

Which evolution and technological solutions for sustainable land transport systems / Quale evoluzione e soluzioni tecnologiche per i trasporti terrestri sostenibili

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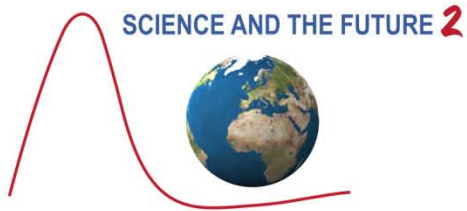
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SCIENCE AND THE FUTURE 2



TORINO, 12 - 16 NOVEMBRE 2018

CONTRADDIZIONI E SFIDE **CONTRADICTIONS AND CHALLENGES**



**Quale evoluzione e soluzioni tecnologiche per i
trasporti terrestri sostenibili**

*Which evolution and technological solutions for
sustainable land transport systems*

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15.11.2018

RÉSUMÉ



1. How are **mobility and traffic are evolving**, in general?
2. What do mobility and logistics **ask for** today, in terms of general trends?
3. Which are the **constraints** – namely in terms of sustainability (CC) - for transport systems in this 1st half of XXI century?
4. The expected **solutions** for transport within **urban contexts**
5. The expected solutions for **extra-urban transport systems**



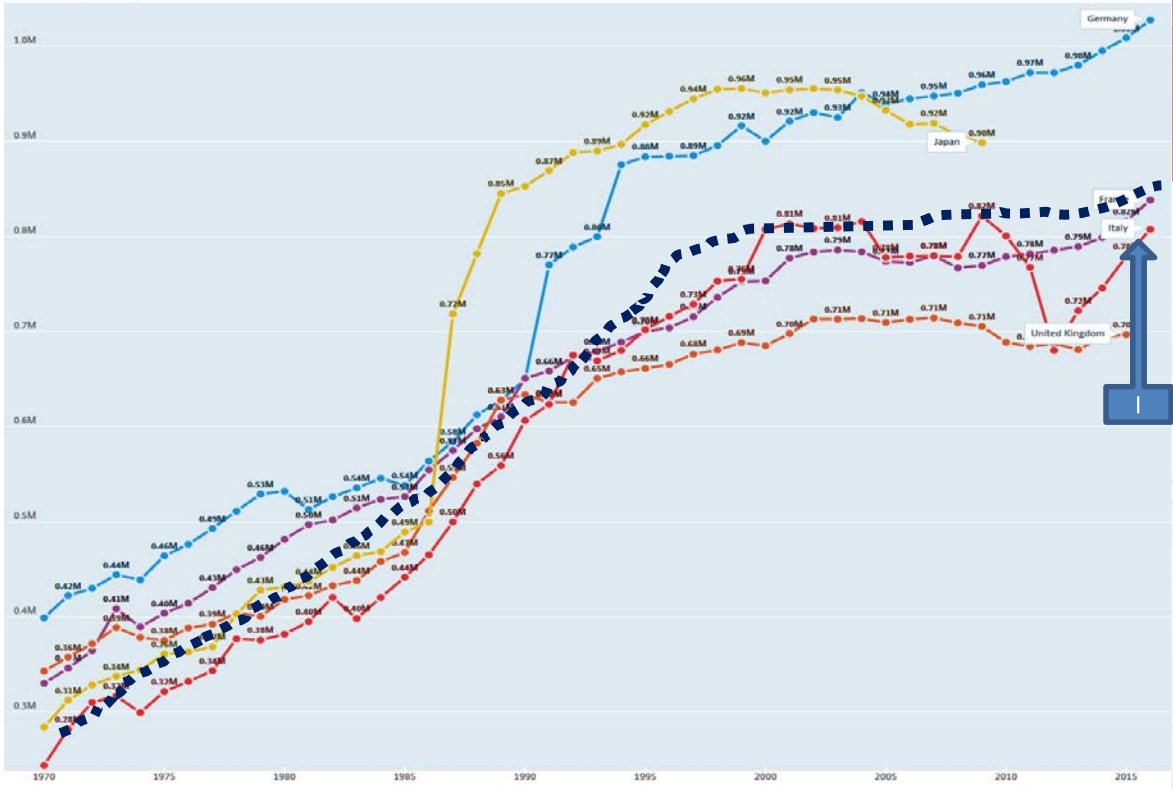
👉 The **conclusions** resume the **technological solutions** that can be expected according to the premises, therefore *compliant with present and expected environmental constraints and goals.*

1/6 How are mobility and traffic evolving?

- Trends during last century and beginning of the XXI
- Motionless communications
- Daily use of automobiles



Passenger transport Road, Million passenger-kilometres, 1970 – 2016



Trends in daily mobility

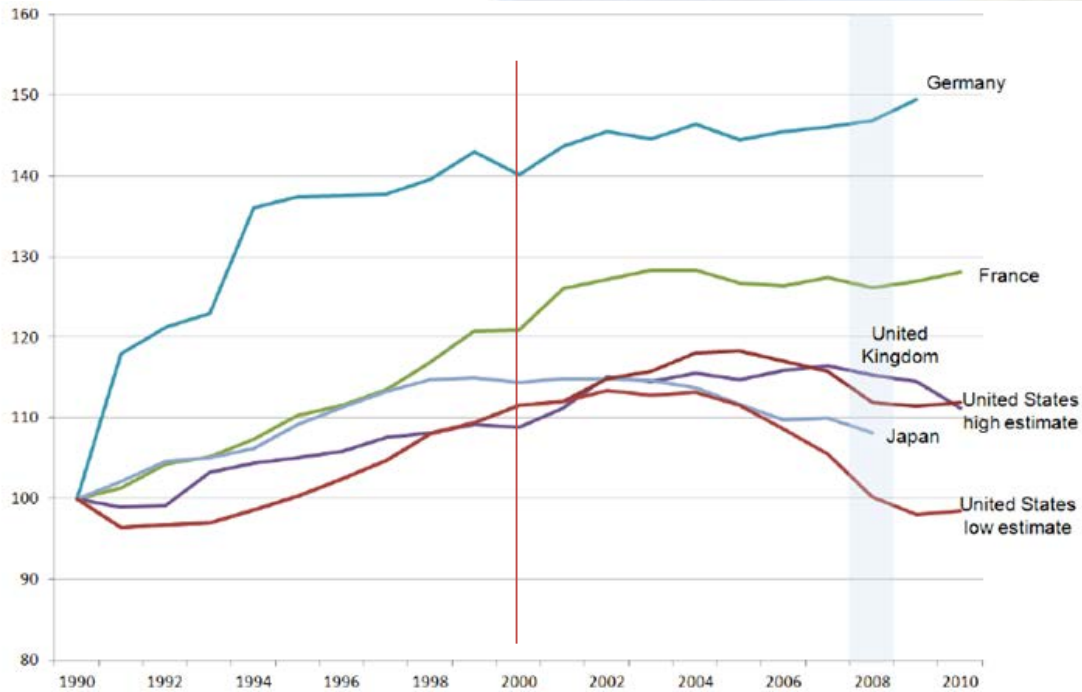
Million passenger kilometres travelled by road, passenger transport, 1970-2015 (OECD, 2018).

- Population
- Supply: road, rail transport

1970

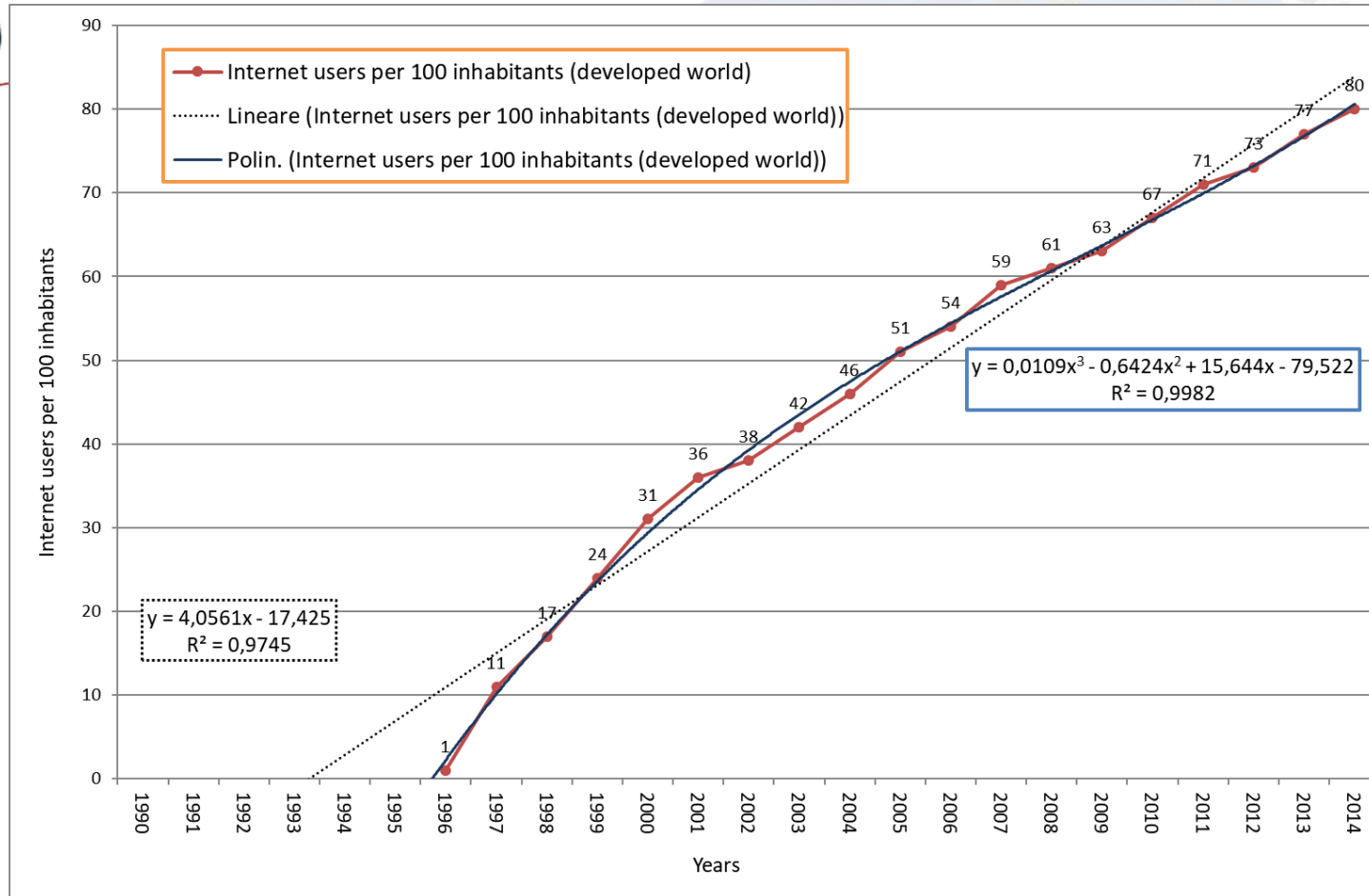
2000

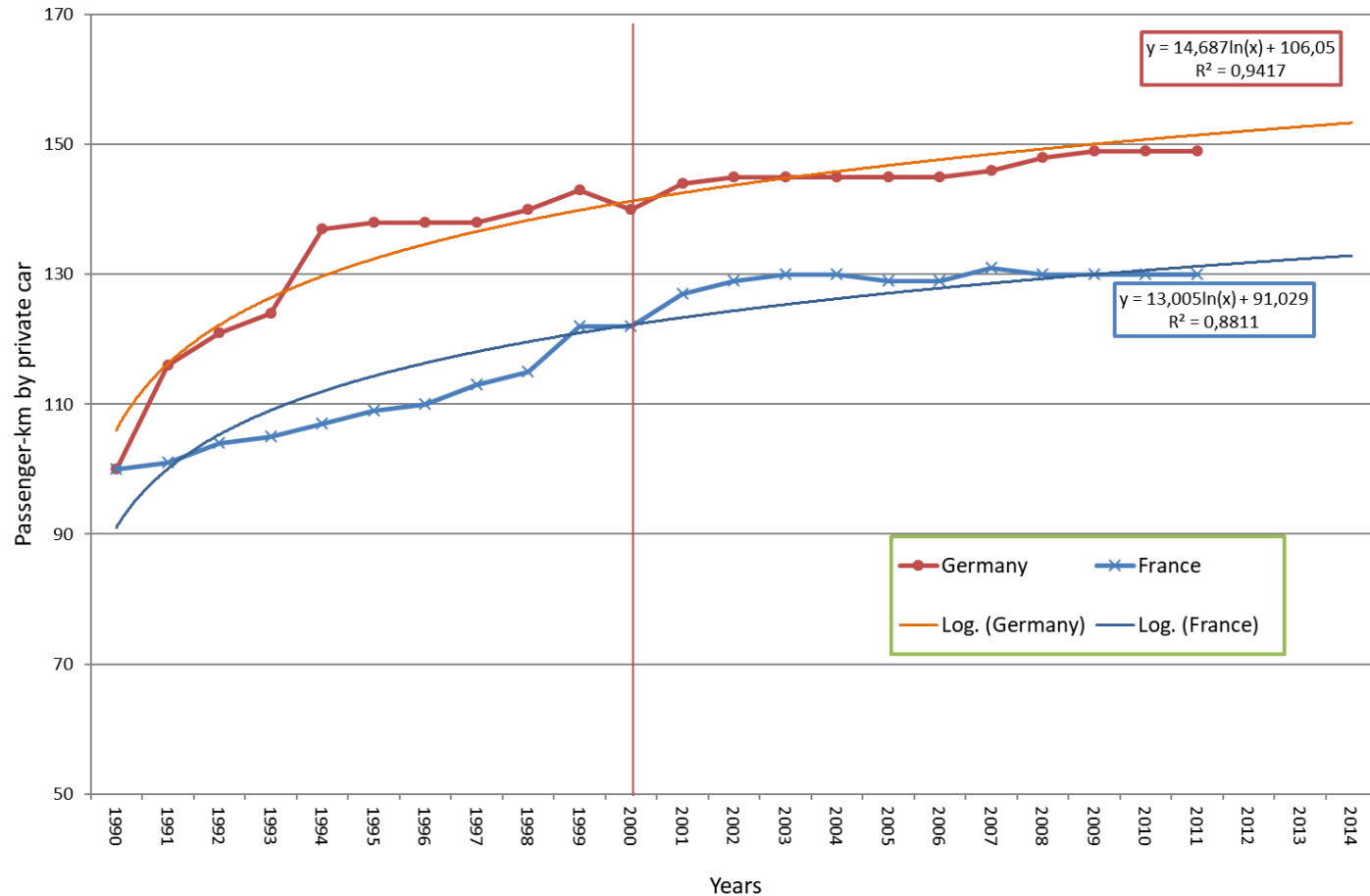
2015



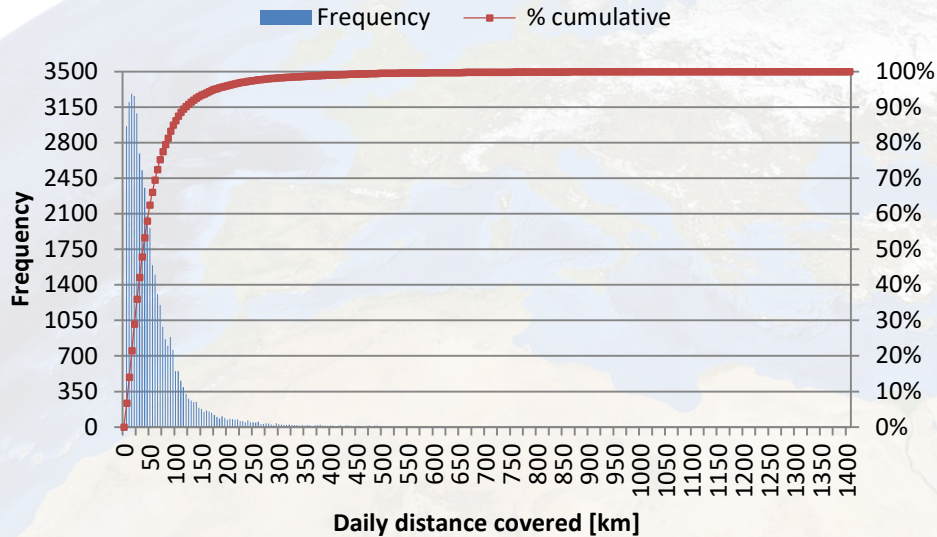
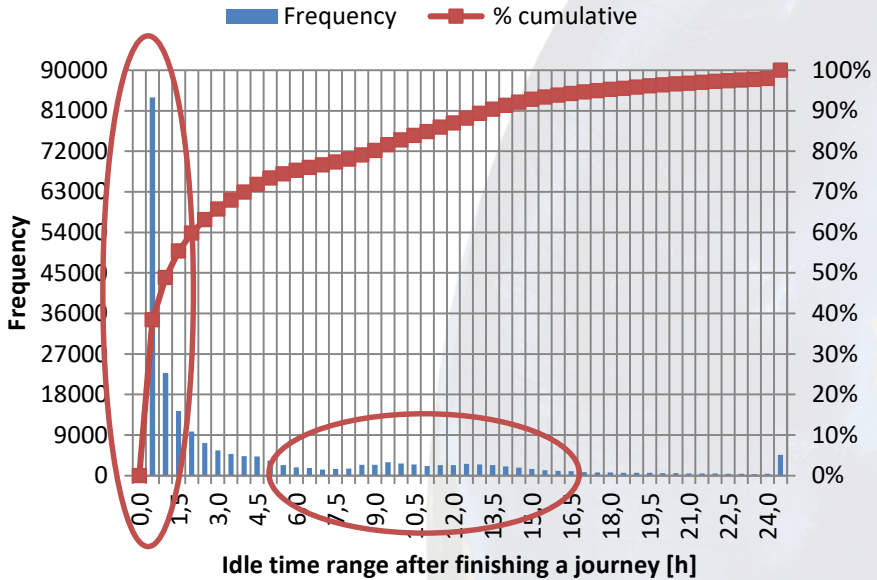
*Trends
in daily
mobility*

Source: ITF statistics; the high estimate for the USA assumes car occupancy rates remain at the level measured in 2001, and the low one that they decline as of 2001 to the level observed in the most recent household travel survey.





Idle time after finishing a trip for all the driving cycles.



Frequency [#days] of the daily distance covered over all the driving cycles (contexts) for all the trips.

2/6 What do mobility and logistics ask for today

- **Efficiency**

- **Quality**

- **Safety-security**

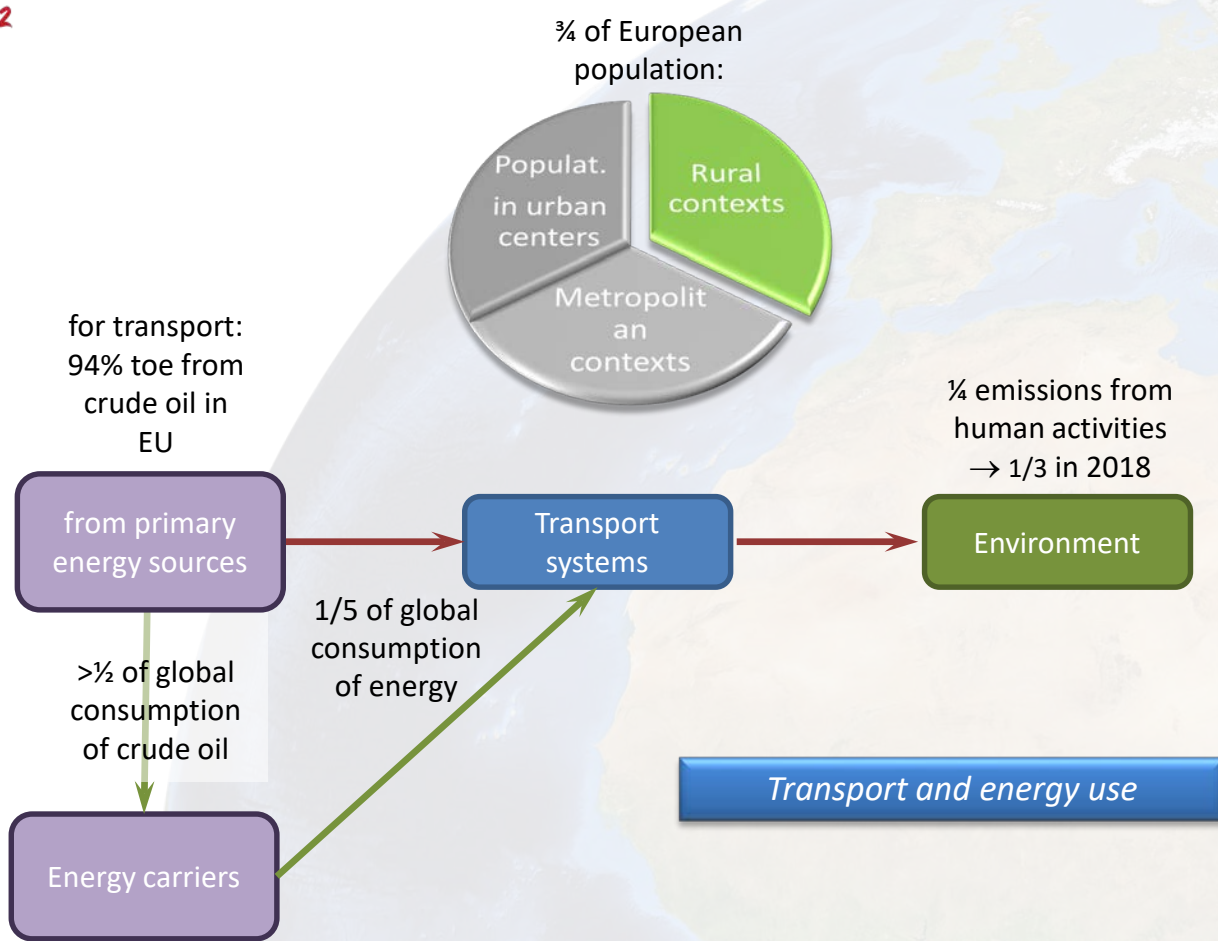
- **“Green” (hybridisation, decarb./electrif., well used PT)**

- **Connected vehicles, flexible modal choice**

- **Assisted driving, transport systems operating on fixed guideways**

Climate change





3/6 Constraints for transport systems in this 1st half of XXI century

- European, in general
- European, automotive
- European, urban pollution

Transport and emissions: general situation EU in various fields (not only transport systems)



CO₂

-40% on 1990
levels by 2030



Renewables

27% by 2030
(some inputs also on 30%)



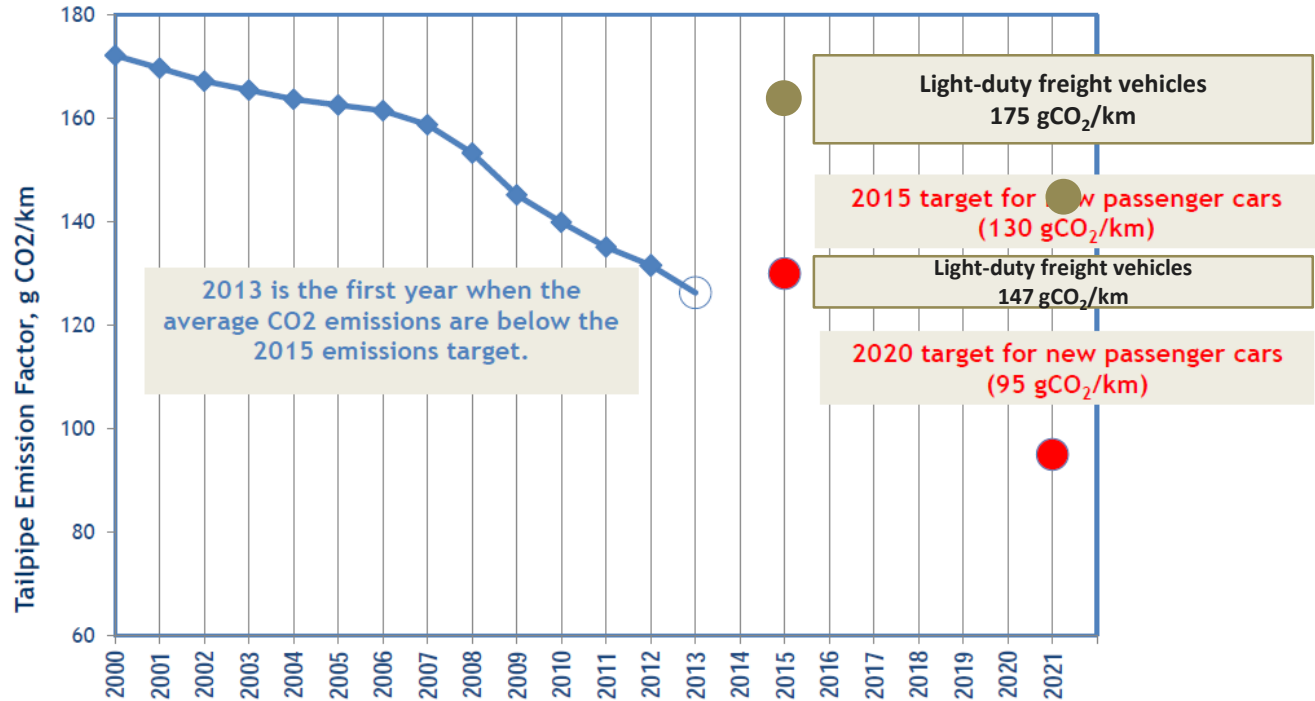
Energy efficiency

27% by 2030
(some inputs up to 38% at
2050)





UE - Emissioni medie CO2 delle vetture nuove immatricolate
 EU - Monitoring CO2 emissions from new passenger cars



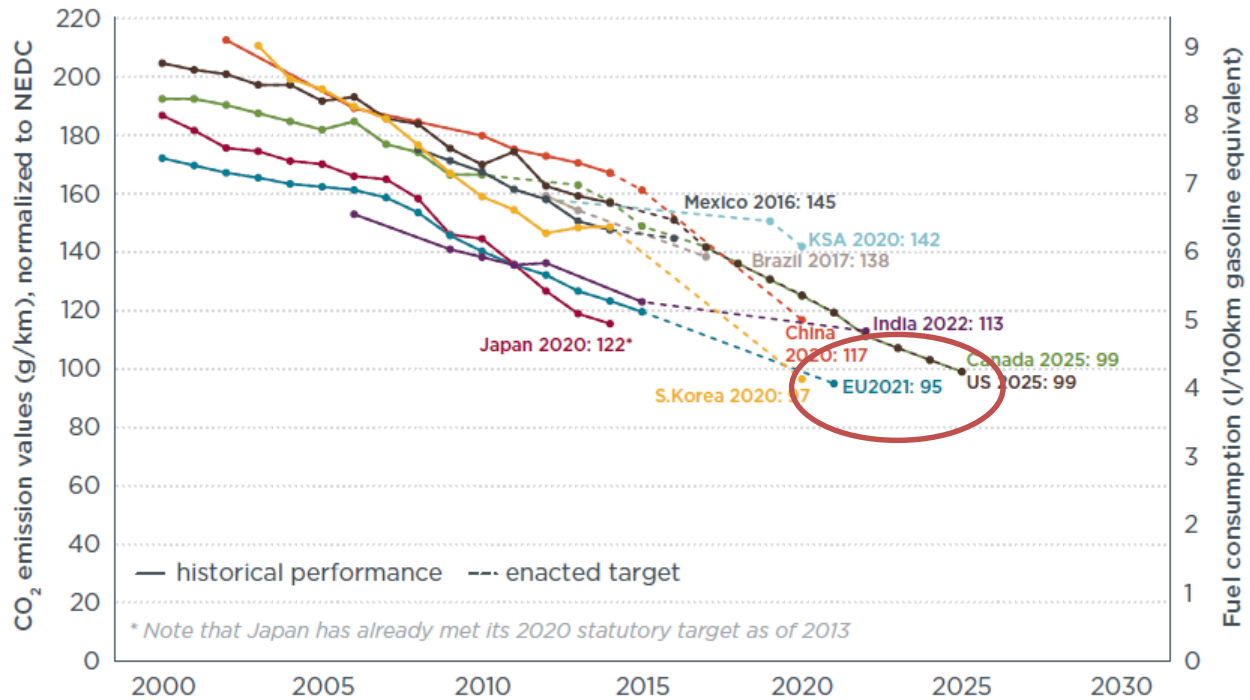
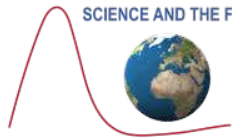


Figure 3. Comparison of global CO₂ regulations for new passenger cars.⁸



<i>Pollutant</i>	<i>Concentration</i>	<i>Averaging period</i>	<i>Legal nature</i>	<i>Permitted exceedences each year</i>
Fine particles (PM2.5)	25 µg/m ³ ***	1 year	Target value entered into force 1.1.2010 Limit value enters into force 1.1.2015	n/a
Sulphur dioxide (SO ₂)	350 µg/m ³	1 hour	Limit value entered into force 1.1.2005	24
	125 µg/ m ³	24 hours	Limit value entered into force 1.1.2005	3
Nitrogen dioxide (NO ₂)	200 µg/ m ³	1 hour	Limit value entered into force 1.1.2010	18
	40 µg/ m ³	1 year	Limit value entered into force 1.1.2010*	n/a
PM ₁₀	50 µg/m ³	24 hours	Limit value entered into force 1.1.2005**	35
	40 µg/m ³	1 year	Limit value entered into force 1.1.2005**	n/a
Lead (Pb)	0.5 µg/m ³	1 year	Limit value entered into force 1.1.2005 (or 1.1.2010 in the immediate vicinity of specific, notified industrial sources; and a 1.0 µg/m ³ limit value applied from 1.1.2005 to 31.12.2009)	n/a
Carbon monoxide (CO)	10 mg/m ³	Maximum daily 8 hour mean	Limit value entered into force 1.1.2005	n/a
Benzene	5 µg/m ³	1 year	Limit value entered into force 1.1.2010**	n/a
Ozone	120 µg/m ³	Maximum daily 8 hour mean	Target value entered into force 1.1.2010	25 days averaged over 3 years
Arsenic (As)	6 ng/m ³	1 year	Target value enters into force 31.12.2012	n/a
Cadmium (Cd)	5 ng/m ³	1 year	Target value enters into force 31.12.2012	n/a
Nickel (Ni)	20 ng/m ³	1 year	Target value enters into force 31.12.2012	n/a
Polycyclic Aromatic Hydrocarbons	1 ng/m ³ (expressed as concentration of Benzo(a)pyrene)	1 year	Target value enters into force 31.12.2012	n/a

4/6 Expected transport solutions for urban contexts

Some European cities, 1900



Milan



Paris

London

A REACHED **AIM**
OF THE EUROPEAN
SOCIETY

**DIFFUSED
MOTORISATION**

Nowadays frequently
REGULATED, CONTROLLED
ELECTRIFIED (fixed guideway)

Same cities, today



Some EU cities, today



Technological solutions

**Automated
Undergrounds**
(> ~10 k pp/h x d)
and People Movers
(< ~10 k pp/h x d)

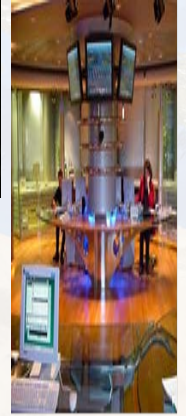
**Flexible mobility
through
Intelligent transport
systems (ITS)**

**More oil-
independent
vehicles and green
motor vehicles**
including sharing

urban contexts



Some EU trends in cities



Transport systems in guided ways

Intelligent transport systems

Oil-independent road transport

Practical example: VAL Torino (ex. for the effects of the lengthening of the line of the attracted traffic)

Passengers :

- **2006** (*Fermi-XVIII Dicembre*): **7 million 880 k pp**
- **2007** (extension to *Porta Nuova* from Oct.): **12 million 433 k pp**
- **2008**: **20 million 509 k pp**
- **2015**: **41 million 119 k pp**

Source GTT, 2018: <http://www.gtt.to.it/cms/notizie-eventi-e-informazioni/2443-2006-2016-10-anni-di-metropolitana-a-torino-3>

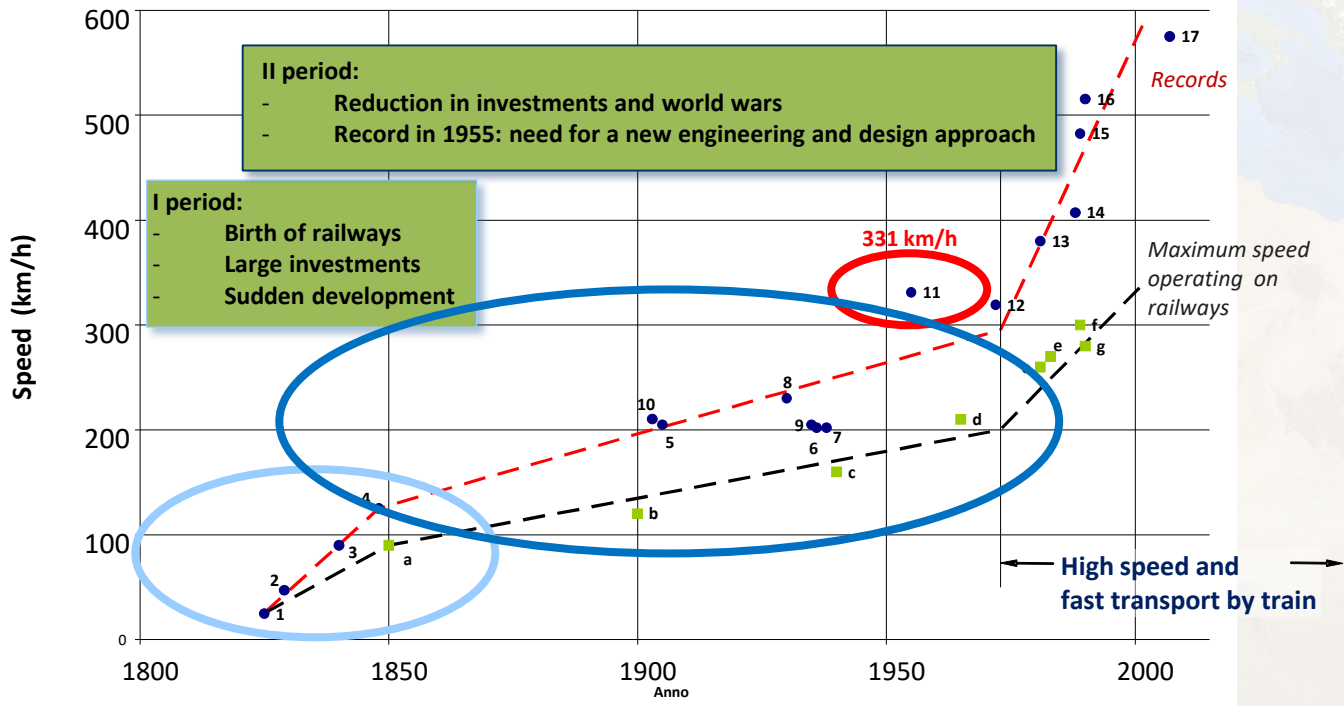


5/6 Expected transport solutions for extra-urban contexts

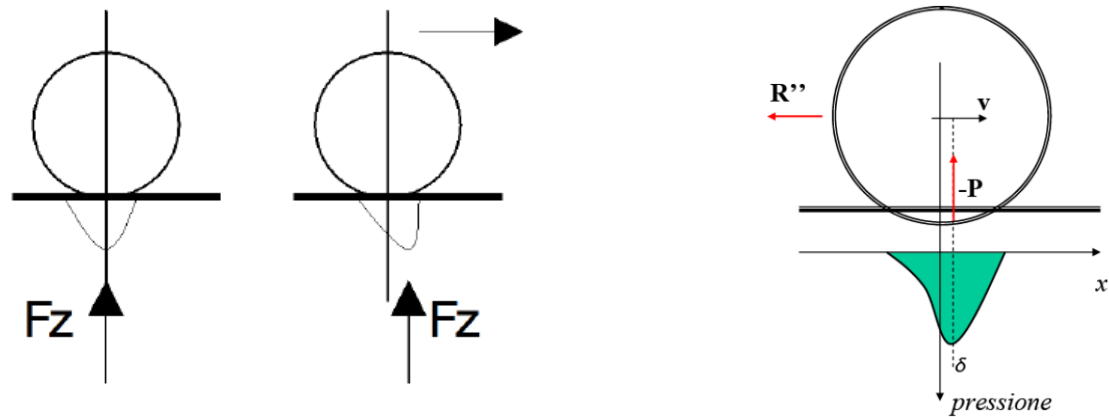
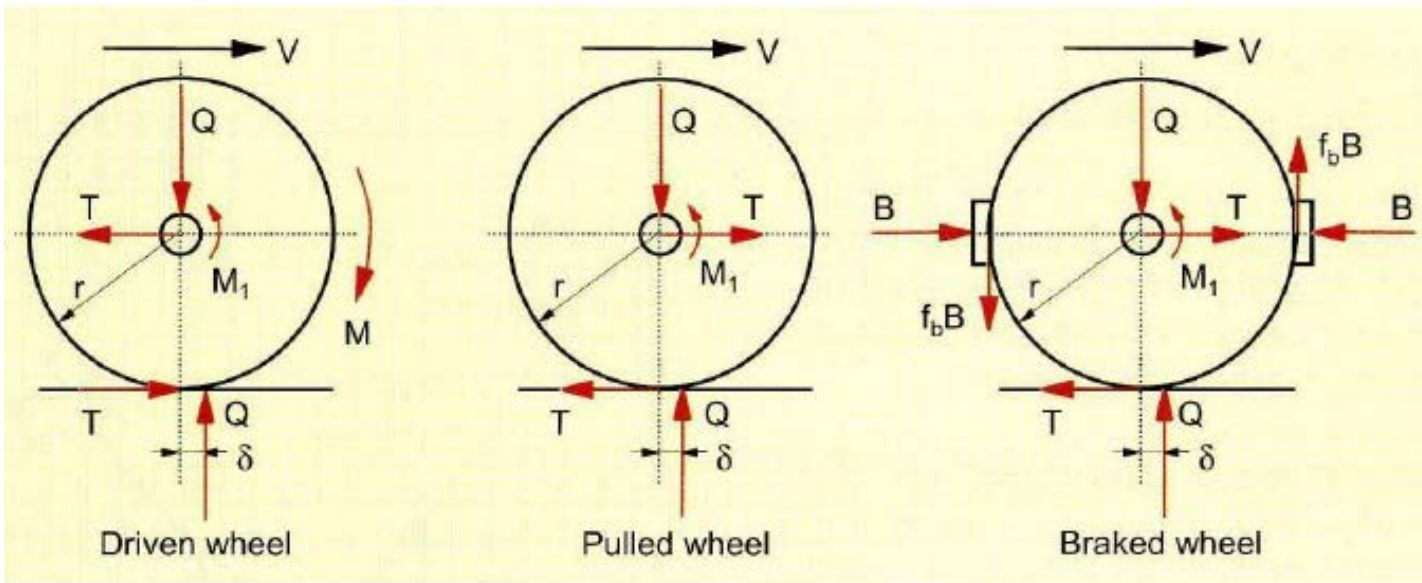
Records and maximum speeds on railways

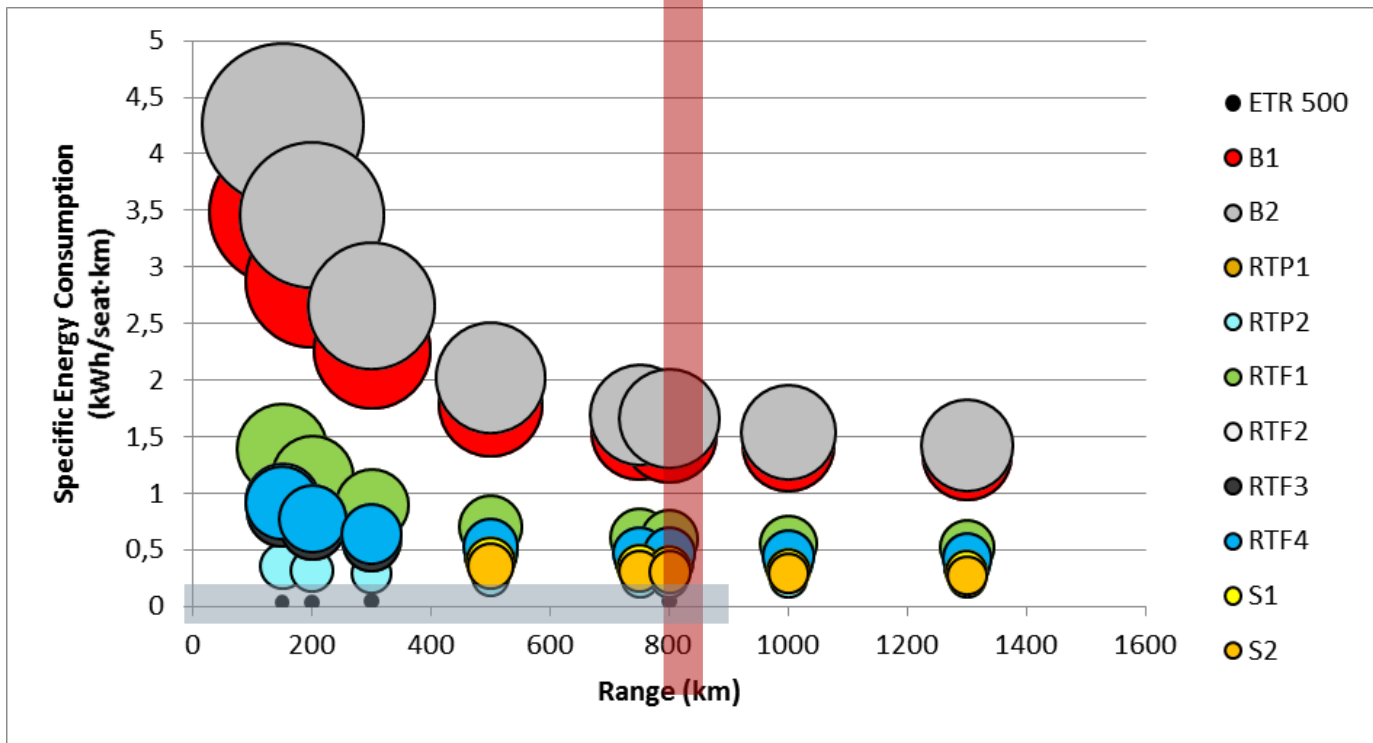
Territories

574.8 km/h (2007)



© Dalla Chiara B., Cornaglia L.; Deflorio F., A macro-analysis of the evolution of motorised mobility and relationships with the development of motionless communication systems, IET Intelligent Transport Systems, DOI: 10.1049/iet-its.2016.0083 , Volume 10, Issue 9, November 2016, p. 613 – 621





Specific energy consumption HSR (**High speed Rail**) vs **air transport** for different route lengths (PASSENGERS)

LA LGV PARIS-LYON AUJOURD'HUI

UN AXE EUROPÉEN MAJEUR



LA LIGNE
LA PLUS CIRCULÉE
D'EUROPE

1/3 DU TRAFIC national français

Des liaisons transeuropéennes importantes avec **l'Espagne l'Italie & le nord de l'Europe**

240

TRAINS PAR JOUR en moyenne sur le tronçon le plus chargé, dans les 2 sens

44,4

MILLIONS de voyageurs en 2017

plus de **460**

KM de voies

37

ANS DE SERVICE depuis 1981

Extra urban context:
a practical example

LA LGV PARIS-LYON

UN AXE
MAJEUR



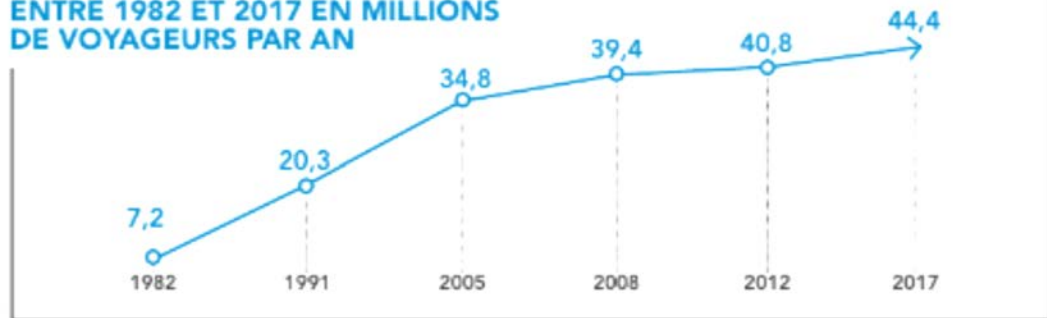
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TRAINS PAR JOUR en moyenne sur le tronçon le plus chargé, dans les 2 sens

ÉVOLUTION DE LA FRÉQUENTATION ENTRE 1982 ET 2017 EN MILLIONS DE VOYAGEURS PAR AN



Source SNCF Réseau

44,4

MILLIONS de voyageurs en 2017

plus de **460** KM de voies

37

ANS DE SERVICE depuis 1981

Extra urban context:
a practical example

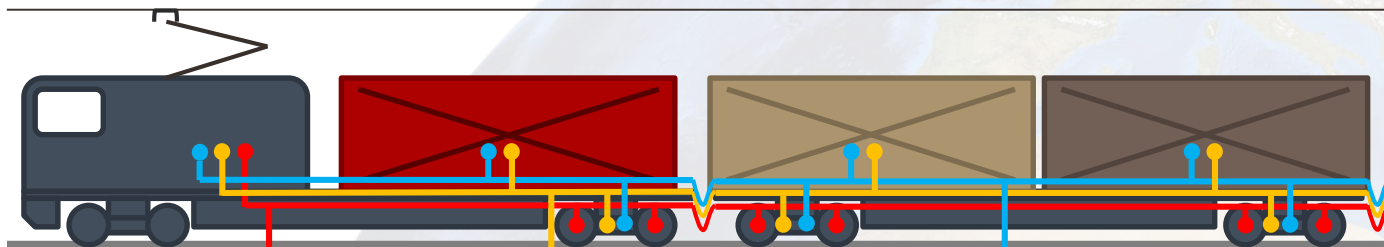
Torino-Milano, HSR (ex. for the effects of the lengthening of the rail line AV on the supply and demand)

- **December 2009 – 7 couple of HST in week days**
4 of these continuing towards Rome, with stop in Milan Porta Garibaldi, the others at Milan Centrale. On Saturdays 3 couples, 5 on Sundays
- **Today (Sept 2018): 28 couples for Trenitalia, 21 for NTV/Italo.**





Distributed-power freight trains – “freight EMUs”



Power link

Distributed traction power:

- More power with the same axle load
- Better traction control
- Longer and heavier trains (35 wagons – 750 m, even on steep lines)

Control link

Active control of the whole train:

- Active traction control
- Braking control and modulation
- Control and power supply of secondary devices and plants besides cargo (refrigeration)

Supervision link

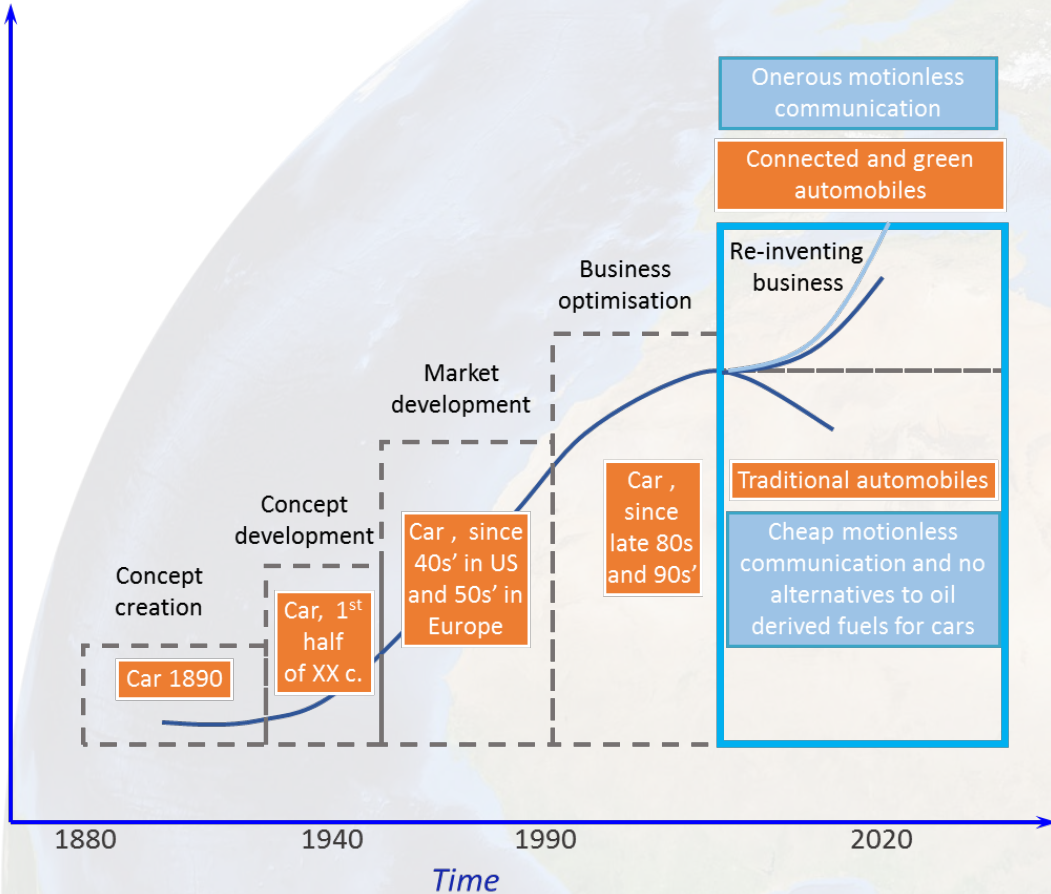
Supervision of the whole train:

- Supervision of the wagons sub-systems
- Supervision of the traction and braking sub-systems
- Wheelset supervision

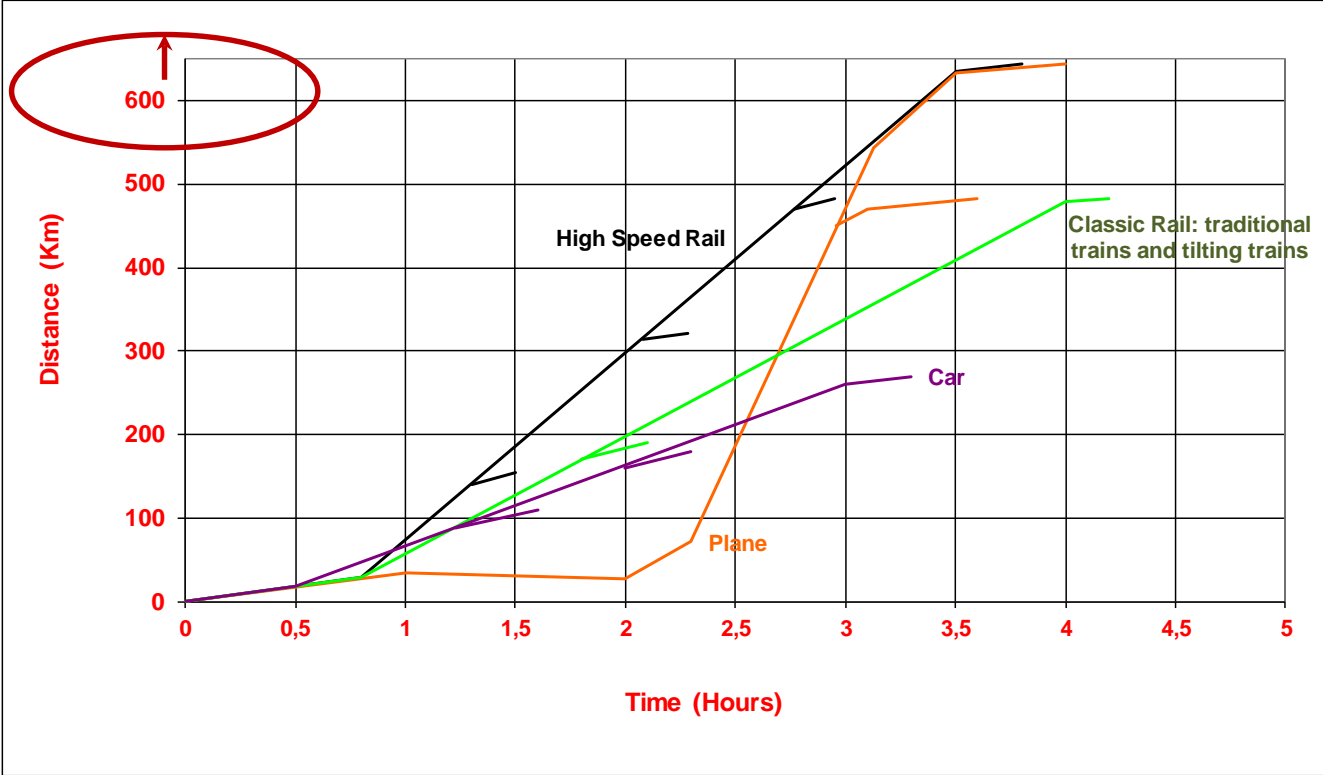
- Higher speed with the same load
- Possibility to be used on HS/HC lines besides traditional railways (long trains)
- Better energy performances (better running profiles)
- Supervision of the electrical, mechanical and pneumatic sub-systems (improved maintenance)
- Cargo supervision
- Cargo refrigeration



Growth



Door-to-door travel time



6/6 Therefore... (Conclusions)



A. A European rail network of medium-big cities in a hierarchical co-modal EU network

- Mega-cities
 - burn land
 - depreciate land already used
- “Stop” to the use of land for constructions
- A HSL rail network for medium-cities
- Air/train HUBs for VLD by airplane

B. A EU network of rail terminals (inland-ports-industries)

- freight EMUs
- HDV with ICE and PHEV/HEV for mixed use



C. Flexible co-modality in cities

(1st feasible step against global warming)

- **PHEV (Plug-in hybrid electric automobiles)**
- **Electric vehicles** when each night the depot or parking is fixed
- **Sharing (PT included); bikes**
- **MAAS**



TORINO, 12 - 16 NOVEMBRE 2018

CONTRADDIZIONI E SFIDE
CONTRADICTIONS AND CHALLENGES



Grazie per l'attenzione
Thank you

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