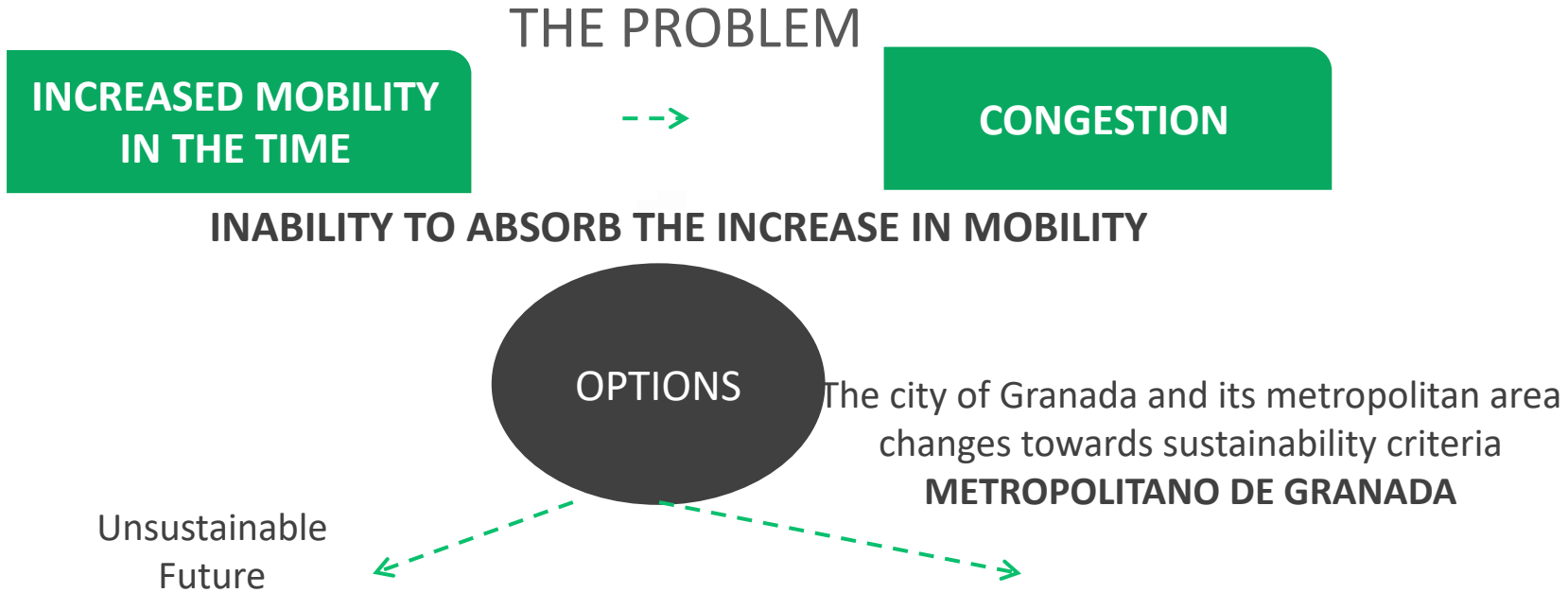


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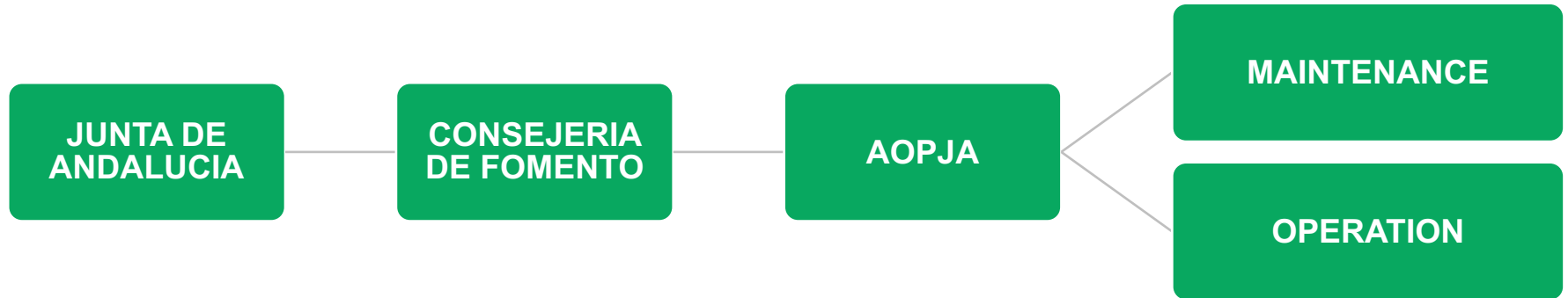


Junta de Andalucía

CONTEXTUALIZATION



CORPORATE STRUCTURE





EMPLOYMENT

More than 300 jobs in operation
and maintenance

BUSINESS ORGANISATION

558M€

INVESTMENT

Capital of MGR,S.A
107,89M€

Capital subsidies provided by Junta de Andalucía through AOPJA
107,94M€

Loan from the European Investment Bank
260,00M€

Loans from various commercial banks
85,00M€



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THE LINE

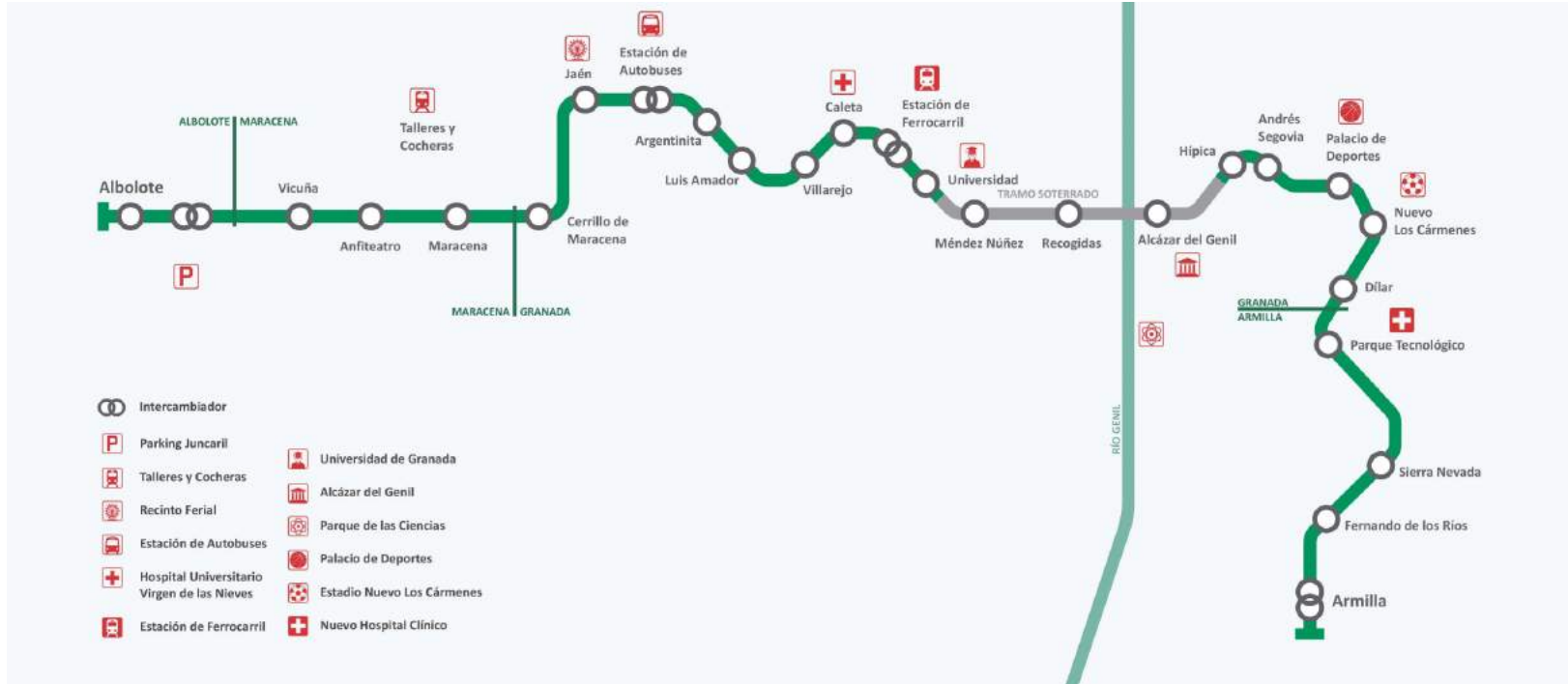


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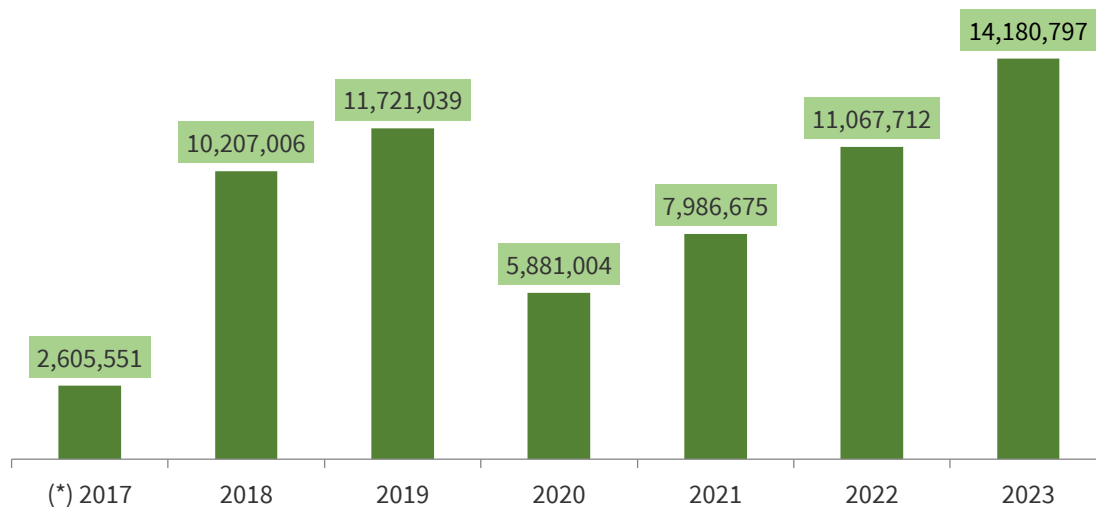
THE LINE



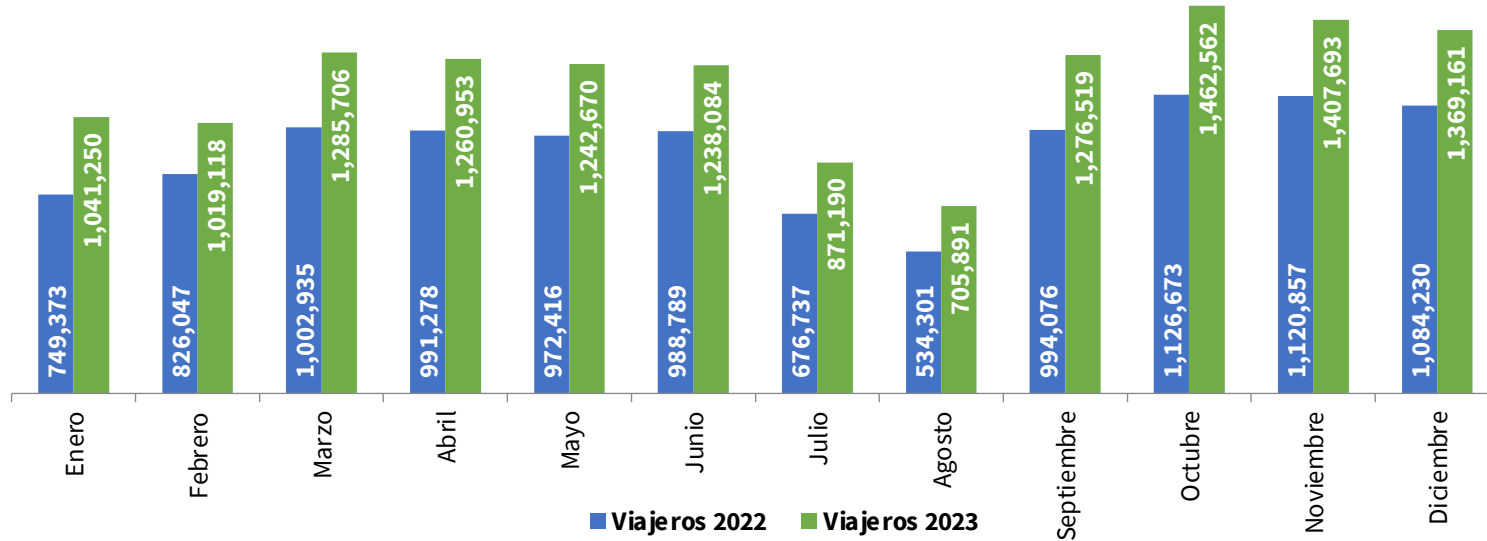
THE LINE

Total accumulated passengers

63.649.784

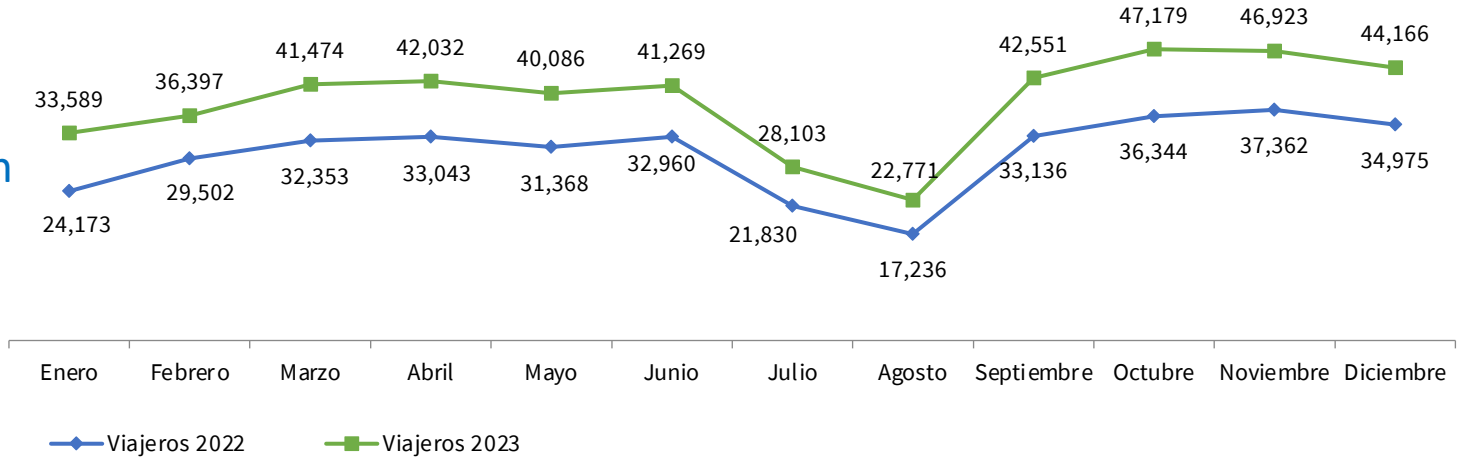


THE LINE



THE LINE

Evolution of the average daily demands per month and the annual averages

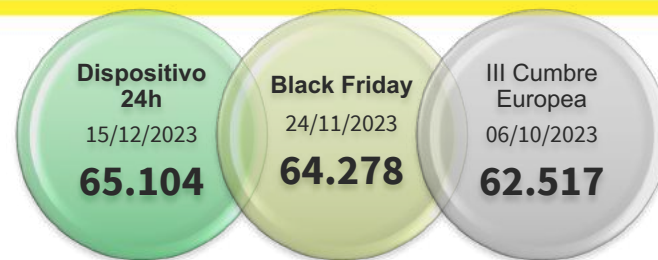
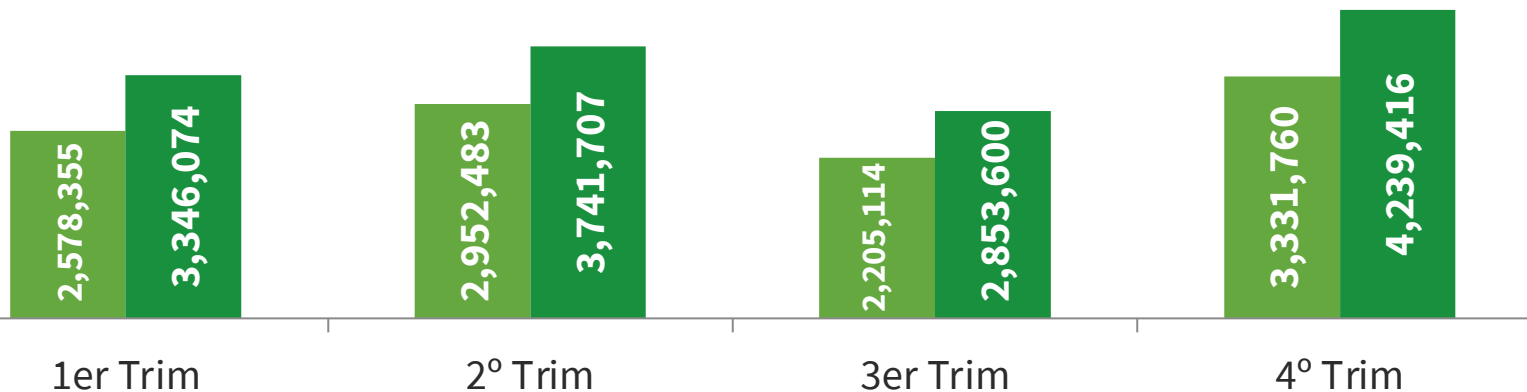


Media Anual Viajeros	2022	2023
Total	30.322	38.851
Laborables	34.718	44.396
Fin sem. / festivos	21.005	27.245

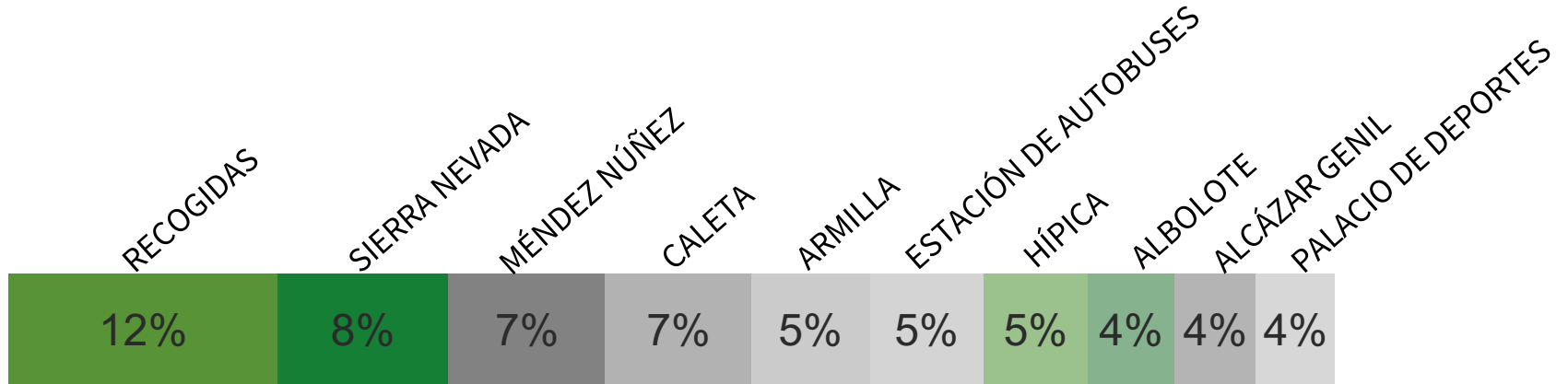
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The demand comparison by quarters 2022/2023

■ Viajeros 2022 ■ Viajeros 2023



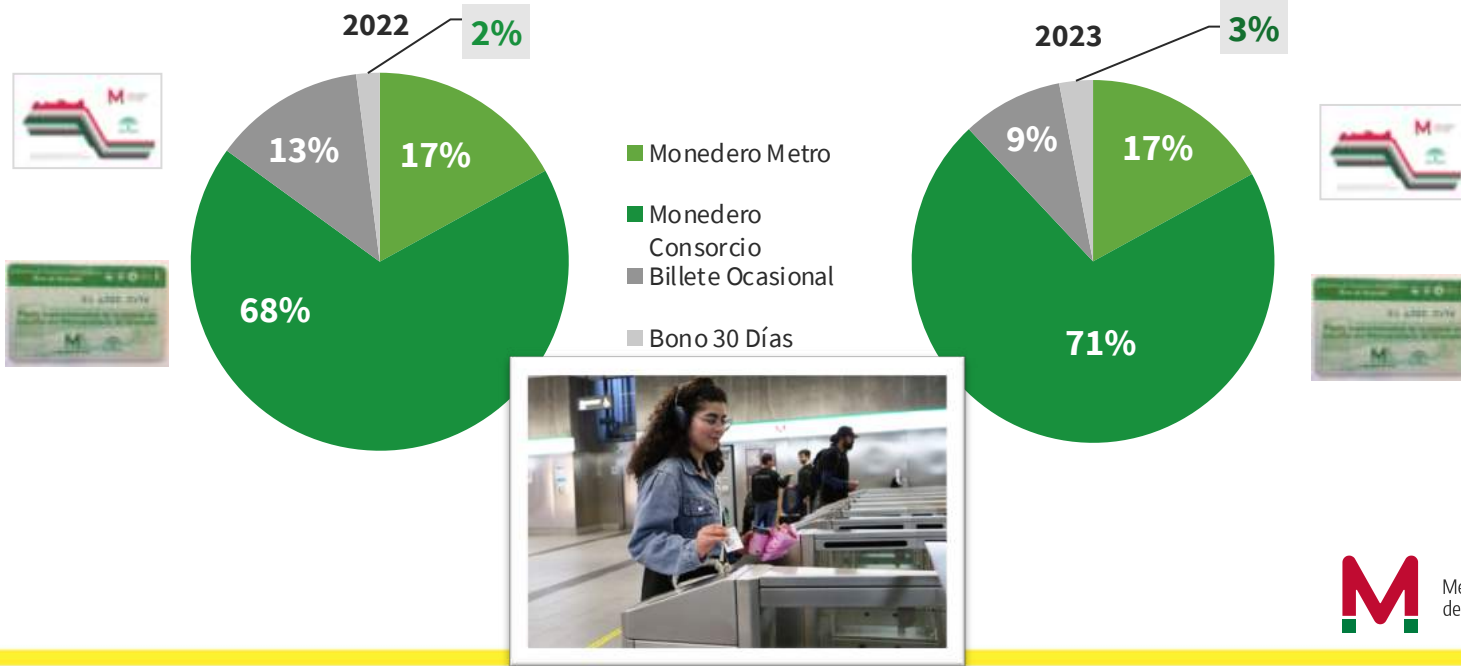
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Ten most important Metro stations and stops by passenger volume.

THE LINE

TRAVEL TICKET



THE LINE

A satisfaction survey of the Granada Metro

Calification by passengers

- punctuality, environmental friendliness, and accessibility.

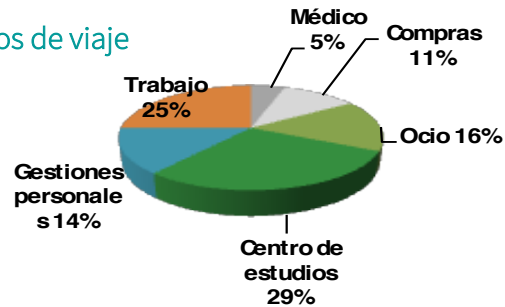
Overall rating

8,3

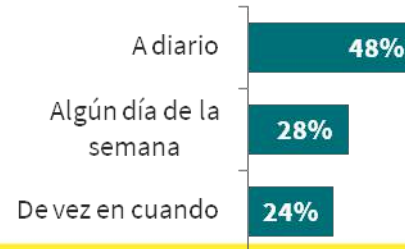


The mobility habits of users

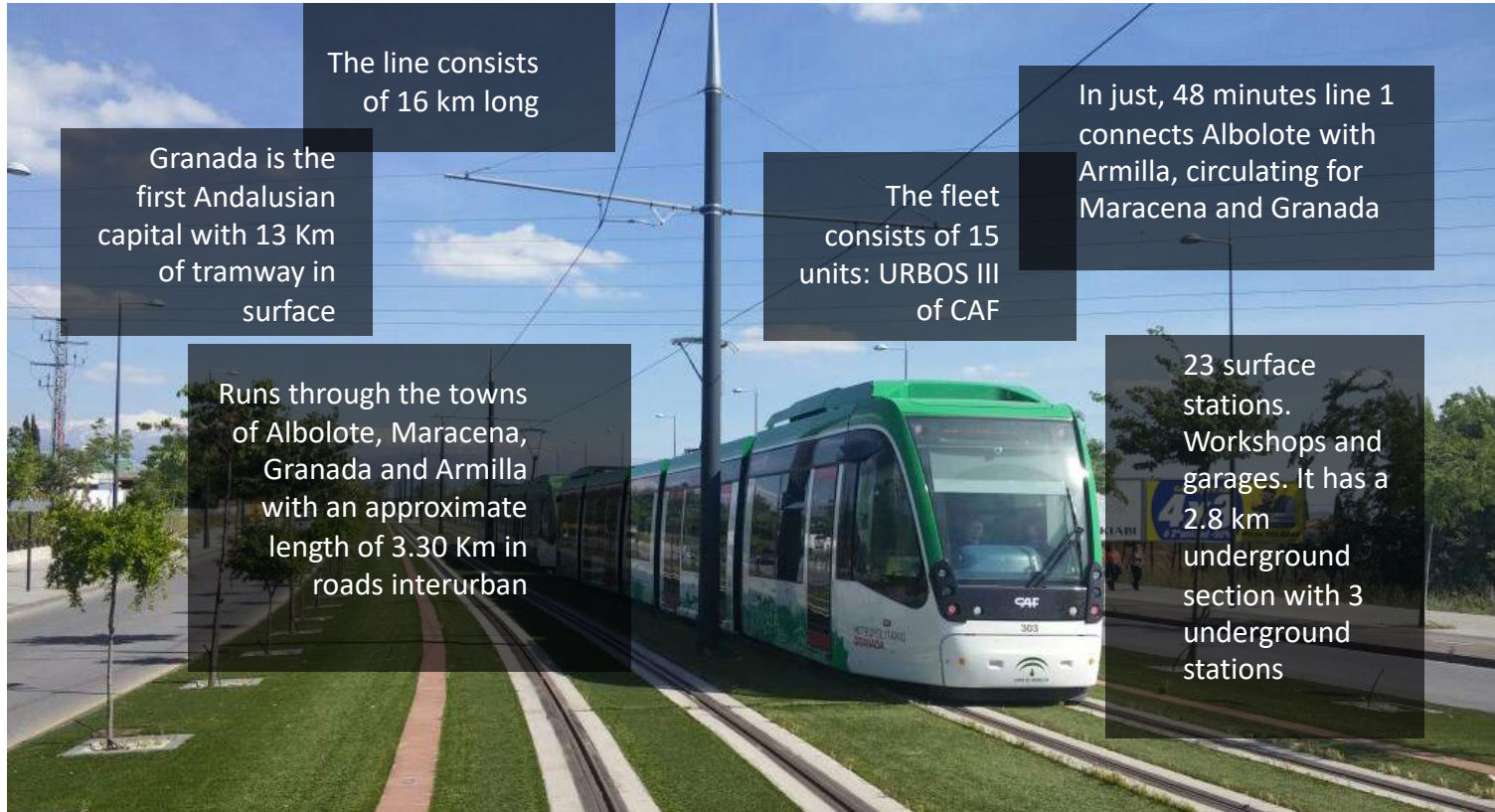
Motivos de viaje



Frecuencia de uso



THE LINE



The line consists of 16 km long

Granada is the first Andalusian capital with 13 Km of tramway in surface

Runs through the towns of Albolote, Maracena, Granada and Armilla with an approximate length of 3.30 Km in roads interurban

The fleet consists of 15 units: URBOS III of CAF

In just, 48 minutes line 1 connects Albolote with Armilla, circulating for Maracena and Granada

23 surface stations. Workshops and garages. It has a 2.8 km underground section with 3 underground stations

THE LINE

DATOS	RESULTADOS FINALES
DISEÑO DEL ANDEN	
DISTANCIA EJE ANDEN	1400 mm
ALTURA DEL ANDEN	300 mm
RADIO MINIMO EN PARADA	400 m
RAMPA MAXIMA EN PARADA	2,00% deseable
RADIO PARABOLICO MINIMO EN PARADA	3000 m
ANCHO DE ANDEN	3,00 m para los laterales con 2,50 m mini. útiles 4,00 m para los centrales con 3,00 m mini. útiles
LONGITUD DE ANDEN	68 m y 65 m mini. Excepcionalmente
TIPOLOGIA ANDENES	Laterales, salvo problemas de inserción y terminales
DISEÑO DE LA VIA	
VELOCIDAD MAXIMA	50 km/h en superficie 70 km/h en túnel
ACELERACION TRANSVERSAL SIN COMPENSAR (calculo)	0,65 m/s ²
ACELERACION TRANSVERSAL SIN COMPENSAR (diseño)	1,00 m/s ²
VARIACION DE ACELERACION SIN COMPENSAR	0,40 m/s ²
RADIO MINIMO EN PLANTA	50 m (excepcionalmente 25 m) en línea 20 m en talleres
RADIO MINIMO DE LOS ACUERDOS VERTICALES	1000m 500 m excepcional cóncavo 500 m excepcional convexo
COMBINACION DE UNA PARABOLA VERTICAL Y DE UNA CURVA EN PLANTA	40 m ≤ R ≤ 70m ⇔ Kv ≥ 3000 m 70 m ≤ R ≤ 200m ⇔ Kv ≥ 1500 m
RAMPA MAXIMA	5,00% 7,00% excepcional
RELACION ENTRE DECLIVIDAD p Y RADIO R	$p + 800/R \leq 70‰$
PERALTE MAXIMO	150 mm
RAMPA DE PERALTE MAXIMA	2mm/m 3m/m excepcional
INSUFICIENCIA DE PERALTE	100 mm
LONGITUD MINIMA DE CLOTOIDE	12 m

DESIGN PARAMETERS



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THE LINE

THE LINE DATA

- **Commercial line speed:** 20 km/h
- **Travel Time:** 48 minutes
- **Regulation Time:** 4 minutes
- **Rotation Time:** $2 * (48 + 4) = 104$ minutes
- **Maximum load at rush hour:** 1270 passengers
- **Frequency at Rush Hour:** 8 minutes
- **Fleet:** 13 trains operating + 2 trains booking
- **Rolling Stock:** approximate capacity of 200 people (4 pax / m²)
- **Annual production:** 1,280,269 km/year



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THE LINE

SURFACE AND UNDERGROUND STATIONS

It's a line of clear Metropolitan functionality, which includes **23 stations on surface and 3 underground stations** to access equipment of interest, as well as to promote exchange with other modes of transport.

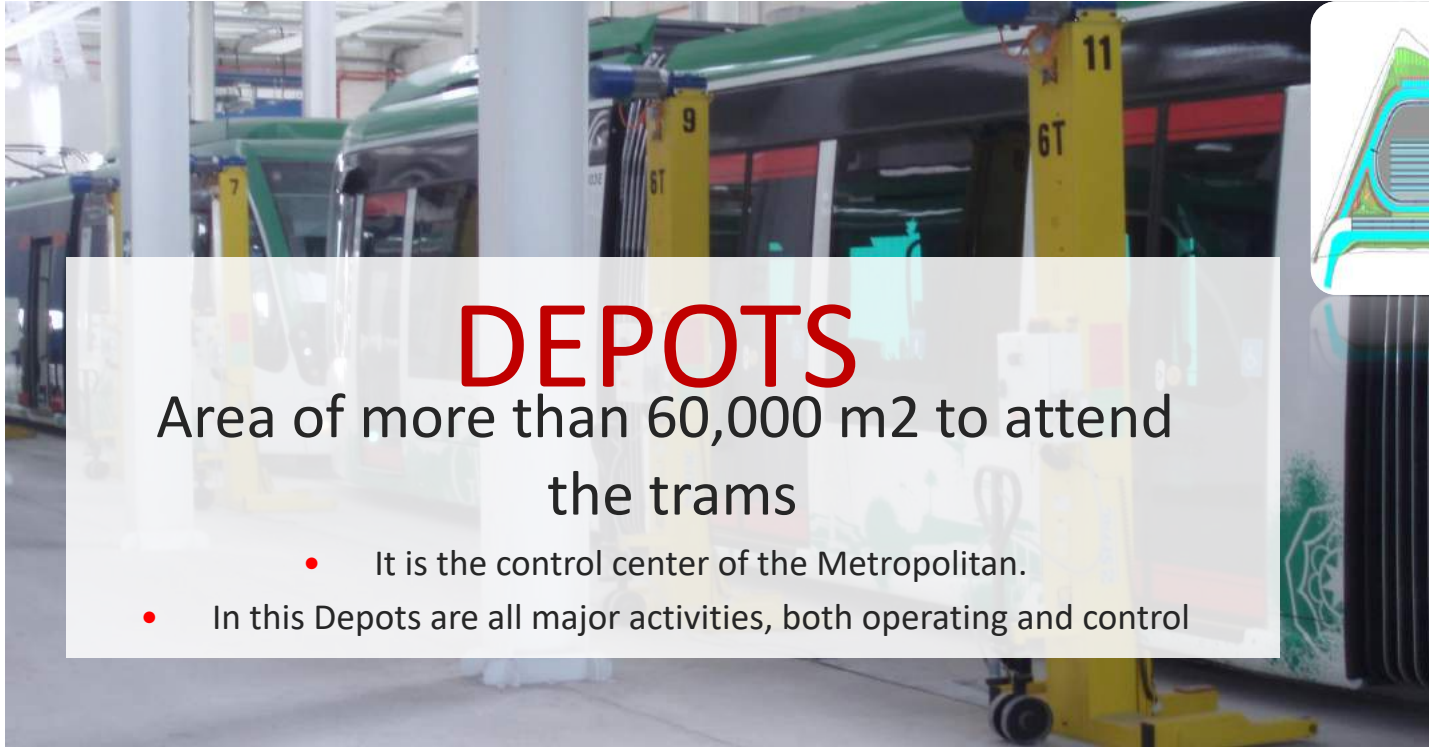


SURFACE AND UNDERGROUND STATIONS

Underground stations: There are two levels to save the difference of altitude between the street and the pavement → 12 meters

In “Alcazar del Genil” station have been integrated the archaeological remains of “Albercón”
(Time Nazari)

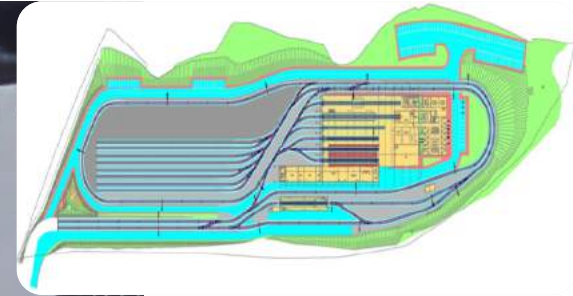




DEPOTS

Area of more than 60,000 m² to attend the trams

- It is the control center of the Metropolitan.
- In this Depots are all major activities, both operating and control



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FACILITIES

INFORMATION POINT located at the ends of the line and Recogidas Station

PARK AND RIDE JUNCARIL: point of exchange between the private car, bicycle,... and the Metropolitan to avoid them entering the city

PEDESTRIAN UNDERPASS in Cerrillo de Maracena, which facilitates access to the station Cerrillo Maracena, passing under existing train tracks



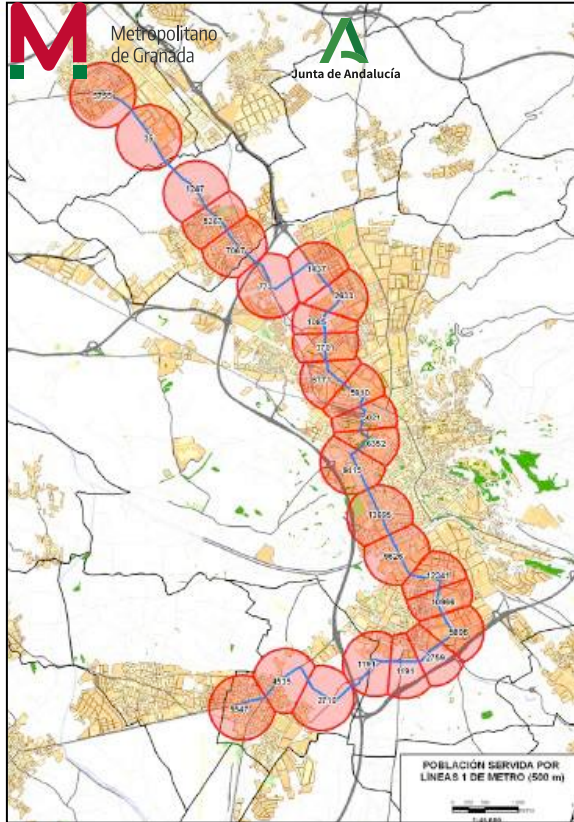
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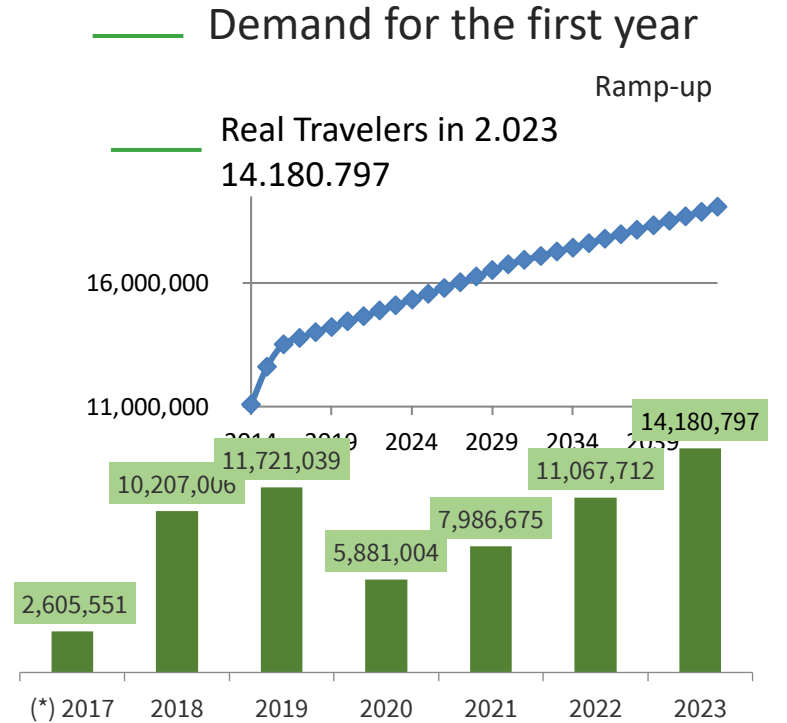
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THE LINE

DATA LINE



Year	%	Travelers/year
1	→	11.085.870
2	13,8%	12.615.240
3	7,2%	13.520.400
4	1,8%	13.766.100
5	1,8%	14.016.300
6	→ 1,5%	14.226.545
7	1,5%	14.439.943
8	1,5%	14.656.542
9	1,5%	14.876.390
10	1,5%	15.099.536
11	1,5%	15.326.029
12	1,5%	15.555.919
13	1,5%	15.789.258
14	1,5%	16.026.097
15	1,5%	16.266.488
16	1,5%	16.510.486
17	1,5%	16.758.143
18	1,0%	16.925.724
19	1,0%	17.094.982
20	1,0%	17.265.931
21	1,0%	17.438.591
22	1,0%	17.612.977
23	1,0%	17.789.106
24	1,0%	17.966.998
25	1,0%	18.146.667
26	1,0%	18.328.134
27	1,0%	18.511.416
28	1,0%	18.696.530
29	1,0%	18.883.495
30	1,0%	19.072.330



Population served: 133.636 inhabitants located less than 500 m from each station

METROPOLITAN IMPROVEMENTS



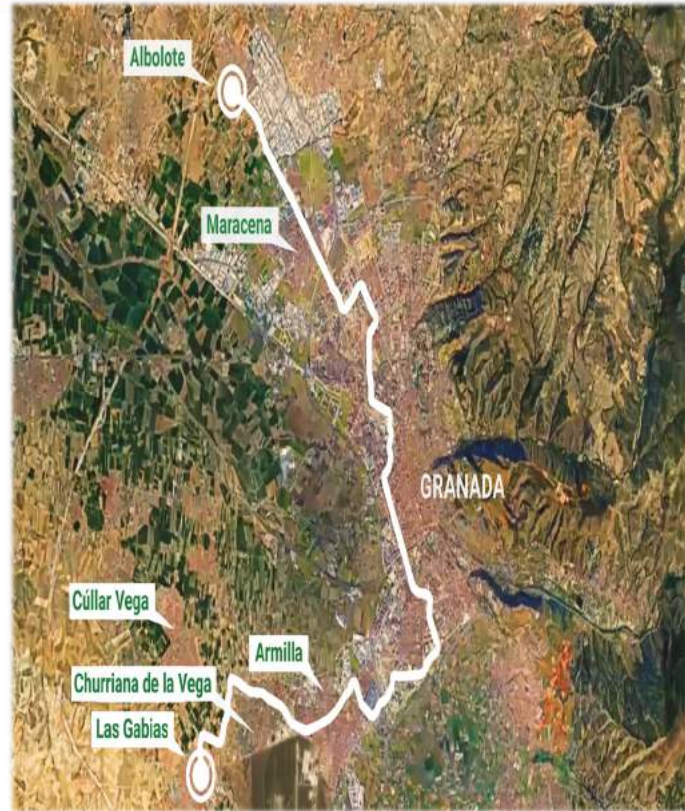
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METROPOLITAN IMPROVEMENTS

The southern extension of the Granada Metro with Building Information Modeling (BIM)



Proyectos	Longitud (m)	Nuevas Estaciones
PPR1 Ramal Armilla - Churriana de la Vega	2,70	4
PPR2 Ramal Churriana de la Vega - Las Gabias	2,07	3
PPR3 Instalaciones de PPR1 + PPR2	4,77	7

Características principales

- Longitud total 4,774 metros
 - Via única: 962 m
 - Via doble: 3,812 m
- 7 nuevas paradas
- 1 Intercambiador con aparcamiento disuasorio
- Todo el trazado en superficie
- Nueva estructura sobre el río Dilar



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METROPOLITAN IMPROVEMENTS

Special services

Simulation. Safety



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METROPOLITAN IMPROVEMENTS

8 units New Trains
URBOS 100
CAF

New Ticketing System EuroPay
EMV



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Cultural Space in ALCÁZAR GENIL



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Green roof in depot



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In 2023, with 14.180.797 registered passengers, the Granada Metro prevented 4.017.892 car trips. And additionally, 6.867,29 tons of CO2 emissions have been avoided from being released into the atmosphere.

METROPOLITAN IMPROVEMENTS

New Ticket Design in the Sixth Year of Operation



Students Visits. Metro School



METROPOLITAN IMPROVEMENTS

The screenshot displays the website for the Metropolitan of Granada, featuring the logos of the Metropolitan of Granada and the Junta de Andalucía. The navigation menu includes: INICIO, NOTICIAS, EL METROPOLITANO, MAPA, HORARIOS, TARIFAS, INFORMACIÓN TURÍSTICA, and ATENCIÓN AL CLIENTE. A search bar is present with fields for 'Origen' and 'Destino', and a 'Buscar' button. Below the search bar is a map of the metro line with 18 stations: Albalade, Juncarill, Viscosa, Andújar, Maracena, Cerrillo Maracena, Jalo, Estación Autobuses, Argemolina, Luis Amador, Vilbarro, Cáceres, Estación Ferrocarril, Universidad, Mimosas Nieves, Percebalas, Alcazar Genil, Hípica, Andrés Segovia, Palacio Deportes, Nuevo Los Carmenes, Dilar, Parque Tecnológico, Sierra Nevada, Fernando de los Rios, and Armilla. A legend at the bottom identifies various icons: Intercambiador, Hospital Universitario Virgen de las Nieves, Estadio Nuevo Los Carmenes, Tramo Soterrado, Estación de Ferrocarril, Universidad / Facultad, Nuevo Hospital Clínico, Parking Juncarill, Restos Arqueológicos, Talleres y Cocheras, Recinto Ferial, Parque de las Ciencias, and Estación de Autobuses, Palacio de Deportes.

Web Metro de Granada
and social media
Facebook, X, Instagram,

METROPOLITAN IMPROVEMENTS

URBANIZATION OF "FACADE TO FACADE"



Towards a more **attractive** city

Towards a more **sustainable** city

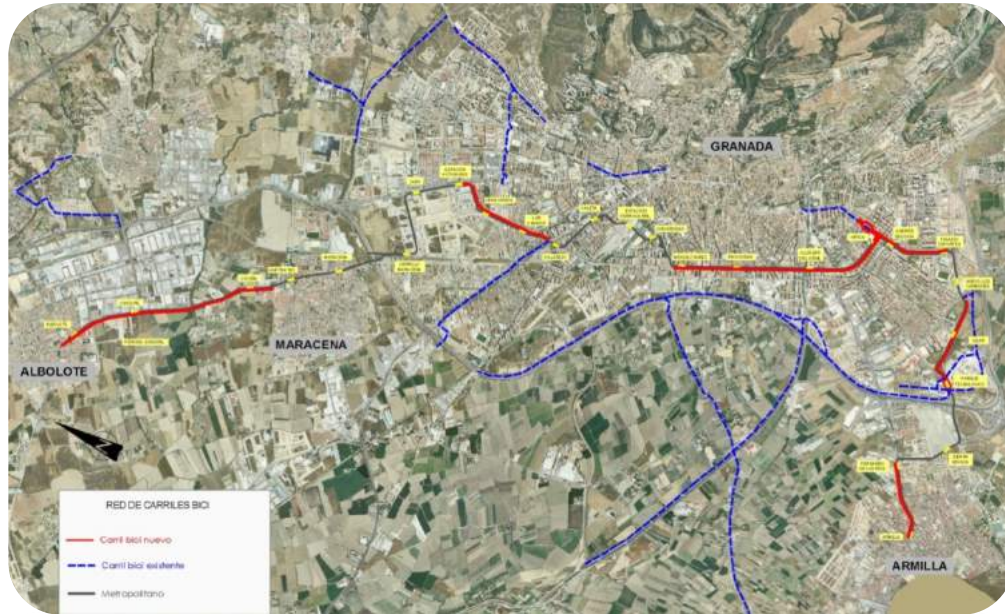
Towards a more **accessible** city

Towards a city **with greater freedom of mobility**

**URBANIZATION OF "FACADE TO FACADE":
718.984 m²**

METROPOLITAN IMPROVEMENTS

RAILS BICYCLE



Albolote-Maracena (2.432 m)

E. Autobuses-Av. Andalucía
(1.629 m)

Méndez Núñez-Palacio de
Deportes (4.229 m)

Armilla (623 m)

RAILS BICYCLE: 8.913 m

METROPOLITAN IMPROVEMENTS

TREES

More than 4,000 new trees have been planted.



This, together with the planting of almost 70,000 bushes, causes a reduction of CO₂:

1.227,388 tons CO₂/year



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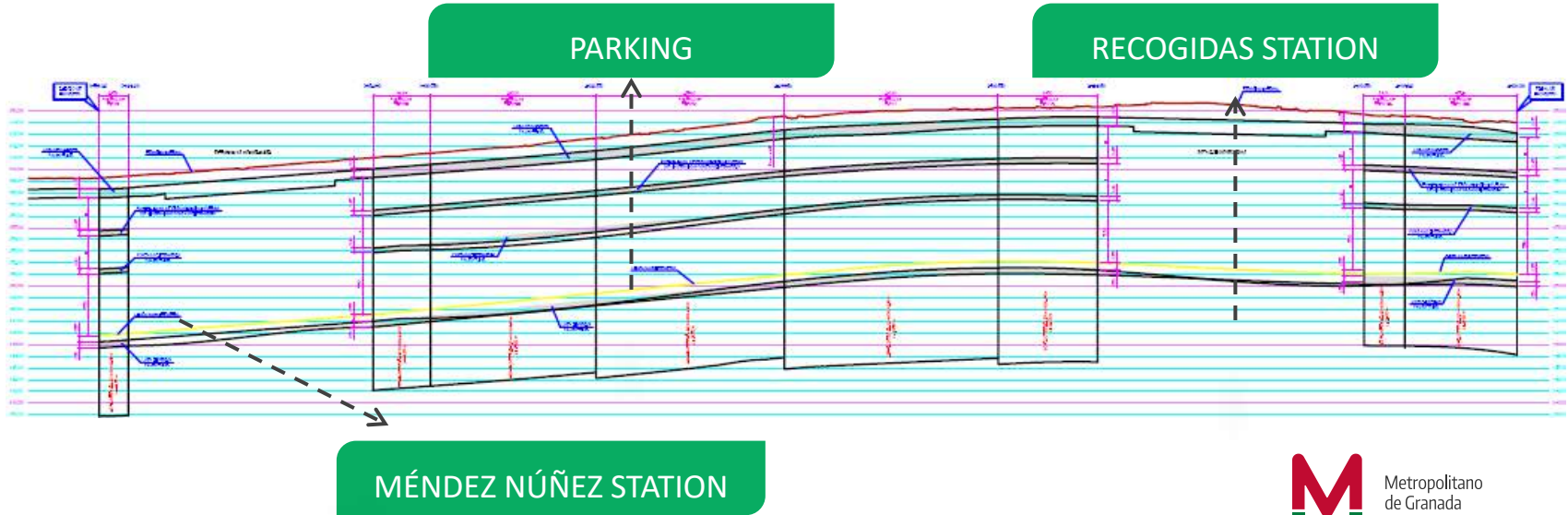


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METROPOLITAN IMPROVEMENTS

UNDERGROUND PARKING

Underground Parking between Méndez Núñez and Recogidas stations



METROPOLITAN IMPROVEMENTS

INTERMODALITY



Bicycles: rails bicycle and zones of parking close to the stations

Cars: Park-and-ride Juncaril

Transport: Bus station and the Railway station

ROLLING STOCK



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ROLLING STOCK

URBOS III and URBOS 100 CAF



ROLLING STOCK

FICHA TÉCNICA

 COMPOSICIÓN	Mc-S-R-S-Mc
 LONGITUD DE TREN (MM)	32.314
 TOTAL PLAZAS	194
 VELOCIDAD MÁXIMA (KM/H)	70
 EQUIPAMIENTO	
	<ul style="list-style-type: none">› Aire acondicionado en cabina› Aire acondicionado en sala de viajeros› Información a viajeros, acústica y visual› Registrador de eventos (caja negra)› Sistema de control y supervisión› Sistema de cuenta pasajeros a bordo› Videovigilancia› ACR



URBOS III - CAF

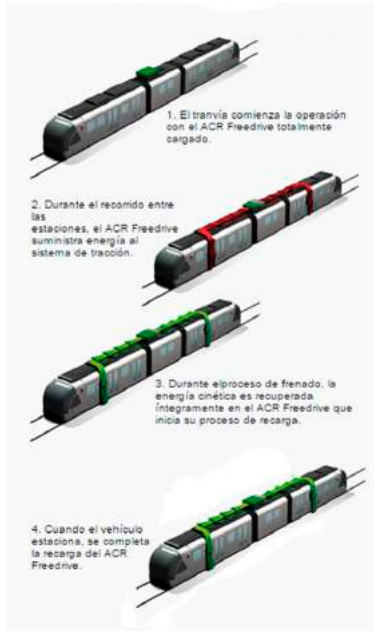


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SECTIONS WITHOUT CATENARY – ACR SYSTEM



The ACR system is an innovative technology that has 2 interesting features (energy storage modules integrated into rolling stock):

- Increase the energy efficiency of the system: retrieves and stores energy during braking and then uses it to circulate.
- Allow the exploitation of sections without catenary along the line.

ROLLING STOCK

SECTIONS WITHOUT CATENARY – ACR SYSTEM

Optimization of the power supply

Reduction of “visual” pollution

Autonomy for circular by “sections without catenary”

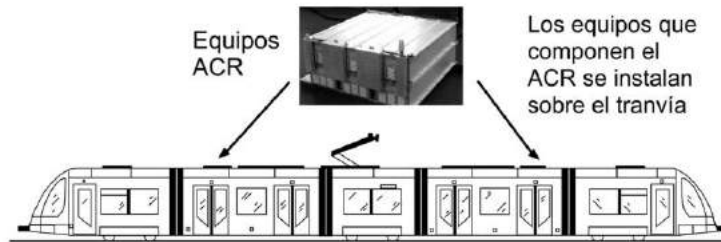
Energy savings: 30%.

Hybrid technology. It allows to optimize the system from the point of view of performance and cost

Ultra fast charging: 20 seconds

Reduction of investment in infrastructure

Proven Solution: Granada, Sevilla and Zaragoza

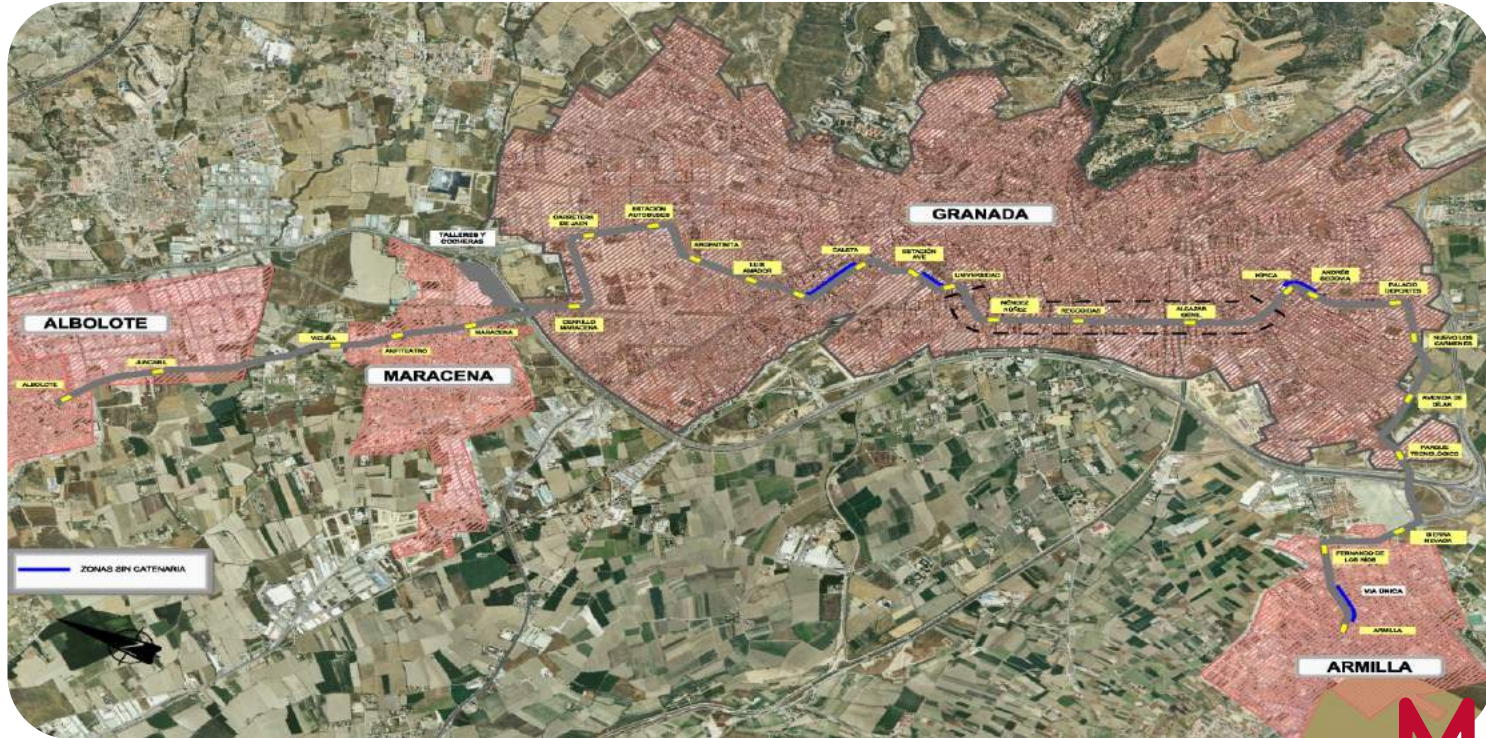


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ROLLING STOCK

SECTIONS WITHOUT CATENARY
ACR SYSTEM



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A METRO FOR PEOPLE

THE METROPOLITAN CONNECTED CITY



- Intercambiador
- Parking Juncaril
- Talleres y Cocheras
- Recinto Ferial
- Estación de Autobuses
- Hospital Universitario Virgen de las Nieves
- Estación de Ferrocarril
- Universidad de Granada
- Alcázar del Genil
- Parque de las Ciencias
- Palacio de Deportes
- Estadio Nuevo Los Cármenes
- Nuevo Hospital Clínico

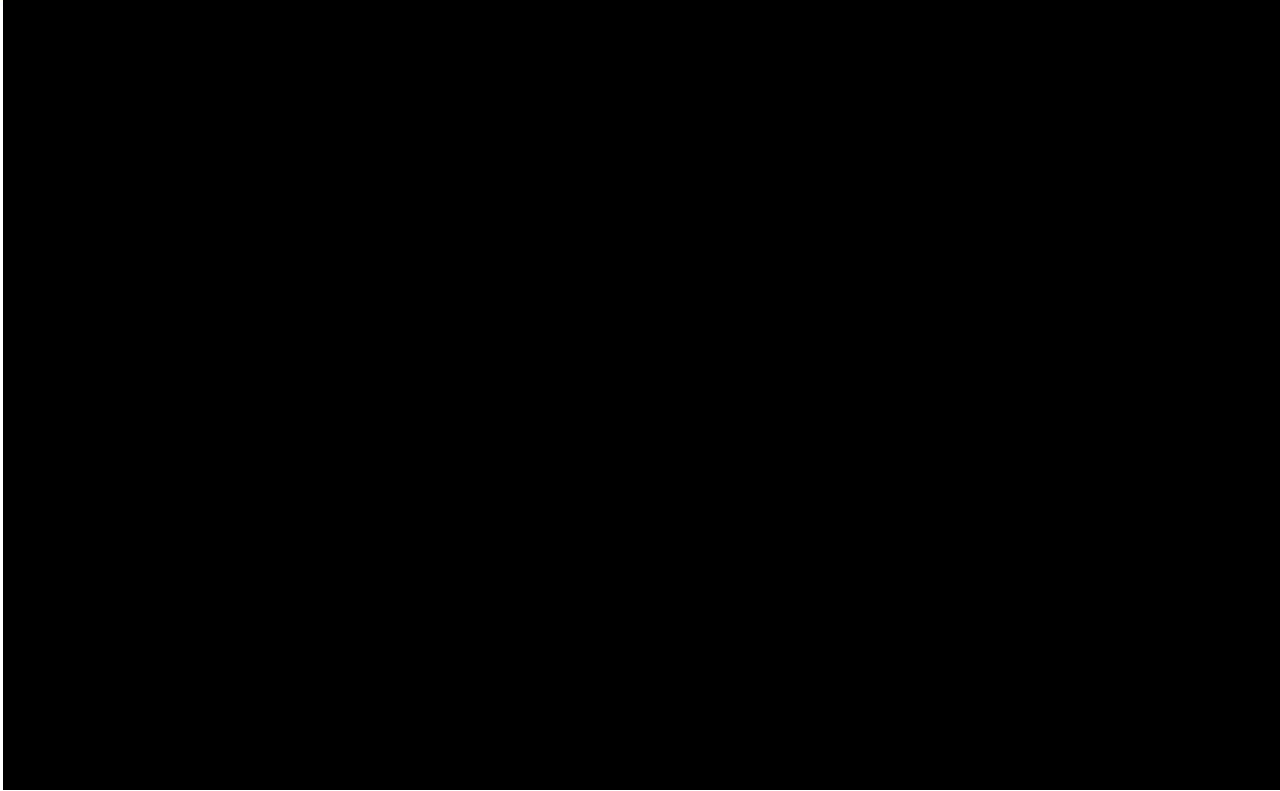


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Granada Metro

A Metro for People



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THANKS FOR YOUR ATTENTION

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