



JORNADAS SOBRE MOVILIDAD URBANA GIJÓN

2018/06/11

Tendencias de futuro del ferrocarril como transporte urbano

1. CAF AT A GLANCE

Comprehensive Solutions

CAF has an extensive experience in the execution of complex integral railway transportation projects worldwide

Some references:



Mexico City



Toluca



Kaohsiung



Saragossa



Rolling Stock

High Speed Trains



Regional Trains



Commuter Trains



Metros



LRVs & Tram-Trains



Trams & Light Metros



Locomotives



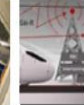
Coaches



Signalling

Infrastructure and on-board signalling systems:

- ERTMS 1 and 2
- Mass transit signalling solution (metro and tramway)
- Computer based interlocking (CBI)
- Centralised railway traffic centres



Maintenance / Refurbishment / Operation

- Infrastructure and rolling stock maintenance
- Spare parts supply
- Commercial service operation



Critical Equipment Supplies

Wheelsets and their parts

- Complete wheelset
- Wheels
- Axles
- Gearboxes
- Couplers
- After Sales



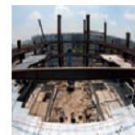
Traction & Communication Equipment

- Electric Traction Systems
- Electric DC Traction Converter
- Electric AC Traction Converter
- Locomotive Traction Converter



Civil Works EPC

- Platform construction
- Construction and refurbishment of classic and elastic rails
- Railway terminals and stations
- Railway bridges
- Railway yard, maintenance workshops, centralised traffic control and services building
- Power substations



Power Supply

Electrification of the lines:
-Engineering, Design, Technical Service, Works Management and Commissioning for railway superstructure and infrastructure projects.



Other Electromechanical Systems

- Systems for stations and tunnels:
- Video-surveillance systems (CCTV)
 - Remote control and command systems
 - Internal communication systems
 - Ticketing



**Simulation Systems
Documentation Management
Testing, etc.**

1. CAF AT A GLANCE

Worldwide projects

operating in more than 40 countries across 5 continents

Integrated offering

providing a one-stop solution for railway systems

Employing 7,581 staff

of which c.30% is highly qualified ⁽¹⁾

Strong R&D and Engineering capabilities

more than 850 people



Revenue
€1.3bn

EBITDA/Margin
€166m/12.9%

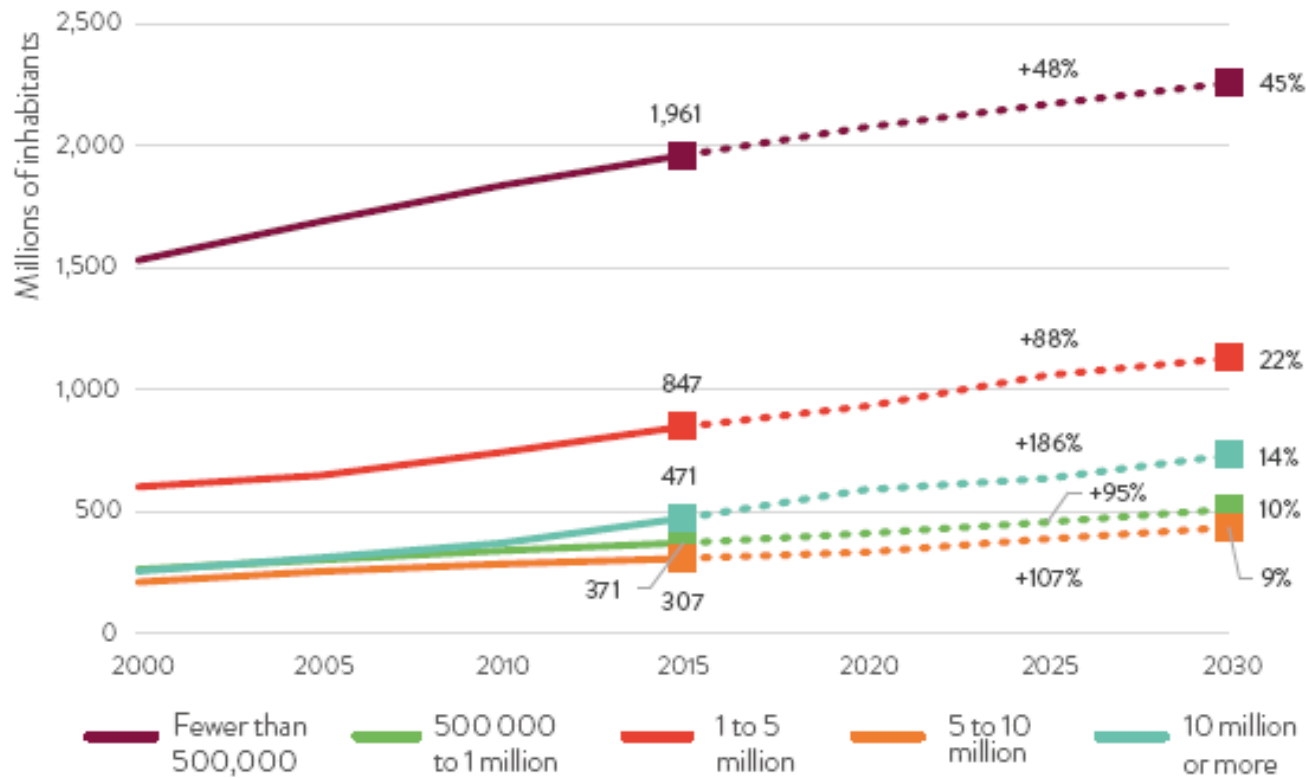
Order Backlog
€4.9bn

International as %
of Revenue
80%

Note: Data as of 31 December 2015
(1) i.e. engineers and other university degree holders

2. URBAN TRANSPORT TODAY

Urban population according to city sizes 2000-2030



Source: UITP

Larger metropolitan areas are likely to drive the development of new public transport infrastructure

2. URBAN TRANSPORT TODAY



Source: <http://catalystreview.net/>



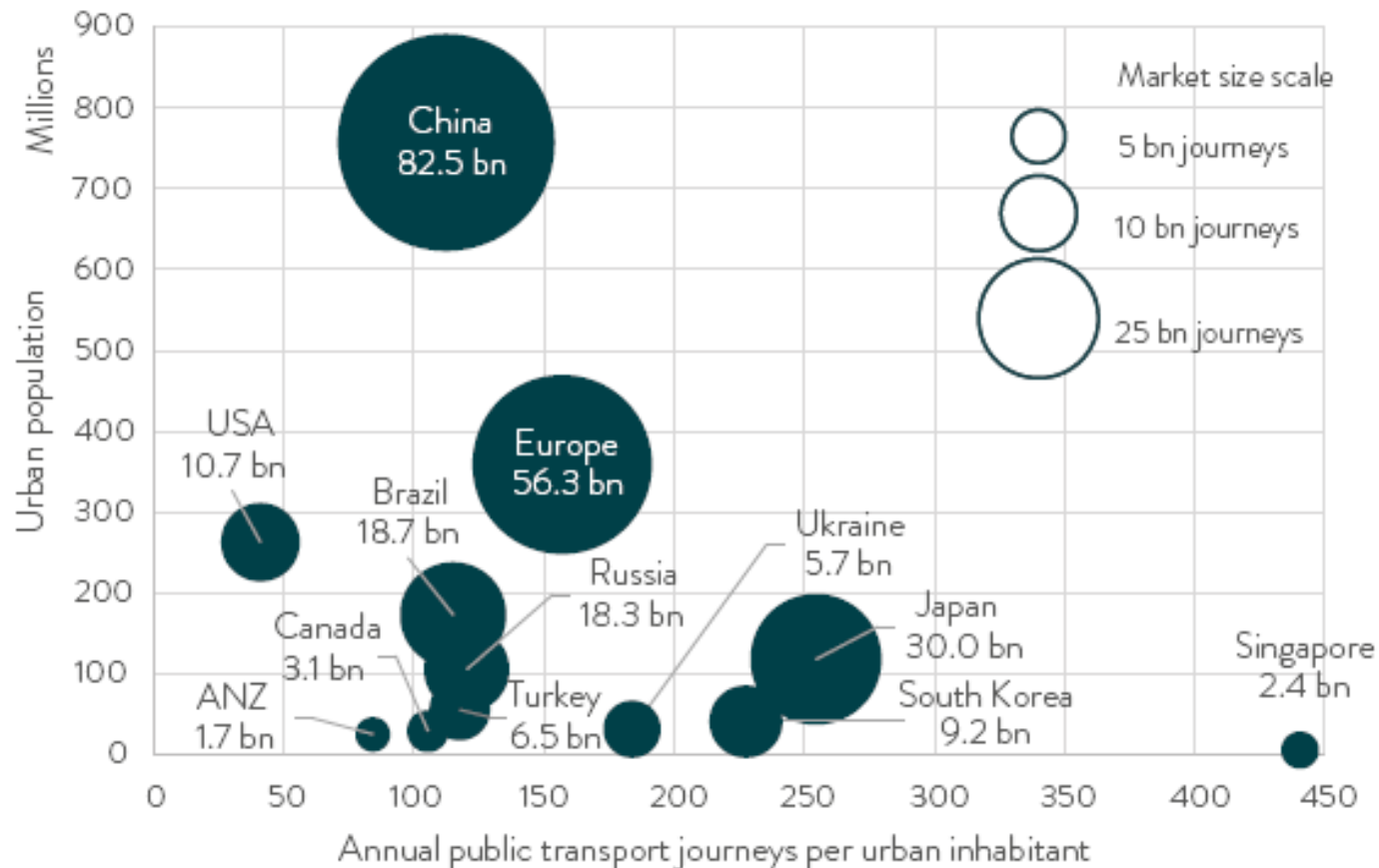
Shanghai 1990



Shanghai 2010

2. URBAN TRANSPORT TODAY

Average rate of public transport usage



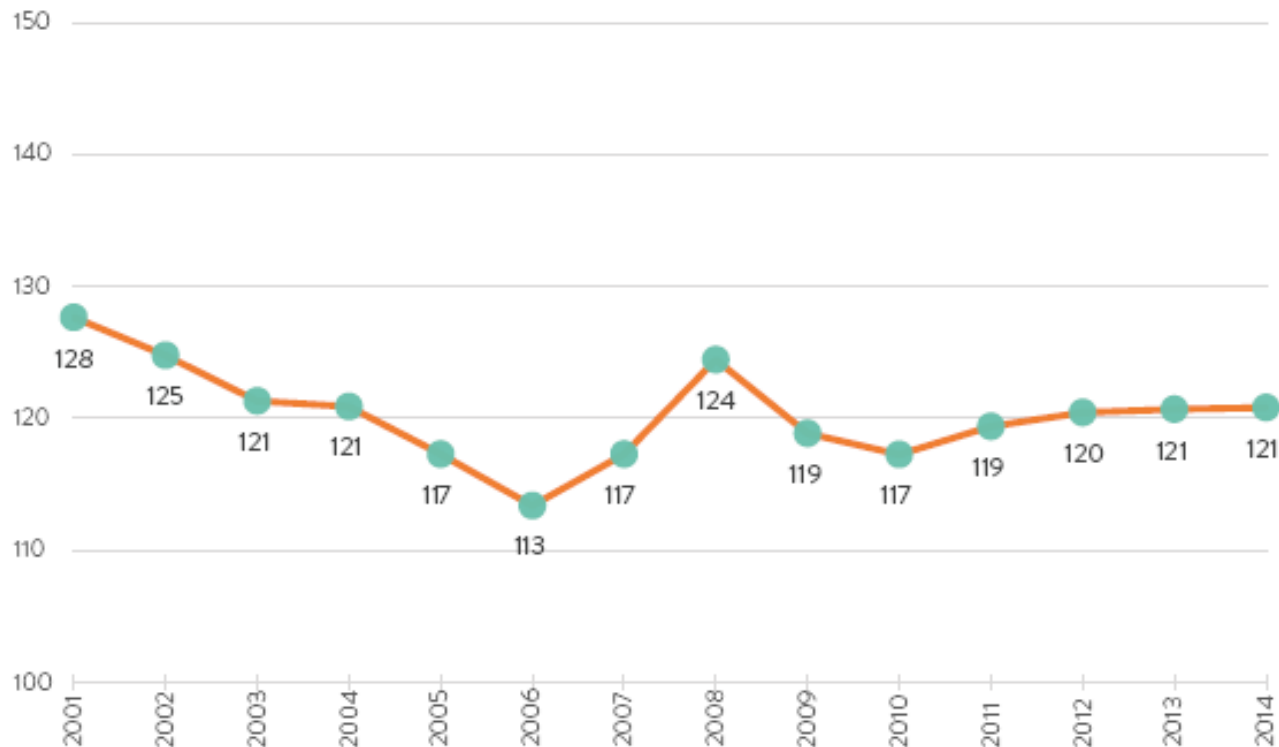
37 countries

Average usage:
124 trips/year

Source: UITP

2. URBAN TRANSPORT TODAY

Average rate of public transport usage

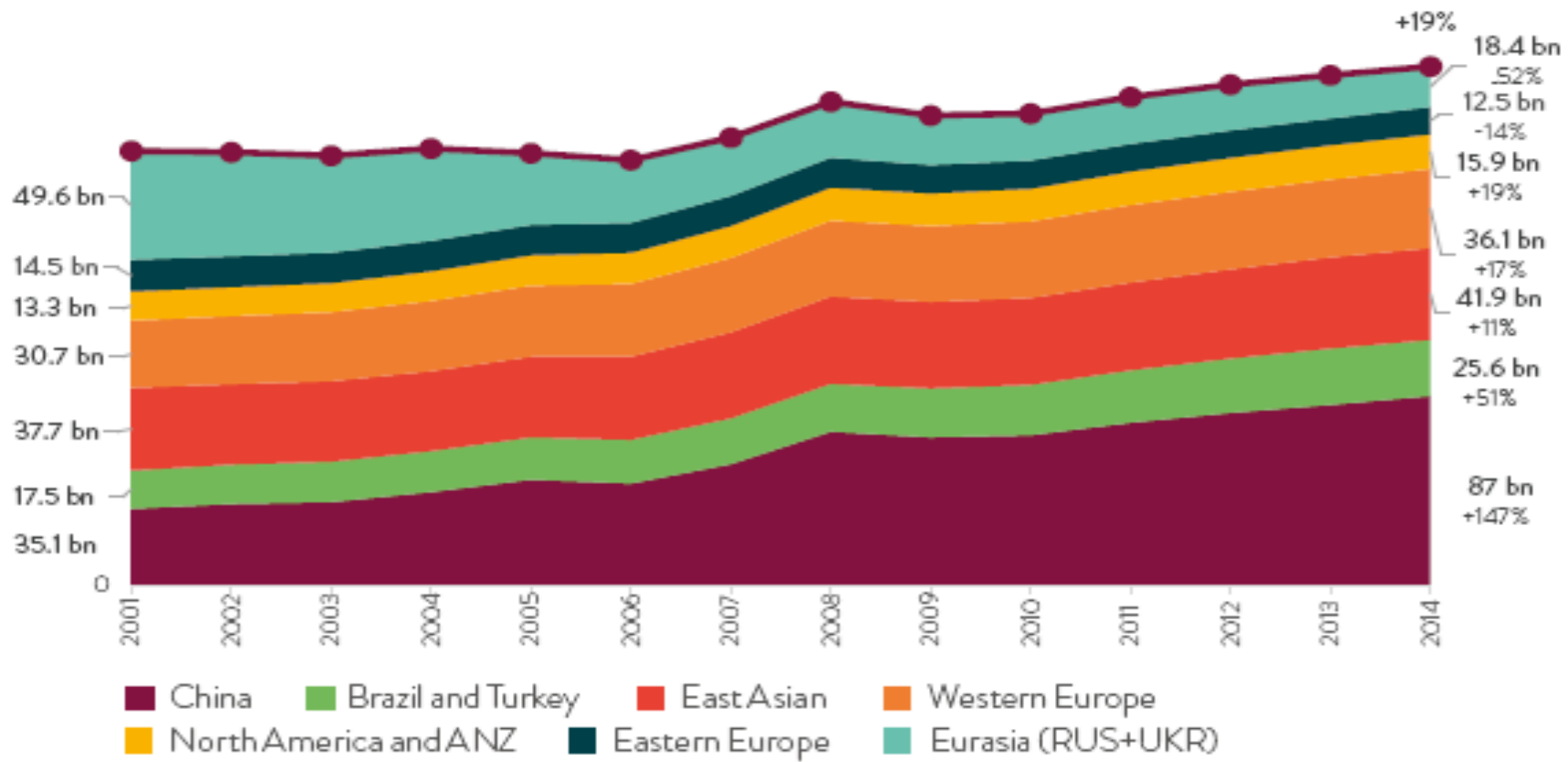


Source: UITP

People generally make fewer trips when economy is contracting, irrespective of transport mode

2. URBAN TRANSPORT TODAY

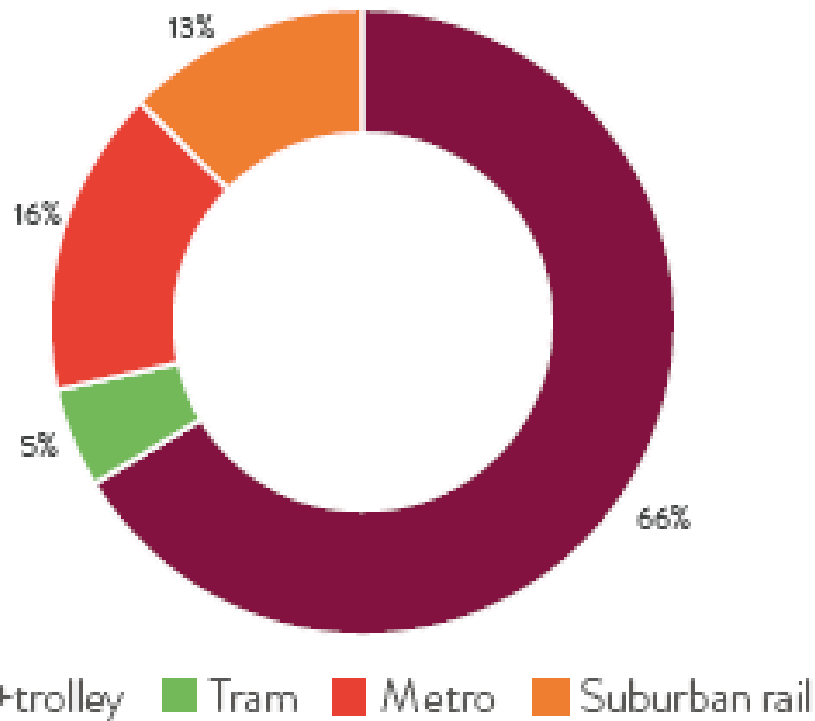
Evolution of public transport demand



Source: UITP

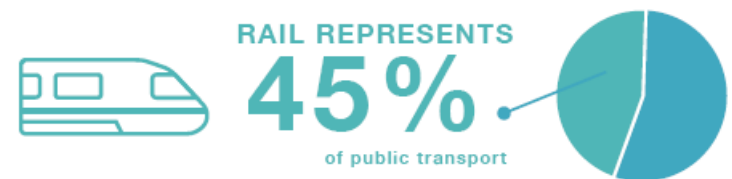
2. URBAN TRANSPORT TODAY

Modal breakdown of public transport (2014)



Source: UITP

In European metropolitan areas, **400 billion trips** are made each year: 15% by public transport, 30% by non-motorised means and 55% by private car. Rail represents 45% of public transport.



2. URBAN TRANSPORT TODAY



Starbucks partners with Lyft through its loyalty scheme 'Starbucks Rewards'

Alternate-day car ban in Delhi to reduce air pollution

Test phase of WEPod, the first driverless bus in the Netherlands

US National Highway Transportation Safety Administration (NHTSA) recognises the internal computer in Google's self-driving car as the 'driver' of the vehicle



Marrakesh tests electric buses, a first for Africa



Apple invests \$1 billion in Chinese ride-hailing company Didi



CarPostal debuts its pilot operation of autonomous shuttle buses in Sion, Switzerland

Moscow opens its Central Circle line, one of the largest PPP suburban rail schemes in the world. By 2020, it will be 54km long with 31 interchange stations



Paris uses an odd-even number plate rule to fight pollution

2. URBAN TRANSPORT TODAY

MAIN CHALLENGES



2. URBAN TRANSPORT TODAY

MAIN CHALLENGES



3. RAILWAYS TODAY

- First known electric locomotive was built in 1837, powered by galvanic cells
- The first electric passenger train was presented by Werner von Siemens at Berlin in 1879



➔ 300 m circular track

- The world's first electric tram line operated in Sestroretsk – 1880
- The first electrically-worked underground line was opened in London - 1890

3. RAILWAYS TODAY

- The first practical AC electric locomotive working for Oerlikon, Zürich in 1896
- Italian railways were the first in the world to introduce electric traction for the entire length of a main line in 1902 (106 Km)



- Massive electrification of mainline railways in 1950-1980
- Development of high speed railways 1980-2015

3. RAILWAYS TODAY

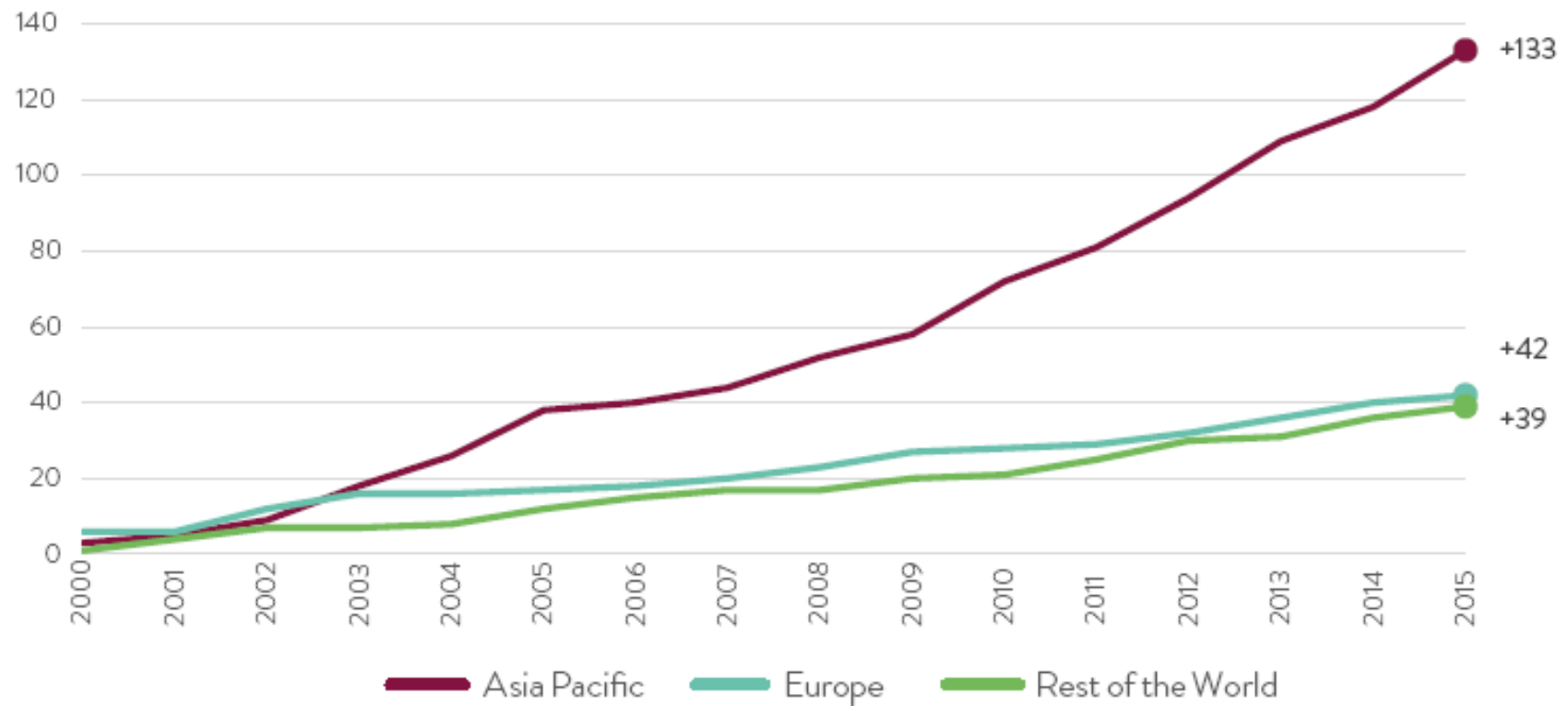
Metro lines worldwide (2014)

Region	Ridership (billions)	Number of cities	Number of lines	Infrastructure length (km)
Asia-Pacific	25.9	54	202	5,119
Europe	9.9	46	165	2,820
Latin America	5.3	18	51	858
Eurasia	4.9	16	44	781
North America	3.4	16	76	1,481
MENA	1.9	7	13	298
World total	51.3	157	551	11,357

Source: UITP

3. RAILWAYS TODAY

Number of new metro lines opened since 2000



Source: UITP

3. RAILWAYS TODAY

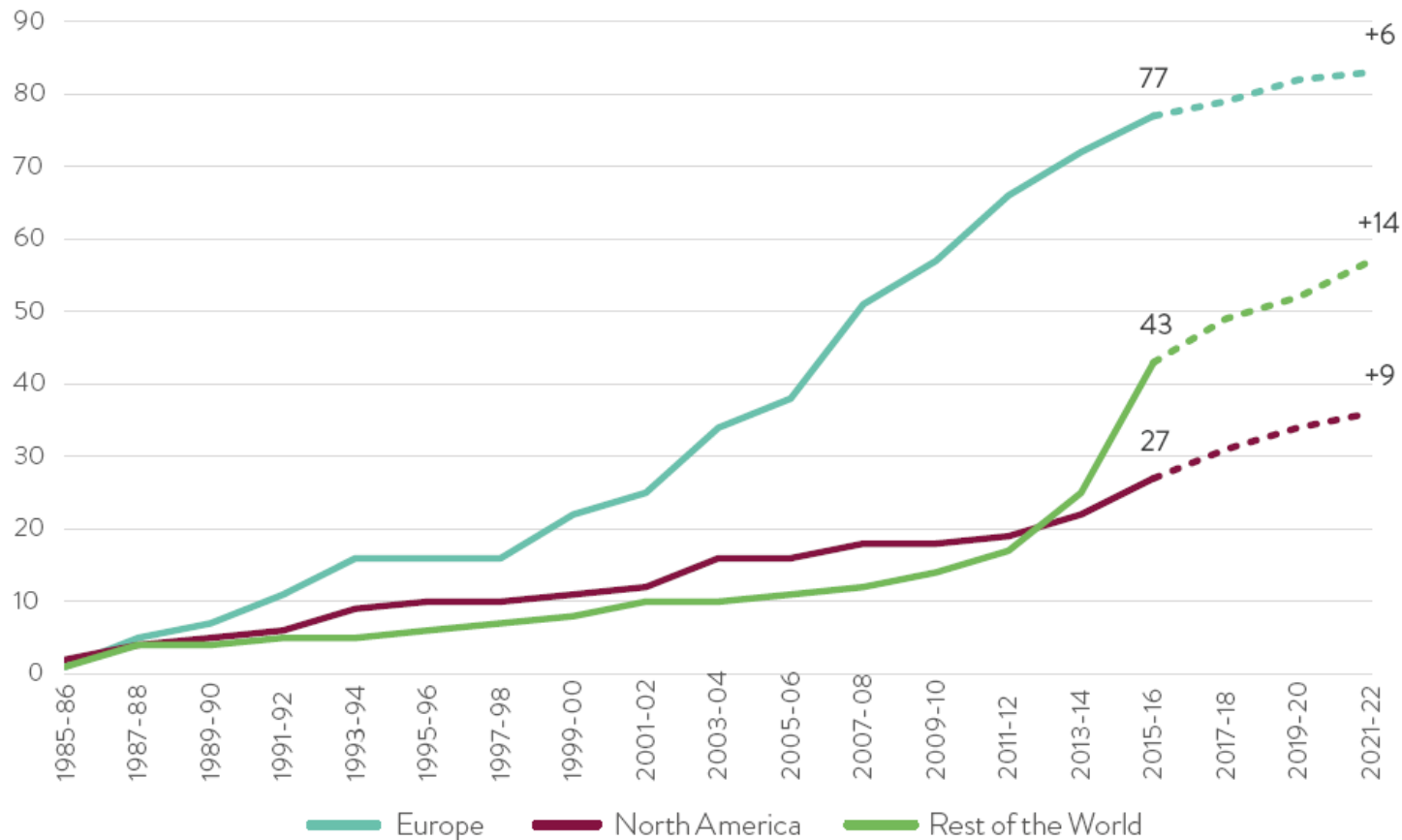
Tram and LRT lines worldwide (2014)

Region	Ridership (millions)	Number of cities	Number of lines	Infrastructure length (km)
Europe	8,825	206	1,277	8,954
Eurasia	3,135	93	744	3,855
Asia-Pacific	720	41	144	1,016
North America	711	36	106	1,525
MENA	324	9	36	226
Latin America	0.6	2	2	20
Africa	n/a	1	2	34
World total	13,716	388	2,311	15,630

Source: UITP

3. RAILWAYS TODAY

Evolution of new tramway lines opened since 1985



Source: UITP

3. RAILWAYS TODAY

Rail is the safest form of land transport, having the lowest risk of death and serious injury: rail is **1.5 times safer** than travel by long-distance **coach** and **24 times safer** than travelling by **car**. Similarly, **tramways** are **6 times safer than cars** in terms of accidents.

8,9

BILLION PASSENGERS
COMMUTER RAIL



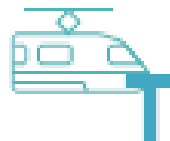
9,5

BILLION PASSENGERS
METRO



8,5

BILLION PASSENGERS
TRAM & LIGHT RAIL



EACH YEAR

YOUR SAFETY IS OUR TOP PRIORITY

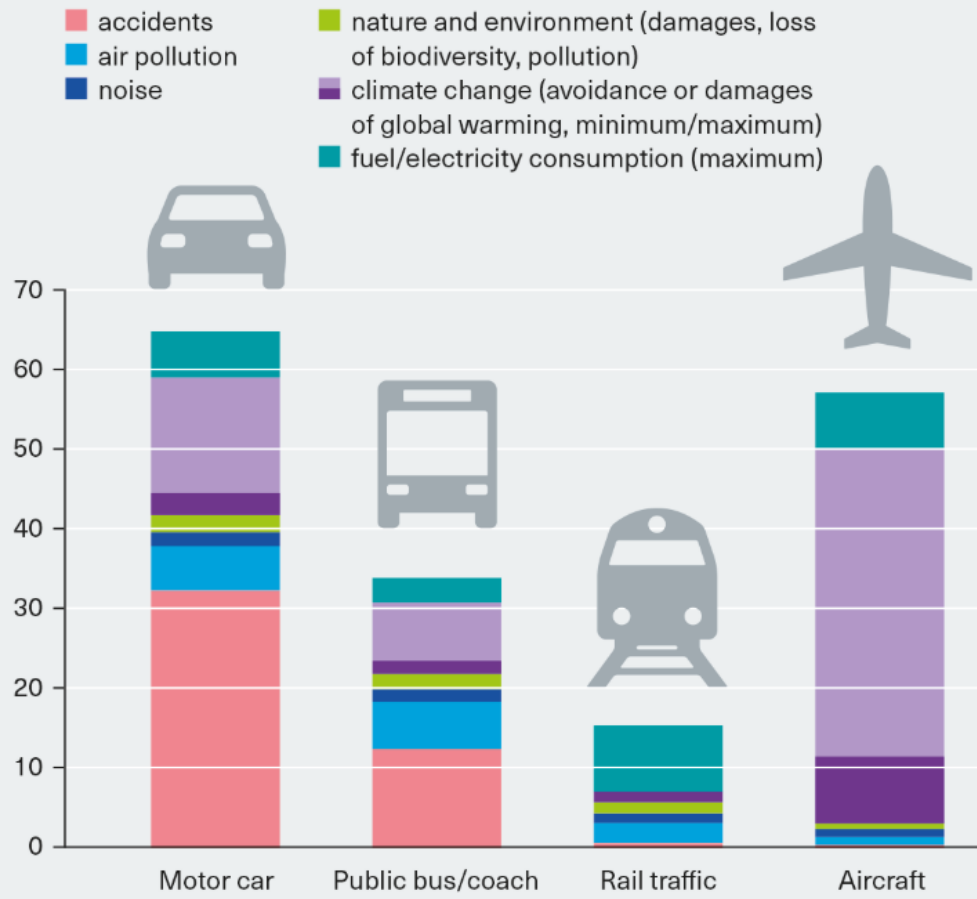
- Always be alert and aware around all railroad tracks and crossings.
- Drivers should never stop on the tracks.
- Do not walk on the railroad tracks. It is unsafe and illegal.
- In Quiet Zones, train horns will not sound at crossings, unless there is an emergency. Stay alert.



3. RAILWAYS TODAY

HIDDEN COSTS

Euro per person and 1,000 kilometres in the EU, air traffic: inner-European flights, 2008



Source: CE Delft et al

Rail transport is recognised as the most environmentally friendly form of **mass transport**. Its sustainability comes from:

- Low levels of atmospheric emissions compared to automotive and air transport
- Widespread use of electric traction
- Low energy consumption due to low friction between rail and wheel
- Relatively small land use of its infrastructure
- Moving large volumes of people and goods over long distances.

Average consumption of 0.12 kWh per passenger-km

7 times more energy efficient per passenger than car travel in cities

4. RAILWAYS TOMORROW



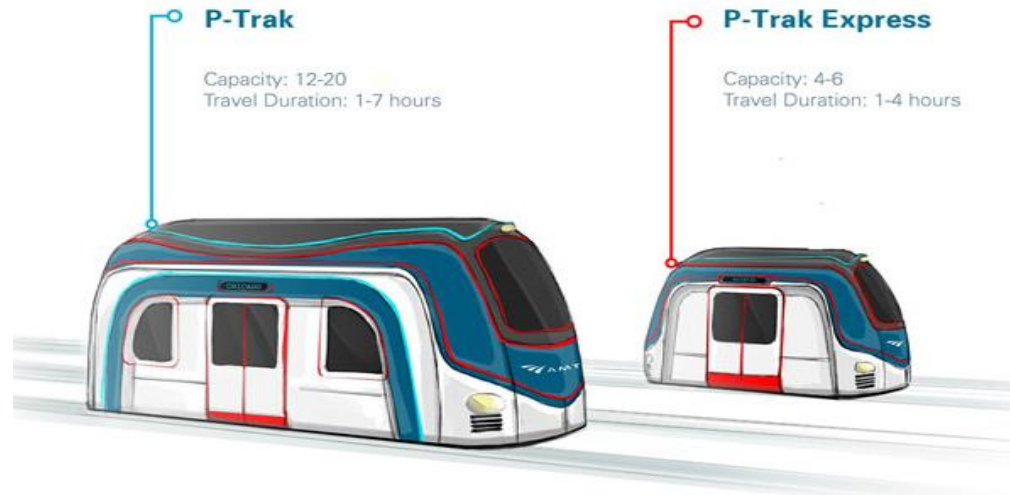
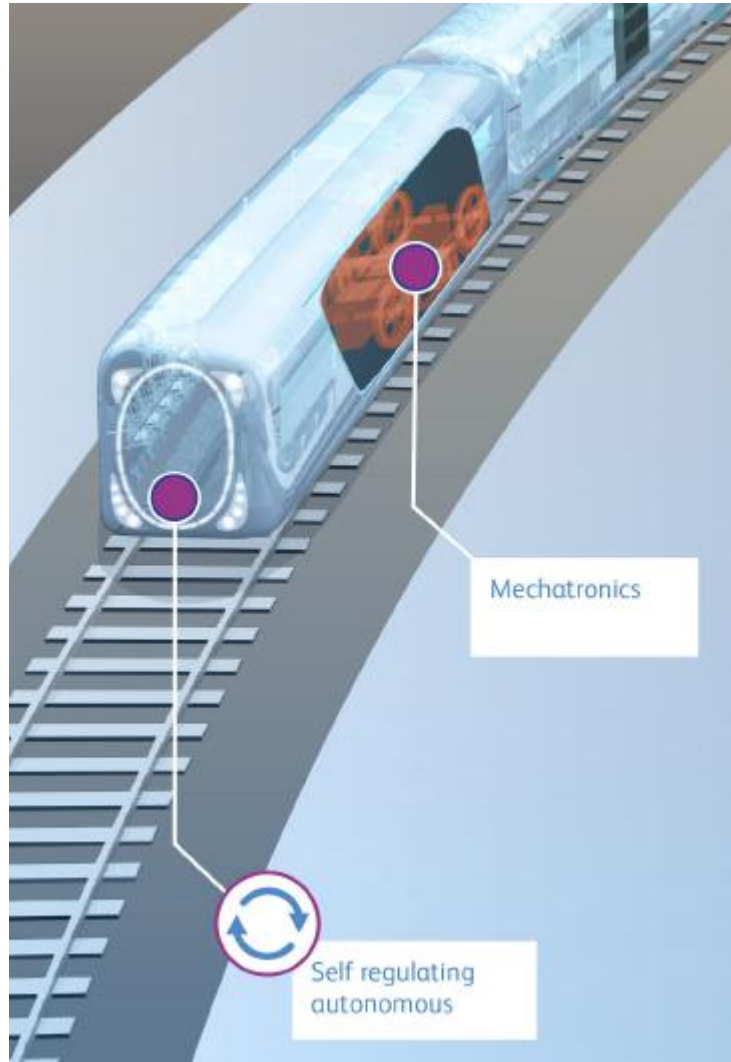
Visions for
2050

Source ARUP

4. RAILWAYS TOMORROW

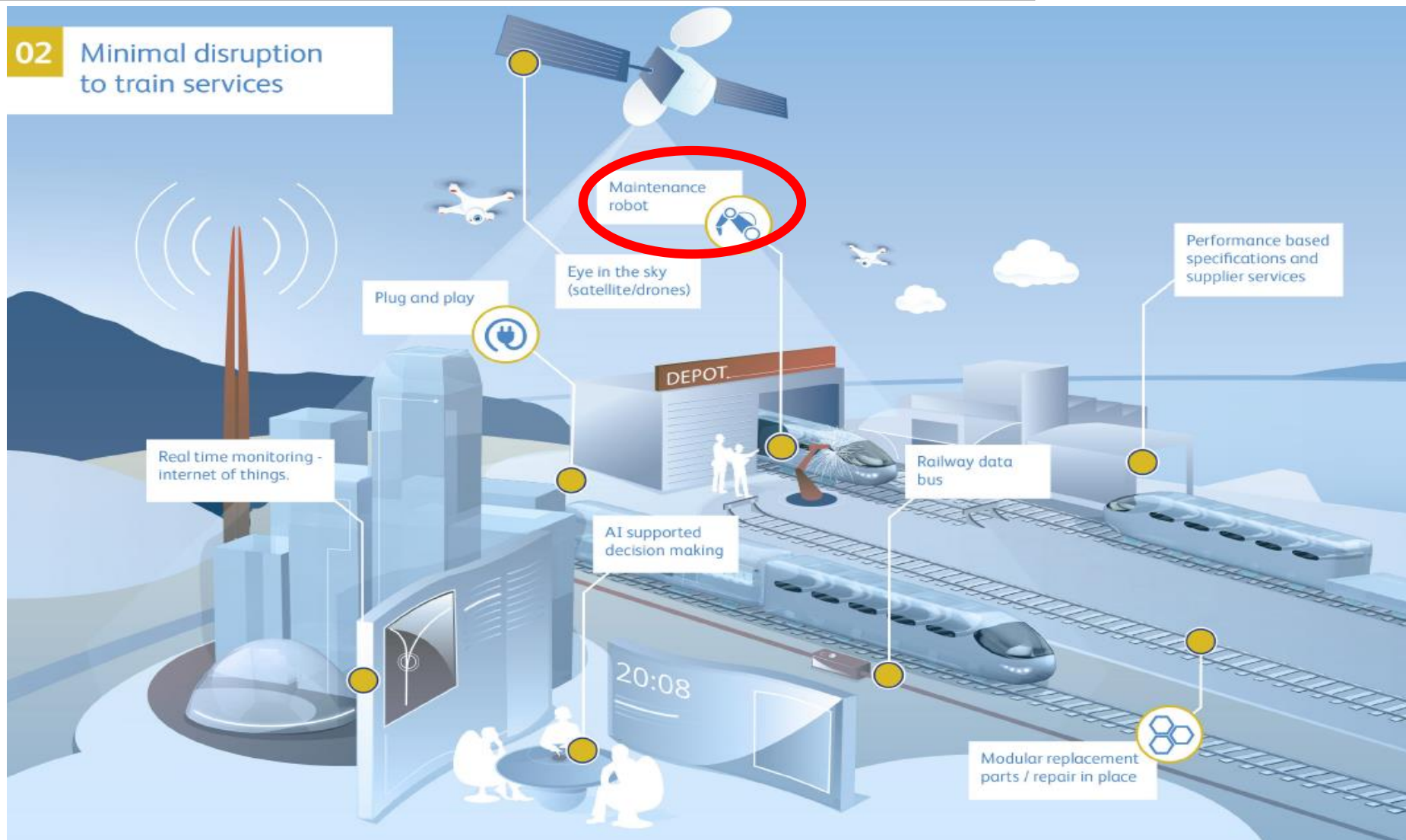


4. RAILWAYS TOMORROW



4. RAILWAYS TOMORROW

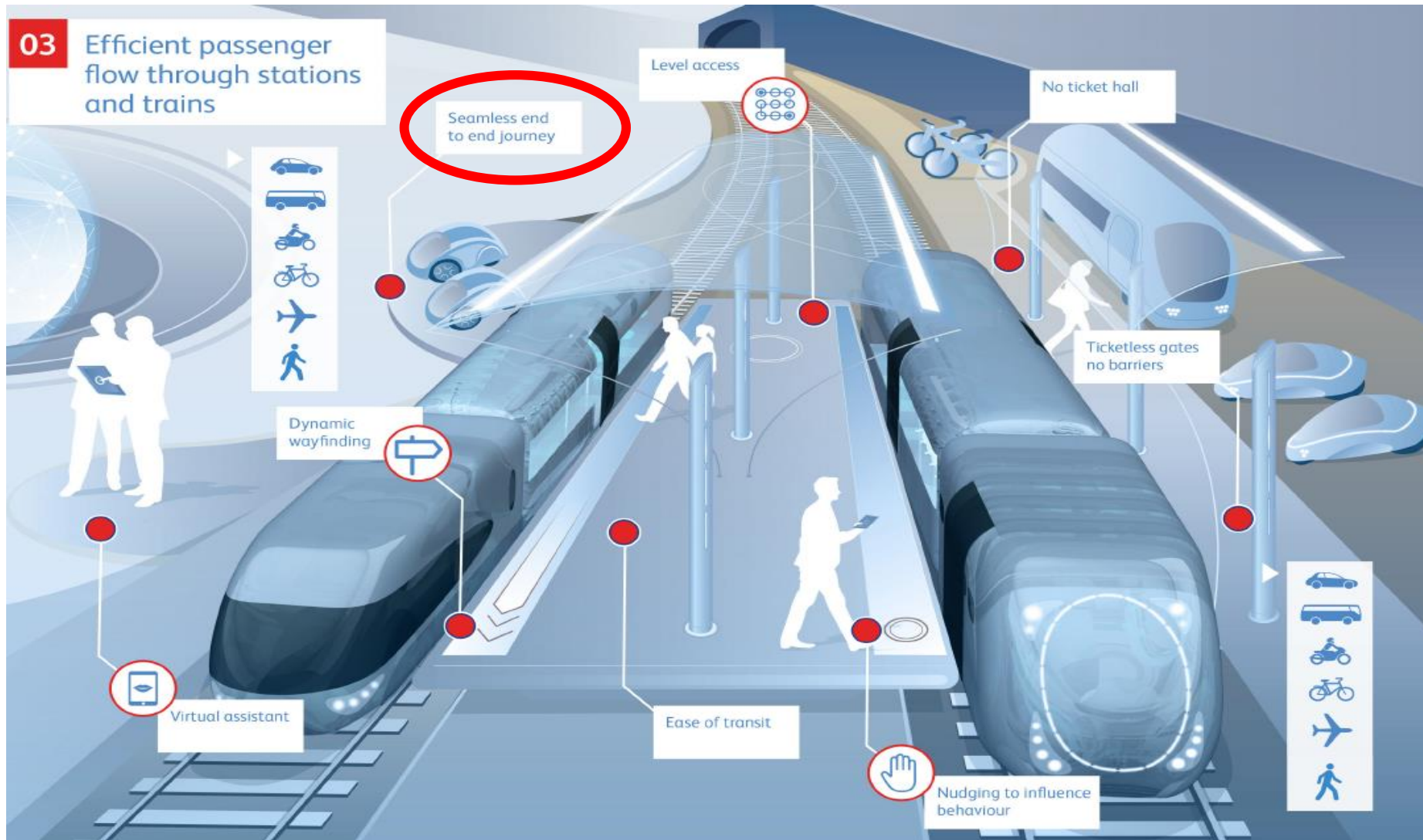
02 Minimal disruption to train services



4. RAILWAYS TOMORROW



4. RAILWAYS TOMORROW



4. RAILWAYS TOMORROW

Autonomous vehicles will only help to meet public policy goals if they come as shared fleets integrated with public transport

Autonomous vehicles

Shared fleet of vehicles

- + Strong reduction in number of cars (reduced car ownership, effective use of cars as they operate most time of the day)
- + Drastically improved mobility for people that do not own a car

Privately owned cars



- ⊖ No effect on car ownership
- ⊖ No effect on number of parked cars (cars unused most of the day)
- ⊖ No effects on costs /km
- ⊖ No effects on mobility for people that do not own a car
- ⊖ Even more car traffic (as it is even more comfortable and attractive to go by car)

> Unsustainable, even more car traffic

Fleet cars COMPETING with traditional public transport services



- + Street reclaiming (less parked cars)
- + Improved access to public transport
- + Improved mobility for people that do not own a car
- ⊖ More traffic (strong increase in Vehicle Miles Traveled - VMT)
- ⊖ Inefficiency (small vehicles replacing buses and trains)
- ⊖ Passenger loss for traditional public transport walking and cycling

> Better mobility, less efficiency

Fleet cars INTEGRATED with traditional public transport services

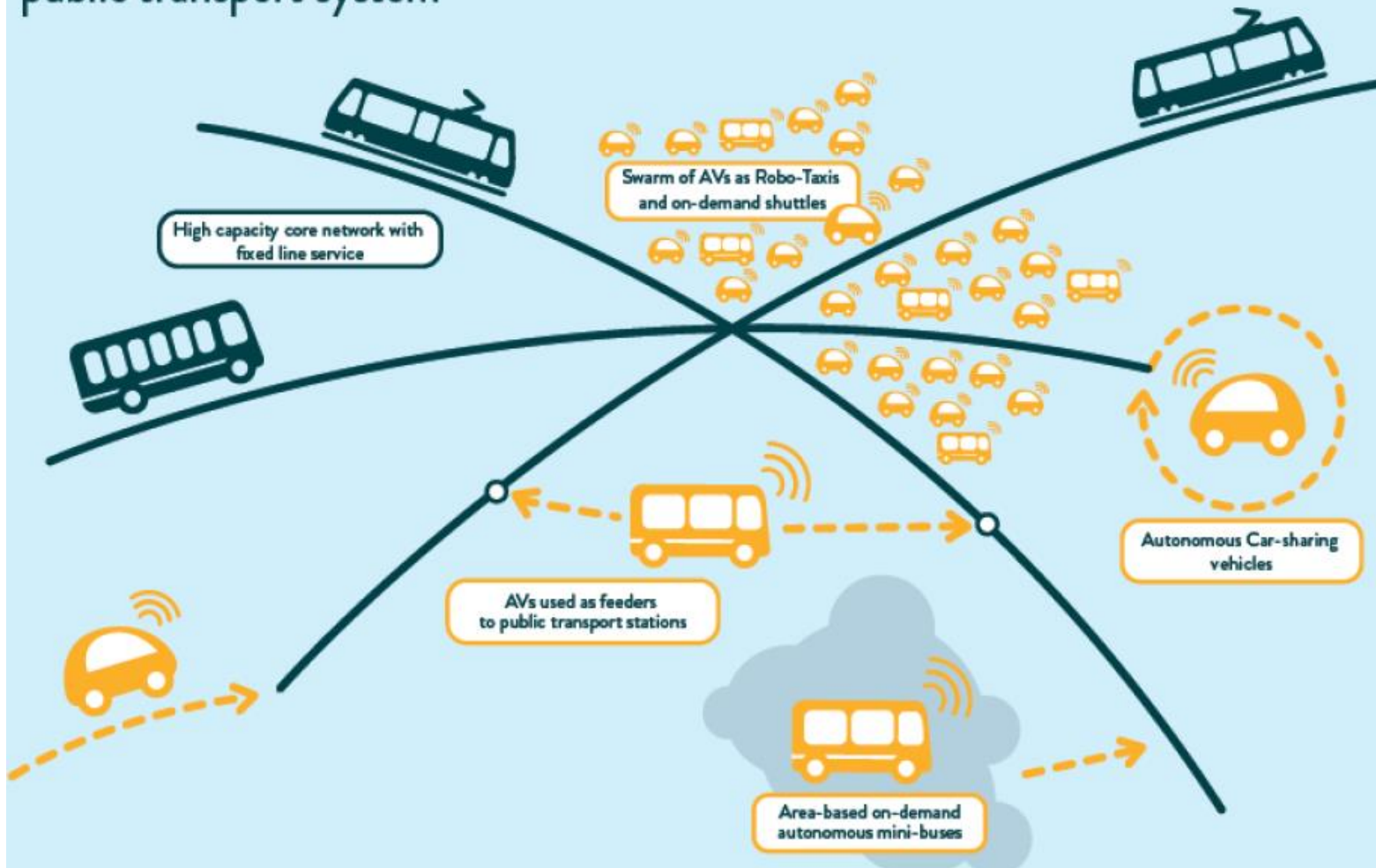


- + Large scale street reclaiming
- + Highly improved access to public transport
- + Highly improved mobility for people that do not own a car
- + Strong decrease in VMT
- + High gain of efficiency (large and small vehicles perfectly mixed)
- + Low costs/km

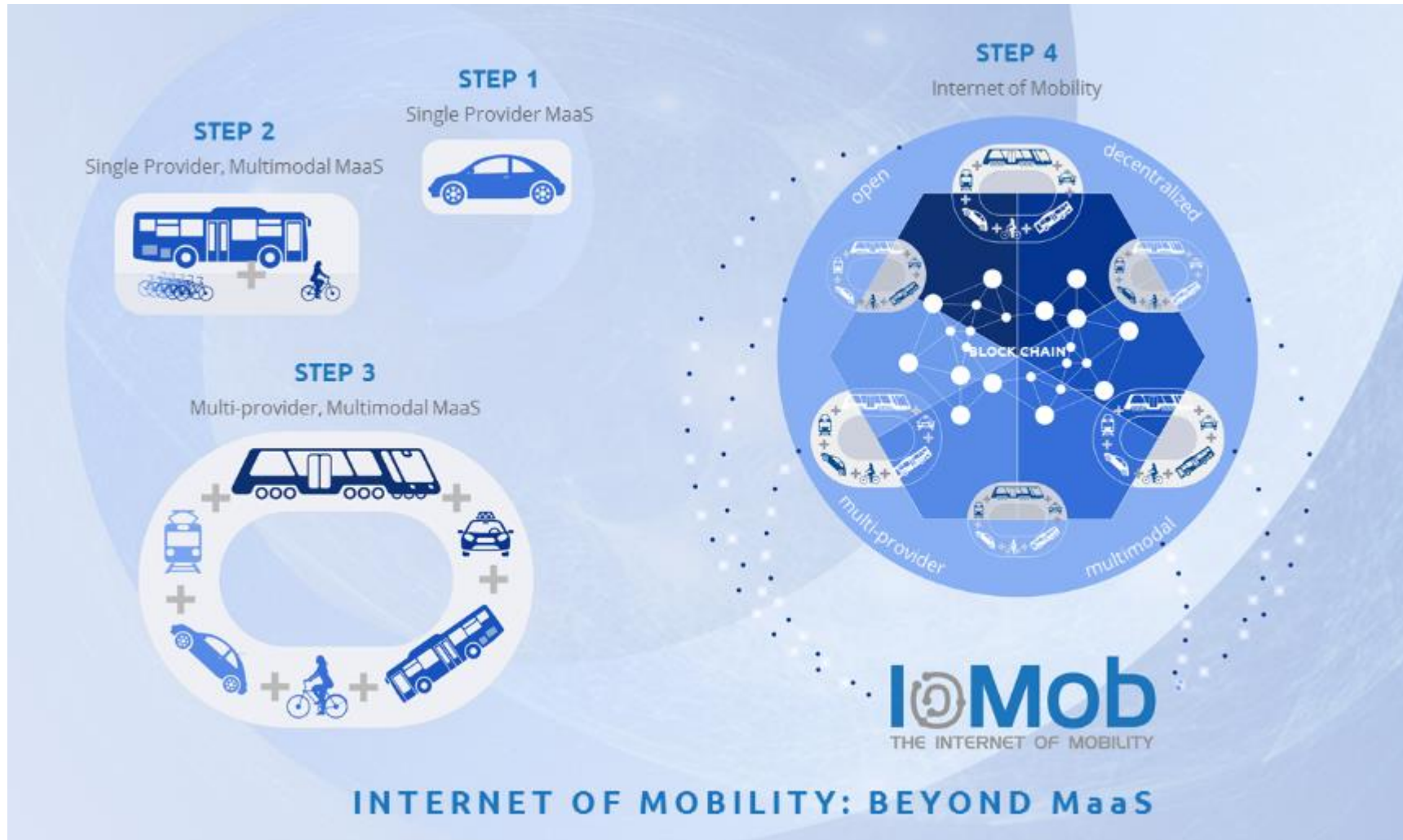
> Sustainable, better mobility and equity

4. RAILWAYS TOMORROW

Possible applications of autonomous vehicles (AVs) as part of a diversified public transport system



4. RAILWAYS TOMORROW



4. RAILWAYS TOMORROW

04 More value from data



4. RAILWAYS TOMORROW

Power equipment monitoring system

Forecast contact wire wear

Monitoring data can be used to forecast future contact wire wear and assess the timing of maintenance

Forecast data for XX years in the future

Collect data on the condition of the contact wires

Perform frequent monitoring using in-service commuter trains. Height, deviation and wear of contact wires, pantograph bounce arc, pantograph collision...

Monitor data

Equipment maintenance work



Forecast contact wire wear

Identify causes of sectional wearing

Forecast data for XX years in the future

Excessive deviation

Excessive pitch

Making decision concerning equipment maintenance work



Reduce deviation Adjust height variations

Smart mobile ticketing

10010
01101
10010



Biometric permission to travel

4. RAILWAYS TOMORROW

05 Optimum energy use



Battery/Dual power systems

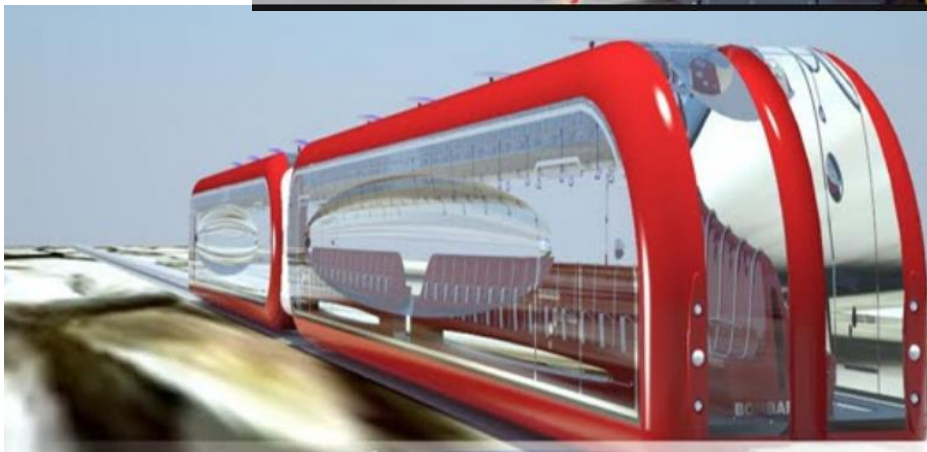
Sustainable energy solutions

Optimising energy

Smart grid technologies

Transferring energy

4. RAILWAYS TOMORROW



4. RAILWAYS TOMORROW



Gracias por su atención

