October 2006

QUICK HITS

2. Limiting speed

UKERC

- An enforced 70mph speed limit could cut carbon emissions by 1 million tonnes of carbon (MtC) per year by 2010
- A new 60mph limit could double this to 1.94 MtC
- If added to the transport measures in the UK Climate Change Programme, carbon savings would increase by 15% (70 mph) or 29% (60 mph)

What are Quick Hits?

Quick Hits are a series of proposed initiatives developed by the Demand Reduction theme of the UK Energy Research Centre (www.ukerc.ac.uk). They are intended to make a useful contribution in reducing carbon emissions by 2010, and are designed to be relatively easy for the Government or local authorities to implement. Legislative changes or expenditure needed would be small in nature, hence the title 'Quick Hits'.

The Quick Hit series is organised by Dr Brenda Boardman, Co-Director of the UKERC's Demand Reduction theme, at the Environment Change Institute, University of Oxford. This Quick Hit was co-authored by Jillian Anable, of UKERC and the Centre for Transport Policy, Robert Gordon University; Paige Mitchell of the Slower Speeds Initiative; and Russell Layberry, of UKERC and the Environmental Change Institute, University of Oxford and is based on one of four papers to win the Low Carbon Vehicles Partnership Road Transport Challenge 2006.

Further information on this Quick Hit is available from Jillian Anable, tel. 01224 263136 / 07930 330155 or Matthew Ledbury, tel. 01865 275893, both of UKERC.

What is the Quick Hit?

This Quick Hit outlines how limiting the speed limit on motorways and dual carriageways to 60 mph or even merely better enforcing the current 70 mph limit could be one of the most equitable, cost-effective and potentially popular routes to achieve reductions in carbon emissions. If implemented, it could also have the potential to slow traffic growth and influence the vehicle market with further carbon reduction benefits, in addition to optimising current road network capacity and bringing significant safety benefits.

Limiting speed as a method of reducing carbon emissions has often been dismissed as politically unviable. However, the 'unpopular' measure of a lower top national speed limit was introduced in the world's most car-dependent nation, the USA, in response to the 1973 oil crisis and stood for nearly a quarter of a century. It still applies on many highways in the USA.

The best available official data on the vehicle fleet, fuel consumption, emissions factors, traffic flows and speeds on motorways and dual carriageways have been used to develop a model to assess potential carbon savings between now and 2010 from (i) enforcing the current top 70mph speed limit and (ii) reducing this limit to 60mph. In addition, the wider effects of a lower top speed limit on traffic demand, vehicle design, traffic flow and road safety are explored.

The vital statistics: speed, motorway traffic and CO_2 emissions

Fuel consumption and carbon dioxide (CO_2) emissions are a function of speed, mileage, vehicle weight, engine and fuel type, driving style, traffic flow conditions and, to an increasing extent, optional features such as air conditioning. The graph below shows the relevant CO_2 emission curves for two engine size groups of Euro II cars[1]. Petrol Euro II cars with engines between 1.4 litres and 2 litres emit almost 10% less CO_2 at 60mph than they do at 70mph. Diesel Euro II cars with engines over 2 litres emit about 16% less. At 80mph, Euro II petrol cars with engines between 1.4 litres and 2 litres emit 14% more CO_2 per kilometre and diesel cars with engines over 2 litres will emit 25% more CO2 than at 70mph (Figure 1).

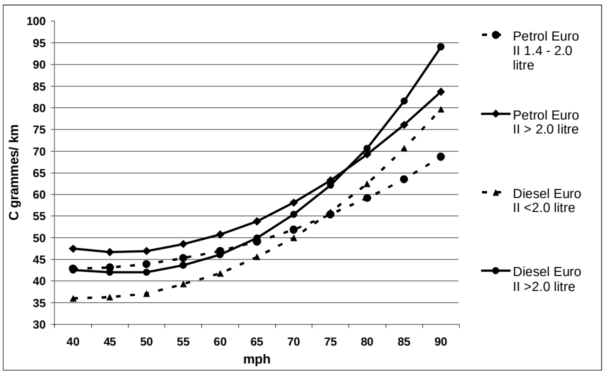

Figure 1: Changes in CO_2 emissions with speed
Source: *NETCEN National Atmospheric Emissions Inventory*

Motorways account for less than 1% of Britain's total road length, yet account for 19% of total annual road mileage, of which 75% is accounted for by cars and taxis[2]. Driven speeds on motorways and dual carriageways are well above the optimum for fuel efficiency. Traffic is distributed across various speed bands, ranging from 50mph and below to 90mph and above[3]. On average, 53% of cars exceed the motorway speed limit on weekdays, and 63% at weekends, with 19% of cars on motorways travelling at more than 80 mph. Nearly half of all cars on dual carriageways exceed the 70 mph speed limit, with 13% travelling faster than 80 mph. Although adhering to their 60 mph limit on motorways due to automated speed limiters, on dual carriageways, 86% of articulated heavy goods vehicles (HGVs) exceed their 50 mph limit and 2% go faster than 60 mph[4].

In 2003, road transport accounted for just under 33 MtC by source - 23% of the UK's total CO_2 emissions of 152 MtC[5]. Using the most recent figures[6] on the distribution of distance travelled by each vehicle type in each speed band, 13.2 MtC was emitted by all categories of four-wheeled vehicles driving on roads with 70mph limits in 2005. This is about 37% of the annual emissions by source from the road transport sector.

How much CO_2 could be saved?

A model was developed to calculate the emissions savings from speed reduction and enforcement under a number of scenarios[7]. These included different speed limit scenarios (Business as Usual (BAU), 70mph enforced and 60mph enforced) and different assumptions relating to the extent to which speed reductions will curb traffic growth.

Per Annum carbon savings (MtC)					Total cumulative savings in 2010
	2007	2008	2009	2010	
70mph enforced	0.96	0.98	1.00	1.00	3.94
60mph enforced	1.84	1.88	1.91	1.94	7.57

Table 1 shows the annual and cumulative carbon savings from (i) enforcement of the current 70mph speed limit and (ii) enforcement of a 60 mph limit on motorways and dual carriageways, assuming that no change in mileage takes place as a result of the policy.

Taking 2006 as a baseline, the calculations show that carbon emissions would be reduced by between an average of 1.0 and 1.9 MtC in each year to 2010. These estimates are conservative because of moderate estimates of traffic growth and the assumption that there would be no restraining effect on traffic growth. We take the potential impact on distances travelled into account below.

Given that the BAU projections for emissions from 4-wheeled vehicles on roads with 70 mph limits are projected in this model to be just under 14.6 MtC in 2010, this equates to a reduction of between 6.6% and 12.9% in 2010. As total road traffic (all roads and all vehicle types) is projected by this model to be 34.5Mtc in 2010, this policy could be responsible for a reduction of between 2.8% and 5.4% of carbon emissions from this sector.

According to the Sustainable Development Commission, the strict enforcement of speed limits on main motorways was tested in France in 2004, and it resulted in a reduction in carbon emissions of 19%[8].

Could additional carbon savings be achieved?

Recent carbon savings from improvements in vehicle efficiency have been eroded by offsetting changes in vehicle weight, performance and distance travelled. Countervailing demand management measures are needed if the benefits of greater fuel efficiency are to be realised. The argument for a lower speed limit is also primarily based on increasing fuel efficiency by ensuring that average speeds are closer to the optimum. However, a lower motorway speed limit has the advantage of being simultaneously a demand management measure by having an effect on traffic flow, journey time and the utility of high performance vehicles. Hence, speed enforcement could amplify the benefits of many of the changes that are being proposed to curb emissions from road transport in the following ways:

Reduction in traffic growth

In 1994, the Standing Advisory Committee on Trunk Road Assessment concluded that "travel speed affects the amount of traffic"[9] and this 'speed elasticity' can determine the traffic induced by the improvement of infrastructure[10]. Given the relative invariance of the average travel time budget, reducing average speeds, especially on motorways where the longer journeys are made and where traffic is growing the fastest, has the potential both to reduce present levels of traffic and slow the rate of traffic growth.

Maximising existing capacity by improving traffic flow

Highway capacity is also a function of speed. The highest speed at which maximum capacity is safely and reliably achieved is 60mph. The traffic smoothing effects of a 60mph limit would help to reduce harsh driving styles and overtaking which can cause flow breakdown, crashes and disruption, further reducing CO_2 emissions and optimising existing capacity. Making better use of existing capacity would render motorway widening schemes unnecessary. A speed limit of 60mph or less would increase capacity while simultaneously discouraging traffic growth due to the restraining effect of lower speeds.

How would speed limits be enforced?

Speed limit enforcement works towards raising real and perceived penalty chances using awareness campaigns, advisory road sign messaging, communication about enforcement practice, and primarily extending and improving both the quality and quantity of enforcement on the road and the judicial follow-up. Speed cameras are the most reliable method: a recent report found that the use of SPECS time-over-distance cameras reduced vehicles exceeding the speed limit by 53%, and those exceeding it by more than 15mph by 100%[11]. The most extensive set-up introduced yet on an interurban road network in the UK, on the A77 in South Ayrshire in 2005, found a marked change in driver behaviour on the road, with 80% fewer vehicles going over the speed limits on dual carriageway sections and 75% fewer on single carriageways than before the cameras went in[12].

There are also a variety of 'in car' adaptations that could be utilised such as intelligent speed adaptation, in car speed warning systems, redesigning speedometers so that they are easier to read, and in-car fuel management information. Furthermore, setting a limit to the top speeds acceptable on the public highway could trigger far-reaching changes to vehicle design. In the short to medium term, lower limits and appropriate levels of enforcement would encourage the voluntary uptake of speed limiters. Fiscal incentives to drivers to adopt speed limiters would hasten this process.

Emissions can also be reduced at low or negative cost by reducing vehicle weight, top speed and acceleration[13]. Currently, 64% of the car fleet has engine capacities well above the 10 best performing petrol and diesel vehicles where CO_2 emissions are concerned[14]. The average top speed of these 'best performing' models is 102mph. In the longer term, vehicles could be designed, possibly through the use of regulation, to 'cap' top speed capability. This would ensure that top speed is more closely related to the highest permitted speed limit and would help re-orientate vehicle design and re-appropriate the improvements in fuel efficiency which have so far been devoted to travelling further, faster, in heavier cars. Research in the Netherlands has shown that "a combined approach of downsizing power and speed, enforcing speed limits and in-car guidance of drivers' behaviour" could reduce CO_2 emissions by 50%[15].

What other benefits are there?

Speed enforcement and reduction have certain advantages over other transport measures to reduce carbon emissions:

Early Win/ Certainty

National administrations in England, Scotland and Wales are responsible for setting speed limits on motorways and trunk roads. Unlike other technologies needing a lead time, the enforcement of the 70mph limit and the introduction of a 60mph limit could begin immediately. No technological developments or innovation is required and it is straightforward and relatively cheap.

Equity

Unlike many other transport demand restraint mechanisms, lowering speed limits would be one of the fairest ways of reducing emissions as it applies to all of the people, regardless of income or geography, all of the time and will reduce the differential between the fast and the slow, the rich and the poor.

Cost-effectiveness

There is other evidence that a lower speed limit would be cost effective. A recent report to Defra on reducing road transport emissions (NO_x, PM10 and CO_2) ranked 'revised speed policy for motorways close to urban areas' as the second out of three options which should be prioritised for the 2005-2010 time period on the basis of a cost benefit analysis[16]. In addition, a lower motorway speed limit (90kph or 55mph) has been shown to be among the most effective and least expensive ways to 'save oil in a hurry'. The implementation cost of a 55mph motorway speed limit in Europe, including signage and enforcement, has been calculated to be around $11 per barrel of oil saved, or around £40 per tonne of carbon saved[17].

Public acceptance

Any measures requiring behaviour change require publicity campaigns explaining the need for the change. The general absence of lower speed limits from discussions of measures to curb CO_2 emissions may be due to the assumption that lower limits would be politically unacceptable. However, objections from motorists might be far less than feared. With suitable publicity and explanation, the public and business may consider lower speed limits the most acceptable as well as most convenient of all the options. Drivers would experience direct benefits in fuel savings and operating costs. Moreover, speed limit enforcement would require less behavioural change than other technological, regulatory or fiscal measures. In other words, of all measures to manage the demand for travel by car, speed limits are simultaneously the mildest, the most straightforward, the least intrusive and the most egalitarian in their impacts.

Indeed, there is recent UK evidence on driver response to lower motorway speed limits that show for the majority, the time penalties of speed enforcement proved to be non-existent, minimal or outweighed by the gains of improved fuel economy, safety, reliability and reduced stress. 'Active traffic management' systems, using variable speed limits as low as 40mph, have been introduced on the M25 and more recently on the M42 near Birmingham, where speed is controlled to smooth traffic flow, reduce congestion, and prevent crashes and associated disruption. A survey of users of the M25 system found that the majority (68%) of drivers liked it and wanted to see it extended to other sections of motorways. Significantly, the survey found that "the most irritating aspect of a journey relates to congestion and resultant delays"[18]. Similar results were found in a survey of M42 users, where 72% wanted variable speed limits expanded to elsewhere on the motorway network, and 45% said they felt their journeys had improved. Despite the absence of an automatic enforcement system, compliance is high, at up to 95% in some cases[19].

How does this compare to other policies?

In 2006, the UK Climate Change Programme Review[20] forecast that measures included as part of the 2000 Climate Change Programme (CCP), such as the EU Voluntary Agreement between car manufacturers, the (now abandoned) fuel duty escalator and 'wider measures' originating in the Ten Year Plan for Transport would reduce emissions by 5.1 MtC below trend by 2010. New measures introduced from 2006 (the Road Traffic Fuels Obligation (RTFO) and a further Voluntary Agreement after 2008) would add another 1.7 MtC to this total. Speed limit enforcement does not feature in the CCP. Yet, the policy of speed enforcement described in this Quick Hit, saving between 1.00 and 1.94 MtC (based on low projections of traffic growth and not including traffic restraint or knock on effects on the car market) could add an additional 15% (70 mph) or 29% (60 mph) to the total savings expected from the transport sector by 2010. Out of the 37 existing or possible additional measures outlined in the CCP Review, a 60mph speed limit would rank sixth in terms of the scale of carbon savings that could be made. These estimated savings are significant given the fact that the UK is set to miss its domestic target to reduce emissions of CO_2 by 20% from 1990 levels by 2010 by the order of some 4%, or approximately 6MtC[21].

Notes

[1]The way emissions vary with average speed for most vehicle types making up the national fleet has been calculated for the National Atmospheric Emissions Inventory (NAEI): NETCEN (2003) Vehicle Emissions Factor Database v02.8.xls

[2]Department for Transport (2005) *Transport Statistics Great Britain 2005*, Table 7.8, 7.3 and 7.4

[3]Department for Transport (2006) *Vehicle Speeds in Great Britain: 2005*, Table 1

[4]Ibid, Table 3

[5]Department for Transport (2005) *Transport Statistics Great Britain 2005,* Table 3.8

[6]On 22nd December 2005, the DfT released a Freedom of Information (FOI) request for an analysis of the impact on carbon of changes to vehicle speeds. The figures provided in their spreadsheet formed the basis for many of the figures used in the model developed for this paper. See: http://www.dft.gov.uk/stellent/groups/dft_foi/documents/divisionhomepage/610911.hcsp

[7]The following assumptions were used in the modelling:

- An average emissions coefficient reflecting fleet technology mix for each year and the relevant speed distribution based on 2004 data for motorways and dual carriageways. (Netcen (2003) Vehicle Emissions Factor Database; DfT (2005) Vehicle Speeds Great Britain 2004; and the FOI spreadsheet cited in note 6.)
- For speed reduction scenarios, all of the distance previously driven above either 70mph or 60mph is redistributed to the highest remaining band.
- Figures for traffic growth are based on the National Traffic Model *midpoint* projections for interurban roads between 2000 and 2010 (29-35%). Given the actual growth rates witnessed since these projections were made, this appears to be a conservative estimate of growth, and therefore the emissions savings in the model may be an underestimate.
- Figures apply to all vehicles travelling in 70mph speed limits except motorcycles.
- Levels of non compliance with the speed limits are not accounted for in this model.

[8]Sustainable Development Commission (2006) *SDC Submission to the Environmental Audit Committee inquiry on Reducing Carbon Emissions from Transport*

[9]SACTRA (The Standing Advisory Committee on Trunk Road Assessment) (1994) Trunk Roads and the Generation of Traffic, London: HMSO

[10]Pfleiderer, R. and Dieterich, M. (2003) *Speed elasticity and mileage demand* World Transport Policy and Practice Vol.9 (4), pp.21-27

[11]University College, London and PA Consulting Group (2005) *The National Safety Camera Programme*: *A Four Year Evaluation Report*

[12]A77 Safety Group press release, August 2006 *Safety cameras on A77 showing positive effects in first year*, http://www.a77safetygroup.com/index.cfm/page/31/newsitem/20/newscategory/0/

[13]Kågeson, P. (2005) *Reducing CO_2 Emissions from New Cars,* Brussels: T&E European Federation for Transport and Environment (p4).

[14]Vehicle Certification Agency (2006) (www.vcacarfueldata.org.uk/information/tables.asp)

[15]Kroon, M. (1998) *Downsizing power and speed, the safe road to fuel economy,* Road safety and sustainability paper for the Safety of Transportation Congress, Delft 1998

[16]Kollamthodi, S (2005) *Technical and Non-technical Options to Reduce Emissions of Air Pollutants from Road Transport. Final Report to DEFRA.* AEA Technology Environment

[17]International Energy Agency (2005) *Saving Oil in a Hurry*, Paris: International Energy Agency

[18]Highways Agency (2004) *M25 Controlled Motorways: Summary Report* (http://www.highways.gov.uk/news/press_releases/general/2004_12_06b.htm 050915)

[19]Anthony Aston, M42 Active Traffic Management Pilot Communications Officer (2006), personal communication

[20]DEFRA (2006) *Climate Change The UK Programme 2006* available at http://www.defra.gov.uk/environment/climatechange/uk/ukccp/index.htm

[21]DTI (2006) *UK Energy and CO_2 Emissions July* supplementary document to the *Energy Review*