

Logistics and Location:

Decoupling Freight and CO₂

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Climate Change Policy: Emission Reduction Targets

Aim to keep global CO₂ level below 450 parts per million

Temperature rise over period to 2100 limited to 2° C

'Stabilisation at 450 ppm CO₂e is already almost out of reach, given that we are likely to reach this level within ten years and there are real difficulties of making the sharp reductions required with current and foreseeable technologies' (Stern Report, p. xv)

EU Climate Change Target: *20% reduction in CO₂ by 2020*

UK Climate Change Bill: *60% reduction in CO₂ by 2050*

Scottish Climate Change Bill: *80% reduction in CO₂ by 2050*

Million tonnes of CO₂ (UK)

1990 594

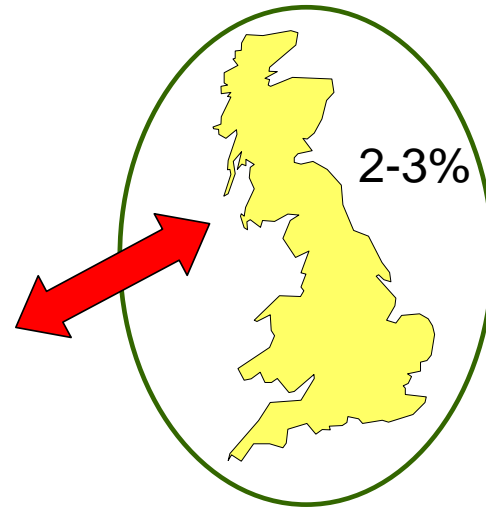
2006 561

2050 238

Possible under-estimation of required CO₂ reduction

Estimates of UK's Carbon Footprint

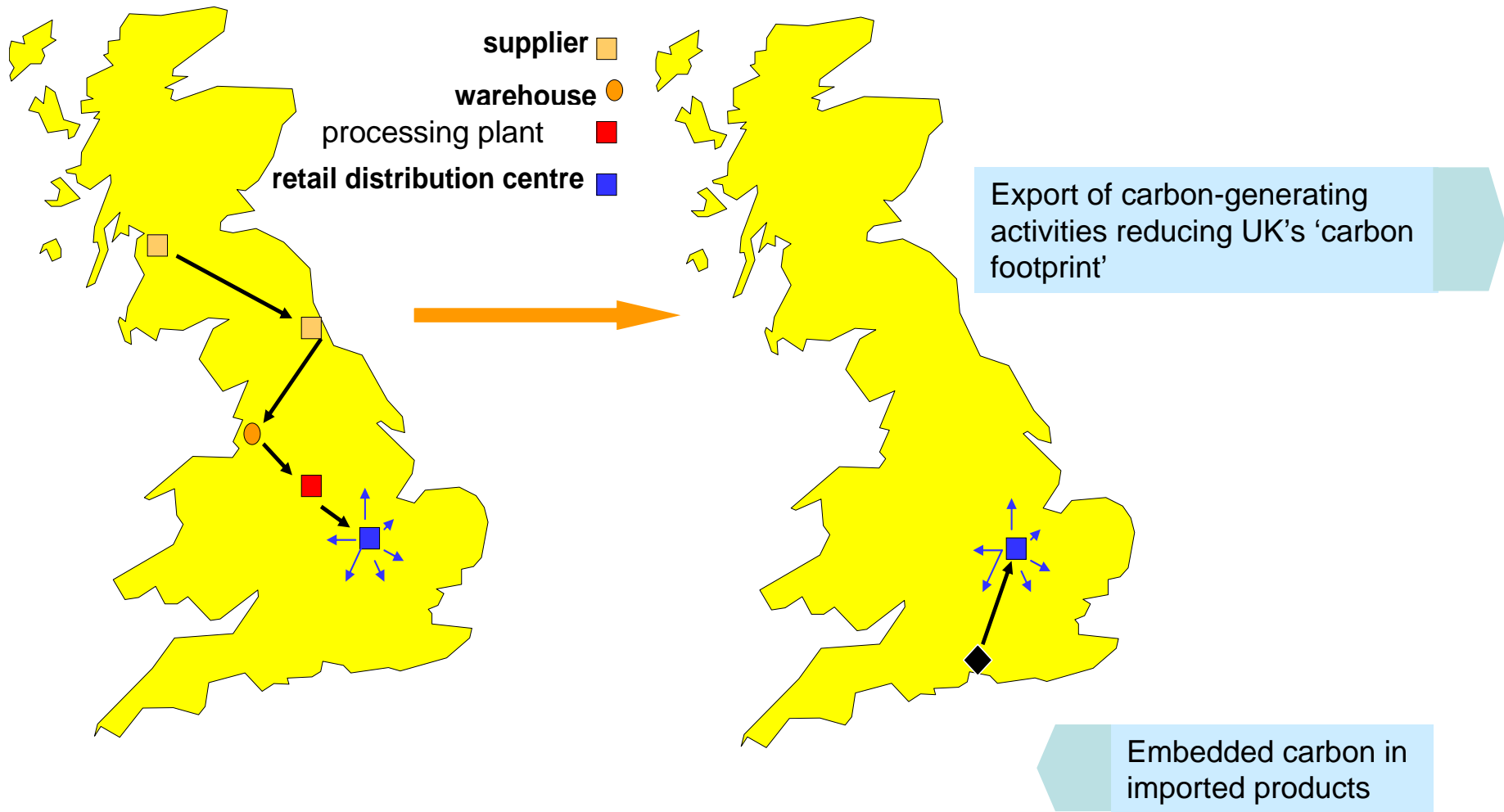
Kyoto calculation excludes UK external transport links, overseas business interests and embedded carbon in imported goods



Addition of embedded carbon in imports, bunker fuels emissions from international transport services and net emissions from tourism increases UK carbon footprint by roughly 60%

Helm, Smale and Philips, 2007

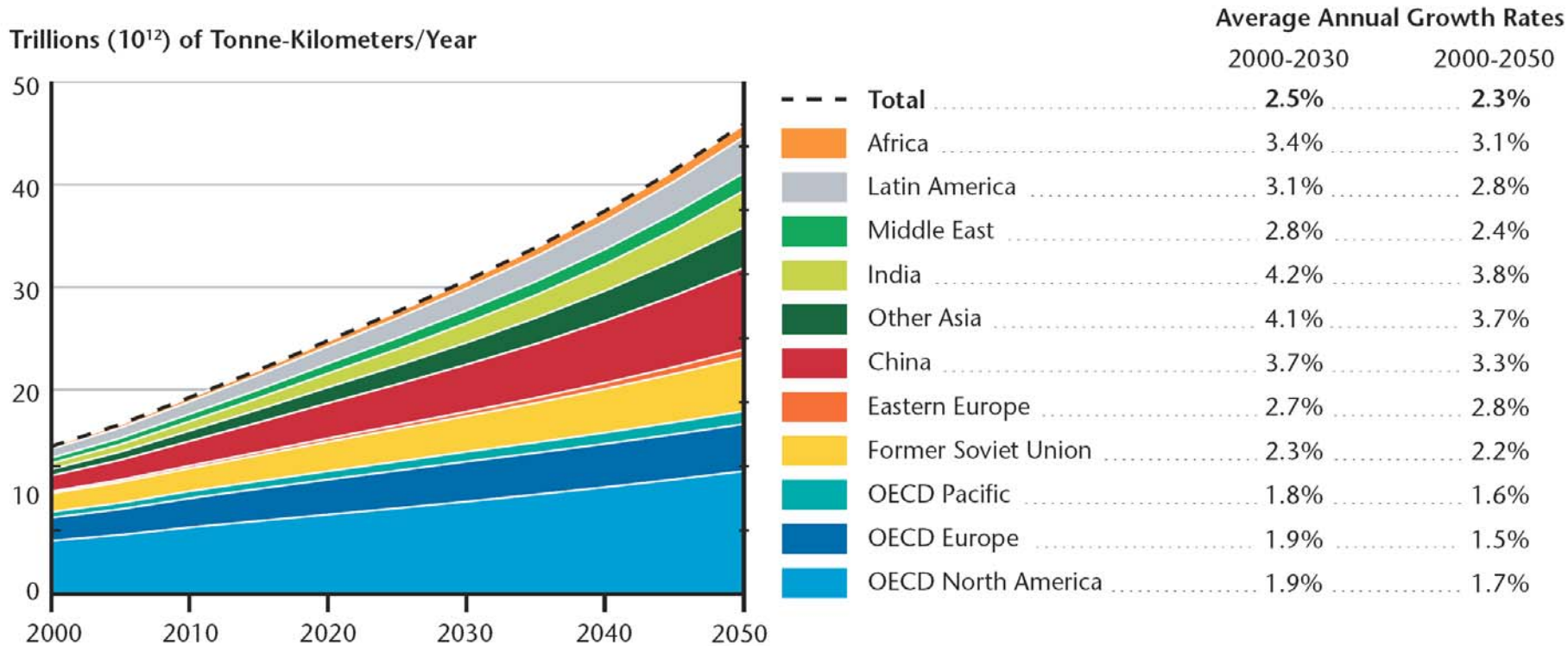
Off-shoring of Manufacturing and the Upstream Supply Chain



UK contributing to the growth of CO₂ emissions in exporting countries

Forecast Growth of Freight Transport Activity by Region 2000-2050

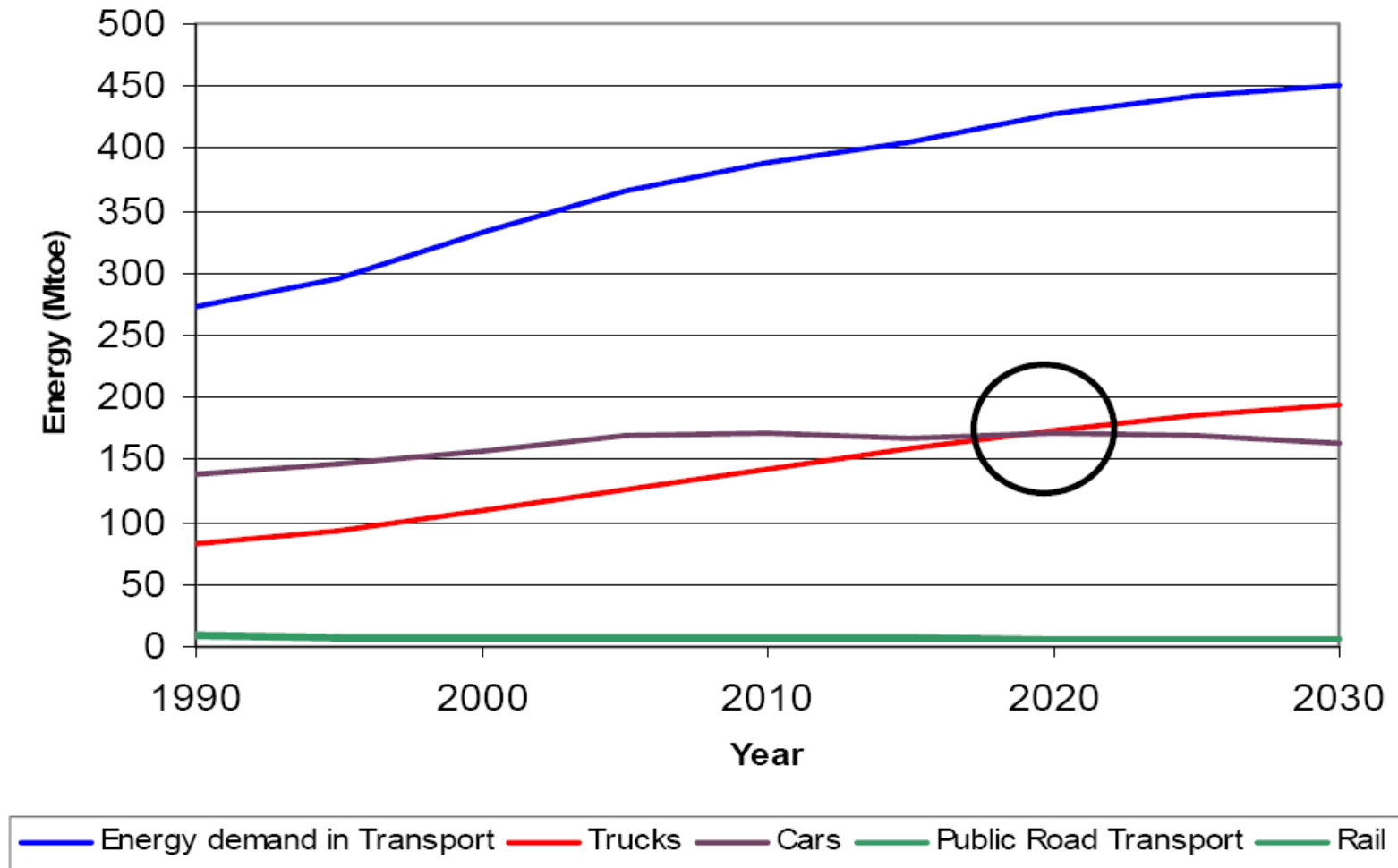
- All transport = 14% of all Greenhouse Gas emissions
- Over past decade, transport has grown faster than any other energy-using sector
- Worldwide freight transport is growing faster than passenger transport



Source: World Business Council for Sustainable Development - Mobility 2030 report

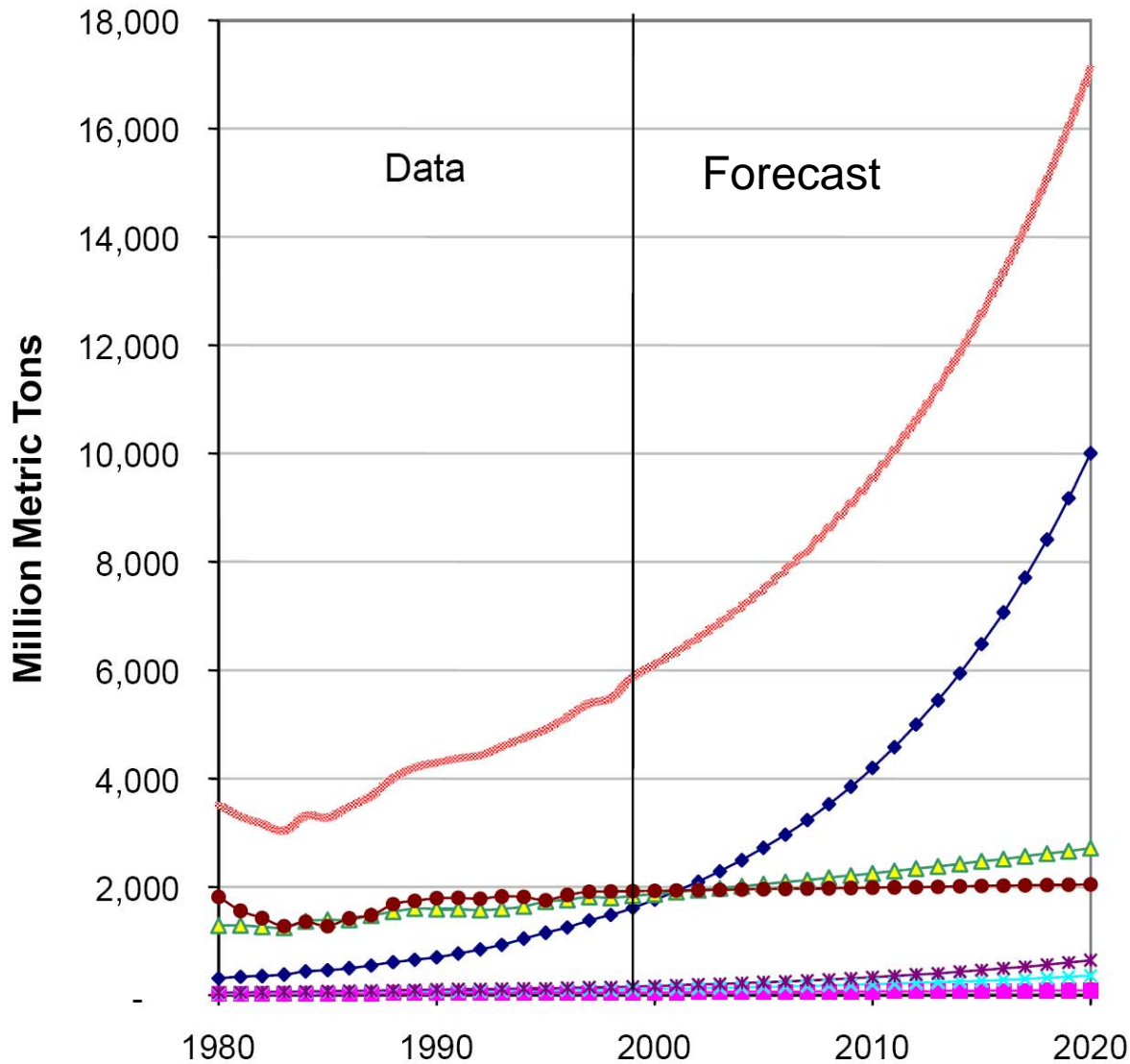
<http://www.wbcsd.org/plugins/DocSearch/details.asp?type=DocDet&ObjectId=NjA5NA>

Truck Energy Use Exceeds Car Energy Use by 2020



Source: Jonathan James / WBCSD 'Mobility 2030' Report

Projected Growth of Shipping



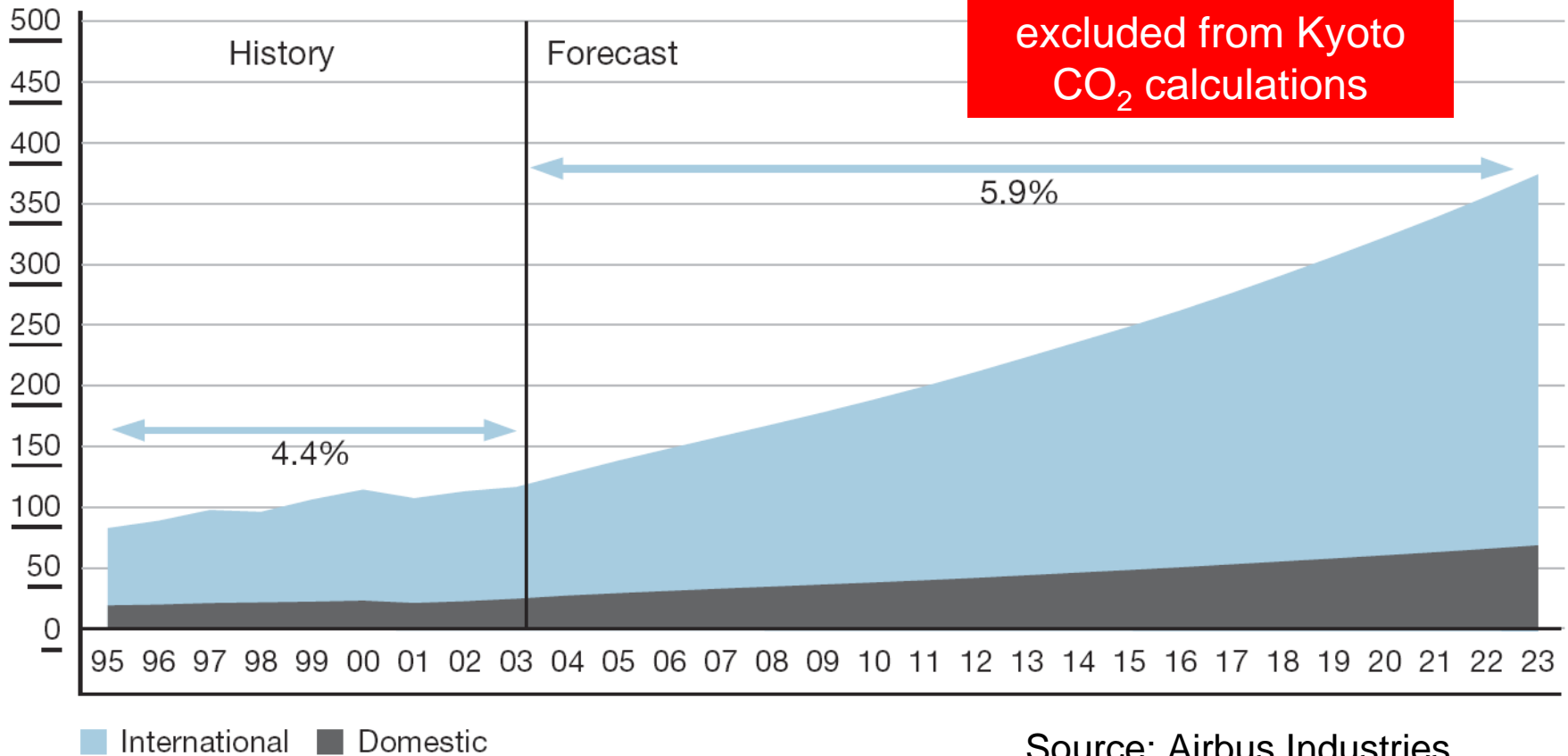
International shipping excluded from Kyoto CO₂ calculations

- ◆— container tons, approx.
- reefer tons
- ▲— dry bulker tons
- ×— chemicals tanker tons
- *— gas carrier tons
- oil tanker tons
- ...— total tons

Source: Corbett / ITF

Growth of Airfreight Traffic

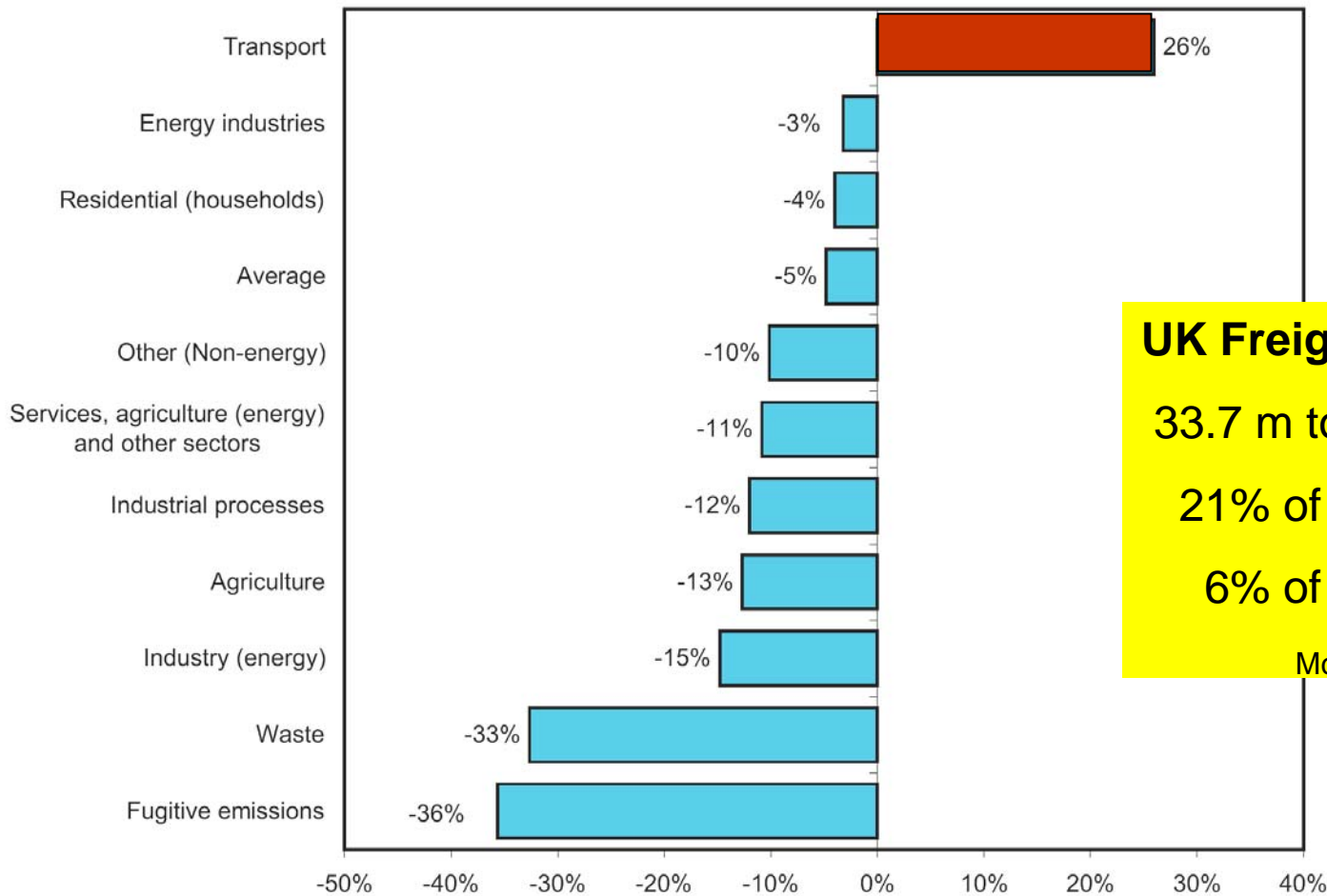
FTKs (billions)



No tax imposed on the kerosene used by aircraft
 CO₂ emissions at high altitude 2-4 times more damaging (radiative forcing)
 1 tonne moved 1000 kms by air emits 1.2 tonnes of CO₂
 Prospect of this environmental anomaly being corrected?

Contribution of Transport to CO₂ Emissions

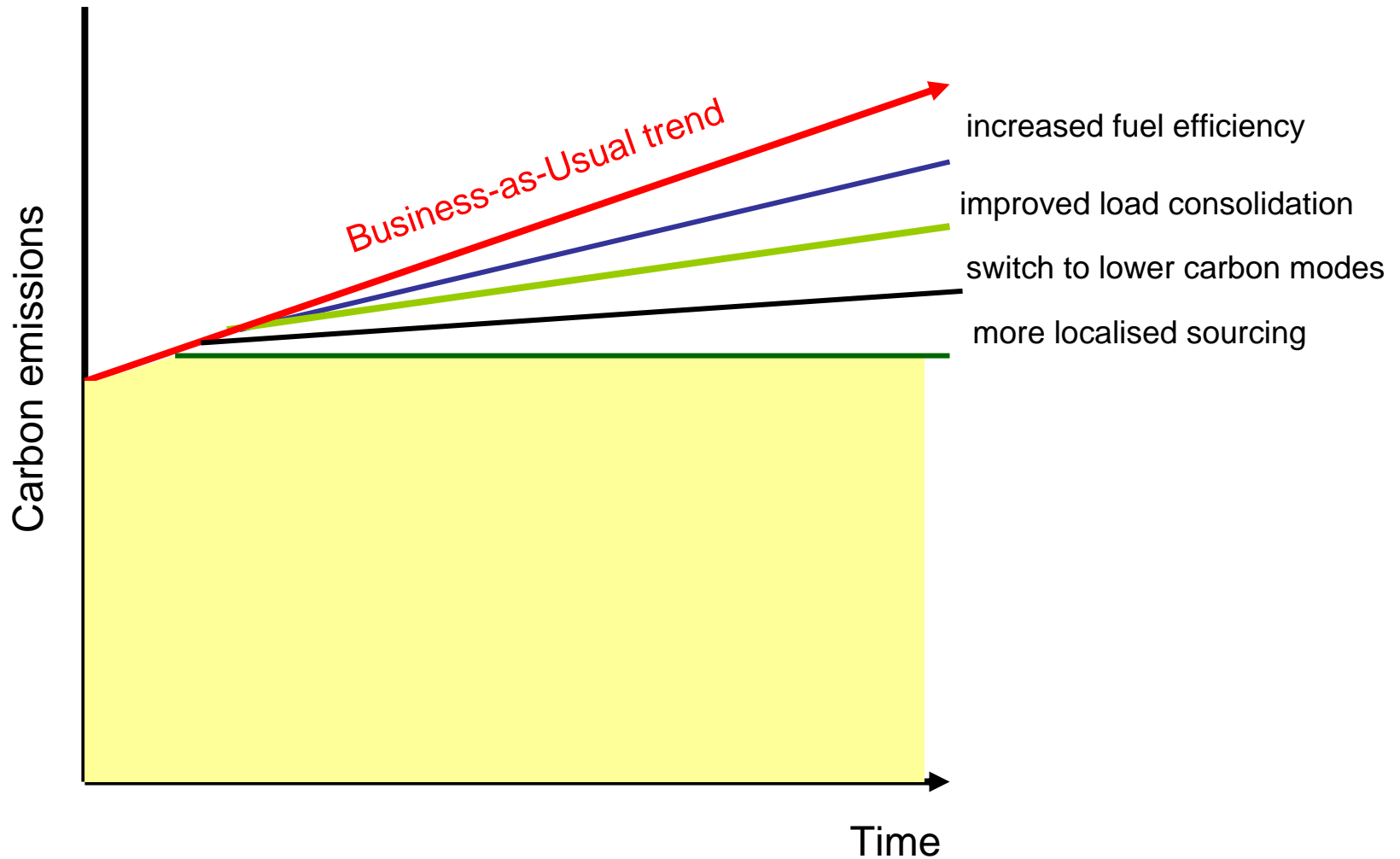
Transport: the only sector increasing CO₂ emissions (EU25) 1990 - 2005



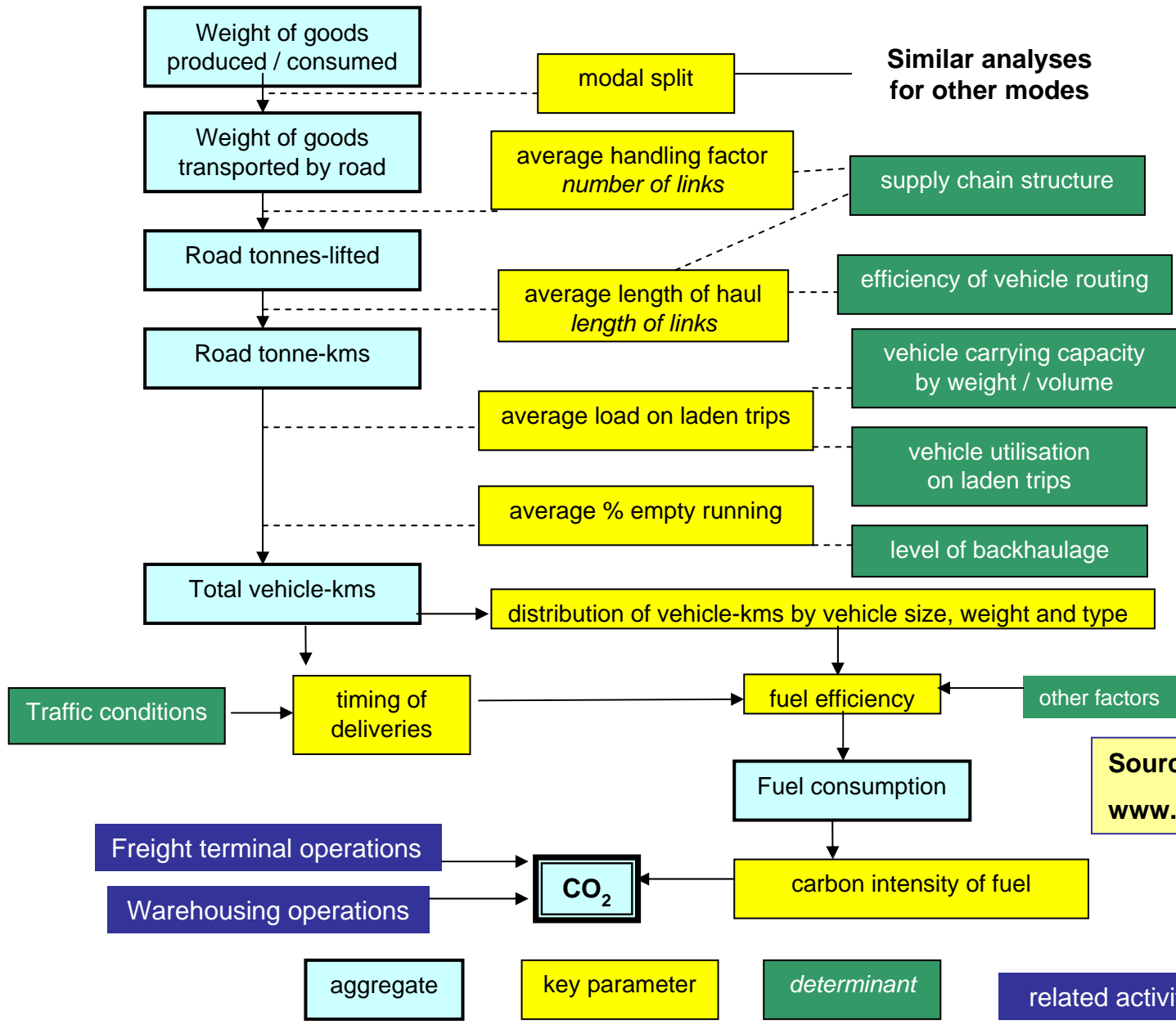
UK Freight Transport
33.7 m tonnes (2004)
21% of all transport CO₂
6% of total UK CO₂
McKinnon (2007)

Stabilisation Wedges

applied to freight transport operations



Decarbonisation Framework for Freight Transport ('9-lever model')

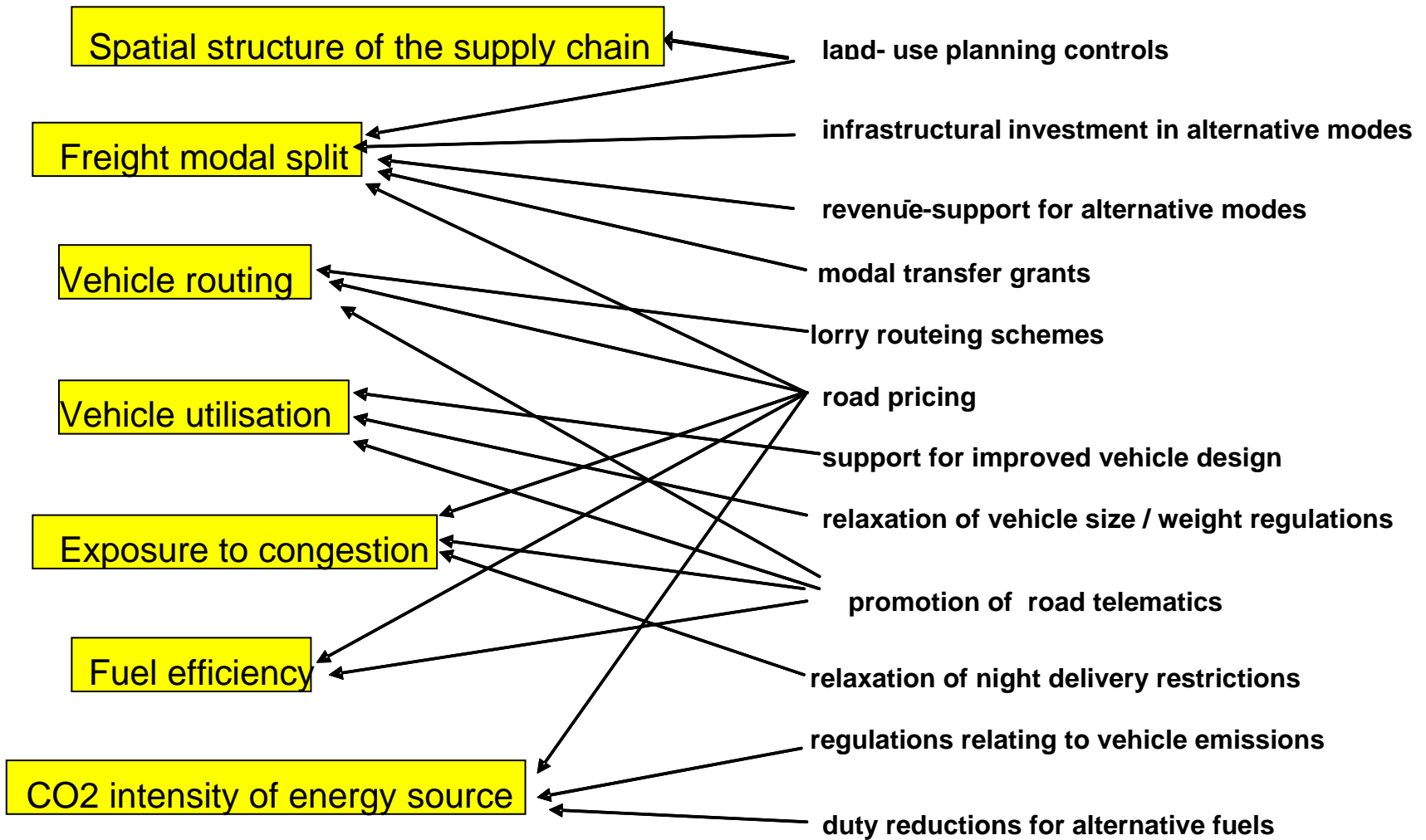


Source: Green Logistics project
www.greenlogistics.org

Public Policy Levers on Key Freight Transport Variables

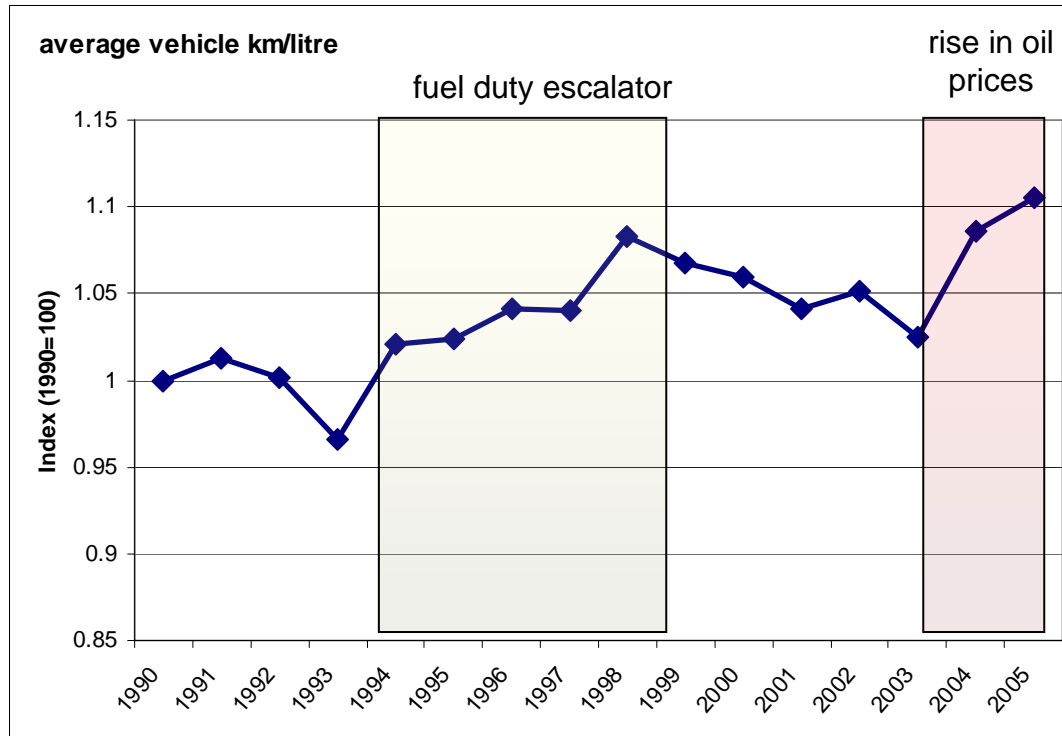
key freight variables

Government measures



Taxation policy and advice / exhortation affects all variables

Sensitivity of Truck Fuel Efficiency to Fuel Price Increases



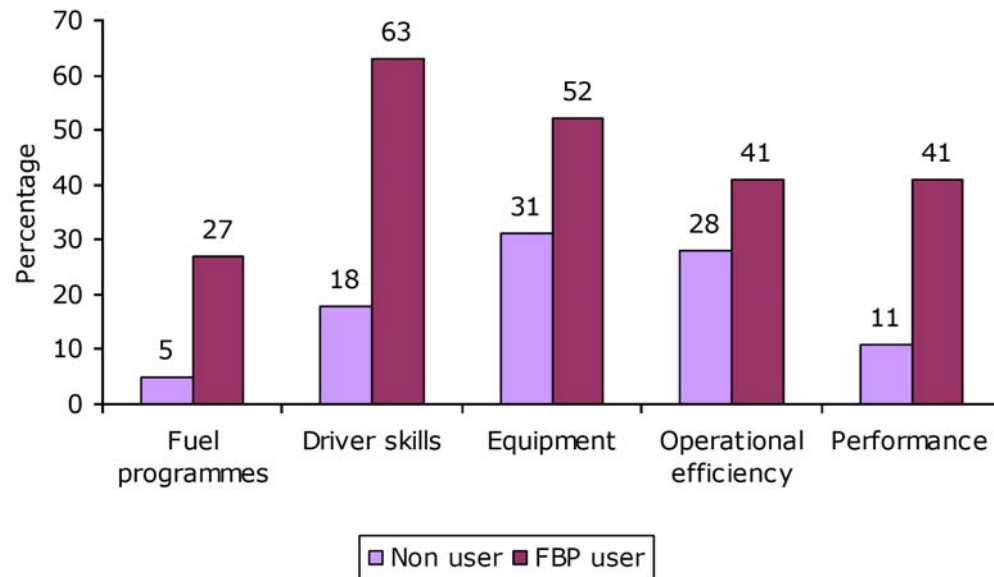
Source: UK Dept for Transport

Cost-effectiveness of the UK Freight Best Practice Programme

Advisory reports and services on fuel efficiency, vehicle loading and routing, efficiency benchmarking and other sustainable distribution measures

www.freightbestpractice.org.uk

Fleet size	Aware of programme	Used programme
1 vehicle	20%	6%
2-14 vehicles	24%	9%
15+ vehicles	49%	24%
All fleets	24%	9%



FBP cost 2004-6: £2m

Estimated CO₂ savings: 240,000 tonnes
 Cost per tonne of CO₂ saved: £8

Problems in Estimating Cost Effectiveness of Carbon Mitigation Measures

- Additionality: *what would have happened in the absence of the measure?*
- Multiple benefits: *what other benefits does the measure yield?*
- Counteracting effects: *what will be the net effect on carbon emissions?*
- Predicting degree of behaviour change: *what level of response is likely?*
 - awareness → involvement → implementation → behavioural change
- Durability of the change: *how long will the change be maintained?*
- Uncertainty about carbon valuations: *both present and future valuations*

Environmental Trade-offs

Longer and heavier vehicles



Truck + dolly/semitrailer

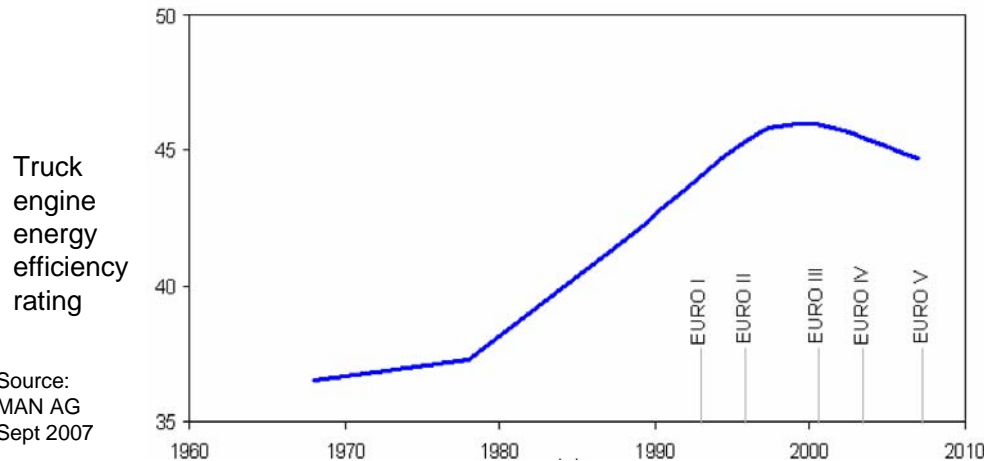
Reduction in carbon intensity of road freight
(CO₂ gm / tkm)

Diversion of freight from rail and water

Generation of additional freight movement

Net change in CO₂

CO₂ versus other emissions



Euro 6 standard for heavy duty vehicles will carry 2-3% CO₂ penalty

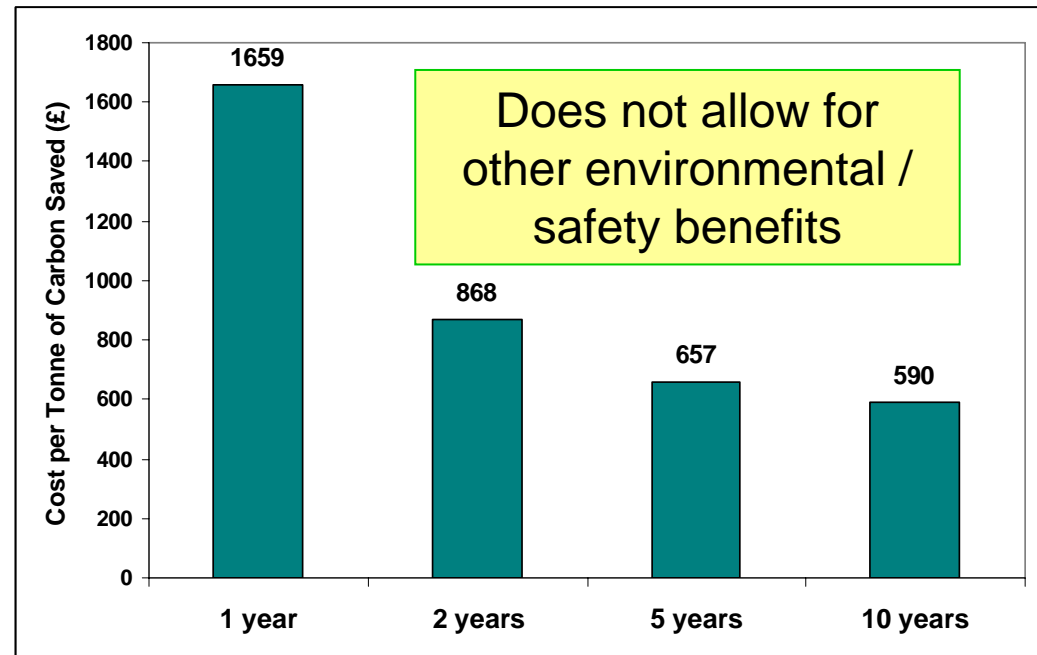
Use of Truck Simulators to Promote Fuel Efficient Driving

2 truck simulators

£3.2 million programme



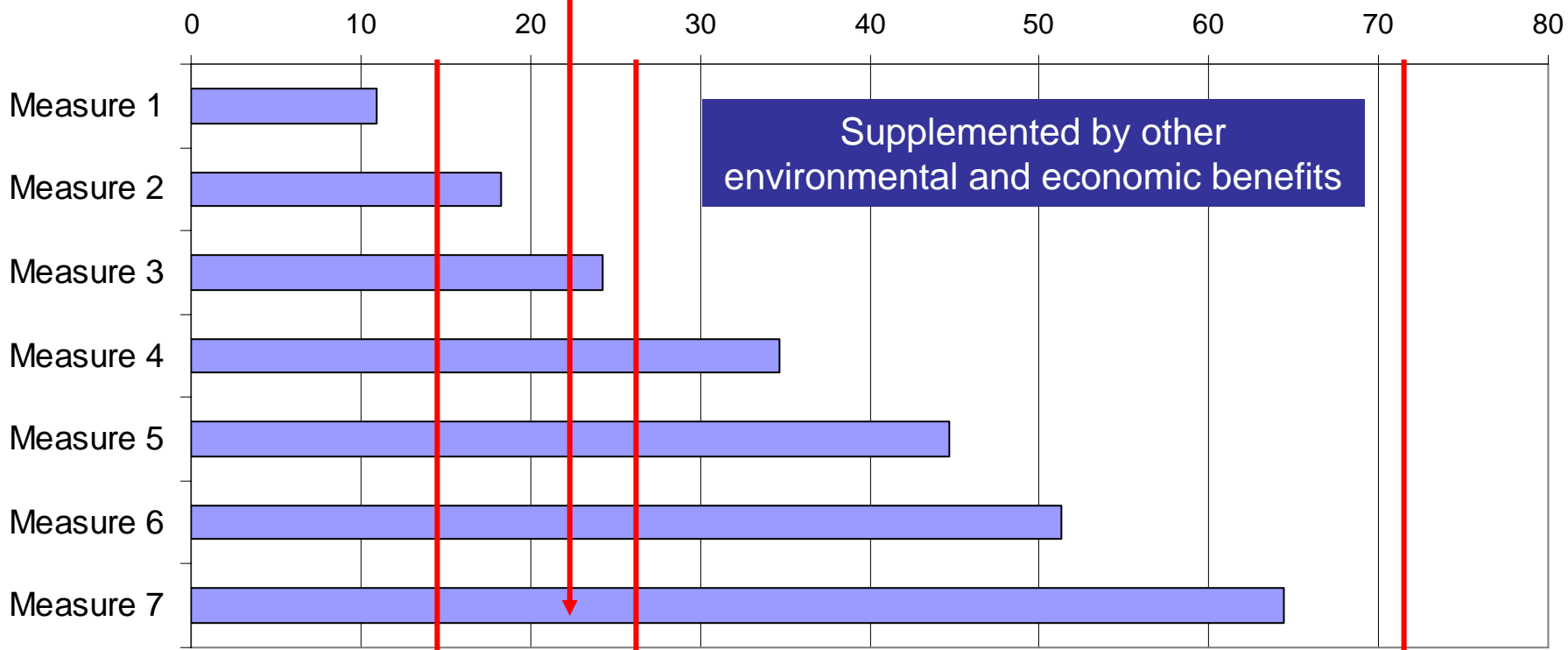
Drivers trained per year	1500
Average improvement in fuel efficiency	5%
Average distance driven annually	95000 km
Initial fuel efficiency (HGV)	2.7 km / lt



Economic Justification for Sustainable Logistics Measures

**European Emission Trading Scheme phase 2
£22**

£ per tonne of CO2 saved



Supplemented by other environmental and economic benefits

Typical carbon offset cost £15

UK government shadow price of carbon £26.50

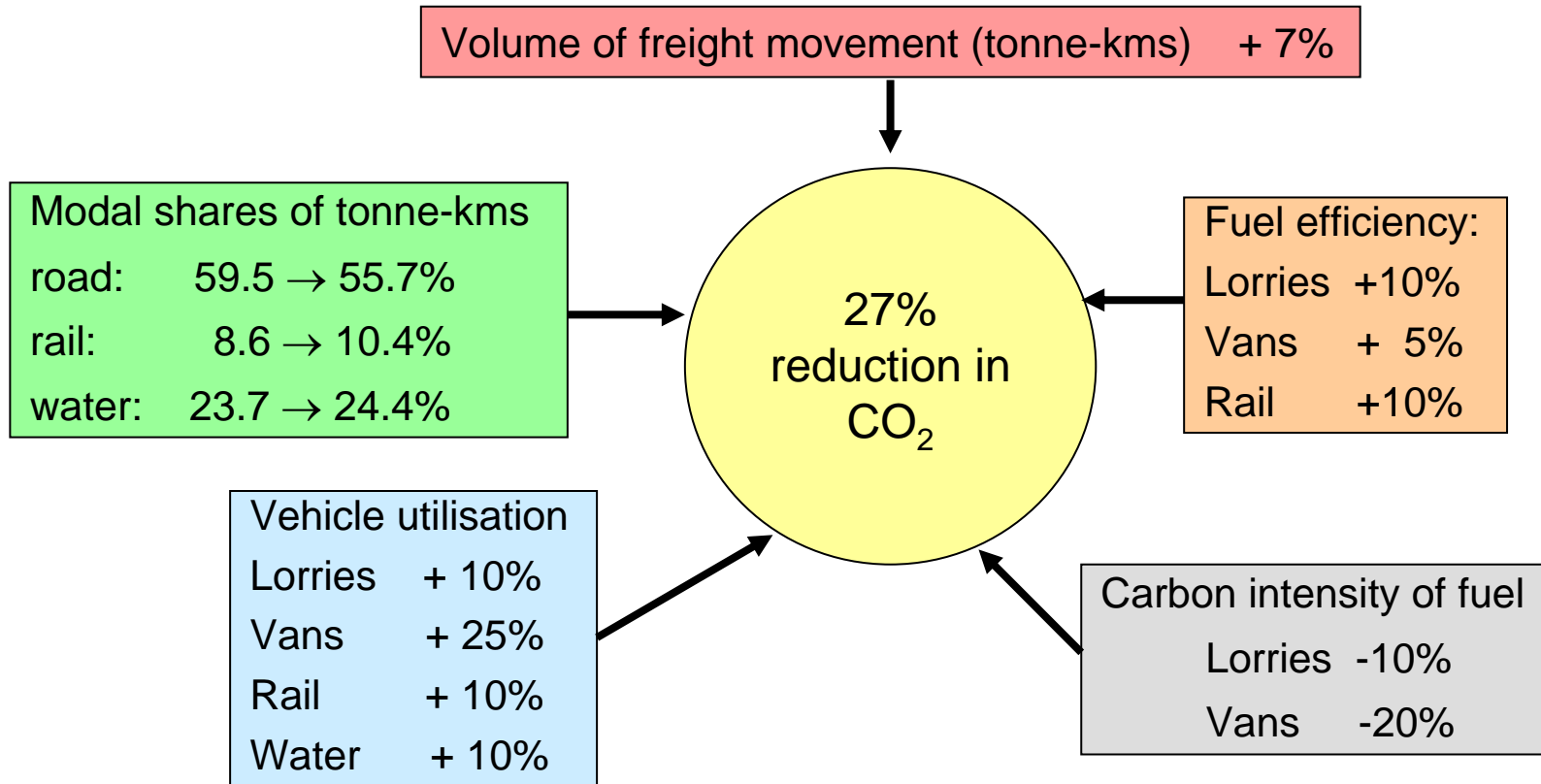
Stern social cost of carbon £72 (2006)

'Decarbonising Freight Transport': 5 Key Ratios

1. Total tonne-kms to GDP: **freight transport intensity**
2. Road / air tonne-kms to rail / water tonne-kms: **mode split**
3. Tonne-kms to vehicle-kms: **vehicle utilisation**
4. Vehicle-kms to energy consumption: **energy efficiency**
5. CO₂ emissions to energy consumption: **carbon intensity**

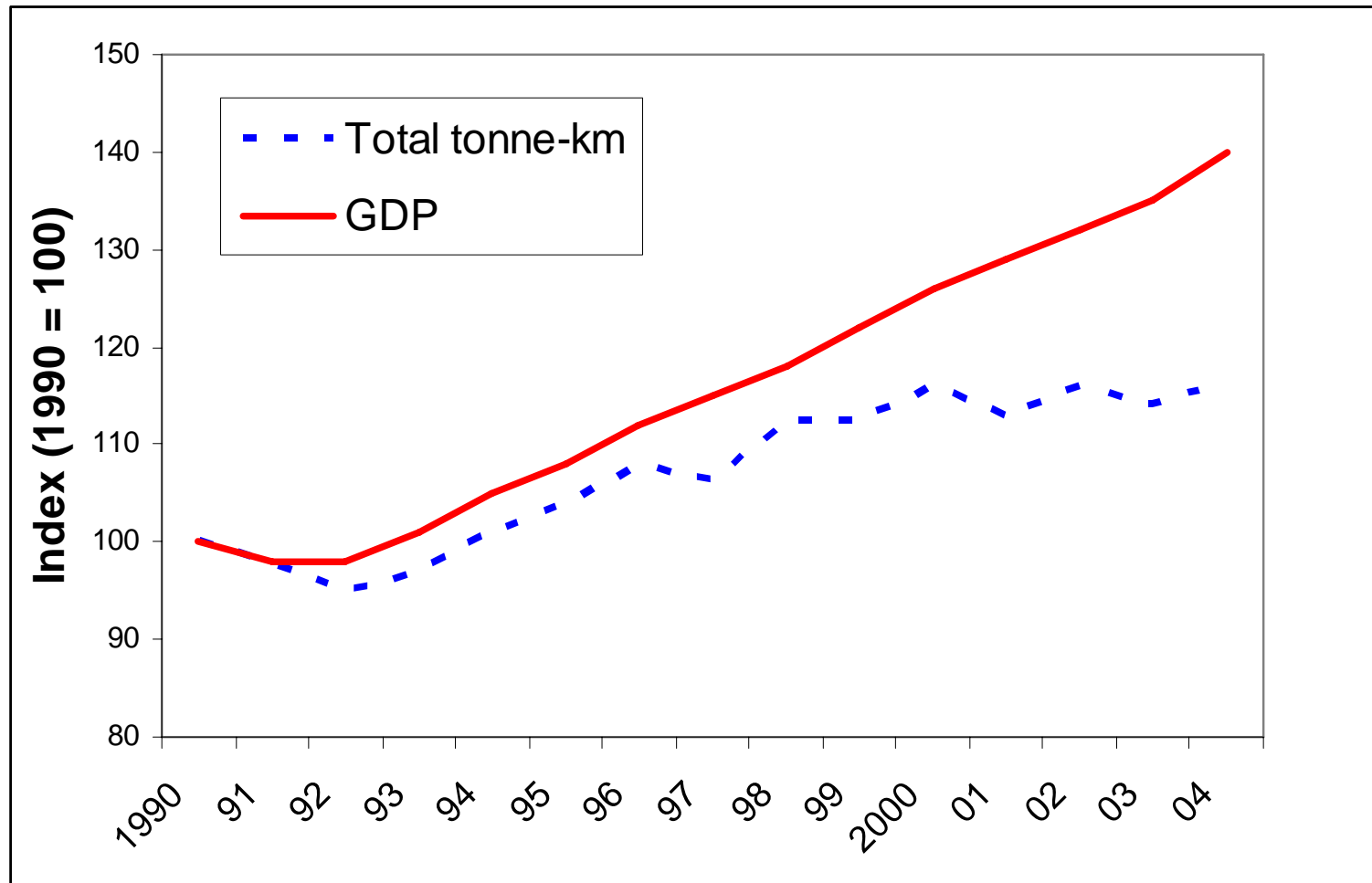
Freight Transport CO₂ : Aspirational Scenarios for UK

Baseline 2004

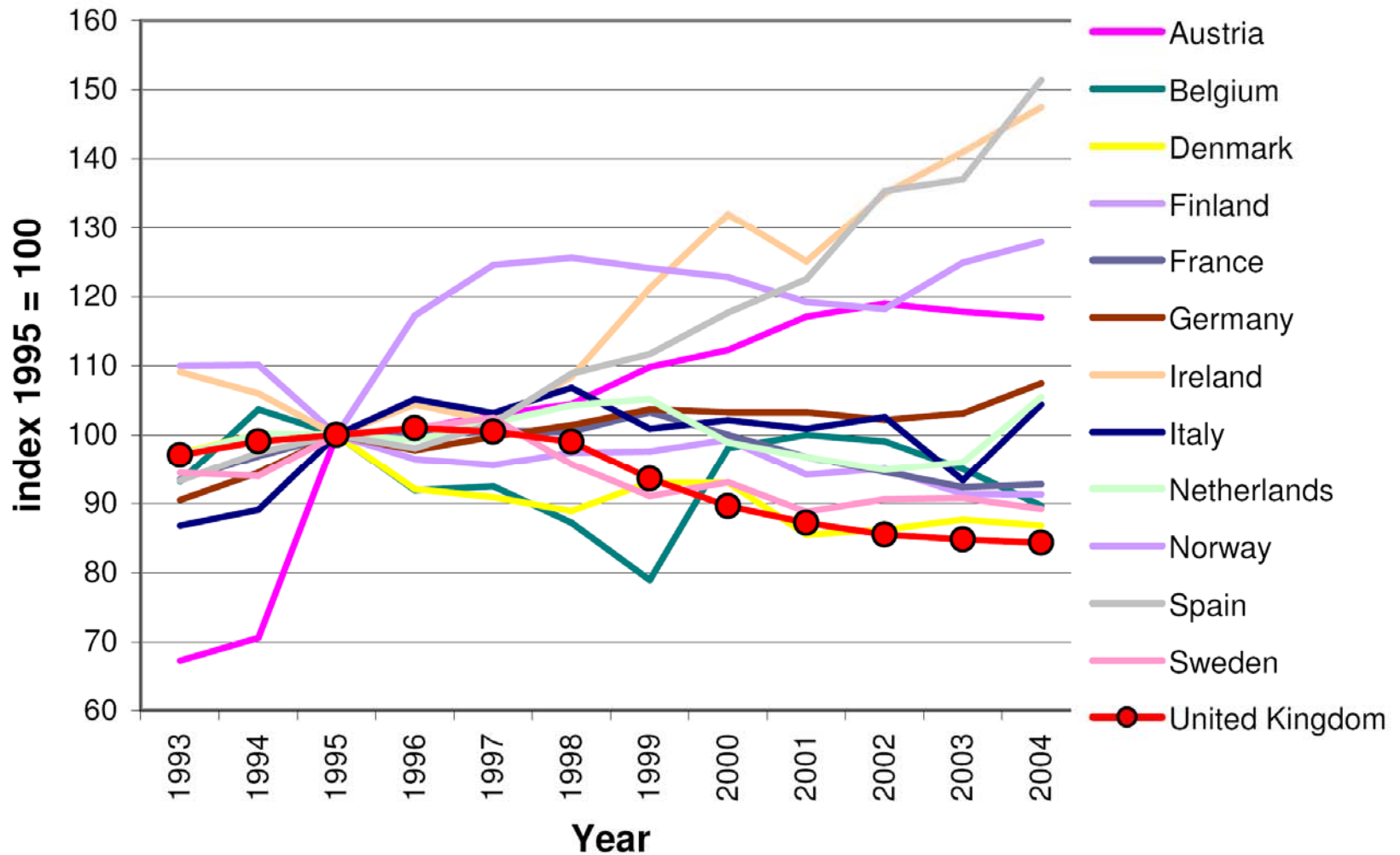


Ratio 1: Freight Transport Intensity

Decoupling of the GDP and Freight Tonne-km Trends in the UK

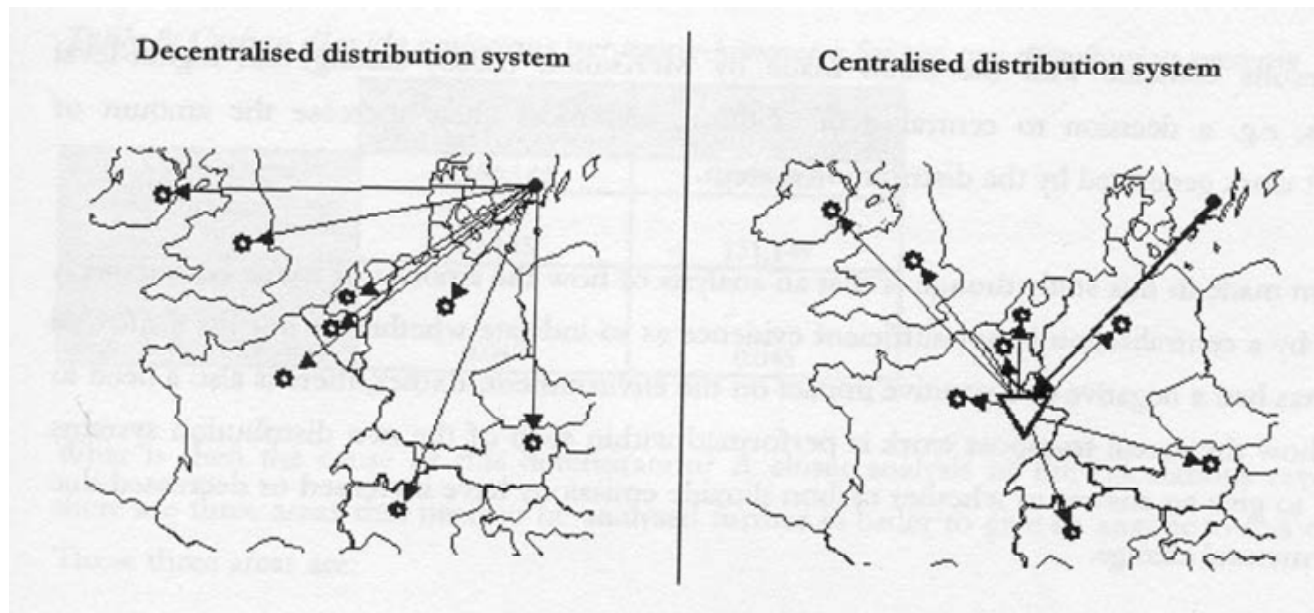


Freight Intensity Trends: European countries



Need to analyse energy / CO₂ trade-offs between transport, inventory and storage

ITT Flygt – manufacturer of submersible pumps and mixers



	<i>Decentralised</i>	<i>Centralised</i>
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

Potential CO₂ 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 CO₂ in construction, operation and maintenance

Larger warehouses can be more energy efficient:

emit less CO₂ per unit of throughput

Decarbonising Warehousing Operations

EcoTemplate Warehouse *occupied by Woolworth, Bedford UK*



Source <http://www.gazeley.co.uk>

DHL proposing to install small wind farms on 100 of its 800 distribution sites in the UK

Improve energy efficiency of warehousing:

Better insulation

Less movement of product

Move to paperless operation

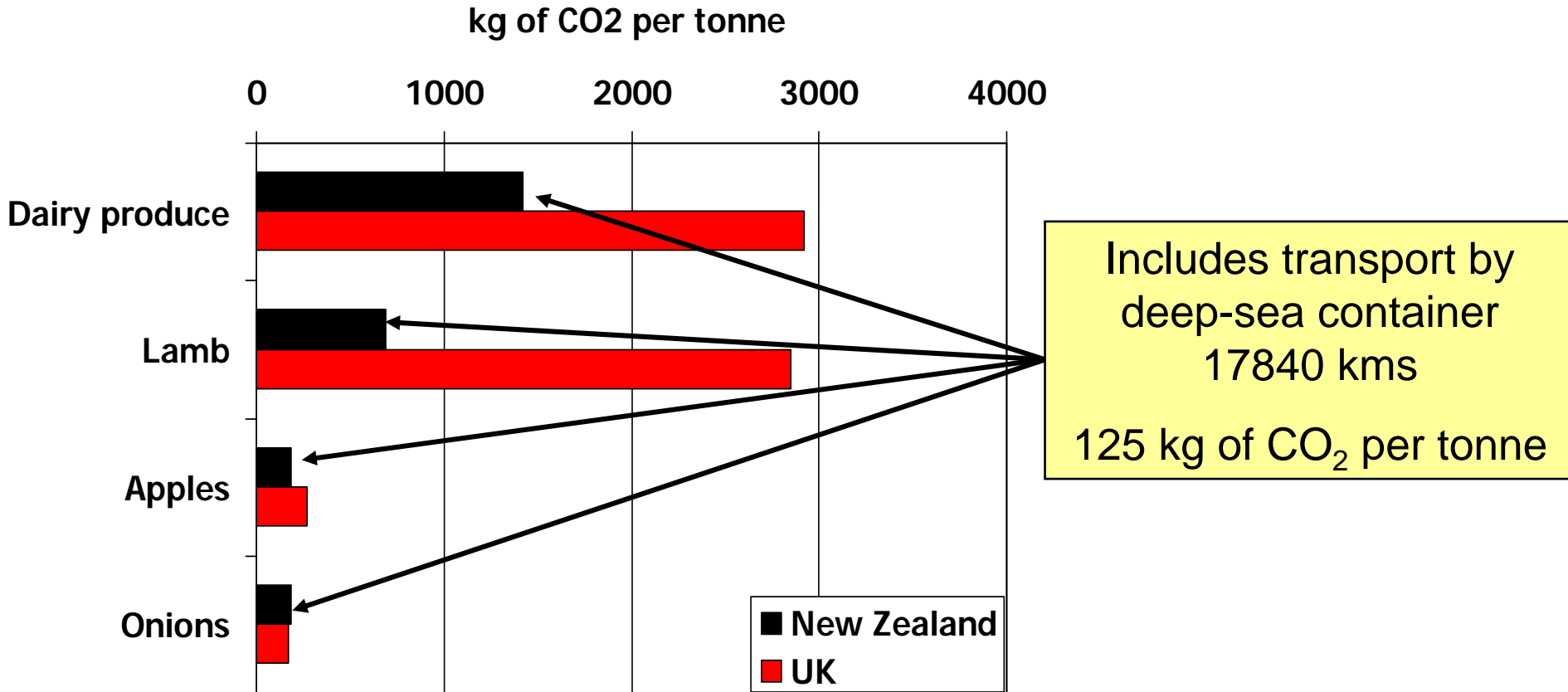
More energy efficient equipment

More reliance on natural lighting

Comparative CO₂ Emissions: life cycle analysis of 'food miles'

Importing of food from New Zealand to the UK

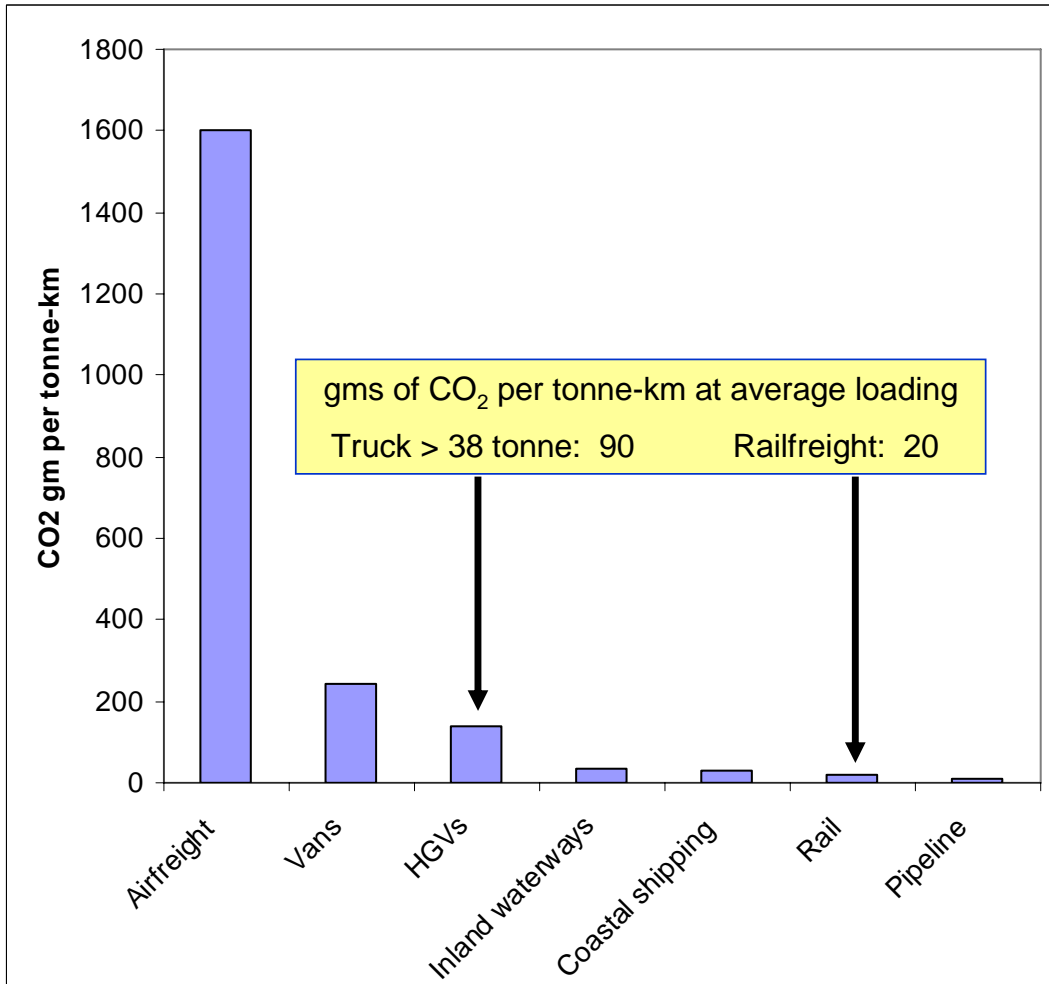
Much food production is more energy efficient in New Zealand



Source: Saunders, Barber and Taylor, 2006

Ratio 2: Freight Modal Shift

Variations in CO2 Intensity by Freight Transport Mode



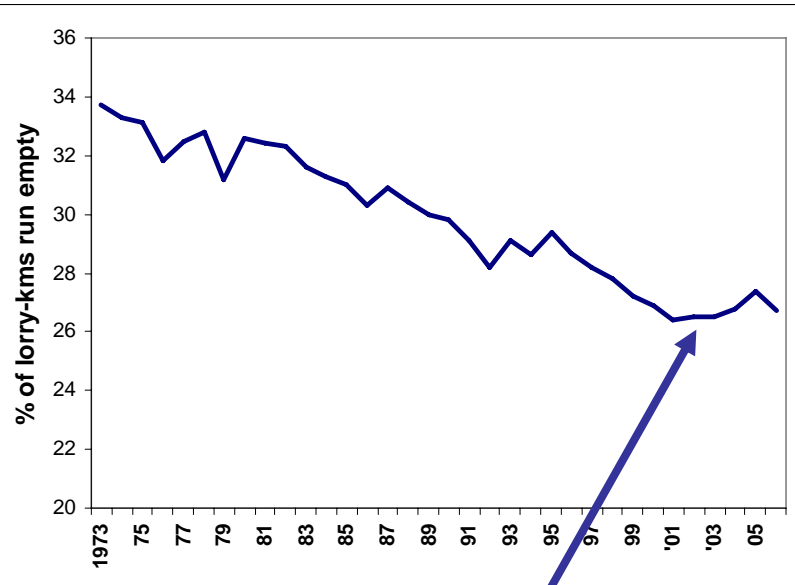
Source: McKinnon / Commission for Integrated Transport

- Assumptions about average load factors ?
- Line-haul or door-to-door ?
- Primary energy source of electricity ?
- Inclusion of infrastructure development and maintenance ?
- Passenger/freight split (bellyhold air & ferries) ?

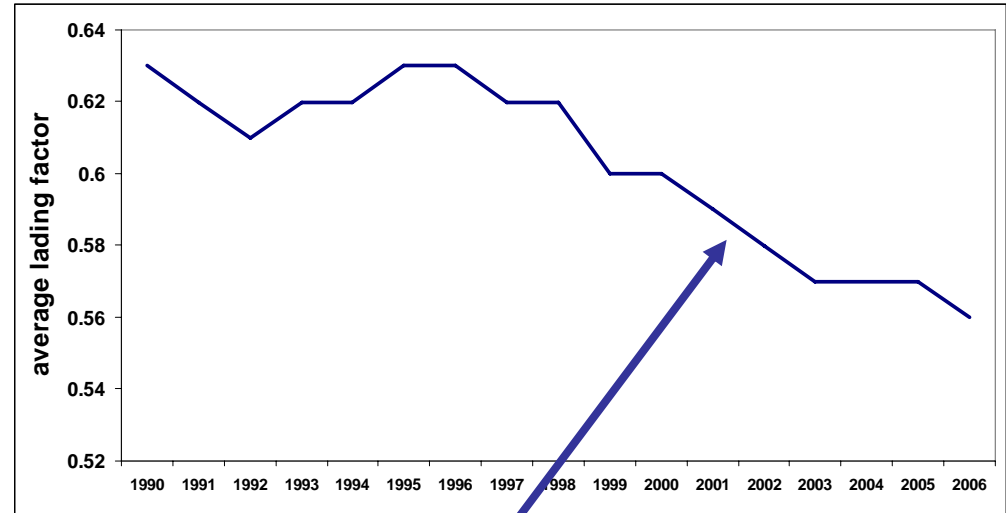
Ratio 3: Vehicle Utilisation

Loading of trucks

UK - decline / stabilisation of **empty running**



UK - recent decline in **loading factor**



Source: Dept for Transport

Has the long term trend now stabilised?

Opportunities for further reductions?

Causes of the recent decline?

Increase in max truck weight ?

Lack of utilisation data for other modes

Increases in Vehicle Weights and Dimensions

Increase maximum weight



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

Double-deck / high cube trucks

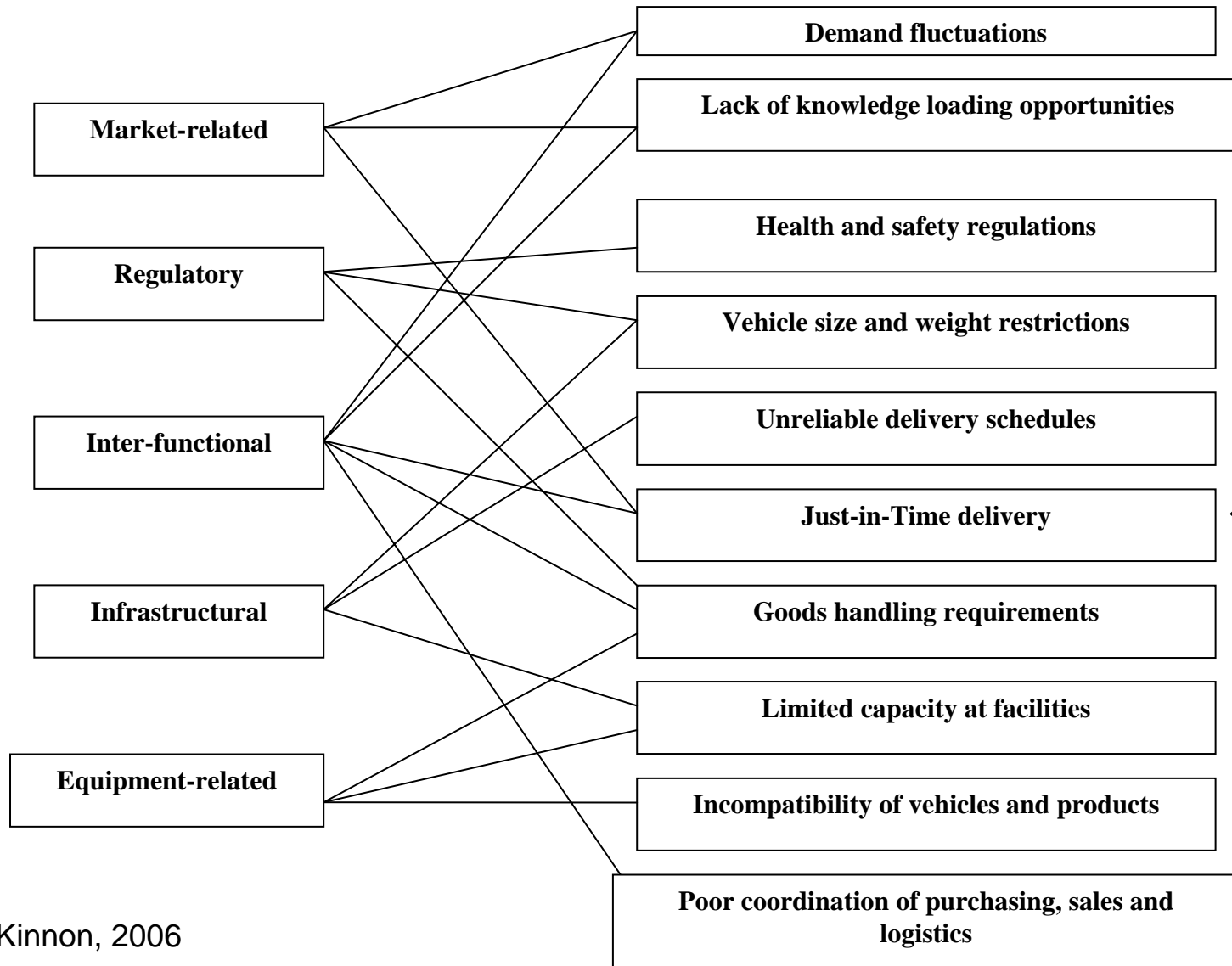


Longer vehicles



Truck + dolly/semi-trailer

Constraints on Vehicle Utilisation



Applying Lean Supply Chain Principles on CO₂ Emissions

Analysis of a food supply chain in the UK

Concluded that leaner supply chains also had lower CO₂ emissions

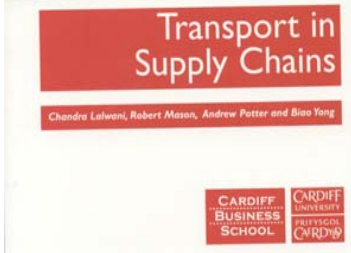
	Current State				Future State			
	Time	%	CO2	%	Time	%	CO2	%
VA	22.2h	5.3	142g	28	22.2h	7.0	142g	28
NNVA	6.5h	1.6	26.5g	5	6.5h	2.0	27.9g	5.5
NVA	387h	93.1	395g	79	289h	91	368g	74
Total	416h	100	564g	112	318h	100	538g	108

Value Add Time
Total Time



Supply Chain CO₂
Unit Weight

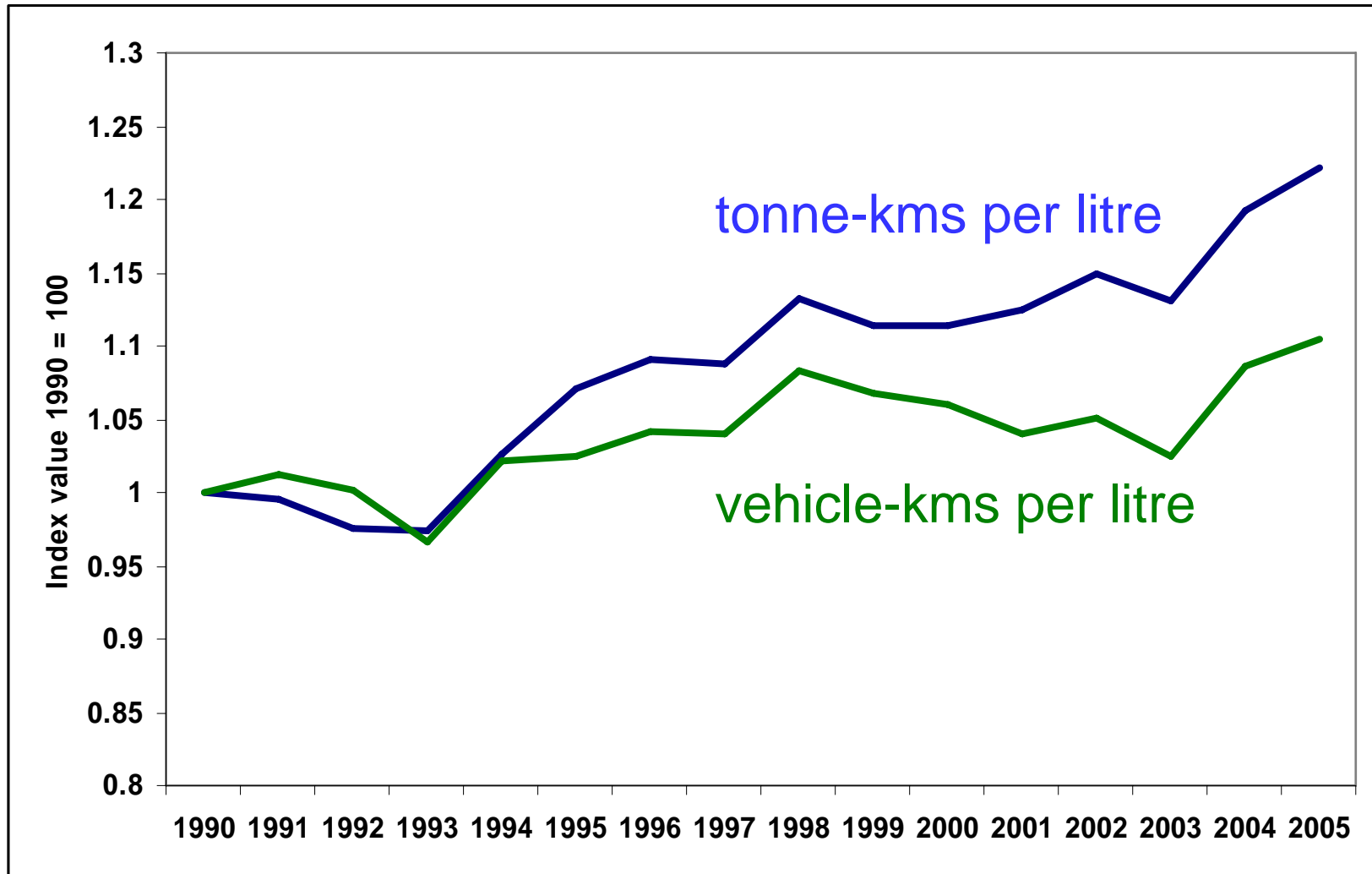
Source: Mason et al,
Cardiff University,
2002



ITeLs Project

Ratio 4: Fuel Efficiency

Increasing Energy Efficiency or UK Road Freight Transport



Source: UK Dept for Transport

Fuel Economy Standard for Trucks

Japanese 'Top Runner Programme' (from 2006)

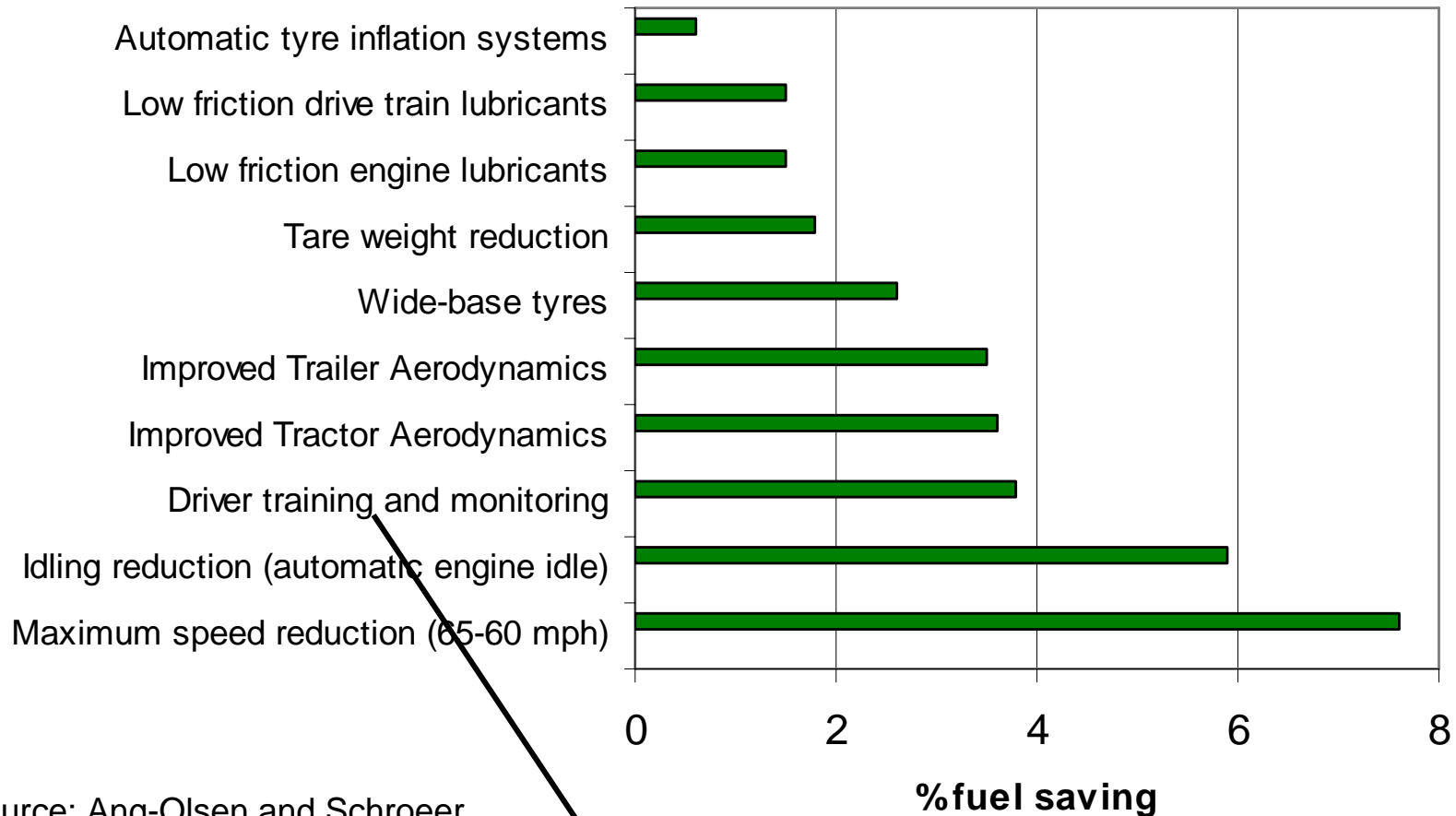
Fuel efficiency and carbon targets

	2002	2015
Fuel efficiency <i>kms per litre</i>	6.32	7.09
Carbon intensity <i>gm CO2 per km</i>	415	370



More difficult to set fuel economy standards for trucks than for cars and vans.

Impact of Fuel Efficiency Measures (US data)



Source: Ang-Olsen and Schroeer



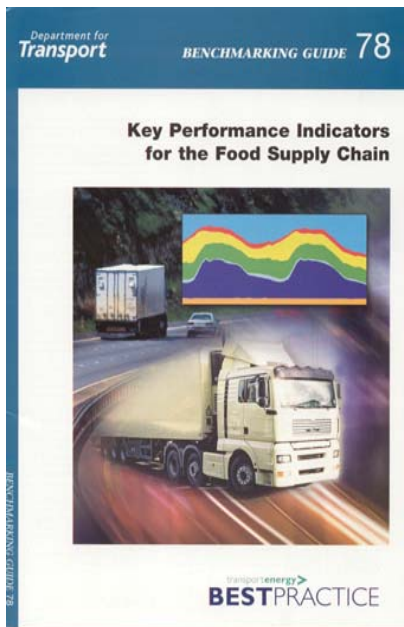
UK: 5% fuel efficiency gain

Benchmarking of Energy Efficiency

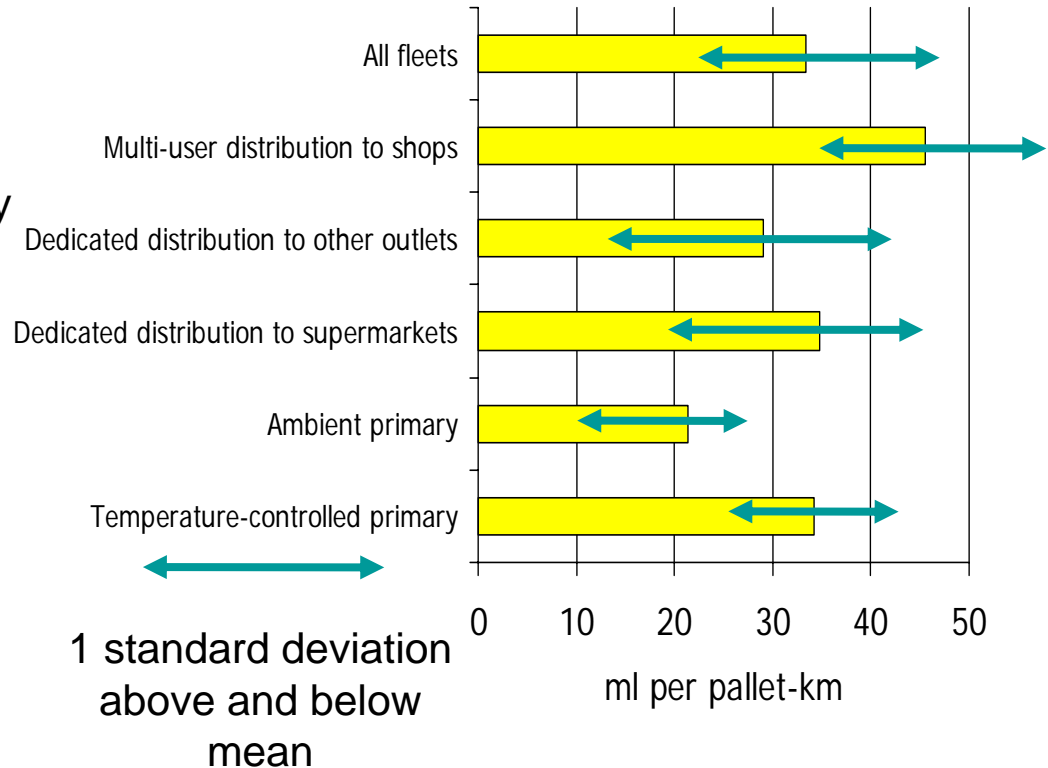
Freight Best Practice programme

Transport KPI Initiative

- Key Performance Indicators (KPI) surveys
- 56 fleets in the food supply chain (2002)
- Synchronised audit of transport efficiency
- 3500 vehicles monitored over 48 hours
- Incentivizing companies to improve vehicle fill and improve energy efficiency



Wide variations in energy intensity



Fleets below mean raise energy efficiency to:

Sub-sectoral mean: 5% cut in CO₂

Mean of top 1/3 in sub-sector: 19% cut in CO₂

Environmental Sustainability of Biodiesel?

- Balancing of CO₂ absorption during biofuel plant growth with CO₂ emissions in combustion
- Switch to biodiesel was key element in corporate carbon abatement strategies:
e.g TESCO and M&S
- Strong government policy support for biofuels:
 - *EU Renewal Transport Fuel Obligation (RTFO) – 5.75% biofuels in transport fuel by 2010 and proposal for 10% by 2020*
 - *in 2006 \$13-15 billion in subsidies to biofuel production in OECD countries*

- On life cycle basis, some biodiesel are more carbon-intensive than conventional diesel
- Large-scale biodiesel production will be environmentally unsustainable due to:
 - *lack of arable land / distortion of agricultural markets / destruction of ecosystems*
- No certification schemes as yet for sustainability of biodiesel production and distribution
- 2nd generation biofuels may hold the answer – but time-scale and cost are uncertain
- *'Improving energy efficiency in transport has much greater potential, and at lower cost, than promoting biofuels for reducing energy supply vulnerability and reducing greenhouse gas emissions' (International Transport Forum, 2007)*

Use of Electric Vehicles

zero-emission or 'elsewhere-emission' vehicle?

Carbon-intensity largely depends on nature of primary energy source



Tesco installing wind-turbines at some of its premises

Will generate more electricity than required to recharge electric vans

New Business Opportunity 3rd Party Logistics Market?

JPM ECO LOGISTICS LTD

Eco-friendly Haulage Company



EcoFacts

- Produces no GREENHOUSE GASSES. no GLOBAL WARMING.
- ENVIRONMENTALLY FRIENDLY. Produced from renewable materials
- Contains virtually no sulphur (0.001%)
- Emits the same amount of carbon dioxide as plants absorb in growth
- No Benzene or other carcinogenic polyaromatic components
- Non Hazardous (very high flashpoint)
- Bio fuel biologically causing no harm to soil or water

carbon-neutral haulage?

Environmental status rests on use of 100% biodiesel from rape-seed oil

<http://www.jpmeccologistics.co.uk/>

Is carbon auditing and management capability a new competitive differentiator for logistics service providers?

How much importance will clients attach to 3PL's 'carbon offering' ?

Will they be prepared to pay more for it ?



aims to cut its CO₂ emissions by 30% by 2020

How will it be audited?

How will it reflect changes in:

- *traffic level / volume of business*

- *customer / traffic mix*

How will it be achieved?

Supply Chain Carbon Auditing at Product Level

UK Carbon Trust: Use of carbon labelling to commit companies to reducing CO₂ emissions by target amounts

Tesco May 2008

Carbon labels on own-brand varieties of orange juice, potatoes, energy-efficiency light bulbs and detergent

Amount of time and effort in analysing CO₂-intensity at SKU level?

To what extent will CO₂ labelling influence consumer behaviour?

Will it mainly influence corporate buying behaviour?

Practicalities of putting a carbon rating on the label?

Pre-requisite for carbon trading at corporate and consumer levels?

Results of Carbon Footprinting Exercise for Shampoo Products

	% of CO ₂
Materials	5%
Production	0.3%
Distribution	2%
Warming water for hair wash	93%
Retailing / Disposal	Excluded

Source: Boots

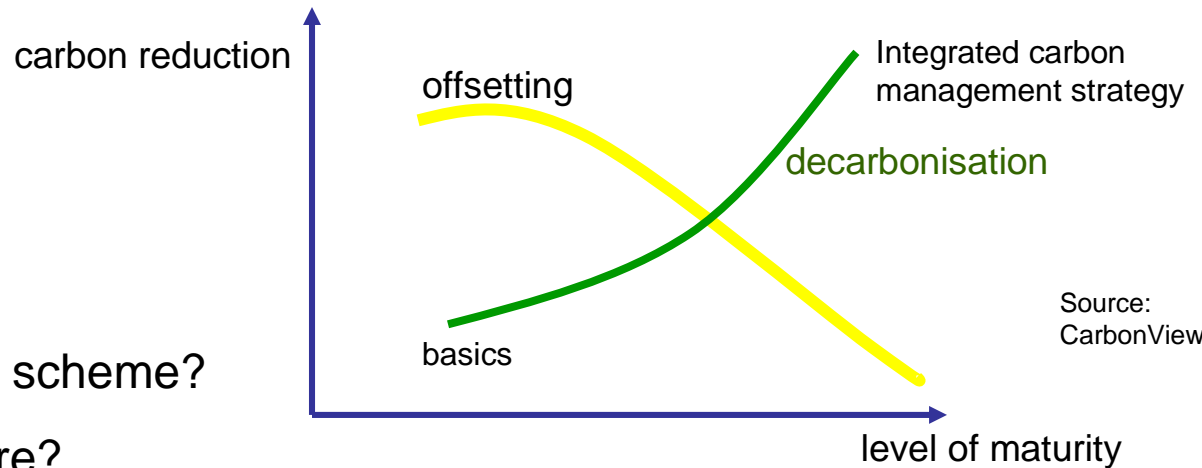
Carbon Offsetting

An Acceptable Route to Carbon Neutrality?

Paying others to cut / absorb CO₂ to balance your emissions

Critical questions to ask:

- What is the nature of the scheme?
- Is it an additional measure?
- When is the CO₂ being removed from the atmosphere?
- How permanent will the CO₂ reduction be?
- Can the scheme be scaled up as the demand for offsetting grows?
- Is it diverting attention and effort from energy conservation?
- Is the scheme genuine, honest and fair?



Source:
CarbonView

Best seen as a measure of last resort....

Conclusions

- Carbon mitigation will not simply be another short-term business fad: it will be an enduring managerial priority
- Broad range of decarbonisation measures and incentives available
- Close correlation between CO₂ and cost reductions
- On a life cycle basis, minimising movement need not minimise CO₂
- Lack data on:
 - *relative cost effectiveness of carbon abatement measures in freight transport*
 - *modal demand elasticities and cross-elasticities in the freight sector*
- Economic incentives should be targeted on modal choice, vehicle utilisation and fuel efficiency: *limited financial leverage on logistics / supply chain structures and wider business trends*
- Need to co-ordinate freight transport measures with wider decarbonisation initiatives

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