Sustainable Logistics

A European Perspective

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Dilemma for the EU

Reconciling economic and environmental objectives

Environmental sustainability

Reducing carbon emissions

20% reduction in CO_2 below 1990 level by 2020

Improve vehicle utilisation

Shift mode to rail and water

Increase energy efficiency of transport
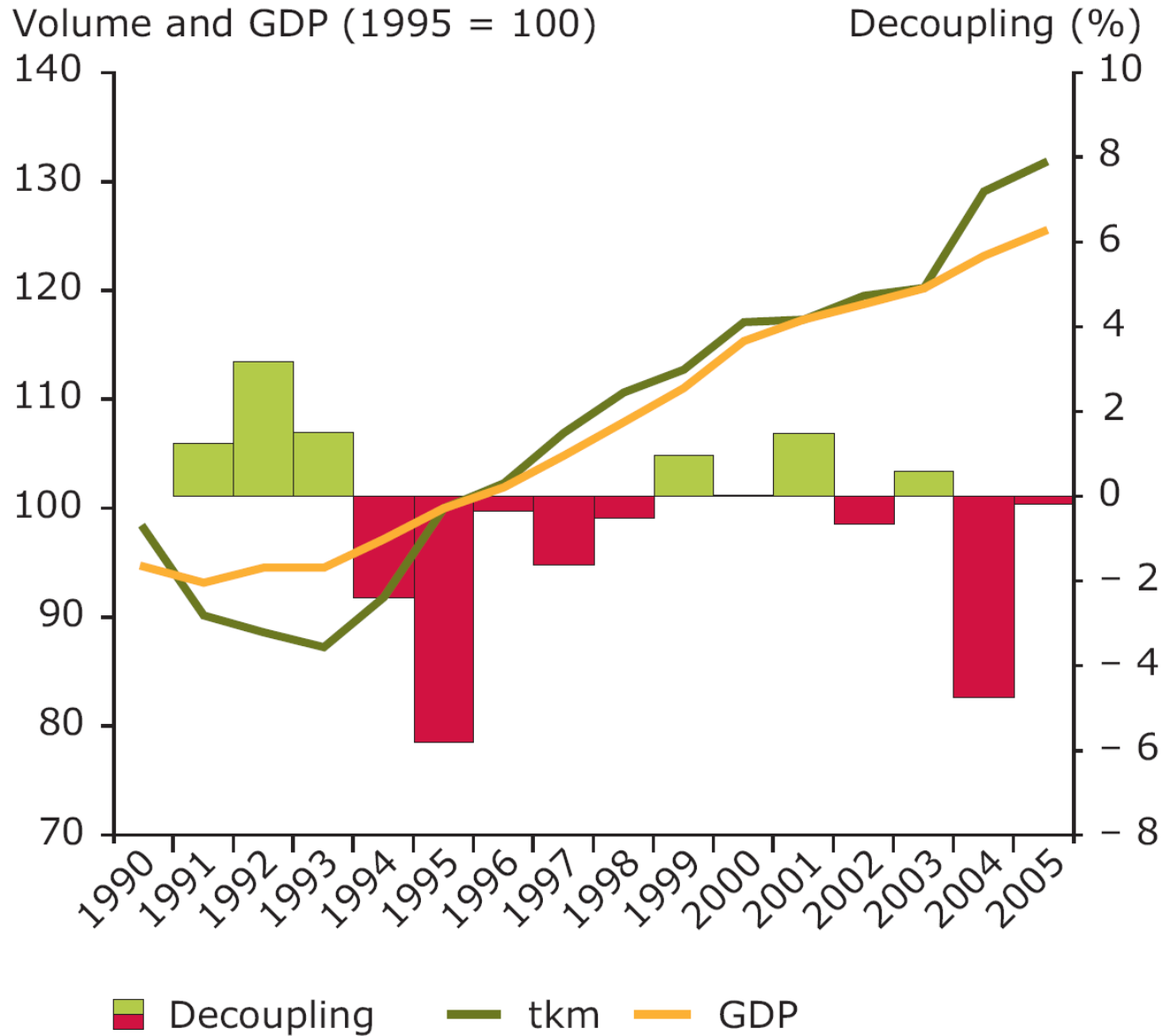
Reduce carbon content of fuels

Increasing freight transport intensity
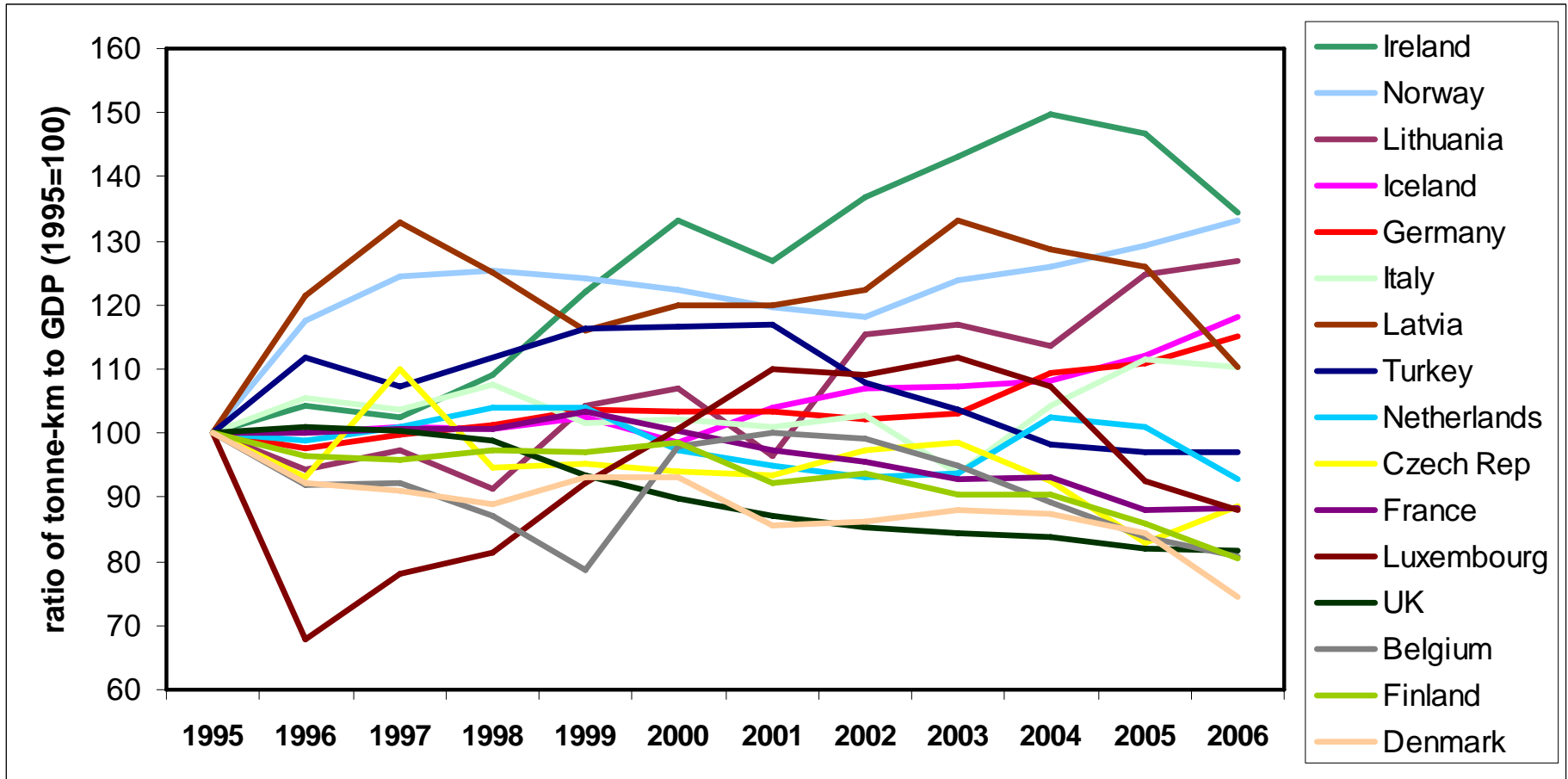
Greater prosperity

Economic integration

Geographical enlargement

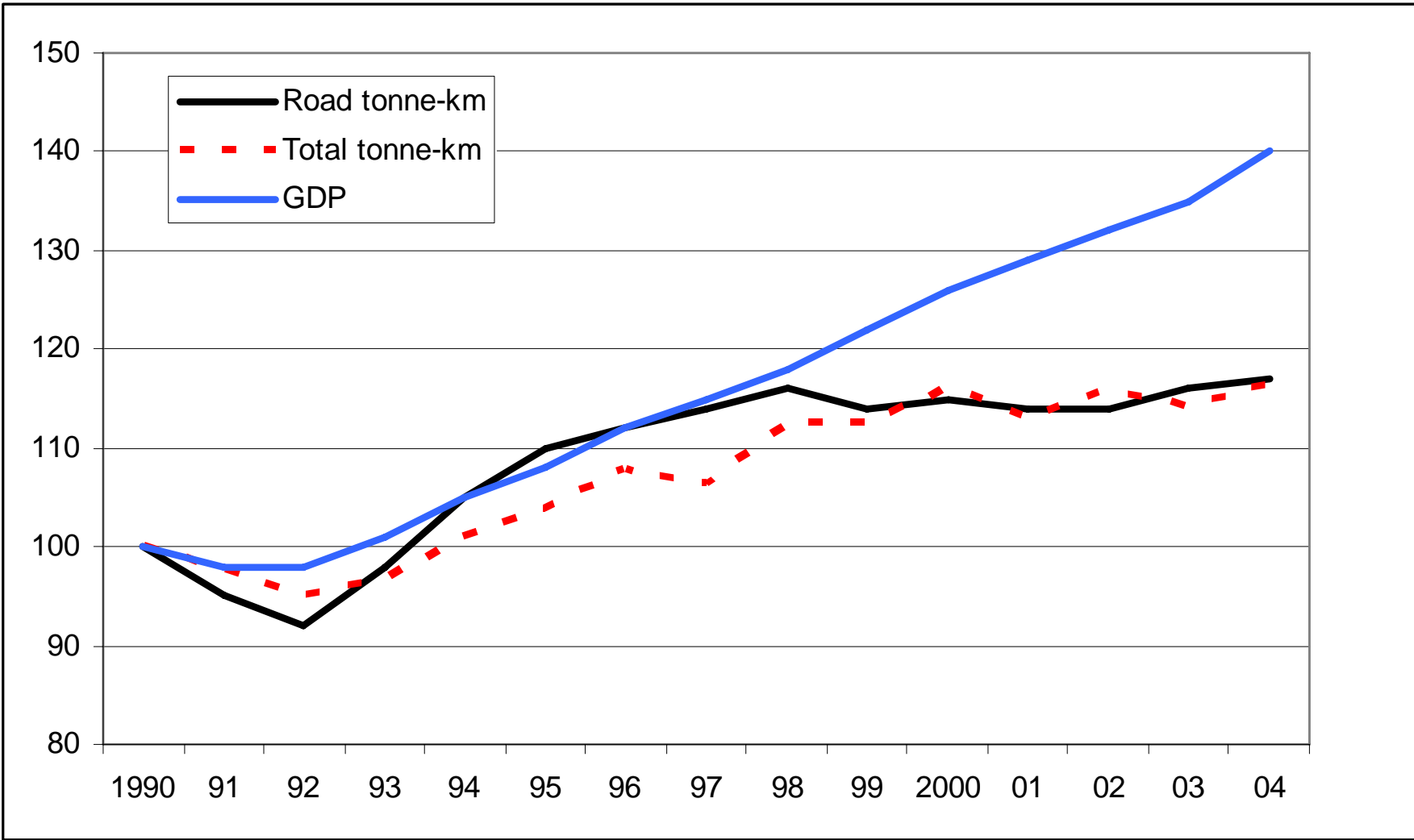# Relationship between Tonne-kms and GDP (EU15)

Freight Intensity of the EU Member States

Source: Eurostat

Why do the freight intensity trends vary so much between EU countries?

Decoupling of Tonne-km and GDP trends: UK

Off-shoring of Manufacturing and the Upstream Supply Chain

supplier ▢
warehouse ●
processing plant ■
retail distribution centre ■
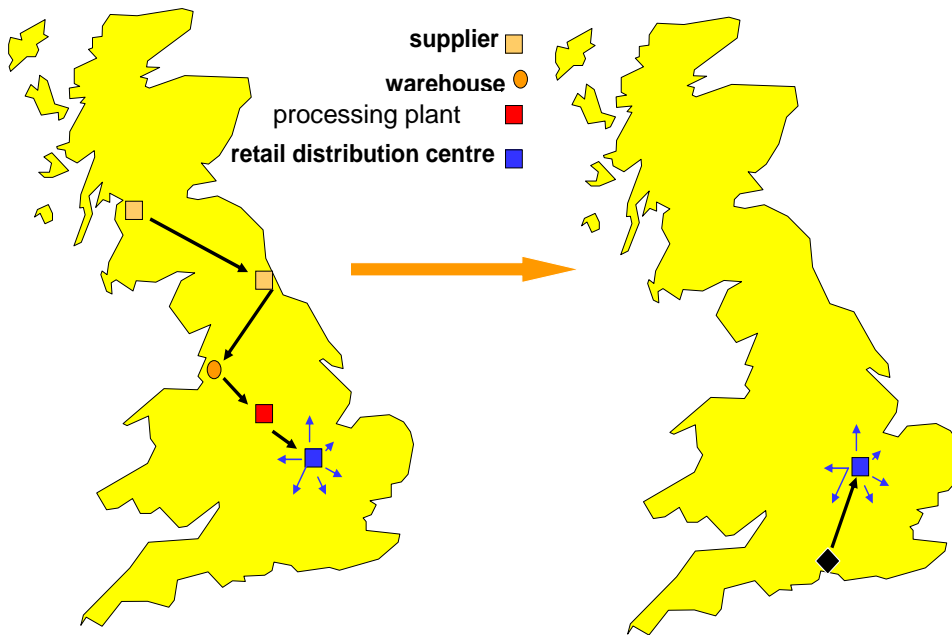
Export of carbon-generating activities reducing UK's 'carbon footprint'

Embedded carbon in imported products

UK's contribution to external GHG emissions

Greenhouse gas emissions (MtCO2e)

☐ Kyoto emissions ☐ Net emissions from tourism ☐ Net imports of carbon ☐ Bunker emissions

Source: Helm, Smale and Phillips, 2007
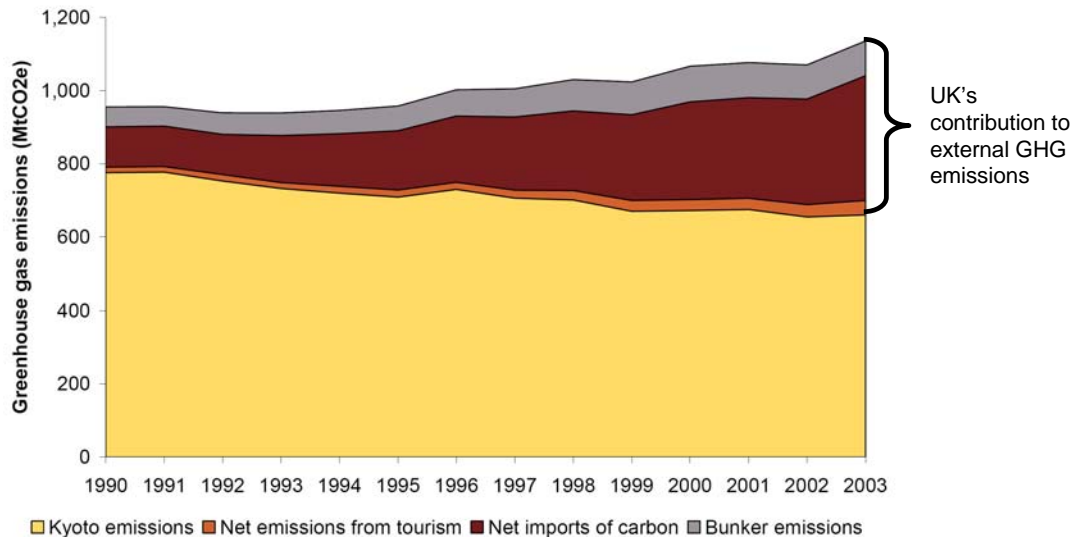
Decarbonisation Framework for Freight Transport ('9-lever model')

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modal split

| Weight of goods produced / consumed |

Similar analyses for other modes

modal split

| Weight of goods transported by road |

average handling factor
number of links

| Road tonnes-lifted |

supply chain structure
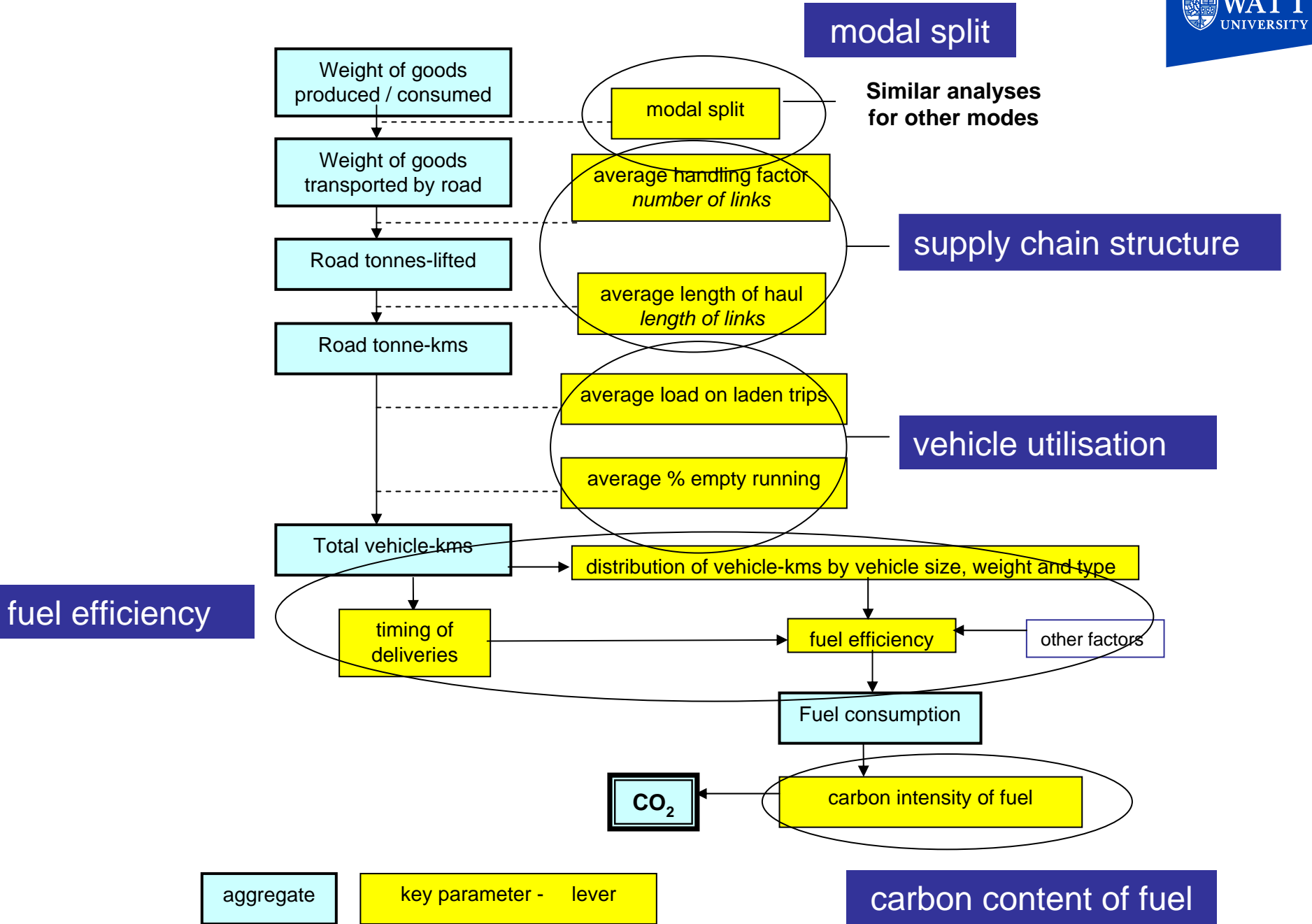
average length of haul
length of links

| Road tonne-kms |

average load on laden trips

vehicle utilisation

average % empty running

| Total vehicle-kms |

distribution of vehicle-kms by vehicle size, weight and type

fuel efficiency

timing of deliveries

fuel efficiency

other factors

| Fuel consumption |

CO$_2$

carbon intensity of fuel

| aggregate | key parameter - lever |

carbon content of fuel

Freight Transport CO_2 : Aspirational Scenario for UK 2015

Baseline 2004

Volume of freight movement (tonne-kms)   + 7%

Modal shares of tonne-kms
road: 59.5 → 55.7%
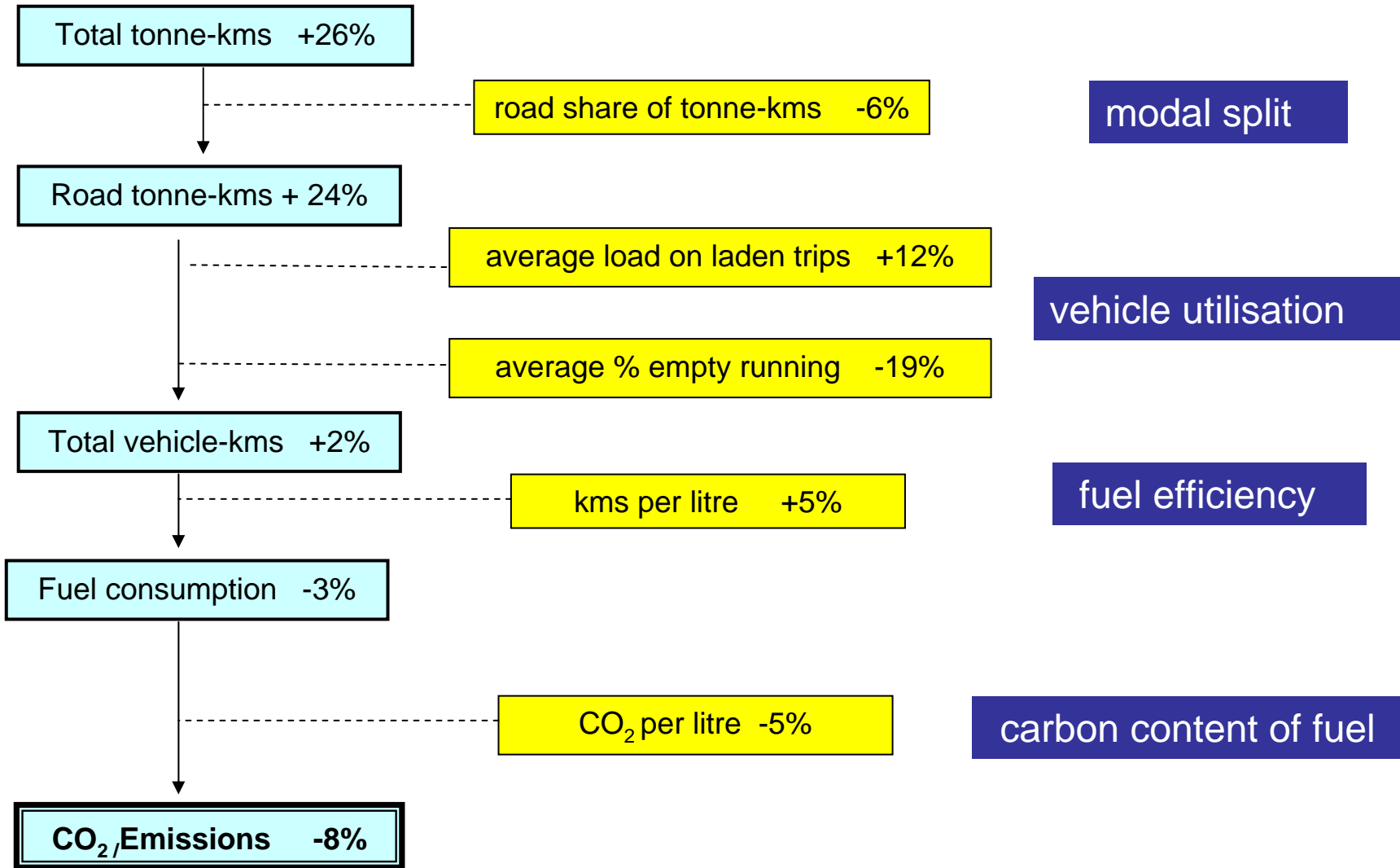rail: 8.6 → 10.4%
water: 23.7 → 24.4%

27% reduction in CO_2

Fuel efficiency:
Lorries +10%
Vans   + 5%
Rail   +10%

Vehicle utilisation
Lorries   + 10%
Vans   + 25%
Rail   + 10%
Water   + 10%

Carbon intensity of fuel
Lorries -10%
Vans   -20%

Source: McKinnon / Commission for Integrated Transport 2007

UK Delphi Survey of 100 Logistics Specialists: *Projection 2006-2020*

Total tonne-kms   +26%

↓ ········ road share of tonne-kms   -6%   **modal split**

Road tonne-kms + 24%

↓ ········ average load on laden trips   +12%

vehicle utilisation

········ average % empty running   -19%

Total vehicle-kms   +2%

↓ ········ kms per litre   +5%   **fuel efficiency**

Fuel consumption   -3%

↓ ········ CO_2 per litre -5%   **carbon content of fuel**

CO_2 Emissions   -8%

Source: Piecyk and McKinnon, 2008

Levels of Logistical Decision-making

STRATEGIC: numbers, locations and capacity of factories and warehouses

Restructuring of logistical systems

COMMERCIAL: trading links to suppliers, customers and sub-contractors

Reconfiguring supply chains

OPERATIONAL: scheduling of production and distribution operations

Rescheduling of freight flows

FUNCTIONAL: day-to-day management of the logistics function

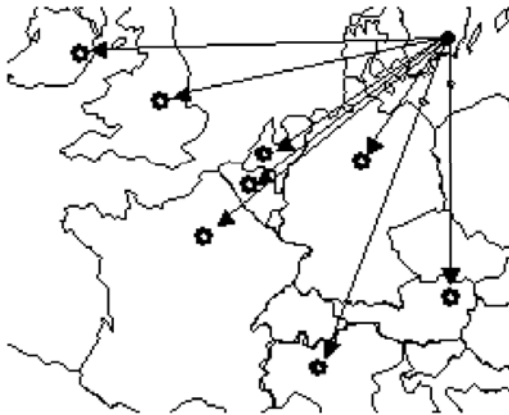Changes in the management of freight transport

Interaction between decisions at different level determines volume of freight traffic and related externalities

Green measures implemented at lower levels offset by effects of higher level strategic decisions

Environmental Trade-offs in Strategic Logistics Decisions

ITT Flygt – manufacturer of submersible pumps and mixers

Decentralised distribution system | Centralised distribution system

	Decentralised	*Centralised*
Average length of haul	1512 km	2153 km
Total tonne-kms	2.2 million	2.9 million
CO_2 emissions	92.2 tonnes	131.1 tonnes

Source: Kohn 2005

Modelling Energy / CO_2 Trade-offs between Transport, Warehousing and Inventory

Potential CO_2 Benefits from Inventory Centralisation:

Lower inventory levels:

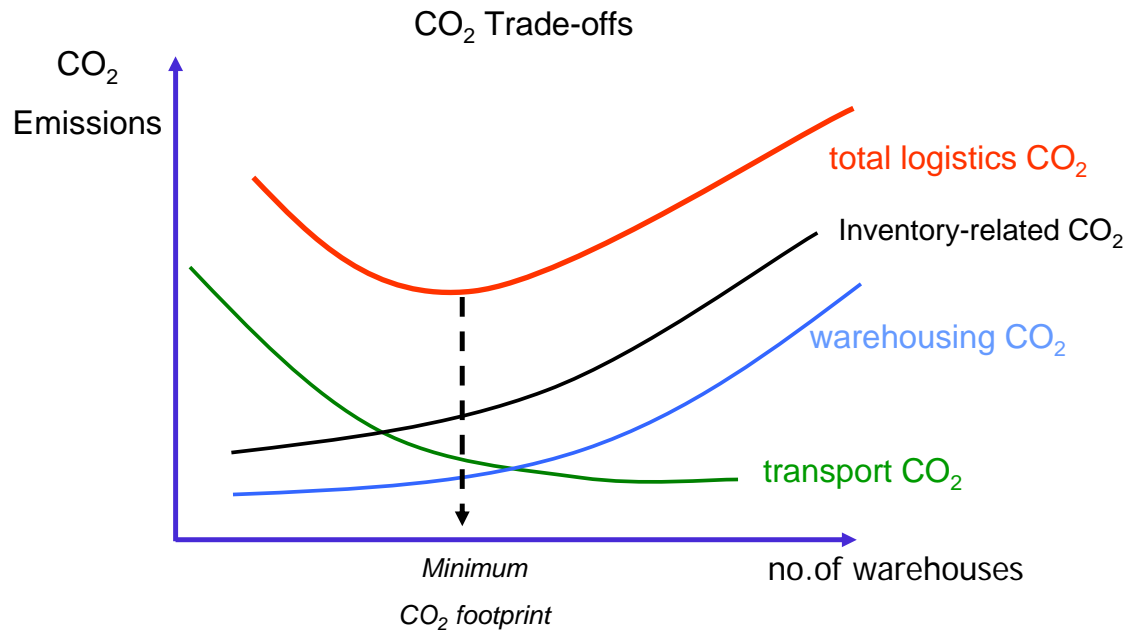   *less energy use in storage (heating, refrigeration, lighting etc.)*
   less wastage of product

Less warehouse space required:

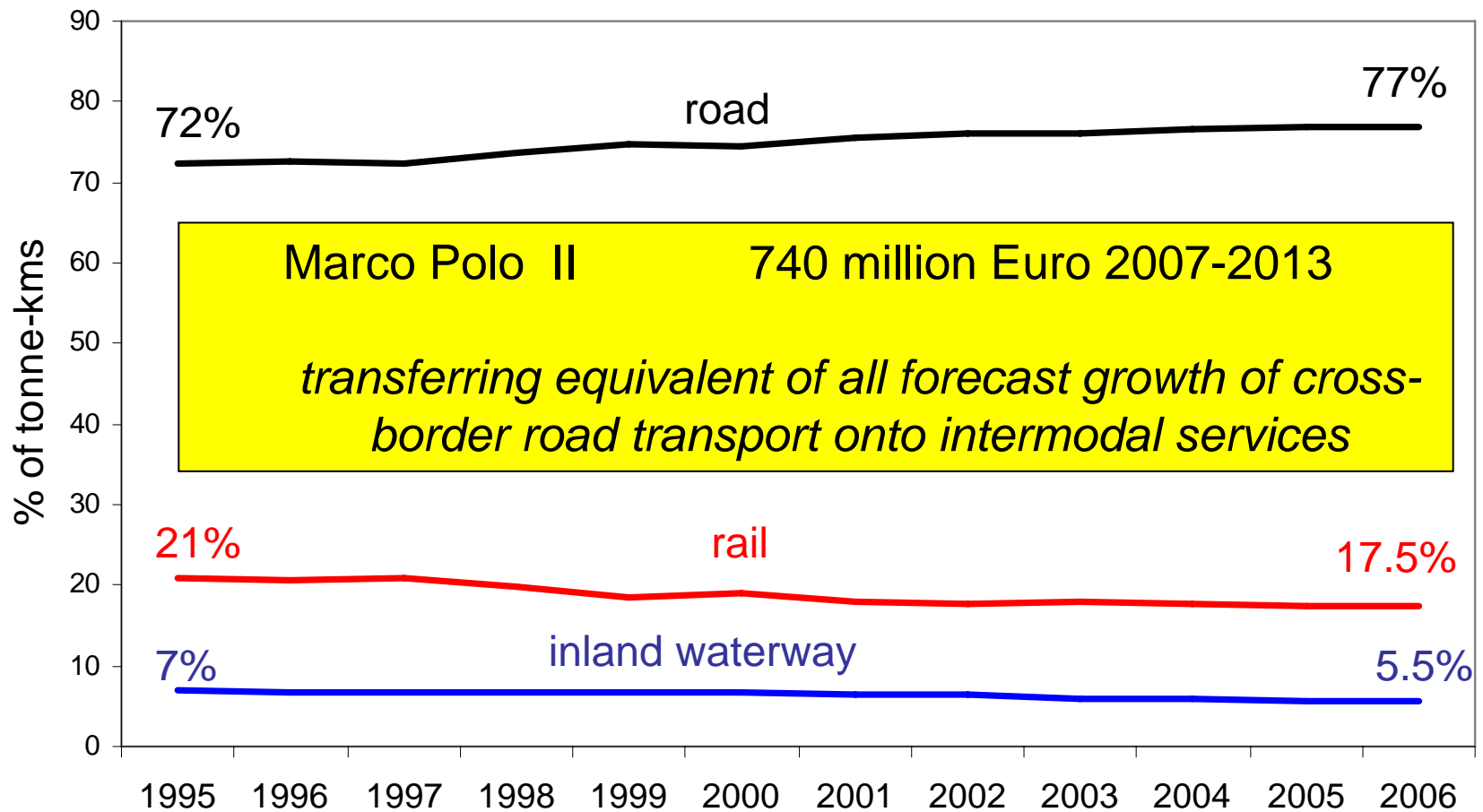   *less CO_2 in construction, operation and maintenance*

Larger warehouses can be more energy efficient:
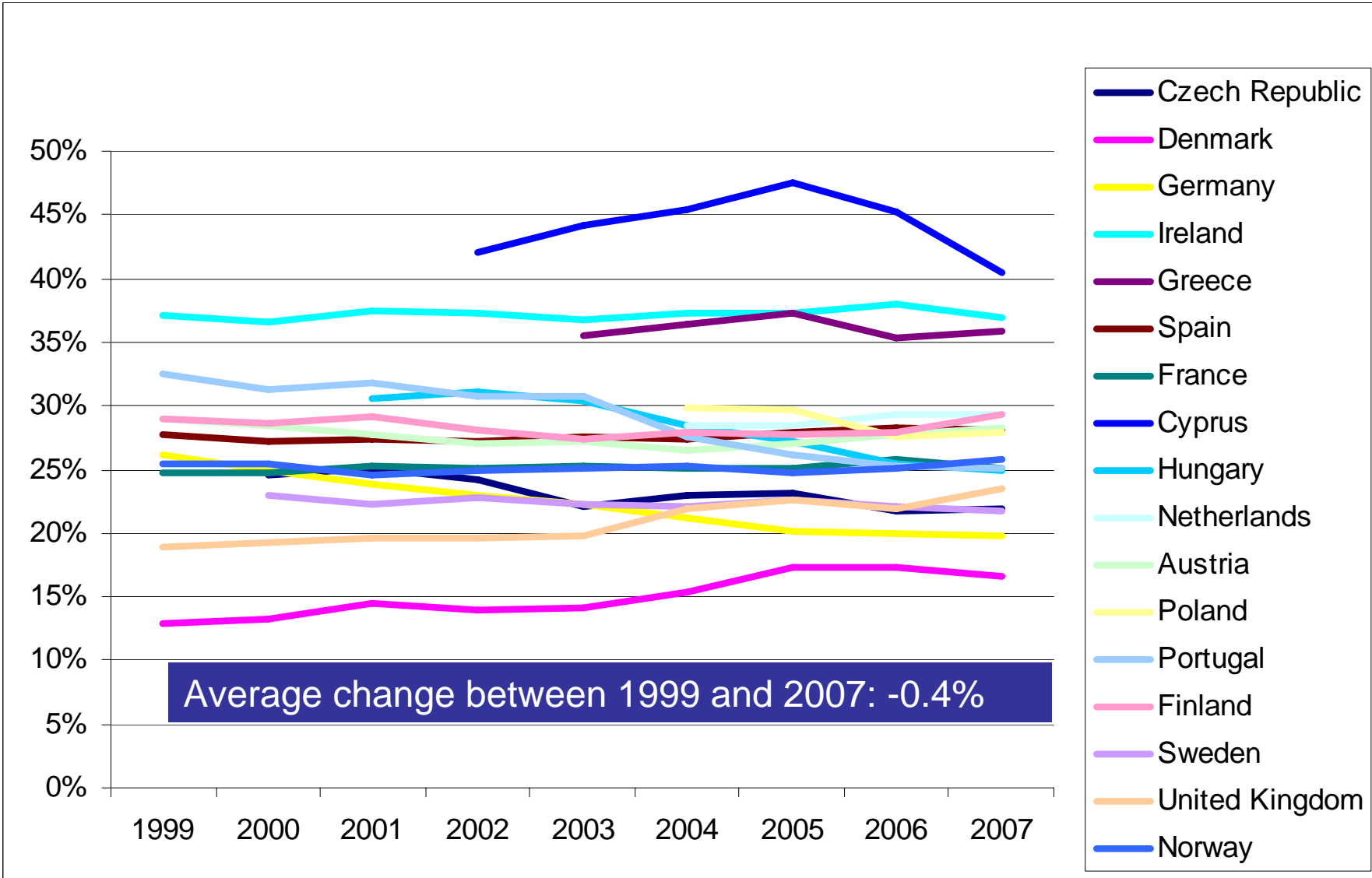
   emit less CO_2 per unit of throughput

CO_2 Trade-offs

CO_2 Emissions — no. of warehouses

total logistics CO_2

Inventory-related CO_2

warehousing CO_2

transport CO_2

Minimum

CO_2 footprint

Modal Shift to Road (EU25)

% of total inland freight tonne-kms

y-axis: % of tonne-kms (0 to 90)

road: 72% (1995) → 77% (2006)

Marco Polo II   740 million Euro 2007-2013

transferring equivalent of all forecast growth of cross-border road transport onto intermodal services

rail: 21% (1995) → 17.5% (2006)

inland waterway: 7% (1995) → 5.5% (2006)

x-axis: 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006

Source: Eurostat

% of truck kms run empty in European countries

Average change between 1999 and 2007: -0.4%

Legend:
- Czech Republic
- Denmark
- Germany
- Ireland
- Greece
- Spain
- France
- Cyprus
- Hungary
- Netherlands
- Austria
- Poland
- Portugal
- Finland
- Sweden
- United Kingdom
- Norway

Source: Eurostat

Average payload weight on laden trips

European countries

Average change 1999-2007: +6%

Average payload weight in 2007: 10.3 tonnes

Legend:
- Belgium
- Bulgaria
- Czech Republic
- Denmark
- Germany
- Estonia
- Ireland
- Greece
- Spain
- France
- Italy
- Cyprus
- Latvia
- Lithuania
- Luxembourg
- Hungary
- Netherlands
- Austria
- Poland
- Portugal
- Romania
- Slovenia
- Slovakia
- Finland
- Sweden
- United Kingdom
- Norway

Source: Eurostat

Factors constraining vehicle loading

Categories		Factors
Market-related		**Demand fluctuations**
		Lack of knowledge of backloading opportunities
Regulatory		**Health and safety regulations**
		Vehicle size and weight restrictions
Inter-functional		**Unreliable delivery schedules**
		Just-in-Time delivery
Infrastructural		**Goods handling requirements**
		Limited capacity at facilities
Equipment-related		**Incompatibility of vehicles and products**
		Poor coordination of purchasing, sales and logistics

Increases in Maximum Truck Weight since 1945
Weight limits for domestic road freight operations
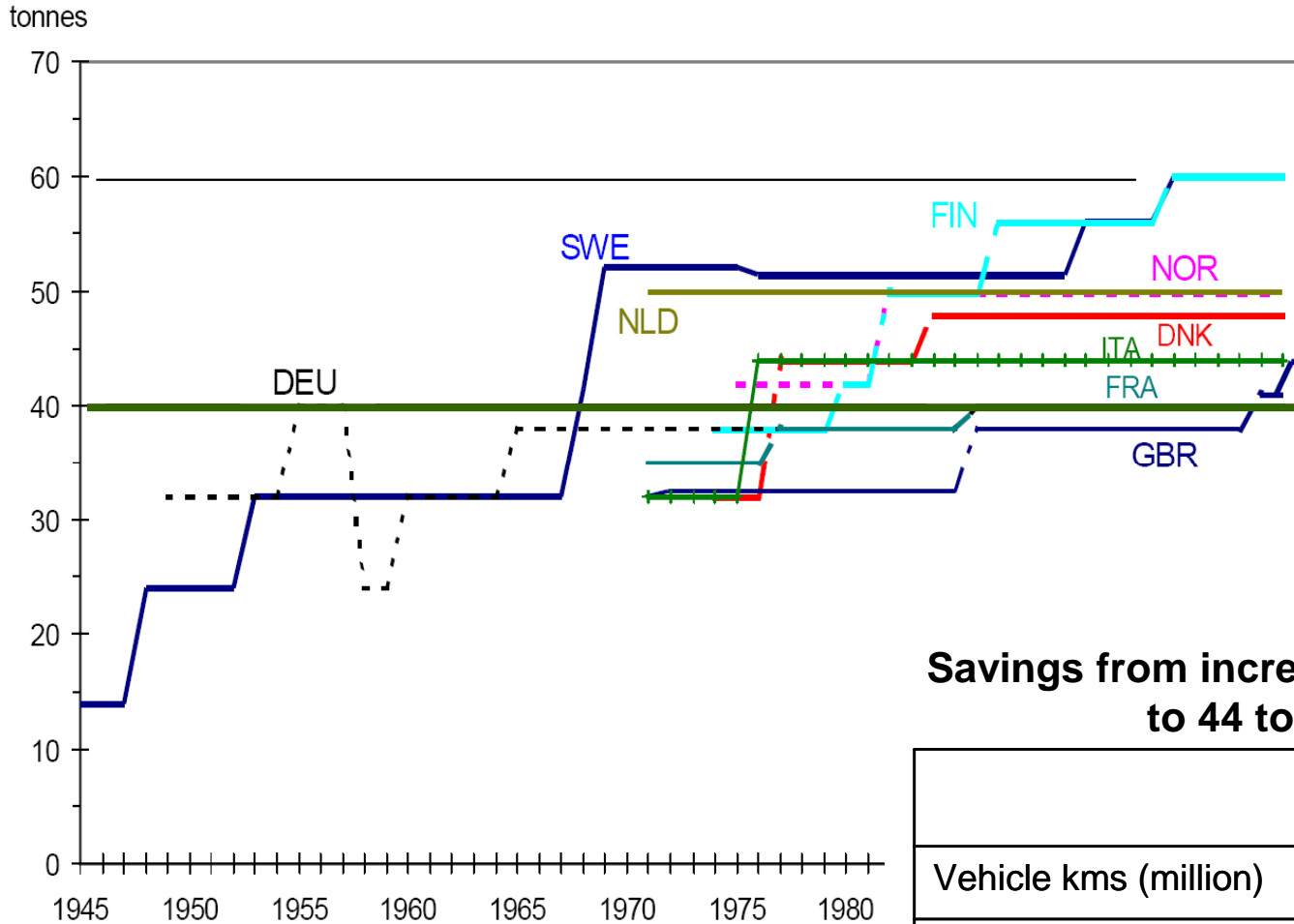
Cross-border movements 40 tonne limit

Savings from increase in maximum weight to 44 tonnes in 2001

	2003	*2007*
Vehicle kms (million)	134	170
Operating costs (£m)	110	140
Fuel saving (m litres)	51	65
CO_2 ('000 tonnes)	136	173

% of Loads Constrained by Volume and Weight in the UK

Chart: Weight-constrained vs Volume-constrained

Vehicle type	Weight-constrained	Volume-constrained
Drawbar	~49%	~46%
Artic 32-38T	~9%	~45%
Artic >38 T	~27%	~59%

Legend: ■ Weight-constrained ■ Volume-constrained
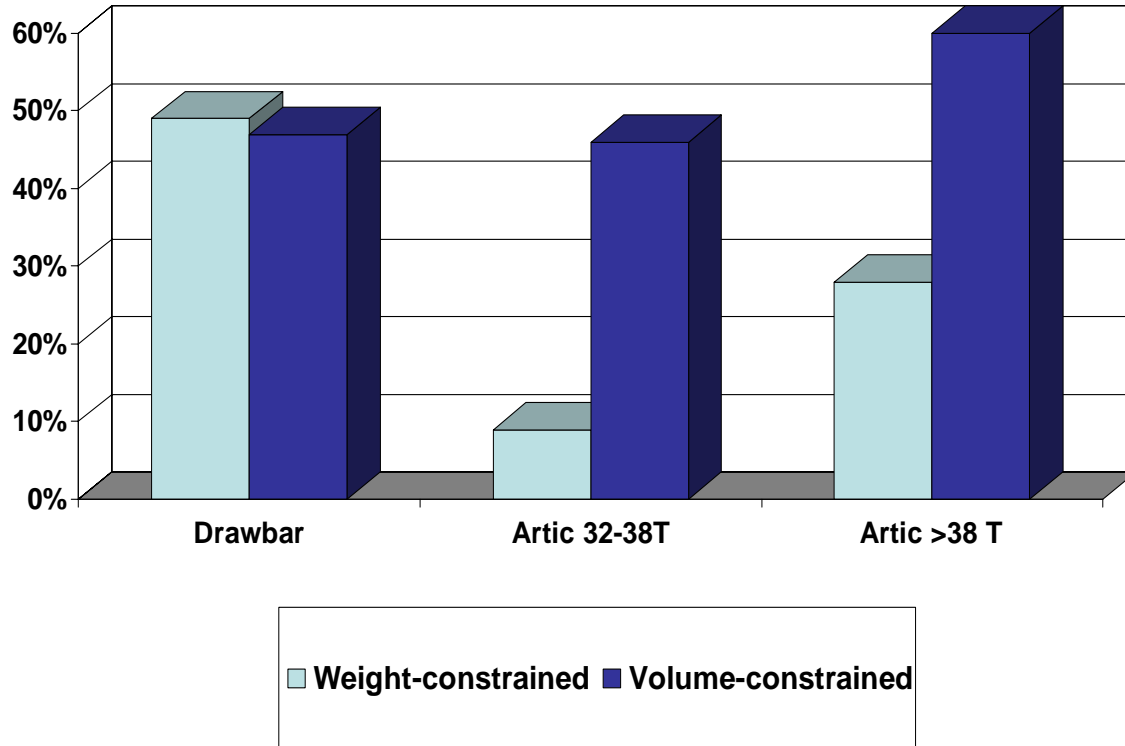
Double-deck / high cube trucks

Longer vehicles

Truck + dolly/semitrailer

Longer and Heavier Vehicles in Europe

Denmark:
trial from Jan 2008

Sweden / Finland
25.25 metre LHVs
55-60 tonne limit - in general use

Netherlands: trialled
25.25 metre LHVs
50 tonne limit – general use

Germany: limited trial
rejection of LHVs

UK: Desk-based study
TRL / Heriot-Watt
for Dept for Transport
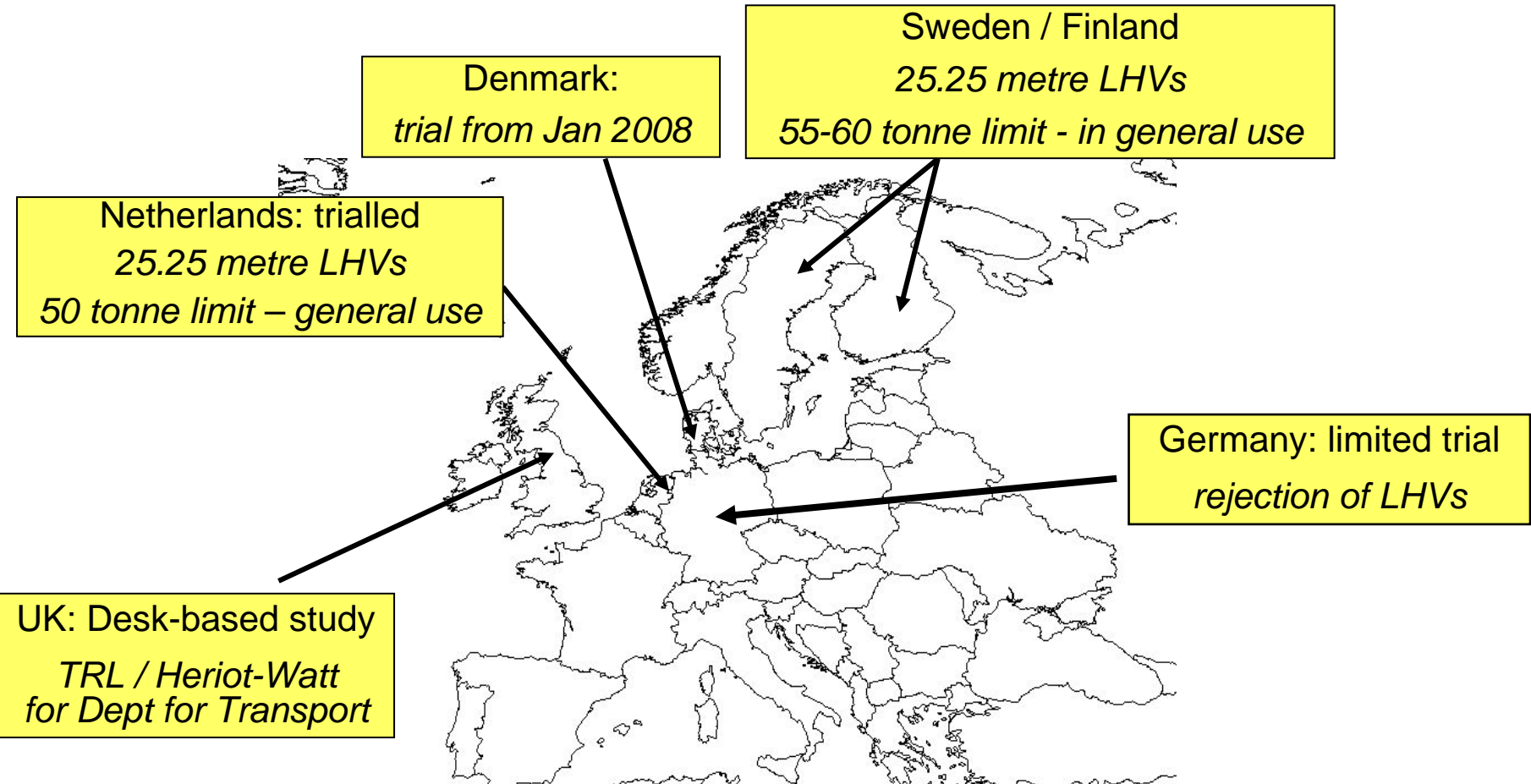
June 2008: UK government rejects case for 25 m and longer LHVs

Considering slightly longer semi-trailer: *articulated vehicle from 16.5 $\Rightarrow$ 18.75m*

European Commission project: final report imminent

A Rail Industry Perspective on LHVs

How "LOW COST" trucking will make demand for road transport explode?

CER – European Rail Association

UK Government 'Freight Best Practice' Programme

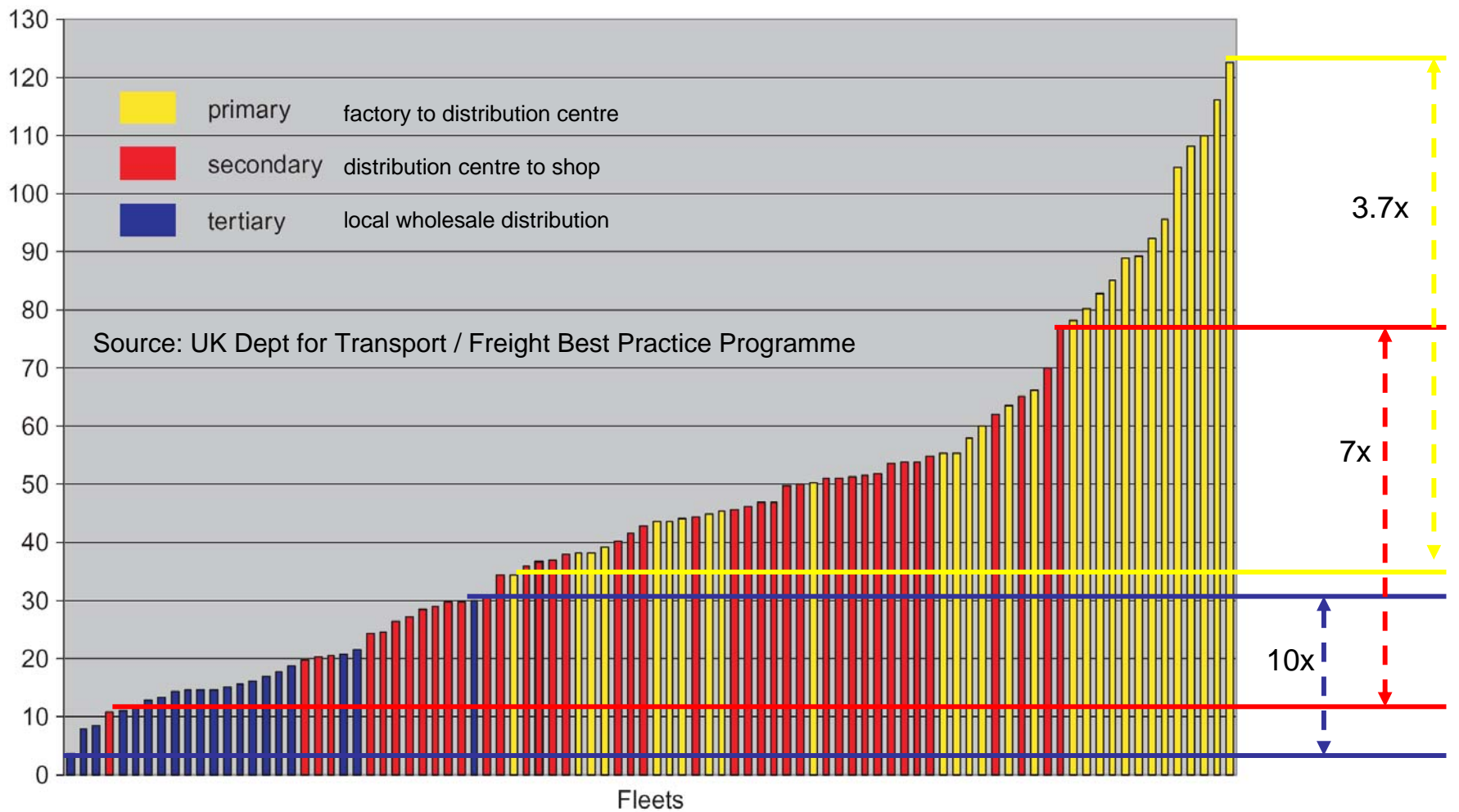www.freightbestpractice.org.uk

UK Transport KPI Benchmarking Surveys

Synchronised Audits against Standard Set of KPIs

Sector	Date	Fleets	Articulated vehicles	Rigid vehicles	Total	Trips	Distance Travelled (km)
Refrigerated food	1997	11	795	0	795	2981	519963
Food	1998	36	1393	182	1575	4024	1161911
Automotive	2001	7	143	50	193	679	179428
Food	2002	53	1446	546	1992	6068	1454221
Non-food retailing	2002	26	705	145	850	2496	744087
Pallet-load networks	2004	17	34	105	139	295	65880
Next day parcel delivery	2005	12	42	107	149	863	111464
Building Merchants	2006	35	3	113	116	379	23120
Food and drink	2006	113	4,696	1,600	6,296	8.000	1,300,000
Totals		**310**	**9257**	**2848**	**12105**	**25785**	**5,560,074**

Source: McKinnon, 2007

Variation in Energy Intensity of UK Food Distribution (2006)
pallet-kms per litre

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Legend:
- **primary** — factory to distribution centre (yellow)
- **secondary** — distribution centre to shop (red)
- **tertiary** — local wholesale distribution (blue)

Source: UK Dept for Transport / Freight Best Practice Programme
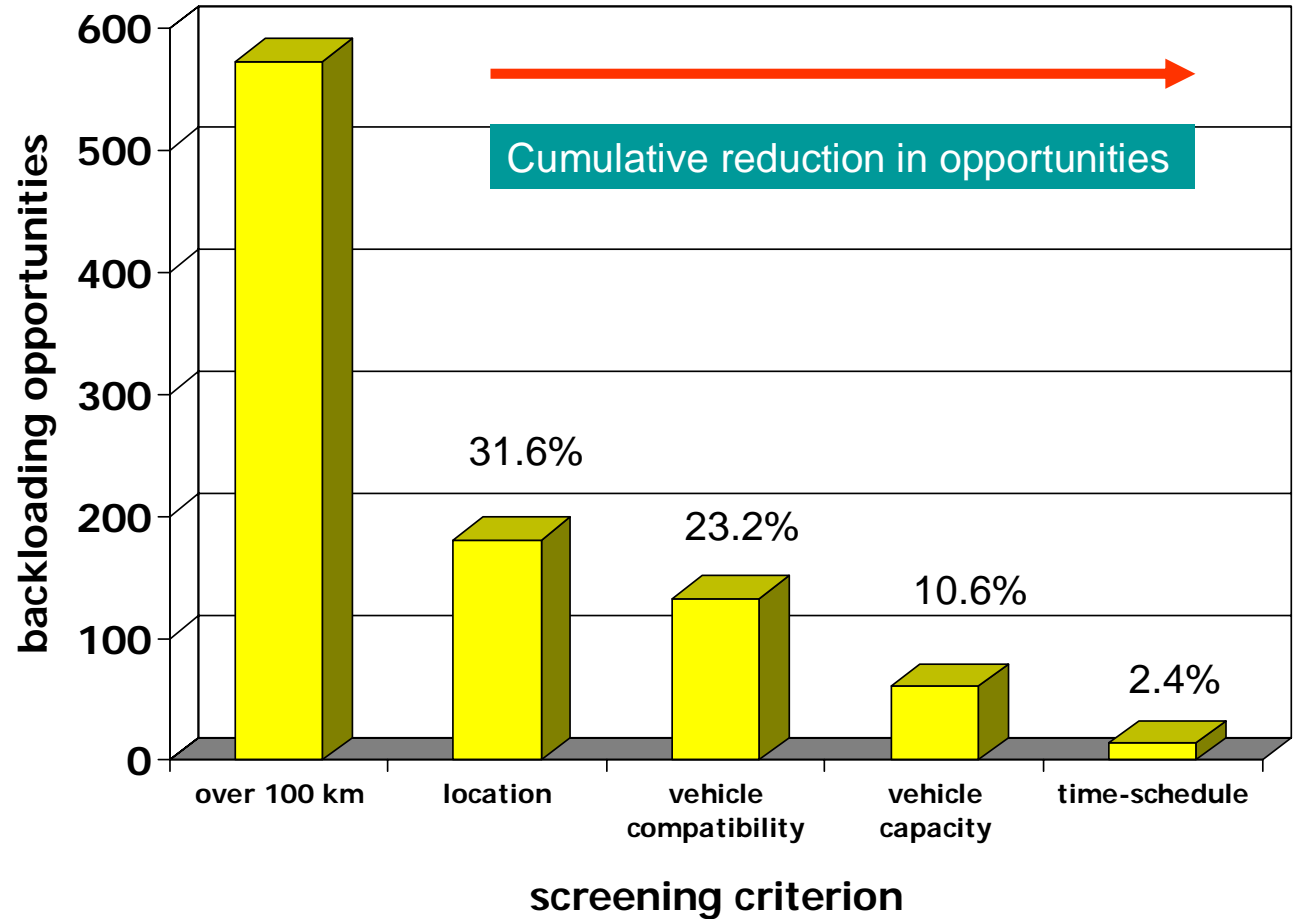
3.7x
7x
10x

Fleets

2002 Benchmark survey in food supply chain
Fleets below mean raise energy efficiency to:

Sub-sectoral mean: 5% cut in CO_2
Mean of top 1/3 in sub-sector: 19% cut in CO_2
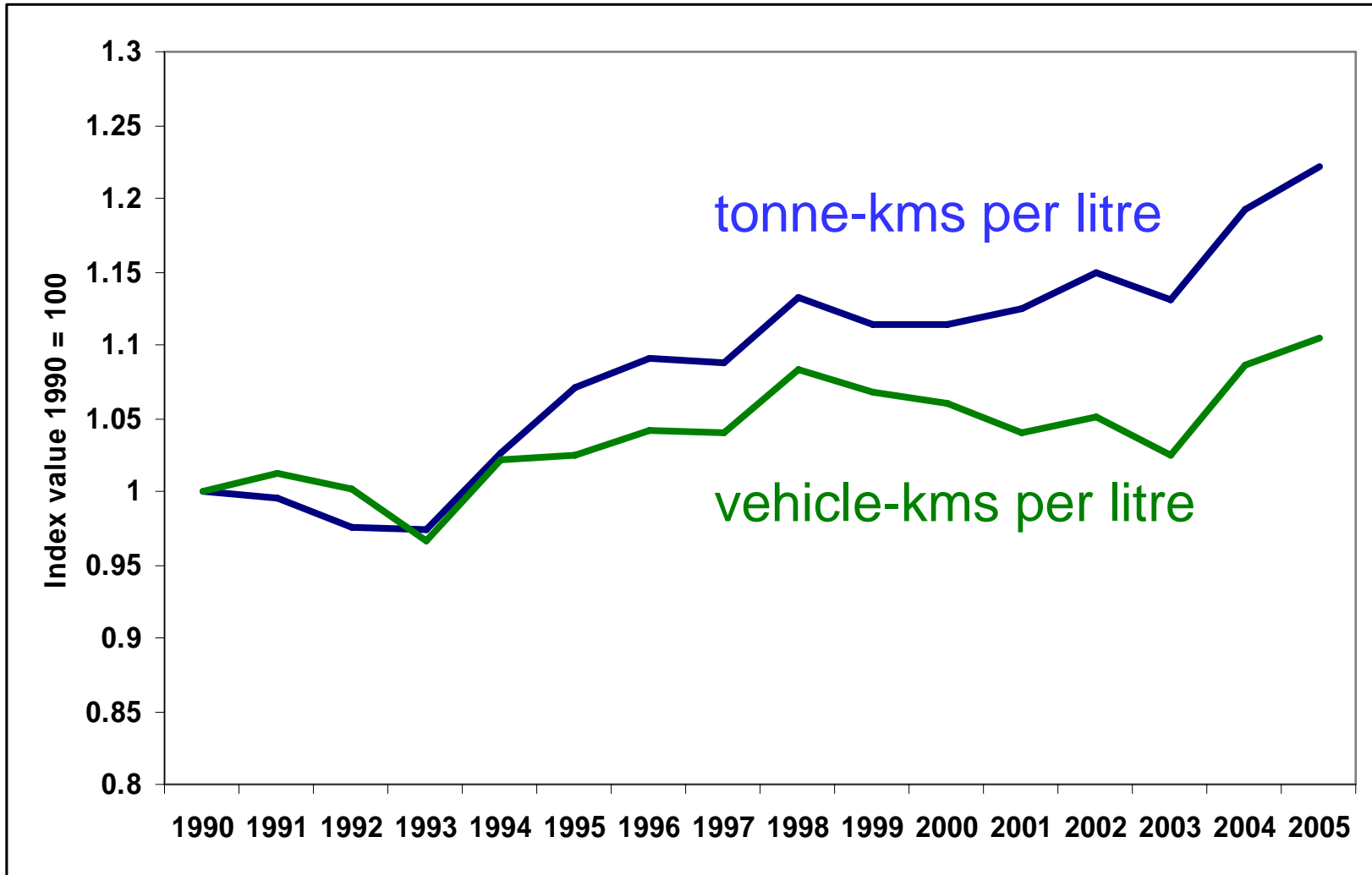
Retrospective Analysis of Backhaul Opportunities
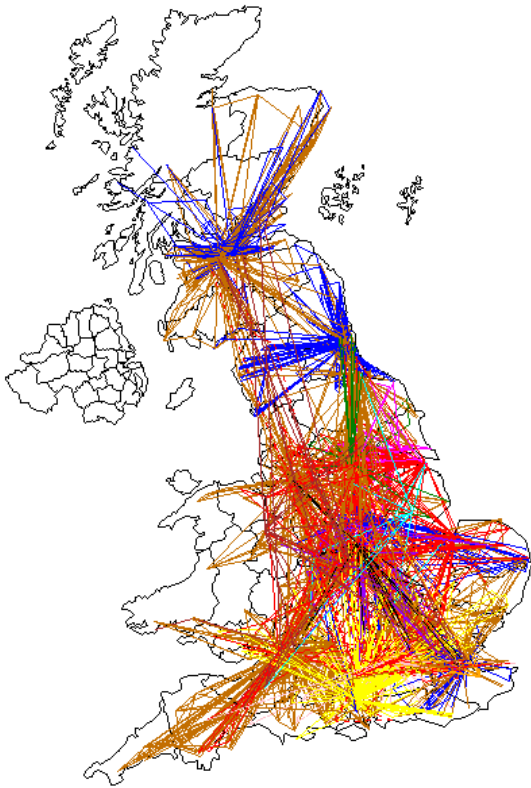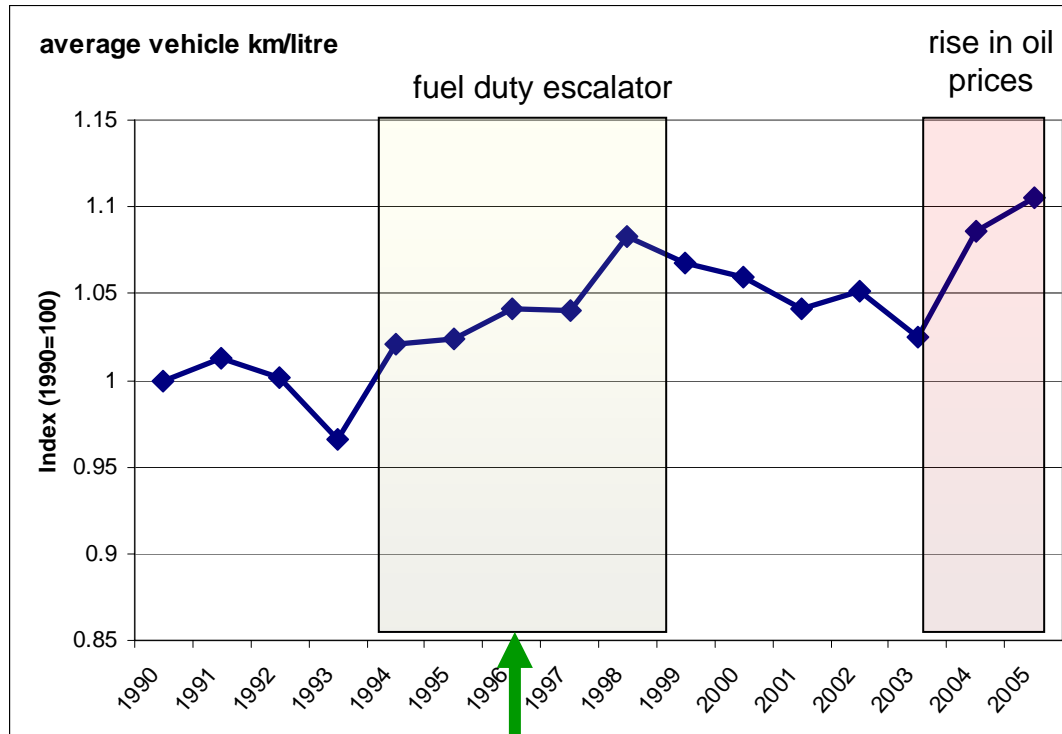

29 fleets: 8995 journey legs

Source: McKinnon and Ge, 2006

Increasing Energy Efficiency or UK Road Freight Transport

tonne-kms per litre

vehicle-kms per litre

Index value 1990 = 100

Source: DfT CSRGT

Sensitivity of Truck Fuel Efficiency to Fuel Price Increases

Source: UK Dept for Transport
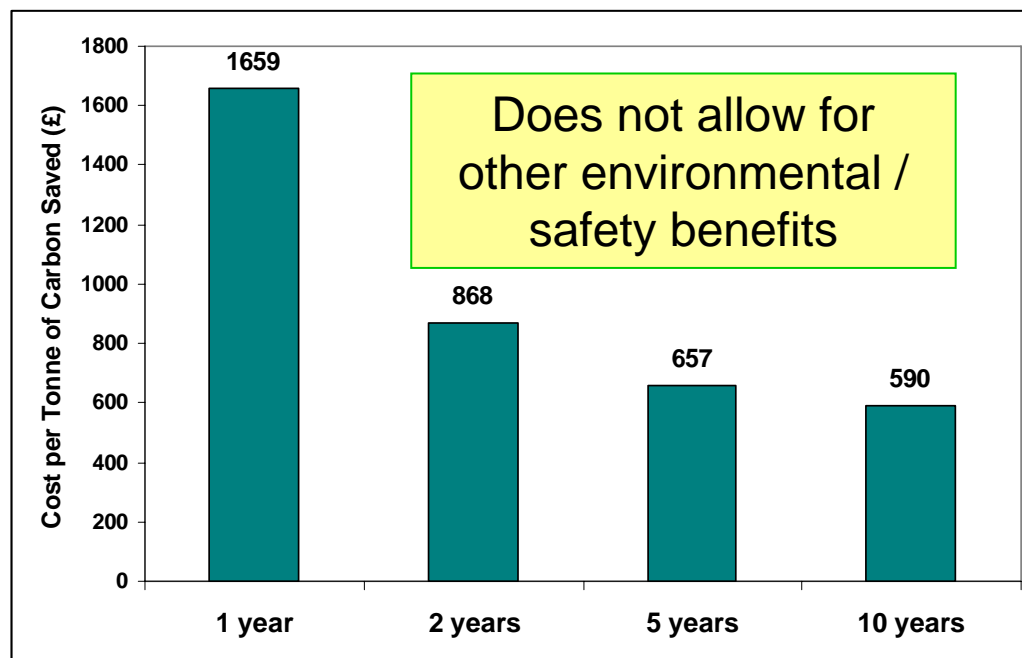
1994-7: 5% per annum increase in fuel tax

1997-9: 6% per annum increase in fuel tax

Use of Truck Simulators to Promote Fuel Efficient Driving

2 truck simulators

£3.2 million programme

scotsim
Simulation for the Truck Driving Professional

Drivers trained per year	1500
Average improvement in fuel efficiency	5%
Average distance driven annually	95000 km
Initial fuel efficiency (HGV)	2.7 km / lt

Bar chart: Cost per Tonne of Carbon Saved (£)
- 1 year: 1659
- 2 years: 868
- 5 years: 657
- 10 years: 590

Does not allow for other environmental / safety benefits

Economic Justification for Freight-related Carbon Abatement Measures

Euro / tonne of CO2 emitted

Measure	Value (bar)
Driver training in fuel efficient driving	(short)
Aerodynamic profiling of trucks	
Application of computerised vehicle routing	
Install solar panels on warehouse	
Modal shift from road to rail	
Major switch to localised sourcing	
Decentralisation / relocation of warehousing	(longest)
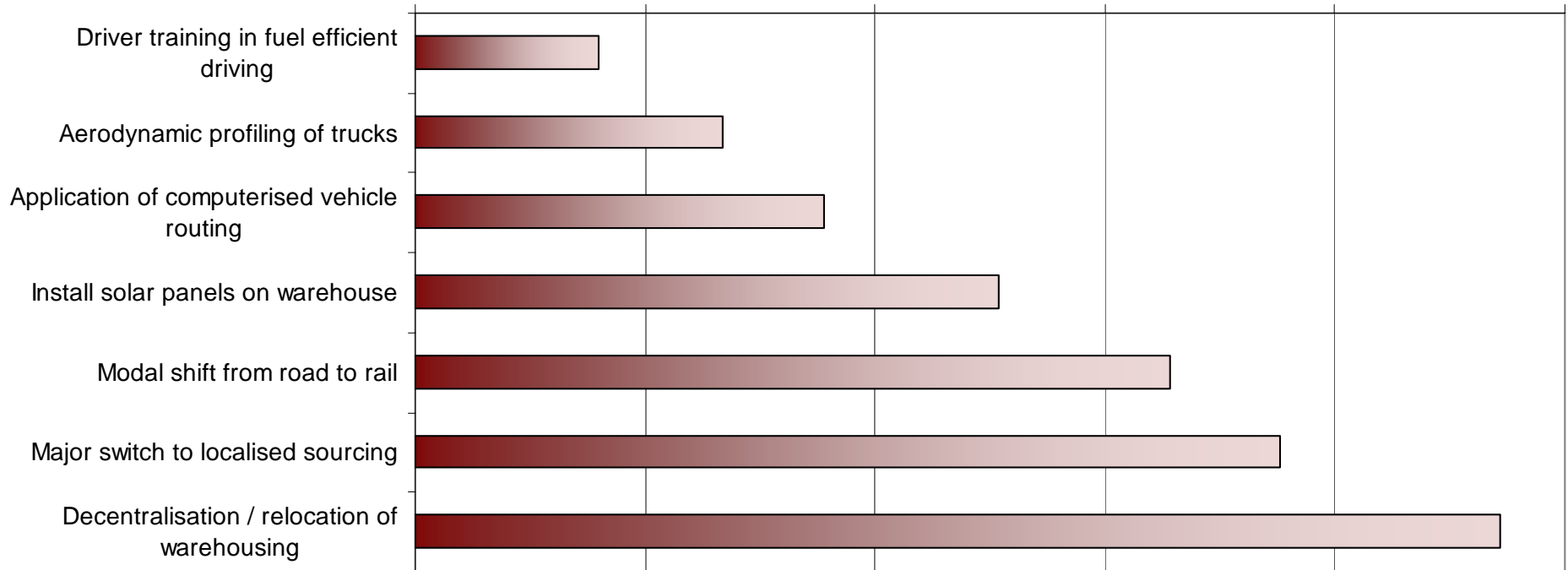
Typical CO_2 offset cost	European Emission Trading Scheme phase 2	UK government shadow price of CO_2	Stern social cost of CO_2
£13	CO_2 **£18 / tonne**	**£26**	**£75 tonne (2000)**

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www.greenlogistics.org