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Transport

emissions projections

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Executive Summary

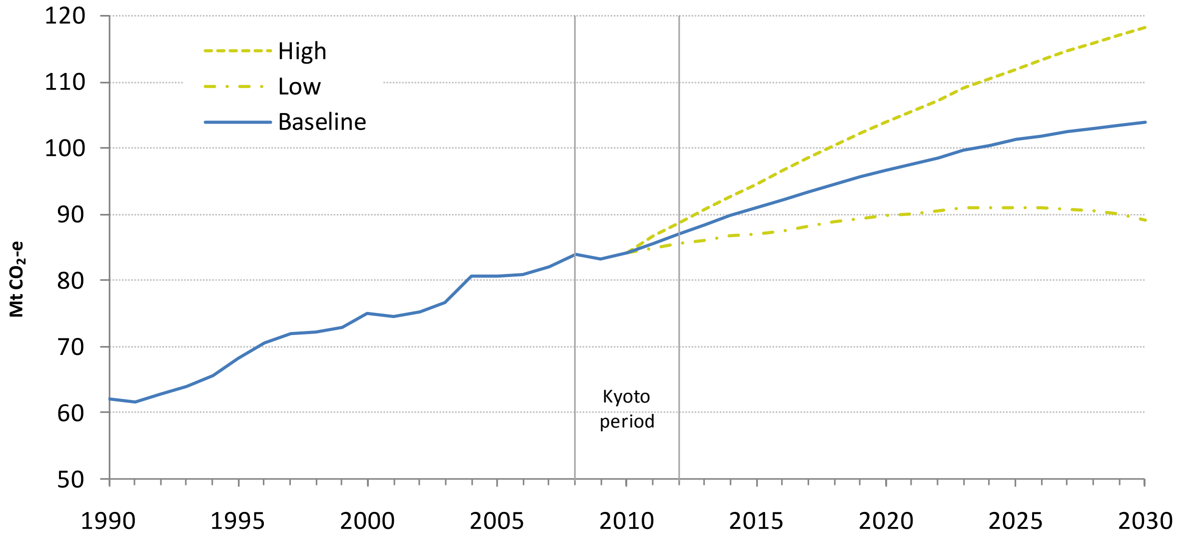
Key Points

- Transport emissions accounted for 14 per cent of Australia's total domestic emissions in 2009 at 83 Mt CO_2-e.
- Baseline transport emissions are projected to average 85 Mt CO_2-e per year in the Kyoto period, 37 per cent above 1990 levels. In 2020, transport emissions are projected to be 97 Mt CO_2-e, 29 per cent higher than in 2000.
- Road transport accounts for the largest proportion of emissions in this sector, averaging 73 Mt CO_2-e per year over the Kyoto period and 83 Mt CO_2-e in 2020.
- Indicative modelling suggests baseline transport emissions will be around 104 Mt CO_2-e in 2030.

Baseline projection

- Greenhouse gas emissions from the transport sector are projected to average 85 Mt CO_2-e per year over the Kyoto period (2008-2012), 37 per cent above 1990 levels[1]. This emissions growth is due to increased transport activity, which in turn is primarily driven by economic and population growth.

Figure 1 Baseline transport emissions, 1990 to 2030



Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

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[1] All years in this publication are Australian financial years, ending on the 30 June of the year quoted.

- Transport emissions are projected to increase by 16 per cent to 97 Mt CO_2-e between 2009 and 2020. This increase is driven primarily by population and income growth for passenger travel and economic growth for freight transport. The magnitude of this emissions increase is partially offset by efficiency improvements.

Table 1 Baseline transport emissions, Kyoto period average and 2020

	1990	2000	Kyoto period average 2008-12		2020	
	Mt CO_2-e	Mt CO_2-e	Mt CO_2-e	Increase on 1990 (%)	Mt CO_2-e	Increase on 2000 (%)
Road	54	66	73	35	83	25
Domestic aviation	2.9	5	6	109	7	49
Domestic shipping	3.0	2.4	3.0	-0.7	3.4	46
Railways	1.7	1.6	2.5	41	3.0	94
Off road recreational	0.04	0.04	0.04	9	0.05	20
Total	**62**	**75**	**85**	**37**	**97**	**29**

Note: Totals may not add due to rounding. Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

Business-as-usual projection

- The business-as-usual projection indicates that without existing policies and measures, transport emission would have averaged around 86 Mt CO_2-e per year in the Kyoto period and 98 Mt CO_2-e in 2020.

Impact of measures

- There are four transport measures for which abatement estimates are currently possible:
  - Energy Efficiency Opportunities program
  - Greenhouse Gas Abatement Program
  - NSW Biofuel Act
  - Alternative Fuels Conversion Program
- The net abatement from these policies and measures in the transport sector is estimated to average 0.8 Mt CO_2-e per year in the Kyoto Period and 1.3 Mt CO_2-e in 2020.

Changes from 2009 projection

- These transport emission projections reflect a full update of the 2009 projections released in *Australia's Fifth National Communication on Climate Change* to the UNFCCC.
- Annual emissions from the transport sector are projected to average 3.3 Mt CO_2-e higher over the Kyoto period than in the 2009 projections and 1.3 Mt CO_2-e higher in 2020.
- The majority of this upward revision is attributable to an increase in historical emissions in the National Greenhouse Gas Inventory (NGGI), due to the partial reallocation of diesel from the stationary energy to the transport sector in ABARE's *Australian Energy Statistics – Australian Energy Update 2009.* This has been partially offset in 2020 due to higher fuel efficiency projections for vehicles.

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Introduction

This paper presents projections of greenhouse gas emissions from the Australian transport sector and forms part of the 2010 emissions projections update.

The 2010 transport sector projection is a full update of the 2009 transport projections. This projection is a composite of the projections of two different modelling groups, the Bureau of Infrastructure, Transport and Regional Economics (BITRE) and Sinclair Knight Merz McLennan Magasanik Associates (SKM-MMA). Indicative projections of transport emissions out to 2030 have also been provided[2].

Table 2 Projections scenarios

Scenario	Description
Business-as-usual (BAU)	Emissions in the absence of Government abatement policies and measures
Baseline	Emissions given current policy settings
High/ low	Sensitivity scenarios around the baseline – determined by modifying key assumptions such as economic growth rates

Two projections scenarios are provided, a baseline and business-as-usual (BAU). High and low sensitivity scenarios are also provided to indicate the level of uncertainty around key assumptions. The baseline projections have been developed on the basis of current policies in place and do not include the impact of a carbon price.

Coverage of the sector

Greenhouse gas emissions from the transport sector are defined in the National Greenhouse Gas Inventory (NGGI) as emissions from the direct combustion of fuels in road transportation, railways, domestic shipping, domestic aviation and off road recreational vehicle activity. Emissions from military transport, miscellaneous non-recreational off road vehicles[3] and mobile utility engines[4] are accounted for in the stationary energy sector rather than the transport sector.

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[2] All years in this publication are Australian financial years, ending on the 30 June of the year quoted.

[3] Including tractors and other farm vehicles, quarry trucks, construction equipment and forklifts.

[4] Including lawn mowers, chain saws, portable generators and mobile compressors.

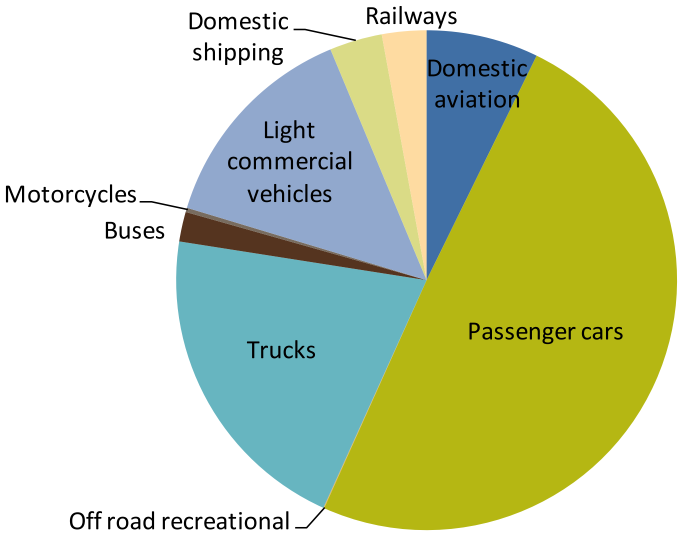
Table 3 Coverage of the transport sector

Projections subsectors	**Description**
Road	Includes civilian passenger vehicles, light commercial vehicles, trucks, buses and motorcycles. Military road transportation is part of the stationary energy sector.
Domestic aviation	Comprises domestic air transport — commercial passenger and light aircraft using either aviation gasoline or jet kerosene. International air transport is not included in Australia's total emissions in line with international guidelines. Military aviation is part of the stationary energy sector.
Railways	Consists of all rail transport except for electric rail, which is included in the stationary energy sector.
Domestic shipping	Includes domestic shipping and small craft but excludes international shipping, military navigation and fishing vessels. International shipping is not included in Australia's total emissions, in line with international guidelines. Military navigation and fishing vessels are reported as part of the stationary energy sector.
Off road recreational vehicles	Consists of off road recreational vehicles. Other off road vehicles, such as farm vehicles and construction equipment are accounted for in the stationary energy sector.

Recent trends – National Greenhouse Gas Inventory

The latest National Greenhouse Gas Inventory (June quarter 2010) estimates total transport sector emissions for 2009 at 83 Mt CO_2-e, accounting for around 14 per cent of Australia's total emissions. Around half of the emissions in this sector were from passenger cars (41 Mt CO_2-e), around a fifth were from trucks (17 Mt CO_2-e), 14 per cent were from light commercial vehicles and 7 per cent were from domestic civil aviation. The remaining transport emissions were from domestic shipping, railways, motorcycles and off road recreational vehicles.

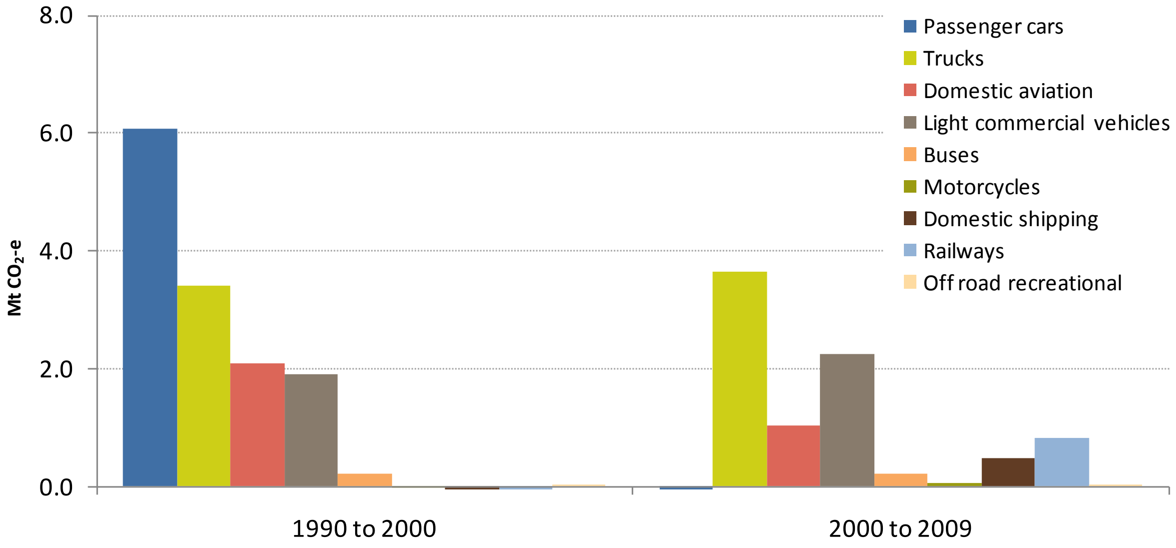
Figure 2 Transport emissions in 2009



Source: DCCEE analysis

Between 1990 and 2009, emissions in the sector have grown 34 per cent, at an average rate of 1.6 per cent a year. Transport emissions growth has primarily been driven by increased transport activity due to economic and population growth.

Figure 3 Growth in transport emissions,1990 to 2009



Source: DCCEE analysis

Between 1990 and 2000 transport emissions grew 21 per cent (13 Mt CO_2-e), at an average 1.9 per cent per year. The majority of this growth was from passenger cars (6 Mt CO_2-e), which grew on average 1.6 per cent per year. Other significant contributors to the emissions growth were trucks, light commercial vehicles and domestic aviation. Domestic shipping and railway emissions decreased during this period due to fuel efficiency improvements.

Between 2000 and 2009 transport emissions grew 11 per cent (8 Mt CO_2-e). Growth during this period was 1.2 per cent year. This rate was lower than in the previous decade. The primary source of this lower growth was a decrease in car emissions during this period. This decrease was due to relatively high oil prices, which both encouraged a shift towards smaller vehicles and discouraged some travel, and the economic slowdown following the global financial crisis.

Projections results

Transport emissions are projected to increase by 16 per cent between 2009 and 2020 to reach 97 Mt CO_2-e. This is 29 per cent above 2000 emissions levels. This increase in emissions is attributable to growth in all subsectors due to higher passenger travel and freight transportation activity. The magnitude of the emissions increase due to growth in transport activity is suppressed by efficiency improvements.

Table 4 Baseline transport emissions, Kyoto period average and 2020

	1990	**2000**	**Kyoto period average 2008-12**		**2020**	
	Mt CO_2-e	Mt CO_2-e	Mt CO_2-e	Increase on 1990 (%)	Mt CO_2-e	Increase on 2000 (%)
Road	54	66	73	35	83	25
Passenger cars	*35*	*41*	*41*	*18*	*44*	*7*
Light commercial vehicles	*8*	*9*	*12*	*58*	*14*	*50*
Trucks	*10*	*14*	*18*	*75*	*22*	*60*
Buses	*1.2*	*1.4*	*1.7*	*43*	*2.0*	*47*
Motorcycles	*0.2*	*0.2*	*0.2*	*13*	*0.3*	*54*
Domestic aviation	2.9	5	6	109	7	49
Domestic shipping	3.0	2.4	3.0	-0.7	3.4	46
Railways	1.7	1.6	2.5	41	3.0	94
Off road recreational	0.04	0.04	0.04	9	0.05	20
Total	**62**	**75**	**85**	**37**	**97**	**29**

Note: Totals may not add due to rounding. Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

Over the Kyoto period, transport emissions are projected to average 85 Mt CO_2-e per year, 37 per cent above the 1990 level.

Indicative modelling suggests that baseline emissions will be 104 Mt CO_2-e in 2030.

Trends in the transport projections

Transport emissions are projected to grow on average 1.4 per cent per year between 2009 and 2020. This is slightly lower than the historical growth rate of 1.6 per cent per year. All subsectors contribute to this growth in emissions. The slowest growing subsector is passenger cars, which grows on average 0.7 per cent per year. This low growth rate is due to a combination of high fuel efficiency improvements and modest growth in travel.

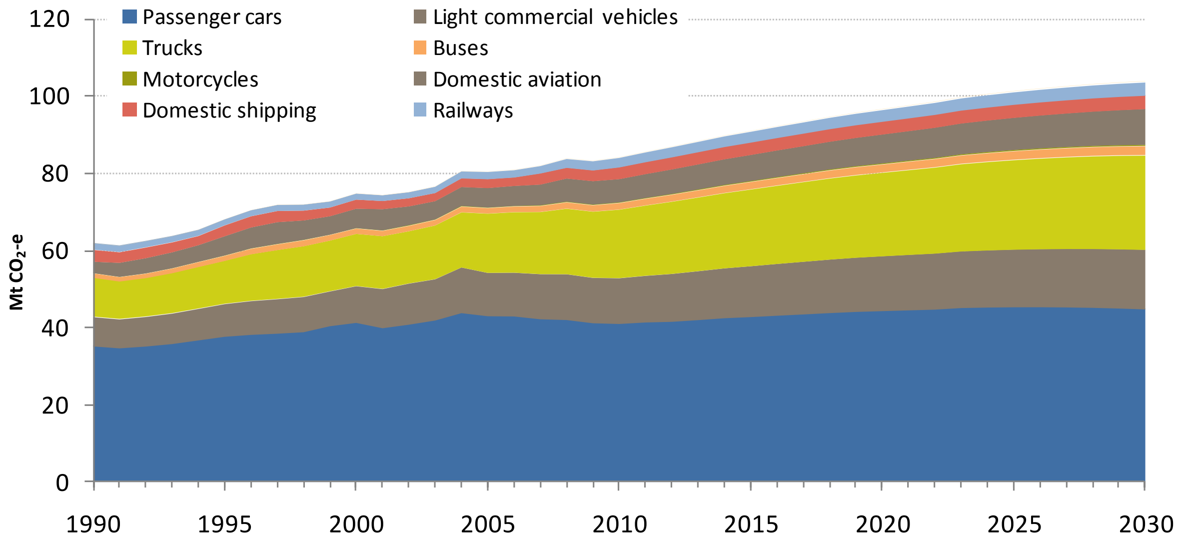
Table 5 Baseline transport emissions, 1990 to 2030, Mt CO_2-e

	1990	2009	KPA	2020	2030
Road	54	72	73	83	87
Passenger cars	*35*	*41*	*41*	*44*	*45*
Light commercial vehicles	*8*	*12*	*12*	*14*	*15*
Trucks	*10*	*17*	*18*	*22*	*25*
Buses	*1.2*	*1.6*	*1.7*	*2.0*	*2.3*
Motorcycles	*0.2*	*0.2*	*0.2*	*0.3*	*0.3*
Domestic aviation	2.9	6	6	7	9
Domestic shipping	3.0	2.8	3.0	3.4	3.7
Railways	1.7	2.4	2.5	3.0	3.4
Off road recreational	0.04	0.04	0.04	0.05	0.06
Total	**62**	**83**	**85**	**97**	**104**

Note: Totals may not add due to rounding. Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

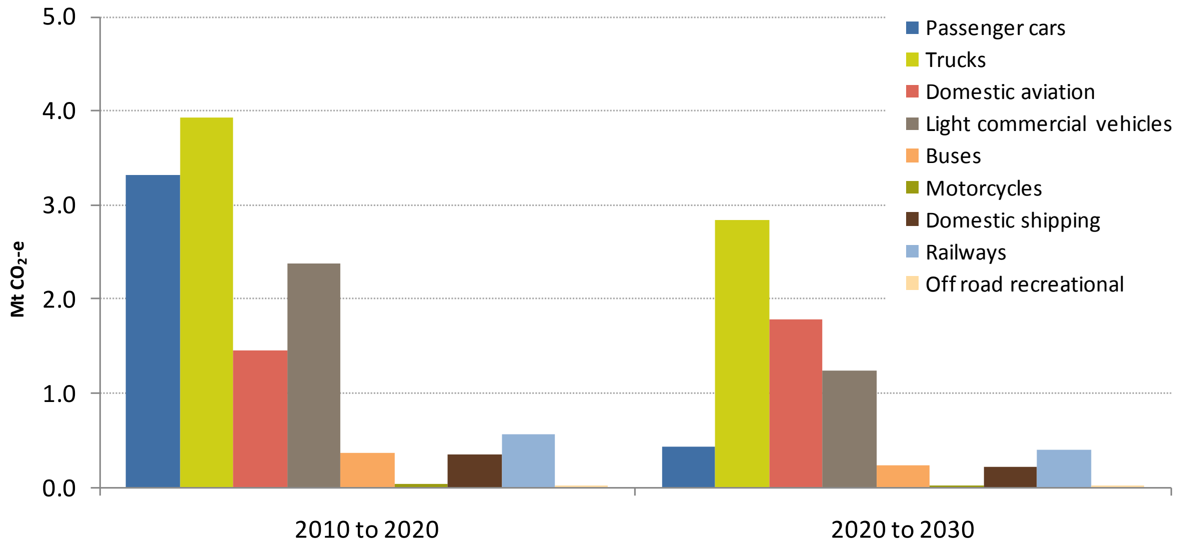
Between 2020 and 2030, transport emissions are projected to grow on average 0.7 per cent per year. This is half the average projected growth rate for the period 2009 to 2020. Emissions growth between 2020 and 2030 is lower in all subsectors compared to the previous decade, with the exception of domestic aviation. Growth in domestic aviation emissions is maintained due to strong growth in demand for air travel. Emissions growth is particularly lower for passenger cars due to vehicle efficiency improvements and stabilising passenger travel activity.

Figure 4 Baseline transport emissions trends, 1990 to 2030



Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

Figure 5 Growth in transport emissions, 2010 to 2030



Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

Main drivers of sectoral emissions

Transport sector emission projections are highly dependent on a number of key forecast variables including:

- economic and demographic indicators, such as GDP, international oil prices, income and population;
- vehicle technology, such as fuel efficiency and design standards;
- the future travel behaviour of individuals and firms; and
- the impact of policy and measures.

The two main activities in the transport sector are passenger travel and freight transport. The main drivers behind passenger travel are population and per capita daily travel. Per capita daily travel tends to increase with per capita income levels. However, the rate of increase in travel begins to slow and decouple from income as people spend as much of their time travelling as they are willing to commit.

The amount of freight transported is strongly linked to economic activity. Current growth in freight activity (tonne-kilometres) is in line with the overall growth rate of the economy. While this cannot continue indefinitely there are no current signs of saturation of freight activity and there appears to be significant scope for further growth.

Business-as-usual scenario and measures estimates

The business-as-usual projection indicates that without existing policies and measures, transport emission would have averaged around 86 Mt CO_2-e per year in the Kyoto period and 98 Mt CO_2-e in 2020.

There are four transport measures for which abatement estimates are currently possible:

- Energy Efficiency Opportunities
- Greenhouse Gas Abatement Program
- NSW Biofuel Act
- Alternative Fuels Conversion Program

The net abatement from policies and measures in the transport sector is estimated to average 0.8 Mt CO_2-e per year in the Kyoto period and 1.3 Mt CO_2-e in 2020.

The Energy Efficiency Opportunities program encourages large energy-using businesses to improve their energy efficiency. The majority of the abatement from this program occurs in the stationary energy sector, however, it is estimated to generate 0.5 Mt CO_2-e of abatement in the transport sector in 2020.

The Greenhouse Gas Abatement Program provided funding for two travel behaviour programs in the transport sector. This is estimated to result in 0.5 Mt CO_2-e of abatement in 2020.

The New South Wales Government Biofuel Act mandated targets for ethanol and biodiesel. This legislation is estimated to generate 0.3 Mt CO_2-e of abatement in 2020.

The Alternative Fuels Conversion Program supports the conversion of vehicles to new technologies. This program was designed to demonstrate the commercial viability of new technologies, rather than have specific greenhouse gas abatement benefits. The abatement from this program in 2020 is estimated to be negligible.

The Australian Government has proposed a mandatory carbon dioxide emission standard for all new light vehicles, including cars. The level of the standard is still open for consultation and as a result this measure was not incorporated in the baseline.

The impact of the Queensland Government’s 5 per cent mandate on ethanol-blended fuel was not incorporated in the baseline, as the implementation of this mandate has been suspended.

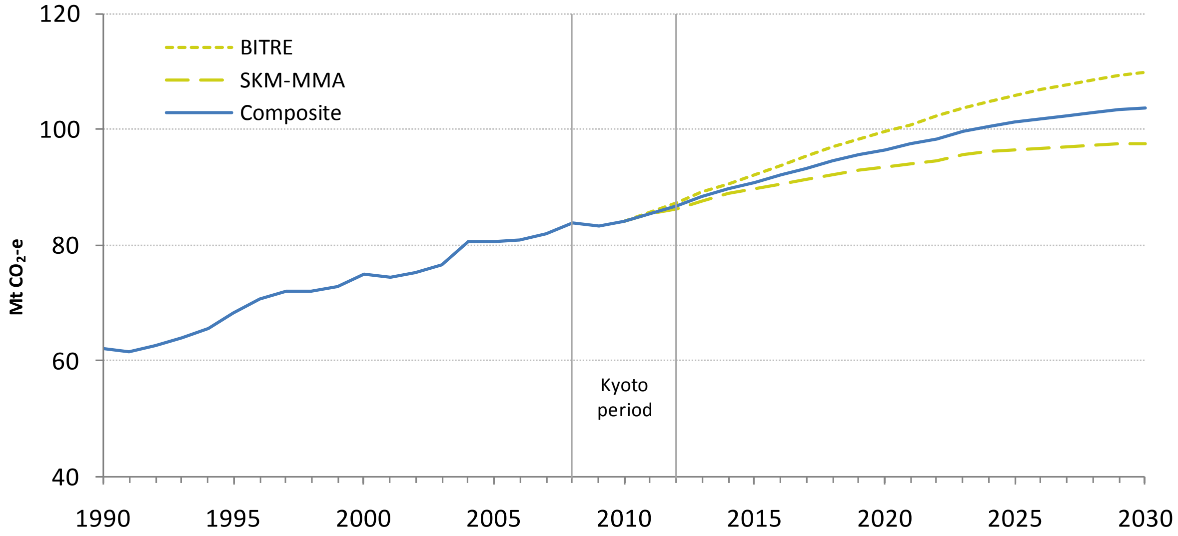
For more details, see Appendix A.

Comparison of modellers

As noted elsewhere, the transport emissions projection is a composite of the projections of two different modelling groups, BITRE and SKM-MMA.

The BITRE emission projections are 6 per cent higher than the SKM-MMA projections in 2020. In general, this is a result of BITRE projecting more gradual fuel efficiency improvements than SKM-MMA. This effect is partially offset by SKM-MMA's higher projected transport activity.

Figure 6 Baseline transport emissions by modeller, 1990 to 2030



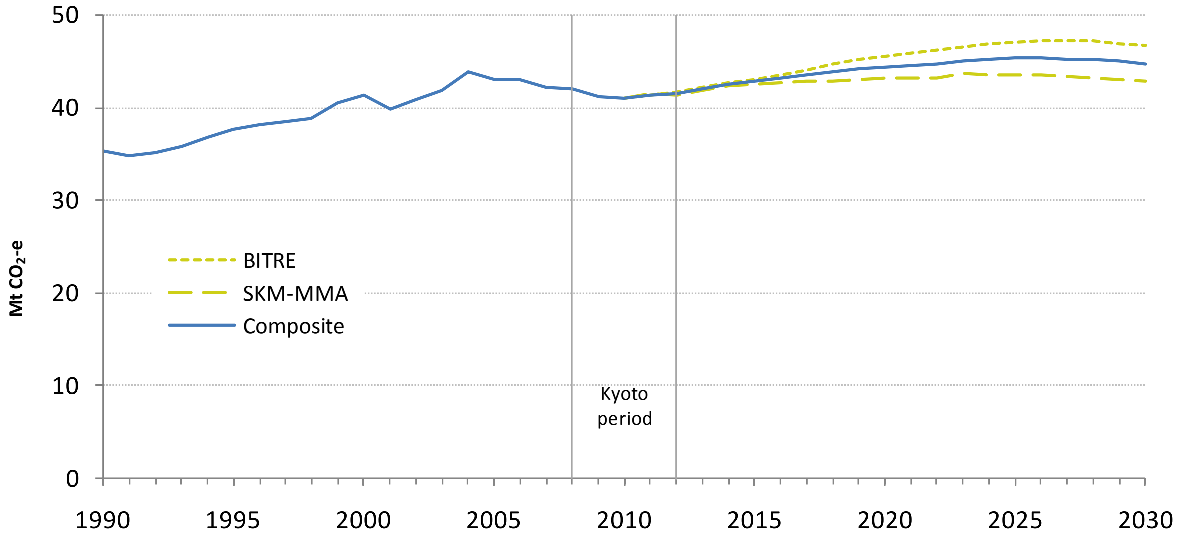
Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

Passenger cars

Passenger cars are the largest source of emissions in this sector, accounting for almost half of transport emissions in 2009. Passenger car emissions are projected to average 41 Mt CO_2-e per year in the Kyoto period and grow to 44 Mt CO_2-e by 2020.

Passenger car emissions are primarily related to total passenger vehicle kilometres travelled (passenger VKT) and the fuel efficiency of the vehicle fleet.

Figure 7 Passenger car emissions, 1990 to 2030



Note: Composite is the average of the projections of the two modellers.
Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

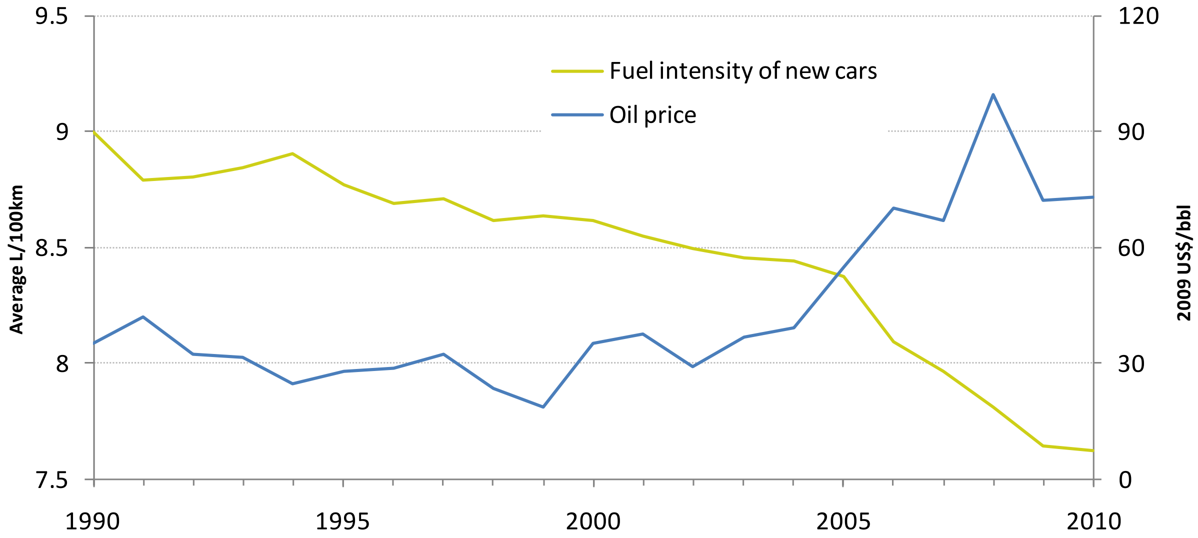
Between 1990 and 2004 emissions in this subsector grew on average 1.6 per cent per year. However, between 2004 and 2009 passenger car emissions decreased on average 1.2 per cent per year. This decrease is likely to be related to increasing oil prices over this period and household budgets being squeezed due to the global financial crisis. Increasing oil prices were observed throughout this period and the impact of the global financial crisis was felt near the end of the period. These factors appear to have combined to result in lower passenger travel and motorists purchasing smaller, more fuel efficient vehicles.

The emissions from cars decreased 2.6 Mt CO_2-e from 2004 to 2009. Approximately 1.1 Mt CO_2-e of this decrease can be attributed to a decrease in kilometres travelled, 1.2 Mt CO_2-e due to an increase in the fuel efficiency of the vehicle fleet and 0.3 Mt CO_2-e due to the uptake of ethanol blended fuels.

As shown in Figure 8, between 1990 and 2004 only modest fluctuations in oil price and decreases in the fuel intensity of new cars were observed. In contrast between 2004 and 2009, strong increases in the oil price and significant decreases in the fuel intensity of new cars were observed. These fleet-wide fuel efficiency improvements were due to both a shift to smaller vehicles and more fuel efficient cars. Light cars increased from 35 per cent of the new car market in 2004 to 45 per cent in 2009.

Both modellers agree that this is only a temporary downturn and passenger vehicle emissions will continue to rise in the future, as incomes recover and oil prices experience modest growth over the projection period.

Figure 8 Fuel intensity of new cars and oil prices, 1990 to 2010



Source: BITRE (2010), IEA (2009), FCAI (2010 and earlier)

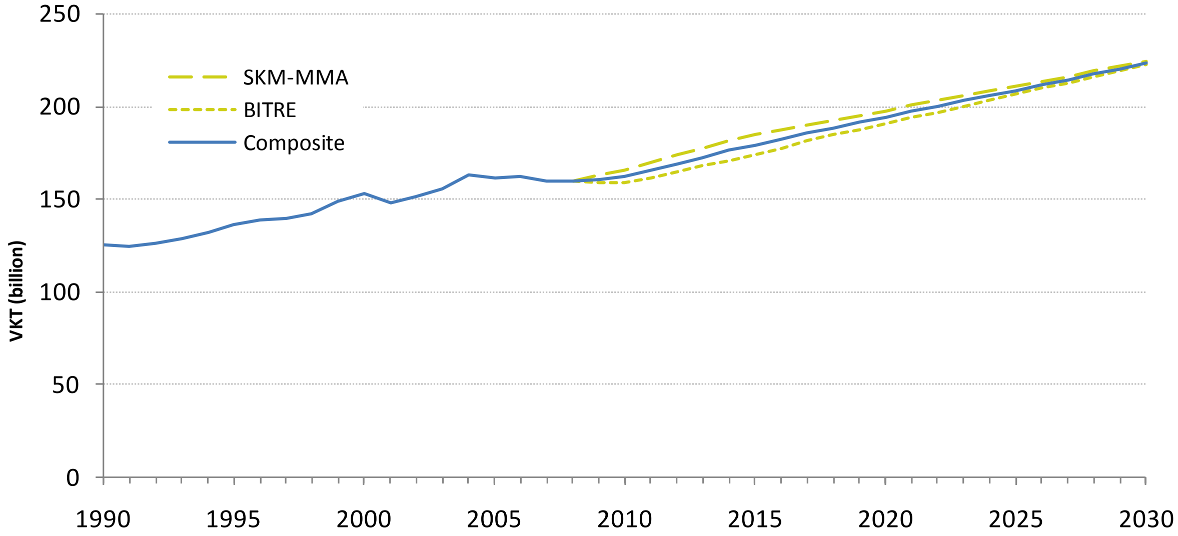
Passenger car activity

Between 2010 and 2020 passenger vehicle kilometres travelled (passenger VKT) are forecast to increase at an average 1.8 per cent per year. This is slightly lower than the average annual growth of around 1.9 per cent experienced between 1990 and 2004, yet significantly higher than the average growth of around -0.3 per cent per year experienced between 2004 and 2009 where high oil prices and the global financial crisis were felt.

The primary drivers for passenger VKT are population growth and per capita travel, which in turn is largely driven by income levels. The dominant driver of the future increase in passenger VKT is population growth. Population is forecast to increase steadily over the projection period at an average 1.4 per cent between 2010 and 2020 and 1.3 per cent between 2020 and 2030.

Per capita travel is projected to increase again due to the economic recovery and modest projected oil prices. Both modellers agree that as income levels and motor vehicle affordability increase over time, average travel per person will also increase. However, it is also projected that Australia will approach a saturating level near which per capita VKT will become increasingly decoupled from per capita income growth. This is essentially because people will eventually spend as much time on daily travel as they are prepared to commit, even if incomes do rise further.

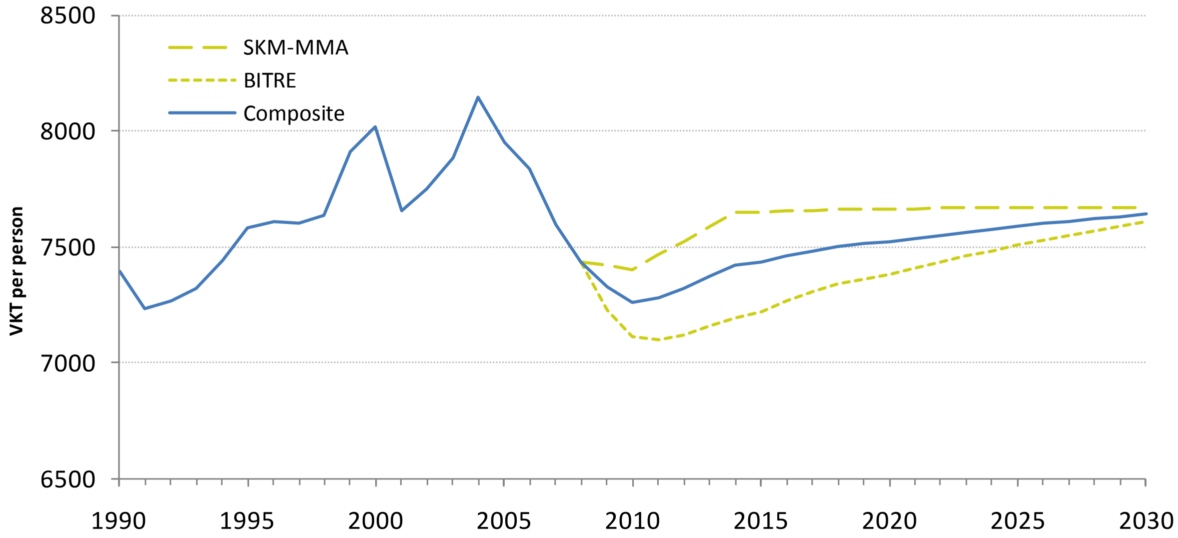
Figure 9 Passenger car vehicle kilometres travelled (VKT), 1990 to 2030



Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

The exact point at which Australia reaches this saturation point is a key area of uncertainty for this projection. The two modellers projected different results. SKM-MMA project strong growth in per capita travel between 2010 and 2014 of 0.8 per cent per year after which per capita travel reaches saturation and stays relatively flat throughout the rest of the projection period. In contrast BITRE project a sustained modest growth of 0.3 per cent per year throughout the projection period, implying that saturation has not yet been reached. Despite the two modellers forecasting different levels of growth in per capita travel, they projected similar passenger VKT, as population growth is the key determinant of future passenger VKT.

Figure 10 Passenger car vehicle kilometres travelled (VKT) per person, 1990 to 2030



Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

Emissions intensity

The emissions intensity of cars is expected to improve at an increasing rate over the projection period. The emissions intensity of cars is projected to decrease by 11 per cent between 2009 and 2020 and 12 per cent between 2020 and 2030. This decrease in the emissions intensity of cars is largely due to the projected fuel efficiency improvement of new cars. As new cars replace scrapped vehicles, the efficiency of the entire car fleet improves. As a result, emissions grow more slowly than vehicle kilometres travelled (VKT) over the projections period.

The fuel efficiency of new cars is projected to improve due to:

- the continuing improvement in the fuel efficiency of conventional engines;
- a continued shift to smaller cars;
- the uptake of new more efficient technologies; and
- the use of alternative fuels.

The size and technology of future new cars is highly uncertain, as it depends on consumer choices. Recently, higher oil prices and the global financial crisis appear to have influenced new car choices. The sales weighted fuel efficiency (litres per 100 km) of new cars fell on average 2.2 per cent per year between 2006 and 2009 due to both a shift to smaller cars and the purchasing of more fuel efficient vehicles. Sports Utility Vehicles (SUVs) have maintained their market share during this period, and have only experienced slight decreases.

The two modelling groups differ on their projections of fuel efficiency trends over the projection period. BITRE results find that given projected increases in income levels and only gradually increasing oil prices, future fuel efficiency improvements will be modest and the shift to smaller vehicles will not be sustained over the long term. This is supported by the 2010 vehicle sales data, in which the average sales-weighted litres per 100 km of new cars fell less than 0.3 per cent per year during 2010. In contrast, SKM-MMA expects the shift to smaller cars to continue throughout the projection period and forecast strong fuel efficiency improvements.

Vehicle technology is projected to change over the projection period. The switch to more fuel efficient technology is driven by motorist’s desire to minimise fuel costs. As a result, the uptake of more fuel efficient cars is driven by the trend in oil prices. The savings for motorists from more fuel efficient technologies is limited by the increased capital costs of purchasing the vehicles, as these technologies are generally more expensive than their conventional equivalents. Consequently, these new technologies become more cost competitive as this price differential decreases over time as the technology matures.

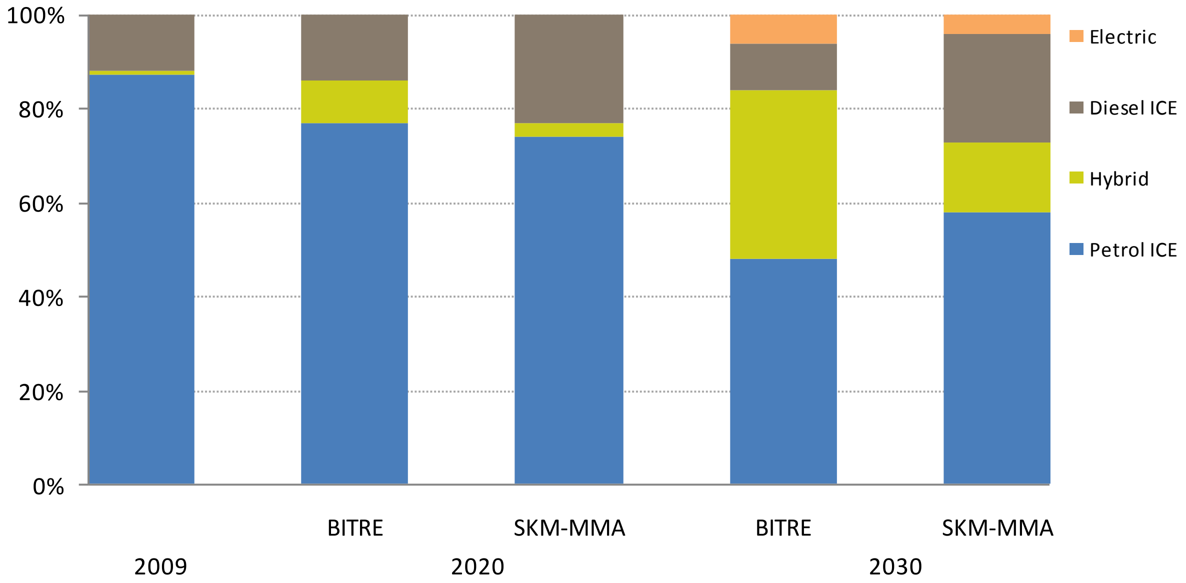
The rate of uptake of new technology is dampened by motorist’s preferences for high performance and risk aversion to new technology (e.g batteries for electric vehicles). The current limited range of models of new technology such as hybrids could also be playing a part in the slow uptake of this technology to date.

The key fuel efficient technologies options considered in this analysis are:

- diesel internal combustion engines (ICE) which are approximately 20 per cent less emissions intensive than petrol equivalents;
- hybrids which include both normal hybrids, which are typically 10 to 40 per cent more fuel efficient than conventional engines as they use an electric motor and battery storage to assist their internal combustion engine (ICE) and enable regenerative braking and plug-in hybrids, which are similar to normal hybrids but also allow the motorist to recharge the battery using electricity; and
- electric cars.

The uptake of hybrid vehicles, relative to diesel vehicles is another point of difference between the two modelling groups. BITRE project a higher uptake of hybrid relative to diesel vehicles, while SKM-MMA project more diesel vehicles relative to hybrids.

Figure 11 Technology of new cars, 2009 to 2030, per cent



Source: BITRE (2010), SKM-MMA (2010)

Road freight

Over the projection period, road transportation remains competitive relative to other modes of freight transportation (rail, air and sea) and accounts for 38 per cent of the freight task in 2020.

There are three main vehicle categories carrying road freight:

- Light commercial vehicles
- Rigid trucks
- Articulated trucks

Light commercial vehicles do not generally compete with rigid and articulated trucks, as a significant proportion of the freight carried by light commercial vehicles is not actually the movement of goods, but rather the daily transportation of tools of trade by service personnel.

The amount of freight transported by articulated vehicles, which are the least fuel intensive mode of road freight transportation (in petajoules per tonne kilometres travelled, PJ/TKM terms), is projected to grow at a higher rate than rigid trucks. This is because they are more efficient at transporting long haul road freight.

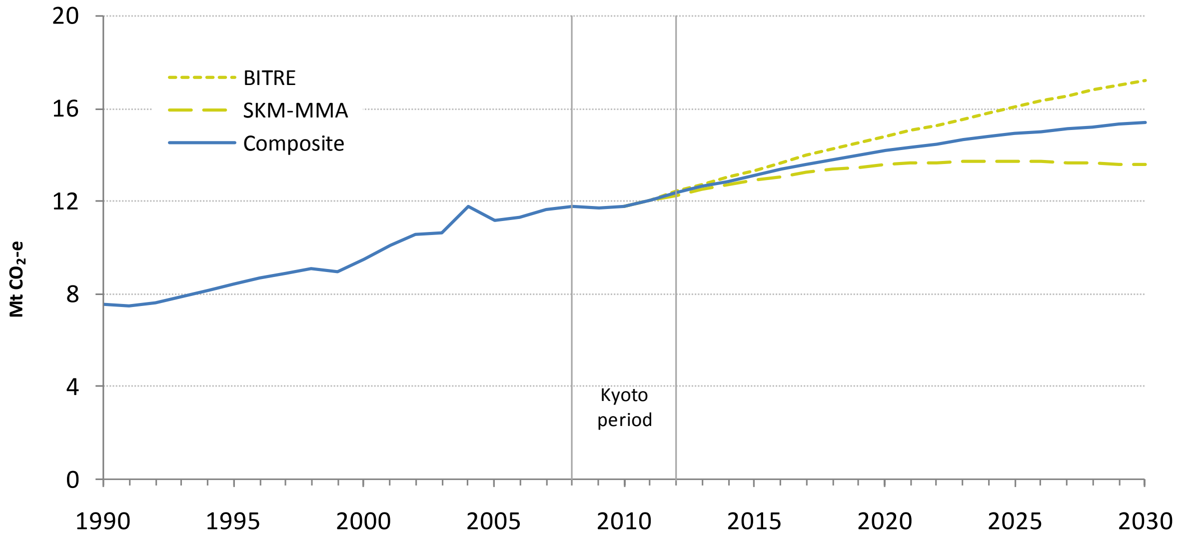
The emissions intensity of freight vehicles is projected to continue to decrease as a result of improvements in freight logistics and an increase in vehicle carrying capacity. However, due to the relatively high fuel efficiency of freight vehicles, there is less scope for improvements compared to passenger cars. The modellers also project an increased use of biofuels and natural gas. For both modellers, the projected decrease in the emissions intensity of the vehicles partially offsets growth in emissions due to increased activity.

BITRE projected higher road freight emissions than SKM-MMA. This was due to BITRE’s higher projected emissions intensity, which was counteracted somewhat by lower road freight activity. Another interesting point of difference between the modellers is that SKM-MMA project a larger uptake of natural gas in trucks after 2020 compared to BITRE.

Light commercial vehicles

Light commercial vehicles (LCVs) are vehicles weighing less than 3.5 tonnes Gross Vehicle Mass. They include vehicles like panel vans and utilities. LCVs account for 16 per cent of road emissions in 2009 (12 Mt CO_2-e). Emissions from LCVs are projected to average 12 Mt CO_2-e per year over the Kyoto period and grow by an average 1.8 per cent per year to reach 14 Mt CO_2-e by 2020.

Figure 12 Light commercial vehicle emissions, 1990 to 2030

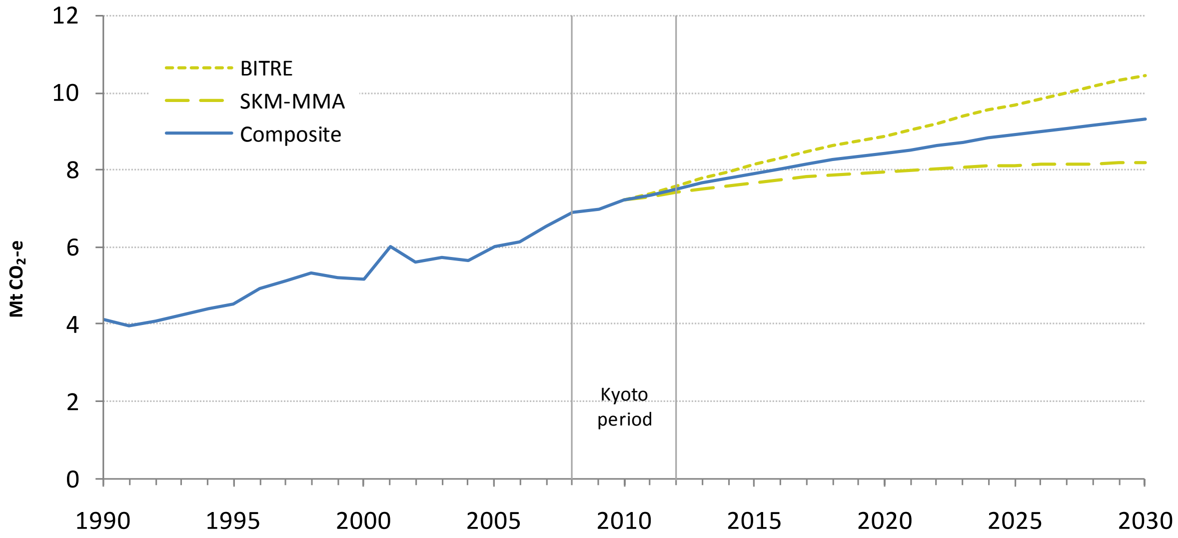


Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

Rigid trucks

Emissions from rigid trucks accounted for 10 per cent of road emissions in 2009 (7 Mt CO_2-e). Rigid truck emissions are projected to average 7 Mt CO_2-e per year over the Kyoto period and grow by an average 1.7 per cent per year between 2009 and 2020 to reach 8 Mt CO_2-e by 2020.

Figure 13 Rigid truck emissions, 1990 to 2030

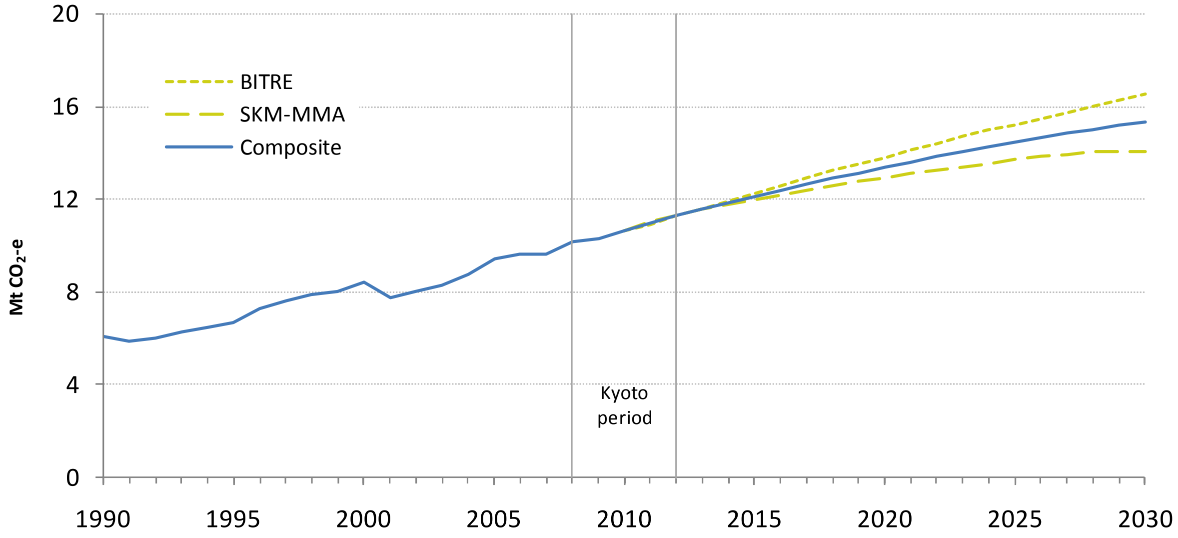


Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

Articulated trucks

Emissions from articulated trucks accounted 14 per cent of road emissions in 2009 (10 Mt CO_2-e). Articulated truck emissions are projected to average 11 Mt CO_2-e per year over the Kyoto period and grow by an average 2.4 per cent per year between 2009 and 2020 to reach 13 Mt CO_2-e by 2020.

Figure 14 Articulated truck emissions, 1990 to 2030

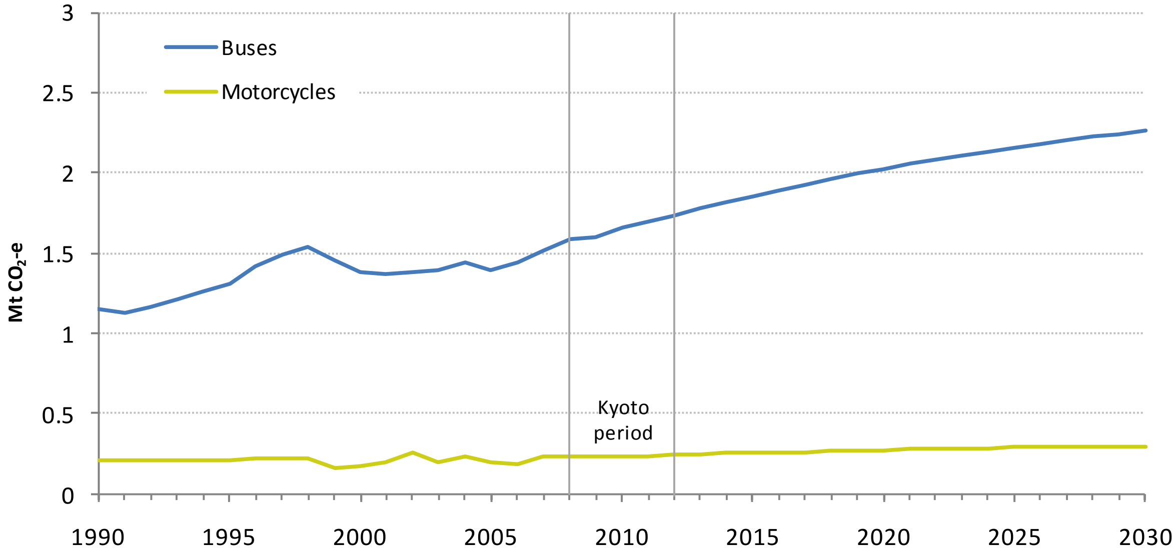


Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

Motorcycles, buses and off road recreational vehicles

Emissions from motorcycles, buses and off road vehicles grow over the projection period from a small base. Only 2 per cent of transport emissions were attributable to these subsectors in 2009.

Figure 15 Buses and motorcycle emissions, 1990 to 2030



Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

Domestic aviation

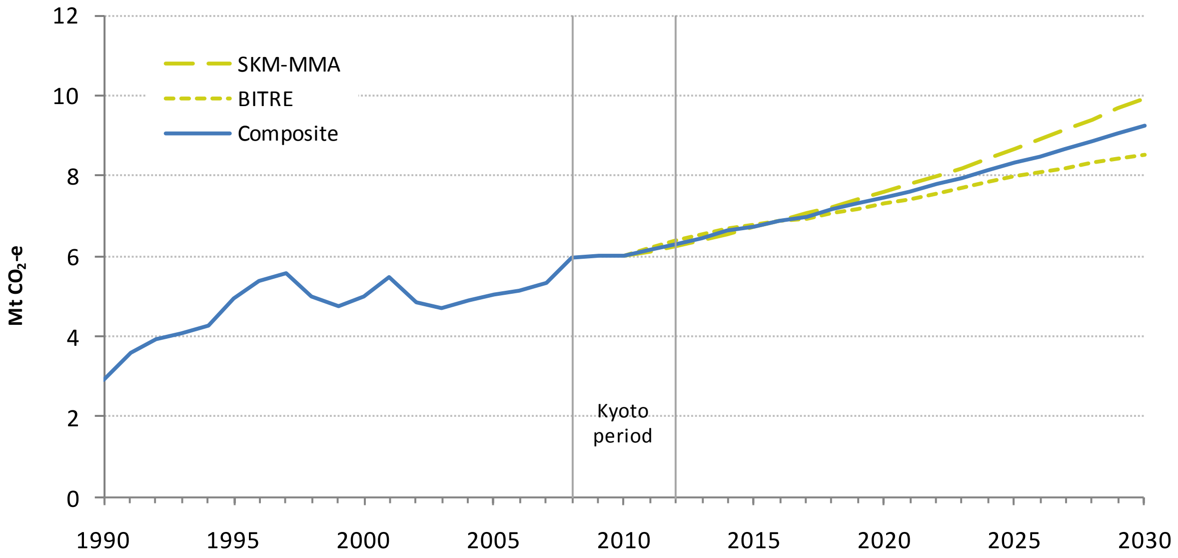
The domestic aviation subsector contributed 7 per cent of transport emissions in 2009. Emissions from domestic aviation are projected to average 6 Mt CO_2-e per year over the Kyoto period, 109 per cent higher than 1990. Emissions from this subsector are projected to reach 7 Mt CO_2-e in 2020.

From 1990 to 2009 domestic aviation was the fastest growing subsector in the transport sector. During this period, emissions from domestic aviation grew on average 4 per cent per year, compared to the road emissions which grew on average 1.5 per cent per year. This strong growth was essentially due to increasing average income levels and the attractiveness of shorter trip times for air travel.

Emissions from domestic aviation fell between 2001 and 2003 due mostly to depressed demand from Australian and tourist passengers following the collapse of Ansett and a reduction in international tourism following fears of terrorism. However, recent trends have displayed strong growth in domestic passenger numbers and this is expected to continue throughout the projections period.

Air travel is projected to continue to grow faster than other modes of passenger travel due to the time advantage of air travel over car travel. The mode share for non-urban travel by cars decreases over the projection period as aviation displaces it. As a result, emissions from domestic aviation are projected to continue to rise steadily out to 2030, at an average rate of 2.1 per cent per year.

Figure 16 Domestic aviation emissions, 1990 to 2030



Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

SKM-MMA projected slightly higher emissions in domestic aviation to BITRE. This was due to higher projected activity, partly counteracted by slightly higher efficiency improvements. This was the only subsector in which SKM-MMA projected higher emissions.

Domestic shipping

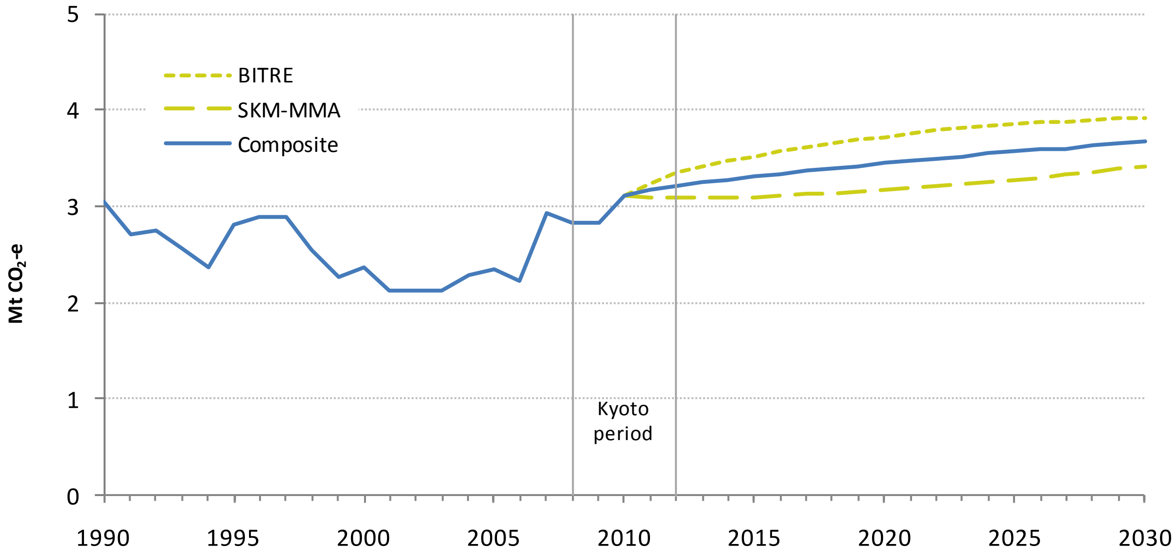
Emissions from domestic shipping made up 3 per cent of transport emissions in 2009. Emissions from this subsector are projected to be 3 Mt CO_2-e per year in the Kyoto period (1 per cent below 1990 levels) and 3.4 Mt CO_2-e by 2020 (46 per cent above 2000 levels).

Though over a third of the emissions in this subsector are from small pleasure craft, the largest source of emissions in this subsector is shipping. The most dominant source of emissions is the long-distance carriage of bulk goods on coastal ships, and consequently domestic shipping emissions projections primarily rely on projections of bulk commodity movements.

Domestic shipping emissions decreased between 1990 and 2004. This was mostly due to strong improvements in the energy efficiency of shipping freight emanating from some replacement of the existing aging fleet, improved operational practices and continued rationalisation of services. Emissions grew between 2005 and 2020 due to the growing domestic shipping task.

Emissions from domestic shipping are projected to continue to increase throughout the projection period at an average 1.1 per cent per year between 2010 and 2020 and 0.6 per cent per year between 2020 and 2030. This growth is driven by steady growth in the domestic shipping task.

Figure 17 Domestic shipping emissions, 1990 to 2030



Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

BITRE projected higher domestic shipping emissions compared to SKM-MMA, despite projecting lower freight activity levels. This can be attributed to BITRE's lower projected fuel efficiency.

Rail

Rail emissions included within the transport sector include only those emissions arising from non-electric rail, which is mostly comprised of hire and reward freight, and ancillary freight activities, with a small contribution from passenger rail. Emissions associated with electricity generated to power electric rail are accounted for within the stationary energy sector.

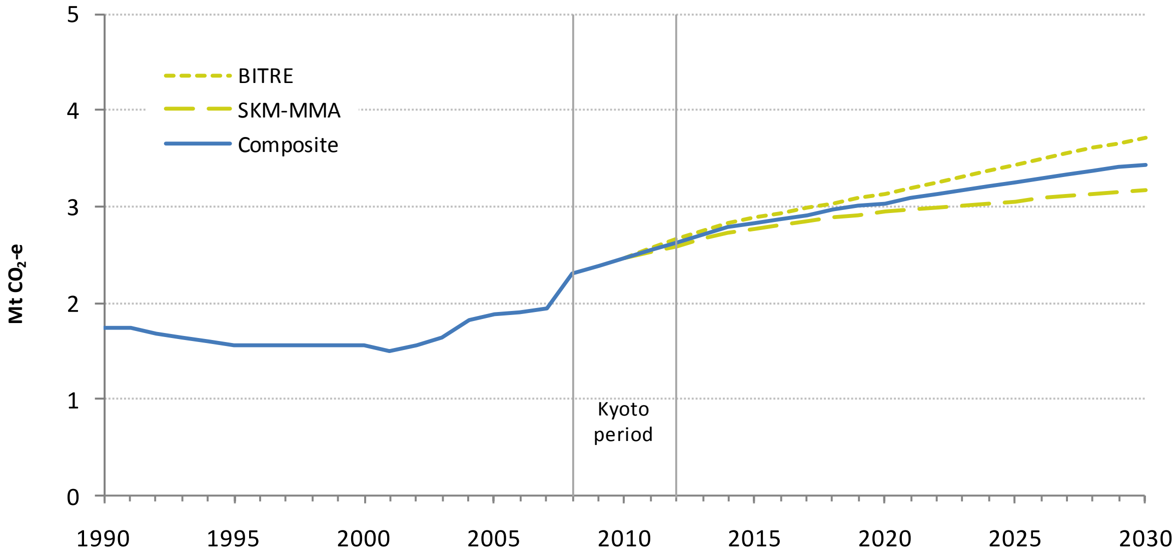
Freight rail use dominates emissions in this subsector and in 2009 accounted for 92 per cent of non-electric rail emissions, since the bulk of energy used in passenger rail is electricity.

Until 2003, rail emissions had been trending down due to improvements in the energy efficiency of rail freight systems through investment in rolling stock, track infrastructure and enhanced operational practices. Since 2003, bulk freight rail emissions have grown strongly on the back of strong demand for bulk Australian commodities by overseas trading partners.

At 2.4 Mt CO_2-e, emissions from non-electric rail made up 3 per cent of transport emissions in 2009. Rail emissions are projected to average 2.5 Mt CO_2-e per year over the Kyoto period. Between 2010 and 2020 growth in rail emissions is projected to average 2.1 per cent per year to reach 3.0 Mt CO_2-e in 2020. This is lower than the average growth of 4.8 per cent per year observed between 2000 and 2010. The growth in rail emissions is projected to further decrease to 1.3 per cent per year between 2020 and 2030.

A continuing increase in projected demand for railway services (especially in the movement of bulk raw materials for export markets) is the main driver of increasing rail emissions over the projection period. The combination of improved infrastructure, high petrol prices and increased traffic congestion also lead to relatively strong patronage on public transport. BITRE projected higher rail emissions than SKM-MMA, despite projecting lower activity levels. This can be attributed to BITRE's lower projected fuel efficiency.

Figure 18 Rail emissions, 1990 to 2030



Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

Sensitivity analysis

Uncertainty surrounds the future values of key parameters such as future populations, economic growth and the fuel efficiency of vehicles. Emissions scenarios have been modelled to help inform the uncertainty bounds around the projections.

The sensitivity scenarios are a result of running the BITRE and SKM-MMA models with the deviations to key parameters as shown in Table 6.

Table 6 Parameter deviations for sensitivity analysis

Parameter	Deviation
Oil price	Derived from a variety of scenarios (for short to longer term projections of crude oil prices) released by ABARE (2010), the IEA (2009) and the US Energy Information Administration (EIA 2009, 2010)—such as published in their Annual Energy Outlook.
Annual population growth rate	+/- 0.1 percentage points
Annual economic growth rate	+/- 0.5 percentage points
Fuel intensity	fuel efficiency of new cars - +/- 15 per cent in 2030 fuel intensity of trucks - +/- 0.1 percentage points per year fuel intensity of aviation - +/- 10 percentage points
Congestion parameter	+/- 50 per cent

High and low emissions scenarios which combine these variations were also modelled. The results for each of the parameter variations and for the high and low scenarios are analysed below.

The sensitivity analysis demonstrates the significant uncertainty surrounding emissions projections, particularly out to 2030, due to uncertainty surrounding oil prices and the future fuel intensity of transport. The results of this analysis are shown in Table 7.

Table 7 Sensitivity scenarios, 2020 and 2030

	2020		2030	
	Mt CO_2-e	Change on baseline (%)	Mt CO_2-e	Change on baseline (%)
High oil price	-2	-3	-5	-4
Low oil price	2	2	5	4
Low population	0.0	0.0	-0.7	-0.6
High population	0.9	1.0	1.4	1.3
Low economic growth	-2	-2	-5	-4
High economic growth	2	2	3	3
Low fuel intensity	-1.3	-1.3	-5	-5
High fuel intensity	1.1	1.1	3	3
Low congestion	-1.4	-1.5	-2	-2
High congestion	2	3	3	3
High combination	7	8	15	14
Low combination	-7	-7	-15	-14

Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

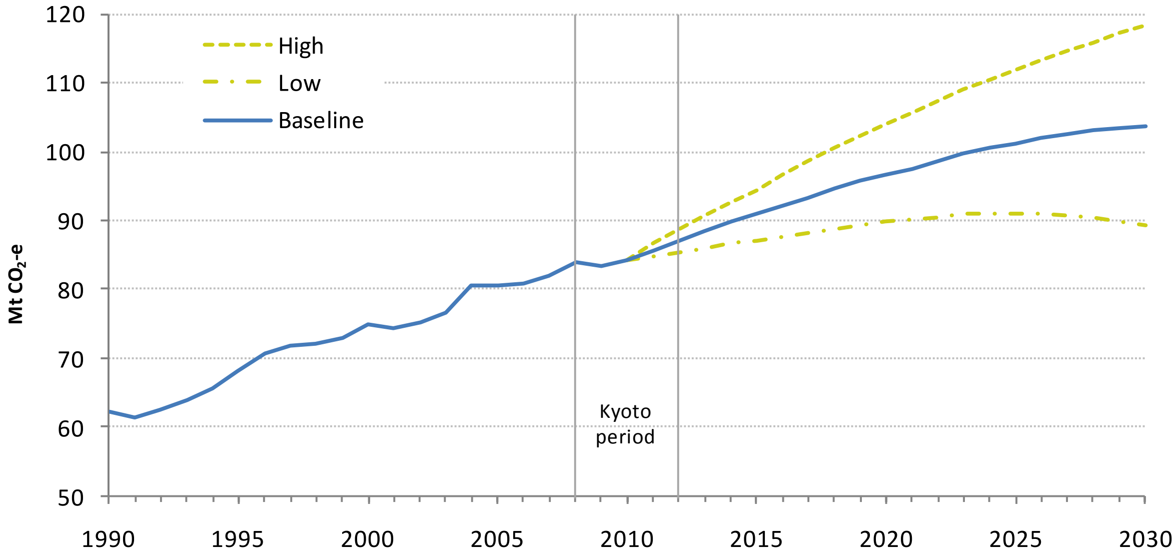
High and low scenarios

High and low combination baseline scenarios have been modelled to provide an indication of the uncertainty underlying the transport emission projections.

The high emissions scenario is the result of running the BITRE and SKM-MMA models using the combination of deviations in key parameters that yield the highest likely level of aggregate emissions (i.e. low future oil prices, high population growth, high economic growth, a lower rate of fuel intensity improvements, and high congestion on average fuel economy). Under the high scenario, emissions are projected to average around 0.6 per cent higher than the baseline in the Kyoto period. In 2020, emissions under the high scenario are projected to be 104 Mt CO_2-e, or 8 per cent higher than the baseline. By 2030, emissions under the high scenario are projected to be 118 Mt CO_2-e, or 14 per cent higher than the baseline scenario.

The low emissions scenario is the result of using the combination of deviations in the same key parameters that yields the lowest likely level of aggregate transport emissions (i.e. high oil prices, low population growth, low economic growth, a higher rate of fuel intensity improvements, and low congestion effects on fuel consumption rates). Emissions under the low scenario are projected to average around 0.6 per cent lower than the baseline in the Kyoto period. In 2020, emissions are projected to be 90 Mt CO_2-e, or 7 per cent lower than the baseline. By 2030, emissions are projected to be 89 Mt CO_2-e, or 14 per cent lower than the baseline.

Figure 19 High and low transport sensitivities



Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

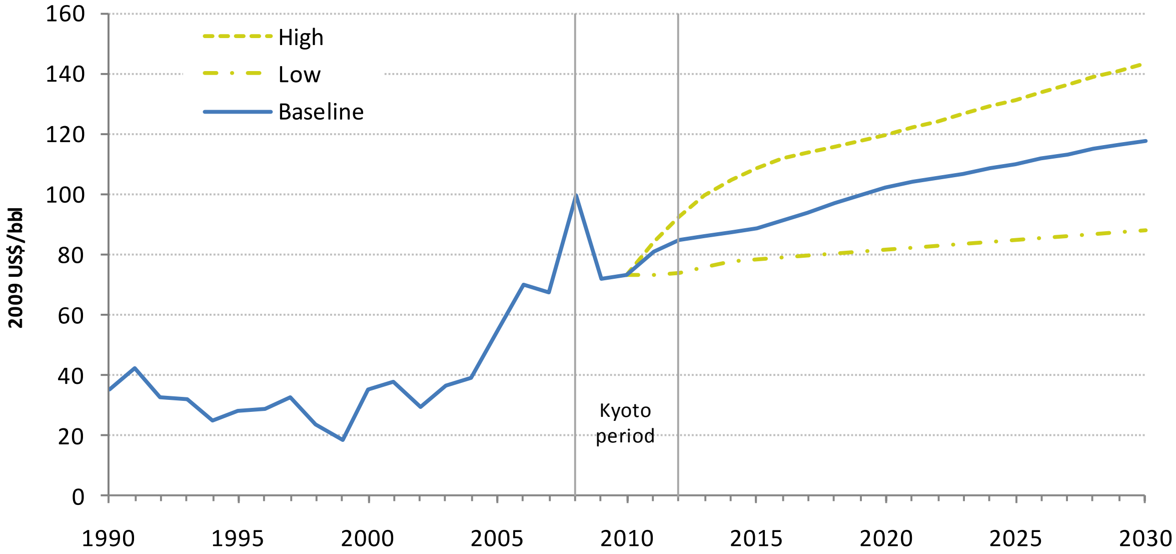
Oil price

The oil price forecasts included in the projections are from the 2009 International Energy Agency (IEA) World Energy Outlook. These project West Texas Intermediate (WTI) oil prices to continue to grow strongly, at an average annual rate of 3.2 per cent in real terms from $72 per barrel in 2009 to $102 per barrel in 2020. This growth is more modest than the dramatic growth of on average 11 per cent per year observed between 2000 and 2009. The rate of growth is expected to be lower between 2020 and 2030, on average 1.4 per cent per year to reach $118 per barrel in 2030.

Most transport modes are relatively inelastic to oil price in the short term, as transport operators and motorists have limited ability to change their transport activity in response to oil prices. However, over the longer term, high oil prices provide additional incentive for transport operators and motorists to switch to more fuel efficient vehicles. Recently, high oil prices are believed to have been a contributing factor to both lower car travel and a shift to smaller, more efficient vehicles.

To provide an indication of the sensitivity of the transport emissions projections to oil prices, high and low oil price scenarios have been modelled. In the low scenario, oil price growth rates decrease to 1.1 per cent per year on average between 2009 and 2020, to only reach $82 per barrel in 2020 and 0.7 per cent per year between 2020 and 2030, to reach $88 per barrel in 2030. In the high scenario, oil prices grow strongly at 4.8 per cent on average between 2009 and 2020 to reach $120 per barrel in 2020 and 1.8 per cent between 2020 and 2030 to reach $144 per barrel in 2030.

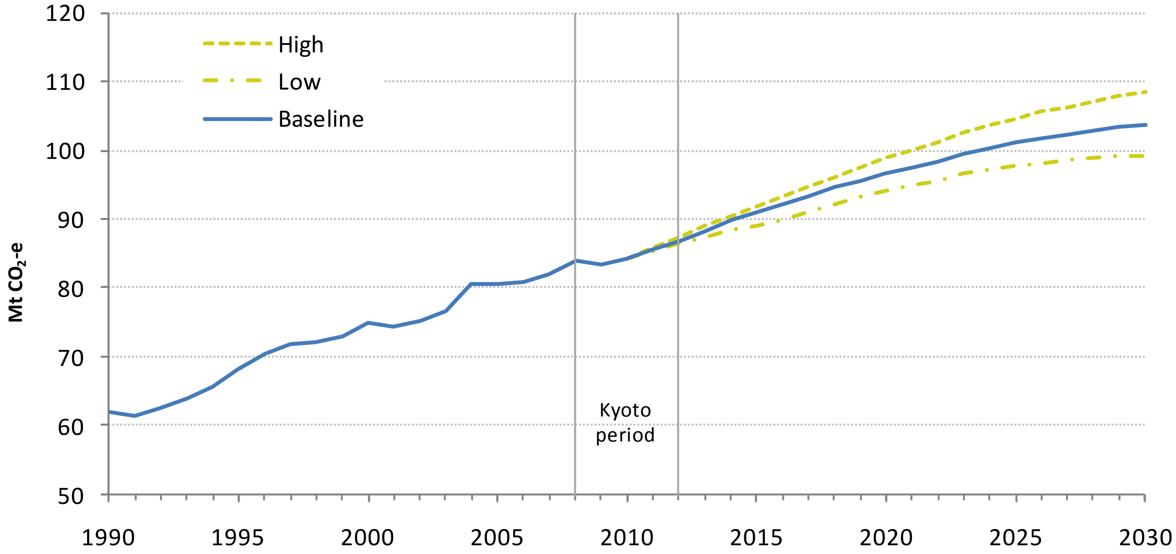
Figure 20 Oil prices for sensitivity scenarios



Source: BITRE (2010), IEA (2009), DCCEE analysis.

Under the high oil price scenario, emissions are projected to be 2.5 per cent lower in 2020 (2.5 Mt CO_2-e) and 4.5 per cent lower in 2030 (4.7 Mt CO_2-e). High oil prices were found to decrease emissions from the road and aviation sectors by approximately 3 and 2 per cent in 2020 respectively. In contract, emissions from the rail sector increased by 4 per cent in 2020 due to a shift to rail. Domestic shipping emissions were only minimally influenced by high oil prices.

Figure 21 Oil price sensitivities



Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

Similarly, under the low oil price scenario, emissions are projected to be 2.3 per cent higher in 2020 (2.3 Mt CO_2-e) and 4.5 per cent lower in 2030 (4.6 Mt CO_2-e). Low oil prices were found to increase emissions from the road and aviation sectors by approximately 2 and 3 per cent in 2020 respectively. Emissions from the rail sector also increased by

1 per cent in 2020 and domestic shipping emissions were only minimally influenced by low oil prices.

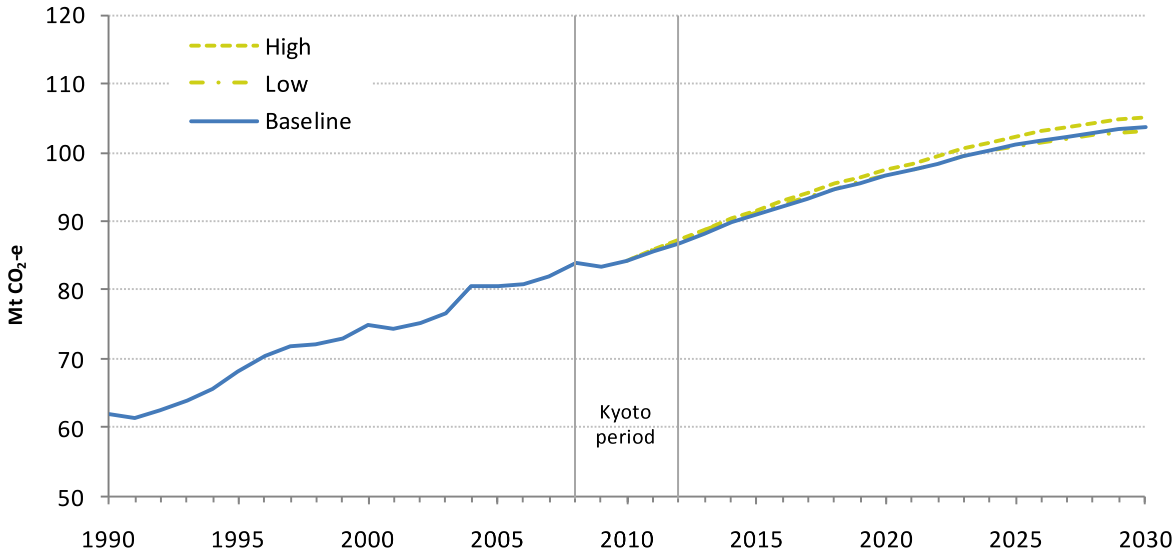
The estimated impacts include only the direct effects of oil prices on transport emissions. This analysis does not include any effects of higher oil prices on underlying economic structure or activity.

An additional issue is the potential timing of when world demand for oil may outstrip productive capacity. Though there are still large global oil reserves, energy forecasters tend to disagree strongly about the timing of such a roll-over or production peak; some predicting the short-term, others predicting it is well in the future. The projections are based on the assumption that oil production peak will occur after the projections period, which is consistent with the balance of current evidence. Should oil production peak before 2030, the results of the transport emissions projections could be significantly different.

Population growth

Population is a direct determinant of passenger travel demand. The population forecasts used in the projections were consistent with the *Pre-Election Economic and Fiscal Outlook (PEFO) 2010* and *Intergenerational Report (IGR) 2010*. To provide an indication of the sensitivity of transport emissions to population growth high and low scenarios were modelled.

Figure 22 Population sensitivities



Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

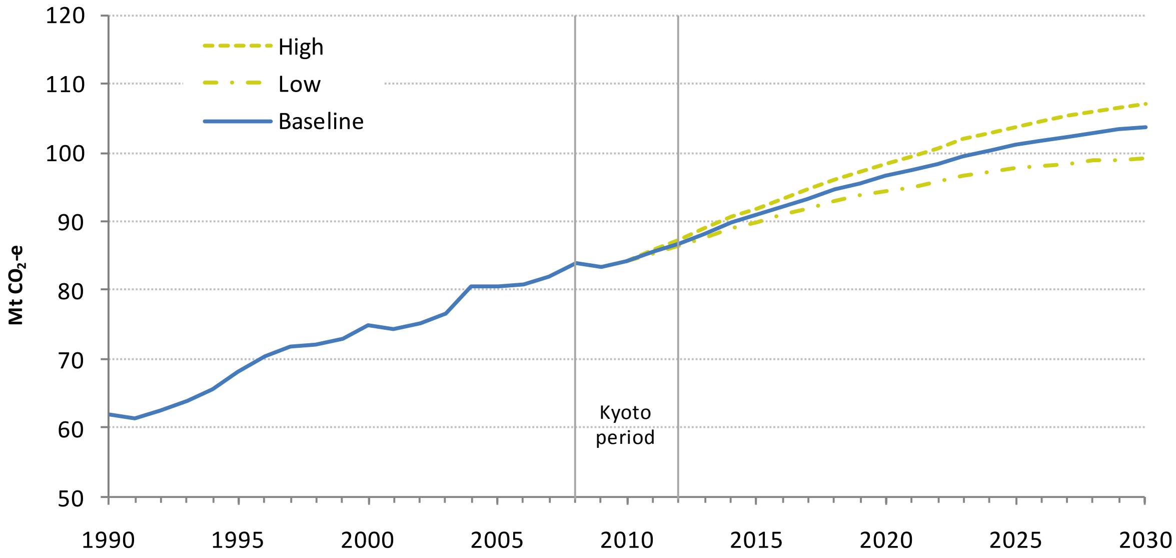
Under the high scenario, annual population growth was 0.1 percentage points higher than the baseline. This is equivalent to an additional 256,000 people in 2020 (1 per cent) and 582,000 people in 2030 (2 per cent). Under the low scenario, annual population growth was 0.1 percentage points lower than the baseline. This is equivalent to 253,000 people in 2020 (1 per cent) and 582,000 people in 2030 (2 per cent).

These deviations in population were found to have a small impact on transport emissions (around 1 per cent in 2020). This is due to both the small magnitude of the deviations, which reflect the lower uncertainty associated with population relative to the other parameters and the fact that population is not a key driver of a significant portion of freight movement in Australia. Also, the side effect of increasing population while keeping GDP constant, is that the per capita income levels decreased, which slightly decreased per capita travel.

Economic growth

Economic growth is a determinant of demand for freight transportation and passenger travel due to the impact of economic growth on income levels per capita. The economic growth (GDP) forecasts used in the projections were consistent with the 2010 Intergenerational Report. To provide an indication of the sensitivity of transport emissions to economic growth high and low scenarios were modelled.

Figure 23 Economic growth sensitivities



Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

Under the high scenario, annual economic growth was 0.5 percentage points higher than the baseline. This is equivalent to GDP being $82 billion (2008 dollars) higher in 2020 (5 per cent) than the baseline and $219 billion higher in 2030 (10 per cent). This increase in GDP resulted in an increase in transport emissions of 1.9 per cent in 2020. Different sub sectors were found to respond at different rates to an increase in GDP. Rail activity and hence rail emissions was found to be the most responsive (7.4 per cent higher in 2020). This was followed by domestic aviation (3.8 per cent higher), domestic shipping (2.6 per cent higher) and road transportation (1.5 per cent higher).

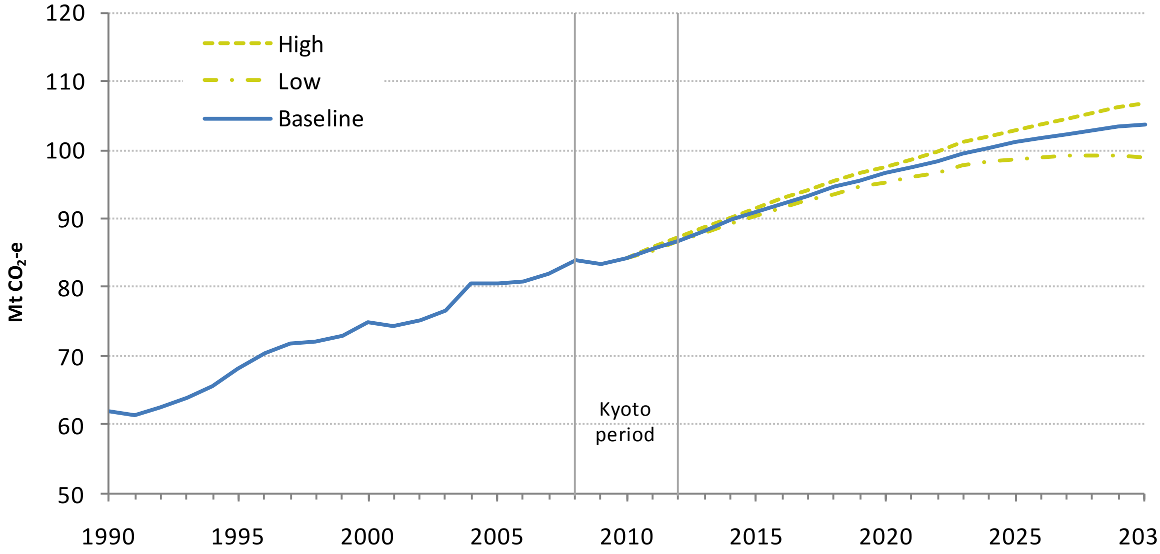
Under the low scenario, annual economic growth was 0.5 percentage points lower than the baseline. This is equivalent to GDP being $79 billion (2008 dollars) lower in 2020 (4.7 per cent) than the baseline and $200 billion lower in 2030 (9.3 per cent). Emissions are projected to be 1.3 per cent lower in 2020 (2.2 Mt CO_2-e). A decrease in GDP was found to reduce domestic aviation by 3.7 per cent in 2020 due to the decrease in per capita income, domestic shipping was found to decrease by 2.5 per cent, road decreased by 2.2 per cent and rail decreased by only 0.7 per cent.

Fuel intensity

The future fuel intensity of vehicles and in particular passenger cars is a key point of uncertainty for the projections. The fuel efficiency of cars is determined by both the size and technology. New car choice is determined by consumer preference and as a result is difficult to predict.

The sensitivity of the emission projections to differing fuel intensities of car, trucks and domestic aviation was tested. Emissions were found to decrease by 1.3 per cent in 2020 due to the low fuel intensity parameters and increase by 1.1 per cent due to the high fuel intensity parameters.

Figure 24 Fuel intensity sensitivities

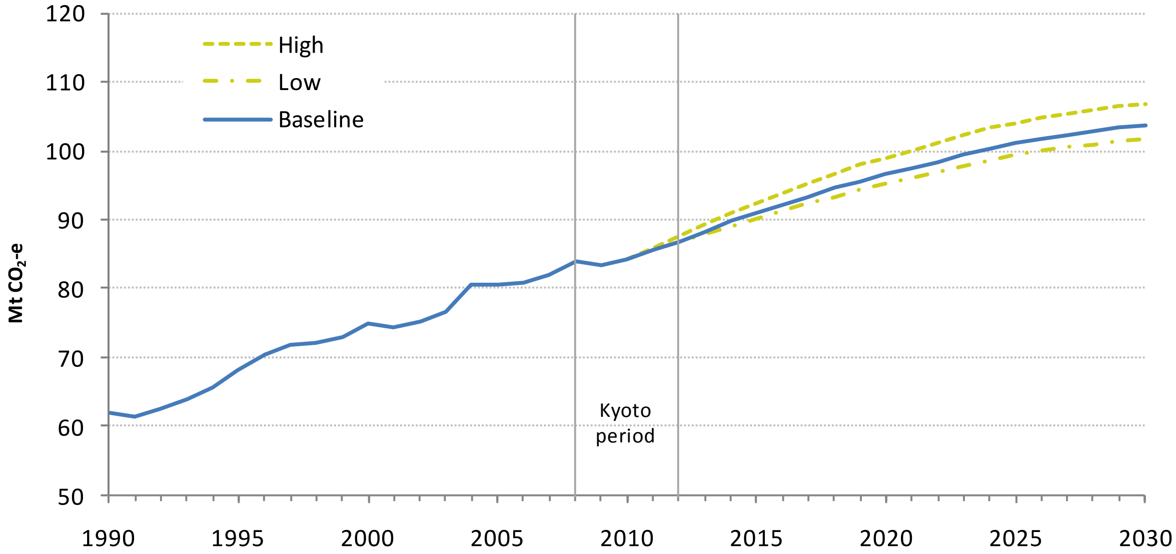


Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

Congestion

Congestion influences both the emissions intensity of vehicles on the road and the competiveness of road transport compared to other modes. The two modelling groups used their own forecasts of future congestion. SKM-MMA incorporated the effect of congestion on the emissions intensity of car travel, while BITRE also incorporate it into mode selection (for example, public transport). Higher congestion was found to have a more significant impact on transport sector emissions than lower congestion. High congestion’s effects on fuel consumption rates increased emissions by 2.6 per cent in 2020, while low congestion effects only decreased emissions by 1.5 per cent.

Figure 25 Congestion sensitivities



Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

Appendix A – Measures

Table 8 Greenhouse gas abatement from transport measures

Name	Kyoto period average ($Mt CO_2$-e)	2020 ($Mt CO_2$-e)
Energy Efficiency Opportunities	0.3	0.5
Greenhouse Gas Abatement Program	0.5	0.4
NSW Biofuel Act	0.1	0.3
Alternative Fuels Conversion Program	<0.1	<0.1
Total	**0.8**	**1.3**

Note: Totals may not add due to rounding. Source: BITRE (2010), SKM-MMA (2010), DCCEE analysis.

Energy Efficiency Opportunities

The Energy Efficiency Opportunities program encourages large energy-using businesses to improve their energy efficiency. It does this by requiring businesses to identify, evaluate and report publicly on cost effective energy savings opportunities.

Greenhouse Gas Abatement Program

GGAP was a competitive grants program established in 2001 and designed to reduce net emissions by supporting activities likely to result in substantial emissions reductions or offset emissions. Grants were issued to two projects that reduce emissions in the transport sector:

- WA TravelSmart
- National Travel Behaviour Change Project (NTBCP)

No further grants are being offered.

NSW Biofuels Act

The original Act came into effect in 2007. The purpose of this Act was to provide for a minimum ethanol content requirement of 2 per cent in respect of the total volume of petrol sales in the State, at the primary wholesale level.

The Act was amended in 2009 to increase the volumetric ethanol mandate to 4 per cent from 1 January 2010 and 6 per cent from 1 January 2011. It also requires all regular grade unleaded petrol to be E10 from 1 July 2011. The amended Act establishes a volumetric biodiesel mandate of 2 per cent (this requirement has been suspended until 1 January 2010) and increases the biodiesel mandate to 5 per cent from 1 January 2012.

Alternative Fuels Conversion Program

The Alternative Fuels Conversion Program (AFCP) commenced in January 2000 and concluded on 30 June 2008. The AFCP was established to provide assistance to heavy vehicle operators to convert from diesel to alternative fuels that had the potential for reducing greenhouse gas emissions. The two fuels initially included in the AFCP were liquefied petroleum gas (LPG) and compressed natural gas (CNG) as these were considered to be the most promising for commercial use.

Following a review of the program in 2002, the emphasis of the program was changed slightly and the AFCP became solely directed at supporting key commercial fleet operators to trial selected alternatively-fuelled or hybrid diesel/electric engines in order to assess the commercial viability and environmental performance of these engine systems in heavy vehicles and to demonstrate their feasibility to the wider transport industry.

Over 60 projects were funded through the program, covering both bus and truck fleets. The fuels/technologies included Compressed Natural Gas (CNG), Liquefied Natural Gas (LNG), Liquefied Petroleum Gas (LPG), hydrogen fuel cell and hybrid diesel/electric.

Emission Standards for Cars

The Commonwealth Government has proposed a mandatory carbon dioxide emission standard for all new light vehicles, including cars, from 2015. This measure was not incorporated in the baseline as the level of the standard is still subject to consultation.

Average mandatory emission standards of 190 g/km by 2015 and 155 g/km by 2024 will be the starting point for further consultation.

The mandatory standard will set a national fleet-wide target of average carbon dioxide emissions and each individual motor vehicle company will have to contribute to this target.

All new four-wheeled light vehicles with a gross vehicle mass of 3.5 tonnes or less– passenger cars, sports utility vehicles and light commercial vehicles sold in Australia, whether they are imported or manufactured locally– will be included in the standards.

QLD Ethanol Mandate

The Queensland Government has suspended the implementation of the proposed 5 per cent mandate on ethanol-blended fuel in Queensland.

Appendix B – Changes from 2009 projection

The 2010 transport emission projections reflect a full update of the 2009 projections released in Australia’s Fifth National Communication on Climate Change to the UNFCCC.

Over the Kyoto period, annual emissions from the transport sector are projected to average 3.3 Mt CO_2-e higher than in the 2009 projections. Projected emissions in the sector have been revised up by 1.3 Mt CO_2-e in 2020.

The majority of this upward revision is attributable to an increase in emissions in the National Greenhouse Gas Inventory (NGGI), due to the partial reallocation of diesel from the stationary energy to the transport sector in ABARE’s *Australian Energy Statistics – Australian Energy Update 2009.* This has been partially offset in 2020 due to higher fuel efficiency projections for vehicles.

Table 9 Changes from 2009 projection

	Kyoto period average 2008-12	**2020**
	Mt CO_2-e	Mt CO_2-e
Road	3.0	0.9
Passenger cars	*-0.1*	*-1.2*
Light commercial vehicles	*0.5*	*-0.3*
Heavy Duty Trucks and Buses	*2.6*	*2.4*
Motorcycles	*0.0*	*0.0*
Domestic aviation	-0.1	-0.1
Domestic shipping	0.1	0.2
Rail	0.3	0.2
Off road recreational	0.0	0.0
Total	**3.3**	**1.3**

Note: Totals may not add due to rounding. Source: BITRE (2010), SKM-MMA (2010), DCCEE (2010), DCCEE analysis.

Appendix C – Methodology

The transport projection is a composite of the projections of two different modelling groups, the Bureau of Infrastructure, Transport and Regional Economics (BITRE) and Sinclair Knight Merz McLennan Magasanik Associates (SKM-MMA).

Both consultants use a detailed bottom up modelling approach to projecting transport emissions. The models are consistent with, and are based on the methodologies used for compiling the National Greenhouse Gas Inventory (NGGI). Both modellers project transport activity and fuel levels, and then combine this with specific emission factors to arrive at a baseline projection. The baseline projection takes into account past, present or committed policies and measures that have an impact on greenhouse gas emissions in the transport sector. Results from the two modellers were given equal weight and averaged to arrive at a composite emissions projection for the transport sector.

There are differences in the BITRE and SKM-MMA models. However, some core principles are the same.

Activity

Urban and non-urban passenger travel activity was projected based on population forecasts and saturating relationships derived from the historical relationship between income and passenger travel levels. The mode share for this passengers travel was estimated by comparing the cost competitiveness, suitability (e.g time) and availability (e.g availability of public transport) of modes for both urban (cars, buses, rail and trams) and non-urban (cars, rail, aviation).

Freight transportation activity (usually tonnes-kilometre) was projected using historical relationships between freight activity levels and economic growth (gross domestic production, GDP). The mode via which freight is transported (rigid trucks, articulated trucks, light commercial vehicles, rail, aviation and shipping) was determined by the suitability (e.g timing for perishables), availability (such as accessibility to rail networks) and the cost competitiveness of the modes.

Oil prices influenced the costs of the various transport modes.

Fuel intensity

The fuel intensity of the travel modes were estimated using knowledge of fuel efficiency trends and expected technology changes.

For passenger cars a model of the car fleet was used to derive the fuel efficiency of motor vehicle travel. The fuel efficiency of new cars was estimated using the cost competitiveness of different technologies (internal combustion engines, normal hybrids, plug in hybrids, electric vehicles) and knowledge of consumer behaviour in regards to the uptake of new technologies. BITRE used technology costs consistent with CSIRO (2008) and AECOM (2009). SKM-MMA conducted a technology review, which involved an economic analysis and review of Australian and international trends in motor vehicle technologies and vehicle efficiencies. The car technologies considered in this analysis include:

- Conventional petrol internal combustion engines (ICE)
- Diesel internal combustion engines (ICE)
- LPG cars
- Petrol electric hybrids
- Diesel electric hybrids
- Plug-in hybrids
- Electric cars

Some other factors considered in the fuel efficiency of cars include:

- improvements in the fuel efficiency of all technologies over time;
- use of alternative fuels, based on the cost competiveness of production compared to conventional fuels; and
- congestion.

Emissions

The carbon dioxide, nitrous oxide and methane emissions from the fuel use were calculated using methods consistent with the NGGI.

Appendix D – Key Assumptions

Table 10 GDP and population assumptions

	2010 to 2020	2020 to 2030
GDP (average annual percentage growth)	3.0	2.6
Population (average annual percentage growth)	1.4	1.3

Source: PEFO(2010), IGR(2010)

Table 11 Oil price assumptions

	1990	2009	KPA	2020	2030
Oil price (2009$US/barrel)[1]	35	72	82	102	118

[1] West Texas Intermediate (WTI) Source: WEO(2009)

Table 12 New passenger car technology price assumptions, medium sized, $ ’000

	BITRE			SKM-MMA		
	2010	2020	2030	2010	2020	2030
Conventional internal combustion engine (ICE)	25	25	25	-	-	-
Petrol ICE	-	-	-	*25*	*25*	*25*
Diesel ICE	-	-	-	*27*	*25*	*25*
LPG	-	-	-	*26*	*26*	*26*
Optimised ICE	27	28	27	-	-	-
Normal hybrid	30	28	27	-	-	-
Petrol hybrid	-	-	-	*29*	*27*	*25*
Diesel hybrid	-	-	-	*35*	*30*	*25*
Plug-in hybrid	45	35	29	-	-	-
Electric vehicle	51	39	31	37	30	29

Source: BITRE (2010), SKM-MMA(2010)

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Appendix F – Glossary

Abatement	Refers to emissions reductions made beyond that which would have been achieved in the business as usual scenario.
Articulated trucks	Vehicles constructed primarily for the carriage of goods, consisting of a prime mover (having no significant load-carrying area) but linked, with a turntable device, to a trailer.
Baseline	Emissions given current policy settings.
Business as usual (BAU)	Emissions in the absence of Government abatement policies and measures.
Domestic aviation subsector	Comprises domestic air transport – commercial passenger and light aircraft using either aviation gasoline or jet kerosene. International air transport is not included in Australia's total emissions in line with international guidelines. Military aviation is part of the stationary energy sector.
Domestic shipping subsector	Includes domestic shipping and small craft but excludes international shipping, military navigation and fishing vessels. International shipping is not included in Australia's total emissions in line with international guidelines. Military navigation and fishing vessels are reported as part of the stationary energy sector.
GDP	Gross domestic product
High scenario	A 'high emissions' scenario applying plausible high emission assumptions to the 'baseline' scenario.
IGR	Intergeneration Report
Kyoto period average (KPA)	The Kyoto period average refers to the average of emissions over the 5 year Kyoto Protocol reporting period, 2008-2012.
Light Commercial Vehicles	Includes rigid trucks less than 3.5 tonnes, utilities, panel vans and vans without rear seats.
Low scenario	A 'low emissions' scenario applying plausible low emission assumptions to the 'baseline scenario.

Measures	Refers to past, current or committed Australian, State/Territory or local government policy actions that have an impact on greenhouse gas emissions, causing them to deviate from the BAU path after the base year of 1990.
Mt CO_2-e	Megatonnes of carbon dioxide equivalent
PEFO	Pre-Election Economic and Fiscal Outlook
Off road recreational vehicles subsector	Consists of off road recreational vehicles. Other off road vehicles, such as farm vehicles and construction equipment are accounted for in the stationary energy sector.
Railways subsector	Consists of all rail transport except for electric rail, which is included in the stationary energy sector.
Rigid trucks	Motor vehicles exceeding 3.5 tonnes, constructed with a load carrying area.
Road subsector	Includes civilian passenger vehicles, light commercial vehicles, trucks, buses and motorcycles. Military road transportation is part of the stationary energy sector.
Tonne kilometres (TKM)	The number of kilometres travelled by a vehicle (VKT) multiplied by the mass of freight (measured in tonnes) transported. TKMs = VKT x freight carried (t).
Trucks	Includes light commercial vehicles, articulated trucks and rigid trucks.
Vehicle kilometres travelled (VKT)	The number of kilometres travelled by a vehicle.