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ISSN 0267-5943
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Copy for the next issue, to be published in March, must be in the hands of Mr King by:
Last copy on paper: 7 January
Text on disc: 14 January
Text by email: 21 January
Copy to: editor@railwatch.org.uk
Advertising
Full page: £95. Half page: £45
Quarter page: £22. Small ads: 30p per word (20p to members)
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Printed by Print-Out, High Street, Histon, Cambridge CB4 4JD
Tel: 01223 232709

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Energy half truths exposed

Recent claims that cars and planes are less polluting than trains are based on a selective and simplistic use of data. Rail is a far better performer when all the factors are taken into account.

Railfuture's Norman Bradbury helps you understand how the real picture has been distorted.

Much confusion seems to have followed from a critique of recent trends in rail energy efficiency per passenger, by Professor Roger Kemp for Lancaster University, and which inspired articles by Roger Ford in Modern Railways and others in the national press.

The purpose of Professor Kemp's study was to highlight the fact that current legislation applied to rail fire and safety regulations and disability access has reduced rail's competitiveness with other modes as it has made trains both heavier and reduced seating capacity, while car and aircraft energy efficiency per passenger have improved – a double whammy for rail!

However, it is clear Professor Kemp's study was not a like-for-like comparison and, although the gap may have narrowed, rail is still ahead in terms of environmental advantages and the following points should be noted: Professor Kemp compared a fully loaded modern economical car such as a Toyota Avensis or Ford Focus with a 125mph (200kph) train on a journey from London to Edinburgh and found the carbon dioxide emissions per seat from each to be about the same. It should be noted the train journey takes a few minutes over four hours. A car could not come anywhere near that time if driven with proper care and consideration.

A car will reach its maximum fuel efficiency at 56mph, above which speed its fuel consumption will increase on an exponential curve. It cannot be assumed that many car drivers would have the patience to keep within this speed for 400 miles and those few that might do would take well over seven hours even without "comfort breaks" or any traffic delays. Speed comes at a cost but it costs much more pro rata for road vehicles than rail.

The train carries a licensed restaurant and lavatories so "comfort breaks" are not needed.

A car carrying four or five people would have a higher average vehicle fuel consumption due to the extra weight and if each person had taken luggage it is likely a roof rack would be required which would cause an even sharper increase in fuel consumption. Multiplying vehicle energy efficiency by the number of seats is not an accurate method for calculating passenger energy efficiency. In reality, the average car occupancy is under 1.5 persons and a significant majority of car drivers exceed the 70mph motorway speed limit.

For the most part, the car would have been using modern carriageway roads laid out for continuous running at the most economical speed (and more) while the train would have been running largely on a Victorian alignment which, although much improved, still has a number of tight curves and flat junctions that constrain both speed and capacity.

The train journey was serving a different purpose to both the car and air journey examples quoted by Professor Kemp. The train service connects a number of towns and cities along the route and even the fastest train of the day stops at York and Newcastle between London and Edinburgh. It would be interesting to see the effect on the fuel consumption of the latest Airbus if it had to call at airports near to York and Newcastle, let alone the many other towns served by rail. Professor Kemp also made a hypothetical comparison between a new Airbus and a 220mph train that does not, and probably never will exist, and again found the energy consumption per seat to be about the same. Even if a new north-south high speed railway is ever built, in view of the close proximity of cities in the UK it is more likely a maximum of 186mph would be approved and this would still undercut air city centre to centre times.

For comparative purposes it is worth quoting from a TGV "road test" which appeared in *Autocar* magazine for December 1990: At 300kph an eight-coach single deck TGV with 375 seats covers on average 0.75 miles on the equivalent of a gallon of oil-based fuel. This equates to 281 passenger miles per gallon and is equal to 94 four-seater cars capable of 70 miles per gallon at 186mph!

This is not far short of the maximum speed of a Formula 1 racing car which typically manages just two miles per gallon with one passenger.

More recently, the double deck "Duplex" TGV has entered service. This provides 569 seats in the same train length (eight cars) and is currently the most cost effective high-speed train anywhere and, technically at least, could be seen in London on completion of the Channel Tunnel rail link.

Safety and disabled access: Aircraft have no "crash worthiness". How many, if any at all, wheelchair spaces and disabled toilets will the new Airbus provide? "Economical" family cars have none of these.

By contrast, a four-car Virgin Voyager has three disabled toilets, each occupying the space of 10 to 12 seats.

Even though modern cars do have an element of crash worthiness, it is of little use in the event of a collision with a heavier vehicle or at high speed.

On the other hand, health and safety regulations require new trains designed for 125mph to have the same crash worthiness as those running at 100mph.

This has constricted passenger occupancy of the front and rear cars of modern trains even though the latest train control technologies will virtually eliminate train accidents like those at Southall and Ladbroke Grove. Rail is already the safest transport mode for like-for-like journeys and a realistic risk assessment is urgently needed.

Aviation emissions released at high altitude are far more damaging and longer lasting than those at ground level.

As a guide to average fuel efficiency by mode rather than hypothetical comparisons, AEA Technology conducted an environmental study for ATOC and the Railway Forum which showed carbon dioxide emissions in the chart on page 2.

Under peak-load conditions rail is significantly more efficient than other modes. A 1992 study found a fully loaded suburban train consumed no more energy per passenger mile than a pedestrian.

New technologies and widespread adoption of regenerative braking provide rail with many opportunities to further enhance energy efficiency. However, the need to switch to low-sulphur fuels has been acknowledged by the rail industry. But there are practical difficulties and rail does not benefit from tax incentives similar to those afforded to road transport to encourage such a switch and it will take time to organise on a national scale.

A paper on the environmental benefits of rail transport would not be complete without reference to the efficient use of space. The Channel Tunnel rail link is a good example as this twin-track main line has a design capacity the equal of seven motorway lanes in less than a quarter of the space for such a road. On completion of current upgrade work, the West Coast main line will be the equal of eight motorway lanes throughout most of its length.

Adrian Lyons, director general of the Railway Forum said: "Rail is still ahead of the game as the least environmentally damaging form of powered transport yet too often false comparisons between road and rail are made, for example, contrasting the environmental impact of a small saloon car with a high-speed train."

Finally, in view of the diverse variety of functions in terms of safety, disabled access, comfort, speed, journey purpose (inter-urban connections etc.) and the historical nature of most of the infrastructure, is energy per seat any longer a valid comparison of efficiency?

Footnote: The example of the 125mph train from London to Edinburgh included power losses in the electricity generating and distribution network.

Following a switch to low sulphur diesel fuel and the progressive adoption of power generation from renewable sources, rail will become in all respects the least environmentally damaging transport mode.

Toxic talk

More expert information on pollution is available from America's National Library of Health and National Institutes of Health website. http://toxtown.nlm.nih.gov/text_version/index.html

The case for rail

If you would like a copy if Norman Bradbury's Railfuture booklet *The Case for Rail* send a cheque for £2.75 (made payable to Railfuture) to cover post and packing to Railfuture, Room 205, The Colourworks, 2 Abbot Street, London E8 3DP.

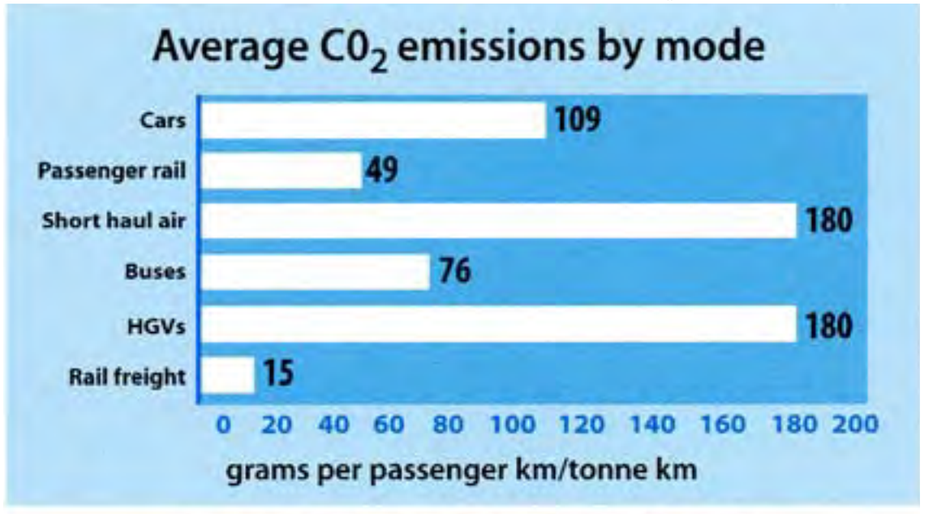
Edited by Keith Dyall, it contains several colour pictures and is packed with information which helps to undermine the half truths peddled by both the road and aviation industries.

ATOC and the Railway Forum have also produced a leaflet *Rail and the Environment* explaining the facts about road and rail pollution. Contacts:

The Railway Forum, 12 Grosvenor Place, London SW1X 7HH
Tel: 020 7259 6543
Fax: 020 7259 6544

The Association of Train Operating Companies, 40 Bernard Street, London WC1N 1BY
Tel: 020 7841 8020
Fax: 7841 8263

Remember, rail remains the least environmentally damaging form of powered transport.



Source: AEA Technology Environment for SRA, NAEI

❖ Carbon dioxide is the principal greenhouse gas causing global warming and climate change.

❖ Rail produces less than 1% of the total UK emissions of carbon dioxide, compared to 21% from road transport.

❖ Average emissions of carbon dioxide per passenger kilometre are significantly lower than other modes.

❖ Average rail freight emissions of carbon dioxide per tonne kilometre are just 8% of lorries.

Average pollutant emissions by mode
(grams per passenger km/tonne km)

	Car	Passenger rail	HGVs	Rail freight
PM_{10}	0.012	0.016	0.048	0.004
NO_x	0.5	0.31	1.74	0.11
SO_2	0.003	0.21	0.005	0.016
VOCs	0.25	0.029	0.15	0.021
CO	2.57	0.08	0.33	0.032

Source: AEA Technology Environment for SRA

All motorised transport produces harmful pollutants which degrade the quality of the air we breathe but rail performs relatively well compared to its rivals.

PM_{10} Particulate matter

Rail generates only 1% of total UK emissions of PM_{10}s. Road transport generates 21%. But rail does produce more PM_{10}s per passenger kilometre than cars. PM_{10}s cause heart and respiratory disease.

NO_x Nitrogen oxides

Rail generates only 1% of total UK emissions of $N0_x$. Road transport generates 49%. Nitrogen oxides destroy lung tissue and cause burning and swelling of tissues in the throat, difficult breathing and throat spasms.

SO_2 Sulphur dioxide

Rail produces more emissions of SO_2 per passenger kilometre than cars. It causes breathing problems, respiratory illness, changes in the lung's defences, and worsening of respiratory and cardiovascular disease.

VOCs Volatile organic compounds

Causes cancer as well as damage to the liver, kidneys and central nervous system. Also causes eye and respiratory tract irritation, headaches, dizziness, visual disorders, fatigue, loss of coordination, allergic skin reactions, nausea, and memory impairment.

CO Carbon monoxide

Rail generates only 1% of total UK emissions of CO. Road transport generates 62% of CO. Carbon monoxide is poisonous at 0.3% concentration.

Rail and lorries

Rail freight emits less of all pollutants (except $S0_2$) than lorries.