IS 21

Greenhouse Gas Emissions to 2020

Projected Trends for Australian Transport

The BTRE has recently projected greenhouse gas emissions and energy use by the Australian transport sector using two different methods (both of which give similar results for aggregate forecast trends):

- modelling transport sub-sectors (typically using vehicle fleet models), and then aggregating to sector totals (here termed a '***bottom-up***' approach); and
- modelling the sector as a part of the total economy (a 'macro modelling' or '***top-down***' approach) typically derived using an economy-wide General Equilibrium model.

The next section presents the BTRE **bottom-up base case projections** - or '*business-as-usual*' scenario. For comparison, aggregate projection results from the BTRE top-down modelling are given in Box A.

Findings from the bottom-up approach

The BTRE estimates that direct greenhouse gas emissions from transport energy end-use in 2000 were 71.7 million tonnes (of carbon dioxide equivalent). This is about 20 per cent above 1990 levels (of 59.7 million tonnes). Transport energy use currently accounts for around 14 per cent of Australia's net greenhouse gas emissions (in terms of CO_2 equivalent).

Greenhouse emissions from the domestic transport sector by 2010 are projected, under base case (or business-as-usual) assumptions, to be close to 47 per cent above the level for 1990 (the Kyoto target base year), reaching 87.4 million tonnes. By 2020, the BTRE projects such business-as-usual emissions to be 68 per cent above 1990 levels (at 100.2 million tonnes). While these projections exhibit a relatively strong rate of growth in emissions (at about 1.7 per cent per annum between 2000 and 2020), the average projected growth rate is slightly below that of the 1990s (of about 1.9 per cent a year).

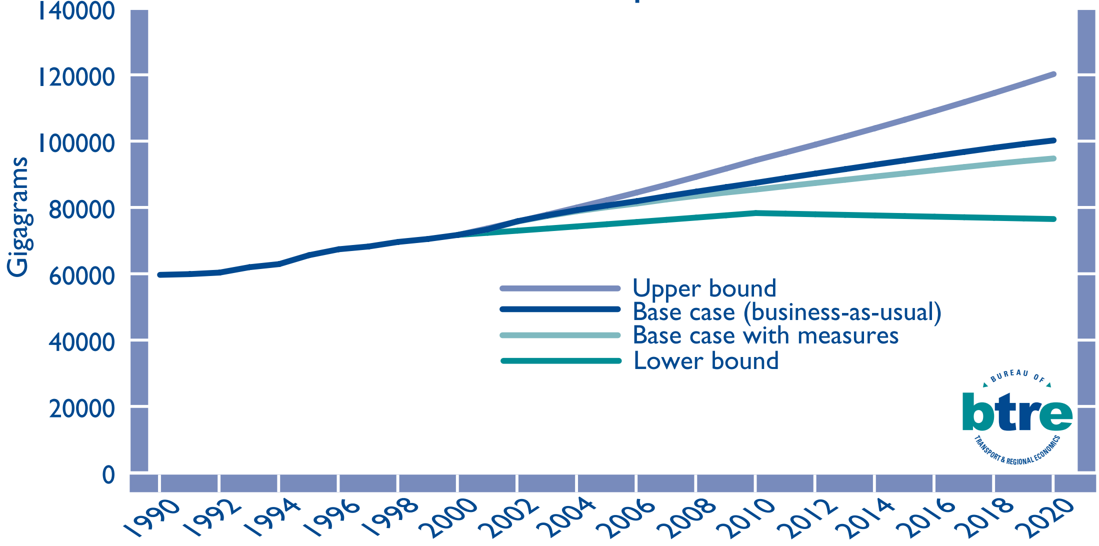
Policy measures (aimed at greenhouse gas abatement from transport) that have already been put in place include the Compressed Natural Gas Infrastructure Program (which aims to establish a network of publicly accessible compressed natural gas refuelling stations), the Alternative Fuels Conversion Program (which facilitates heavier commercial vehicles operating on natural gas or LPG), the Environmental Strategy for the Motor Vehicle Industry (encompassing a range of measures to enhance the environmental performance of the automotive industry) and the Diesel and Alternative Fuels Grants Scheme (which pays a rebate on all on-road diesel and alternative fuel use by eligible heavy vehicles). These measures are estimated as potentially capable of reducing the base case projection of 47 per cent growth by 2010 to about a 43 per cent growth. (The projected emission trend for a 'base case with measures' scenario is plotted together with the base case estimates in figure 1.)

The scale of these forecast increases (which are similar in magnitude to previously released Bureau projections of transport emissions) points to the fact that Australian transport demand is highly dependent on underlying economic and population growth. Similar orders of magnitude increases were found for most Australian States and Territories.

Total passenger travel tends to grow at somewhat above the rate of population growth, with the total passenger-kilometre task for Australia projected to grow at around 2 per cent per annum between 2000 and 2020. The road freight task has tended to increase at above the economic growth rate (which has averaged about 3.4 per cent over the last 20 years) – and the base case has an average projected growth of around 4 per cent per annum for aggregate road tonne-kilometres. Since coastal shipping has a reasonably low projected growth rate, the base case has total domestic freight tonne-kilometres increasing at slightly below 3 per cent per annum to 2020.

The base case also takes account of ongoing improvement in the fuel efficiency of vehicle fleets – with future trends in technical innovation assumed to be comparable to those encountered over the last couple of decades. The base case projections have the overall energy intensity of the Australian domestic passenger task (discounting, for the moment, the adverse effects of increasing urban traffic congestion) declining by around 1.2 per cent per annum and that of the Australian domestic freight task by around 1.8 per cent per annum.

Figure 1 **Projections of CO_2 Equivalent Emissions from Australian Domestic Transport**



Notes: 'Base case with measures' projections adjust the business-as-usual projections to allow for the possible effects of Australian government policy measures (aimed at abating greenhouse emissions from the transport sector) that have already been put in place.
'Upper bound' projections consist of the highest level of emissions likely (pessimistic sensitivity scenario).
'Lower bound' projections consist of the lowest level of emissions likely (optimistic sensitivity scenario).
All emission values given here refer to direct carbon dioxide (CO_2) equivalent emissions—ie they include solely the effects (relative to an equivalent mass of CO_2) of the directly radiative gases emitted from transport fuel use: CO_2, methane (CH_4) and nitrous oxide (N_2O). Emissions are also those from energy end-use, ie do not include emissions due to power generation for electric railways or to transport fuel supply and processing.

Source: BTRE Report 107

Within the aggregate forecast growth in domestic transport emissions over the next two decades (at about 1.7 per cent per annum), aviation is projected to have the strongest rate of growth (averaging about 4.4 per cent per annum), followed by commercial road vehicles (2.2 per cent per annum). The passenger car fleet will remain the single largest contributor to total sector emissions, but is expected to exhibit a slower rate of growth (of around 1 per cent per annum between 2000 and 2020), due to average vehicle use per person in the future tending towards a saturation level (of about 9000 kilometres per year). The sum of emissions from all other transport activities (accounting for around 9 per cent of total transport emissions) is forecast to grow at close to 1 per cent per annum (2000–2020). See figure 2 for the base case projections of modal fuel use to 2020.

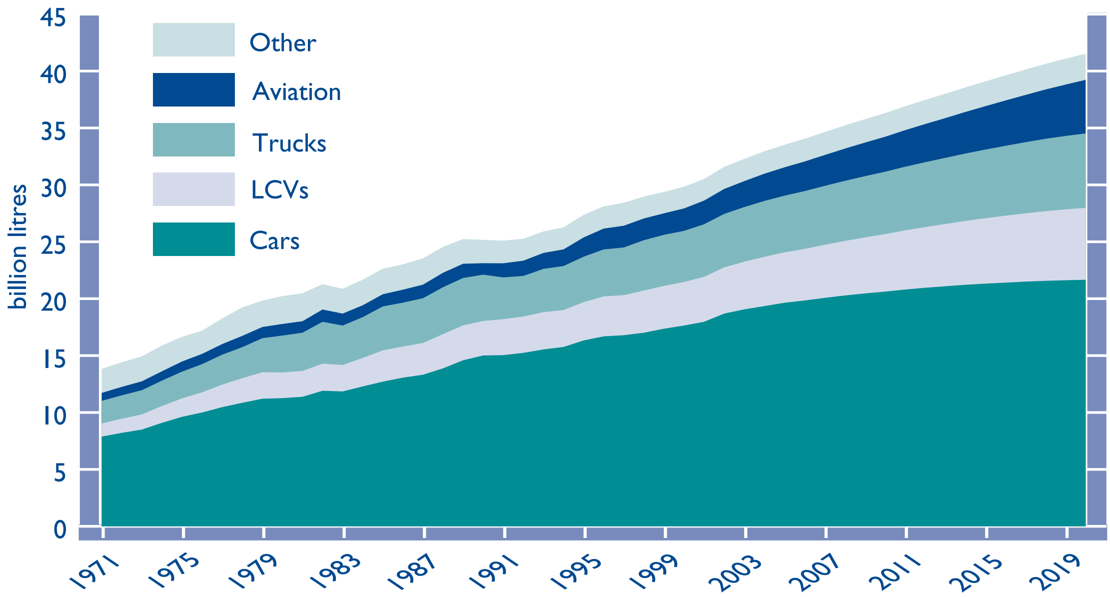
The projections are, of course, subject to considerable uncertainty, principally concerning the likelihood of the various assumptions that had to be made in the modelling process. As part of the study, sensitivity analyses were performed - where the values assumed for the major explanatory variables (such as economic growth, population growth and vehicle fuel intensity) were varied, and the effects on the emission projections examined.

Using the most optimistic assumptions (i.e. choosing future values for each of the major explanatory factors so as to give the lowest likely emission projections for a base case trend), carbon dioxide equivalent emissions from Australian transport in 2010 would still reach 78.3 million tonnes (an increase of 31 per cent over the 1990 base level). Alternatively, pessimistic assumptions for the major underlying factors imply that total greenhouse emissions from Australian transport could reach 94.2 million tonnes by 2010 (an increase of 58 per cent over 1990 levels). Trend curves for these sensitivity analyses are also presented in figure 1.

The BTRE base case results presented here differ somewhat from projections published last year by the Australian Greenhouse Office (AGO 2002). The projections issued by the AGO were derived by averaging the results of the BTRE bottom-up modelling study, top-down results using an earlier specification of the Centre of Policy Studies' (Monash University) MMRF-Green model than that discussed in Box A, and results from another top-down model (ABARE's GTEM). Unless the input data are structured appropriately, top-down models will typically generate higher transport projections than the BTRE's bottom-up fleet models - primarily due to most top-down models lacking any constraint parameters to allow for the trend towards saturation in future Australian car use per person. These 'averaged' projections in the AGO's National Communication 2002 have business-as-usual growth for the transport sector as 54 per cent between 1990 and 2010 (with a likely range of 46 to 62 per cent, as opposed to the BTRE base case result of 47 per cent). 'With measures' growth (1990-2010) is projected in the AGO report to be 48 per cent (versus the BTRE result of 43 per cent).

A detailed presentation of the bottom-up modelling research is given in BTRE Report 107 — *Greenhouse Gas Emissions from Transport: Australian Trends to 2020*. Report 107 also discusses issues concerning policy scenarios for reducing emissions from the transport sector (including, for example, the impacts of imposing road congestion pricing in metropolitan areas).

Figure 2 Australian Domestic Transport Fuel Consumption to 2020



Notes: Oil and gas consumption (end-use) – i.e. do not include electricity consumption. 'Other' consists of the maritime sector, non-electric rail and minor motor vehicle use (e.g. motorcycles and buses).

Source: BTRE Report 107.

BOX A: Findings from the top-down approach

BTRE has also used an enhanced version of the MMRF–GREEN (Monash Multi-Regional Forecasting-Green) model to make projections of greenhouse gas emissions from the Australian transport sector. (The top-down modelling study is detailed in BTRE Working Paper 52, *Greenhouse Gas Emissions from Australian Transport: a Macro Modelling Approach*).

For the reference (business-as-usual) case, it is assumed that over the coming decade:

- the Australian economy will expand at an average annual rate of 3.4 per cent;
- population will grow at an average annual rate of 0.93 per cent;
- household tastes will remain the same as in recent years;
- fuel efficiency in the private use of transport services will improve at a slower rate than in the past;
- fuel-using technology in the trucking industry will improve at a faster rate than in the past; and
- the world oil price will gradually fall from around US$30 per barrel in 2001 to US$20 by 2006.

Given these assumptions, the model predicts that:

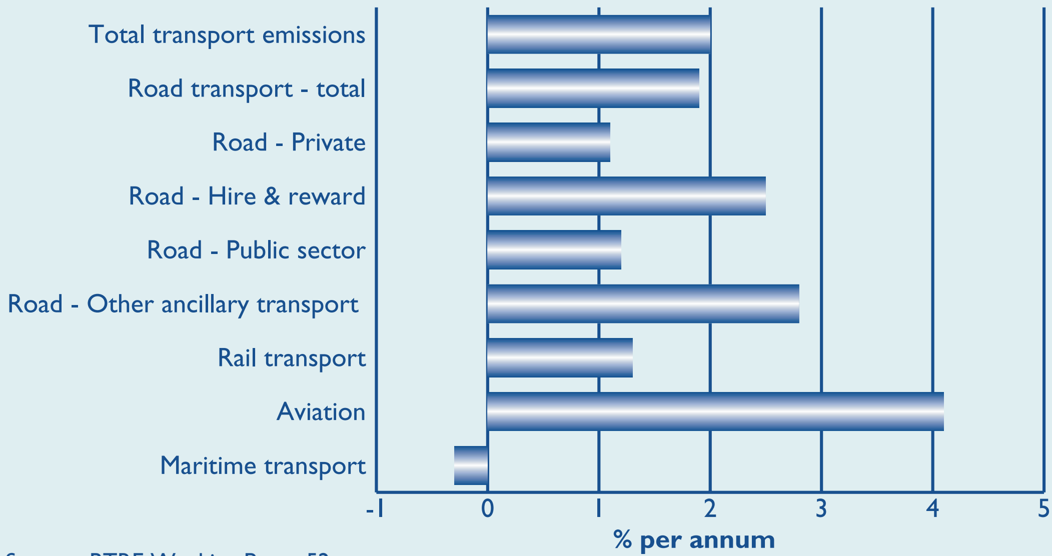
- **total transport emissions in 2010 will be 45.4 per cent higher than the 1990 level**;
- road transport emissions will remain the dominant source of total transport emissions and will grow at an average annual rate of 1.9 per cent; and
- emissions from non-road transport will grow slightly faster (2.8 per cent per annum) than from road, principally due to the high growth from air transport (4.1 per cent per annum).

Sensitivity analyses carried out under high and low GDP growth scenarios suggest that a half percentage point increase (or decrease) in the assumed annual growth rate for GDP causes 2010 transport emissions to be 3.4 per cent greater (or less). Sensitivity analyses for fuel prices imply that if the crude oil price were to remain at the level of about US$30 per barrel over the forecast period, total transport emissions in 2010 could be 1.5 per cent below the reference case.

The aggregate results for the BTRE macro modelling approach are essentially equivalent to those of the BTRE 'bottom-up' modelling study. Whereas the 'top-down' study projects growth in transport emissions between 1990 and 2010 of 45.4 per cent, the bottom-up modelling forecasts an increase of 46.5 per cent over this period. (See figure 3 for the sectoral components of the projections.)

The study represents the BTRE's first application of its recently acquired Computable General Equilibrium model in the area of transport emissions. As a result of this work, the model should now be well equipped to analyse the economy-wide impact of a range of environmental policies.

Figure 3 Projected growth in Australian greenhouse emissions, by sector, to 2010
(per cent per year increase in CO_2 equivalent emissions)



Source: BTRE Working Paper 52.

References

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BTRE 2002, *Greenhouse Gas Emissions from Transport: Australian Trends to 2020*, Report 107, BTRE, Canberra.

BTRE 2003, *Greenhouse Gas Emissions from Australian Transport: a Macro Modelling Approach*, Working Paper 52, BTRE, Canberra. *(forthcoming)*

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