The King Review: Low Carbon Cars

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Stimulating innovation in low carbon vehicle technologies

LowCVP Fifth Annual Conference 22nd July 2008

CO_2 from transport

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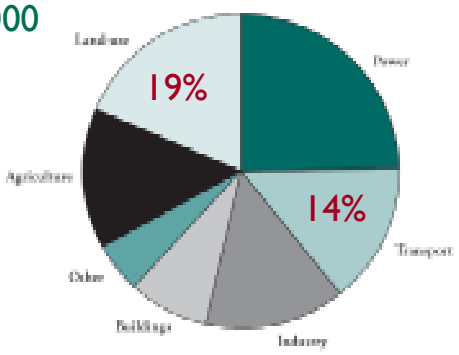
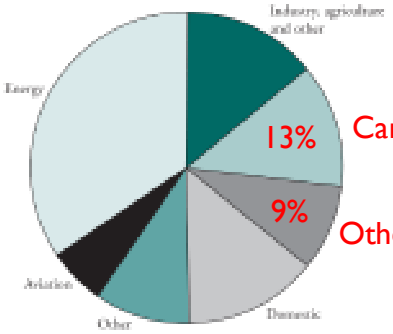
Global:2000



UK:2005



Cars

Other road

UK road transport:
22% of total emissions

Source: WRI (2006)

UK emissions prediction

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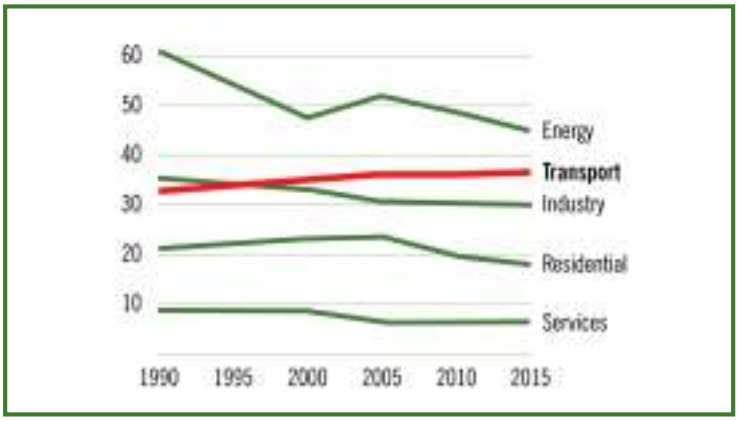
Million tonnes carbon



Source: ENERGY WHITE PAPER (DTI 2007)

The UK Government's Business Taskforce on Sustainable Consumption and Production

The UK challenge

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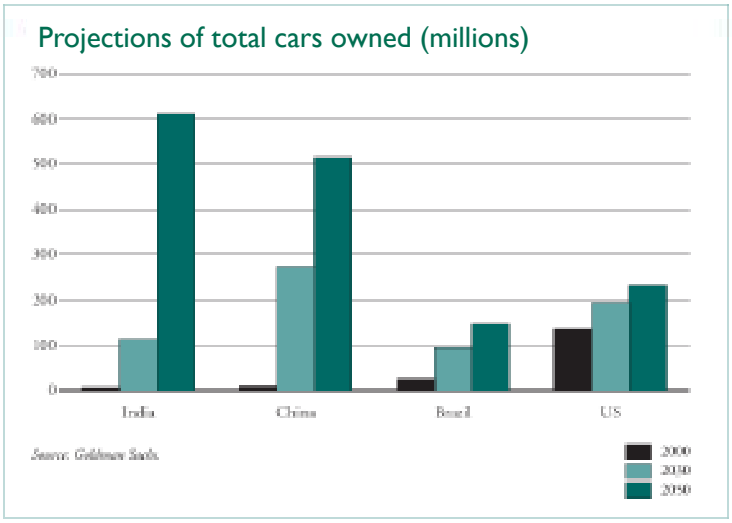
- The developed world will need to reduce emissions by 80% by 2050
- UK Climate Change Bill commitment: a *minimum* of 60% by 2050
- Transport is the second largest contributor to CO_2 emissions after energy
- Transport is currently the only major sector with emissions predicted to continue to be increasing a decade after Stern…

Source: Goldman Sachs

A challenge and an opportunity



Source: Goldman Sachs

King Review: Parts 1 and 2

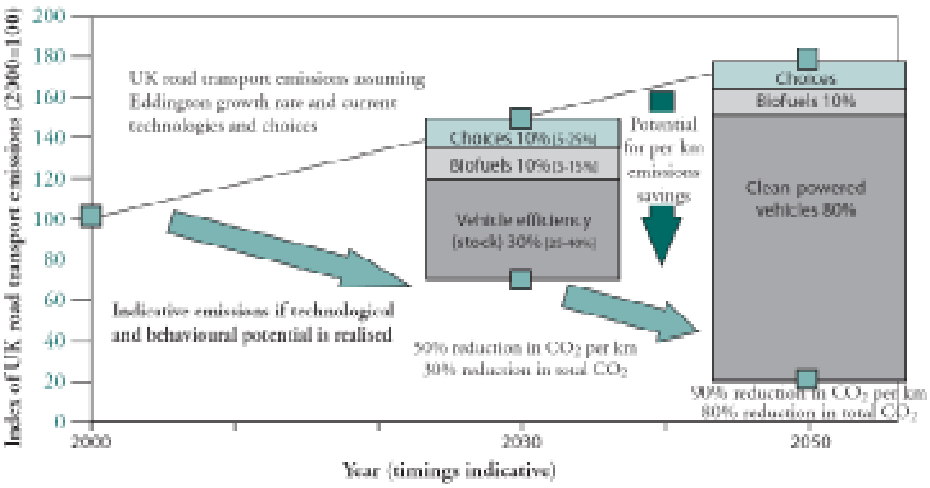
There is huge potential for CO_2 savings from:

- 'cleaner' fuels
- more efficient vehicles
- smart driver choices and behaviour

Policy and interventions to deliver:

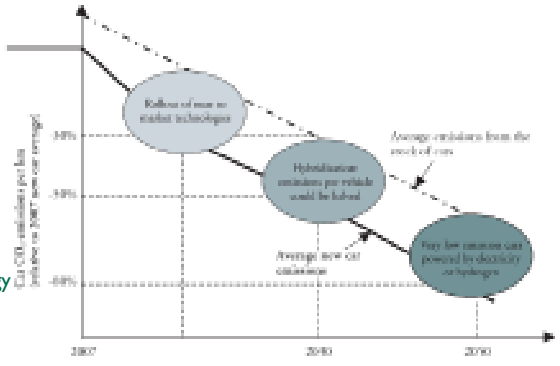
- vehicles with reduced emissions in the short, medium and long term
- 'smart' consumer choices: buying and driving
- sustainable low CO_2 fuels
- innovative R&D for automotive and fuel technologies – funded and implemented

Meeting the 80% target

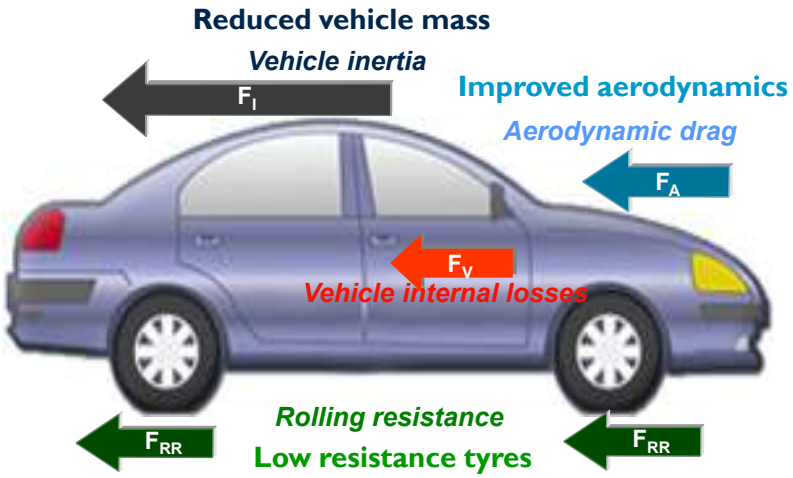


Road to 'zero-carbon' vehicles

- In the next 5 – 10 years: 30% CO_2 reduction with 'available' technology
- Cars that emit 50% less CO_2 than today could be on the road by 2025-2030
  - plug-in hybrids with a small internal combustion engine, electric vehicles
- By 2050 electric vehicles could reduce CO_2 emissions per vehicle by up to 80%
- Technology challenges
  - new technology and skills
  - recycling/sustainability
  - energy storage
- Manufacturing challenges
  - cost reduction
  - supply chain
  - investment and skills
- Policy challenges
  - accelerating the technology
  - developing the market
  - low C power generation
  - infrastructure and skills



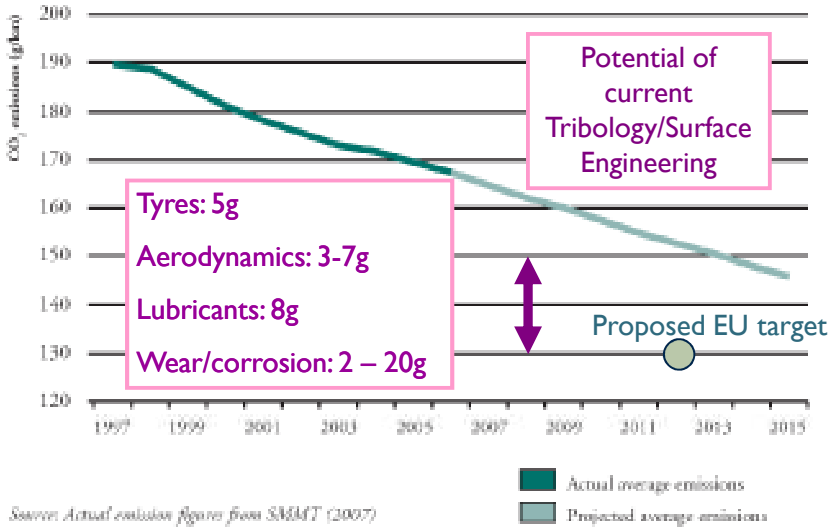
Cars: 30% savings in the short term



Vehicle efficiency:
significant scope for short-term savings

- Available technology could reduce CO_2 emissions per car by 30%
  - this includes direct injection, variable valve actuation, cylinder-deactivation, stop-start; regenerative braking, variable drive technology, weight reduction, improved lubricants and surface treatments to reduce mechanical friction, low resistance tyres…
  - they *could* be standard within 5-10 years
  - Polo Blue Motion and the Seat Ibiza Ecomotive: 74mpg or 99g CO_2/km
- These technologies would be cost-effective for the user
  - some carry a cost premium - estimates suggest £1000 - £1500
  - but better fuel efficiency gives 2 – 3 year payback
- Barriers delaying deployment pose a challenge for policy
  - supply-side: manufacturers need to be confident of a market
  - demand-side: consumers have to want the vehicles
  - carbon pricing/trading won't deliver results in the short term

Surface engineering: friction, lubrication and surfaces



Source: Actual emission figures from SMMT (2007)

'Close to market' efficiency options

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New engine and transmission efficiency savings and indicative costs

Technology	Efficiency saving	Cost per vehicle (£)
Direct injection and lean burn	10 – 13 %	200 – 400
Variable valve actuation	5 – 7%	175 – 250
Downsizing engine capacity with turbocharging or supercharging	10 – 15%	150 – 300
Dual clutch transmission	4 – 5%	400 – 600
Stop–start	3 – 4% *	100 – 200
Stop-start with regenerative braking	7%*	350 – 450
Electric motor assist	7%*	1,000
Reduced mechanical friction components	3 – 5%	Negligible

* Figure quoted is for the whole drive cycle. Savings are much greater in urban driving conditions.

Ranges derived from a number of sources, including the International Energy Agency (IEA), Institute of European Environmental Policy (IEEP), California Air Resources Board (CARB), Ricardo. Car estimates derived using approximate conversion to Sterling.

and some exciting UK developments…

Torotrak continuously variable transmission	15 – 20%	cost as automatic transmission
Ricardo 2/4 stroke research engine	27%	research prototype

Short term: how do we make it happen?

- Stimulate the market
  - consumer information and incentives
- Regulatory emissions reduction targets
  - EU wide
  - for short, medium and long term
- Government/public procurement
- Supply base support: BERR Manufacturing Strategy
  - new manufacturing routes
  - cost reduction
  - skills

Medium term and long term: challenges

- Electric systems, plug-in hybrids
  - Energy storage technologies, sustainable biofuels, sustainable hydrogen
  - Costs
- Infrastructure
  - Charging, grid impacts: standardisation
  - Hydrogen
- Manufacturing
  - Cost reduction
  - Sustainability/recycling
- Low carbon electricity!
- R and D: R for 2050 should be in the research base now
- Raise public profile and 'excitement': major initiatives
  - skill base
  - consumer interest
  - supplier response

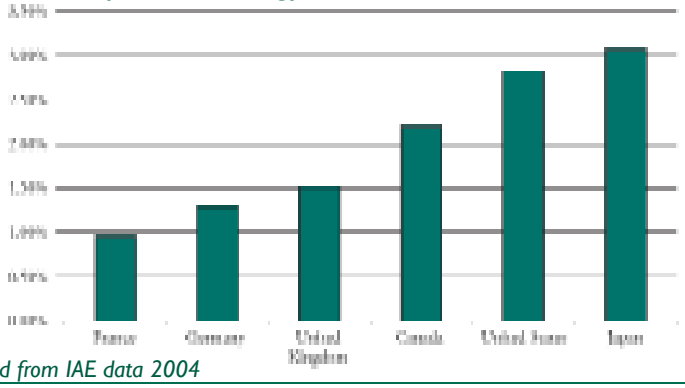
Variation in electric vehicle emissions

- 6g CO_2/km in Sweden
- 12g CO_2/km in France
- 72g CO_2/km in Germany
- 120g CO_2/km in Greece

Recommendations: public R&D funding

- Focus: a much larger share of Public/Government R and D funding assigned to low carbon R&D

Public civil R&D spent on energy 2004 (excluding nuclear and fossil fuel extraction)



Source: Derived from IAE data 2004

Recommendations: R, D and D

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- The UK can position itself as a leader in key areas of underpinning science and engineering for future low-CO_2 vehicles
- Focussed funding
- Strengthened research in key areas: consumer behaviour, plant breeding and GM, life cycle analysis, fuels from waste, low C electricity, lightweight materials, sustainability, recycling
- System-level demonstration: eg charging infrastructure and grid impact of electric vehicles
- Standards
- Research competitions around major, long term challenges
- R&D collaborations with developing countries

Recommendations: expand the Low Carbon Vehicles IP

Recommendations: 'grand challenges'

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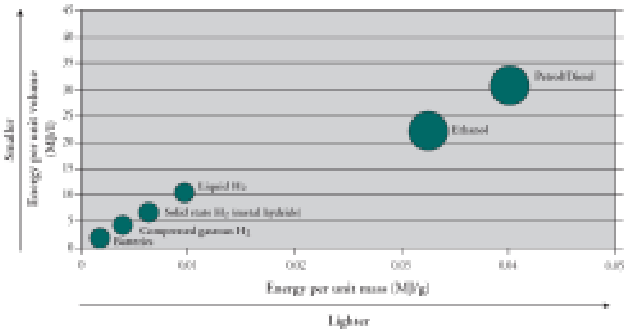
Excite and engage the research base: competitions around key long term challenges

- novel, sustainable, high power density battery technologies
- new sustainable biofuels
- sustainable routes to hydrogen
- alternative energy storage
- rethinking car design



Leadership, innovation and urgent action

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'The world faces an unprecedented challenge which requires urgent global action to sustain growth and guard against the risks of climate change'

Lord Stern, London, April 2008

Urgent action is needed by Governments, consumers, energy and automotive industries and the research community

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