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

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 constrains 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

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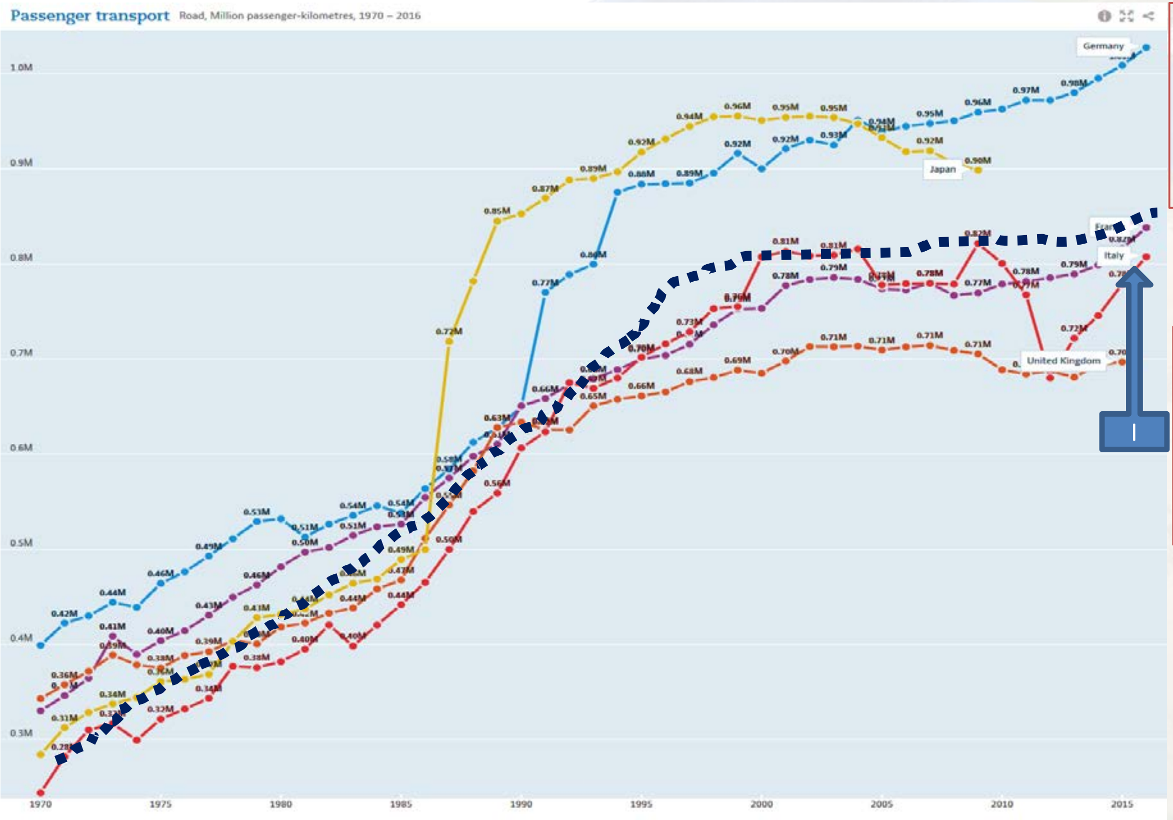
Trends in daily mobility



1970 2000 2015

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

- *Population*
- *Supply: road, rail transport*

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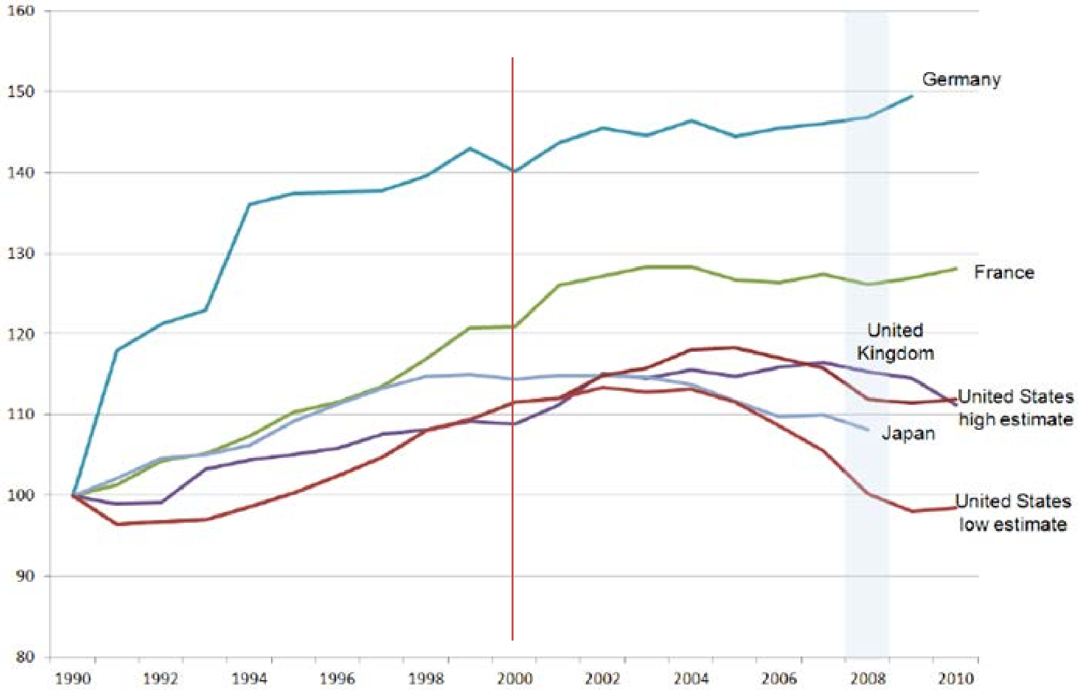
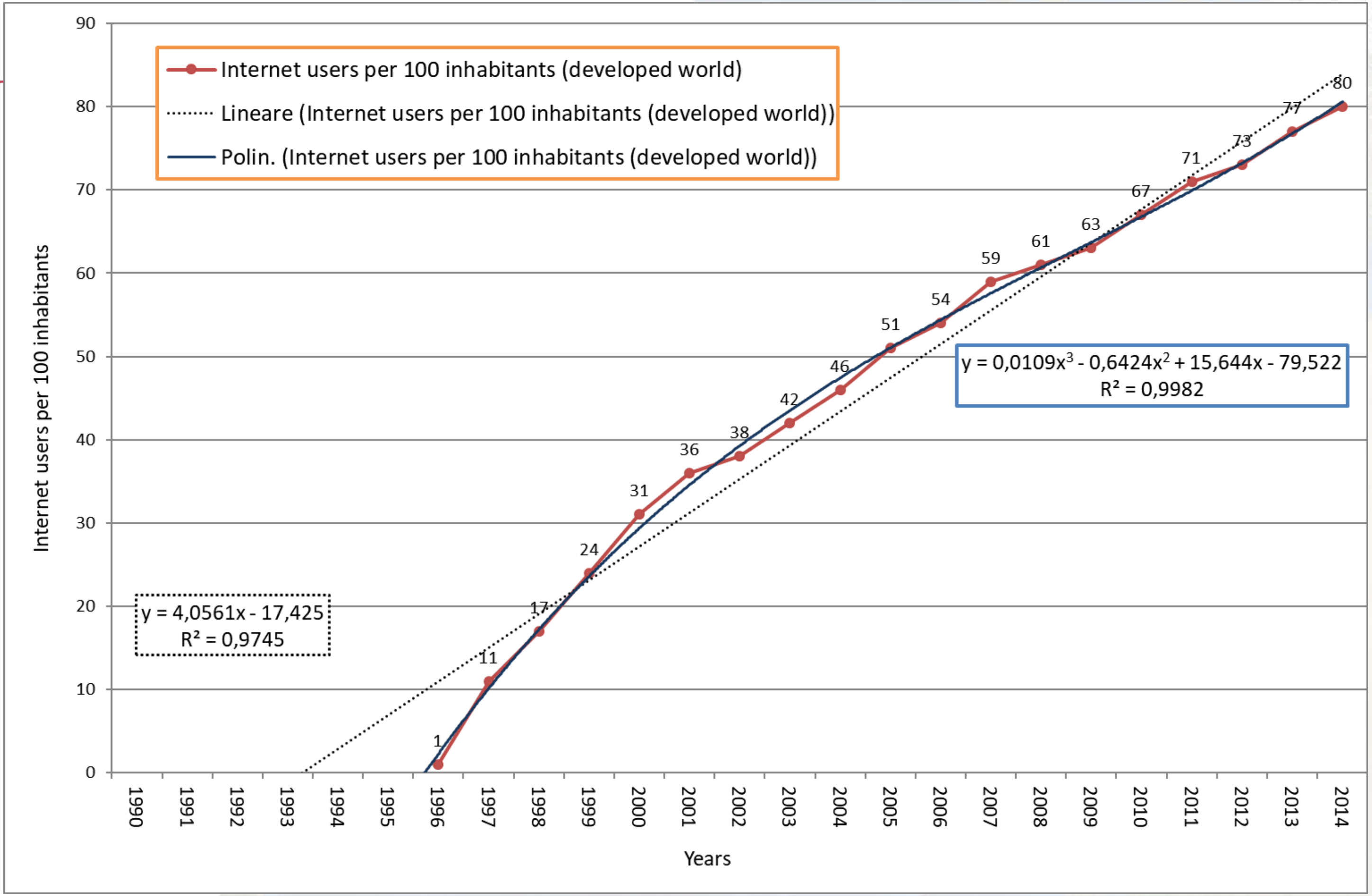
Trends in daily mobility



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.



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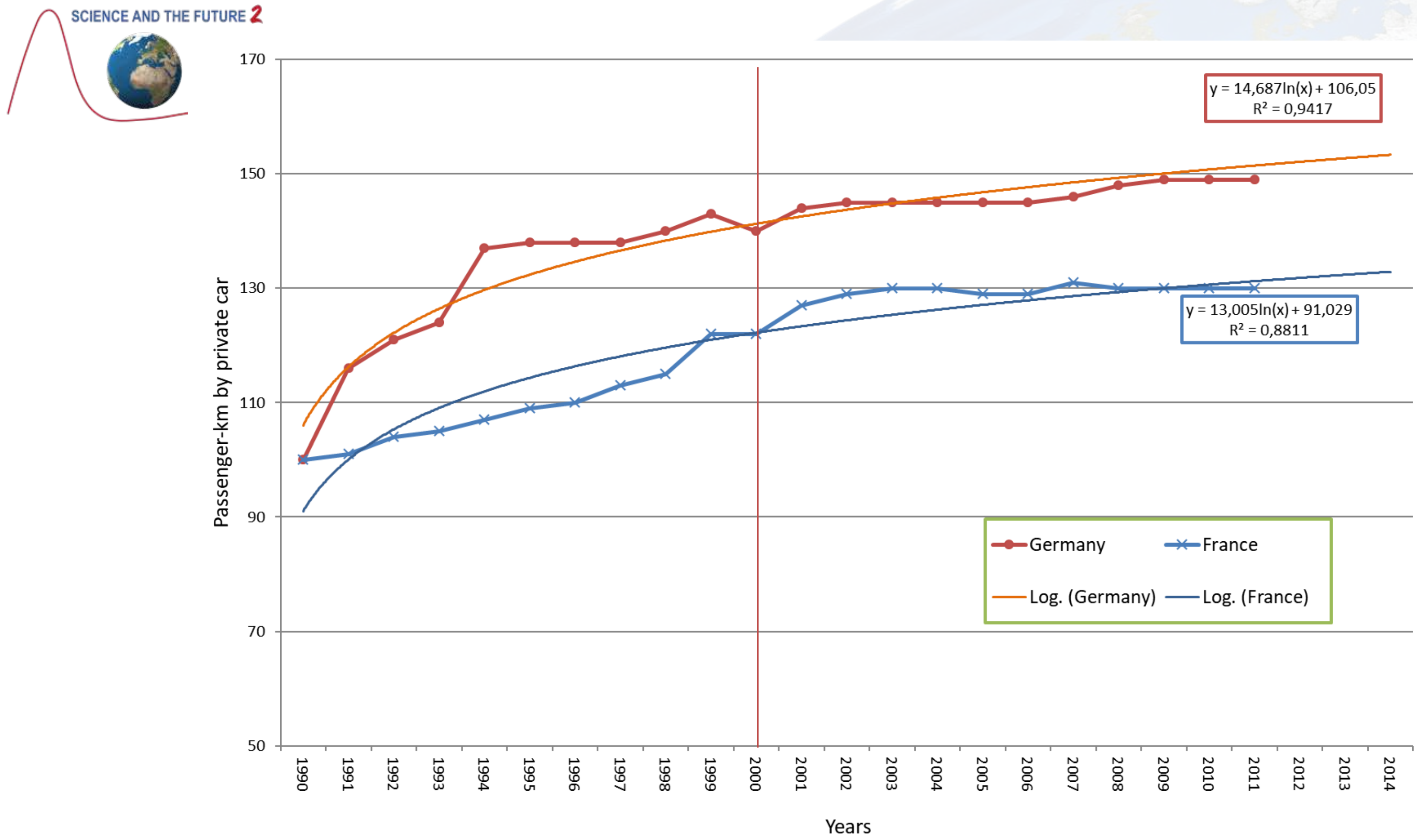

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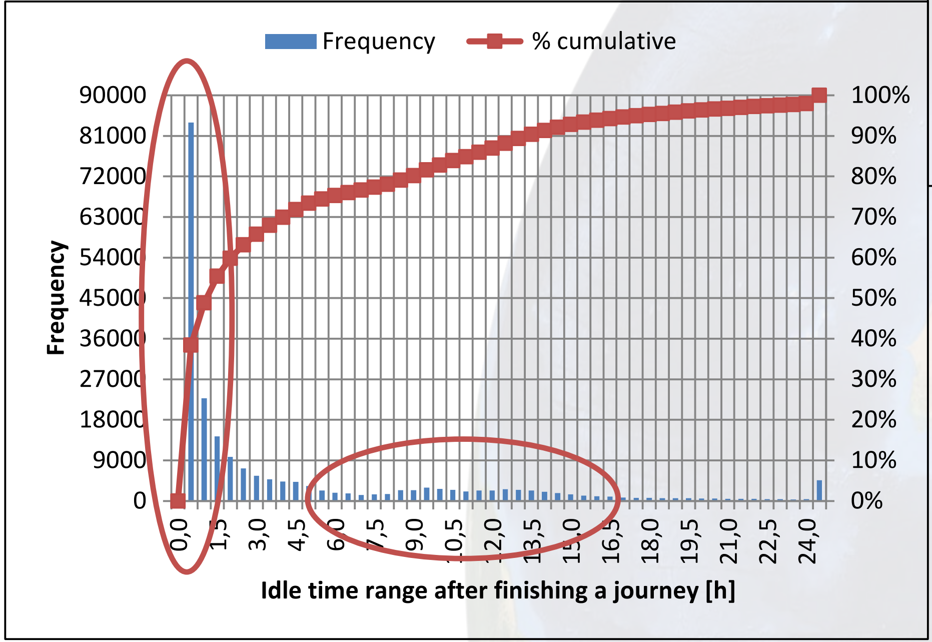
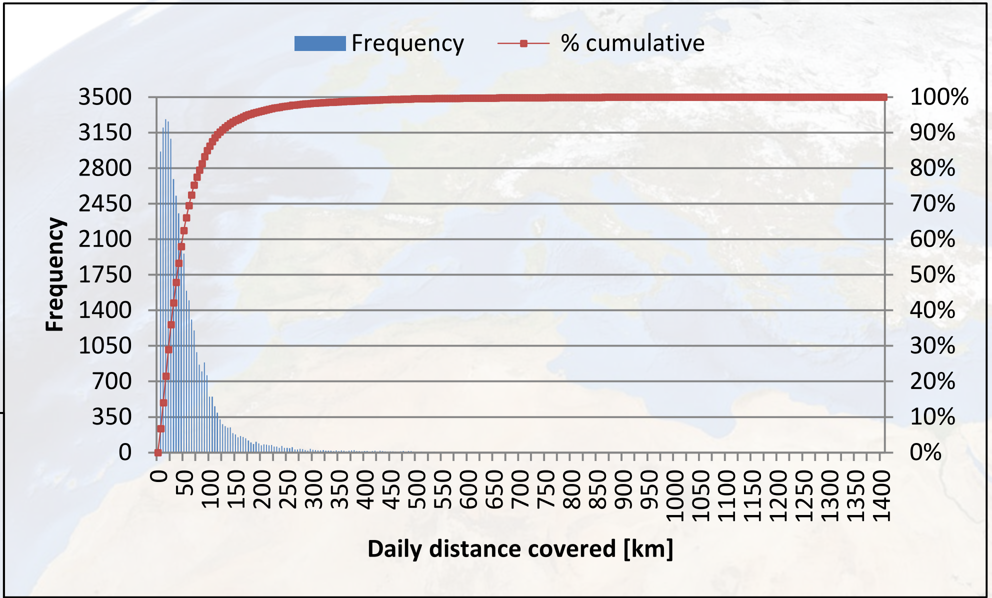
Idle time after finishing a trip for all the driving cycles.





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

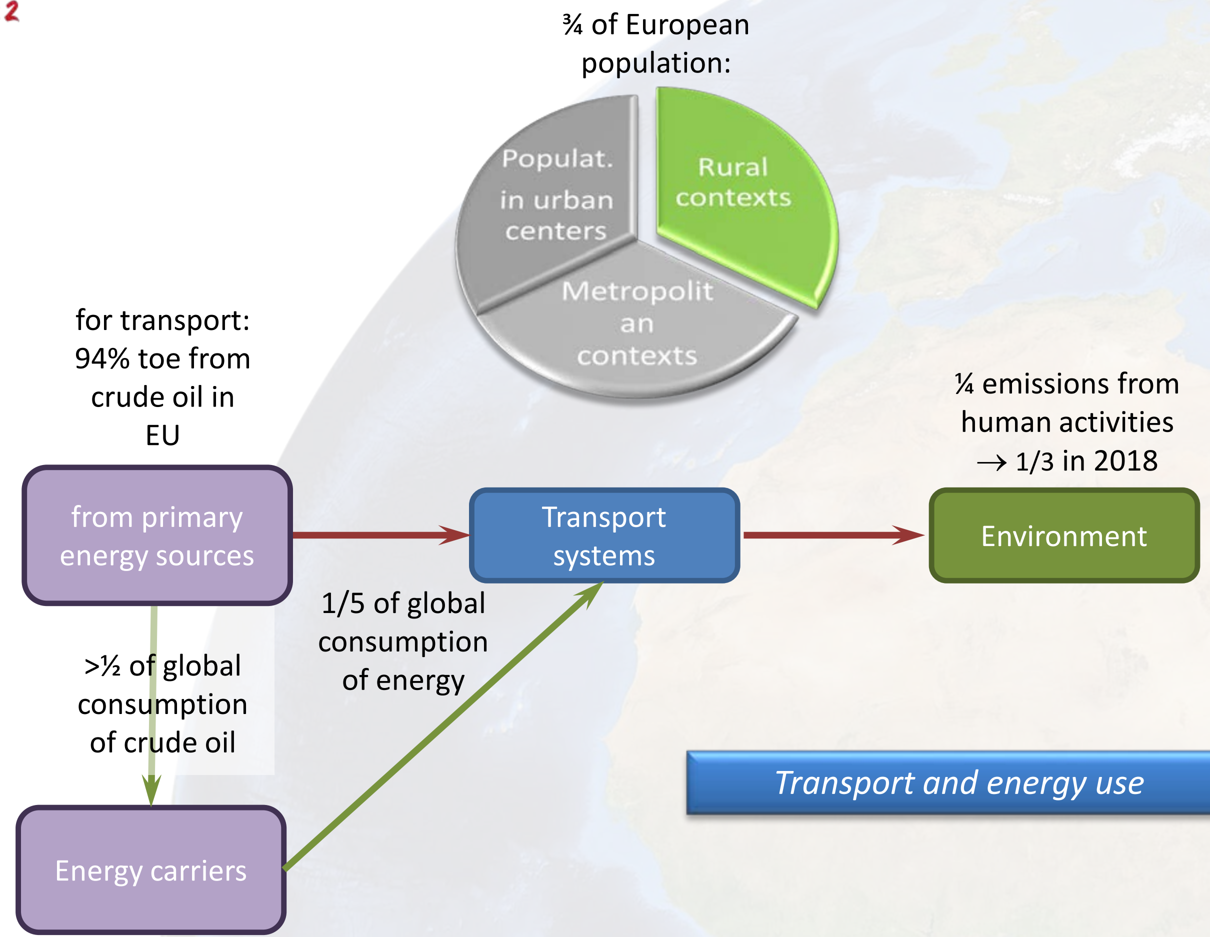
© Dalla Chiara B., Deflorio F., Eid M., Analysis of real driving data to explore travelling needs in relation to hybrid–electric vehicle solutions, Transport Policy, Available online 26 April 2018, ISSN 0967-070X, https://doi.org/10.1016/j.tranpol.2018.04.009

2/6 What do mobility and logistics ask for today

Climate change

- **Efficiency**
- **“Green” (hybridisation, decarb./electrif., well used PT)**
- **Quality**
- **Connected vehicles, flexible modal choice**
- **Safety-security**
- **Assisted driving, transport systems operating on fixed guideways**

Transport and energy use



© aggiornamento da: SIDT, Società Italiana Docenti di Trasporti, Position Paper della SIDT, «Cambiamenti climatici e futuro del trasporto urbano», Roma - La Sapienza, 2 ottobre 2014

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3/6 Contraints 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)

CO_2

-40% on 1990

levels by 2030

Renewables

27% by 2030

(some inputs also on 30%)

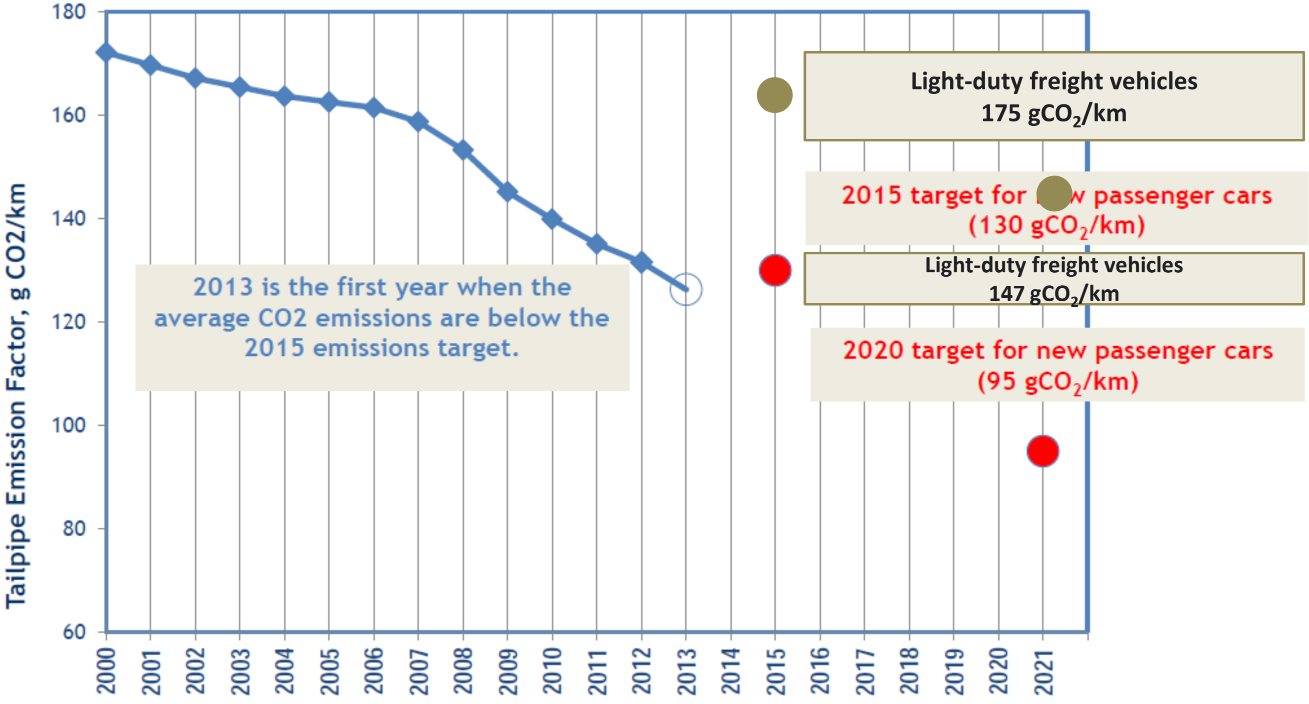
Energy efficiency

27% by 2030

(some inputs up to 38% at 2050)

EU, 24.10.2014: constraining values at European level, indicative at national level; substitute previous target 20-20-20

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



fonte: Anfia su dati EEA

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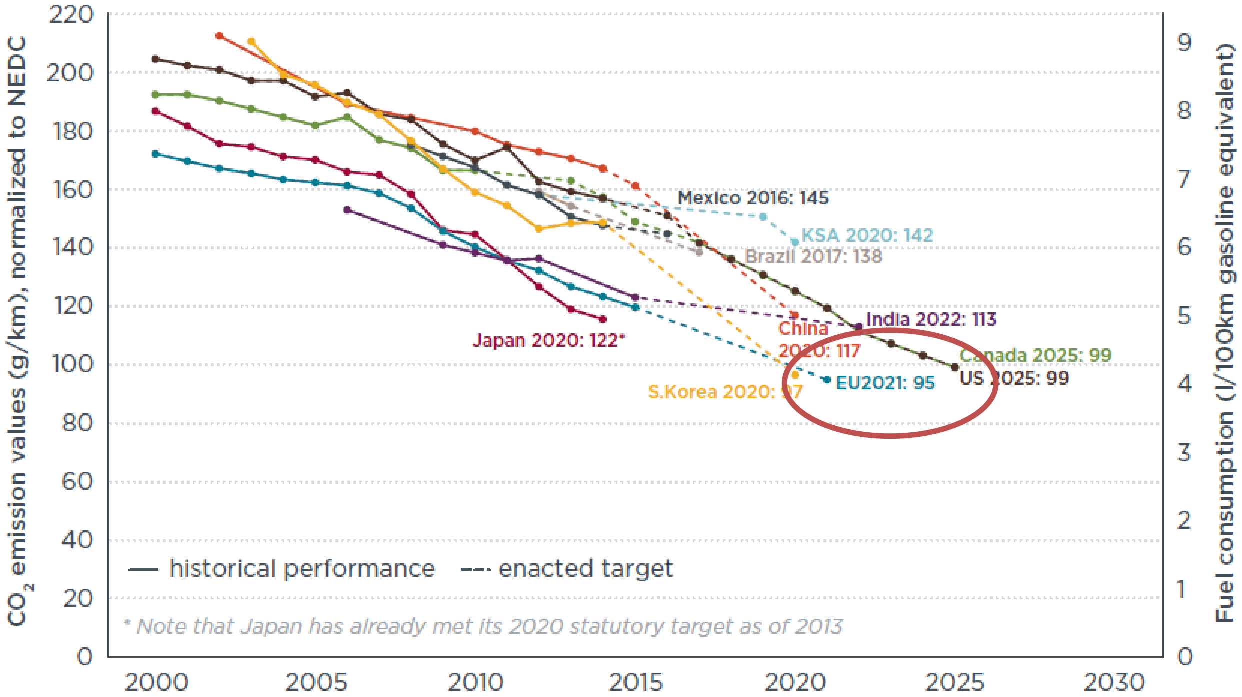

Figure 3. Comparison of global CO_2 regulations for new passenger cars.[8]

icct
THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION
JULY 2017

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Pollutant	*Concentration*	*Averaging period*	*Legal nature*	*Permitted exceedences each year*
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 (SO2)	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 (NO2)	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
PM10	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/m3 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

Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe. Air Quality Plan", to pursue the respect of thresholds.

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4/6 Expected transport solutions for urban contexts

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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

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Some EU cities, today

FUTURE **AIMS**
OF SOCIETY

QUALITY,
SAFETY,
SECURITY,
EFFICENCY

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

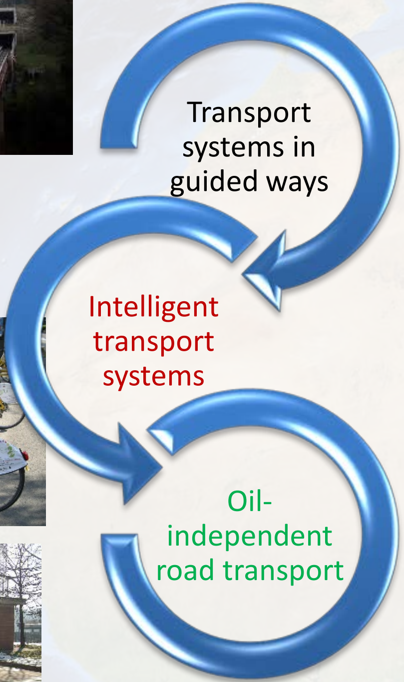
Some EU trends in cities

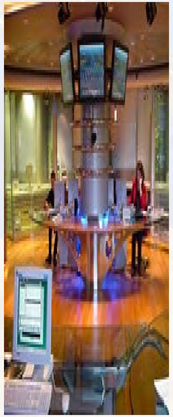
urban contexts



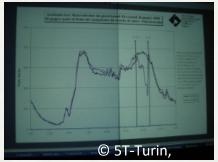








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Practical example: VAL Torino (ex. for the effects of the lengthening of the line of the attracted traffic)

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

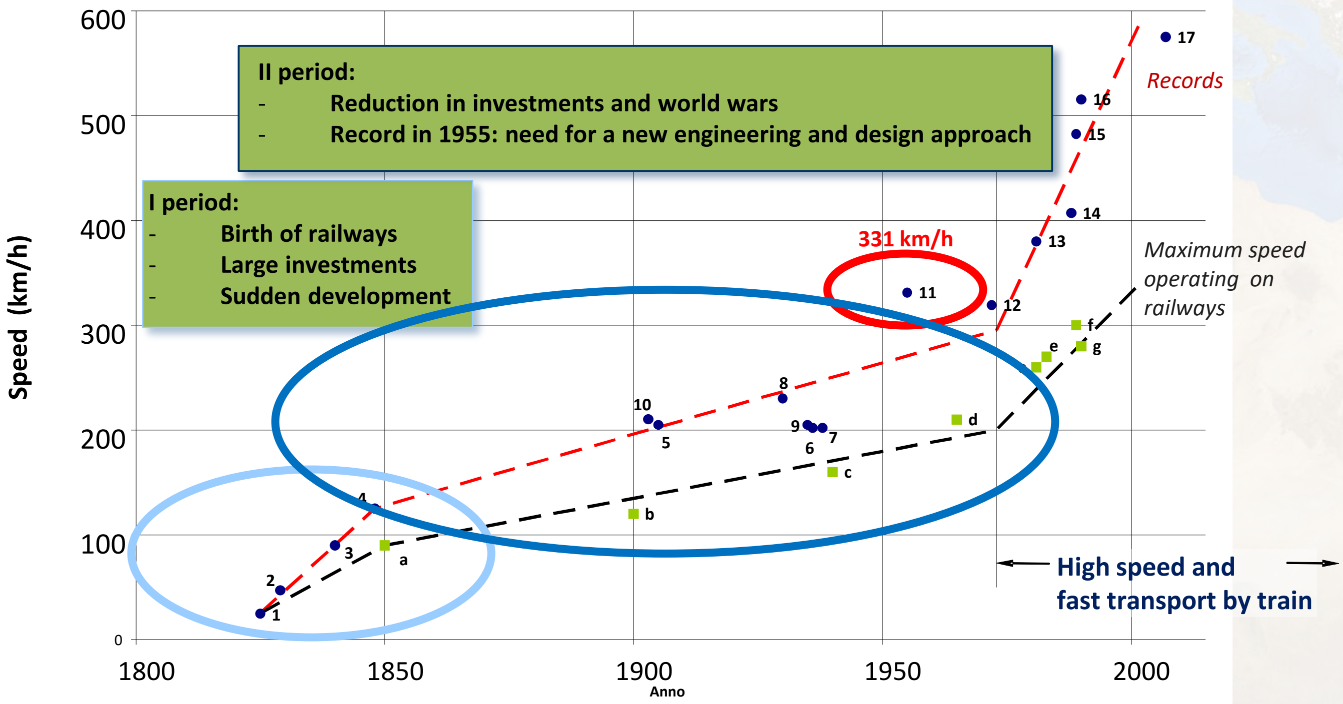
Source GTT, 2018: http://www.gtt.to.it/cms/notizie-eventi-e-informazioni/2443-2006-2016-10-anni-di-metropolitana-a-torino-3

5/6 Expected transport solutions for extra-urban contexts

Records and maximum speeds on railways

Territories

574.8 km/h (2007)



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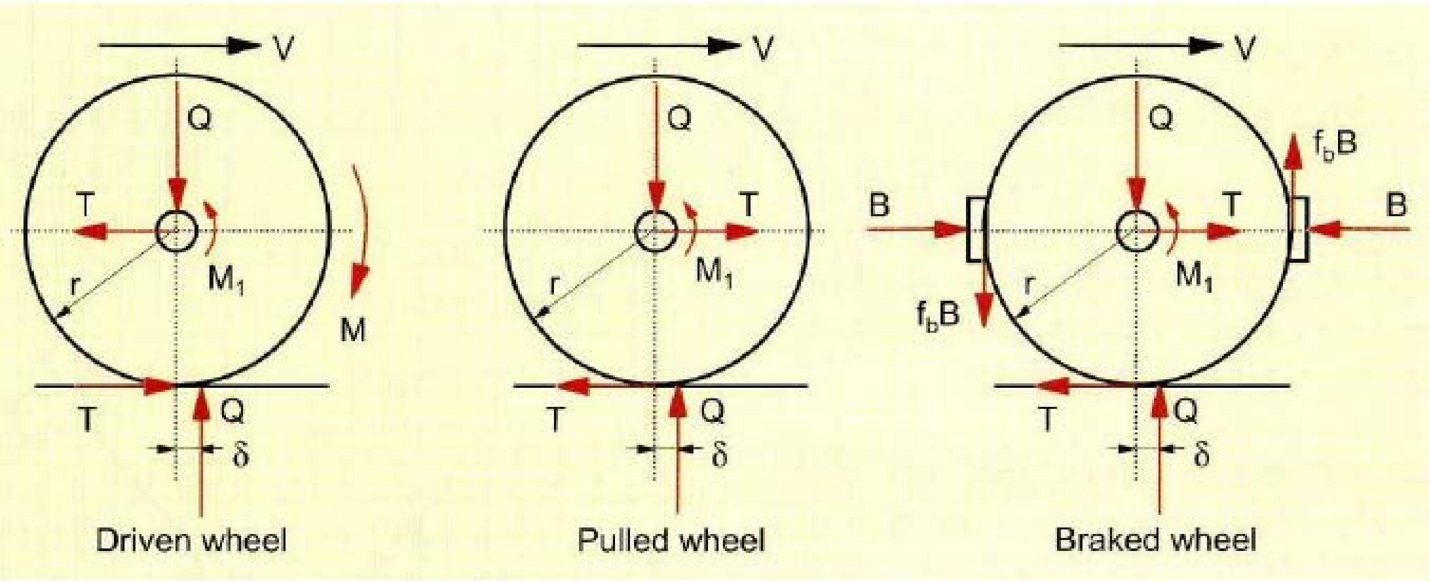
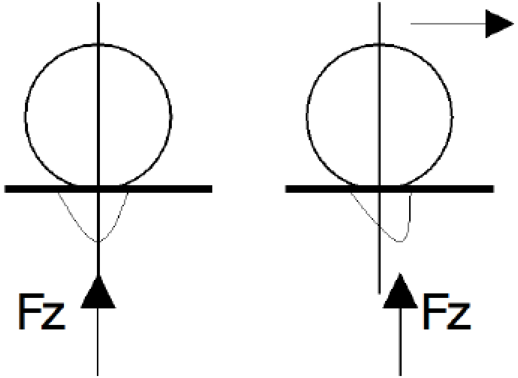
Dispense di «Sistemi di trasporto ferroviari, metropolitani e a fune», Politecnico di Torino, 2018


V
Q
T
M1
M
r
δ
Driven wheel
Pulled wheel
B
fbB
Braked wheel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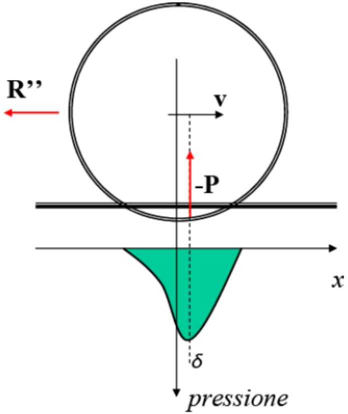
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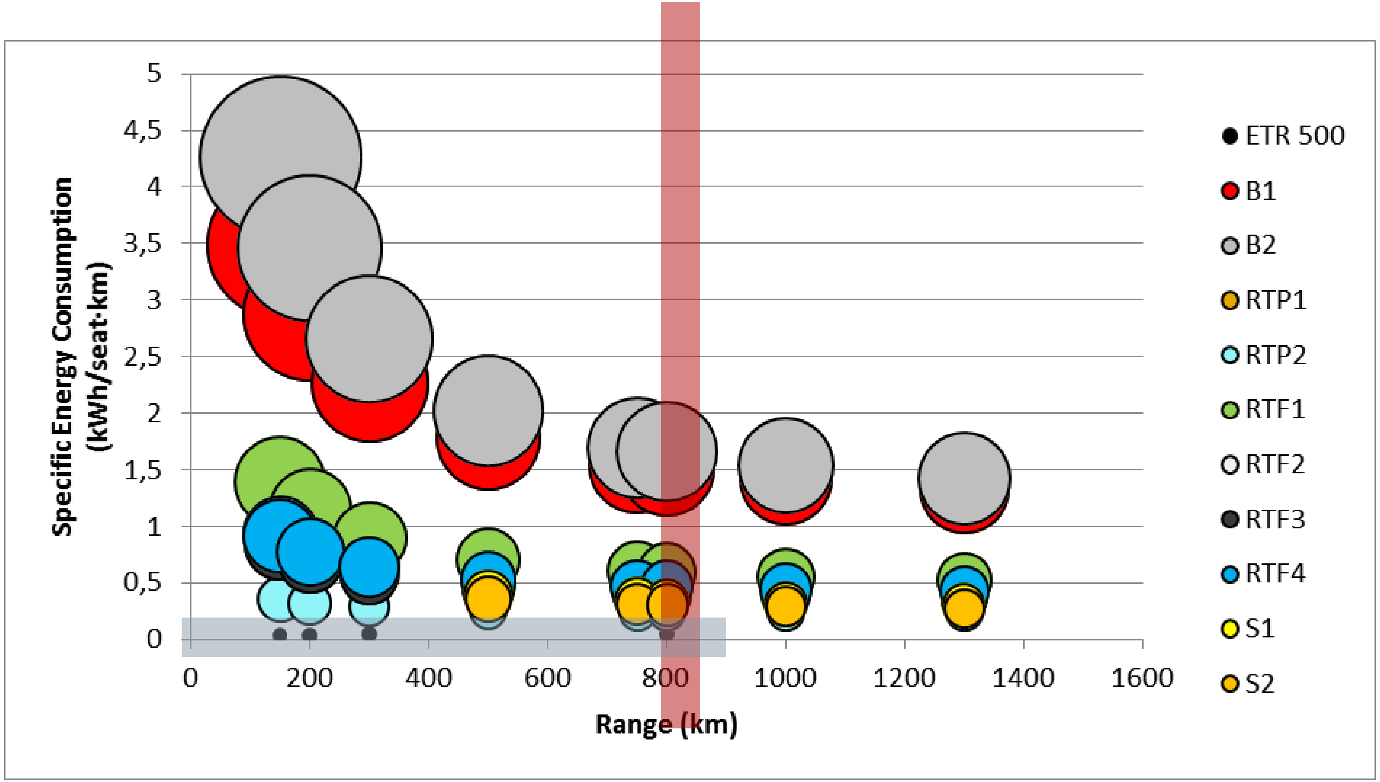


Specific energy consumption HSR (**High speed Rail**) vs **air transport** for different route lengths (PASSENGERS)

© Dalla Chiara B., De Franco D., Coviello N., Pastrone D., **Comparative specific energy consumption between air transport and high-speed rail transport: A practical assessment, Transportation Research Part D**: Transport and Environment, Volume 52, Part A, May 2017, Pages 227-243

Extra urban context: a practical example

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

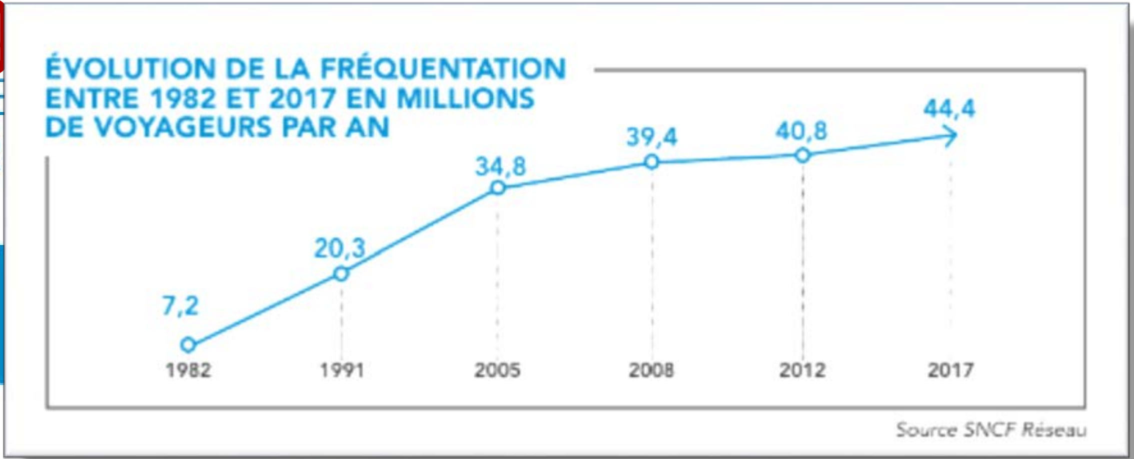
plus de 460 KM de voies

37
ANS DE SERVICE
depuis 1981

LA LGV PARIS-LYON

UN AXE

MAJEUR



1/3 DU TRAFIC national français

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

plus de 460 KM de voies

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

37 ANS DE SERVICE depuis 1981

Extra urban context: a practical example

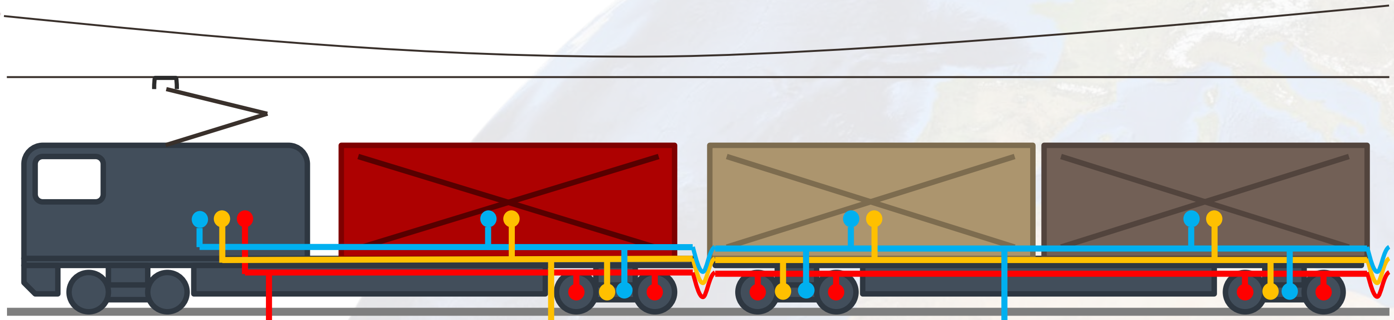
Extra urban context: a practical example

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)

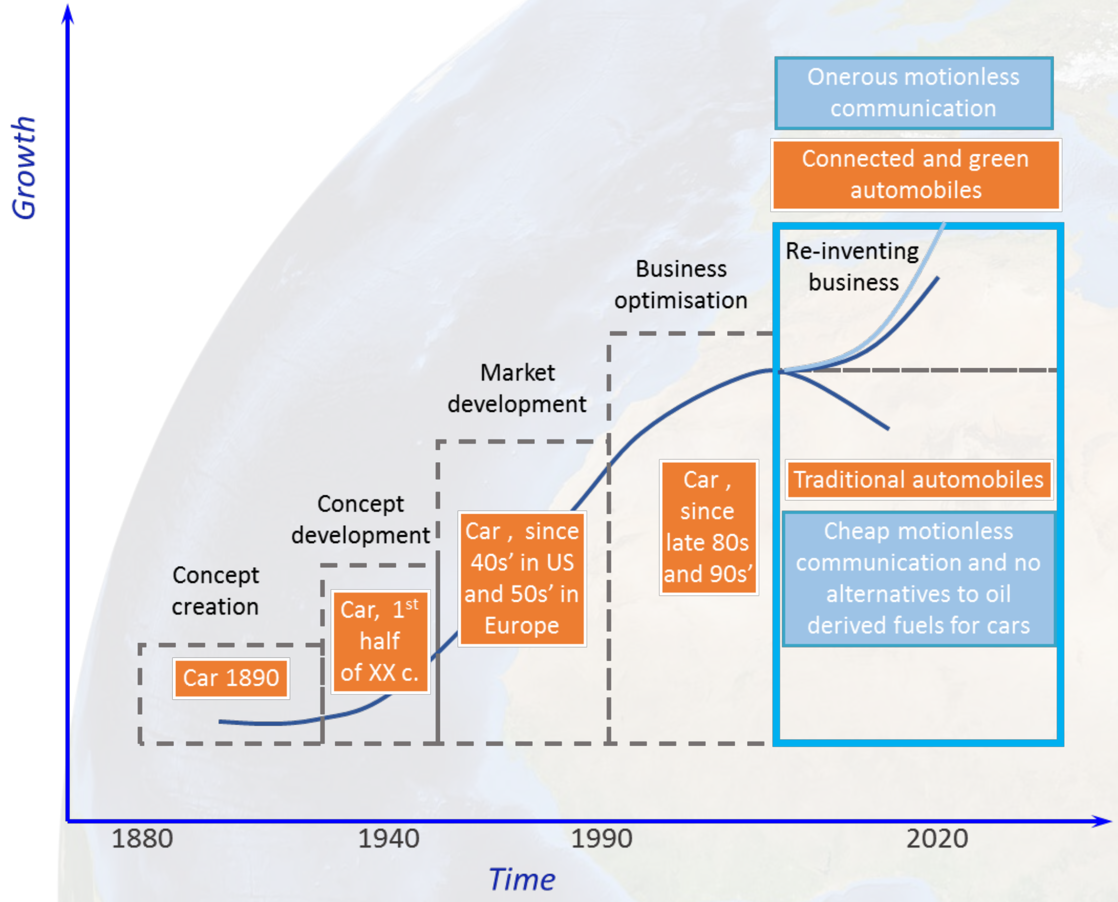
Control link

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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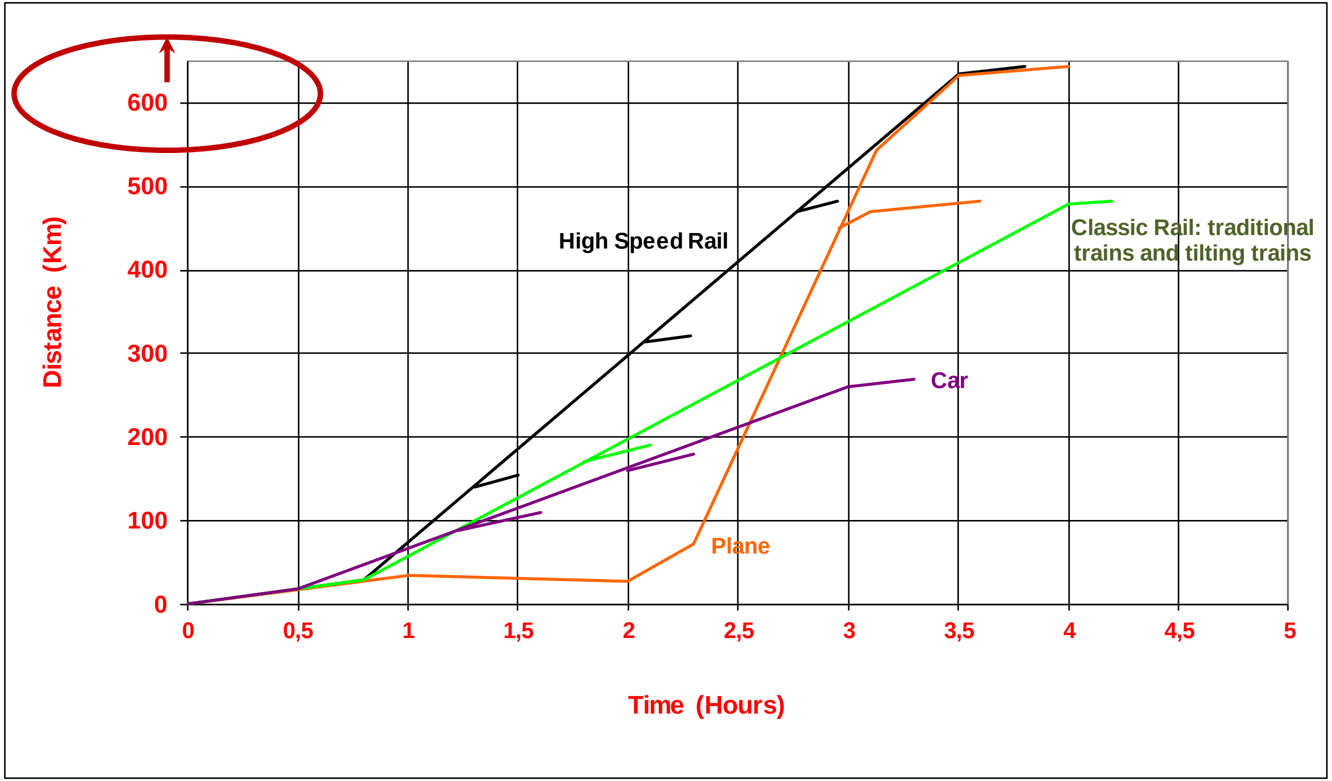
Growth
Time
1880
1940
1990
2020
Concept creation
Car 1890
Concept development
Car, 1st half of XX c.
Market development
Car , since 40s' in US and 50s' in Europe
Business optimisation
Car , since late 80s and 90s'
Re-inventing business
Onerous motionless communication
Connected and green automobiles
Traditional automobiles
Cheap motionless communication and no alternatives to oil derived fuels for cars

Door-to-door travel time



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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

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TORINO, 12 - 16 NOVEMBRE 2018

CONTRADDIZIONI E SFIDE
CONTRADICTIONS AND CHALLENGES

Grazie per l'attenzione
Thank you

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