Towards autonomous, connected and efficient mobility. Shuttle by CTAG

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Efficient Mobility Area Manager

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AUTOMOTIVE TECHNOLOGY CENTER OF GALICIA

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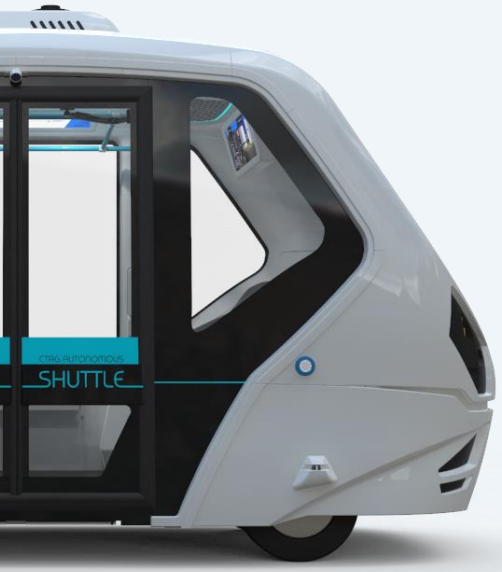


01

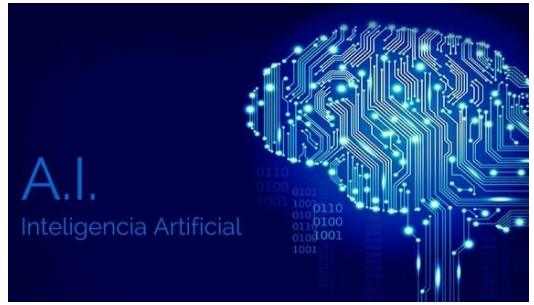
Mobility

Main macro-trends in mobility

Population aging

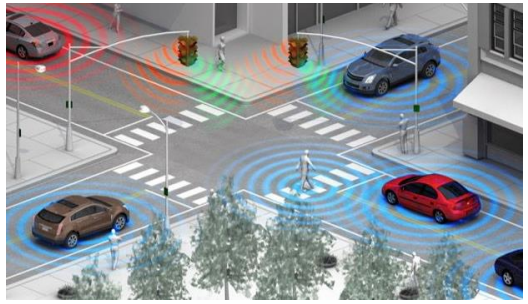
Urban population increase

Smart Infrastructures



Artificial Inteligence

Connectivity

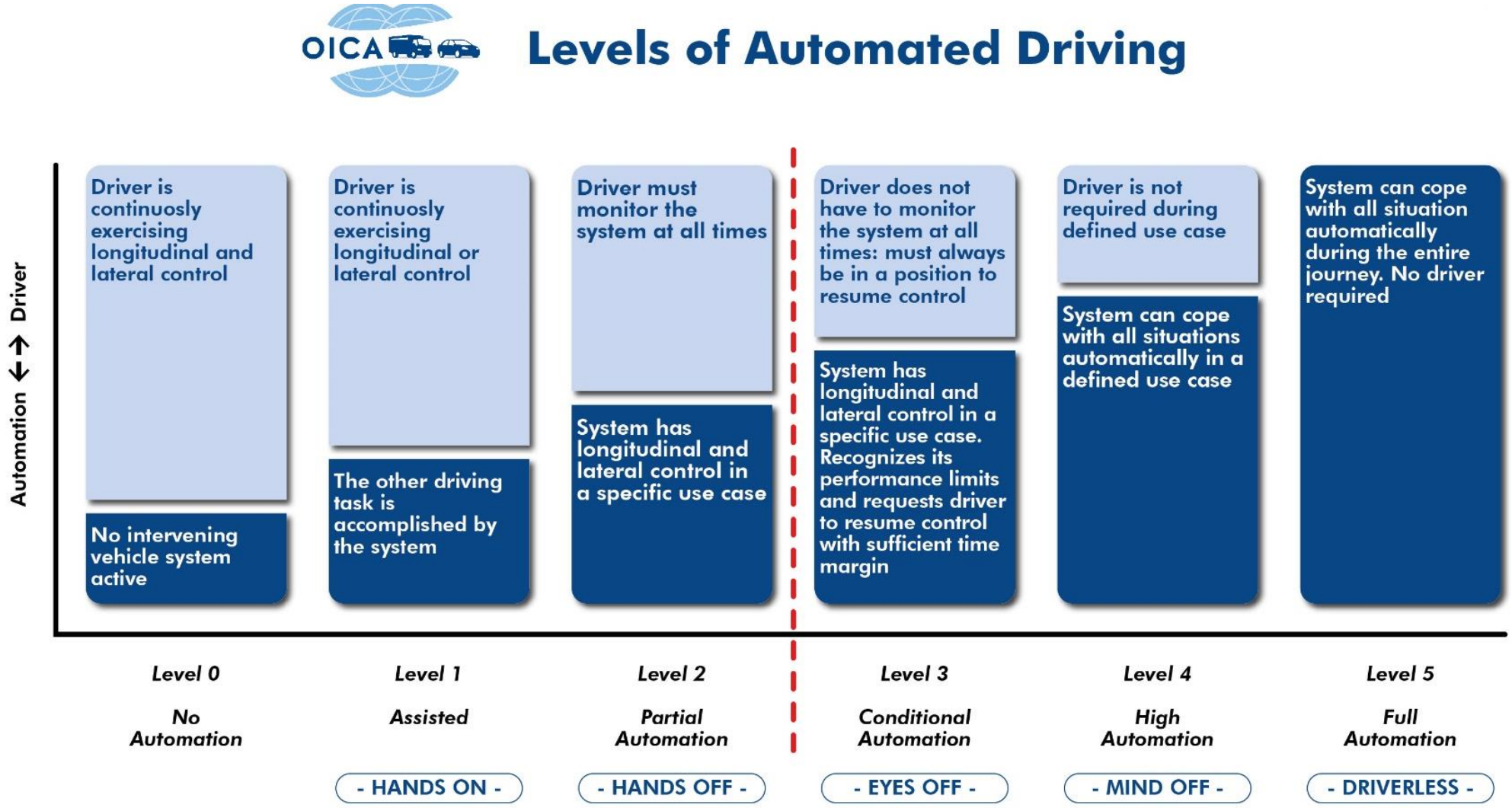


Autonomous Vehicles

Electrification

MaaS

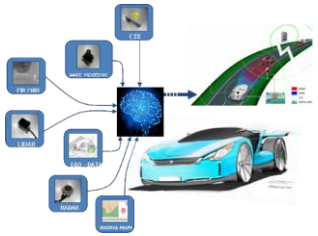
Towards autonomous and connected mobility



Towards autonomous and connected mobility.

Technical Challenges

Tests & validation



Sensors & perception

Functions & control

Connectivity

Legislation

HMI & Human Factor

Infrastructure adaptation

Towards autonomous and connected mobility.

Legal Advances

- **Autonomous robotaxis services in states such as San Francisco and Phoenix**

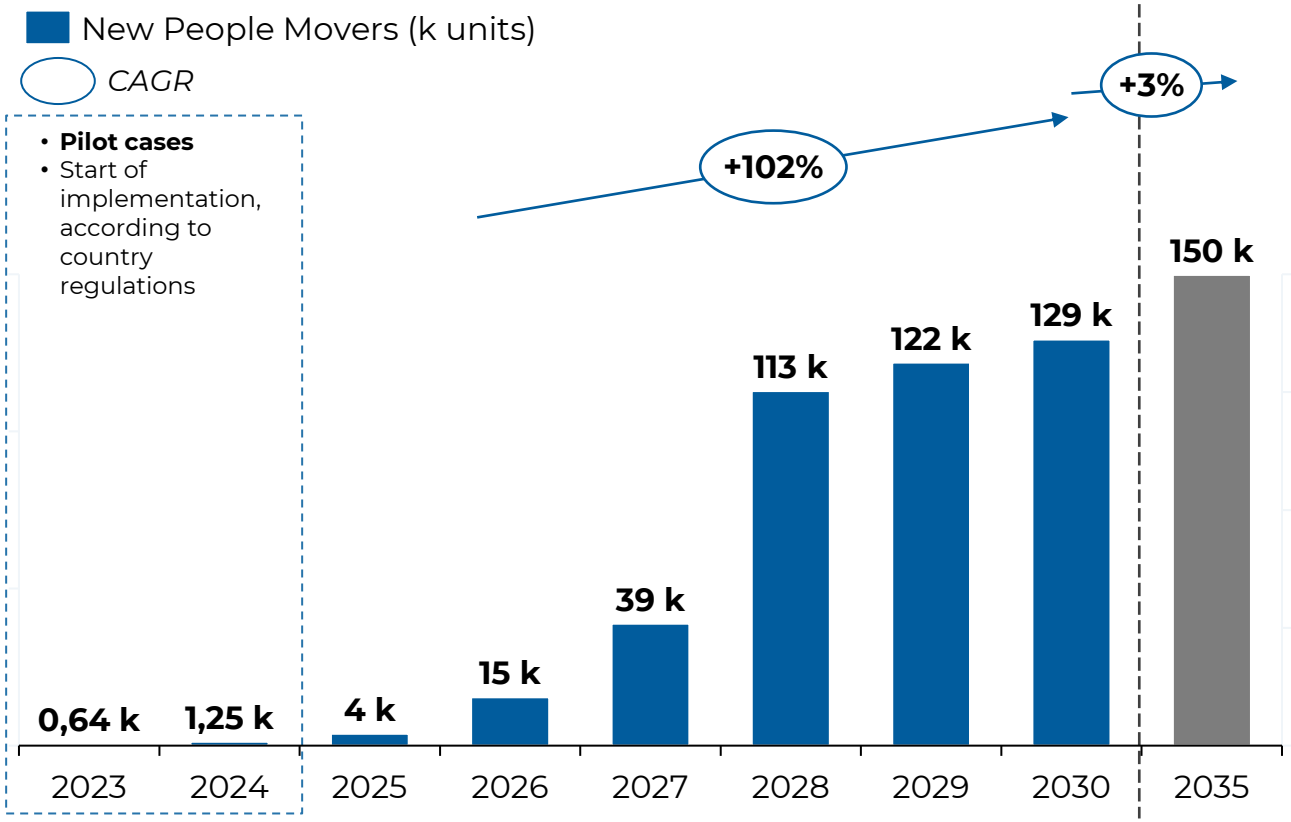
- **Autonomous robotaxis service in Shenzhen (China) and deployment of autonomous shuttle tests**

- **France and Germany** as spearheads in Europe
- France allows, under certain circumstances, the operation of **driverless vehicles on “open” circuits**

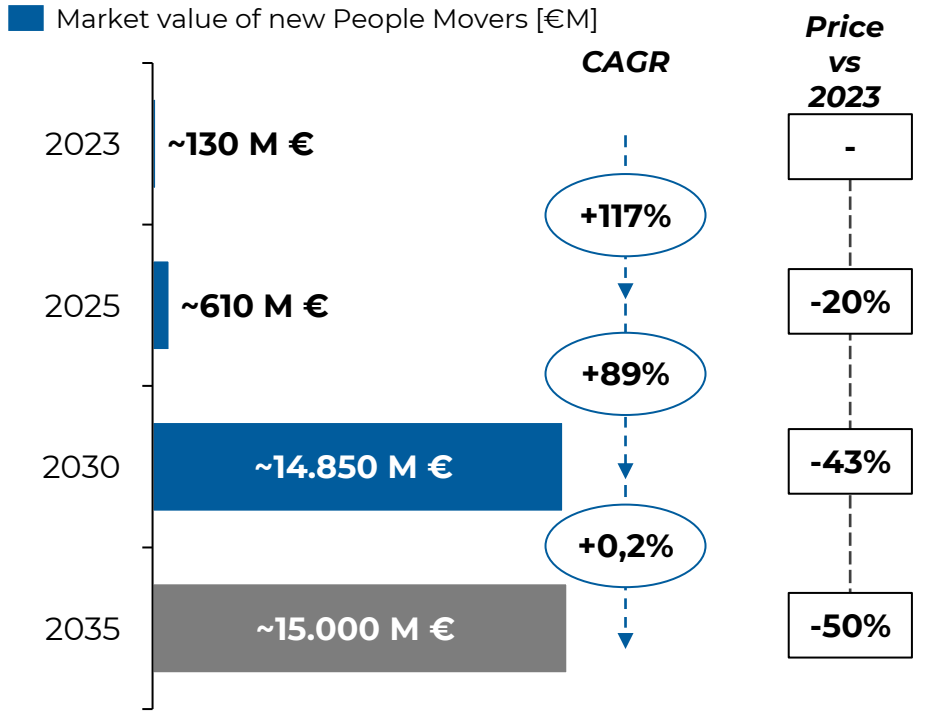
- First pilots have been deployed in **Spain** (mandatory supervisor on board the vehicle)
- **INSIA, together with CTAG**, in collaboration with the DGT, **become the 1st Technological Recognition Center in Spain**

Evolution of the global People Mover market

Evolution of new People Movers [k units]

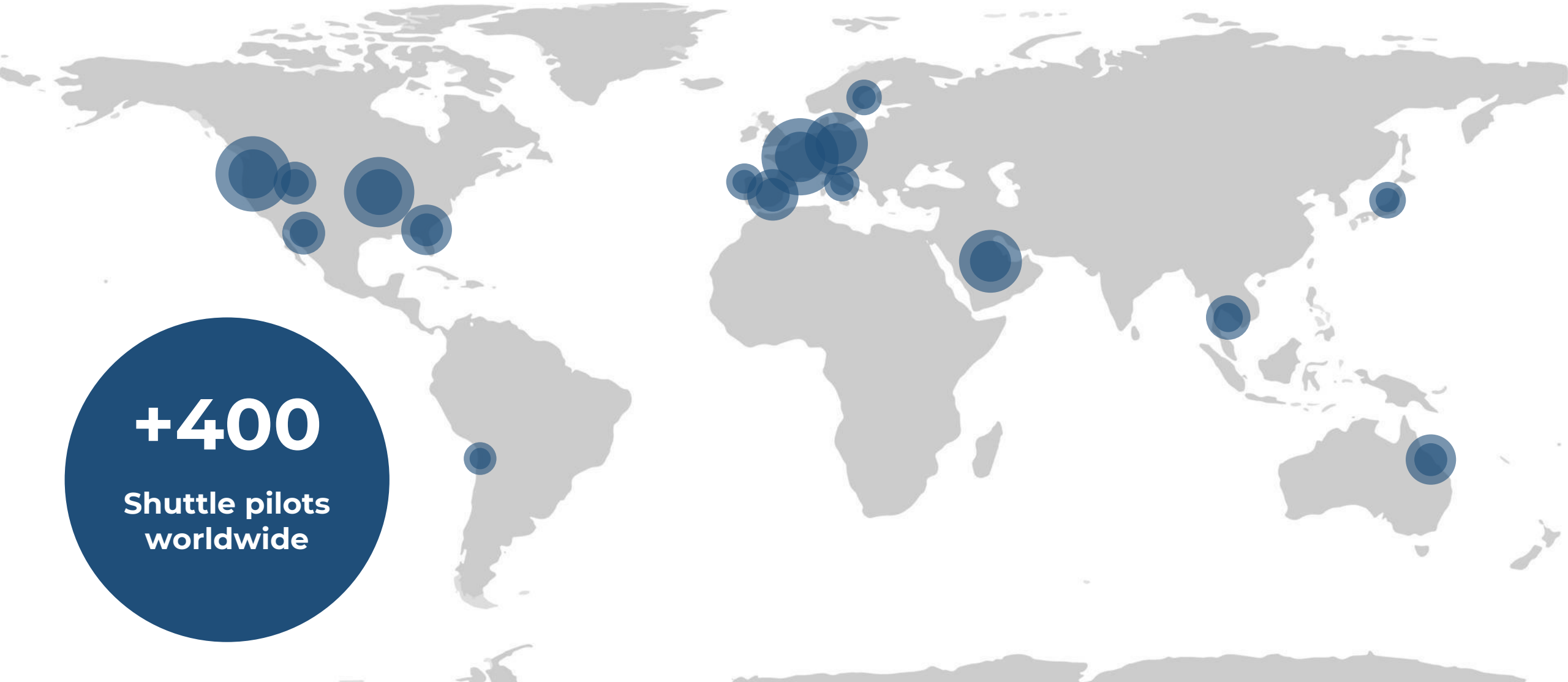


Market Value [M €]



Notas: PM: People Mover; CAGR: compound annual growth rate | Fuente: PwC

Autonomous Shuttle Deployments Worldwide



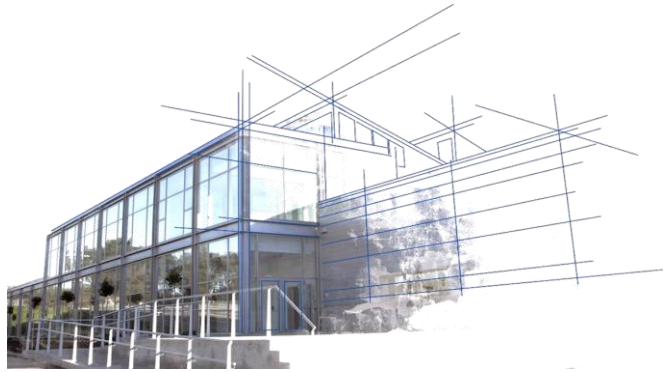
+400

Shuttle pilots worldwide

02

Shuttle
By CTAG

CTAG – Automotive Technology Center of Galicia



+1200
80% Engineers

70M
Total Investment

60M
T.O. 2023

65%
International Activity

50%
OEMs

Activity Fields

Electronics & Smart Mobility

Materials & Processes

Testing & Validation

Passive Safety

Clients

BENTLEY · SEAT · STELLANTIS · NISSAN · JAGUAR · LAND ROVER · Valeo · FICOSA · LEAR · MAGNA · faurecia · Gestamp · Simoldes · ANTOLIN · ZF · Eurostyle Systems · KYB · AKWEL · SMRC · 3M · ArcelorMittal · BENTELER Automotive · TUYAUTO · Megatech · YAZAKI · NOVARES · avanza · Castrosua · SISTEM · Telefónica · vodafone · cintra · DGT · Arteixo · TUI

Shuttle by CTAG

L0	L1	L2	L3	L4	L5
Not automated	Drive assist	Partial automations	Conditional automation	High automation	Full automation

History

- **INSIA – CTAG 1st Technological Recognition Center in Spain** — 2024
- **+10 pilots done** — 2023
- **1st Market Unit** — 2022
- **1st Prototipe** — 2019

Values

- At the forefront of **innovation**
- **Unique mobility experience**
- **Electric, autonomous and connected**
- **Attractive and ergonomic design**

Multiple operating environments

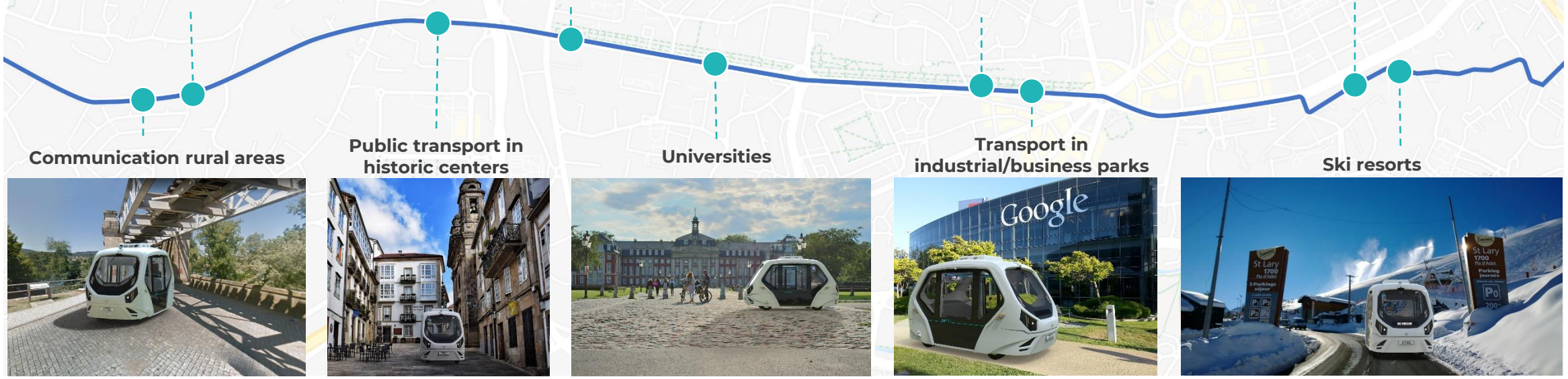
It allows to **meet the needs of transporting people safely and sustainably** in multiple environments, whether in **cities or rural areas**:

Special public services

Tourist applications

Connection of Transport Hubs

Airports



Shuttle by CTAG deployments

Arteixo – August 2022
Connection between two beaches, on a closed circuit

CTAG- Nov 2023 - *Present*
Internal Transport Service

Tui – Valença – October 2022
International Connection Spain – Portugal, between both old towns.

Lisbon – May 2023
Demonstration at ITS Europe Congress

ITS Seville – March 2023
Pilot service at FIBES for the ITS Spain & Iberoamerica Congress

A Coruña – September 2022
Closed circuit route along the promenade of La Coruña

Madrid – December 2022
Piloto trial on a closed circuit

Madrid – October 2023
Demostration at GMC IFEMA

Valencia – April 2023
Pilot service at iENER Congress

Benidorm – September 2022
Closed circuit demonstration at plaza del ayuntamiento

Shuttle by CTAG deployments

Deployments in Numbers

+3.500
Passengers on board

+2.000 kms
in AD on public roads

+10
Deployments

+10
Mobility Events

03

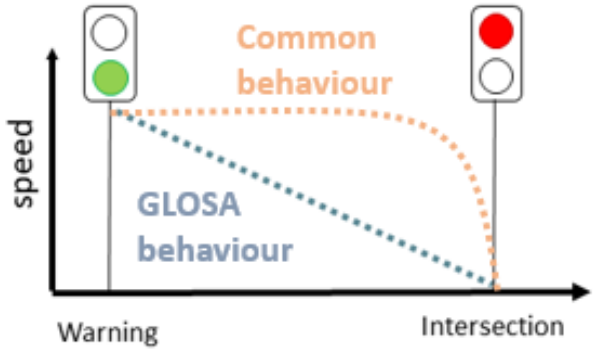
Energy efficiency

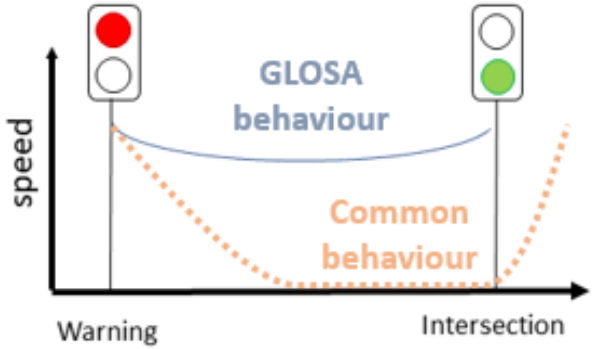
GLOSA as an energy keeper technology

GLOSA (Green Light Optimal Speed Advisor) is a system where **traffic lights send information** about its current phase and remaining time **to vehicles**, in order to **save energy and avoid sudden breakings and accelerations**.

GLOSA as an energy keeper technology

Latest results measured in projects such as C-ROADS or INTEGRA **demonstrate the energy efficiency** achievable by this type of systems, **both in manual driving and autonomous driving**.





GLOSA as an energy keeper technology

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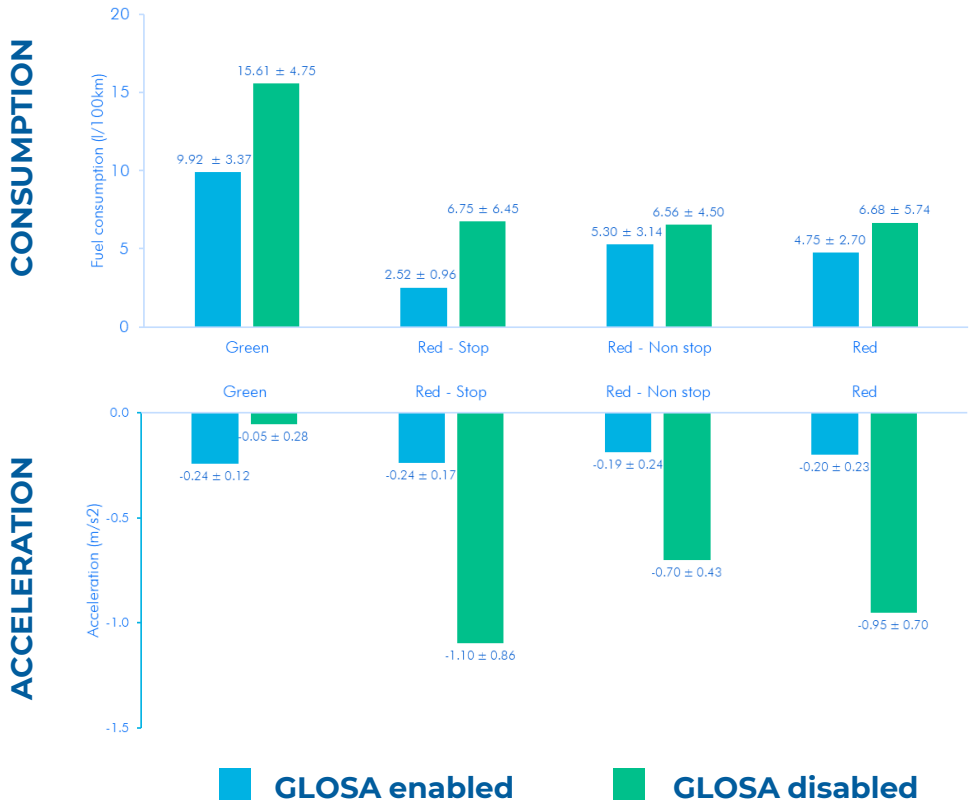


BRAKING

Table 47 The SPTI helps to reduce hard braking (red – green)

Collective	Baseline	Experimental	Variation	Result
Bus	No data to obtain this KPI			
Particular	5.8 %	5.0 %	-13 %	✓
Taxi	3.1 %	2.6 %	-16 %	✓

ACCELERATION

Table 48 The SPTI helps to reduce hard acceleration (green – red)

Collective	Baseline	Experimental	Variation	Result
Bus	No data to obtain this KPI			
Particular	3.6 %	0.9 %	- 75 %	✓
Taxi	4.3 %	2.3 %	- 46 %	✓

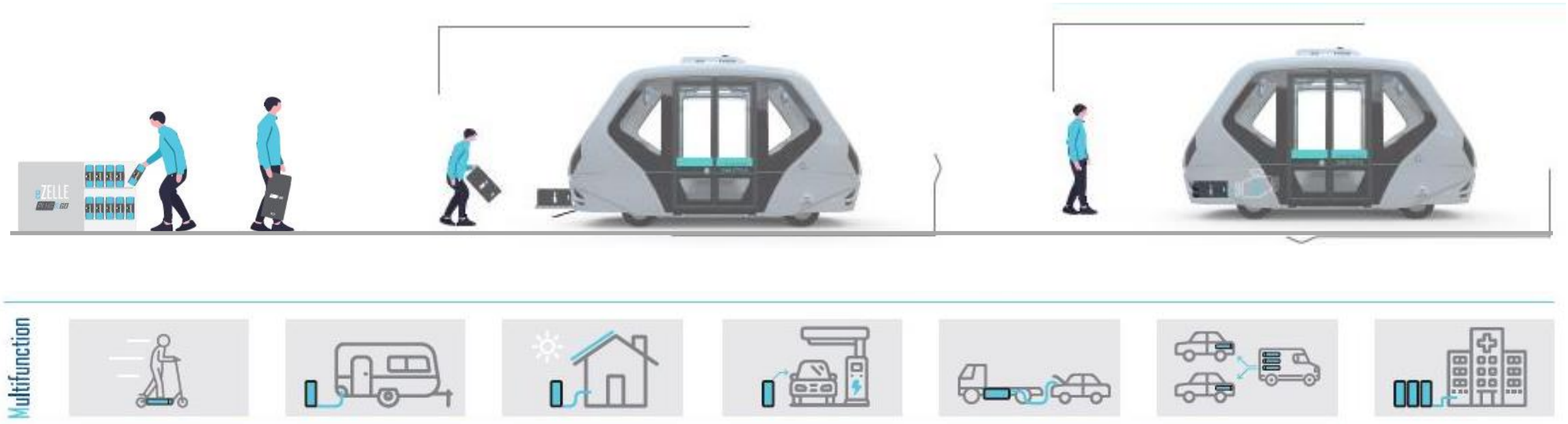
e-Zelles, a new approach to modular batteries

e-Zelles is a **concept** in development that consists of the creation of a **modular system** of interchangeable batteries managed by an **Energy Planner** that **adjusts the energy demand** according to the circumstances and **activates the interchangeable batteries to improve autonomy**.

- *Remove 48V eZelles*2,5KWh modules.*
- *Up to 15kw of extended power allowing an increased range of 50 km.*
- *Can be combined with fast charging to reduce stop times.*
- *Compact format : easily manageable and interchangeable.*
- *Optimal thermal performance.*

e-Zelles, a new approach to modular batteries

The system will use **vehicle information to optimize energy distribution**, ensuring precise and adaptive management for efficient driving. However, given its nature, the system is being designed so that it can be a **useful response in other mobility contexts** and enhance energy multimodality.



Thank You

- Francisco Sánchez Pons -