Low Carbon Technologies for Heavy Duty Vehicles

Prof. Neville Jackson

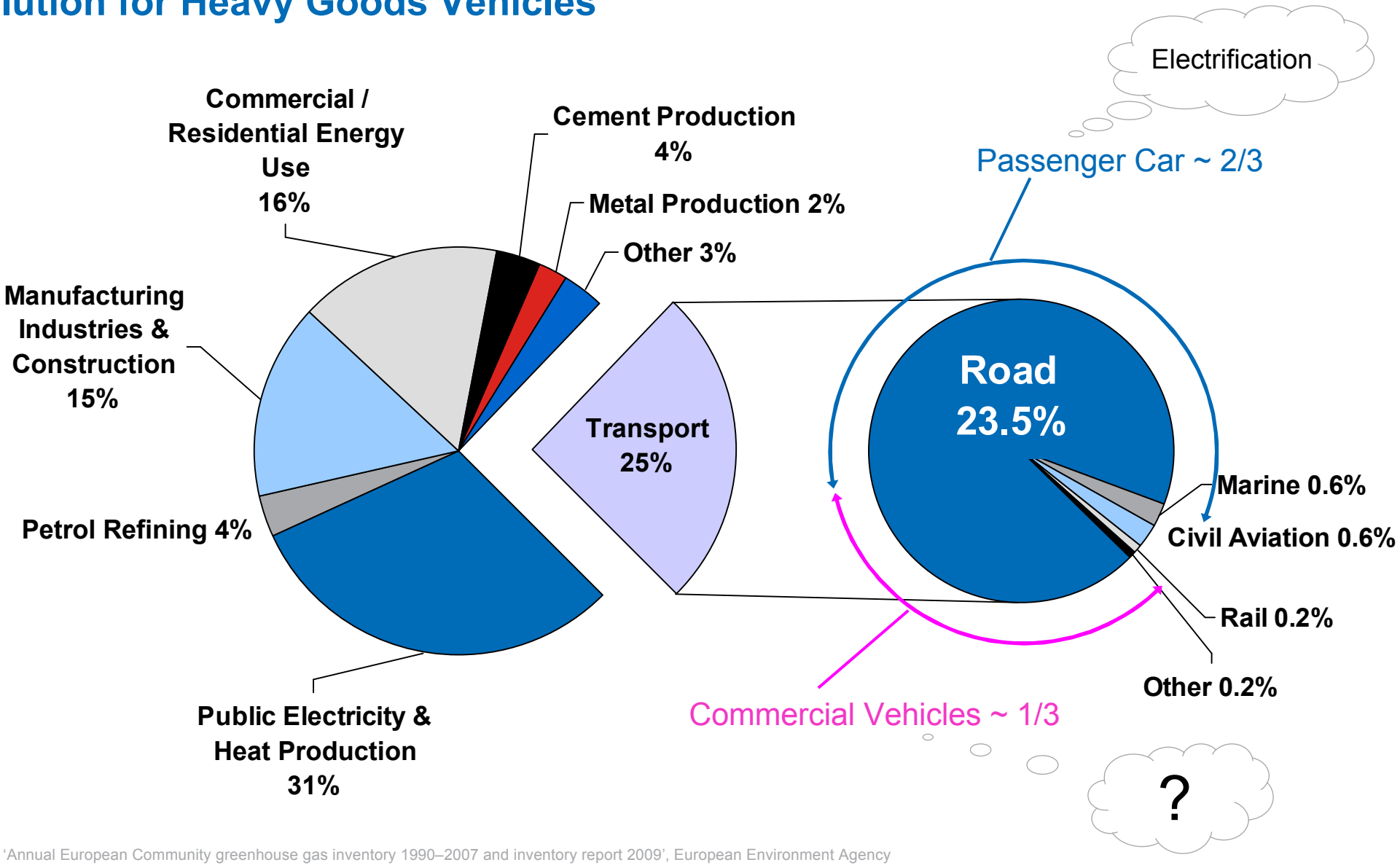
Ricardo plc

International Transport Forum

Innovation in Road Transport

Opportunities for Improving Efficiency

Road Transport accounted for 23.5% of man-made CO_2 emissions in 2007 & has been increasing since 1990 – Electrification not a solution for Heavy Goods Vehicles



Source: 'Annual European Community greenhouse gas inventory 1990–2007 and inventory report 2009', European Environment Agency

Commercial Vehicle Technology Assessment followed 3 stage process and applied to both Medium & Heavy Duty applications

3 Stage Assessment Process:

1. **Technology Identification (Initial Screening)**
2. **Feasibility Analysis (limitations, CO_2 benefits & Costs)**
3. **Technology Summary (Comparative Assessment)**

2 Applications:

Medium Duty (7.5t)

Heavy Duty (>32.5t)

Technology Areas Assessed

Vehicle

Aerodynamics:	Fairings
	Trailers
	Spray suppression
Rolling Resistance:	Low Res. Tyres
	Single Wide Tyres
	Auto Tyre Pressures
Driver/ Control:	Predictive Cruise
	Platooning
	Driver Behaviour

Powertrain

Efficiency:	Combustion
	Friction
	Ancillaries
	Gas Exchange
	Waste Heat Use
	Trans/Driveline
Alternatives:	Fuel cells
	Battery Electric
	ICE/Elec Hybrids

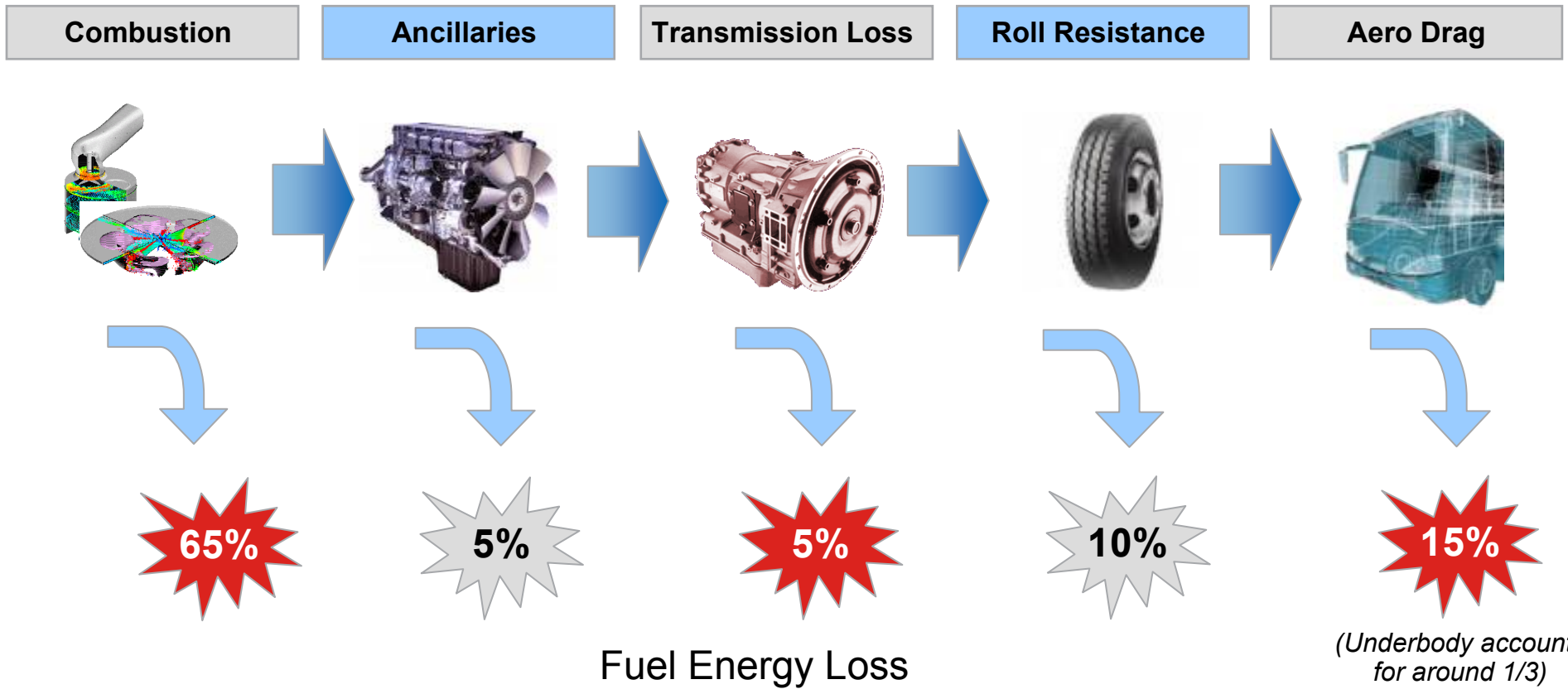
Fuel

Alternatives:	Natural Gas
	Biofuels
	Biogas
	Electricity
	Hydrogen

Typical energy flow losses for a Heavy Duty vehicle at 100 km/h show opportunities to improve engine efficiency, ancillaries, transmission, aerodynamics and rolling resistance

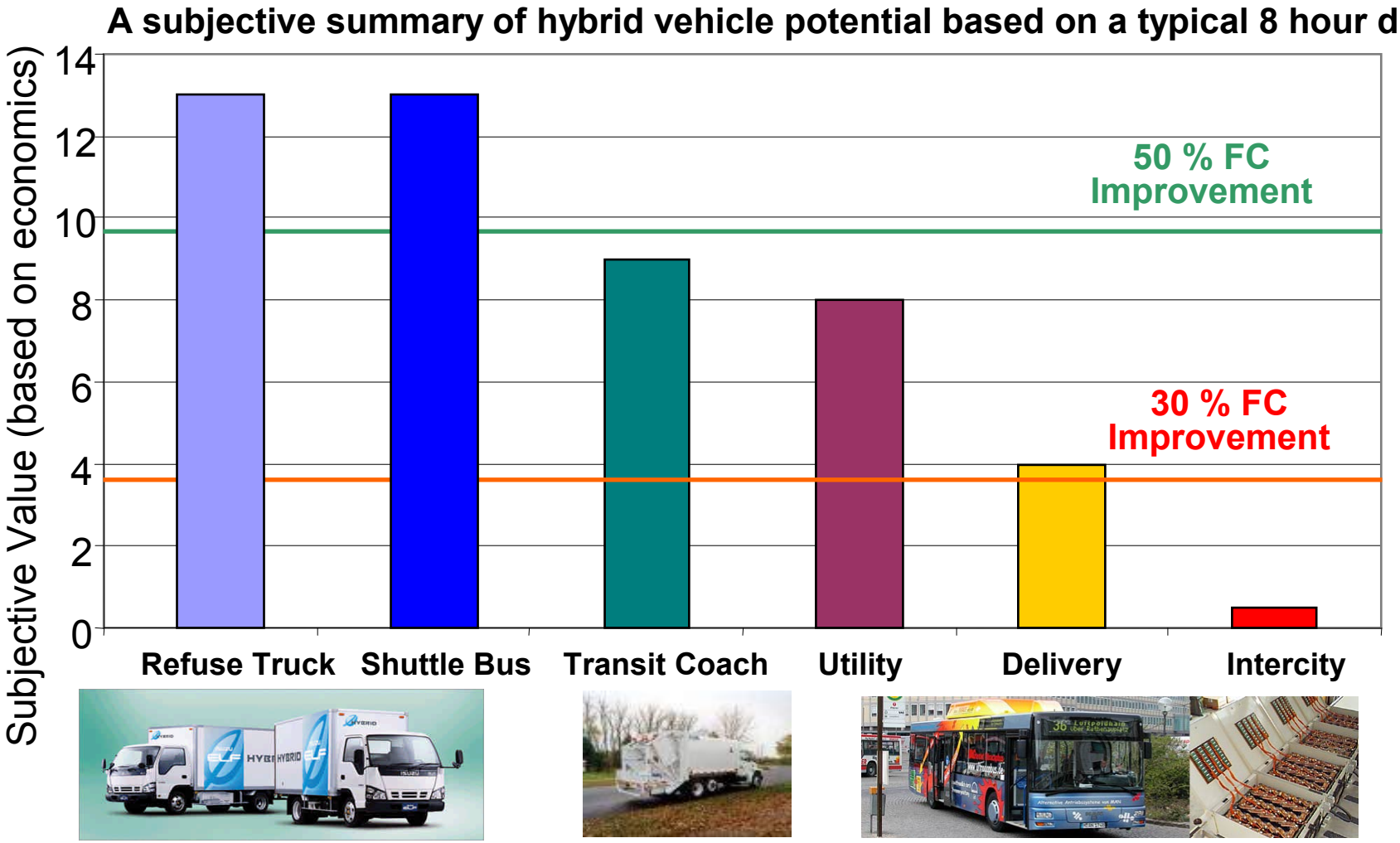
Analysis of Vehicle Energy Flows (Heavy Duty Example)

- From the total amount of fuel used (at 100km/h), the energy flows are as follows:



Source: Ricardo analysis

Hybrid technology can be applied to commercial vehicle applications – Benefits depend on drive cycle as for passenger vehicles

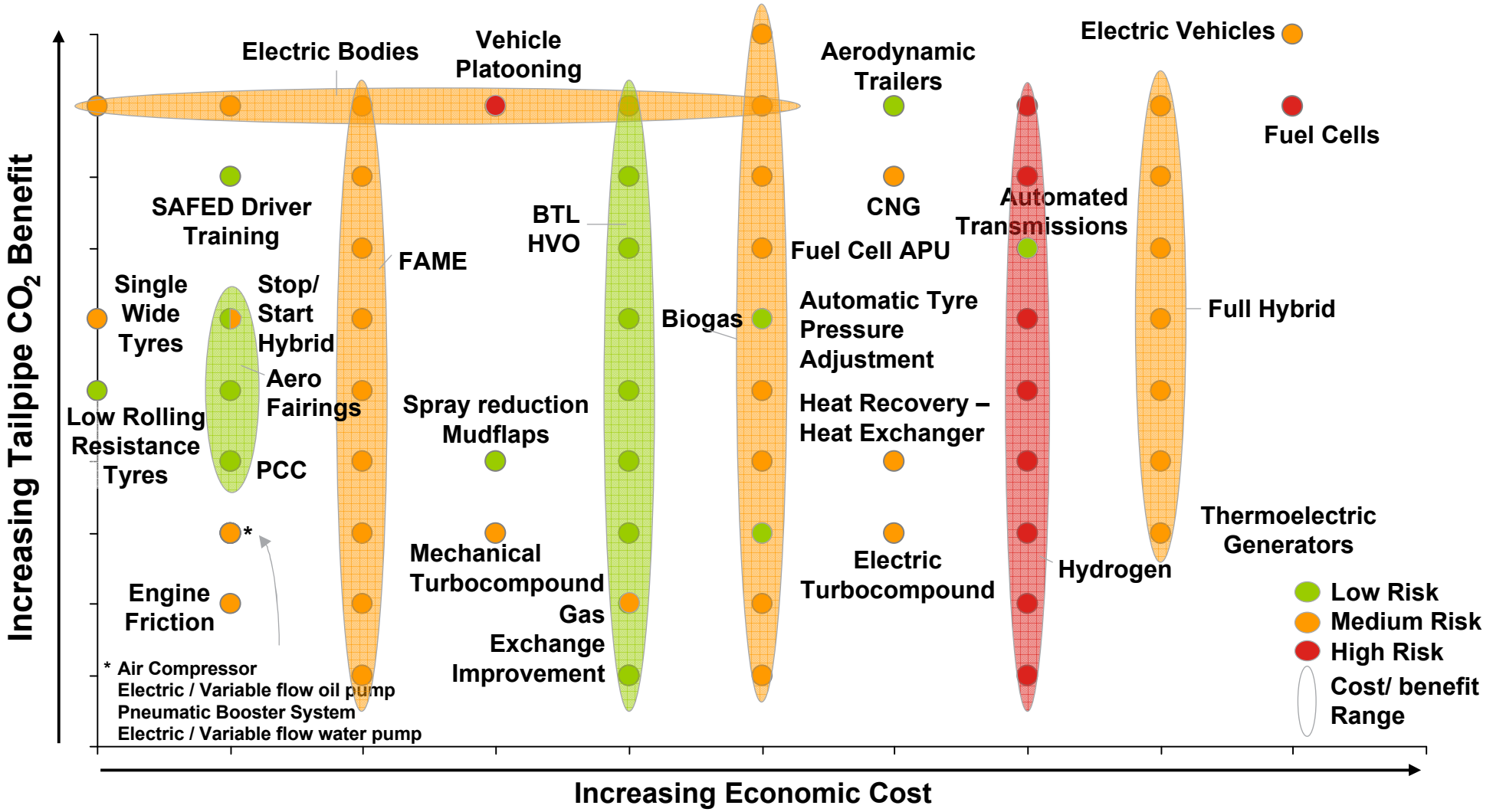


- Key issue for Hybrid Commercial vehicles remains difficulty in business case:
  - Savings in fuel costs must be greater than extra purchase/lease and maintenance of Hybrid compared with conventionally fuelled vehicles

Source: Ricardo analysis

Comparison of CO_2 benefit v costs reveal complex application specific interactions – Trials are required to prove benefits

Cost vs. Benefit of Low Carbon Technologies



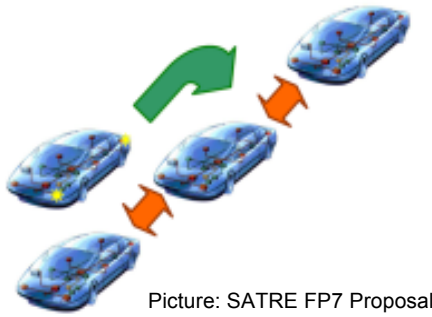
Electric/Alternative fuel bodies, Platooning & Driver Training all show attractive cost/benefit but with varying maturity and risks

Electric/ Alternative Fuel Bodies

- **Concept:** Replacement of existing power sources for vehicle bodies which use diesel for power
- **CO_2 Benefit:** Varies between 10% and 20% depending on the body power system being replaced
- **Costs:** Up to 15% vehicle on cost but depends on technology

Vehicle Platooning

- **Concept:** Vehicle driving in close proximity to each other to create a train
- **CO2 Benefit:** In the region of 20% for motorway speeds
- **Costs:** Anticipated costs of around £305 – £1,600 for additional sensors and active safety features required



Picture: SATRE FP7 Proposal

Driver Behaviour

- **Concept:** Driver training for improved fuel economy and safety
- **CO2 Benefit:** Varies with driver but averages at circa 10%. effectiveness reduces after initial training
- **Costs:** UK SAFED training varies from £150 to £300 per session

SAFED SAFE AND FUEL EFFICIENT DRIVING

Picture: SAFED logo (www.safed.org.uk)

Full Report: http://www.dft.gov.uk/pgr/freight/lowcarbontechnologies/lowcarbon.pdf