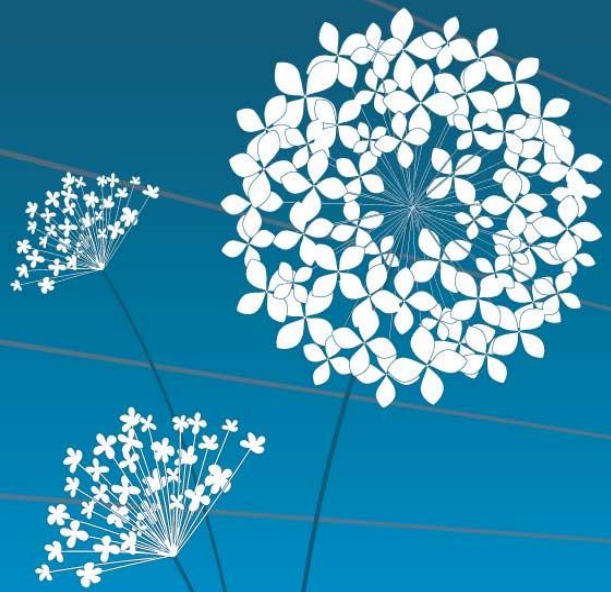
INFRABEL UIC

UIC Energy Efficiency Days 2014

Antwerpen, 16 - 19 June

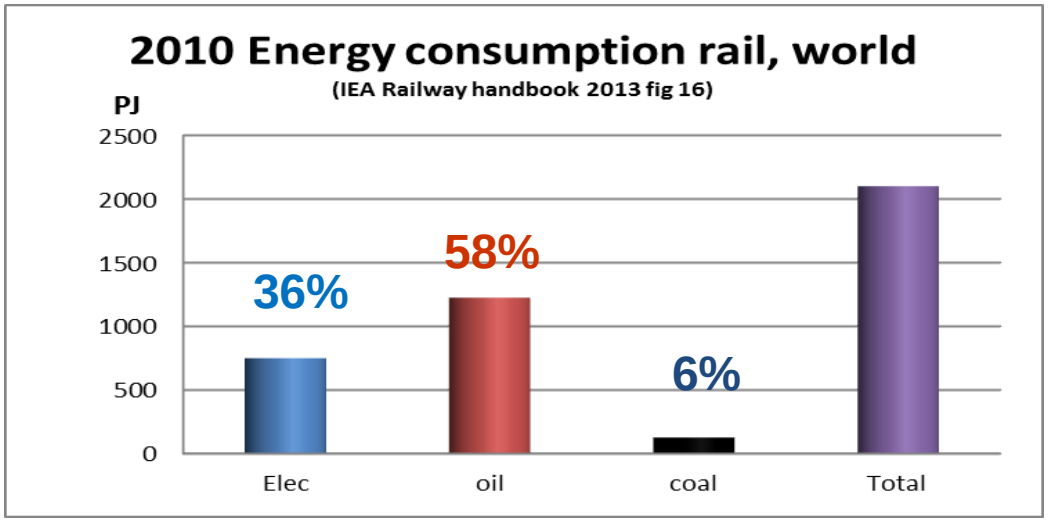


Drivers for energy efficiency in railway business

Wim Bontinck, Chair of UIC Environment, Energy and Sustainability Platform

Energy Efficiency, the best fuel to move our trains!

WORLD RAIL (FINAL) ENERGY CONSUMPTION

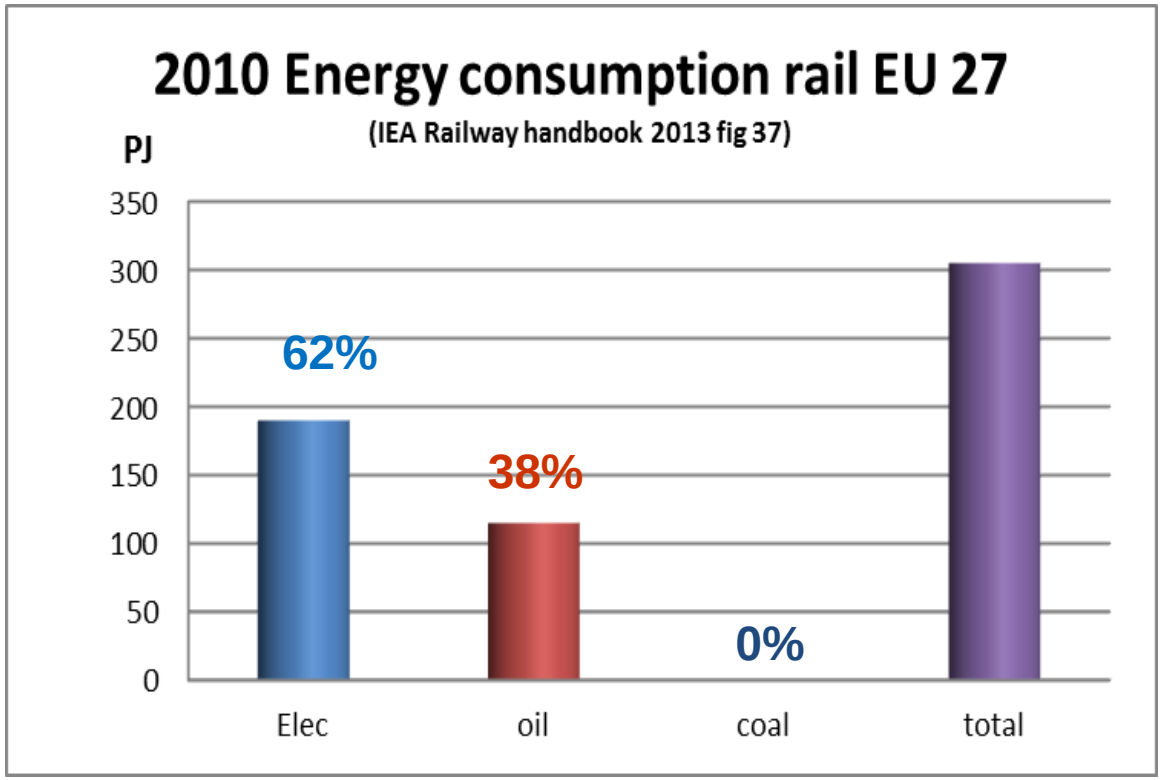


Source Railway energy handbook 2013 iea - UIC

- Comparable to the electricity consumption of 170 millions households
- = 0,6% of world final energy consumption
- **= 2,1% of world final transport energy consumption**

Source key world energy statistics iea

EU27 RAIL (FINAL) ENERGY CONSUMPTION



Source Railway energy handbook 2013 iea - UIC

A cost of about 7 Billion EUR/year

Final energy (Tank to Wheel)

Indicator	Unit
Specific final energy consumption of passenger transport	kWh / pkm or L diesel / pkm
Specific final energy consumption of freight transport	kWh / tkm or L diesel / tkm

Primary energy (Well to Wheel)

Indicator	Unit
Specific primary energy consumption of passenger transport	kJ / pkm
Specific primary energy consumption of freight transport	kJ/ tkm

$$\frac{energy}{passengers-km} = \frac{energy}{\text{gross} - \text{tkm}} \; x \; \frac{\text{gross} - \text{tkm}}{seat - \text{km}} \; x \; \frac{\text{seat} - \text{km}}{passengers - km}$$

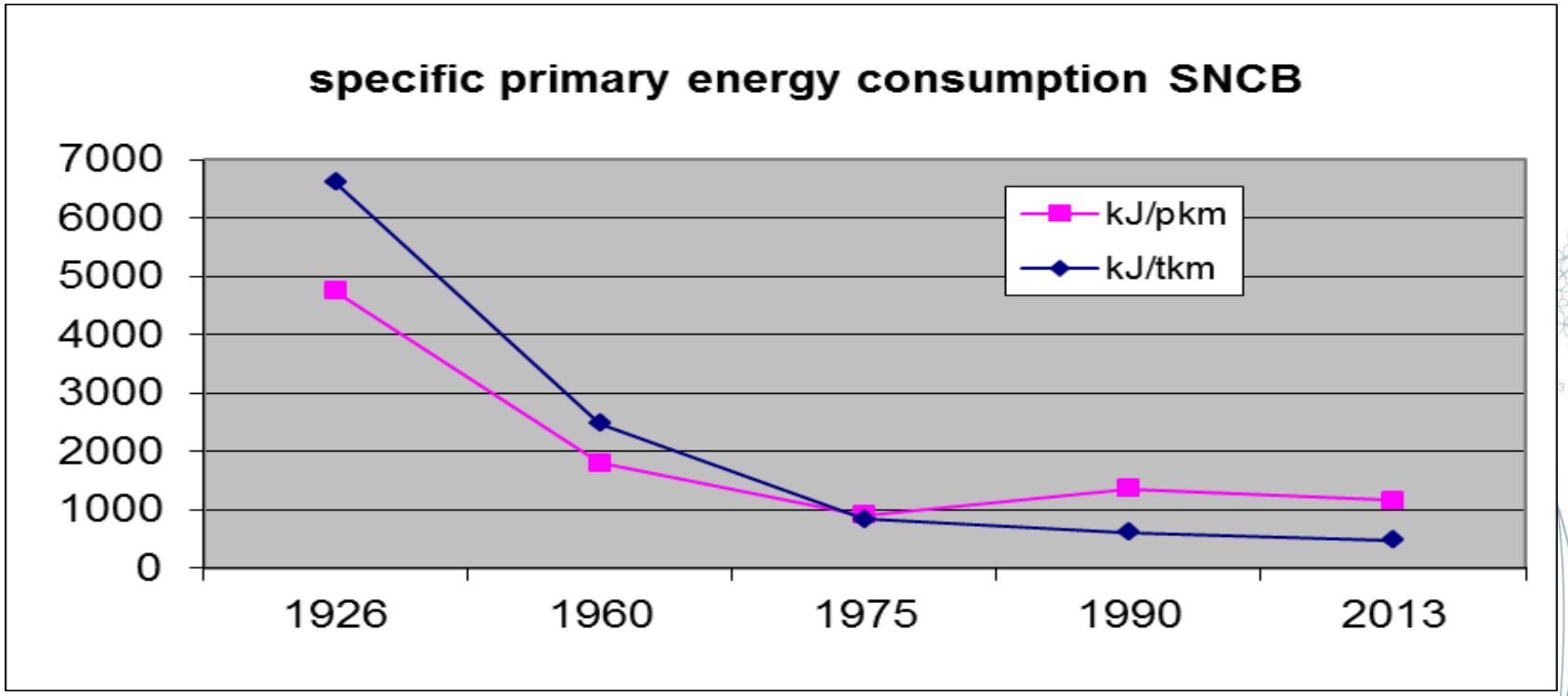
- **Type of train service (HST, IC, Urban): speed, # stops**
- **Eco-driving/use of DAS**
- **Regenerative braking**
- **"Hotel load" management**
- **Infrastructure energy management**
- **Management of trains slots**
- **…**

mass per seat

- **Material use**
- **Design of rolling stock**

Inverse of loadfactor

- **Q trainservices**
- **Tarification**
- **Use and composition of rolling stock**
- **…**


specific primary energy consumption SNCB
7000
6000
5000
4000
3000
2000
1000
0
1926
1960
1975
1990
2013
kJ/pkm
kJ/tkm

Energy and Emission Reduction Drivers UIC Questionnaire 2014

24 answers

Company
VR-Group
NS
ÖBB-Infrastruktur
CFR MARFA
Deutsche Bahn
DSB
FS - Trenitalia
HŽ Infrastruktura
HŽ Putnički prijevoz
East Japan Railway Company
NSB
PKP Cargo
PKP Energetyka
PKP Intercity
PKP PLK
PKP Szybka Kolej Miejska w Trójmieście
ProRail
Swiss Federal Railways, SBB
SNCF
Hungarian State Railways
CP-Comboios de Portugal EPE
SNCB/NMBS
Lithuanian Railways
Green Cargo

Metering on board

- **No metered trains becomes “the exception” in Europe**
- Since more than 10 years, German regulation makes it compulsory to have meters in electrical trains
- NSB, DSB, SJ, VR, RENFE, CFR Marva, PKP, MAV, OBB and CP started about 3 to 10 years ago

- The next 5 years:
  - SNCF will install about 3800 units
  - SBB and MAV (additionally) about 1800 units each
  - SNCB and ÖBB (additionally) about 1000 units each
  - NSB (additionally) about 450 units
  - VR (additionally) : 150, CP (additionally) : 34

Meters on board

- Standardised interoperable rail component EN 50463, TSI rolling stock
- Standardised communication protocol
- Well developed billing procedures

- Meters make savings visible
- Meters encourage savings

Drivers for energy efficiency

$$\frac{energy}{passengers-km} = \frac{energy}{\text{gross} - \text{tkm}} x \frac{\text{gross} - \text{tkm}}{seat - \text{km}} x \frac{\text{seat} - \text{km}}{passengers-km}$$

- On board technology: traction chain, heating, cooling, lighting, ventilation, automatic closing of doors
- Regenerative braking

- Ecodriving and DAS: **punctual train traffic**, smoother trains

- Infrastructure: efficiency of substations, transmission and overhead contact lines, optimization of speed profiles, energy storage

- **Diesel** versus, **electrical** versus **hybrid** traction

Drivers for energy efficiency

$$\frac{energy}{passengers-km} = \frac{energy}{\text{gross} - \text{tkm}} \; x \; \frac{\text{gross} - \text{tkm}}{seat - \text{km}} \; x \; \frac{\text{seat} - \text{km}}{passengers-km}$$

= average mass per seat (mass of traction units included)
varies from about 400 kg/seat to 1050 kg/seat

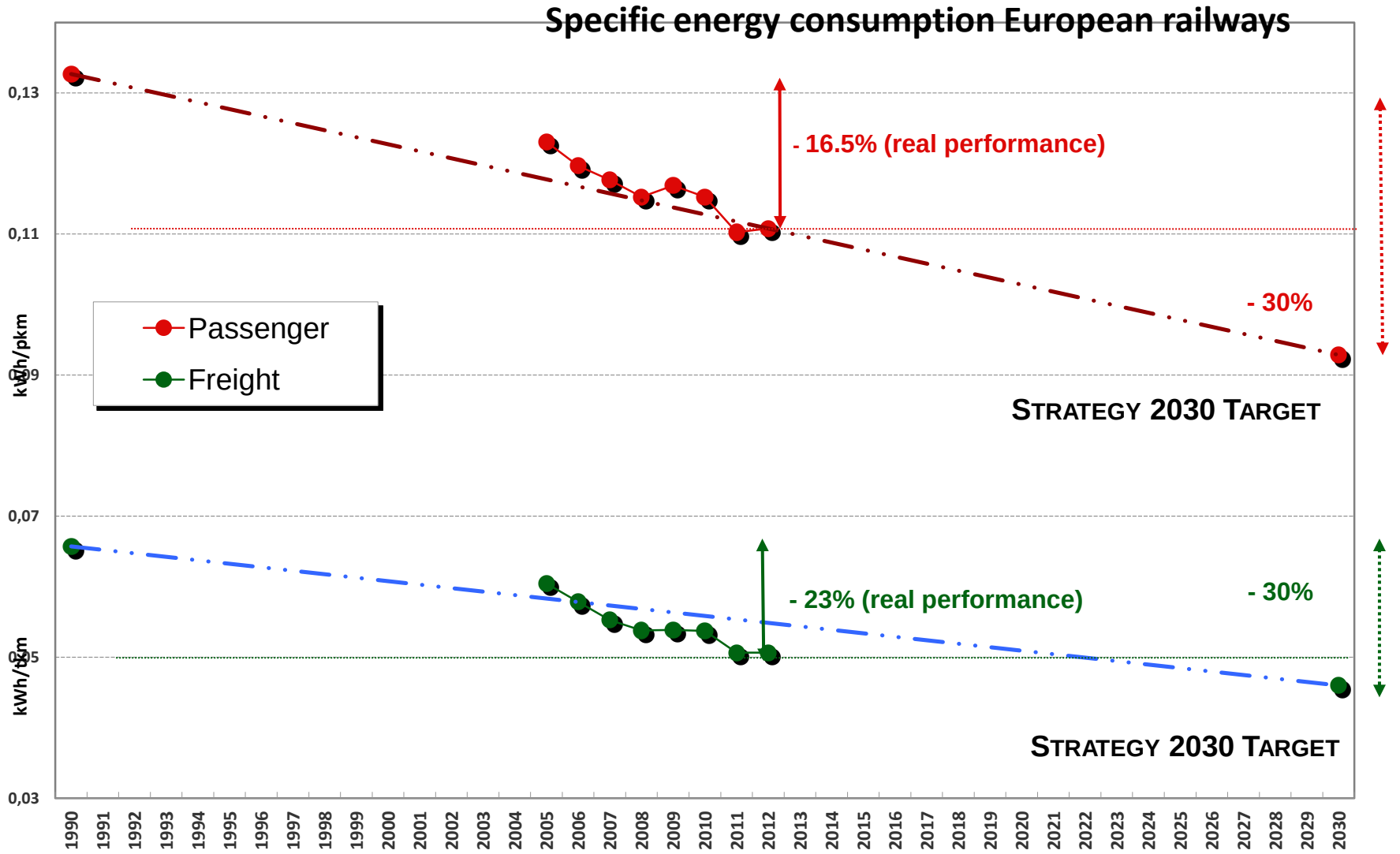
- design of rolling stock, (e.g: double stock, bogies between coaches)
- Material: steel, aluminium, composite
- Type of train service: HST, IC, local

Drivers for energy efficiency

$$\frac{energy}{passengers-km} = \frac{energy}{\text{gross} - \text{tkm}} \; x \; \frac{\text{gross} - \text{tkm}}{seat - \text{km}} \; x \; \frac{\text{seat} - \text{km}}{passengers - km}$$

= inverse of load factor: the main indicator for the efficiency of any transport service

- Punctual and qualitative train service attracts more costumers, modal shift
- modular train composition
- Tariff differentiation as an incentive to travel outside the rush hours
- Automatic assessment of LF, also as a service to the passengers


Specific energy consumption European railways
0,13
0,11
0,09
0,07
0,05
0,03
kWh/pkm
kWh/tkm
Passenger
Freight
- 16.5% (real performance)
- 30%
STRATEGY 2030 TARGET
- 23% (real performance)
- 30%
STRATEGY 2030 TARGET
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030

the past 15 years

the future 15 years

Main driver: More efficient rolling stock

Secondary drivers

- Load factor
- Ecodriving
- Regenerative braking
- infrastructure
- “hotel” loads

Main driver: load factor

Secondary drivers

- More efficient rolling stock
- Ecodriving
- Regenerative braking
- infrastructure
- “hotel loads

Drivers for greenhouse gas reduction

$$\frac{CO2}{passengers-km} = \frac{CO2}{energy} x \frac{energy}{passengers-km}$$

- Well to wheel approach according to Leaflet UIC330
- Only direct and indirect emissions of used energy vectors
- Use of renewable energy sources
- **Diesel** versus, **electrical** versus **hybrid** traction

Thank you for your Attention

Energy Efficiency the best fuel to move our trains

“It always seems impossible until it's done.”

Nelson Mandela