RAC Foundation

September 2012

Keeping the Nation Moving

Cars and the environment

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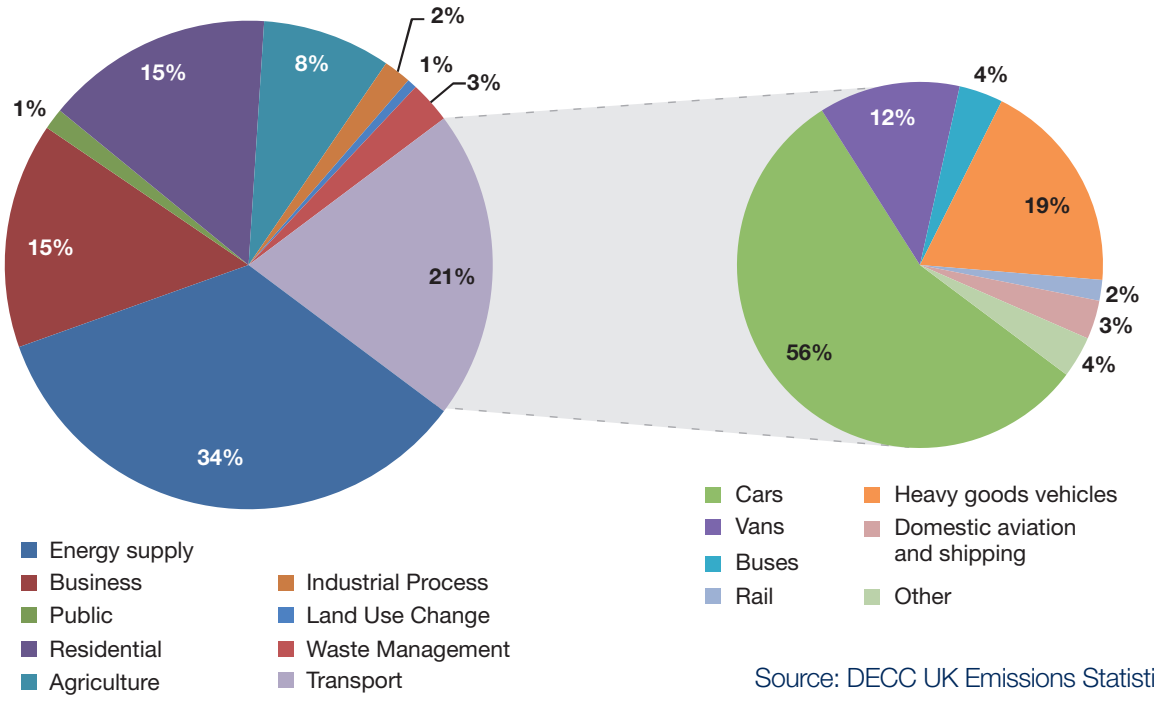
Introduction

The Climate Change Act 2008 legally obliges the UK to cut its greenhouse gas – predominantly CO_2 – emissions by 80% by 2050 (compared to 1990 levels).

Transport accounts for 21% of the UK's greenhouse gas emissions.

Of the transport emissions about 92% come from road traffic.

UK greenhouse gas emissions 2010 (by source)



Source: DECC UK Emissions Statistics

The UK car market

There are 28.4 million cars registered in the UK (2010 figure)

- 20 million are petrol
- 8 million are diesel
- 82,000 are hybrids
- Approx. 2,000 are fully electric

1.94 million new cars were sold in the UK in 2011.

Source: Transport Statistics Great Britain 2011; SMMT Motor Industry Facts 2012

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The goals

In 2011 the average new car sold in the UK produced 138 gCO_2/km (compared with 178 gCO_2/km in 2001).

By 2015 the EU says this must fall to 130 gCO_2/km.

The EU is currently negotiating a target for 2020, probably 95 gCO_2/km.

By 2020 10% of transport fuels must come from renewable sources – biofuels, electricity, hydrogen etc. 95 unleaded petrol already contains up to 5% ethanol (so-called 'E5').

The Committee on Climate Change estimates that for the UK to be on track to meet its 2050 targets up to 1.7 million electric cars will need to be on the road by 2020.

Source: SMMT; EU Regulation (EC) No 443/2009; EU Directive 2009/28/EC; Committee on Climate Change

Making cars green

The less CO_2 a car emits the greener it is.

In simple terms, the amount of CO_2 a car emits from the exhaust is a product of how much energy it uses (which is determined by engine efficiency, aerodynamic drag, rolling resistance and so on) and the CO_2 content of the fuel used to produce that energy.

$$\text{Vehicle } CO_2 \text{ emissions} = \text{Energy consumption} \times CO_2 \text{ content of energy carrier (fuel)}$$

For example, electric cars produce zero CO_2 emissions from the tailpipe even though energy is being used. However, cars using fossil fuels (petrol and diesel) emit the CO_2 contained within them when burned to release energy.

Energy consumption (and hence fuel consumption) can be reduced by making engines more efficient through turbochargers, reducing frictions, but also by making cars smaller, lighter and more aerodynamic. Energy use is also related to how a car is maintained and driven:

- Smooth and reasonable speeds: sharp acceleration and heavy braking wastes fuel, and vehicles tend to be least fuel efficient at quite low or quite high speeds. Aggressive driving can raise fuel consumption by 37%.
- Regular maintenance reduces fuel consumption by as much as 10%.
- Fuel consumption can be further reduced by turning the engine off whilst stuck in traffic, removing roof racks and roof-top boxes whilst not in use and correctly inflating tyres.

Petrol and diesel engines are not as energy-efficient as the motors in electric cars.

Source: RAC Foundation Report
Easy on the Gas

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Does it add up?

Although battery electric cars produce zero CO_2 emissions at the tailpipe (tank-to-wheel), account has to be taken of how the electricity has been produced (well-to-wheel).

If the electricity comes from renewable sources there will be little or virtually no CO_2 emissions. But if it comes from a coal- or gas-fired power station then there will be significant CO_2 emissions associated with production.

Though extremely complicated to do there is a strong case for also considering the life-cycle emissions of the CO_2 emissions related with manufacturing and scrapping vehicles.

Source: RAC Foundation Report The Green Charge

The Plug-in Car Grant Scheme

Since January 2011 the government's Plug-in Car Grant scheme has been offering people buying a car producing less than 75 gCO_2/km a grant of 25% off the purchase price (up to a £5,000 maximum). £230 million has been set aside for the scheme up to the end of this Parliament.

There are currently ten models eligible for the Plug-in Car Grant:

- Chevrolet Volt
- Citroen CZero
- Mia
- Mitsubishi i-MiEV
- Nissan Leaf
- Peugeot iOn
- Renault Fluence ZE
- Smart fortwo electric drive
- Toyota Prius Plug-in Hybrid
- Vauxhall Ampera

As of 30 June 2012, 1,706 claims had been made through the scheme.

In February 2012 vans became eligible for similar discounts (20% off the purchase price up to a £8,000 maximum).

Source: Department for Transport

Local air pollution

Local air pollution is said to cost the economy £20 billion per year and decrease the life expectancy of people in the UK by an average of 7 to 8 months. London has been and still is in breach of EU standards on local air quality and potentially faces large fines.

The main source of air pollution is transport – emissions from petrol and diesel vehicles – accounting for up to 70% of the total in urban areas.

Electric and hydrogen vehicles (and to a lesser extent plug-in hybrids) emit no local air pollutants and thus help improve local air quality.

Source: Environmental Audit Committee Report on Air Quality

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Tax regime

The current rate of fuel duty on a litre of petrol and diesel is 57.95p. On top of this, VAT is charged at 20%.

Domestic electricity – which is used by drivers charging their cars at home – does not attract duty and the VAT level is only 5%.

Vehicle Excise Duty (VED) is currently banded. The more CO_2 a car emits the greater the amount of VED is payable. For example there is no VED payable on a car producing less than 100 gCO_2/km.

In London cars producing less than 100 gCO_2/km and conforming with the Euro 5 standard (the European standards on local air pollutants from vehicles) are also exempt from paying the congestion charge.

The greening of the car fleet presents a problem for the Treasury. By 2029 the annual tax income from VED and fuel duty will be £13 billion (in today's money) less than it is now. If the Treasury is not prepared to forego this revenue from drivers then one day it will have to either start taxing green fuels more heavily or introduce a system of motoring taxation based on distance travelled rather than fuel consumed.

Source: Transport for London; RAC Foundation Report Fuel for Thought

The unknowns

- Batteries: will they reduce in cost and increase in energy density and hence range? What will their life expectancy be?
- Residual value: it is unclear how well electric and hydrogen powered cars will hold their value.
- Fossil fuels: the future supply and cost of oil based fuels is uncertain.
- Life-cycle emissions: how do we adequately account for vehicles' life-cycle emissions?

RAC Future Car Challenge

In 2011 the second RAC Future Car Challenge was held. The goal was to drive the 57 miles from Brighton to London using the least energy possible. More than 60 cars took part in the event. Data collected and analysed from several of the cars produced the results shown in the table.

Source: RAC Foundation Report The Green Charge

Average energy consumption, CO_2 emissions and fuel costs

Power train	Energy consumption (kWh/km)	Tailpipe emissions (gCO_2/km)	Well-to-wheel emissions (gCO_2e/km)	Fuel costs (£)
EVs	0.14	0	86	£1.82
E-REVs/PHEVs	0.30*	68	81*	£3.76
HEVs	0.39	94	113	£4.92
ICE vehicles	0.55	127	154	£6.52
Average overall	**0.24**	**103**	**99**	**£3.01**

* As it was not possible to measure energy use in electric-only mode, the results for E-REVs/PHEVs may be an underestimation of energy consumption, and hence of emissions.

The Royal Automobile Club Foundation for Motoring is a transport policy and research organisation which explores the economic, mobility, safety and environmental issues relating to roads and their users. The Foundation publishes independent and authoritative research with which it promotes informed debate and advocates policy in the interest of the responsible motorist.

For more information about the Foundation and its work please visit the website: **www.racfoundation.org** or contact us on **020 7747 3445**.
You can also follow us on Twitter: **@racfoundation**

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