

AutoCRC Technical Conference
Melbourne, 7th July 2011



A RADICAL REDUCTION IN ROAD TRANSPORT EMISSIONS

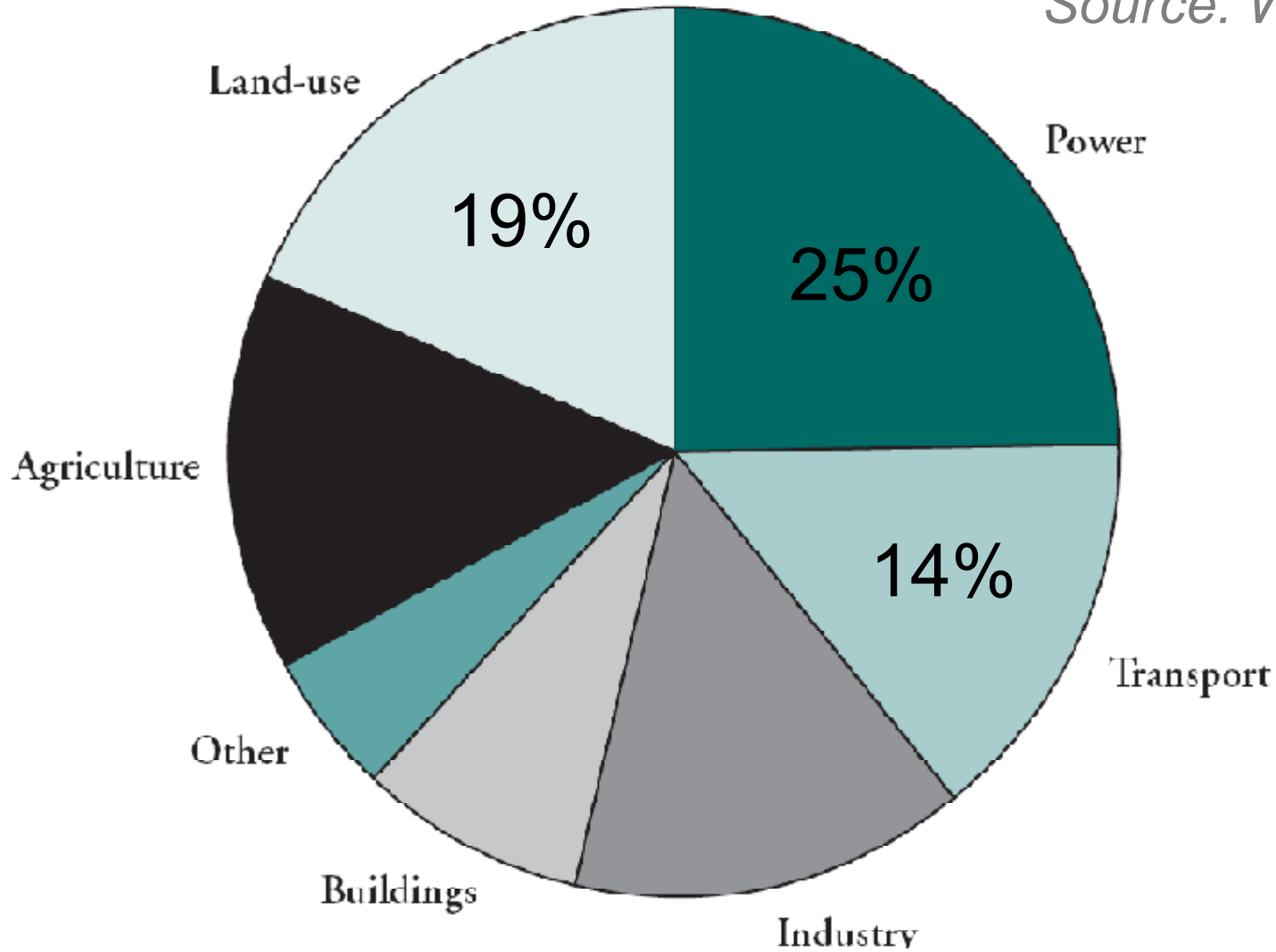
JULIA KING CBE FRENG

**VICE-CHANCELLOR ASTON UNIVERSITY
MEMBER OF THE COMMITTEE ON CLIMATE CHANGE
CHAIR OF THE KING REVIEW
UK LOW CARBON BUSINESS AMBASSADOR**

GLOBAL CO₂ EMISSIONS

Year 2000

Source: WRI (2006)



***US road transport:
33% of total emissions***



A MINIMUM 80% REDUCTION BY 2050

50% cut in global emissions by 2050
to keep temperature rise to below 2°

2050: 20 - 24Gt global emissions 2100: 9Gt

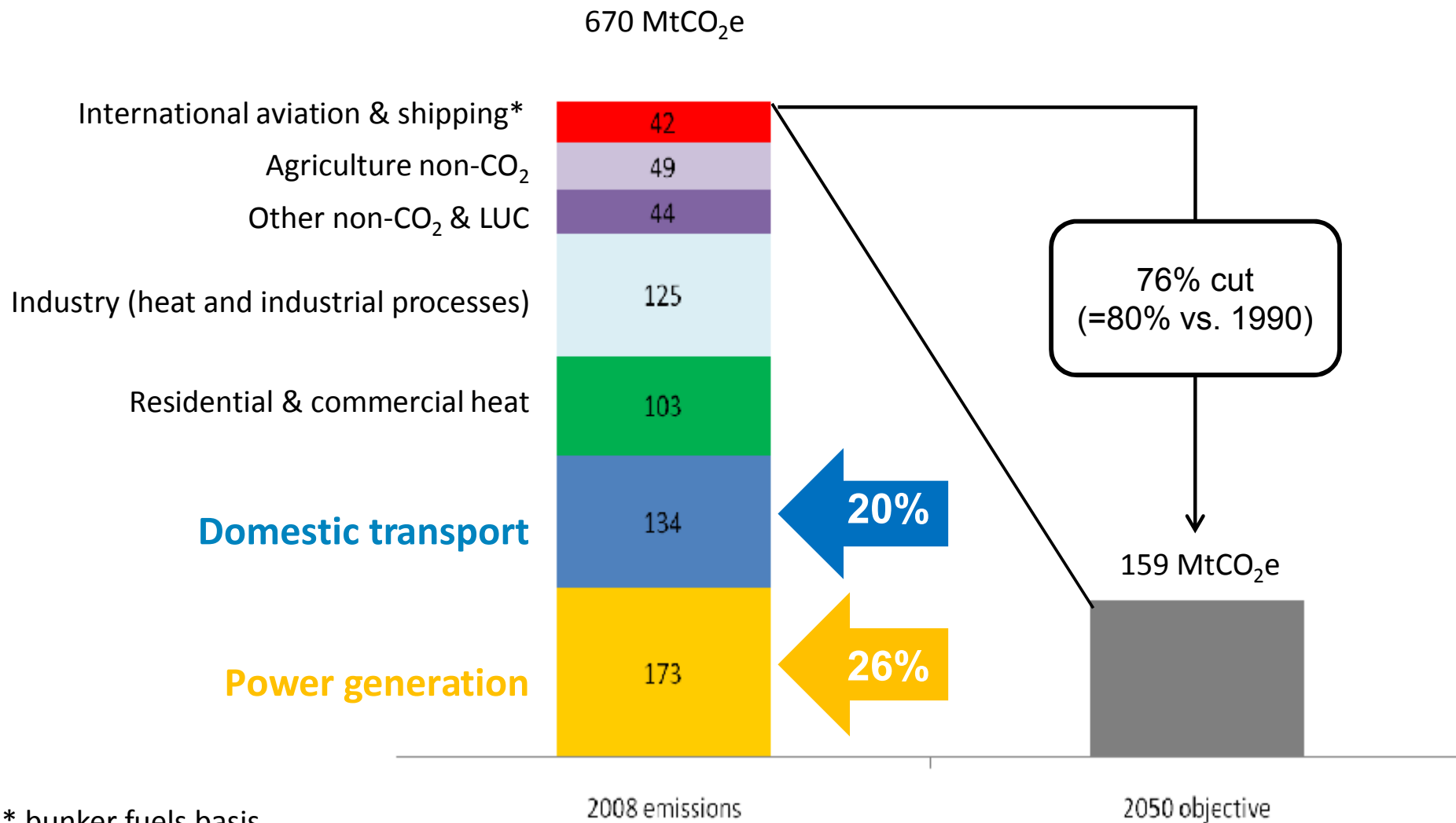
2050: 9 billion people

EQUAL SHARES: 2 – 2.5t per year each

80% reduction in emissions in UK



THE SCALE OF THE UK CO₂ CHALLENGE

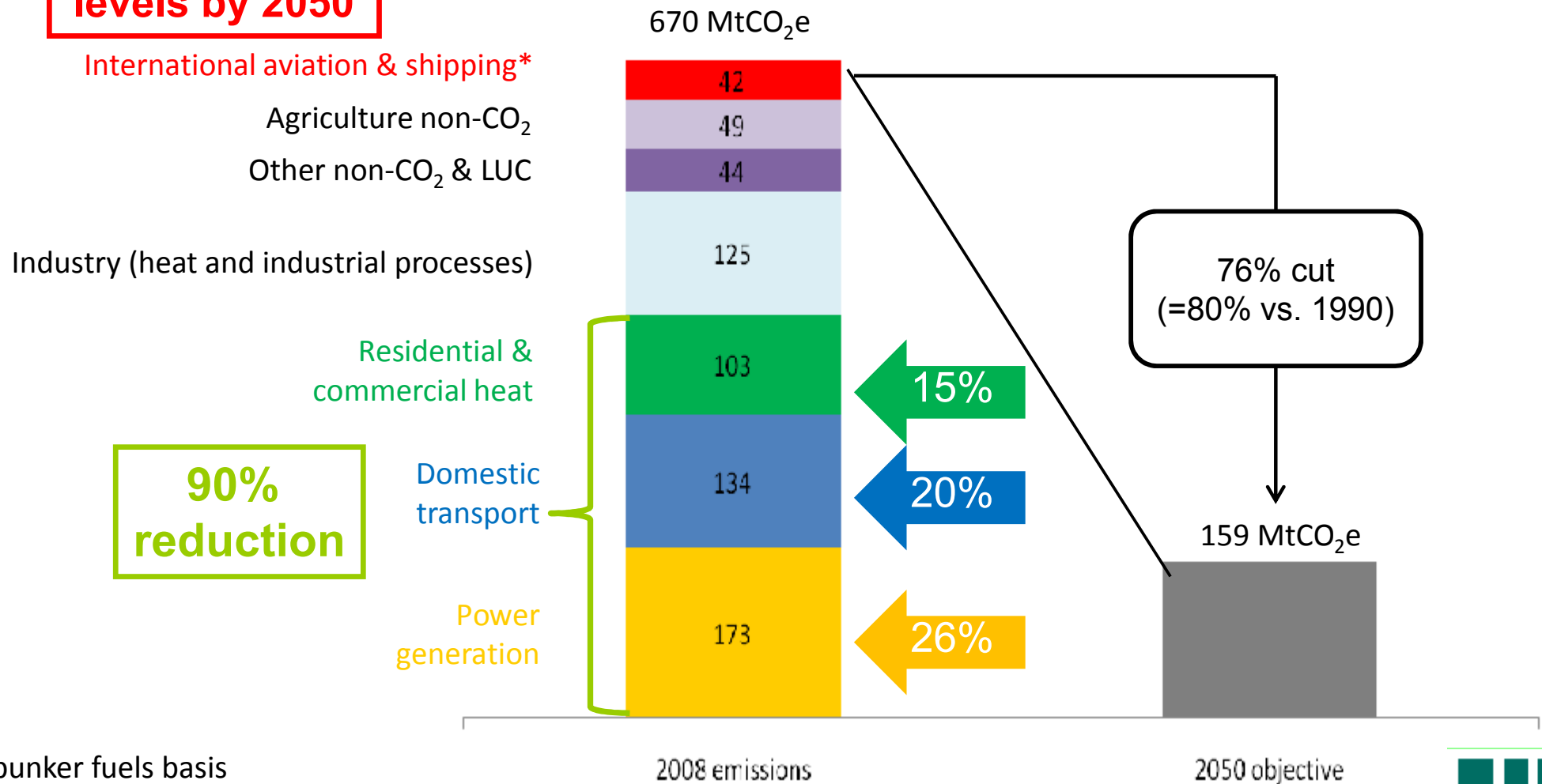


* bunker fuels basis



THE 2050 TARGET: DELIVERING THE REDUCTIONS

Return to 2005 levels by 2050



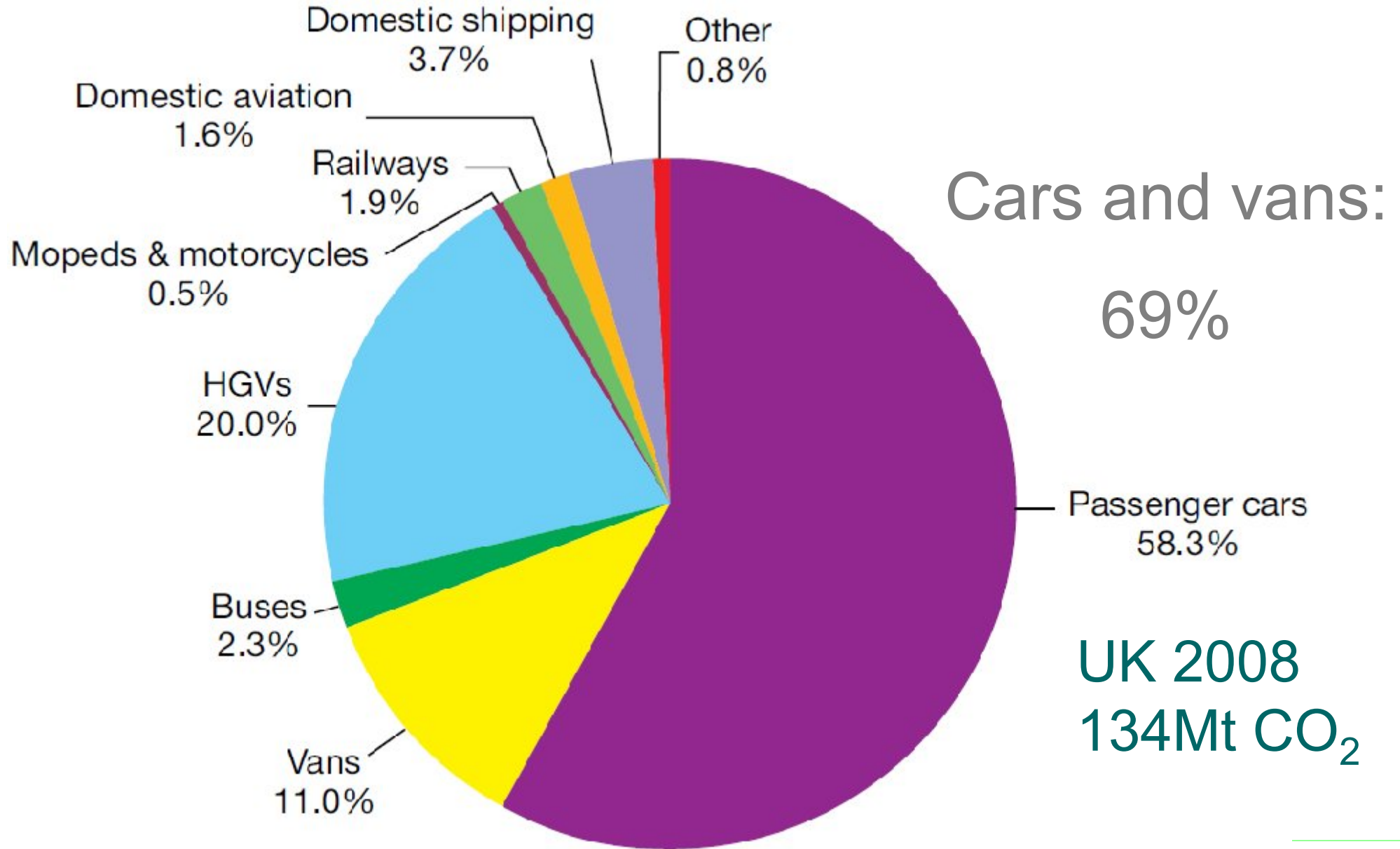
* bunker fuels basis





TRANSPORT EMISSIONS

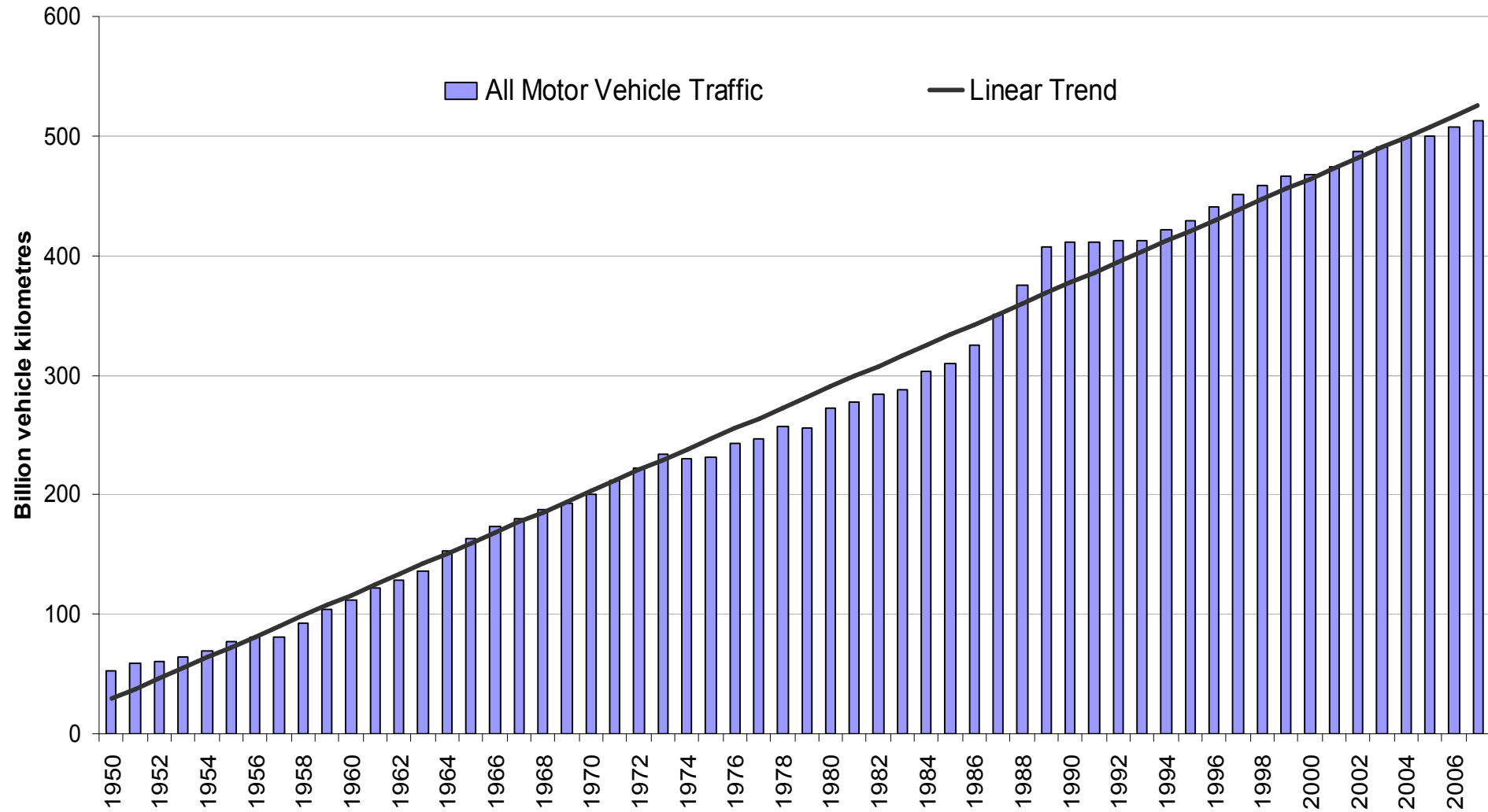
THE UK TRANSPORT EMISSIONS CHALLENGE: CARS



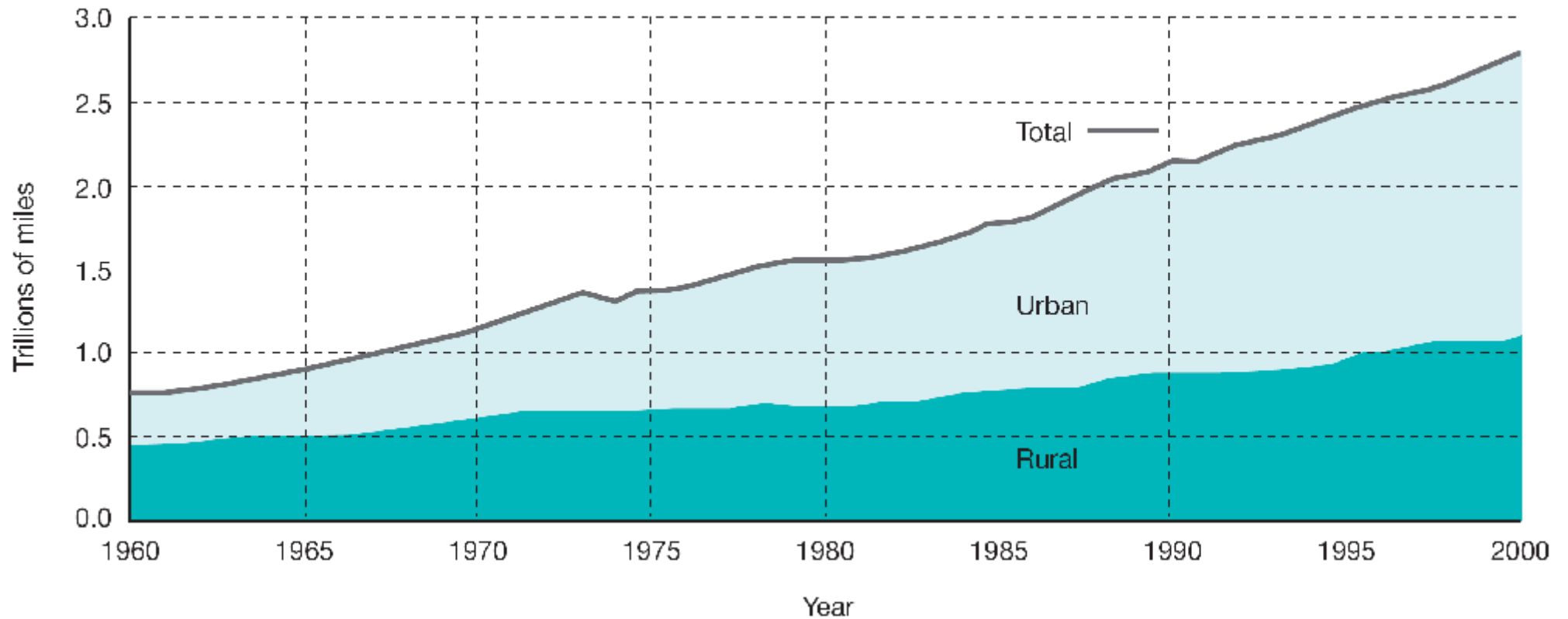
Source: DfT 2009



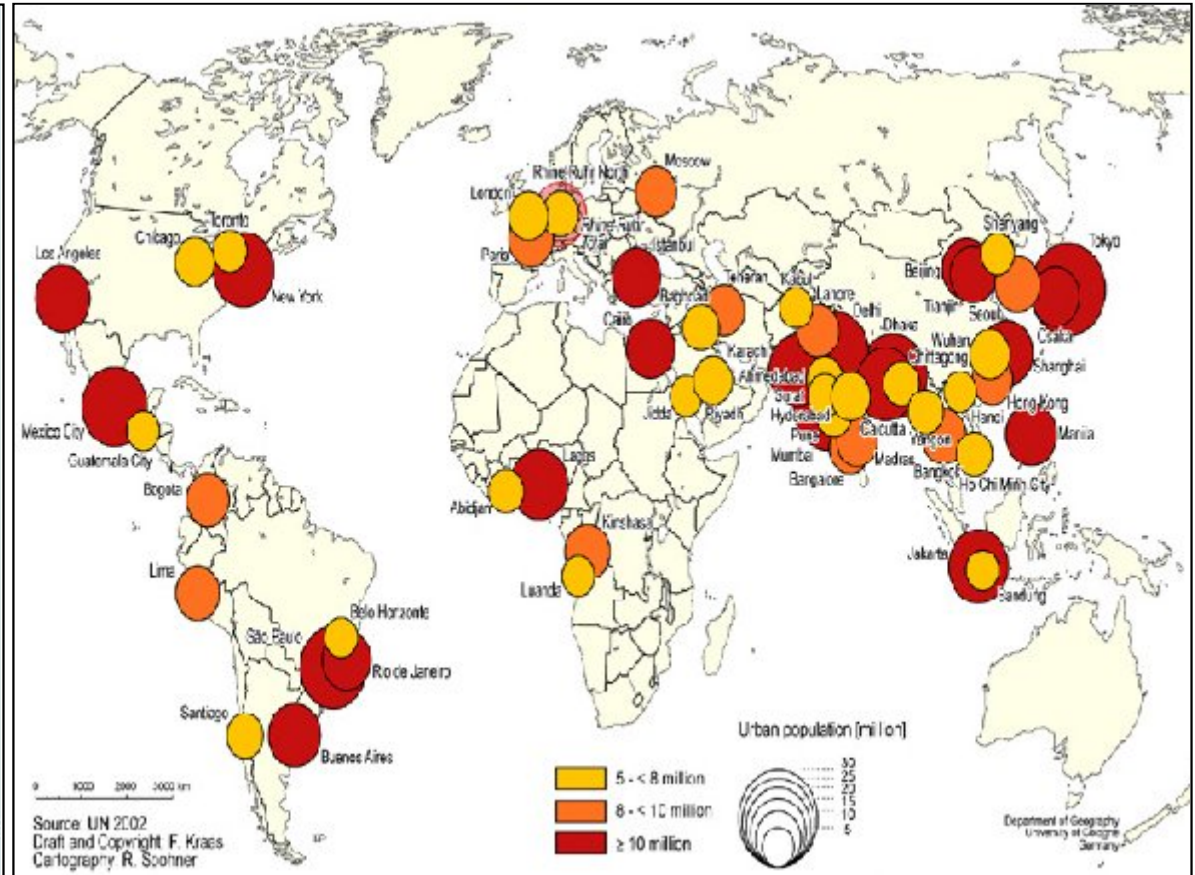
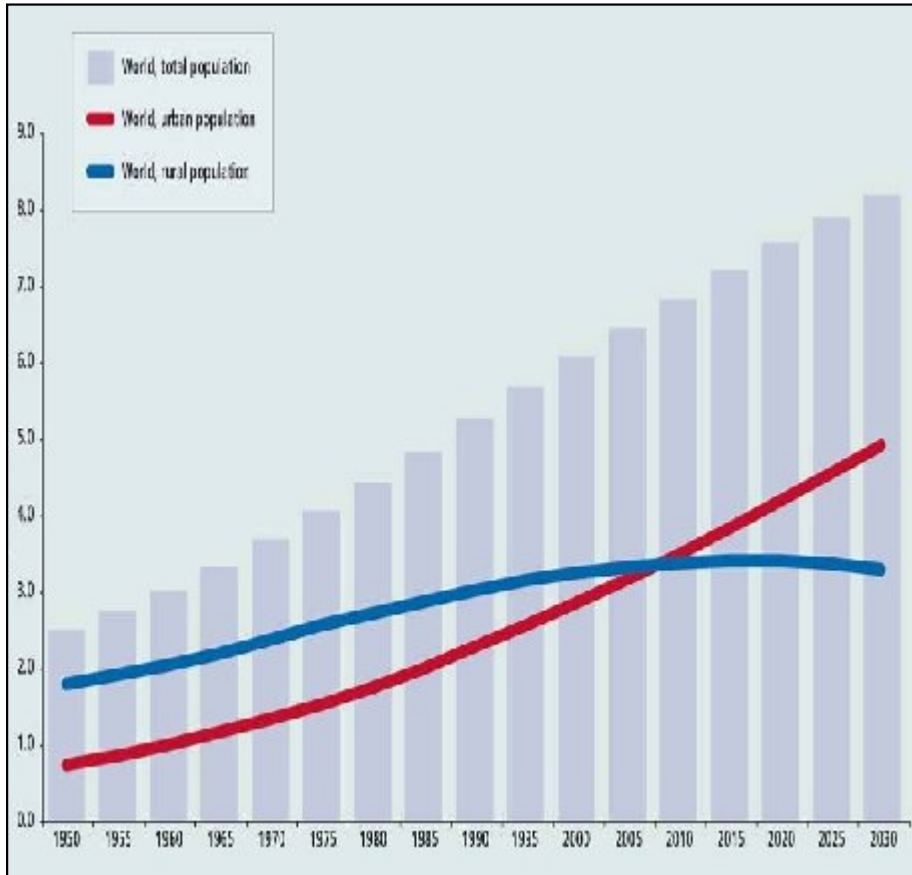
DISTANCE TRAVELLED IN THE UK: 1950 - 2008



DISTANCE TRAVELLED, GLOBAL: 1960 - 2000



2050: POPULATION GROWTH, URBANISATION & WEALTH



Sources: United Nations

2050

9 billion people
70% 'rich' and 'middle class'
6.5 billion urban population

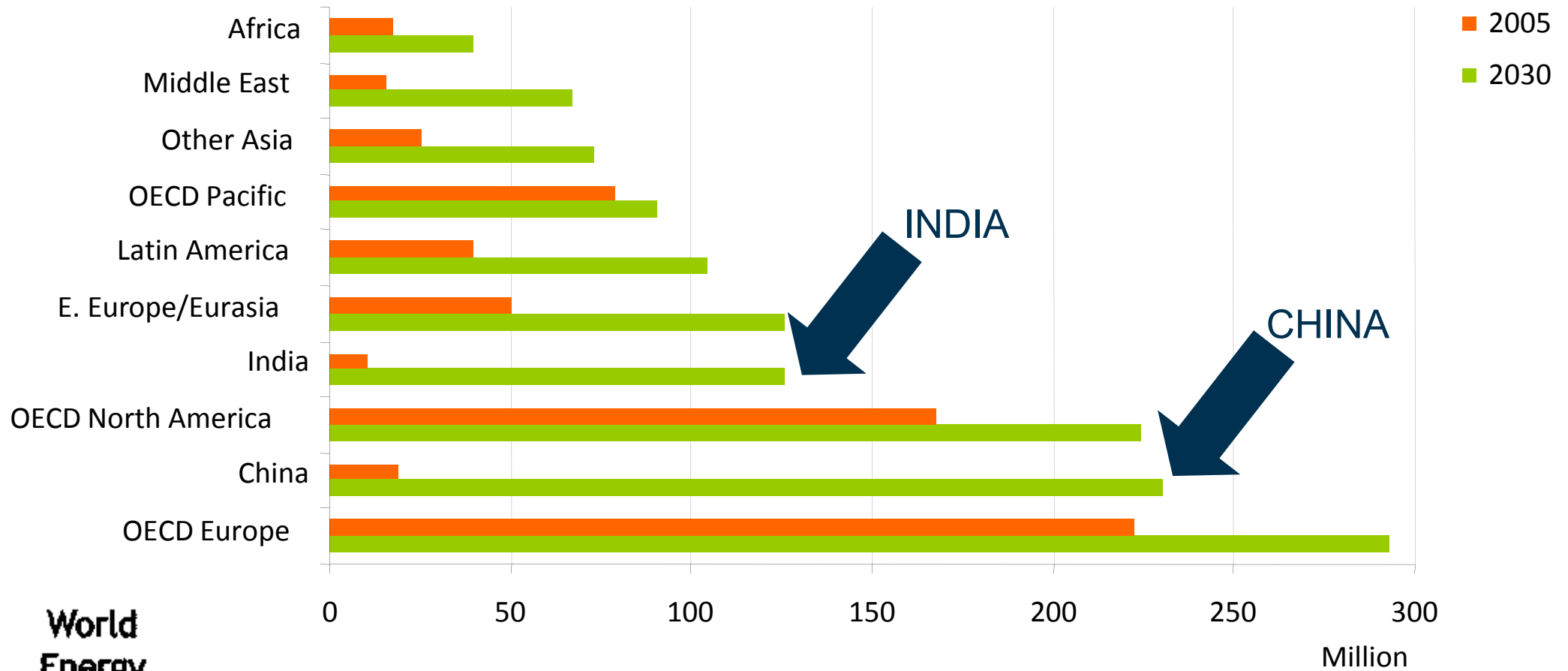
2010

6.4 billion
30%
3 billion



GLOBAL GROWTH IN VEHICLE OWNERSHIP

WEO Reference Scenario





2010

6.4 billion people

1 billion cars

2050

9 billion people

3 billion cars?

CONGESTION

Urban transportation is approximately *twice as energy intense* as intercity transport

Source: Schafer et al
MIT Press 2009

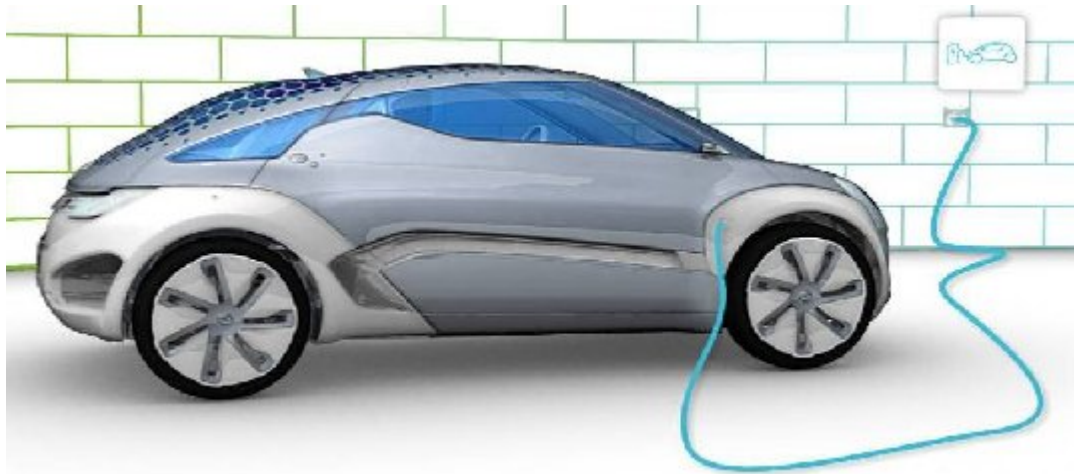


Emissions: in congested urban areas, **30-40% of total fuel** is used by cars **looking for parking**

The average search time is about 8 minutes

Source: MIT

Courtesy: Renault



**WHY DO WE NEED
RADICAL CHANGE?**



Second largest source of emissions in rich countries

**17% global emissions
20% UK emissions
33% US emissions**

1 billion vehicles globally use 53% of oil produced

**50% global GHG reduction by 2050
80% in developed countries, nearer 90% for land transport**

EFFICIENT PEOPLE: SMART BEHAVIOUR

- Driver behaviour has a big effect on CO₂ from road transport
 - vehicle choice: best in class 25 - 40%
 - chose a smaller car
 - eco driving: up to 15%
 - reduce/enforce speed limits: 70mph → 50mph: 20% saving
 - reduced marginal car use
 - car clubs, car sharing
 - modal shift to public transport...
- Behaviour change: potential 50% reduction in emissions
 - and it saves money
- Hard to achieve because...
 - environmental awareness/action in transport lags other sectors
 - powerful cars are symbols of status
 - we heavily discount future fuel cost savings
 - the rebound effect



EFFICIENT CARS

available technology can improve ICE vehicle efficiency by 50%



Source: King Review HMT 2007, 2008

BUT...THE SCALE OF THE CHANGE REQUIRED

- Emissions today:
(No of cars N) x (km driven D) x (per km emissions E) = NDE

Global 50% reduction

- Per km emissions 2050:
 $3N \times 0.5D \times e_{2050} = 0.5NDE$
 $e_{2050} = 0.33E$
67% reduction in per km emissions
144 down to 48g/km

UK 90% reduction

- Per km emissions 2050:
 $1.2N \times 0.5D \times e_{2050} = 0.1NDE$
 $e_{2050} = 0.17E$
83% reduction:
144 down to 24g/km

$$1.2N \times 0.8D \times e_{2050} = 0.1NDE$$
$$e_{2050} = 0.1E$$

90% reduction
144 down to 14g/km




















**DELIVERING
80%+
REDUCTION**

THE 80%+ EMISSIONS REDUCTION OPTIONS

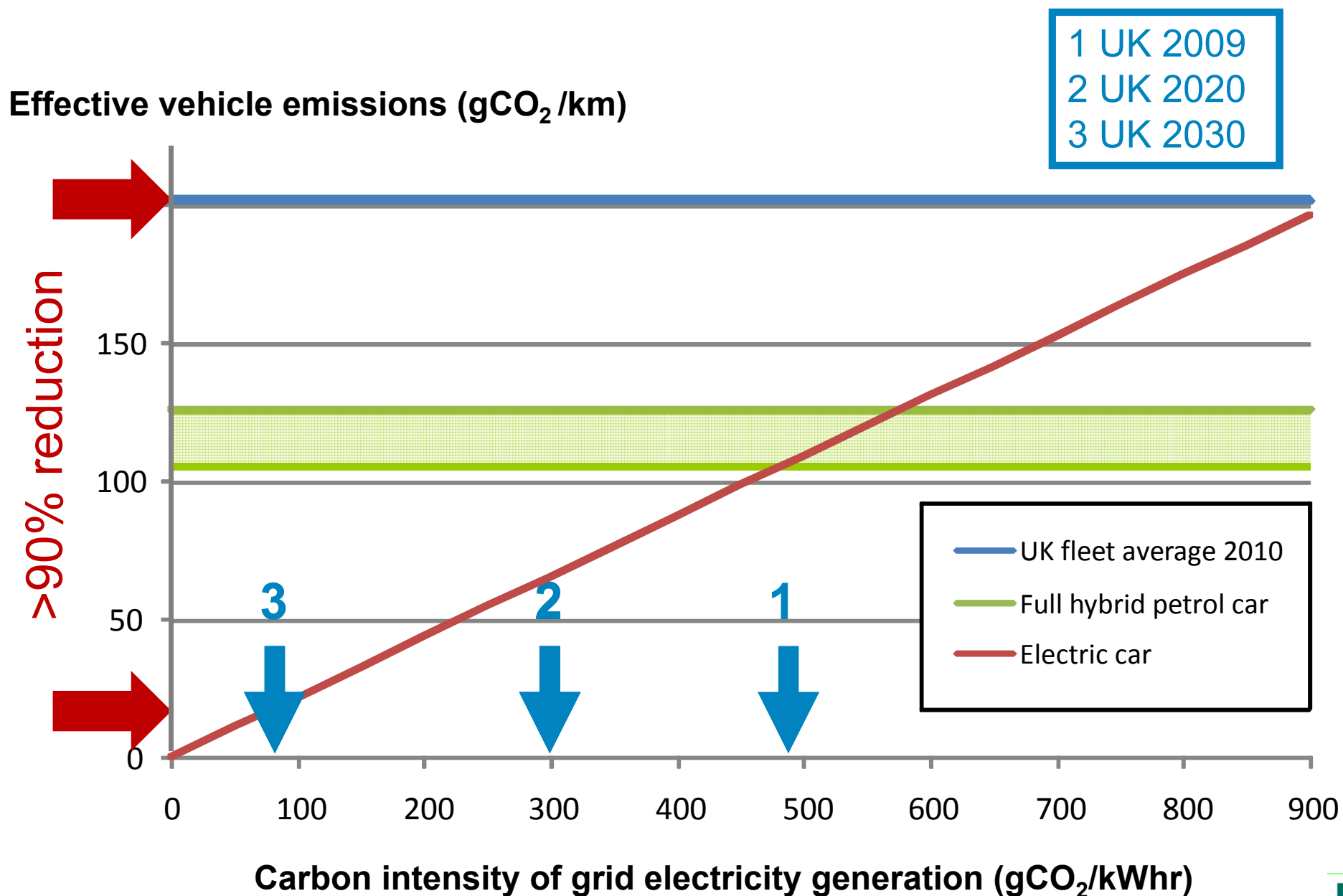
- Biofuels
- Electricity
- Hydrogen

	Fuel Infrastructure			Vehicle Technology	
	Production	Distribution	Dispensing	Powertrain	On-board fuel
Biofuels					
Electric					
Hydrogen					

 Easy/no change  Modest/evolutionary  Major/challenging/revolutionary



ELECTRIC CARS: EFFECTIVE PER KM EMISSIONS



CO₂ EMISSIONS FROM ELECTRICITY GENERATION

UK: 26% of total annual CO₂ emissions

2010 490g CO₂/kWhr

2020 300g CO₂/kWhr

2030 <90g CO₂/kWhr

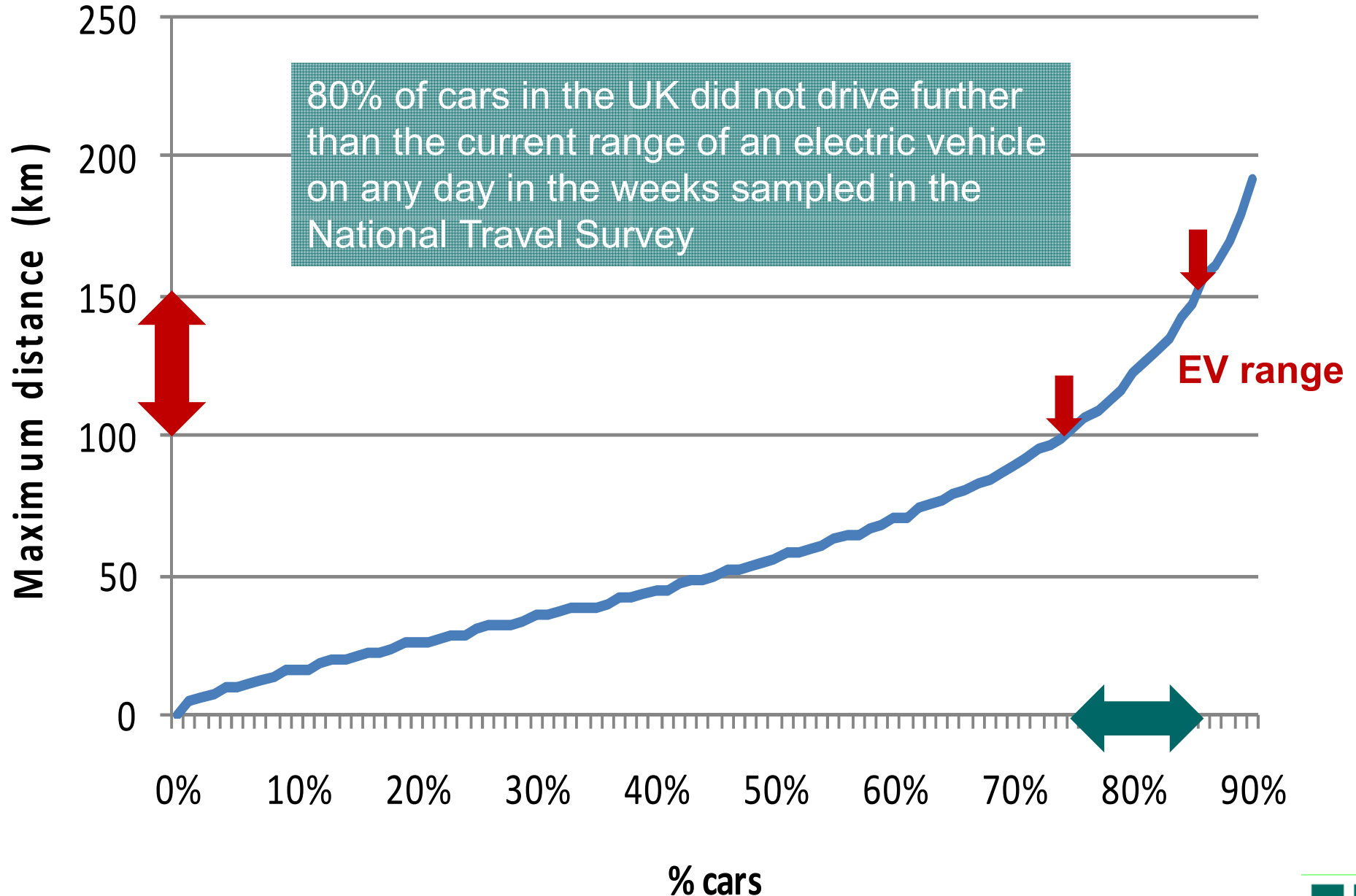


EVs AND PHEVs: CURRENT ISSUES

- Range and range anxiety
- Impact on the electricity system
- Cost



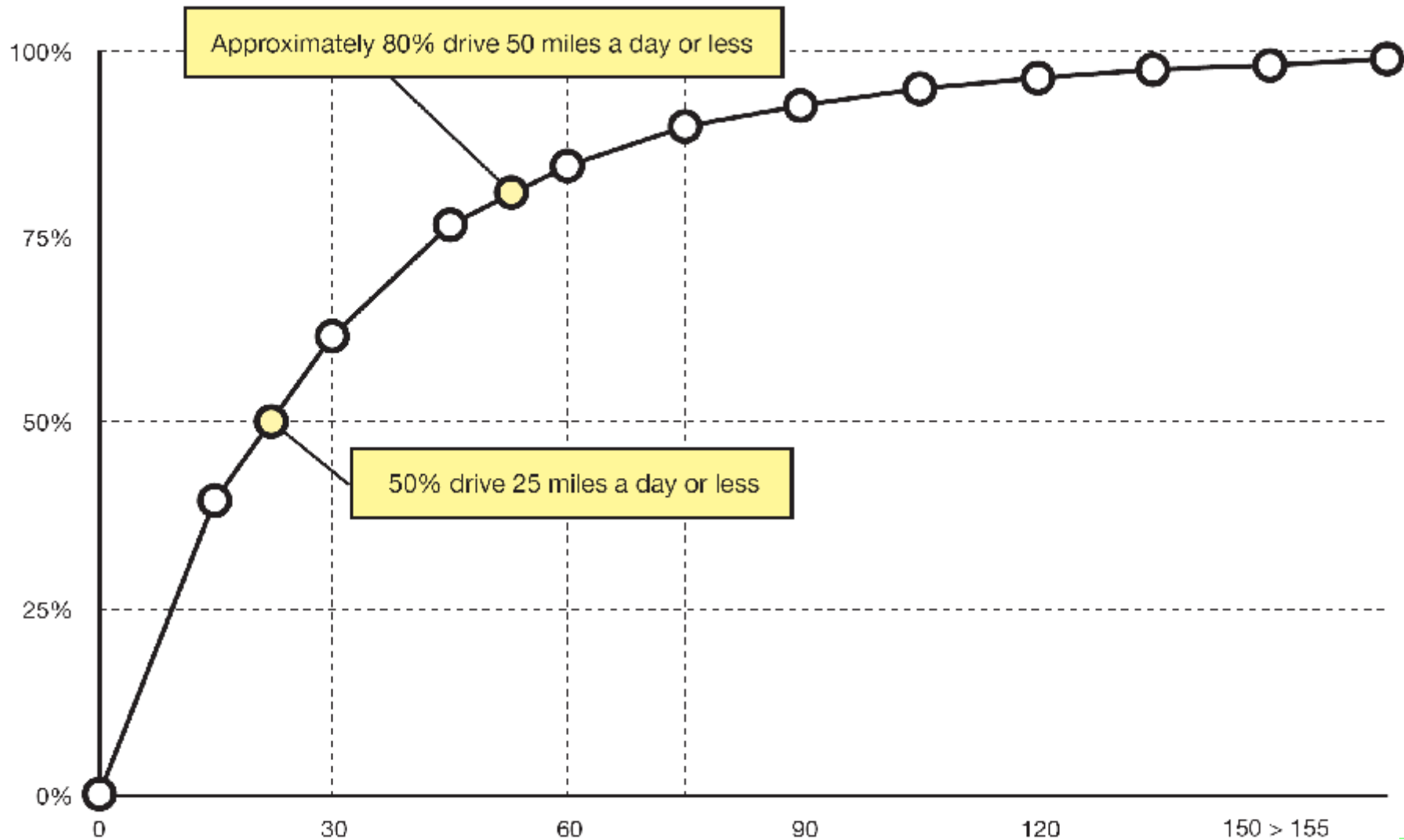
UK MAXIMUM DAILY DRIVING DISTANCES



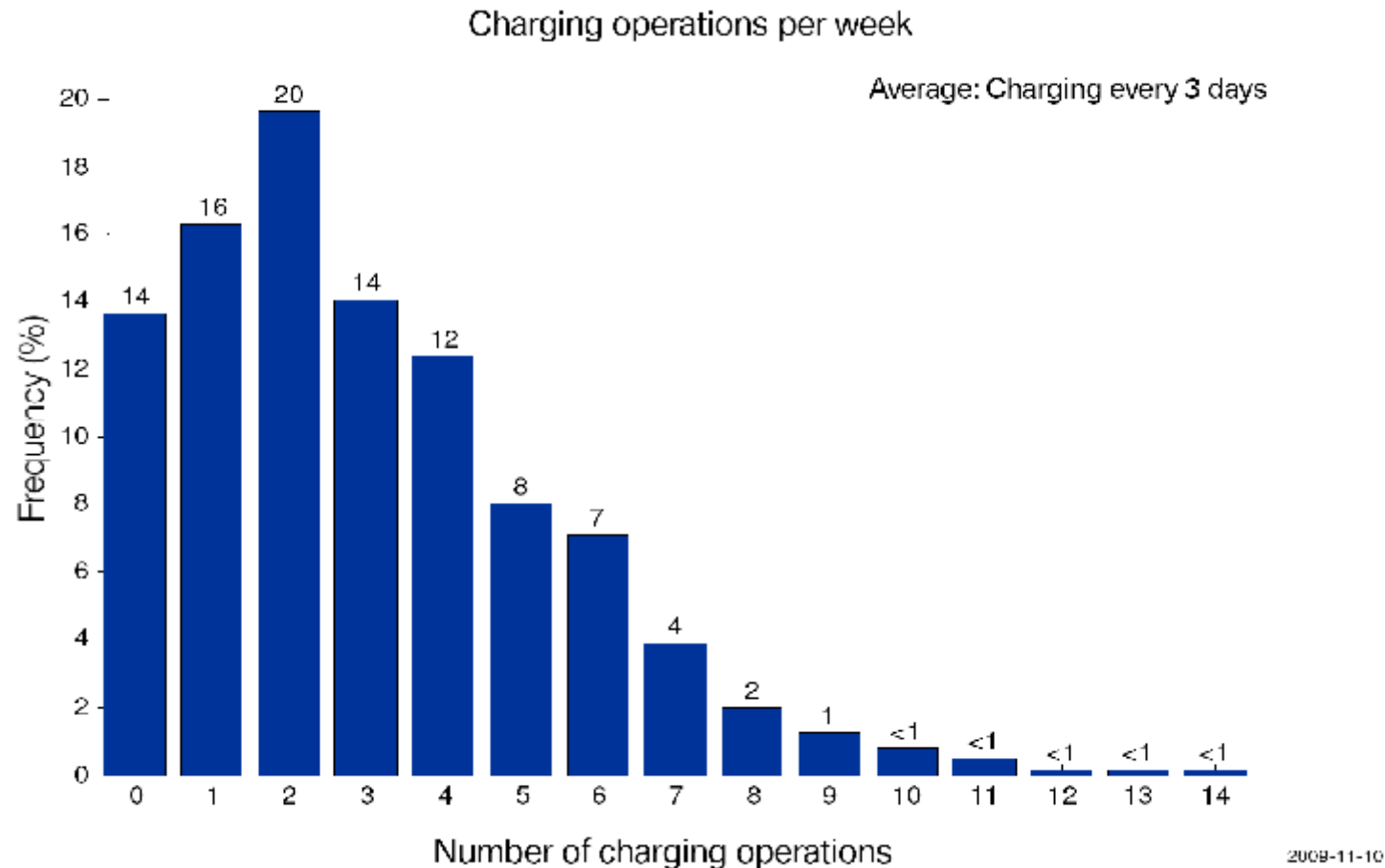
Source: 2008 National Travel Survey



DAILY DRIVING DISTANCES IN THE USA



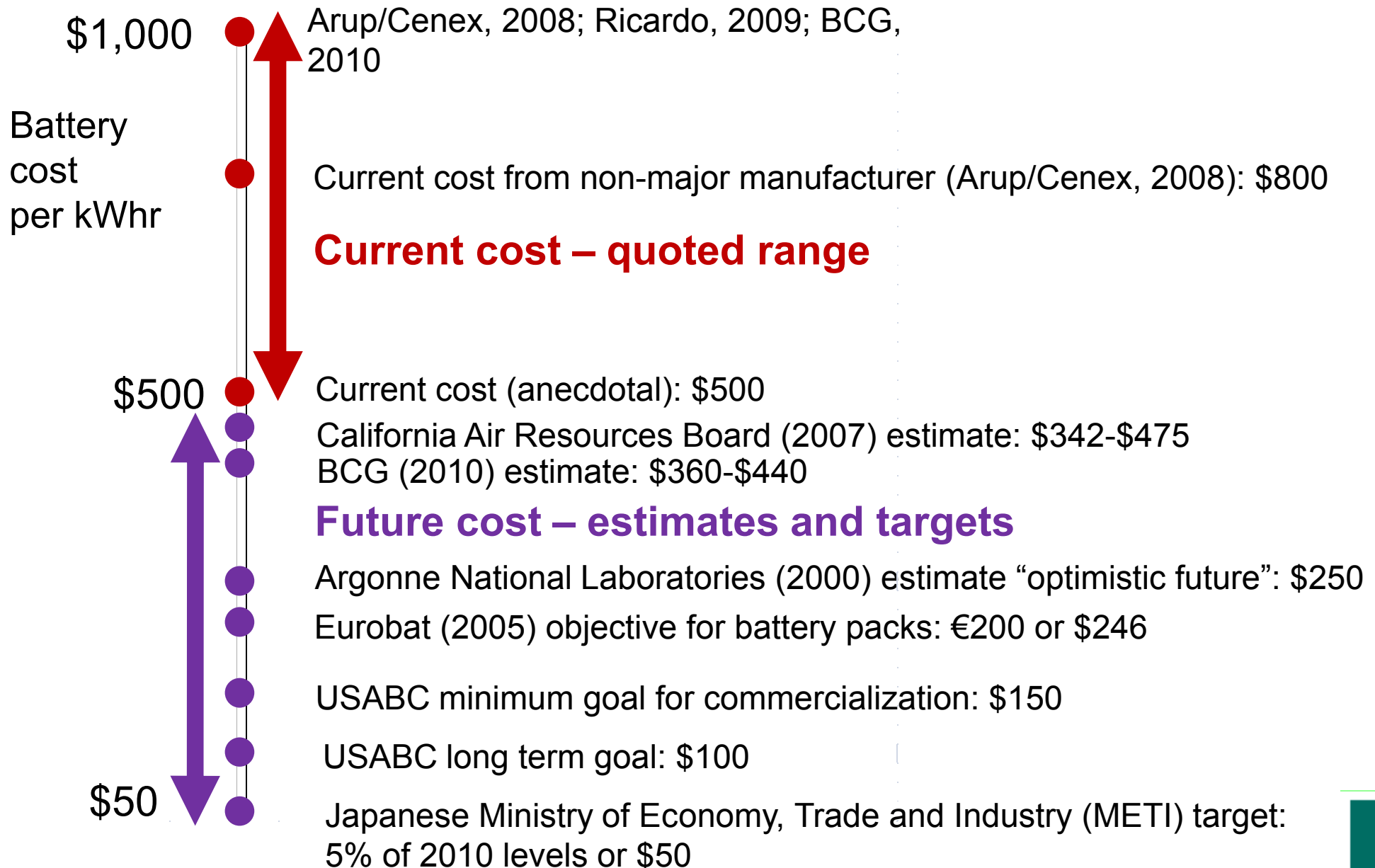
BMW MINI E PILOT BERLIN: 2009



- Daily driving distances in MINI E above German average: 38km
- 90% of users found 200km range sufficient for everyday needs
- Majority of vehicles only charged when parked for more than 5 hours
- 56% drivers never used public charging stations
- 35% of drivers felt less guilty and found driving more fun



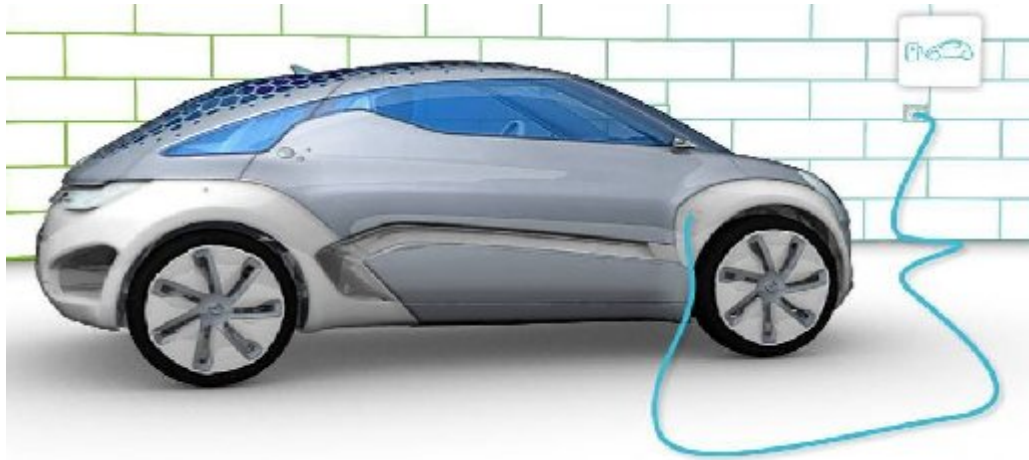
ELECTRIC VEHICLE BATTERY COST PROJECTIONS



ELECTRICITY SYSTEM: ISSUES AND PERCEPTIONS

- Decarbonising the electricity system over time is essential
- Generating capacity – impact starts very small, grows slowly and can be minimised: UK 1.7m EVs would need just 1% of current usage
- Distribution system – will need to adapt over time, but not just for EVs
- Extensive use of fast charging could create problems
- With a SMART GRID
 - millions of EVs can be accommodated without the need for extra capacity
 - EVs can be used to balance the grid
 - ‘second life’ for batteries: stationary, distributed storage and grid balancing





SUMMARY AND CONCLUSIONS

Courtesy: Renault

SUMMARY

- EVs will be an important and growing part of the *global* solution to vehicle emissions - critical by 2030
- It is a huge market!
- We have to start building the industry now (if we don't do it, someone else will)
- The power system impacts could be positive
- There is a large pool of potential early adopters today
- An EV will be an economic proposition for the consumer within 5 years
- Government support for early markets is needed



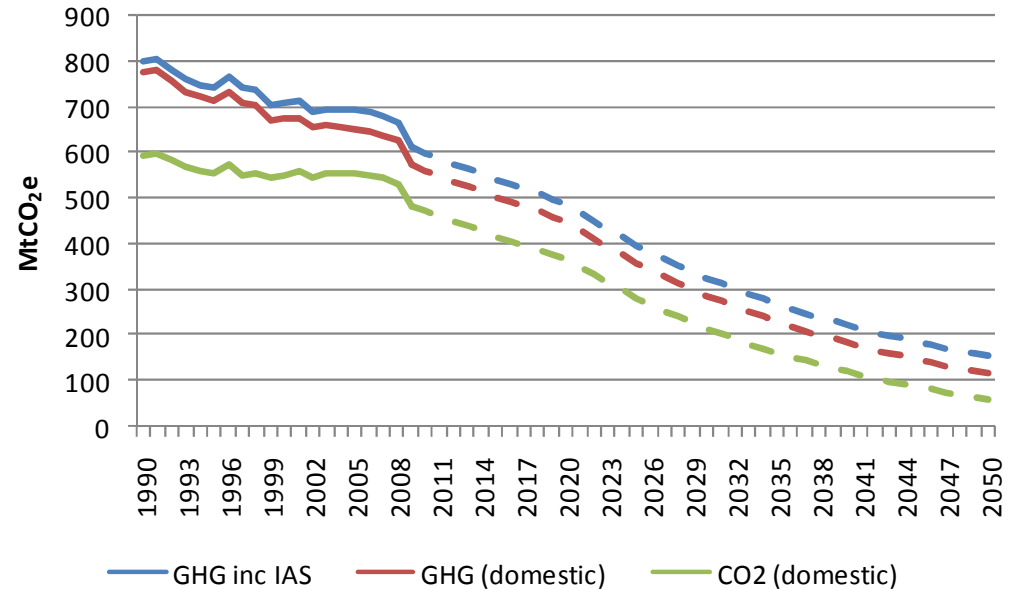
COMMITTEE ON CLIMATE CHANGE 2009 AND 2011

- The Government should aim for up to 1.7 million electric cars and plug in hybrids on the roads in 2020
- Meeting the UK's targets for 2030 and beyond will require some 60% of new cars sold in 2030 to be EVs and PHEVs

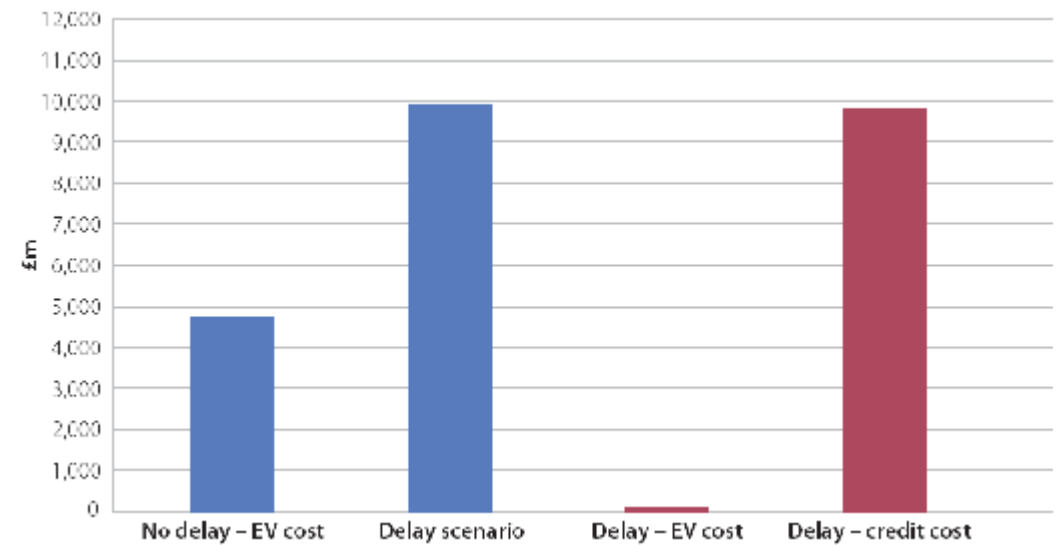


THE CASE FOR EARLY ACTION

- If we don't meet the high levels of ultra low carbon vehicles indicated in the 2030s, the UK will be buying carbon credits in the 2040s to meet its required emissions reduction trajectory.



- DECC forecast carbon price of £135-200/tCO₂e 2040-50
- Substantial cost saving from electric vehicle abatement in 2040s



It is cheaper to act now than to delay



Particular thanks to:

- Patrick Oliva, Michelin
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 - Chris Borroni-Bird, General Motors
 - The King Review team, HM Treasury
 - The Committee on Climate Change team
 - David Bott and the Technology Strategy Board team
 - Robin Haycock and Michael Hurwicz, OLEV
 - John Miles, Arup
 - Dan Sperling and Deborah Gordon: *Two Billion Cars*
 - Renault and BMW
- 

THE KING REVIEW



The King Review of low-carbon cars

Part I: the potential for CO₂ reduction



October 2007



The King Review of low-carbon cars

Part II: recommendations for action



March 2008

www.hm-treasury.gov.uk/king



THE COMMITTEE ON CLIMATE CHANGE

Building a low-carbon economy – the UK's contribution to tackling climate change



Committee on Climate Change
December 2008

Meeting Carbon Budgets – the need for a step change

Progress report to Parliament
Committee on Climate Change
October 2009



www.theccc.org.uk

