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Foster Rail Energy and Environment

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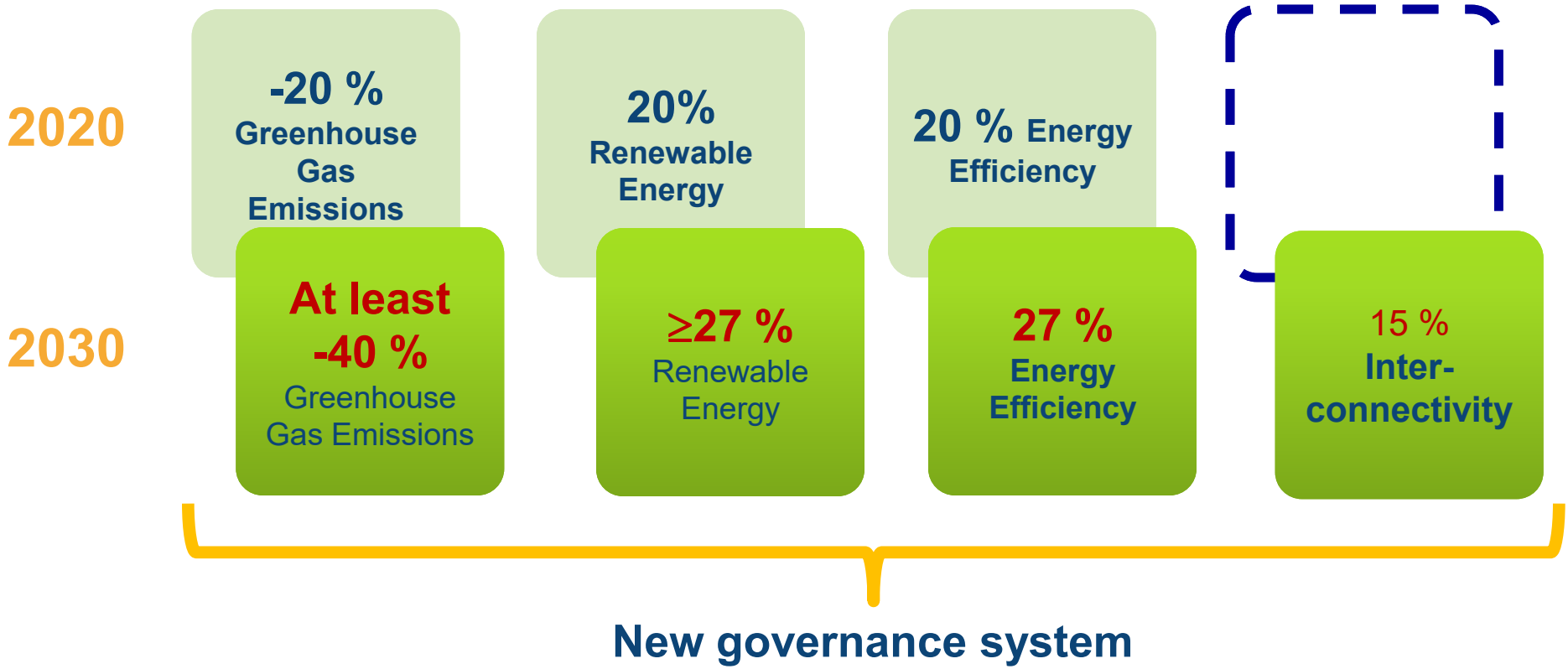
The UIC-CER Strategy of the European railway sector for 2030 and beyond

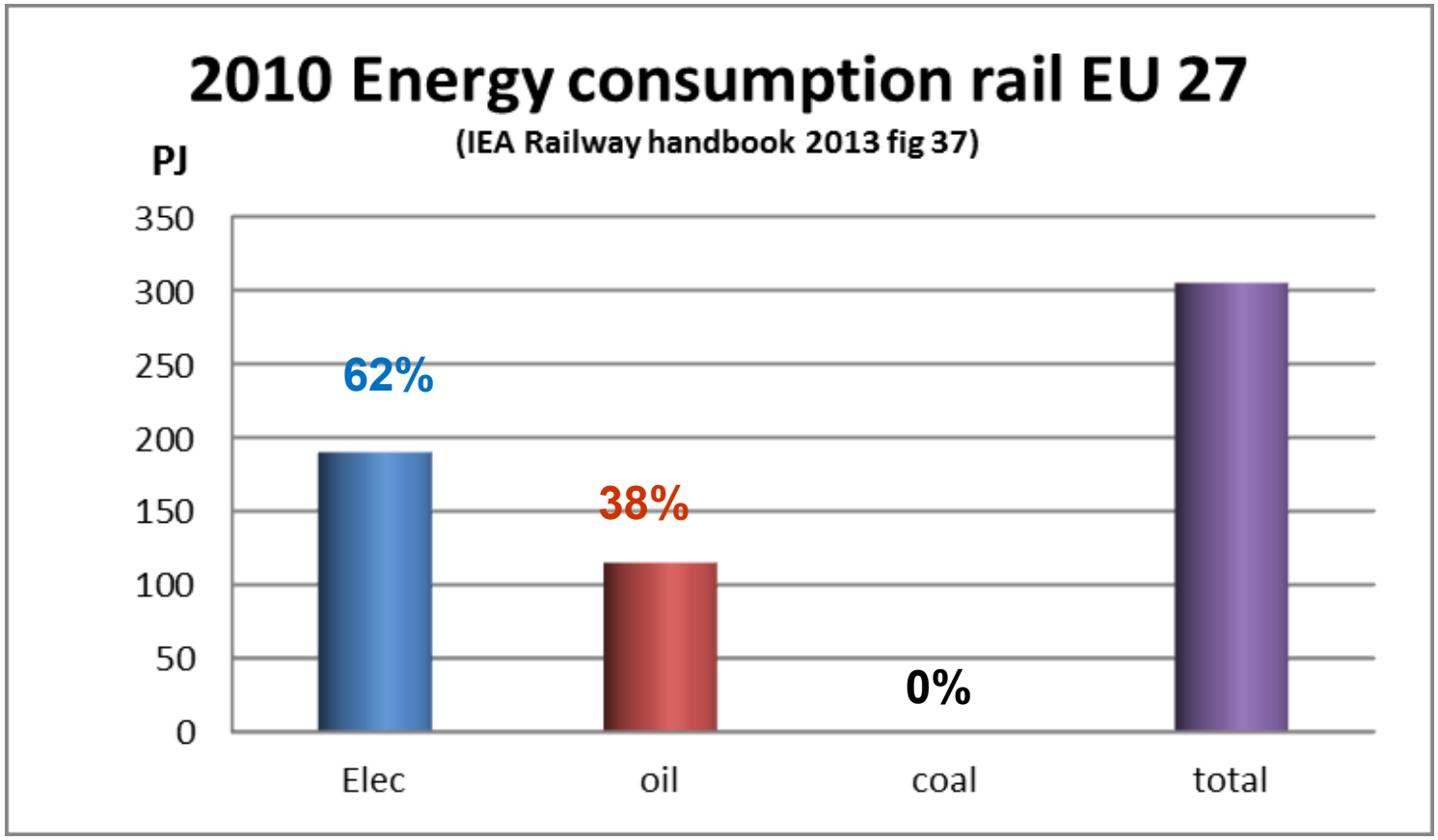
- **targets for which UIC monitor and report progress:**
- Climate Protection
- Energy Efficiency
- Noise and Vibrations
- Energy Efficiency
  - -30% pkm and tkm (2030)
  - -50% pkm and tkm (2050)

European Council (Oct 2014) conclusions: Short and Mid Term targets



EU27 rail (final) energy consumption

A cost of about 7 Billion EUR/year



Method of improvement = the introduction of measurement

- *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

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, (pre) heating, (pre) cooling, lighting, ventilation, automatic closing of doors
- Regenerative braking
- Infrastructure:
  - efficiency of substations, transmission and overhead contact lines, optimization of speed profiles, energy storage
- traction
  - Diesel - Electrical - Hybrid

Drivers for energy efficiency

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

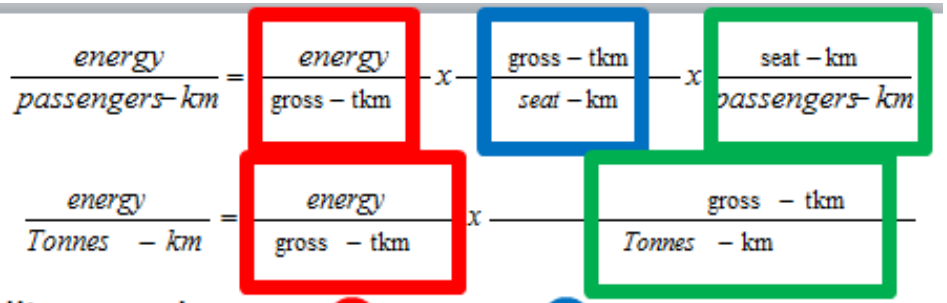
- Average mass per seat (mass of traction units included) varies from about 400 kg/seat to 1050 kg/seat
- Design of rolling stock
  - double stock, bogies between coaches,….
- Material:
  - steel, aluminium, composite
- Type of train service:
  - HST, IC, local

Drivers for energy efficiency

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

- = inverse of load factor:
  - a KPI for the efficiency of any transport service

What and how it is possible to make changes



1. Energy efficient rolling stock
2. Traffic Management System
3. Load factor
4. Non traction energy consumption
5. Electric traction Supply
6. Procurement of rolling stock
7. Planning
8. Diesel
9. Ecodriving and DAS

Energy efficient rolling stock

- Aerodynamics
  - *Increasing the aerodynamic performance of rail vehichles can reduce energy consumption up to 8% for regio and 15% for HS (Bombardier)*
- Engines:
  - Permanent Magnet Motors *improved motor efficiency*
- Fuels:
  - *testing phase Liquid Natural Gas (LNG) instead of Diesel The First Main Line Liquid Gas-Turbine Locomotive: and became lower than EC2012 requirements*
- Weight:
  - *Composite/plastic bodyshells*

Energy efficient rolling stock

- Mechatronics
  - on running gear (steering), this to include self adapting and adjusting capability (as per aerospace) to dramatically reduce wear

- Traffic Management System:
  - Reduction of losses in acceleration and braking sequences
  - Increase of network capacity through accurate driving recommendations

Procurement of rolling stock:

- TecRec100_001 / TS/ now to be converted to EN
  - Specification and verification of energy consumption for railway rolling stock
  - It provide a methodology to measure energy consumption for RS so that measurements over time of for differenct types of RS are comparable.
- Load Factor:
  - To implement different fares to improve occupation rates;
  - modular train composition;
  - Tariff differentiation as an incentive to travel outside the rush hours
- Non traction energy consumption
  - Natural ventilation / PV Systems / New HVAC/LED lighting/ Energy Efficiency in Planning (Influencing energy efficiency at an early stage) - optimised train sizes

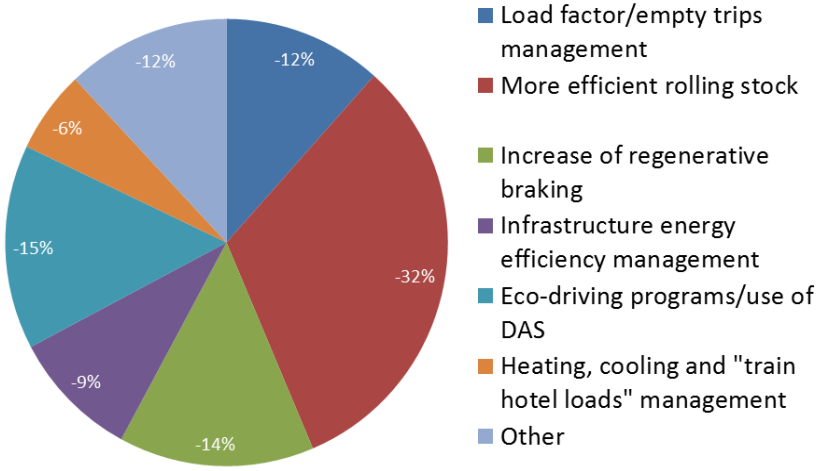
UIC Survey of Energy Driver

the past 15 years **the future 15 years**

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

Main driver: More efficient rolling stock

Attributable reduction of passenger specific energy consumption, 2012

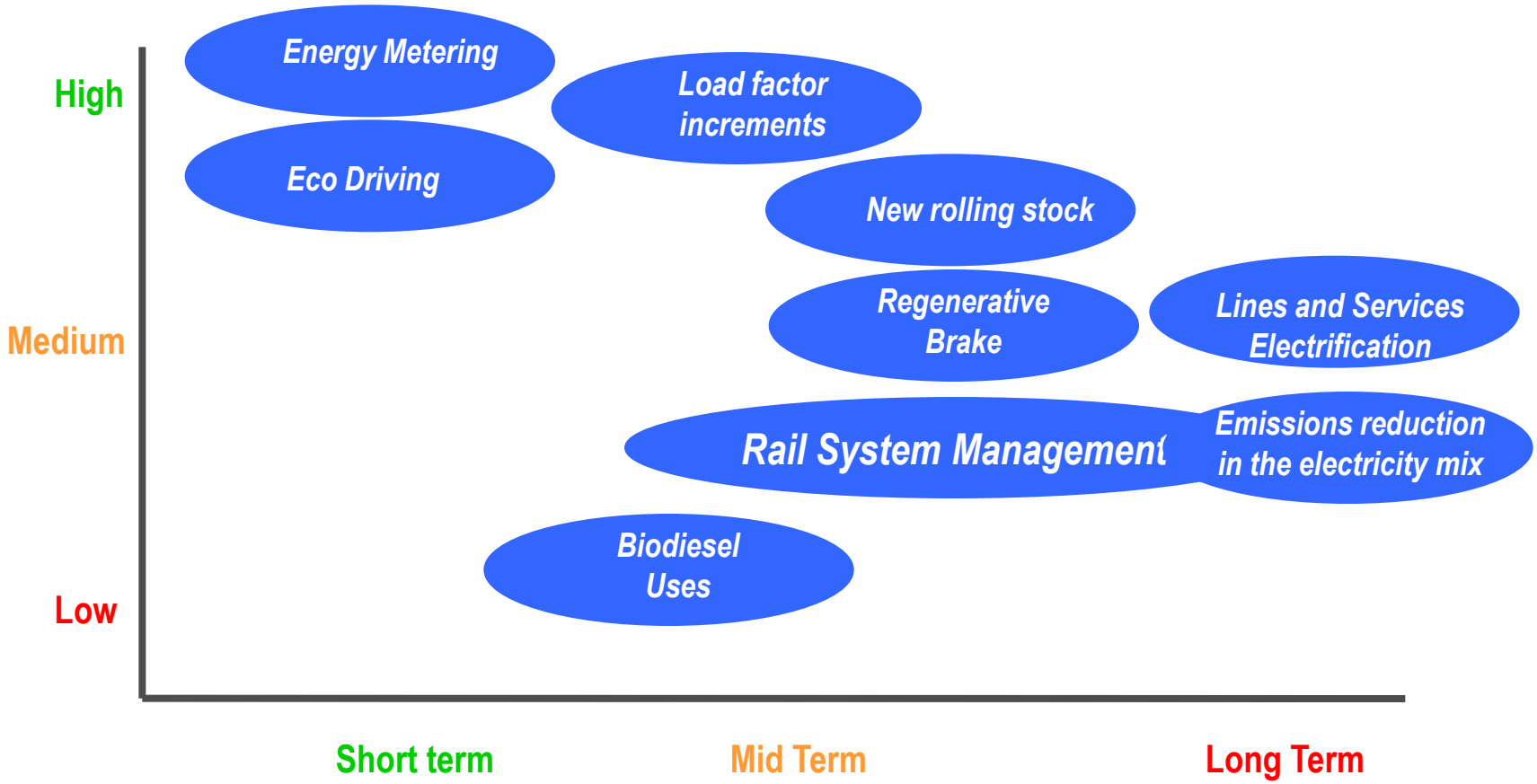


Main driver: load factor

Secondary drivers

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

Energy Management in Rail



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Thank you for your attention

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