Changes made in the 2007 N.A.E.I. Road Transport Inventory: A briefing note produced by AEA on changes in fuel consumption

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Changes made in the 2007 NAEI Road Transport Inventory: A Briefing Note Produced for DECC on Changes in Fuel Consumption

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Overview

Fuel consumption by road vehicles is calculated by the methodology used to estimate national total emissions for road transport in the NAEI/GHGI and is consistent with internationally agreed procedures and Guidelines for reporting emission inventories. In fact, we are able to go further than required by Guidelines because of the availability of transport data in the UK.

The methodology combines traffic activity data (from DfT's national traffic census) with fleet composition data (vehicle mix by engine size, vehicle size, age, engine and exhaust treatment technology, Euro emission standards, fuel type the vehicle uses, based on licensing data from DfT) and fuel consumption/emission factors. The latter are based on published compilations of factors derived from vehicle emission test data from various UK and European sources. Representative samples of vehicles are tested over a range of drive cycles associated with different average speeds on different road conditions: there are many parameters that affect the amount of fuel a vehicle uses and average vehicle speed is one of them, so the NAEI uses functions that relate fuel consumption to average speed.

Methodologies for calculating fuel consumption and emissions are periodically updated as our understanding of the factors that affect them improves. Also, the input data used to calculate them are updated as DfT revises information, provides more detail in the information gathered and as new information becomes available. Consequently, revisions to the trends in calculated values of road transport fuel consumption and emissions are an inevitable consequence as the science and evidence base improves. The NAEI uses consistent data and approaches to meet the needs of Greenhouse Gas Inventory compilations and those for air quality pollutant emissions.

An overarching requirement in the case of calculating fuel consumption and CO_2 emissions at the national level is the need for the total fuel consumption to be consistent with trends in petrol and diesel consumption reported in

DUKES. A normalisation process is used to make the bottom-up calculated estimates of petrol and DERV fuel consumption add up to the amounts given in DUKES (a very small adjustment to the use of DUKES figures on petrol and DERV consumption is first made to account for the amount of these fuels used in off-road applications, e.g. lawn mowers, portable generators etc. We use a separate model to calculate their fuel consumption and deduct this from DUKES to give the total amount used by road transport). **The significance of this is that if we modify the methods or factors used to calculate national fuel consumption for just one class of vehicle (say, diesel cars), then those calculated for other vehicle types using the same fuel (e.g. diesel vans, HGVs, buses) have to be changed to ensure the total DERV still adds up to the DUKES values.**

This is not an ideal situation, but we have discussed this issue with various transport experts, engineers and statisticians in DfT and all have endorsed this approach as necessary given these constraining factors.

Any changes made to the methods used to calculate fuel consumption at national level will be reflected in the factors used to calculate fuel consumption for individual types of vehicles on individual types of roads in the spatial mapping. However, for the mapping, a decision had been made some years ago to calculate emissions on individual road links from factors consistent with the national inventory, but without any normalisation applied to match the total (summed over all road links) with the figures in DUKES.

Changes made to the 2007 Estimates of National Fuel Consumption by Vehicle Type

A number of changes were made to the information and method used to calculate the 2007 time series in fuel consumption and emissions by road transport. These were summarised in a "*Reasons for Change*" document submitted with the 2007 NAEI (and attached as an appendix to this document – the changes affecting fuel consumption are those affecting GHG emissions in this document) and much more detail is given in the methodology annex of the National Greenhouse Gas Inventory report (NIR) methodology section available at:
http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/4771.php and
http://www.airquality.co.uk/reports/cat07/0905131425_ukghgi-90-07_Annexes_Issue2_UNFCCC_Final.pdf

The road transport section starts on p319.

The two most important factors that affected these changes are as follows. More details and references to changes made are given in the NIR methodology annex.

Changes to Petrol Car and Diesel Car Share on Different Road Types

The new methodology basically takes account of the fact that diesel cars travel more miles in a year than petrol cars. The DfT traffic census counts

only the number of cars and makes no distinction between petrol and diesel cars. Until now, we have used vehicle licensing statistics on the population of petrol and diesel cars in each year to define a fuel split to the number of vehicle kilometres travelled which we applied equally to all road types. For the first time this year, we obtained data from DfT from an independent survey which shows the annual mileage done by diesel cars is on average around 1.6 times higher than that travelled by petrol cars. We thus modified the split in vehicle km to take account of that and derived different petrol car/diesel car mixes on different road types on the assumption that the additional mileage done by diesel cars is done mainly through travelling greater distances on motorways.

This change has led to an increase in diesel car activity and hence fuel consumption compared with the previous year's estimates and the new method and assumptions were applied to all previous years on the basis that this has been a long-term trend.

Fuel consumption by HGVs was slightly modified due to changes in the time series of miles per gallon fuel efficiency rates that are published for these types of vehicles by DfT based on the Continuous Survey of Road Goods Transport.

The significant increase in estimates of fuel consumption by diesel cars has meant that, for the national figures, the fuel consumed by diesel LGVs and buses has to be reduced to ensure the total DERV consumption is still consistent with published figures in DUKES.

Changes to Vehicle Speed Data on Different Road Types

The NAEI method uses average speed data for different vehicle types on many different types of roads and uses these to calculate average fuel consumption and emission factors for each vehicle type/road type combination used in the national inventory and the mapping.

DfT periodically carry out traffic surveys and report speed data in various publications. Much more detailed speed data have become available in recent years. The NAEI undertook a major review of speed data from more recent DfT publications, communications and from the London Atmospheric Emissions Inventory and as a consequence has revised the speed data used. The changes led to a revision in the fuel consumption factors used. The changes were significant on some road types, but over all types of roads the changes partly cancelled out so the change in speed data did not have a significant effect on the national inventory. However, the changes on specific roads in specific areas would be emphasised in the mapping.

How well does the calculated fuel consumption at a national level compare with total fuel consumption statistics given in DUKES?

Before the normalisation is carried out to obtain the national fuel consumption and CO_2 estimates, it is worth comparing the petrol and diesel fuel

consumption calculated by the bottom-up method based on traffic, fleet and emission factor data with that indicated by figures published in DUKES. For the 2007 NAEI, the calculated total petrol consumption in 2007 is around 5% lower than the figure published in DUKES while the calculated total diesel consumption in 2007 is around 7% higher than the figure published in DUKES. There are year-to-year variations in this level of agreement, but the overall patterns are much the same. These relative differences between calculated fuel consumption and figures in DUKES represent the amount of scaling up or down necessary in the normalisation process.

The differences will be due to model uncertainties including uncertainties in the vehicle km data and fleet information used and especially in the fuel consumption factors based on samples of vehicles taken to represent the fleet. It is also important to bear in mind the very transient nature of emissions and fuel consumption and that the modelling approach masks the variability in fuel performance of even the same vehicle as it is driven under different conditions, with idling, acceleration, deceleration and cruising modes over a cycle all having very different fuel consumption rates.

Given the inherent uncertainties in the method used in calculating fuel consumption for the national fleet, the agreement between the pre-normalised calculated estimates and figures in DUKES is considered perfectly acceptable.

Comment on mapping fuel consumption

At a local level, the uncertainties in fuel consumption estimates will be higher than indicated by the comparisons shown above for reasons alluded to above. The fuel consumption and emission performance of a particular type of vehicle on a particular type of road link cannot be expected to be the same everywhere because of local variation in the fleet, road and driving conditions and the variable nature of the parameters affecting fuel consumption. As stated earlier, normalisation of the fuel consumption on each road link to the national figures (and figures in DUKES) is deliberately not carried out for the mapping because the normalisation process itself is only considered valid at the national level where national statistics, rather than local information, form the basis of the fuel consumption estimates.

For mapping, the adjustments made to the calculated fuel consumption by LGVs and buses at national level to achieve consistency with DUKES, because of the changes made to the method to calculate diesel car fuel consumption, are not necessary because the summed totals are not constrained to be consistent with DUKES.

What changes will be made in the next inventory?

The NAEI undergoes a continuous improvement programme. The road transport inventory methodology in particular has been going through a major update. This has been in part due to the research undertaken by the

Transport Research Laboratory (TRL) on behalf of DfT which has recently led to a compilation of a new set of vehicle emission factors (and fuel consumption factors) for more detailed classes of vehicles and a revision to some aspects of the inventory methodologies used. It has also been necessary to improve the quality of the NAEI emission projections. The changes made to the 2007 NAEI for some air quality pollutants were in part due to this work, but now the TRL/DfT study is finalised, further changes will be made for the next version of the inventory (2008 NAEI) published at the end of 2009.

A major driving force to the developments is the need to improve the emission estimates for air quality pollutants and emission projections in order to improve air quality modelling and assessments. As well as preparing to use the new TRL emission factors, the NAEI has been reviewing and updating methods for treating cold start emissions and expressions for how emissions and fuel consumption change as vehicles age and has also been reviewing in much more detail the turnover behaviour of the vehicle fleet.

All these features and more will lead to changes in the national emissions inventory for 2008 and in the distribution of fuel consumption between vehicle types (but still tied to DUKES total fuel consumption) and will impact on the spatial patterns of fuel consumption on different road types shown in the mapping provided next year.

Appendix:
Summary of Changes made in the 2007 NAEI Road Transport Inventory as provided in the "*Reasons for Change*" Document

Changes affecting AQ and GHG emissions

- Speed data updated after review of speed data from various DfT sources for different road and area types. Improves consistency with road classifications used in mapping and for projections work done for PCM

- Vehicle km data
    - Use of detailed traffic census data to improve split between vkm on different road types with different speeds
    - Use of new data from DfT on variation in car annual mileage and composition of car fleet by engine size
    - Fuel split on different road types – take account of fact that diesel cars do more annual mileage than petrol cars and use different petrol car/diesel car mix on different road types (previously assumed the split was the same everywhere)

- Fleet composition changes – N Ireland fleet-specific data used for car fleet in N Ireland.

Changes affecting only GHG emissions

- HGV fuel consumption – used revised figures from DfT on mpg fuel efficiency for different sizes of HGVs, 1993-2007. Note this only affects the distribution of CO_2 emissions by vehicle type; the total is unchanged as this is based on DUKES.

- New N_2O emission factors – adopted revised emission factors given in COPERT 4 and Emissions Inventory Guidebook
    - Takes into account effect of fuel-sulphur content
    - Takes into account change in emission factor with accumulated car mileage as catalyst degrades

Changes affecting only AQ emissions

- NO_x and PM hot exhaust emission factors revised using new speed-EF functions from TRL. Also uses:
    - revised emission degradation with mileage functions
    - revised effects of fuel quality on emissions

- Effect of biofuels taken into account using biofuel consumption data and scaling factors for effects of different biofuels on air quality emissions based on recent AEA study