International Transport Forum

GREENHOUSE GAS REDUCTION STRATEGIES IN THE TRANSPORT SECTOR

PRELIMINARY REPORT

OECD

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Message to the International Transport Forum
from the Chair of the OECD-ITF Joint Transport Research Centre
Working Group on GHG Reduction Strategies in the Transport Sector

1. Prevention of Climate Change and Necessity for GHG Emissions Reduction

The reality of climate change has brought to the forefront the need to significantly curb GHG emissions while at the same time adapting to a changing climate.

The most recent analysis of the Intergovernmental Panel on Climate Change in its 4th Assessment Report indicates that a 50% to 80% reduction of global GHG emissions by 2050 from 2000 levels is required to avoid serious and enduring climate change.

Some countries have already agreed to reduce GHG emissions through the Kyoto Protocol and many more countries are engaged in the international discussion addressing GHG emissions for a post-Kyoto period through the UNFCCC.

However, progress to-date towards meeting the Kyoto targets has been difficult. Even if the targets are met, remarkable changes in economic activity and industrial structure will be required to cope with further reduction of GHG emissions in the long term.

2. Transport GHG Emissions and Economic Growth

Transport activity has been a key facilitator and driver of economic prosperity worldwide and it is likely to continue to grow to meet continued and growing transport needs in both developed and developing countries.

However, the transport sector is a significant contributor to GHG emissions in most countries, representing 23% (worldwide) and 30% (OECD) of CO2 emissions from fossil fuel combustion in 2005. Automobile transport is the principal CO2 emitter, but other transport modes also impact global warming – sometimes significantly as in the case of aviation and maritime transport.

Growth in transport sector GHG emissions has typically mirrored growth in economic wealth and has kept pace with or even surpassed growth of emissions from the energy sector.

Because of this, it is likely that most countries will have to include the transport sector in achieving future GHG emissions reductions.

The sector as a whole is also exceedingly affected by changes in energy resources – it is 98% dependent on fossil oil.

For all these reasons, it is likely that most countries will have to envisage a significant departure from "business as usual" policies in the transport sector to cope with climate change.

3. Reconciliation of Transport Activity and GHG Emissions Reduction

The transport sector is confronted with many other imperatives such as economic growth, safety, infrastructure provision and maintenance, competition policy and other non-climate-related environmental concerns. Climate change will surely figure more importantly in transport policy-making as well as the other imperatives above.

Clearly, most countries have and will continue to face a difficult task of meeting transport demand induced by economic activity and people's lives and reducing GHG emissions.

4. Decoupling of GHG Emissions and Economic Growth

Transport activity delivers clear societal and economic benefits. However, these benefits are not solely, nor primarily, a function of the volume of transport activity – they are a function of the manner in which the transport task is carried out. In many instances -- and for freight transport in particular -- it may be possible to deliver the same transport task with lower levels of transport activity. There are significant and as-of-yet-untapped reservoirs of energy efficiency and logistical efficiency that might allow economies to enjoy the same level of transport performance with lower overall levels of energy use or kilometres travelled.

The difficulty that many countries have faced in decoupling transport volume, energy use and GHG emissions from economic growth indicates that current approaches have not been sufficient to exploit these opportunities. There are, however, signs that some countries – notably Germany and Japan – have had some success in decoupling economic activity from transport GHG emissions.

5. GHG Abatement Cost and Co-benefits

Whatever GHG reduction measures countries do adopt in the transport sector, they should not be more expensive than available measures in other sectors unless there are clear and compelling reasons to pay more.

While marginal abatement costs in the transport sector tend to be higher than in other sectors, there remain a number of low and no cost measures that have yet to be exploited by many countries such as the improvement of vehicle components (air conditioning, tyres, lubricants) that are not covered in official fuel economy tests.

There are also higher-cost GHG abatement measures such as infrastructure development, that can nonetheless deliver substantial non-GHG related benefits, especially when they reduce congestion or improve safety required. High marginal abatement cost, per se, need not always become an obstacle to implement a measure.

Finally, considering that the bulk of emissions growth from the transport sector will come from non-ITF countries that are still in the relatively early stages of developing their transport systems and infrastructure, and that as such, many cost-effective CO2 mitigation options remain in these countries, it is essential that a concerted effort is made to exploit cost-effective transport CO2 reduction measures in the developing world. Tools such as the Clean Development Mechanism of the Kyoto protocol represent one such pathway yet, to-date, few transport projects have been approved.

6. GHG Reduction Strategies and Effective Measures

Countries may act in several key areas in order to reduce transport sector GHG emissions. A comprehensive transport-sector GHG reduction strategy should at least address the following four areas:

i) Transport demand: measures targeting land use, improvement of load factors and changes in patterns and scale of transport demand, where appropriate;

ii) Mode share: measures facilitating less GHG intensive modes such as public transport and non-motorised transport, where appropriate;

iii) Fuel choice: measures aiding the development and dissemination of technologies for alternative fuels and new energy; and

iv) Fuel efficiency: development and dissemination of technologies for vehicles (including test cycle measures for vehicle components and accessories) and traffic management, traffic congestion abatement measures, eco-driving.

Where to put emphasis and which mix of specific measures to select will ultimately depend on each country's circumstances. In Japan, for instance, transport CO2 emissions have been decreasing since 2001 despite sustained economic growth over the same period. Our analysis reveals that the increase in fuel efficiency of new cars and trucks, along with increased load factors for truck haulage (caused primarily by a switch from own-carriage to for-hire carriage) and reduced congestion have been the principal causes of this decrease in emissions. Other countries will likely face different circumstances and might have a similar measure of success with completely different measures.

Besides the measures above, there is a clear need for better tracking and monitoring of transport GHG reduction performance across modes and across countries. Not only is this important so that countries that wish to adopt transport GHG reduction measures can monitor their performance, but also so that impacts and costs of measures may better be assessed. Ex-post assessments of transport GHG policies are still lacking in many ITF countries.

In addition to the above-mentioned strategies for road transport, the international community must address international aviation and maritime transport as well.

7. The OECD-ITF JTRC Working Group on GHG Reduction Strategies in the Transport Sector

As called for in its current programme of work, the Joint Transport Research Centre has convened an international working group to assess strategies to reduce GHG emissions from transport activity. This working group is currently in the process of researching and drafting its report which will update past ECMT work on Transport CO2 emission reduction strategies (e.g. "Cutting Transport CO2 Emissions – What Progress", 2006). However, in light of the ITF Leipzig meeting, the working group is releasing in this document several draft chapters from its work in progress along with comprehensive country tables on transport-related GHG data as a resource for Ministers and Forum attendees. These will form part of the final report that will be published in the Spring of 2009.

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Preliminary Report from the OECD and International Transport Forum Working Group on

"GREENHOUSE GAS REDUCTION STRATEGIES IN TRANSPORT SECTOR"

1. LINKING TRANSPORT GHG EMISSIONS TO CLIMATE CHANGE: THE IMPACT PATHWAY

The United Nations Intergovernmental Panel on Climate Change has identified anthropogenic emissions of greenhouse gases (GHG) as the primary driver behind significant and potentially critical changes in global climate (see box). These emissions concern six gases[1] of which three play a predominant role given their volume of emissions (carbon dioxide) and/or elevated warming potential (methane and nitrous oxide). The emission of these gases leads to a chain of events that likely impact global average temperatures, weather patterns and, ultimately, human societies. This chapter describes that impact chain with a particular focus on the relative importance of transport sector emissions.

IPCC 4th Assessment Report: Climate Change

Released in the fall of 2007, the United Nations Intergovernmental Panel on Climate Change 4th Assessment Report assesses the current state of scientific understanding regarding climate change. In its three volumes, the report reviews the physical science basis, discusses impacts as well as issues regarding adaptation and vulnerability and assesses global mitigation options. These volumes are summarised in a Synthesis report for policy-makers. The 4th Assessment Report takes a clear position on the source of recent observed changes in atmospheric temperatures:

> *"Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and rising global average sea level … most of the observed increase in global average temperatures since the mid-20th century is very likely (>90% likelihood) due to the observed increase in anthropogenic greenhouse gas concentrations" (IPCC, WG I TAR, 2007)*

Figure 1-1 illustrates the pathway that links emissions of greenhouse gases to changes in climate and impacts on human activities and ecosystems:

1. Human activities give rise to a sustained pulse of emissions into the atmosphere (Section 2.1).

2. Not all of these emissions remain in the atmosphere – ultimate atmospheric concentrations of GHGs depend on the action of sinks in removing gases as well as reactions amongst gases in the atmosphere. (Section 2.2).

3. At different time scales, these emissions have different relative warming or cooling impacts (e.g. radiative forcing) upon the atmosphere according to the nature of the compound emitted and its

[1] The six greenhouse gases tracked under the Kyoto protocol are: Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), Perfluocarbons (PFCs), Hydrofluorocarbons (HFCs) and Sulphur hexafluoride (SF_6). Other greenhouse gases include ozone-depleting substances as well as several other compounds that lead to changes in atmospheric temperatures (see section 2.3)

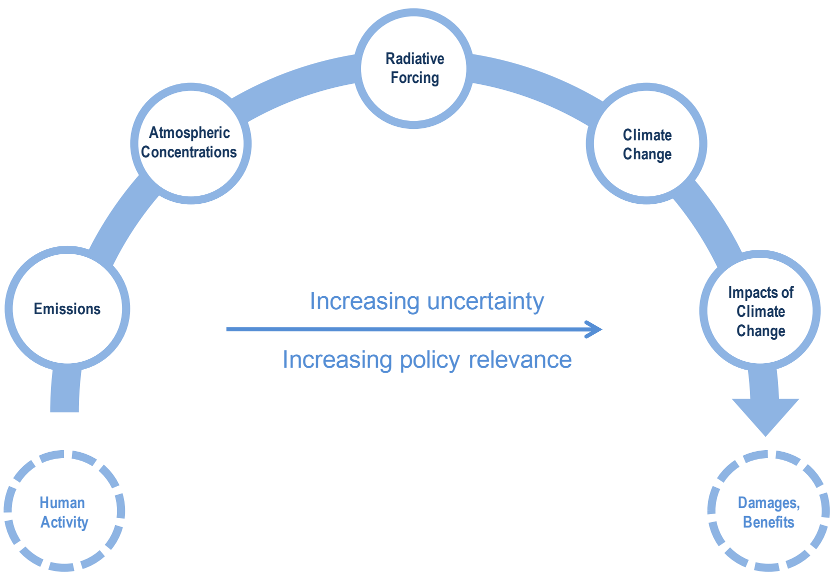
chemical and physical interactions within the atmosphere. For some compounds, the location of emissions also is significant (Section 2.3).

4. Changes in global average atmospheric temperatures lead to changes in the amount and pattern of precipitation, changes in wind patterns and strength, changes in soil moisture, changes in the frequency and strength of extreme weather and changes in sea level (Section 2.4).

5. These changes in turn affect terrestrial systems as well as human settlements and energy needs. Impacts range from changes in yields and spatial distribution of ecosystems and agricultural and forest systems, losses of key ecosystems, changes in water resources, changes in energy needs for heating and cooling, etc. (Section 2.4)

Crucially from the perspective of policy-making, this impact chain is characterized by increasing scientific uncertainty (related to the complex nature of global climate interactions) even as policy relevance increases (e.g. towards a specific estimate of monetised damages that could help to guide policy action). Despite improvements in the scientific understanding of the impact pathway, climate policy-making will likely continue to be characterised by the need to balance significant yet uncertain risks with immediate and consequent actions.

Figure 1-1: Anthropogenic Climate Change Impact Pathway



Source : adapted from Fuglestvedt et al., 2005

1.1. Greenhouse Gas Emissions

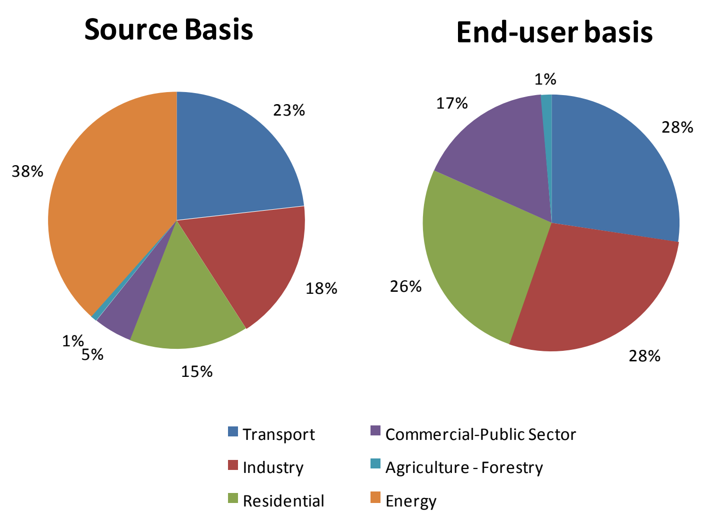
1.1.1. Measuring Greenhouse Gas Emissions

There are two principal sources of data on global GHG emissions: the first is the Netherlands Environmental Assessment Agency's (MNP) EDGAR 3.2 database, expanded to version 4.0 with the EU Joint Research Centre. This dataset underlies several global estimates of GHG trends including the ones made by the IPCC in the 4th Assessment Report and the International Energy Agency (IEA). The second is the on-line Climate Analysis Information Tool (CAIT) of the World Resources Institute. While this data is less recent, it has also been used by several important studies investigating climate change, not the least of which was the Stern Report. Data on the share of transport (including international aviation and maritime) with respect to overall GHG emissions is roughly similar in both datasets (MNP: 13.1% in 2004, CAIT v.3: 14% in 2000 –used by Stern – CAIT v.5: 13.5% in 2000). Unless otherwise noted, this study will use MNP-JRC data when discussing *overall GHG* emissions and trends.

There are significant inherent difficulties in precisely estimating the total amount of greenhouse gas emissions resulting from human activities. This is because at the scale of the planet, there are large uncertainties regarding the links between certain human activities (agriculture, husbandry, forestry biomass combustion and land use change) and emissions. This uncertainty is especially high for CH_4 and N_2O (the margin of error for these gases is estimated to be on the order of 30-50%). While estimates of CO_2 emissions are considered to be more precise, this is not necessarily the case across all sources of CO_2 – e.g. estimates of CO_2 from agriculture and land-use changes have even higher margins of error than CH_4 and N_2O. Given the uncertainty in overall GHG emissions, estimates of these – and estimates of sectoral shares of these in particular -- should be treated with caution.

Below we describe past trends in *overall anthropogenic GHGs* and the share of transport-sector emissions in these. These are indicative figures only and, because of the uncertainty involved in tracking overall GHG emissions from agriculture, deforestation, decaying biomass and land-use change, should not be interpreted as a *precise* measure of GHG emissions nor of the share of transport emissions. We then describe trends in CO_2 emissions from fossil fuel combustion and the share of transport in these. Because production and use of these fuels is closely tracked, these figures are accompanied by much greater levels of certainty and can be granted greater confidence. Unless otherwise noted, when discussing sectoral trends, and in particular, when discussing transport sector emissions, this report focuses on *CO_2 emissions from fossil fuel combustion* and will use IEA data. GHG figures are normalised to 100 year global warming potentials of CO_2 to express non-CO_2 gases in equivalent terms (see section 2.3).

Figure 1-2: UK Carbon Emissions by Sector in 2005: End-user vs. Source Allocation



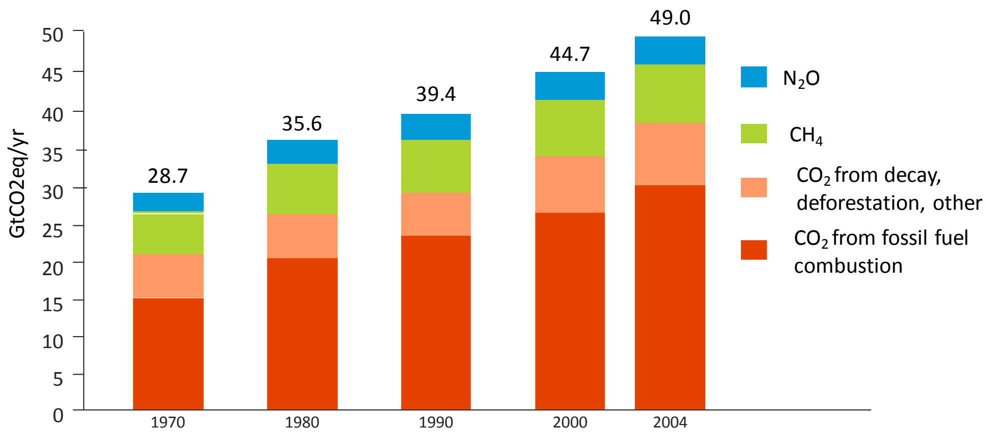
Source : *UK Defra, 2007*

When discussing CO_2 emissions from fossil fuel combustion, this report will use the IEA convention of describing emissions on a source basis. GHG and CO_2 emission data can be calculated on either a “end-user” or “source” basis. End-user calculations allocate GHG emissions per sector including an estimate of their upstream energy-use (e.g. on a well-to-wheel basis -- for example, emissions from transport fuel refining operations would be attributed to the transport sector). Source calculations allocate emissions according to where the fuel is actually used (e.g. emissions from fuel refining would be allocated to energy production and not transport). There can be a considerable difference in the relative contribution of each sub-sector to the total between end-use and source calculations with the latter typically understating the impact of the transport sector (see Figure 1-2). End-user calculations, however, are more uncertain than source calculations. UNFCCC and IEA data are calculated on a source basis.

1.1.2. Global Greenhouse Gas and CO2 Emissions Trends: Focus on Transport

According to MNP-JRC data, global emissions of GHG's rose 70% from 1970 to 2004 – or roughly 1.6% per year (Figure 1-3). CO2 emissions largely dominate and have risen 80% between 1970 and 2004 (1.9%/yr). Of the estimated 49 Gt of GHGs emitted globally in 2004, approximately 56.6% - ~27.7 Gt. - resulted from the combustion of fossil fuel. The IEA estimates that 2004 emissions of CO2 from fuel combustion were 26.3 Gt and 27.3 Gt in 2005. Figure 1-4-A shows the breakdown of overall GHG emissions by source in 2004. Figure 1-4-B shows the *indicative* share of transport sub-sector *CO2* emissions to total *GHG* emissions in 2004 for the world (given that CO2 largely dominates transport-sector GHG emissions, CO2 serves as a good proxy for overall transport GHG emissions). Figure 4-C shows the absolute share of transport sub-sector CO2 emissions to overall CO2 emissions from fuel combustion for both the World and for OECD countries.

Figure 1-3: Global Anthropogenic Emissions of Greenhouse Gases: 1970-2004

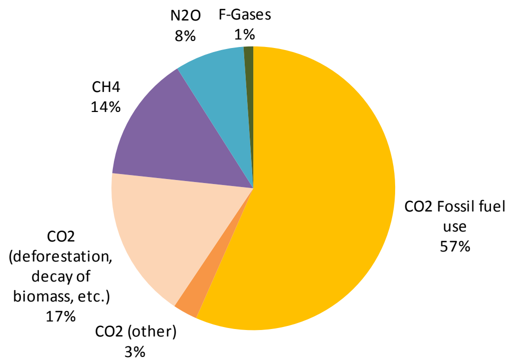


Source : IPCC, 2007

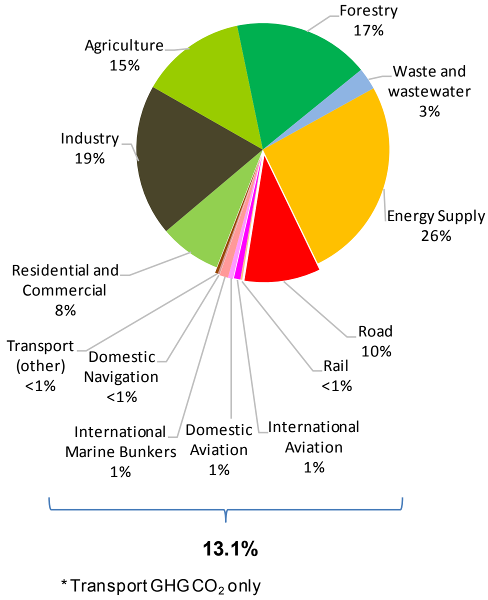
According to Figure 4, the transport sector was responsible for 23% of world CO2 emissions from fuel combustion (30% for OECD countries) with the road sector largely dominating. When factoring in all GHG emissions, transport CO2 emissions accounted for approximately 13% of global GHG emissions – *but this figure is much more tentative given the significant uncertainties in the absolute amount of GHG emissions, especially from agriculture, forestry and biomass decay*.

Figure 1-4: GHG and CO2 Emissions in 2004 and 2005

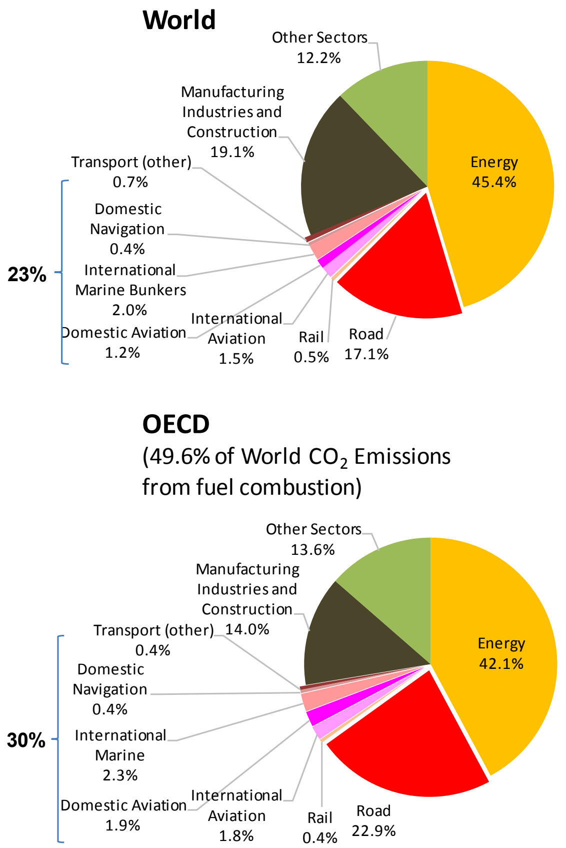
4-A. GHG Emissions by Source/Gas: 2004



4-B. GHG Emissions by Sector*: 2004



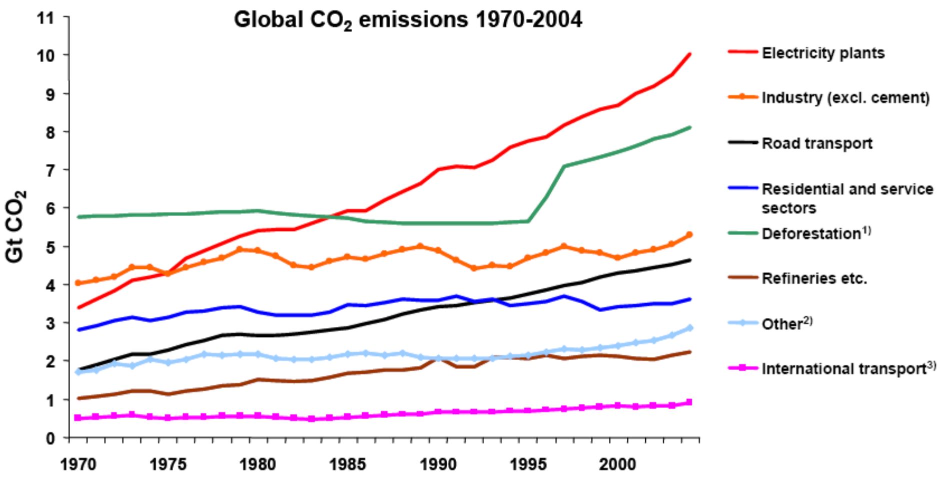
4-C. CO_2 Emissions from Fuel Combustion 2005



Source : 4-A: MNP, 4-B: MNP and IEA, 4-C: IEA Data from "CO2 Emissions from Fuel Combustion" (2007)

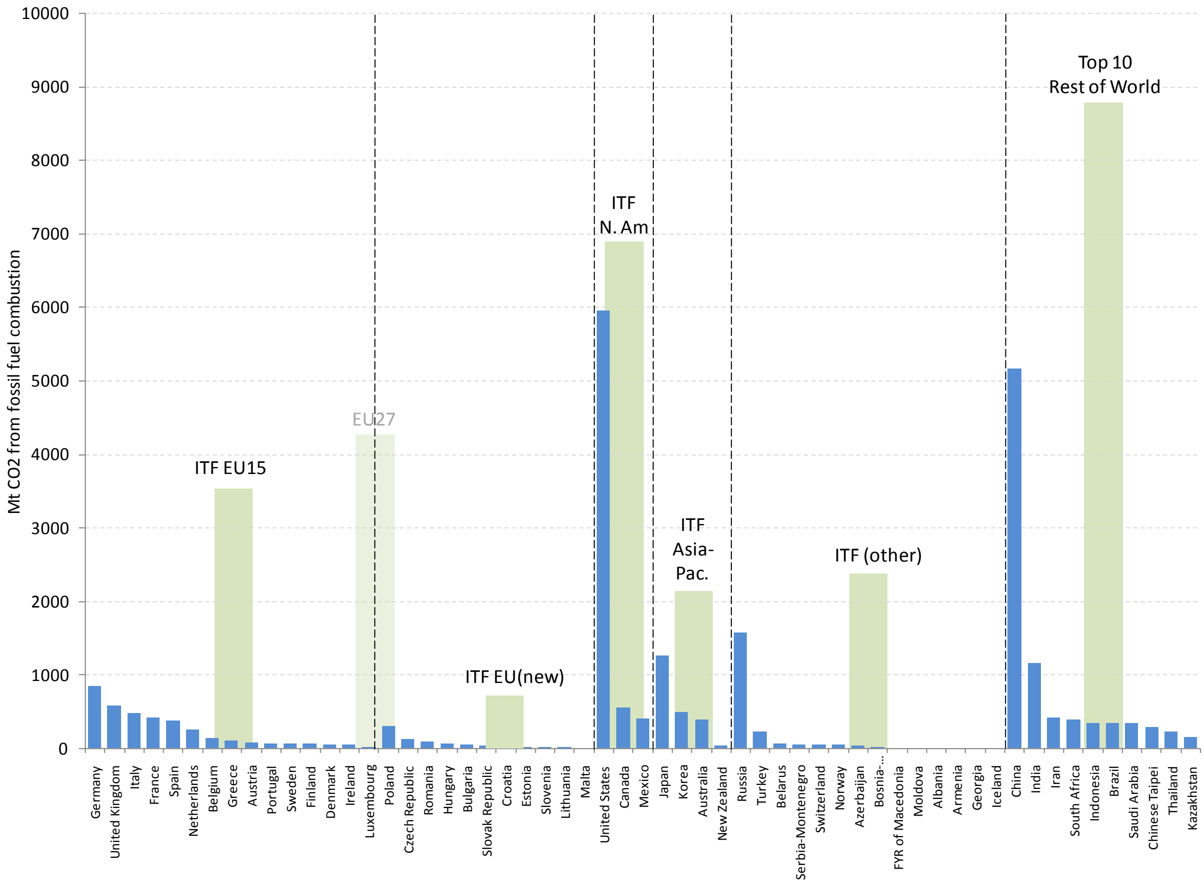
Electricity production, road transport and industrial activity dominate global CO2 emissions from fuel combustion and the former two sectors, along with international shipping and aviation, have experienced higher global growth rates than any other source sector (Figure 1-5).

Figure 1-5: Sources of Global CO2 Emissions 1970-2004



Source : IPCC WG3-1

Figure 1-6: Total CO2 Emissions from Fossil Fuel Combustion (including International Transport) in 2005 by ITF Region and Country



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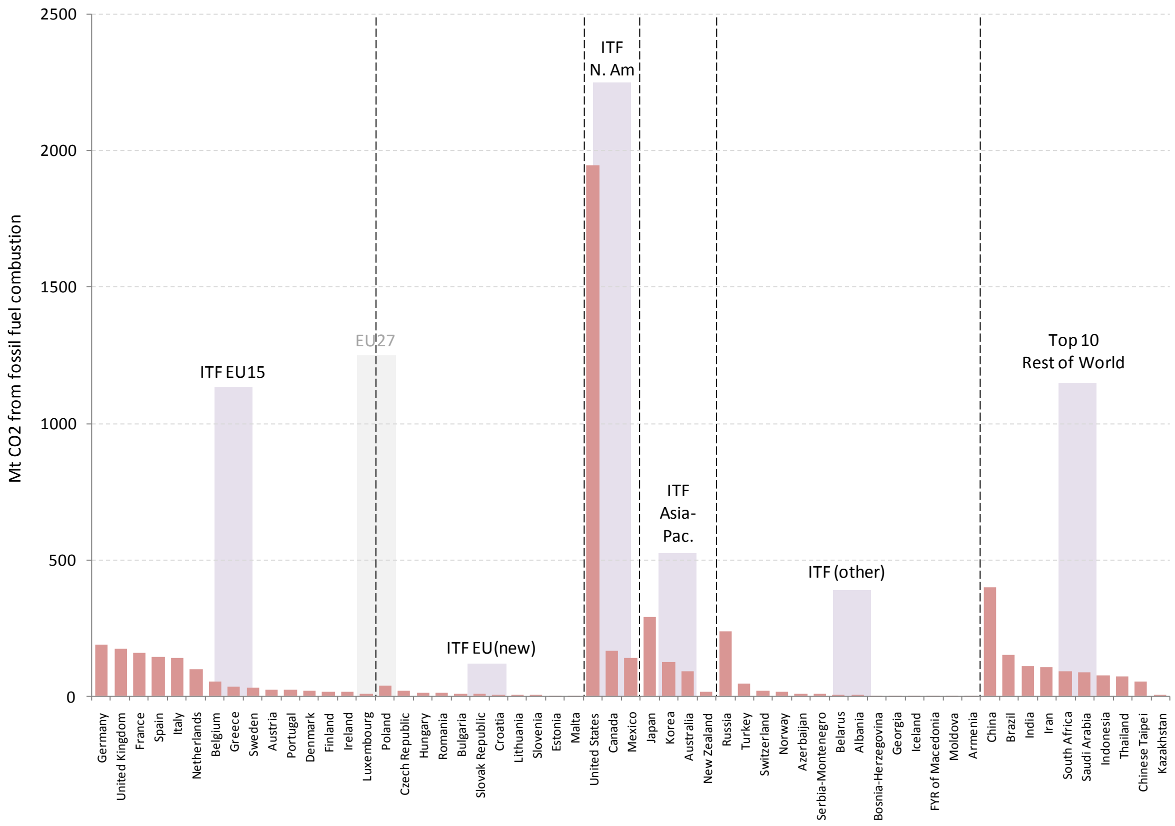
Source: Data from IEA, "CO2 Emissions from Fuel Combustion" (2007)

Figure 1-6 shows total CO2 emissions from fossil fuel (including international bunkers assigned to countries on the basis of national sales) by ITF region and country. North America and the top-ten emitting non-ITF/OECD countries[2] dominate together representing 57% of world emissions. While the EU 27 trails North America within the ITF, the bulk of EU 27 emissions take place in the founding 15 members of the EU. The ITF countries as a whole accounted for approximately 60% of world CO2 emissions. Respective shares for the EU, ITF Asia-Pacific and other ITF countries (dominated by Russia) are 15.6%, 7.9% and 8.7%, respectively.

Figure 1-7 shows total Transport-related CO2 emissions from fossil fuels (including international bunkers assigned to countries on the basis of national sales). North America largely dominates other regions, including the top ten non-ITF countries indicating that a large share of the latter's CO2 emissions comes from non-transport activity. As with total CO2 emissions, EU 15 emissions represent a dominant share of EU27 emissions, and the United States, Japan and Russia largely dominate the transport-related CO2 emissions from their respective regions. Combining international transport emissions with total domestic transport emissions, as done in this figure, can bias the analysis of some nations' true ranking – especially where small countries operate large international ports or airports serving a wider region, as in the case of the Netherlands.

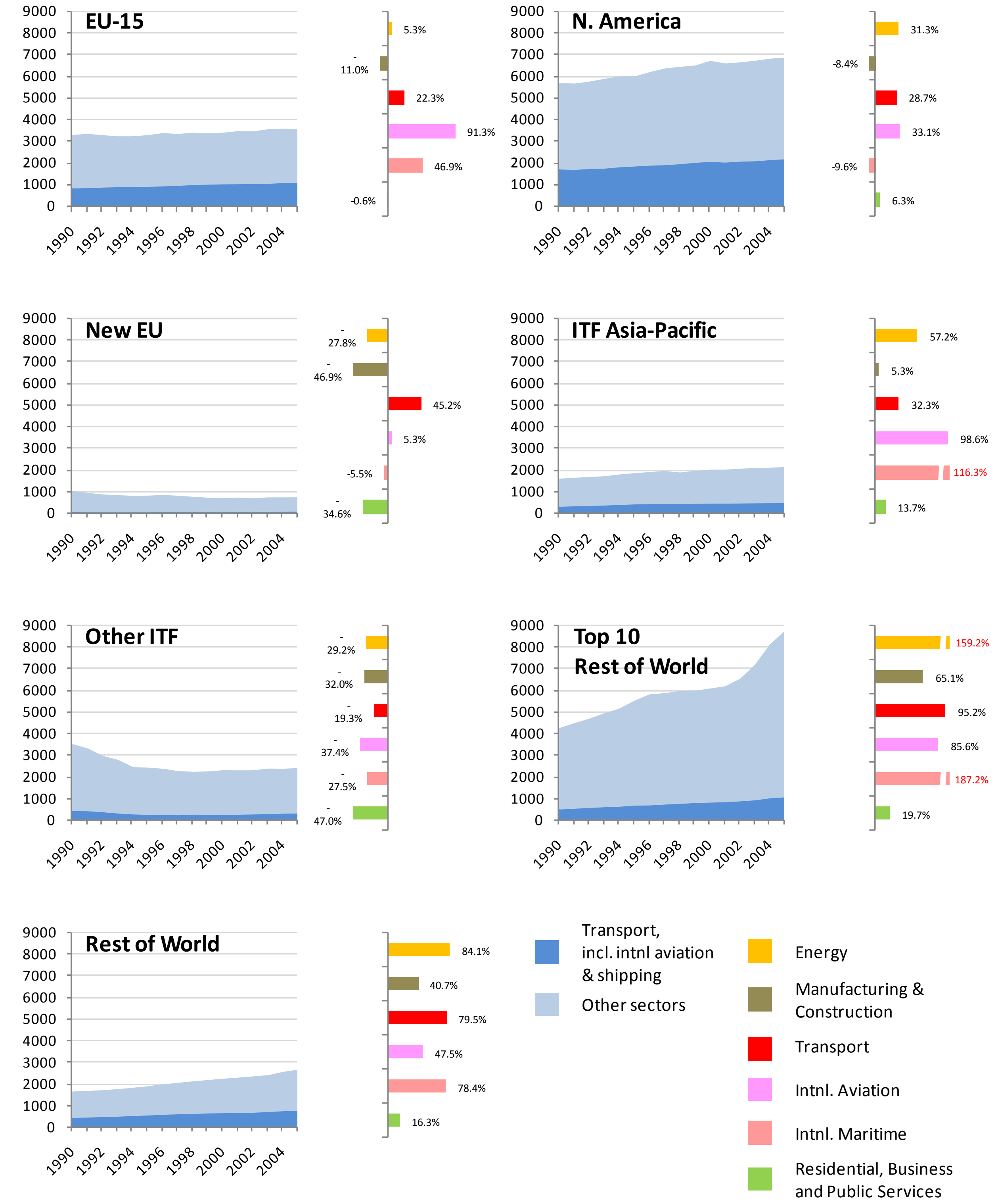
Figure 1-7: Total Transport CO2 Emissions from Fossil Fuel Combustion (including International Transport) in 2005 by ITF Region and Country



Source: Data from IEA, "CO2 Emissions from Fuel Combustion" (2007)

2 China (including Hong Kong), India, Islamic Republic of Iran, Indonesia, South Africa, Brazil, Saudi Arabia, Chinese Taipei, Thailand, Kazakhstan

Figure 1-8: Total CO2 Emissions (Mt) by Region[3] and Growth rates by Sector: 1990-2005



Source : Figures are for CO2 emissions from fuel combustion, data from IEA, "CO2 Emissions from Fuel Combustion" (2007)

[3] See Appendix I for breakdown of regions

Figure 1-9: Transport CO2 (Mt) Emissions 1990-2005

Trends and sub-sectoral shares

Source: Data from IEA, "CO2 Emissions from Fuel Combustion" (2007)

Figure 1-8 displays the regional breakdown of CO2 emissions from fuel combustion and tracks the growth rates in emissions from 1990 to 2005 across different sub-sectors. Growth in CO2 emissions has been variable across these regions but the highest emitting regions have almost all experienced growth in overall CO2 emissions (EU-15 +7.8%, N. America +20.8%, ITF Asia-Pacific +34.6%). Growth has been fastest in the top-ten non-ITF countries where overall emissions grew by 108% between 1990 and 2004. China alone experienced 152% growth in CO2 emissions from fuel combustion over the same period.

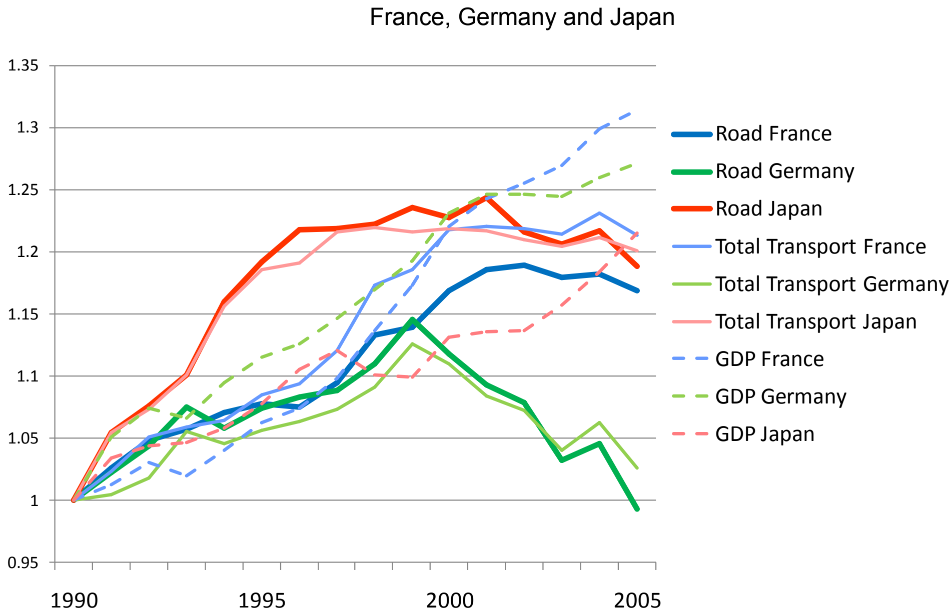
Growth rates of emissions from the main CO2 emitting sectors also vary by region, but the highest emitting regions have seen significant growth in transport-related CO2 emissions. For the EU, all sectors except the transport sector have experienced reductions in emissions. EU transport sector emissions are rising faster in the new EU states (+45% -- albeit from a much smaller base) than in the EU-15 (+22%), but the latter have seen a 91% increase in international aviation emissions over the same period. North America has experienced roughly similar rates of growth for energy, transport and international aviation – and this, from a much higher base (+31%, +29% and +33%, respectively). ITF Asia-Pacific have seen growth in emissions from all sectors. The growth in transport sector emissions in this region (+32.3%) has been lower than the growth in international aviation and maritime transport for these countries (+99% and + 116%, respectively).

Russia dominates the emissions of the other ITF countries and because of the structural changes experienced there in the beginning of the 1990's, CO2 emissions have dropped across all sectors for the period 1990-2005. This trend is reversing and transport emissions have seen a 17% growth across these countries since 2000. Mirroring trends in overall emissions, growth in transport-sector CO2 emissions for the top ten non ITF economies have risen dramatically over the past 15 years. Transport-sector emissions have risen by 95%, international aviation emissions by 86% and international maritime emissions by 187%. However, the relative weight of the transport sector is much less in these countries.

Figure 1-9 displays regional trends in CO2 emissions from all transport sub-sectors as well as the respective shares of these to overall CO2 emissions in 1990 and 2005. The overall rates of emission growth are slightly different than those displayed in figure 6 since international aviation and international maritime are aggregated here with the other transport sub-sectors. In absolute terms, North America and the European Union dominate 2005 *transport-sector* emissions representing 34.7% and 19.2% of global *transport* emissions. The road sector dominates in all regions representing approximately three fourths total transport CO2 emissions from a low of 59% in the non OECD ITF countries to a high of 87% in the new EU member states. Rail has diminished its share of CO2 emissions in many countries but source data such as the IEA's gives a poor measure of the true level of rail-related emissions since it only accounts for fossil fuel-burning rail traction and not electric traction which is largely represented in the sector. The balance of CO2 emissions remaining after accounting for the road sector are more or less equally divided between aviation and maritime/inland navigation according to IEA data. The non-OECD ITF countries are an exception where about 23% of emissions are due to pipeline transport which reflects the importance of this activity in Russia and other former Soviet Union states.

Adjusting for those countries of the former Soviet Union and Eastern Europe that experienced large structural adjustments in the early 1990's, the general trend has been for a near-continuous increase in transport-related CO2 emissions in most economies. Some countries (e.g. Germany, Japan and France – see Figure 10) however, stand out in that they have seen their road and overall transport CO2 emissions stabilise or decrease in recent years despite economic growth over the same period (- 1.7%, -7.9% and -2.3% respectively from 2002 to 2005).

Figure 1-10: Evolution of Total Transport and Road Transport CO2 Emissions: 1990-2005



Source: Data from IEA, "CO2 Emissions from Fuel Combustion" (2007)

1.1.3. Focus on CO2 Emissions from Ocean Shipping

According to IEA data, international maritime activity (calculated by the sale of fuel to vessels whose next port-of-call is outside the country) accounted for 543.4 Mt of CO2 emissions from fuel combustion in 2005. This estimate places international maritime emissions in 8th place in the world between those of Canada and the United Kingdom.

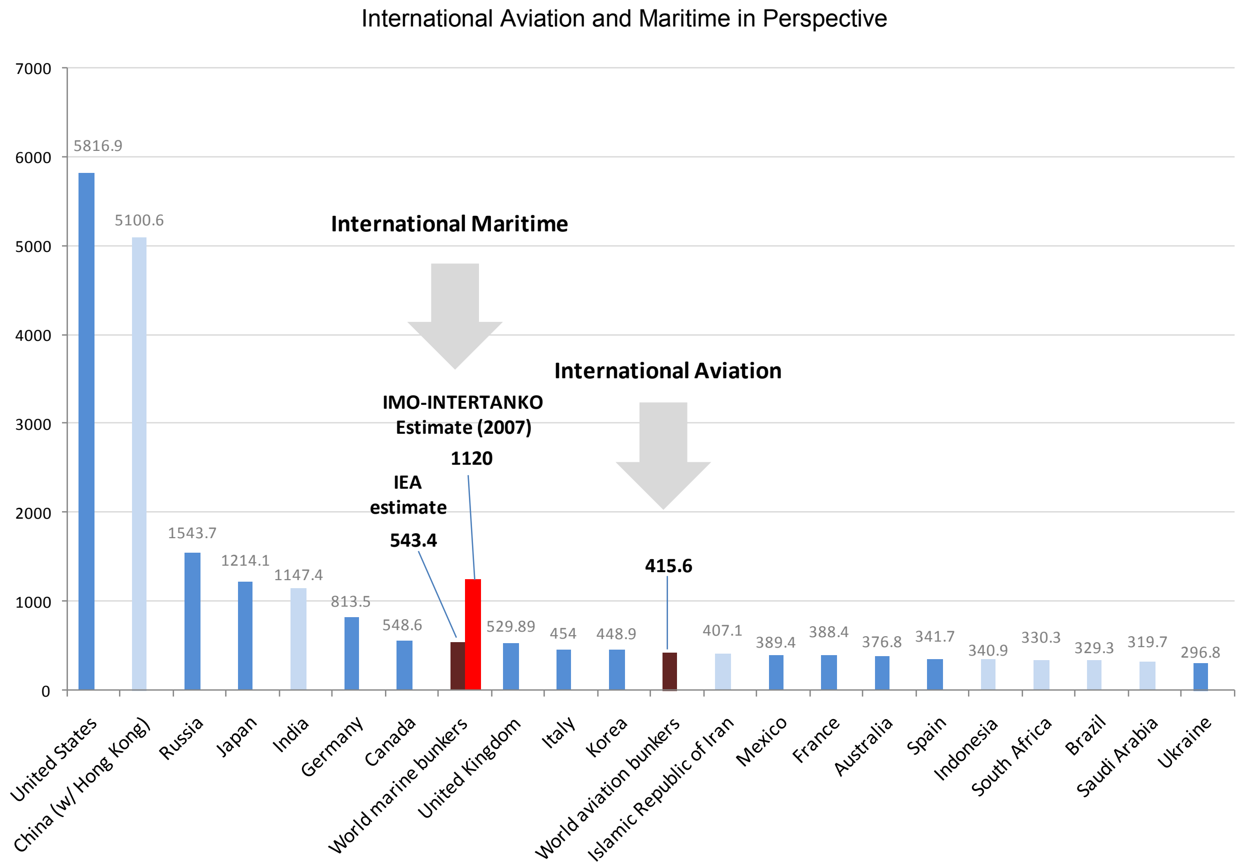
However, figures on fuel use and emissions from international maritime activity are less accurate under current IEA reporting requirements than for road and rail. International marine "bunker" fuel statistics were not conceived to represent the total energy used by ships engaged in global commerce. Rather, these data were designed to differentiate fuel stocks that are and are not covered by the allocation calculations under the IEA's emergency oil sharing system. Some researchers find that that this leads to an erroneous estimate of maritime fuel use. An error ranging between 25% for cargo ships and a factor of two for the world fleet can be found by contrasting international maritime transport fuel sales data with activity-based estimates of ship energy requirements (Corbett, Koehler, 2004, 2007)[4].

Bottom-up studies have sought to estimate maritime fuel consumption and CO2 emissions by modelling the world fleet and accounting for its activity. Some of this work has incorporated detailed manufacturer's data on engines, rated power, operating cycles, actual vessel travel patterns and overall

4 While early IEA estimates of maritime energy use seem to better match activity-based estimates, a clear divergence has emerged in later years. A primary cause of divergence between total fuel use and international fuel sales would perhaps be increased multiple-port calls within a nation over time. This change in voyage behaviour is consistent with the rise of containerized shipping during the 1970-1980 decade where increasing divergence would be expected during rapid transition to multi-port containerized logistics, followed by stabilized container service patterns and constant differences between fuel usage and statistics.

vessel energy consumption (Corbett, Eyring 2007 and IMO 2007), others have looked at historical factors that have had an impact on shipping activity and used fleet-average models (Endresen et al. 2007). Both types of estimates find higher CO2 emissions than the IEA.

Figure 1-11: CO2 Emissions (Mt) from Fuel Combustion: 2005



Source: Data from IEA, "CO2 Emissions from Fuel Combustion" (2007) and IMO,2007

In 2007, the International maritime Organization convened a group of experts to examine the scale of maritime CO2 emissions and to report on how policies being considered at the IMO might impact the future development of these. The expert group undertook a revised update of global maritime CO2 emissions using a bottom-up model (led by industry group INTERTANKO). This study found that in 2007, the world fleet consumed 369.3 Mt of fuel (largely heavy fuel oil) and emitted a total of 1,120 Mt of CO2 – more than twice the IEA estimate for 2005. This new estimate places international maritime emissions in 6th place in the world between those of India and Germany (Figure 1-11).

1.2 Atmospheric Concentrations of Greenhouse Gases

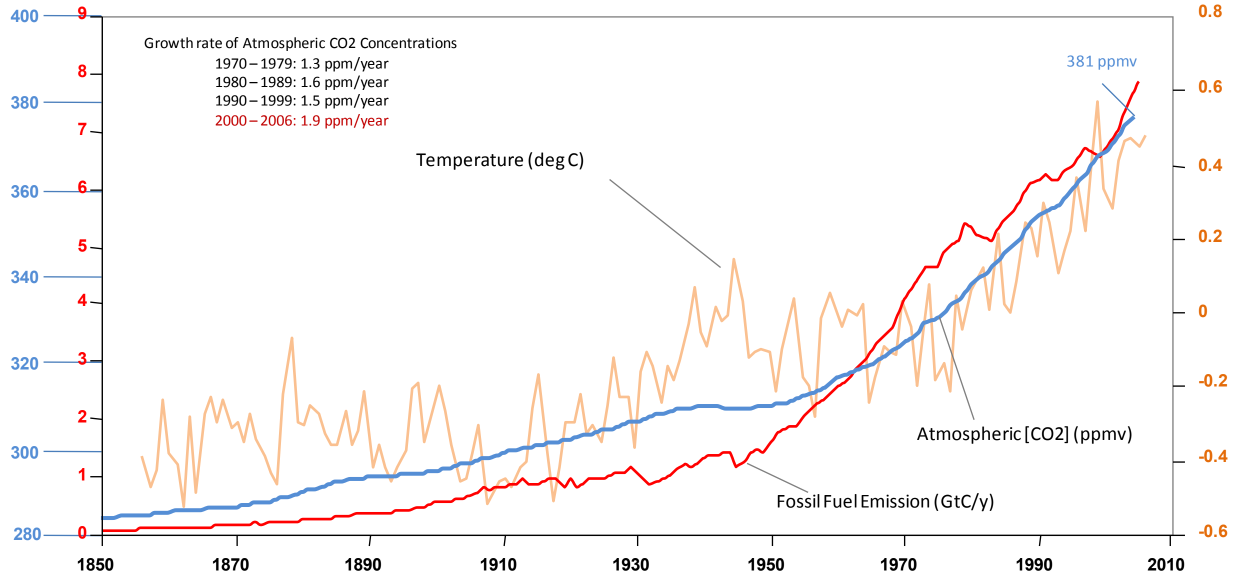
The second step in the climate change impact pathway relates to the manner in which, the extent to which and the time scale at which GHGs are concentrated in the atmosphere.

The concentration of CO2 in the atmosphere has increased from a pre-industrial value of 280 parts per million (ppm) to 381 ppm in 2006 (see Figure 1-12). The current level of carbon dioxide concentration in the atmosphere significantly exceeds the natural range for this variable over the past 650 000 years (180-

300 ppm) and is growing at an accelerated pace. The average growth rate of CO2 concentrations in the atmosphere from 1960 to 2005 was 1.4 ppm per year. The average growth rate for 2000-2005 was 1.9 ppm. This increase in atmospheric concentration tracks fossil fuel emissions and correlates to average atmospheric temperatures.

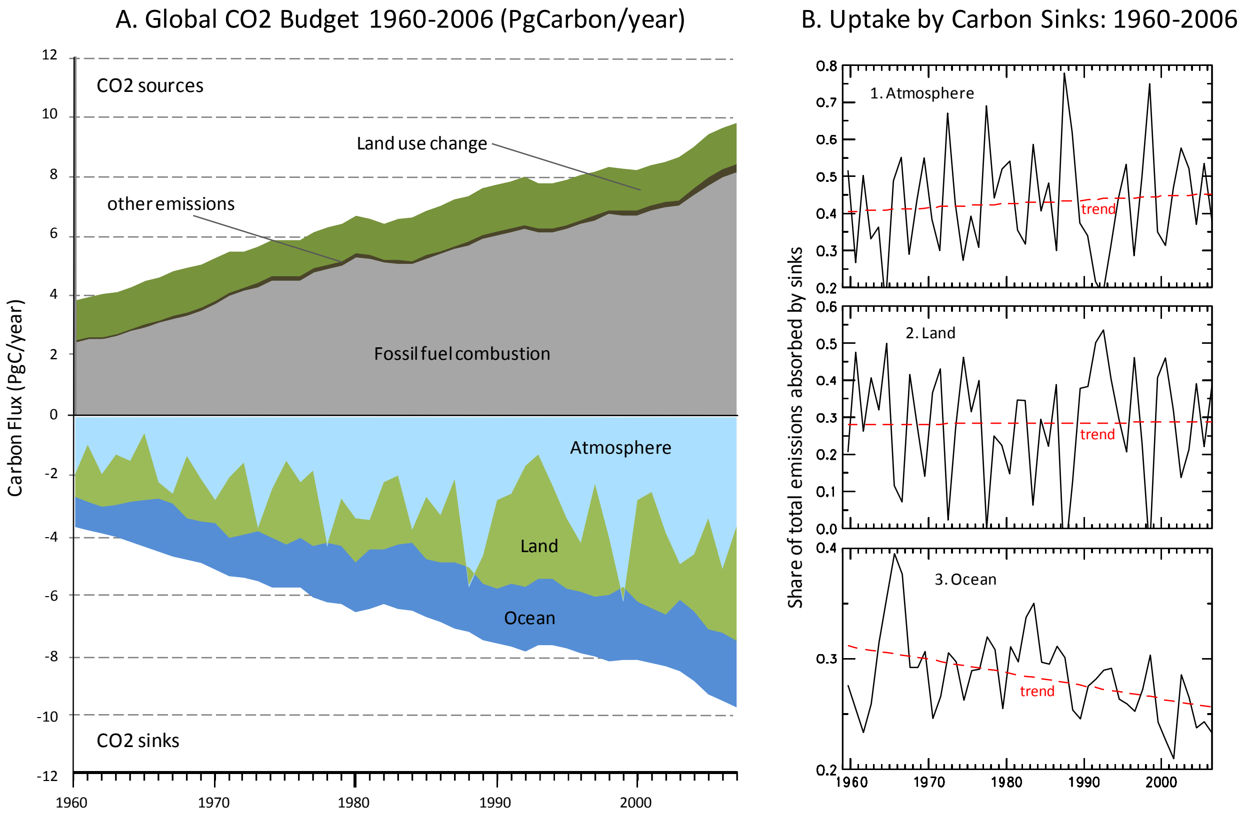
CO2 has an atmospheric half-life on the order of 100 years whereas many other GHGs have atmospheric half-lives on the order of several decades. Much of the CO2 emitted today will still be around and radiatively active by 2050 and half will still be around at the turn of the next century. However, much of the CO2 emitted into the atmosphere is absorbed by large and active natural carbon "sinks" on land and in the ocean (see Figure 1-13A). These sinks have absorbed on the order of 60% of the carbon emitted by as a result of human activities – e.g. 50 years ago, for every ton of carbon emitted, only 400 kgs remained in the atmosphere and 600 kgs were absorbed by land and ocean sinks.

Figure 1-12: World Fossil Fuel CO2 Emissions, Atmospheric Concentration of CO2 and Temperature: 1850-2006



Source : Global Carbon Project, 2007

Figure 1-13: Global Carbon Budget and Efficacy of Global Carbon Sinks: 1960-2006



Source : Global Carbon Project, Canadell, 2007

The long-term efficacy of these sinks can be measured by the ratio of sinks to emissions (Figure 11B). While the interannual variability of these sinks is elevated (especially concerning land-atmosphere exchanges – Figure 1-13B-1 and 13B-2), recent observations indicate that carbon-cycle feedback loops are occurring faster than previous IPCC modelling work would have suggested. For every ton of CO2 now emitted, 450 kgs remain in the atmosphere and 550 kilos are absorbed, a weakening of 10% over the last 50 years – and this rate of uptake appears to be slowing further (Le Quéré, *et al*, 2007).

While changes in land-based sinks can be seen in contributing to the decrease of CO2 uptake by these (e.g. recent droughts in mid-latitude regions have slowed plant growth and thus the rate of CO2 uptake on land[5]), the weakening of large ocean sinks over the past half-century (Figure 1-13B-3) – and in particular that of the Southern Ocean – remains the principal driver of this trend (Canadel, *et al*, 2007). Other research has confirmed a similar finding for the North Atlantic (Schuster and Watson, 2007).

Compounding the effect of this weakening is the fact that many sinks have the potential to become *net sources* of CO2 in time and in reaction to climate change itself. The IPCC Fourth Assessment report discusses the outcome of recent coupled climate-carbon cycle models that investigate feedback loops between climate change and the carbon cycle that suggest that:

5 The variability in land-based sinks can also be explained by the fact that these are composed of a patchwork of sources and sinks – and that while regional decreases in plant growth slows the rate of uptake of CO2, increased CO2 levels in the atmosphere accelerates the growth of biomass in other areas.

- The share of anthropogenic emissions of CO_2 remaining in the atmosphere will increase throughout the 21st century,

- The efficiency of sinks in absorbing atmospheric CO_2 will decrease due to a weakening of the carbonate buffering mechanism[6] in the ocean and through saturation of land sinks, and

- Climate change will weaken land and ocean uptake of CO_2, resulting in a higher concentration of atmospheric CO_2, itself triggering a positive feedback to climate change.

The modelled linkages between climate change and the global carbon cycle can already be observed empirically, for example, in the warming-induced release of CO_2 and CH_4 from melting permafrost soils (IPCC, 2007). There is also a link between ground-level ozone (an important by-product of transport-sector emissions) and reduced uptake of CO_2 by biomass – further weakening the action of land-based CO_2 sinks (Hopkin, 2007 *, Nature* ***448****, 396-397 (26 July 2007)*)

These findings indicate that not only is it likely that more emitted CO_2 will remain in the atmosphere than had previously been the case but that emissions of GHG will result in the release of even more previously stored GHG from major sinks. In other words, the size and timing of pulses of GHG into the atmosphere have an impact not only on rates of extraction of CO_2 from the atmosphere but on the overall level of emissions themselves in an increasing feedback loop. Combined with the possibility of triggering irreversible climate thresholds (see box), this finding implies that the *rate* of GHG emission reduction is crucially important to achieving stabilisation of atmospheric concentrations[7].

[6] CO_2 is soluble in seawater. However, the capacity for CO_2 to be absorbed by seawater is limited – as upper levels of oceans approach saturation, less CO_2 is absorbed. The solubility of CO_2 in seawater is also an inverse function of seawater temperature. As seawater warms (as a result of increases in average atmospheric temperatures), less CO_2 is absorbed.

[7] (IPCC, 2007)

Potential vulnerability of the carbon cycle: nonlinear dynamics, thresholds, and regime shifts

Dynamics of the carbon-climate-human system are likely to contain unknown surprises and thresholds induced by nonlinear feedbacks and interactions among major compartments and processes of the system. These include:

- The stability of ocean circulation (e.g., through possible slowdown or shutoff of the thermohaline circulation).
- The ability of terrestrial ecosystems to sequester carbon in the future as mechanisms responsible for current sinks saturate (CO2 fertilisation; forest regrowth after abandonment).
- The uncertain permanence of current terrestrial carbon stocks due to changes on control processes such as switches due to phenology (the study of the times of recurring natural phenomena), soil respiration, changes in seasonal freeze-thaw dynamics, thawing of permafrost, changes in water table, drought, absence/presence of snow, fire, insect infestation.
- Feedbacks between terrestrial and marine systems such as ocean net primary production enhancement due to dust deposition from land.
- The societal and policy drivers for the changes in carbon systems and for carbon management (linked with the perceptions of risk, due to changing climate and consequent development of new institutional regimes to control greenhouse gas accumulation in the atmosphere).

Most of these processes are the result of interactions between the changing climate, human systems and the global carbon cycle, with the potential for accelerating or decelerating the build-up of atmospheric CO2. The implications of these interactions are that, to achieve stabilisation, an enormous reduction in fossil fuel emission and increase in carbon sequestration is urgently needed.

Although such interactions are likely to occur, their quantification is difficult and is restricted to subsets of their components for the Earth system because fully coupled carbon-climate-human models do not exist.

Coupled carbon-climate models, however, have provided major insights on the types of possible nonlinear responses. These models show a slowdown of the terrestrial sink strength by the middle of this century, with it becoming a source by the end of the century. Coupling biophysical and decision-making models have also produced unpredicted results.

from: Global Carbon Project (http://www.globalcarbonproject.org/misc/vulnerabilities.htm)

1.3 Radiative Forcing: Focus on Transport

Once compounds are emitted and concentrated in the atmosphere, they can have either a warming or cooling impact. The strength and direction of this effect depends on the nature of the compound emitted, its interactions with other compounds present in the atmosphere, the localisation of the concentrations of the compound and atmospheric physics and chemistry. Furthermore, the warming or cooling effect takes place at different time-scales according to the atmospheric life of the compound and its climate-reactive by-products. For these reasons, assessing the climate impact of a pulse of emissions into the atmosphere is a complex task. However, understanding the radiative forcing, or the contribution of a GHG or other climate-reactive compound, to the ultimate change in global average temperatures is an essential element of climate policy-making as it helps to prioritise mitigation of the most relevant gases and compounds. This is especially true for certain transport sub-sectors such as shipping and aviation where the radiative forcing from non-Kyoto gases and compounds is very significant. Furthermore, understanding the time-scales involved in the radiative forcing relationship can help to prioritise action should short-term rapid reductions in radiative forcing be required.

The concepts of radiative forcing (RF) and global warming potential (GWP) allow gases, compounds and atmospheric phenomena such as contrail-induced cloudiness to be assessed according to a single metric. These indices (see box) are not perfect and do not capture the full range of emission-concentration-temperature interactions but do serve as a relatively good proxy for assessing the climate impact of human activity.

Radiative Forcing (RF) and Global Warming Potential (GWP)

The influence of a factor that can cause climate change, such as a greenhouse gas, is often evaluated in terms of its **radiative forcing**. Radiative forcing is a measure of how the energy balance of the Earth-atmosphere system is influenced when factors that aff ect climate are altered. The word radiative arises because these factors change the balance between incoming solar radiation and outgoing infrared radiation within the Earth's atmosphere. This radiative balance controls the Earth's surface temperature. The term forcing is used to indicate that Earth's radiative balance is being pushed away from its normal state.

Radiative forcing is usually quantified as the 'rate of energy change per unit area of the globe as measured at the top of the atmosphere', and is expressed in units of 'Watts per square metre' (see Figure 2). When radiative forcing from a factor or group of factors is evaluated as positive, the energy of the Earth-atmosphere system will ultimately increase, leading to a warming of the system. In contrast, for a negative radiative forcing, the energy will ultimately decrease, leading to a cooling of the system. Important challenges for climate scientists are to identify all the factors that affect climate and the mechanisms by which they exert a forcing, to quantify the radiative forcing of each factor and to evaluate the total radiative forcing from the group of factors.

Multi-component abatement strategies to limit anthropogenic climate change need a framework and numerical values for the trade-off between emissions of different forcing agents. **Global Warming Potentials** or other emission metrics provide a tool that can be used to implement comprehensive and cost-effective policies (Article 3 of the UNFCCC) in a decentralized manner so that multi-gas emitters (nations, industries) can compose mitigation measures, according to a specified emission constraint, by allowing for substitution between different climate agents.

A physical GWP index, based on the time-integrated global mean RF of a pulse emission of 1 kg of some compound (*i*) relative to that of 1 kg of the reference gas CO2, was developed (IPCC, 1990) and adopted for use in the Kyoto Protocol. [However], by its definition, two sets of emissions that are equal in terms of their total GWP-weighted emissions will not be equivalent in terms of the temporal evolution of climate response.

Source: Adapted from IPCC FAR, WG1, CH.2

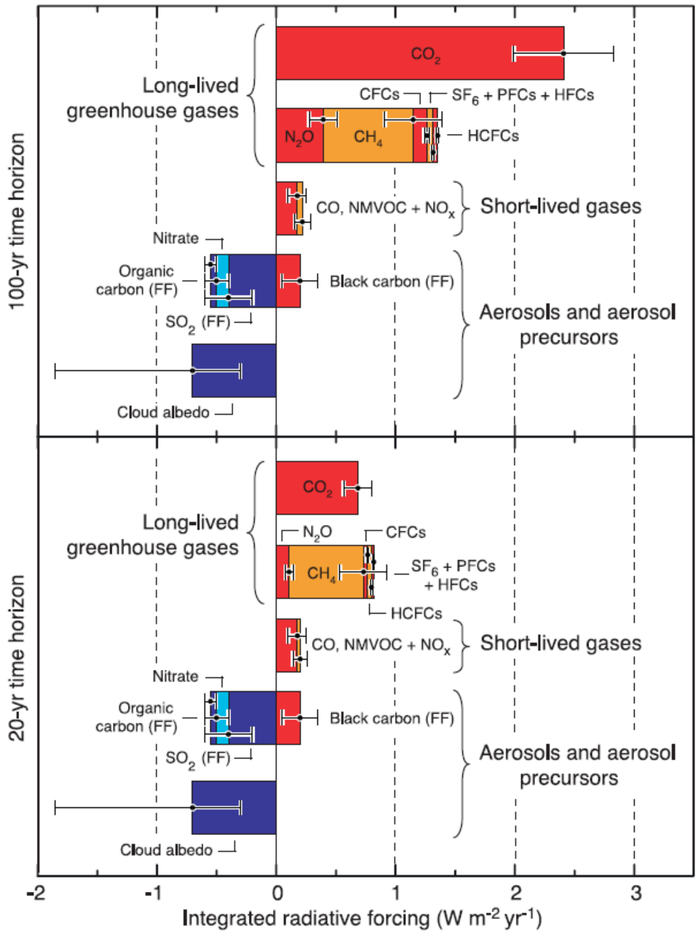
The GWP of the principal Kyoto gases (CO2, CH4, N2O) are relatively well known and can be expressed in relation to the GWP of CO2 where CO2=1. At a hundred-year horizon the forcing of CH4 is 21 times that of CO2 and the forcing from N2O is 310 times that of CO2.

Transport emissions of the main Kyoto gases primarily concern CO2. However, the transport sector emits other climate-reactive compounds that have important warming and cooling impacts -- especially at shorter time scales – and contribute to the formation of ozone (O3), itself a highly climate-relevant compound. These emissions include Nitrogen dioxides (NOx), Volatile organic compounds (VOC's), Carbon monoxide (CO), Black carbon (BC), Organic carbon (OC) and other aerosols as well as Sulphur dioxide (SO2). The manner in which these transport emissions affect climate depends on factors such as the presence of other reactants in the atmosphere, the altitude at which emissions and concentration occur and, crucially, the time scale over which the impact is measured. Many impacts are indirect. For instance, CO emitted from vehicles is eventually transformed into CO2 in the atmosphere, but in so doing, it consumes hydroxyl radicals (OH) which might otherwise reduce CH4 concentrations. Also indirect is the complex interaction between the emission of O3 precursors, the formation of O3 and its ultimate climate impact. NOx emissions can either result in an increase of OH concentrations (and thus contribute to reducing CH4) or can combine with CO and VOC's to form O3 which has a positive RF (see discussion below). Finally, the emissions of aerosols and water vapour by ships and aircraft contribute to cloud formation which also has a climate impact, albeit one that has proven extremely difficult to quantify to-date.

Figure 1-14 shows the IPCC's best assessment of the radiative forcing of different gases and compounds in 2000 at 20-year and 100-year horizons. By contrasting the two, the relative importance of short-lived gases at short time scales becomes apparent. This is of consequence for those transport sectors such as shipping and aviation whose total radiative impact is not dominated by CO2 emissions alone. It is equally important for the road transport sector whose contributions to the formation of tropospheric O3 is significant.

Figure 1-14: Integrated Radiative Forcing for Year 2000 Emissions

(Weighted by 100-yr and 20-yr time horizons)[8]

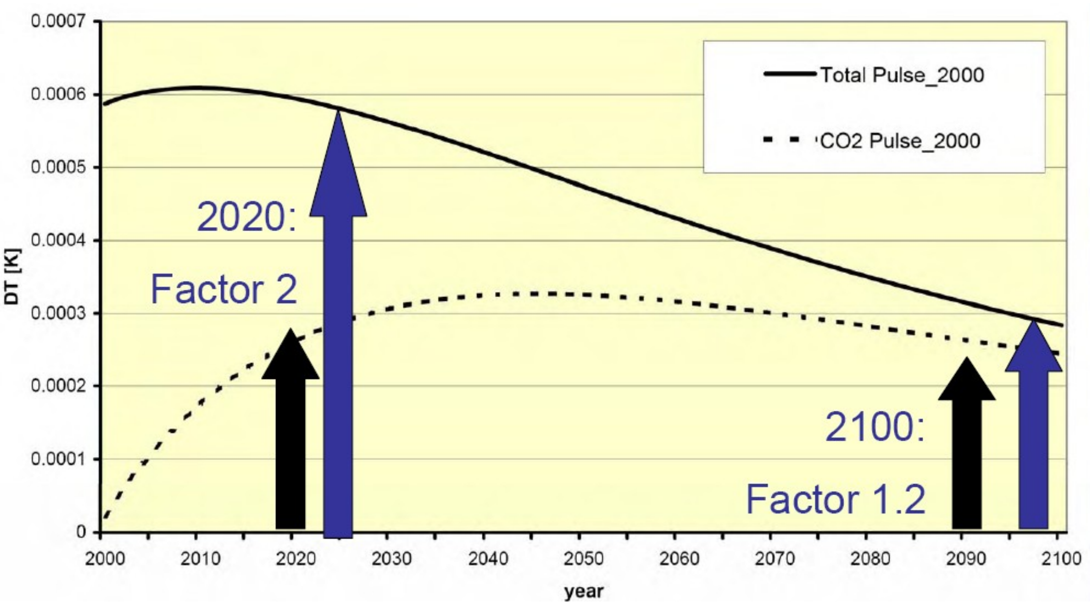


Source : IPCC, 2007 (WG1, CH2)

8 *Integrated RF of year 2000 emissions over two time horizons (20 and 100 years). The figure gives an indication of the future climate impact of current emissions. The values for aerosols and aerosol precursors are essentially equal for the two time horizons. It should be noted that the RFs of short-lived gases and aerosol depend critically on both when and where they are emitted; the values given in the figure apply only to total global annual emissions. For organic carbon and BC, both fossil fuel (FF) and biomass burning emissions are included. The uncertainty estimates are based on the uncertainties in emission sources, lifetime and radiative efficiency estimates.*

Ultimately, the choice of a time horizon with which to assess climate impacts is a political one and reflects the societal weighting given to short-term versus longer term impacts. Most impacts are currently assessed at a 100-year time horizon. Figure 1-15 illustrates, however, how the RF impact of short-lived gases and compounds evolves over 100 years. In this case, the RF impact of a pulse of emissions by aviation is initially dominated not by the CO2 component but, rather, by the non-CO2 components of emissions and their effects. At a 20-year horizon the total RF impact is twice that of CO2, at a 100-year horizon, the total RF impact has reduced to only 20% more than the CO2 impact alone. Given that climate impacts are the result of a near-continuous "pulse" of short-lived and long-lived compounds, reducing the short-lived component of the stream can have a real impact on short-term and cumulative longer-term forcing.

Figure 1-15: Temperature Response from an Annual Pulse of Aviation Emissions



Source: Sausen, et al, DLR, 2007

1.3.1 Assessing Radiative Forcing from Transport Activity

While studies assessing overall emissions from transport activity are numerous, and some studies have sought to assess the climate forcing of aviation (e.g. IPCC 1999, Sausen 2005), very few have attempted to assess the combined climate forcing impact of the sector as a whole. One such study by the Centre for International Climate and Environmental Research-Oslo (CICERO) has done so in the broader context of the EU QUANTIFY[9] project (Fuglestvedt et al. 2007). This study uses recent assessments of RF for transport emissions and their effects (e.g. essentially those used by IPCC, 2007) and attempts to disaggregate these by gas/effect and by transport sub-sector for road, rail, aviation and shipping. It does so for cumulative emissions since pre-industrial times and for the integrated RF of current (e.g. year 2000) emissions evaluated at 20-year, 100-year and 500-year time scales. The study looks at source, not complete life-cycle emissions.

9 See http://www.pa.op.dlr.de/quantify/quantify.php

The study finds that for past transport emissions (1875-2000), RF from CO2 dominates with a total contribution equal to roughly 15%[10] of the total anthropogenic CO2 forcing over the same period (230 mW/m2). The corresponding figures for road transport are 10% and 150mW/m2. The second largest component of man-made climate forcing from transport is from tropospheric ozone where all transport sectors combined represent up to 31% of the total anthropogenic O3 forcing from 1875 to 2000. As with CO2 forcing, the road sector represents the principal source of O3 forcing, with aviation and shipping together representing approximately half of the road-based O3 forcing.

Accounting for all positive and negative forcings for the period 1875-2000, the road sector has had the largest positive forcing (e.g. a warming) impact, followed by aviation and rail. Shipping has most likely had a net negative forcing (e.g. a cooling) impact over the same period – largely due to the direct and indirect cooling impact of sulphur emissions and due to the contribution of shipping NOx emissions to OH formation and ensuing CH4 reduction (see below).

Figure 1-16 displays the estimated integrated forcing of year 2000 emissions by gas and by transport sector. Figure 1-16-A shows the integrated global mean RF (mW/m2/yr) at the 100-year time horizon. Figure 1-16-B shows the integrated mean net RF per sector normalised to the values of road transport at 20-, 100- and 500-year time horizons consistent with the IPCC's Fourth Assessment Report. Uncertainty ranges are displayed as whiskers corresponding to one standard deviation.

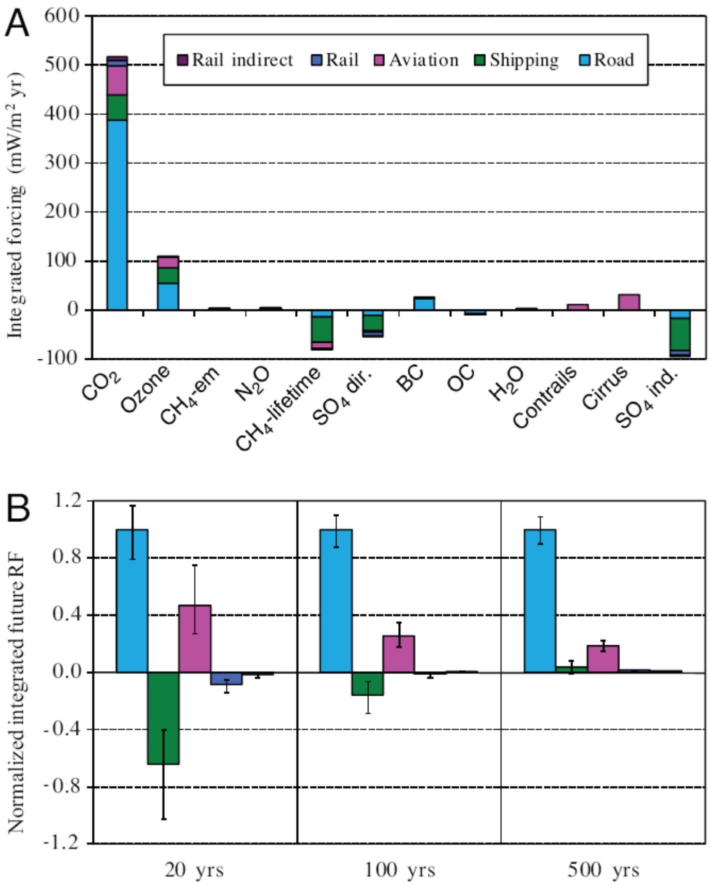
As with the historical outlook, forcing from current road transport CO2 emissions dominate, followed by aviation, shipping and rail. However, the figure and the report on which it is based uses an estimate of shipping fuel consumption and emissions (Endresen et al., 2007) that is considerably lower than other activity-based inventories (e.g. INTERTANKO-IMO 2007, Eyring et al. 2007 and Corbett and Koehler 2004 – see discussion in 2.1.3) and might, therefore, underestimate the CO2 forcing for shipping.

Much as in the historical outlook, forcing from ozone represents the second largest component of transport-related climate forcing, with the largest contribution coming from road transport followed by shipping, aviation and rail. The assessment of radiative forcing from current transport emissions confirms the historical assessment in that road, aviation and rail have positive forcing impacts over all three time horizons whereas shipping has a net cooling impact over the 20-year and 100-year horizons, again, largely due to the direct and indirect cooling impact of sulphur emissions and due to the contribution of shipping NOx emissions to CH4 reduction.

The net cooling impact from shipping requires an explanation. As noted earlier, emissions of NOx can have either a cooling impact by reducing CH4 (through the formation of OH) or a warming impact (through the formation of O3 when combined with CO and VOC's). Shipping emissions have high NOx to CO and high NOx to VOC ratios and take place in a low NOx environment. This means that a smaller share of NOx is converted into O3 and a relatively larger share of NOx is converted to OH which then breaks down CH4. In short, because of the nature and location of shipping NOx emissions, the cooling impact of CH4 removal is greater than the warming impact of O3 formation.

10 This figure reflects the relative shorter and smaller historical emissions of transport vs. other sectors such as agriculture and industry.

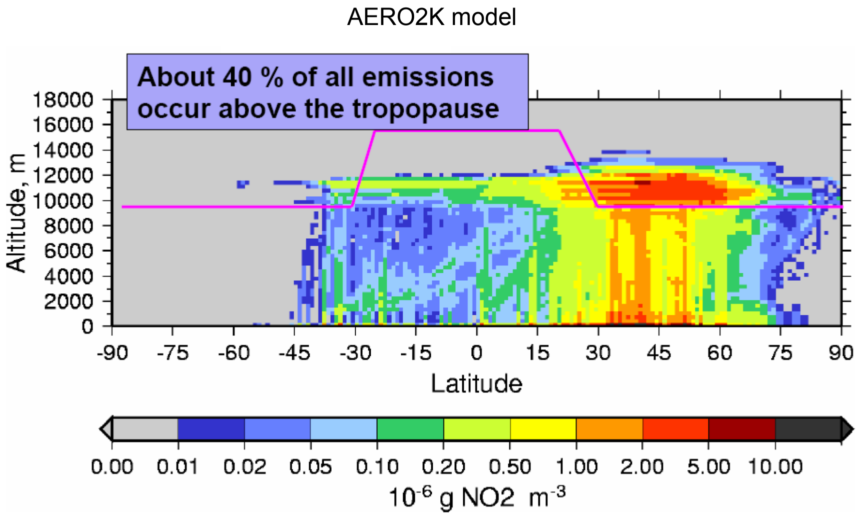
Figure 1-16: Integrated Radiative Forcing of Current Emissions by Substance and by Transport Sector



Source : Fuglestvedt et al. 2007

Aviation emissions, on the other hand, have a lower NOx to CO and a lower NOx to VOC ratio than shipping which indicates a greater potential for aviation NOx to be converted to O3 rather than OH. Aviation emissions resulting from taxiing and take-off can be assimilated to other ground-level NOx emissions and contribute principally to ground-level O3. Sub-sonic aircraft NOx emissions in the upper troposphere and lower stratosphere (e.g. less than 18kms) also tend to increase tropospheric ozone rather than break down CH4 – this is especially true immediately above the tropopause where a large share of aviation emissions take place (see Figure 1-17). This means that the warming impact from aviation-induced O3 creation is more than the cooling impact of aviation-induced CH4 destruction (IPCC 1999, Sausen 2005). Furthermore, O3 is less readily broken down at and above the tropopause and thus tends to have a longer life there than ground-level O3, compounding its climate impact (Rogers, 2002). These NOx-O3-OH reactions are also dependent on the season, latitude and ambient temperature and solar radiance. The most recent evaluation of aviation-related climate forcing (Sausen et al., 2005) finds that the instantaneous forcing from NOx-induced O3 and contrail formation is about twice as high as the CO2 forcing alone (as displayed in Figure 15). The non CO2 forcing from aviation diminishes over time as the relative importance of the CO2 component increases.

Figure 1-17: Vertical Distribution of Global Aviation Emissions



Source : Schuman&Sausen, 2007

Overall, according to CICERO, the total net integrated RF of year 2000 transport-sector emissions represents 16% of the 100-year integrated net RF of all current anthropogenic emissions. This assessment is accompanied by uncertainties related to the effect of contrails and cirrus cloud formation from aviation and to the effect of direct aerosol emissions on cloud formation and surface albedo changes.

The study shows the importance of accounting for transport-sector emissions of compounds and effects that are not addressed in the Kyoto protocol or in the UNFCCC process. The most important of these is O3 which is relevant for road, shipping and aviation emissions – but not in the same manner given the differences in which O3 is formed in each case. Furthermore, the impact of SO2 and NOx emissions (via OH formation) on CH4 reduction should not be overlooked. For instance, while there are highly compelling reasons to reduce SO2 emissions from shipping (e,g, to avoid acid rain), and progress is underway on this front at the IMO, one likely outcome is a decrease in the "cooling" impact of shipping emissions.

Finally, the CICERO work underscores the importance of assessing transport RF impacts on different time-scales. Indeed, doing so may lead to valuable policy insights since enlarging the mitigation focus from the "basket" of Kyoto-gases to other short-lived gases and compounds can lead to more targeted (e.g. in the case that rapid reductions in RF are deemed necessary) and/or cost-effective mitigation of climate change (insofar as lower-cost options may exist for the non-Kyoto gases and compounds).

1.4 Climate Change and its Physical Impacts

The fourth stage in the climate impact pathway is the actual change in global average temperatures triggered by emissions and their concentrations according to their specific RF potential. This, in turn, leads to the fifth stage which concerns the resultant changes in climate patterns and the physical impacts on ecosystems and hydrological resources, food and wood production and human settlements. Since these are of a generic (e.g. non-transport specific) nature, this report will focus only on the key relevant messages of this portion of the IPCC's work.

The IPCC Working Group 2 examined the linkages between emission scenarios, changes in global mean temperature, impacts and key climate vulnerabilities in order to assess a range of climate outcomes and provide "best estimate" guidance on potential "targets" for atmospheric concentrations of GHG's that avert unwanted climate change. Working back from these estimates, it also seeks to provide guidance on the associated reductions in emissions that are likely to lead to these "targets".

Such an approach is not straightforward and is fraught with uncertainties, not the least of which is that such predictions do not take into account the linkages between climate change and carbon cycles described earlier. Other difficulties in this exercise include:

- The difficulty in accurately predicting climate sensitivity, and
- The allocation between mitigation efforts and adaptation efforts.

Nonetheless, The IPCC puts forward its "best estimate" of linkages between atmospheric concentrations of GHG's and global average temperatures as well as the linkages between the latter and different classes of climate-related impact. It also indicates the range of GHG emission reductions necessary to achieve "target" atmospheric concentrations of GHG's. These are set out in Table 1-1.

Table 1-1: Properties of Emission Pathways for Alternative Atmospheric GHG Stabilisation Targets

1	2	3	4	5	6	7
Anthropogenic addition to radiative forcing at stabilization (W/m2)	Multi-gas concentration level (ppmv CO2 eq)	Stabilisation CO2 level, consistent w/ column 2 (ppmv CO2)	Global mean temp. increase above pre-industrial using best estimate (°C)	Likely range of column 4 at equilibrium	Peaking year for CO2 emissions	Change in global emissions to reach column 3 (% of 2000 emissions)
2.5-3.0	445-490	350-400	2.0-2.4	1.4-3.6	2000-2015	-85 to -50
3.0-3.5	490-535	400-440	2.4-2.8	1.6-4.2	2000-2020	-60 to -30
3.5-4.0	535-590	440-485	2.8-3.2	1.9-4.9	2010-2030	-30 to +5
4.0-5.0	590-710	485-570	3.2-4.0	2.2-6.1	2020-2060	+10 to +60
5.0-6.0	710-855	570-660	4.0-4.9	2.7-7.3	2050-2080	+25 to +85
6.0-7.5	855-1130	660-790	4.9-6.1	3.2-8.5	2060-2090	+90 to +140

Source: IPCC, 2007

These estimates are linked to indicative ranges of impacts (See Table 1-2) that provide some examples of the types of impacts that might be avoided by constraining changes in global temperature to a set range as compared to a higher one. These impacts include changes in scale and patterns of precipitation and wind, changes in soil moisture, changes in available water resources, loss of critical ecosystems, changes in ecosystems, agricultural and forest systems including the spatial shift of these, impacts on heating or cooling energy needs, changes in ocean currents and sea levels, changes in the extent and depth of permafrost, changes in snow patterns and cover etc. Already, evidence can be seen of many of the types of impacts described in the table and elsewhere in the IPCC report and there are strong indications that some of the impacts described may have been significantly under-estimated, especially those pertaining to melting in both the West Antarctic and Greenland ice sheets (Potsdam Centre for Climate, 2007)

Table 1-2: Examples of Key Vulnerabilities Associated with Changes in Global Mean Temperature

Increase in Global mean temp. relative to pre-industrial	Global Geophysical Systems (e.g. Greenland Ice Sheet)	Global Biological Systems (e.g. terrestrial ecosystems)	Global Social Systems I (e.g. Water)	Global Social Systems II (e.g. Food supply)	Regional Systems (e.g. Polar regions)	Extreme Events (e.g. fire risk)
>4 °C *(>4°-6°)*	Near total deglaciation	Large scale transformation of ecosystems and ecosystem services. At least 35% of species committed to extinction	Severity of floods, droughts, erosion, and water quality deterioration increases w/ climate change.	Further declines in global food production	Continued warming likely leads to further loss of ice cover and permafrost. Arctic ecosystems further threatened though net ecosystem productivity might increase.	Frequency and intensity likely to be greater, especially in boreal forests and dry peat lands after melting of permafrost.
3°-4° C *(>3.6°-4.6° C)*	Commitment to widespread to near total deglaciation, 2-7 m sea level rise over centuries to several millennia	Global vegetation becomes net source of CO2 above 2°-3° C	Sea level rise extends area of salinisation of ground water, decreasing freshwater avail. In coastal areas.		Economic opportunities may open up (e.g. shipping), costs in infrastructure provision and maintenance to increase, traditional ways of life further disrupted.	
2°-3° C *(>2.6°-3.6°)*	Lowers risk of near total glaciation	Widespread disturbance, sensitive to rate of climate change and land use. 20% to 50% species committed to extinction. *Avoids widespread disturbance to ecosystems and their services and constrains species loss*	Hundreds of millions of people would face reduced water supply.	Global food production peaks and begins to decrease. *Lowers risk of steeper declines in world food production associated with higher temp.*		
1°-2° C *(>1.6°-2.6° C)*	Localized deglaciation (already observed) would increase w/ temp.	10-40% of species committed to extinction. *Reduces extinction rate below 20-50%; prevents vegetation from becoming a net source of CO2.* Many ecosystems already affected	Increased flooding and drought severity. *Lowers risk of floods, droughts, deteriorating water quality and reduced water supply for hundreds of millions of people*	Reduced low-latitude food production, Increased upper latitude food production.	Climate change is already having substantial impacts on societal and ecological systems.	Increased fire frequency and intensity in many areas, particularly where droughts increase.
0°-1° C *(>0.6°-1.6° C)*	Lowers risk of widespread to near total glaciation	*Reduces extinctions to below 10-30%, reduces disturbance levels*		Increased global food production. *Reduces risk of decrease in food production and reduces regional losses/gains.*	*Reduced loss of ice cover and permafrost; limits risk to Arctic ecosystems and limits disruptions of traditional ways of life.*	*Lowers risk of more frequent and more intense fires in many areas.*

Source: IPCC, 2007 WG III Table 3.11

These climate change effects can also have both direct and indirect impacts on transport infrastructure, activity and patterns. These include the following:

- Changes in sea level and the frequency and scale of storm surges have a direct impact on port infrastructure and coastal road and rail infrastructure.
- Changes in hydrological resources can have an impact on inland and estuary navigation.
- Changes in wind strength have an incidence on transport infrastructure (e.g. road signage gantries, port cranes, and overhead electrical transmission wires for rail).
- Changes in permafrost boundaries and depth already have had an impact on road, pipeline and airfield infrastructure in affected zones.
- Loss of snow cover already has reduced access to northern regions via a loss in the use of "snow roads" in Canada, the United States and Russia.
- The indirect impacts of climate change relate largely to the shift in patterns of trade and human migration that might ensue.
- The loss of Arctic sea ice might also open up new trade routes that may have a positive benefit.

The 4th Assessment report indicates that a course leading to no more than a 2°C increase in global mean temperature above pre-industrial levels (range 1.6°C to 2.6°C) will reduce the probability of some of the most critical and irreversible changes triggered by climate change. This implies a peak in CO2 emissions before 2015 and a global decrease in atmospheric CO2 concentrations on the order of 50% to 85% by 2050. It seems likely that current trends will not allow this target to be achieved (See chapter 3). Indeed, the IEA projects a 57% increase of global energy-related CO2 emissions in their "business as usual" reference scenario. Constraining temperature change to a 50% probability that global temperatures do not exceed 3°C by 2100 will require a peak in emissions by 2020 and a 30%-60% reduction from 2000 by 2050.

If annual GHG emissions were to continue at current levels, pre-industrial levels of atmospheric GHG concentrations would nearly double to 550ppm by 2050 – a level at which the IPCC has determined would entail a very high probability that global average atmospheric temperatures would rise by more than 2°C.

Even stabilisation of atmospheric GHG emissions at 2000 levels (which would imply a decrease from current levels) would still lead to a rise in average global atmospheric temperatures by 0.1°C per decade which might result in a greater frequency and intensity of extreme weather events. Stabilisation of GHG concentrations below 550 ppm would require a reduction in total global emissions of GHG by *at least* 25% by 2050. Given growth in developing countries, reaching sub-550 ppm GHG concentrations by 2050 would likely entail even larger reductions in developed countries – on the order of 60-80%.

1.5 Cost Estimate of Climate Change Impacts based on the Stern Review[11]

The Stern Review is an economic analysis of climate change and of the cost and benefits of policies aiming to reduce GHG emissions and global warming impacts. A comparison of three methods constitutes the report's analytical framework:

[11] We do not comment here on the methodological (modeling versus disaggregated data, the choice of the relevant discount rates) and ethical issues related to estimating the economic costs of climate change, though it should be noted that several commentators have criticized Stern for selecting atypical discount rates and selecting extreme scenarios.

⇒ using disaggregated techniques by imputing a cost to each impact (on environment and human life) and a benefit to any action to reduce these impacts;

⇒ using macro-dynamic models figuring the economic system as a whole mechanical system driven by forces and counter-forces (model PAGE 2002 is used);

⇒ comparing the current level and the possible future trends of the social cast of the global warming, including abatement costs.

The basic scenario taken by the Stern review is the following: in 2000, the level of GHG gases in the atmosphere was equivalent to around 430 parts per million CO_2. equivalent (compared to the 280 ppm in the pre-industrial period). He assumes that by 2050 atmospheric concentration of CO2 should reach 550 ppm if the annual flow of emissions does not increase above the current level. This level should be reached by 2035 in case of an acceleration of GHG emissions. The level of 550ppm means a rise of the global average temperature of 2-3°C. He warns that according some "business as usual" scenario projections, the atmospheric concentrations might triple by the end of the 21st century inducing a rise of the global average temperature exceeding 5 °C.

After underlining the physical impacts of climate change around the earth (benefits in the high latitudes countries and high costs in the tropical and desert areas), Stern estimates the cost of the 2-3°C warming scenario by 2050 at "a permanent loss of around 0-3% in **global world output** compared with what could have been achieved in a world without climate change" (Stern Review, Executive Summary, p. ix).

Modelling the BAU climate change (using the basic economics of risk) drives him to conclude to a 20 % reduction in **consumption per *capita***, and a reduction in **welfare** by an amount equivalent to a reduction in consumption per head of between 5 and 20 %.

He also gives some more specific examples of the economic cost of global warming:

⇒ The extreme weather events should cost between 0.5% to 1% of the annual world GDP by 2050;

⇒ In the USA, a 5 or 10% increase in hurricane wind speed should double the annual damage costs;

⇒ In the UK, an increase of the global average temperature by 3°C or 4°C should induce flood losses which cost should increase from 0.1 % of GDP in 200 to 0.2 % to 0.4 % of GDP;

⇒ Europe should experience more heat waves; the cost of the 2003 one was of US $ 15 billion.

The Review mainly focuses on defining relevant targets and estimating the costs and benefits of reducing GHG emissions policies. It gives at a first approximate, with a stabilisation of the stock in the atmosphere between 450-550 ppm CO_2 equivalent is targeted, a social cost of US$ 25-30 per tonne of CO_2. The social cost of carbon should increase over time because of the marginal damages of GHG stock in the atmosphere.

1.6 GHG Reduction and Other Related Targets

A 60%-80% reduction in GHG emissions from 1990 to 2050 is a very ambitious goal, especially given the experience countries have had since 1990 in reducing their overall GHG emissions. A number of countries have agreed binding and/or voluntary targets to reduce their overall GHG emissions. Many of the targets adopted are absolute – that is, they call for a decrease in GHG emissions from a baseline year. Some, however, focus on efficiency and call for relative improvements in GHG emissions as measured against a common denominator – most often per unit of GDP. In the latter case, reductions in the GHG intensity or improvements in the energy efficiency of the economy may be accompanied by increasing overall emissions – albeit at a lower rate than without the targets. Many countries have targets relating to fuel efficiency or share of alternative fuels. These targets, while important, only indirectly address transport-sector GHG emissions. Of the GHG reduction targets adopted or proposed by countries, very few apply specifically to transport-sector emissions but given the relative share of these to total emissions (and of CO2 emissions in particular) in most countries, even non-sector-specific targets are sure to have an incidence on the transport sector.

In this section, we examine the range of targets adopted or proposed by countries, assess progress towards meeting these targets and give an indication of the level of reduction effort required by the targets. The latter is particularly relevant to sectoral policies because, without predicating the level of reduction effort ultimately undertaken in each sector, they do provide a common benchmark against which to measure sectoral policies and to measure trends in emissions vs. emission reduction goals.

1.5.1. Kyoto Protocol Targets

As part of the Kyoto Accord, signed in 1997 by 39 countries and the European Union and entered into force in 2005, 38 countries have agreed to binding emission reduction targets for the period 2008 to 2012. Collectively, these countries' agreed targets represent a 4.1% reduction in GHG emissions. It should be noted that although the European Union agreed to a binding 8% reduction in GHG emissions in 1997 for its then 15 members, it has since then agreed a differentiated burden allocation scheme amongst its current 27 members. Table 3 summarises progress in 2005 towards the Kyoto and EU burden-sharing targets. Although the United States has not ratified the Kyoto Protocol[12], the emission target it signed to in Kyoto and its progress towards that hypothetical target is shown for comparison. It should be noted that because of lack of agreement on the allocation of international aviation and maritime emissions, emissions from these sectors are not included in the Kyoto targets.

Table 1-3 shows absolute emissions in 1990 and 2005, along with an unscaled trendline, in columns 2-4. It then shows the Kyoto or EU burden-sharing target in column 5 along with a measure of performance in 2005 towards the 2008-2012 Kyoto or EU target. Column 6 displays the gap between 2005 performance and the 2008-2012 target (here the ratio of 2005 to 1990 emissions shows 2005 emissions compared to 1990 and should be compared to the Kyoto target in column 5 for an assessment of progress towards the latter) along with a measure of the size of the gap in million tonnes of CO2 equivalent.

In terms of relative performance to target, 13 countries were within 10% of their Kyoto/EU goal in 2005. However, in terms of absolute gaps from target, the graphic highlights the current overshoot of emissions in EU-15 countries (especially Italy and Spain), Australia (where the Kyoto Accord was just ratified in March 2008), Canada and Japan. Additionally, although the United States has no legal Kyoto target, the overshoot of its 2005 emissions in reference to the 7% reduction agreed in Kyoto is twice that of the 2005 overshoot of all other Annex 1 parties combined (1448Mt and 753Mt, respectively). Also notable is the weight of the combined 2005 shortfall in relation to the 2008-2012 Kyoto target. This is due to the large-scale structural changes that many countries have undergone since 1990 – Russia, the Ukraine, Poland and Romania are notable in terms of the sheer volume of reduced emissions. The total undershoot in 2005 is nearly twice that of the Kyoto Annex I parties with agreed binding targets (-1896 Mt and 753 Mt, respectively).

[12] Had the United States ratified the Kyoto Protocol, the total emission target for 2008-2012 would have been -5.1%, not -4.1%.

Table 1-3: Progress Towards Kyoto Targets by UNFCCC Annex I Countries

Rank = 1990 Emissions	Emissions Trend (unscaled) 1990	2005	Kyoto or EU target from 1990**	Performance in 2005 against Target (2010) 2005/1990	Shortfall-Overshoot 2005 vs. Target Mt CO2-eq
United States***	6229.0	7241.5	*-7.0%*	16.3%	1448.47
EU - 15	4258.9	4194.3	*-8.0%*	-2.0%	255.50
Russia	2989.8	2132.5	*0.0%*	-28.7%	857.32
Japan	1272.0	1359.9	*-6.0%*	6.9%	164.19
Germany	1227.9	1001.5	*-21.0%*	-18.7%	27.82
Ukraine	923.8	418.9	*0.0%*	-54.7%	504.92
United Kingdom	771.4	657.4	*-12.5%*	-15.7%	24.93
Canada	596.0	746.9	*-6.0%*	25.3%	186.69
Poland	586.9	399.0	*-6.0%*	-32.0%	152.69
France	567.3	558.4	*0.0%*	-1.9%	10.50
Italy	516.9	579.5	*-6.5%*	12.1%	96.47
Australia	418.3	525.4	*8.0%*	25.6%	73.67
Spain	287.4	440.6	*15.0%*	52.2%	107.79
Romania	282.5	153.7	*-8.0%*	-45.6%	106.20
Netherlands	213.0	212.1	*-6.0%*	-1.2%	10.38
Czech Republic	196.2	145.6	*-8.0%*	-25.8%	35.00
Belgium	145.8	143.8	*-7.5%*	-2.1%	7.92
Bulgaria	132.6	70.0	*-8.0%*	-42.8%	45.94
Belarus	127.4	75.6	*-5.0%*	-40.6%	45.40
Hungary	115.7	80.2	*-6.0%*	-34.6%	35.12
Greece*	108.7	137.6	*25.0%*	25.3%	0.33
Austria	79.1	93.3	*-13.0%*	18.1%	24.57
Sweden	72.2	67.0	*4.0%*	-7.3%	8.19
Slovak Republic	72.1	47.9	*-8.0%*	-33.7%	18.83
Finland	71.0	69.2	*0.0%*	-2.5%	1.80
Denmark	70.4	65.5	*-21.0%*	-7.8%	9.15
New Zealand	61.9	77.2	*0.0%*	24.7%	15.26
Portugal	59.9	85.5	*27.0%*	40.4%	8.16
Ireland	55.4	69.9	*13.0%*	25.3%	6.85
Switzerland	52.7	53.6	*-8.0%*	1.7%	5.12
Norway	49.8	54.2	*1.0%*	8.8%	3.90
Lithuania	49.4	22.7	*-8.0%*	-53.0%	21.65
Estonia	42.6	20.9	*-8.0%*	-51.9%	18.86
Croatia	31.6	30.5	*-5.0%*	-15.6%	3.67
Latvia	26.4	10.9	*-8.0%*	-57.9%	12.93
Slovenia	20.3	20.4	*-8.0%*	0.5%	1.72
Luxembourg	12.7	12.7	*-28.0%*	0.0%	3.56
Iceland	3.4	3.7	*10.0%*	8.8%	0.04
Liechtenstein	0.2	0.3	*-8.0%*	50.0%	0.12

0% 100% 200%

(EU Member)

* 2004

** or alt. base year

*** not yet ratified

Data source: UNFCCC

The European Environment Agency and the Netherlands Environmental Assessment Agency (MNP) have forecast the 2010 performance of Annex I countries with agreed targets and of EU member countries in particular. Excluding as of yet uncertain changes in GHG emissions from land use change and forestry, the MNP finds that industrialised countries with Kyoto targets will likely collectively meet these with a reduction of approximately 11% from 1990 levels by 2010 (compared to the collective 4.1% reduction target). The 11% reduction will be delivered mainly from the projected shortfall in emissions relative to agreed targets of Russia and other Economies in Transition States (-40% from 1990 to 2010) facilitated by the limitation of increases in GHG emissions in OECD countries, and in particular, from a stabilisation of emissions within the EU (MNP, 2008). If currently planned Clean Development Mechanism (CDM)[13] projects are included, the overall decrease in emissions may be as much as 15% over 1990 levels.

Table 1-4: 2010 EEA Forecast Performance against EU Burden-Sharing Targets: EU 27 and Associates

Rank=1990 emissions	Kyoto EU/Target	Proj. performance against target 2010 (2010/1990)	Further planned reduction Mt CO2-eq	Type of measures	Proj. performance against target w/ measures 2010 (2010 adj./1990)	2010 emissions over/under target with measures Mt CO2-eq
Germany	-21.0%	-22.4%	40.9		-25.7%	-58.4
United Kingdom	-12.5%	-23.2%	4.1		-23.7%	-86.7
Poland	-6.0%	-28.4%			-28.4%	-131.7
France	0.0%	0.9%	24.0		-3.4%	-19.0
Italy	-6.5%	13.1%	99.0		-6.0%	2.6
Spain	15.0%	42.2%	37.6		29.2%	40.9
Romania	-8.0%	-31.9%	11.1		-35.8%	-78.5
Netherlands	-6.0%	-0.7%	20.1		-10.1%	-8.7
Czech Republic	-8.0%	-25.8%	6.0		-28.8%	-40.9
Belgium	-7.5%	-3.6%	7.0		-8.4%	-1.3
Bulgaria	-8.0%	-37.0%	6.4		-41.6%	-46.5
Hungary	-6.0%	-28.5%	0.3		-28.7%	-27.8
Greece	25.0%	34.6%	10.9		24.9%	-0.1
Austria	-13.0%	17.2%	24.1		-13.3%	-0.2
Slovak Republic	-8.0%	-20.1%	2.3		-23.3%	-11.2
Sweden	4.0%	-3.5%	2.1		-6.4%	-7.5
Finland	0.0%	19.5%	15.4		-2.1%	-1.5
Denmark	-21.0%	-9.7%	6.5		-19.0%	1.4
Portugal	27.0%	44.5%	13.0		23.2%	-2.3
Ireland	13.0%	22.6%	5.8		12.2%	-0.5
Switzerland	-8.0%	-3.2%	2.9		-8.8%	-0.4
Norway	1.0%	18.9%			-1.2%	-1.1
Lithuania	-8.0%	-30.2%			-30.2%	-10.7
Estonia	-8.0%	-56.6%	1.4		-60.0%	-22.6
Croatia	-5.0%	0.3%	3.9		-10.8%	-2.0
Latvia	-8.0%	-46.2%	0.6		-48.6%	-10.3
Slovenia	-8.0%	6.9%	4.0		-12.9%	-1.0
Luxembourg	-28.0%	11.8%	4.7		-28.3%	0.0
Iceland	10.0%	3.0%			3.0%	-0.2
Liechtenstein	-8.0%	0.0%			0.0%	0.1

0% 100% 200%   add. measures   carbon sinks   Kyoto mech.   0% 100% 200%

Source: EEA data and projections

The EEA has assessed forecast 2010 emissions from EU member and associate states against the EU burden-sharing targets. Table 1-4 summarises this assessment. It displays the EEA forecast performance against the EU burden-sharing target in columns 3 and 4 with the latter displaying the percentage the country is likely to be over or under its 1990 emissions (this figure should be compared to the Kyoto/EU burden sharing target). Column 5 shows the volume (Mt) of further emission reductions planned or underway and column 6 shows the relative weight of each of three types of these further planned emission

[13] CDM projects enable countries to meet their Kyoto targets by claiming emission reductions for certified projects undertaken in developing countries – either by directly implementing or funding the project or by purchasing these reductions (certified emission reduction certificates – CERs) on the market.

reductions; additional measures, carbon sinks (based on vegetation and land-use change) and through the purchase of emission reduction certificates (e.g. through the Kyoto Mechanisms[14]). Finally, columns 7-9 show performance against the EU burden sharing target when all supplementary measures are accounted for as well as the final balance in absolute terms (Mt) against countries' agreed targets.

Some countries projected to meet their targets with existing measures will nonetheless undertake additional GHG reduction measures beyond their EU target (e.g. Germany, UK, Romania, Czech Republic, Bulgaria, Hungary, Slovak Republic, Sweden, Estonia, Latvia and Slovenia). Those countries not projected to meet their targets collectively plan for an additional reduction of 161 Mt of GHG; 48% of which will come from additional measures, 40% from use of Kyoto Mechanisms (e.g. CDM) and the remainder from the use of carbon sinks.

Outside the EU, Japan expects that it will need a 1.6% reduction in GHG from CDM projects to meet its targets and is planning on purchasing part of this reduction from Hungary (and is in negotiations with other parties as well). Japan also projects a further 3.9% reduction from the use of carbon sinks for a total of 5.5% -- nearly all of its Kyoto target. Other non-EU countries experiencing rising emissions from 1990 will likely need to have recourse to Kyoto mechanisms and carbon sinks as well – notably Australia and Canada. The projected demand for emission reduction certificates is relevant for some transport sub-sectors that are facing inclusion in regional carbon trading schemes (aviation and, potentially, maritime transport to/from the EU) as this demand will have an impact on the traded price of carbon.

1.5.2. GHG reduction targets beyond Kyoto

A number of emission reduction or energy efficiency targets that go beyond the Kyoto Protocol have been adopted or proposed by countries and regions. Few, however, specifically address the transport sector. The exceptions are the proposed EU mandatory targets for non ETS sectors which de facto includes a large transport component, the inclusion of aviation emissions in the EU ETS, the transport-specific GHG reduction targets set by Japan and the Netherlands. The most important of the non-Kyoto targets are summarised below:

European Union	• -20% GHG emissions from 1990 levels by 2020 • -30% by 2020 if other countries adopt strong targets • Target to save 20% of the EU's total primary energy consumption by 2020 from what it otherwise might have been. • Proposed directive to include international and domestic aviation emissions in the EU emissions trading system (EU ETS). Effective target is the cap of aviation emissions at 100% of the average of years 2004-2006. Allocation of permits yet undermined but likely to include some auctioning. • An obligation to reach, in aggregate (with different national targets) a 20% share of renewable energy in the EU's final energy consumption by 2020. • An obligation for each member state to reach a biofuels target of 10% share of overall diesel and gasoline consumption by 2020. • Proposed mandatory national targets for sectors not covered by the EU ETS from 2005 to 2020.

[14] In addition to the CDM, the Kyoto Protocol allows for Joint Implementation (countries co-operating on emission reduction projects allowing for parties to claim extra-territorial emission reductions) and through emissions trading. In the present example, the EEA excludes emissions trading under the European Trading System as this forms part of currently planned emission reduction measures of EU States.

Germany:	• -40% GHG emissions from 1990 by 2020
France:	• -20% GHG emissions from 1990 levels by 2020 • -75 GHG emissions from 1990 by 2050 Energy law) • -2%/yr energy intensity improvement (energy consumption to GDP) to 2015 and -2.5%/yr energy intensity improvement from 2015 to 2030.
Netherlands	• -30% GHG emissions from 1990 levels by 2020 • Absolute target of ~30 Mt cut in transport GHG emissions by 2020 (return to 1990 levels, 13-17 Mt below the "business-as-usual projection"). • 2% reduction in energy consumption annually. • 20% renewable energy in 2020.
United Kingdom:	• -20% GHG emissions from 1990 by 2010 (CO2) • -60% GHG emissions from 2000 levels by 2050 (CO2)
Japan:	• -30% energy use from 2003-2030. • Absolute target of 250 Mt CO2 from transport in 2010 from a baseline of 260 Mt in 2002 (compare to 217 Mt in 1990) which represents 24 Mt below the 2010 "business-as-usual" projection.
USA:	• Voluntary Federal target of -18% GHG intensity compared to 2002 levels by 2012. • Federal mandate for 9 billion gallons of biofuels in 2008 and 36 billion gallons of biofuels by 2022
California:	• -80% GHG emissions from 1990 by 2050 (CO2)
NE and Mid-Atlantic States (USA):	• GHG reduced to 2005 levels by 2009-2012 • minus a further 10% by 2015-2018
China:	• -20% energy intensity improvement from 2005-2010

1.5.3. Level of Effort Implied by Targets

Some targets are more ambitious than others and some target relative improvements rather than absolute emission reductions. In order to compare targets to each other, and to compare trends in emissions vs. the reduction efforts implied by the various targets, it is useful to have a common benchmark. One such benchmark is to annualise the reduction effort required by the various adopted or proposed targets.

Level of effort can be represented by the compound annual growth rate (CAGR) implied by reaching a future target from the present. A negative CAGR implies a reduction and a positive CAGR an increase. The 4.1% reduction in GHG emissions for all countries with binding Kyoto targets implies that this group of countries, in aggregate, must reduce emissions by 0.2% per year from 1990 to 2010. For comparison, Table 1-5a displays the CAGR implied by individual Kyoto or EU Burden-sharing targets and Table 1-5b, the implied CAGR for the proposed targets under the EU's objectives on climate change and renewable energy for 2020 for those sectors not covered by the European Trading Scheme (e.g. Transport, Buildings, Services, Agriculture and Waste). Table 5b is particularly relevant for EU transport-related GHG reduction policies as the weight of the transport sector is predominant among the sectors covered. Finally, Table 5c shows the implied CAGR for other non-Kyoto targets discussed in 1.5.2. above.

Obviously, countries face different compound annual growth rates and these are often part of the target design with wealthy countries or countries with relatively easier emission reduction measures available to them signing on for larger emission reduction rates. However, all of these targets are challenging for the transport sector as this sector has most often seen continued growth, not reductions, in emissions over the past years. Thus the reduction efforts implied by the proposed EU mandatory targets for non-EU ETS traded sectors, which, with the exception of Greece and Luxembourg, are all higher than countries' respective Kyoto-related CAGRs, are likely to require efforts significantly beyond "business-as-usual" in the transport sector. Even Japan's absolute target for transport-sector CO2 emissions which implies a relatively low -0.587% yearly reduction in emissions from 2002 to 2010 is greater than the -0.309% p.a. reduction implied by that county's Kyoto target -- which has proven extremely challenging to meet.

Table 1-5c also outlines the CAGR implied by various relative targets proposed by countries. In the next chapter we will compare these to observed efficiency trends. It is interesting to note, however, that China's proposed energy intensity target appears to be the most ambitious of all – although this is understandable since many energy-saving options already implemented in more mature economies are still available to China.

Table 1-5: Kyoto and Non-Kyoto Targets: Implied Compound Annual Growth Rates (CAGR)

5A: Kyoto or EU Burden Sharing Target:

Reference Year=1990
Target Year= 2008-2012 (2010)

	Kyoto/EU Target	Implied CAGR
Australia	8,0%	0,386%
Austria	-13,0%	-0,694%
Belarus	-5,0%	-0,256%
Belgium	-7,5%	-0,389%
Bulgaria	-8,0%	-0,416%
Canada	-6,0%	-0,309%
Croatia	-5,0%	-0,256%
Czech Republic	-8,0%	-0,416%
Denmark	-21,0%	-1,172%
Estonia	-8,0%	-0,416%
EU - 15	-8,0%	-0,416%
Finland	0,0%	0,000%
France	0,0%	0,000%
Germany	-21,0%	-1,172%
Greece	25,0%	1,122%
Hungary	-6,0%	-0,309%
Iceland	10,0%	0,478%
Ireland	13,0%	0,613%
Italy	-6,5%	-0,335%
Japan	-6,0%	-0,309%
Latvia	-8,0%	-0,416%
Liechtenstein	-8,0%	-0,416%
Lithuania	-8,0%	-0,416%
Luxembourg	-28,0%	-1,629%
Netherlands	-6,0%	-0,309%
New Zealand	0,0%	0,000%
Norway	1,0%	0,050%
Poland	-6,0%	-0,309%
Portugal	27,0%	1,202%
Romania	-8,0%	-0,416%
Russia	0,0%	0,000%
Slovak Republic	-8,0%	-0,416%
Slovenia	-8,0%	-0,416%
Spain	15,0%	0,701%
Sweden	4,0%	0,196%
Switzerland	-8,0%	-0,416%
Ukraine	0,0%	0,000%
UK	-12,5%	-0,665%
USA	-7,0%	-0,362%

5B: EU Proposed Mandatory Targets for non-ETS Sectors:

Reference Year=2005
Target Year= 2020

	Non-ETS Target	Implied CAGR
Austria	-16,0%	-1,156%
Belgium	-15,0%	-1,078%
Bulgaria	20,0%	1,223%
Czech Republic	9,0%	0,576%
Denmark	-20,0%	-1,477%
Estonia	11,0%	0,698%
Finland	-16,0%	-1,156%
France	-14,0%	-1,000%
Germany	-14,0%	-1,000%
Greece	-4,0%	-0,272%
Hungary	10,0%	0,637%
Ireland	-20,0%	-1,477%
Italy	-13,0%	-0,924%
Latvia	17,0%	1,052%
Lithuania	15,0%	0,936%
Luxembourg	-20,0%	-1,477%
Netherlands	-16,0%	-1,156%
Poland	14,0%	0,877%
Portugal	1,0%	0,066%
Romania	19,0%	1,166%
Russia		
Slovak Republic	13,0%	0,818%
Slovenia	4,0%	0,262%
Spain	-10,0%	-0,700%
Sweden	-17,0%	-1,235%
UK	-16,0%	-1,156%
Cyprus	-5,0%	-0,341%
Malta	5,0%	0,326%

5C: Other Mandatory or Aspirational Targets

Country/Region	Nature of Target M=Mandatory A=Aspiration	Target indicator	Reference year	Target Year	Target	Implied CAGR
EU	M	emissions (Mt)	1990	2020	-20%	-0,741%
EU	A	emissions (Mt)	1990	2020	-30%	-1,182%
France	M	emissions (Mt)	1990	2020	-25%	-0,954%
France	A	emissions (Mt)	1990	2050	-75% to -80% (-75%)	-2,284%
Germany	M	emissions (Mt)	1990	2020	-40%	-1,688%
Japan	M?	emissions (Mt)	2002 (262 Mt)	2010	250 Mt (-4,6%)	-0,587%
Netherlands	M	emissions (Mt)	1990	2020	-30%	-1,182%
UK	M	emissions (Mt)	1990	2010	-20%	-1,110%
UK	M	emissions (Mt)	2000	2050	-60%	-1,816%
California	M?	emissions (Mt)	1990	2050	-80%	-2,647%
NE + M. Atlantic States (USA)	?	emissions (Mt)	2005	2009-2012 (2012)	-10%	-1,494%
China	?	Energy intensity	2005	2010	-20%	-4,365%
EU	M	Energy efficiency	na	BAU 2020	-20% from BAU	
Japan	?	Energy intensity	2003	2030	-30%	-1,312%
USA	A	GHG intensity	2002	2012	-18%	-1,965%

Chapter Summary

⇒ The climate impact of transport-sector emissions can be tracked along a pathway leading from emissions to atmospheric concentrations, to actual changes in global average temperatures brought on by the radiative forcing properties of emitted compounds and to the physical impacts of climate change. This impact chain is characterized by increasing scientific uncertainty even as policy relevance increases. As a result, climate policy-making is characterised by the need to balance significant yet uncertain risks with immediate and consequent actions.

⇒ The transport sector was responsible for 23% of world CO2 emissions from fuel combustion (30% for OECD countries) in 2005 with the road sector largely dominating. When factoring in all GHG emissions, transport CO2 emissions accounted for approximately 13% of global GHG emissions – *but this figure is much more tentative given the significant uncertainties in the absolute amount of GHG emissions, especially from agriculture, forestry and biomass decay*.

⇒ The transport sector has displayed robust CO2 emissions growth across most ITF regions, even as some regions have seen reductions in CO2 emissions from other sectors. CO2 emissions from international aviation and, to a lesser extent, international maritime transport have grown quickest in most ITF regions.

⇒ There is some dispute as to the true scale of emissions from international maritime activity. Recent activity based estimates, including that undertaken for the IMO, place international maritime emissions at twice the level previously estimated (1.12 Mt in 2007) by IEA fuel sales data and some previous activity-based estimates. This would place CO2 emissions from international maritime activity in 6th place in the world between the emissions of India and Germany.

⇒ Emissions from international aviation are estimated to be in the order of 415Mt (2005) placing the sector in 11th place in relation to top-emitting countries.

⇒ Linking emissions to impacts requires an assessment of the ultimate concentration of GHGs in the atmosphere. There is a robust upwards trend in atmospheric CO2 concentrations and this trend is strongly correlated both to CO2 emissions and to global average temperature changes. There is further evidence that due to the decreasing effectiveness of ocean and, to a lesser extent, land sinks, the rate of CO2 concentration in the atmosphere is accelerating.

⇒ The principal climate forcing impact over the long term comes from road CO2 emissions. However, ozone formation due to emissions of NOx, VOC's and CO are the second-most important source of transport-related climate forcing. According to recent analysis, the total net integrated RF from year 2000 transport-sector emissions represents 16% of the 100-year integrated net RF of all current anthropogenic emissions.

⇒ Due to the nature and location of NOx and Sulphur emissions from shipping, the total net radiative forcing impact of the sector is likely negative at all but the longest time scales. Conversely, NOx emissions and contrail formation stemming from aviation activity represent a significant additional source of radiative forcing beyond the CO2 forcing alone.

⇒ Assessing transport RF impacts from non Kyoto gases and at different time-scales is important for transport climate policies. Enlarging the mitigation focus from the “basket” of Kyoto-gases to other short-lived gases and compounds as well as contrails from aviation can lead to more targeted (e.g. in the case that rapid reductions in RF are deemed necessary) and/or cost-effective mitigation of climate change (insofar as lower-cost options may exist for the non-Kyoto gases and compounds).

⇒ The IPCC indicates that a course leading to no more than a 2°C increase in global mean temperature above pre-industrial levels (range 1.6°C to 2.6°C) will reduce the probability of some of the most critical and irreversible changes triggered by climate change. This implies a peak in CO2 emissions before 2015 and a global decrease in atmospheric CO2 concentrations on the order of 50% to 85% by 2050.

⇒ Industrialised Countries are likely to meet and surpass their agreed Kyoto targets, however this success stems mostly from one-off structural changes in transition economies and in the energy sector rather than through the application of measures in other measures. Other, more rigorous targets have or are being proposed and the level of effort implied by these will be extremely challenging for the transport sector even if they don’t expressly target the transport sector to-date.

2. LINKING TRANSPORT ACTIVITY TO CO_2 EMISSIONS: FACTORS, TRENDS AND PROJECTIONS

The previous chapter investigates the impact pathway linking emissions of greenhouse gases to the climate change-related impacts these contribute to. It identifies transport-related GHG and CO_2 emissions as an important and growing source of overall emissions. Effective policy-making in this field, however, requires a more detailed understanding of how and under what circumstances human activities give rise to transport-related GHG emissions. This chapter looks at the various factors whose sometimes complex interplay has led to the historic trend in transport GHG emissions. Because the bulk of transport GHG emissions concern CO2, it will primarily focus on the factors underpinning transport-related emissions of CO2. It investigates trends in all of the major transport modes including international aviation and maritime transport and, where possible, addresses passenger and freight transport separately.

2.1 Relative Indicators of Transport GHG Emissions

The previous section addressed the absolute levels of GHG and CO2 from International Transport Forum (ITF) countries. Obviously some countries and regions emit more CO2 than others but the reasons for this can be linked to a number of factors such as the size of their population, the size of the country and the level of economic activity. Accounting for emissions per capita and/or emissions per unit of economic activity can better allow policy-makers to compare their country's historic GHG performance and allow comparison with other like countries. Figure 2.1 displays per-capita emissions of CO2 from the transport sector (including international aviation and maritime, allocated by country of sale of fuel) and transport CO2 emissions per unit of GDP in 2005 for all International Transport Forum Countries and the top-ten largest CO2 emitting non ITF economies.

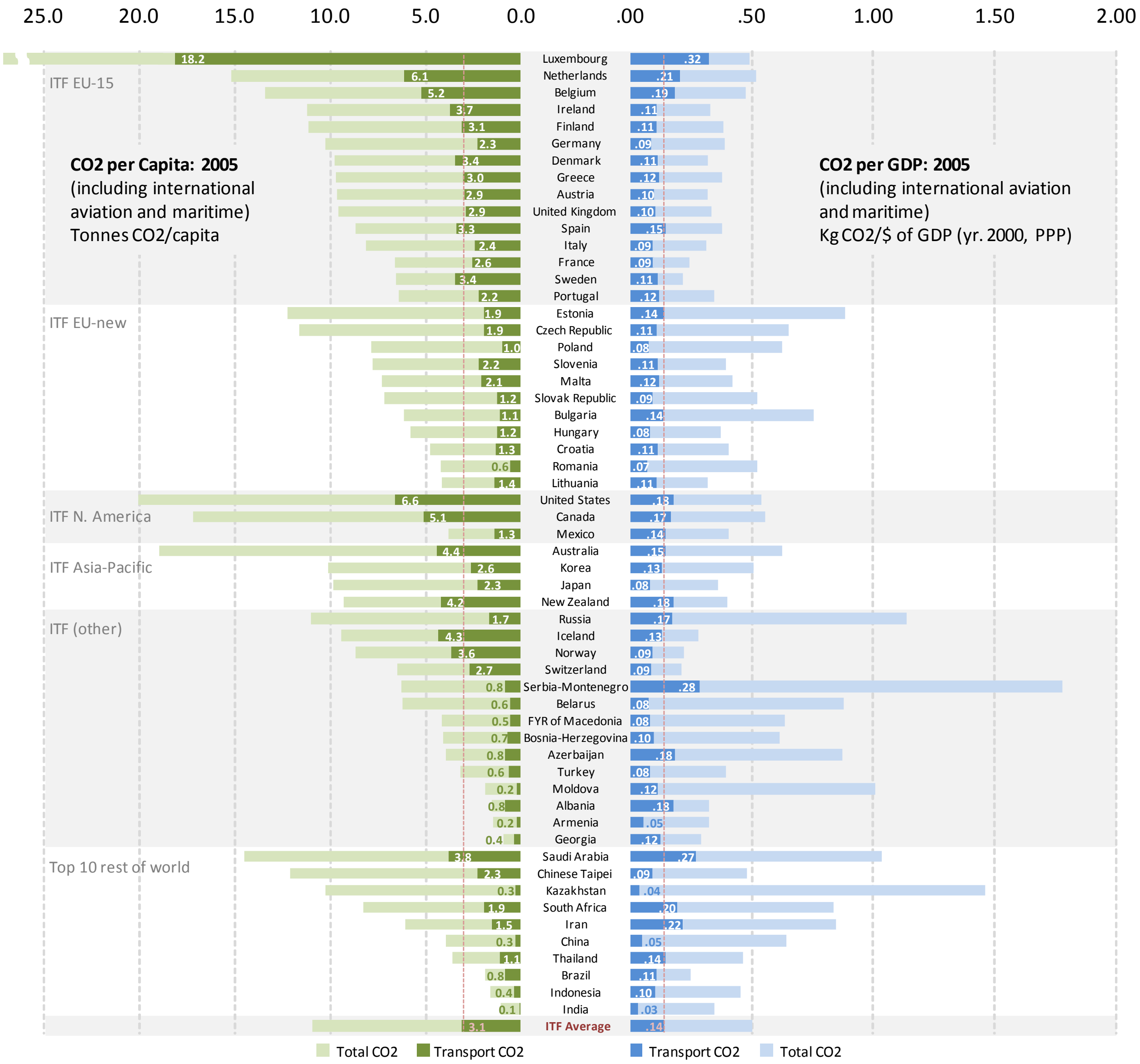
2005 per capita emissions of CO2 from transport among ITF countries varied from 6.6 tonnes in the USA[15] to 0.2 tonnes in Armenia. Average per capita emissions of transport CO2 are 3.1 tonnes for ITF countries which is considerably higher than the per capita emissions of the principal CO2-emitting non-ITF countries (e.g. China, India and Iran's per capita emissions of CO2 from transport are 0.3, 0.1 and 1.5 tonnes respectively).

Levels of transport CO2 emissions per dollar of GDP (PPP, 2000 USD) are more balanced among most ITF countries. The average GDP intensity of transport CO2 emissions for international Transport Forum Countries is 0.14 kg of CO2 per dollar of GDP.

Generally, the creation of more wealth per capita in ITF countries has been accompanied by rising per-capita CO2 emissions from transport activity. Countries differ in the relative per capita transport CO2 intensity of their growth. For instance, Turkey, Denmark, Hungary, New Zealand, Austria and Portugal all experienced roughly the same rate of per-capita GDP growth but displayed a very wide range of per-capita transport CO2 emissions growth. Even if many countries have been able to increase per-capita GDP at relatively lower rates of growth of transport CO2 emissions, the absolute increase in transport-sector CO2 emissions from these countries is not negligible.

[15] Luxembourg shows 18 tonnes per capita but this is largely due to petrol sales to non-Luxembourg residents spurred by low relative fuel tax rates.

Figure 2.1 Per-Capita and Per-GDP Emissions of Transport CO2 in 2005
(including international aviation and maritime transport, allocated by country of fuel sale)

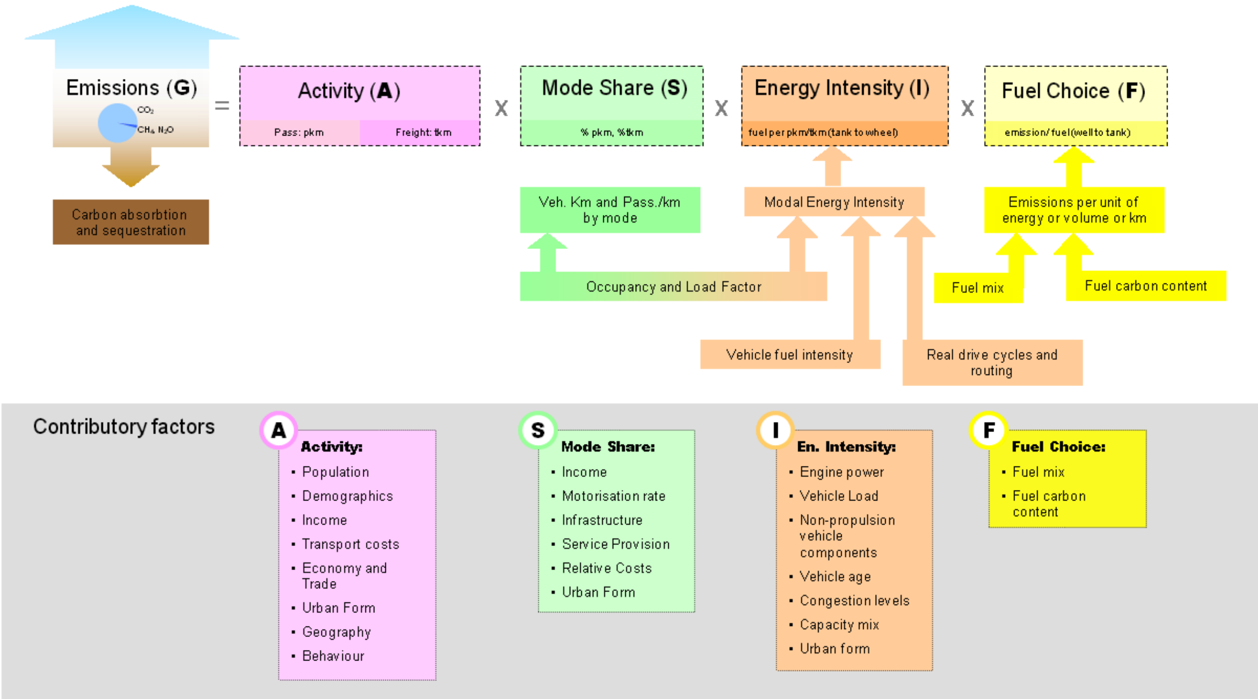


Source: Data from IEA, "CO2 Emissions from Fuel Combustion" (2007)

2.2 Decomposing Transport GHG Emissions: Analytical Framework

Lee Schipper and the International Energy Agency (Schipper, 2000, IEA, 2007, "Energy Use in the New Millennium") have developed a useful analytical framework to track the various components of emissions. This framework is illustrated in Figure 2.2 below.

Figure 2.2: Emissions Decomposition: Factors Underlying Transport CO2 Emissions



Source : adapted from Schipper, 2000 and IEA, "*Energy Use in the New Millennium: Trends in IEA Countries" (2007)*

The decomposition approach breaks down energy-related emissions as a result of four factors which serve as a useful starting point for understanding the underlying trends driving transport CO2 emissions:

- Activity (e.g. volume effect),
- Structure (e.g. mode share effect),
- Energy Intensity (e.g. energy efficiency effect), and
- Fuel (e.g. fuel mix and carbon intensity effect)

The amount of CO2 emitted from transport activity results from the decisions and actions of industry, households, employers and local and national governments across all four of these categories.

The following sections examine each of these factors in turn and analyse which have had an important role in contributing to, or alternatively, moderating growth in transport CO2 emissions. In so doing, they draw on data and analysis undertaken by the International Energy Agency (in particular on the analysis contained in "Energy Use in the New Millennium: Trends in IEA Countries" and data from the IEA Mobility Model). When possible, the following sections will try to provide comparable trend data in terms of energy efficiency for either passenger or freight transport. However, in some cases, detailed data is lacking and general data by transport sub-sector (e.g. road, aviation, etc.) will then be used.

2.3 Activity

Transport activity rate is perhaps the most important factor determining CO2 emissions, not least because it highlights the potential trade-off between transport-induced welfare and increased CO2 emissions. Transport activity is typically described on a first-order basis by measuring vehicle kilometres (vkm) although such a measure does not allow for ready comparisons across modes or take into account varying load factors. It is also necessary to measure passenger kilometres (pkm) or tonne-kilometres (tkm) although these metrics require more detailed data collection. While most ITF countries track tkm annually and survey vkm and pkm periodically, the same cannot be said for the rest of the world where large gaps in available data render detailed activity-based analysis difficult.

2.3.1 Trends in Activity

Figure 2.3 displays key trends in both passenger and freight transport for 17[16] major IEA countries that, together, represent more than 90% of the total energy use among IEA membership. When looking at the historical trend, it is clear that countries have experienced a growing amount of transport activity. This, it should be stressed, even in the present context of GHG emissions has facilitated great increases in welfare and has contributed to a real improvement in people's lives.

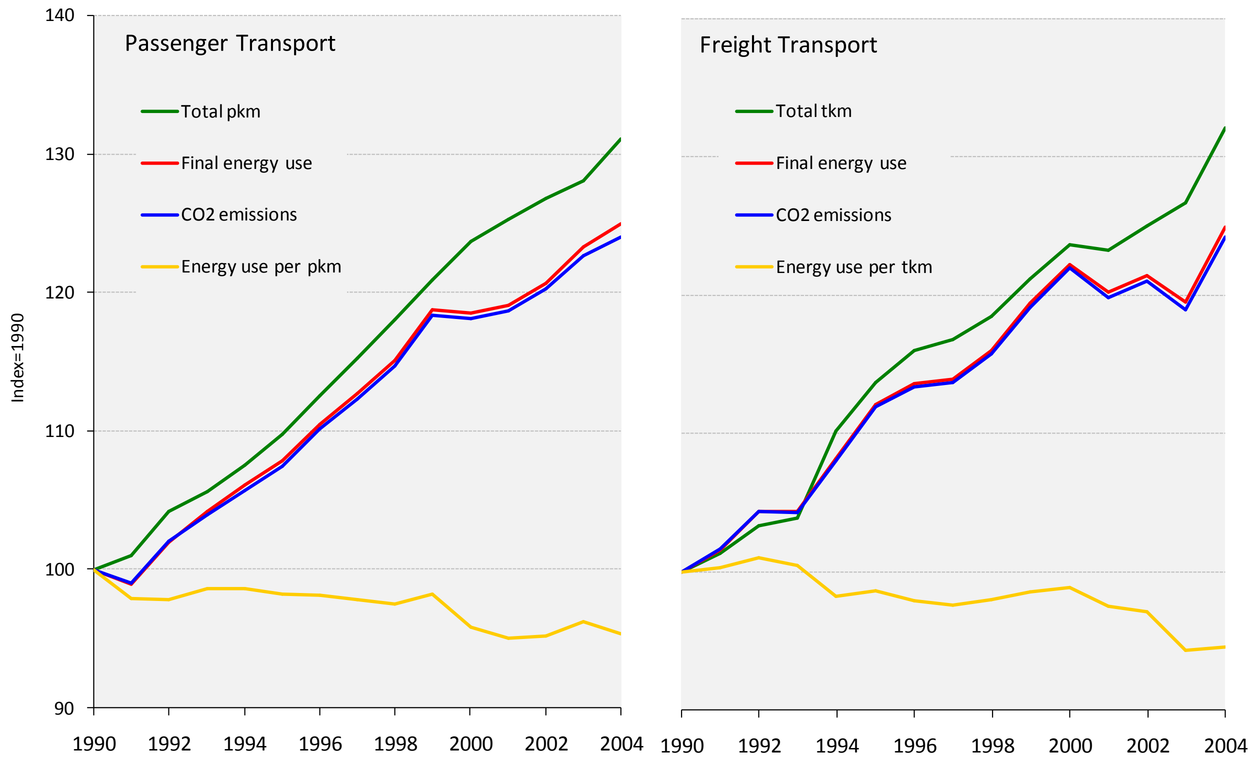
This increased transport activity has been accompanied by a decreasing amount of energy use and emissions per passenger kilometre and tonne kilometre, although overall energy use and emissions have increased (See section 2.4). From 1990 to 2004, passenger kilometres and tonne kilometres travelled increased 31% and 32% respectively, while at the same time, the energy intensity of each passenger kilometre and tonne kilometre travelled decreased by 4.7% and 5.4% respectively. Final energy use rose by 25% for both passenger and freight and while emissions of CO2 generally followed the same trend, a slight de-carbonisation of energy in passenger transport led to slightly lower CO2 emissions than might otherwise have been expected.

Cars are the predominant energy user and source of CO2 emissions for passenger transport representing 88% of energy use and nearly as high a share of CO2 emissions in 2004. This share has remained essentially stable since 1990 for the countries in question. Rail and bus travel accounts for a diminishing share of passenger transport energy use – principally because people have switched from these modes to cars and air. For freight transport, trucks represent the largest energy user and source of CO2 emissions, growing from 77% to 82% of final freight transport energy use while domestic shipping and rail saw their shares decrease from 16% to 12% and from 7% to 6%, respectively over the same period.

[16] Australia, Austria, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Sweden, the United Kingdom and the United States.

Figure 2.3: Key Trends in Passenger and Freight Transport for 17 IEA Countries

(excluding international air for passenger travel, all air for freight travel and international shipping for freight travel)



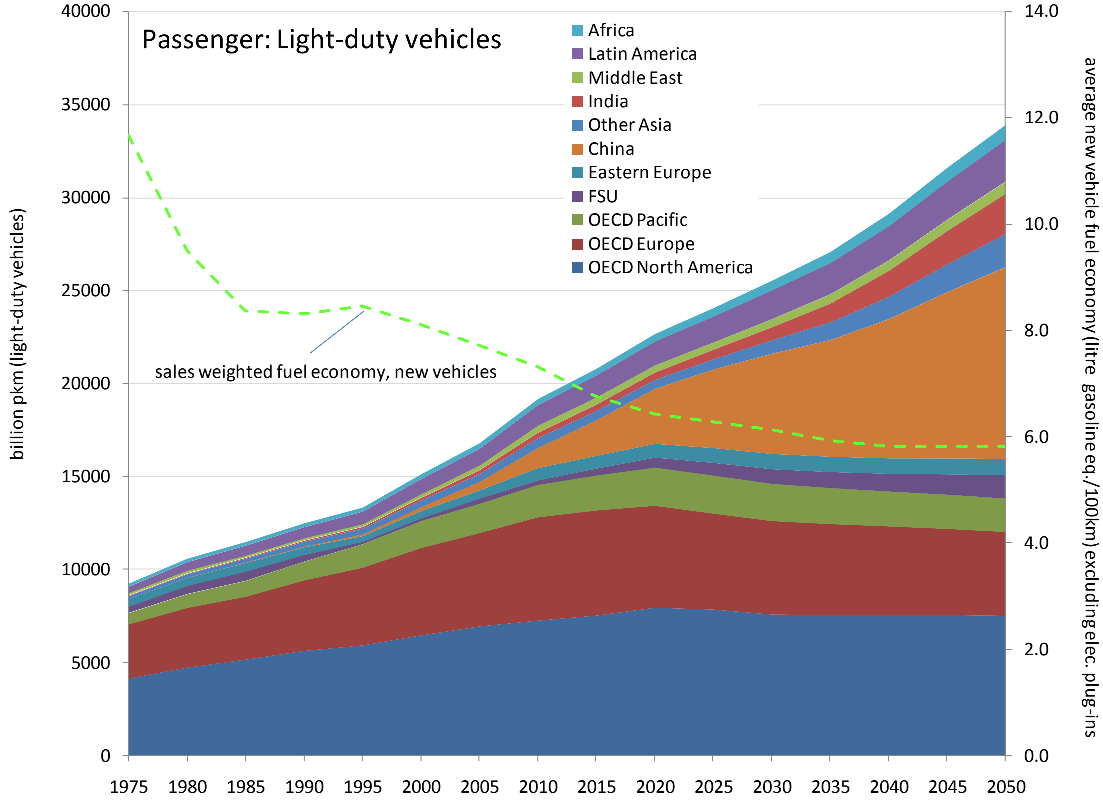
Source: Data from IEA, "Energy Use in the New Millennium: Trends in IEA Countries" (2007)

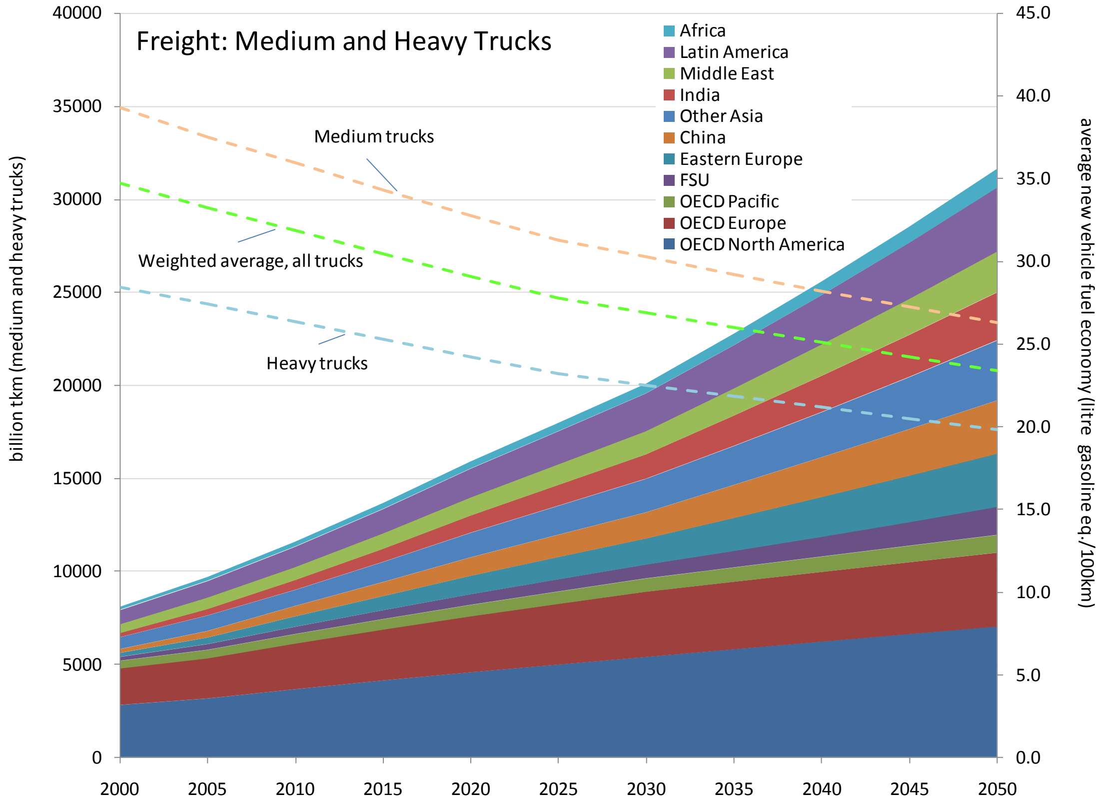
Looking ahead to 2050, the baseline reference scenario from the IEA Mobility Model foresees continued growth in the number of light-duty vehicles (LDVs) and the number of passenger and tonne kilometres travelled. In particular, it foresees a stabilisation and slight decline of passenger kilometres travelled in North America and the European Union – linked to demographic trends and a stabilisation of car ownership rates – as well as a strong increase in LDV travel in China and other rapidly developing countries (see figure 2.4). Overall, it projects LDV passenger kilometres to more-or-less double from 2000 to 2050 world-wide. However, this growth is projected to be accompanied by decrease of about a third of the sales-weighted average fuel economy of new vehicles over the same period.

Aviation and maritime transport have grown strongly as well, often surpassing the rate of growth of road transport and are projected to increase, and even accelerate their growth due to increasing incomes, decreasing relative costs, increasing international trade and tourism and a switch from long-distance and medium-distance road and rail trips in many large markets.

Figure 2.5 shows historical and projected growth in both passenger aviation and air freight cargo out to 2025. The projections made by Boeing for passenger air and Airbus Industries for freight cargo indicate a more than doubling of activity from 2005 to 2025 – a trend which has important repercussions given the additional climate impacts of aviation discussed in the previous chapter. The rate of growth from 2005 on is expected to be above the historical rate of growth in both sub-sectors.

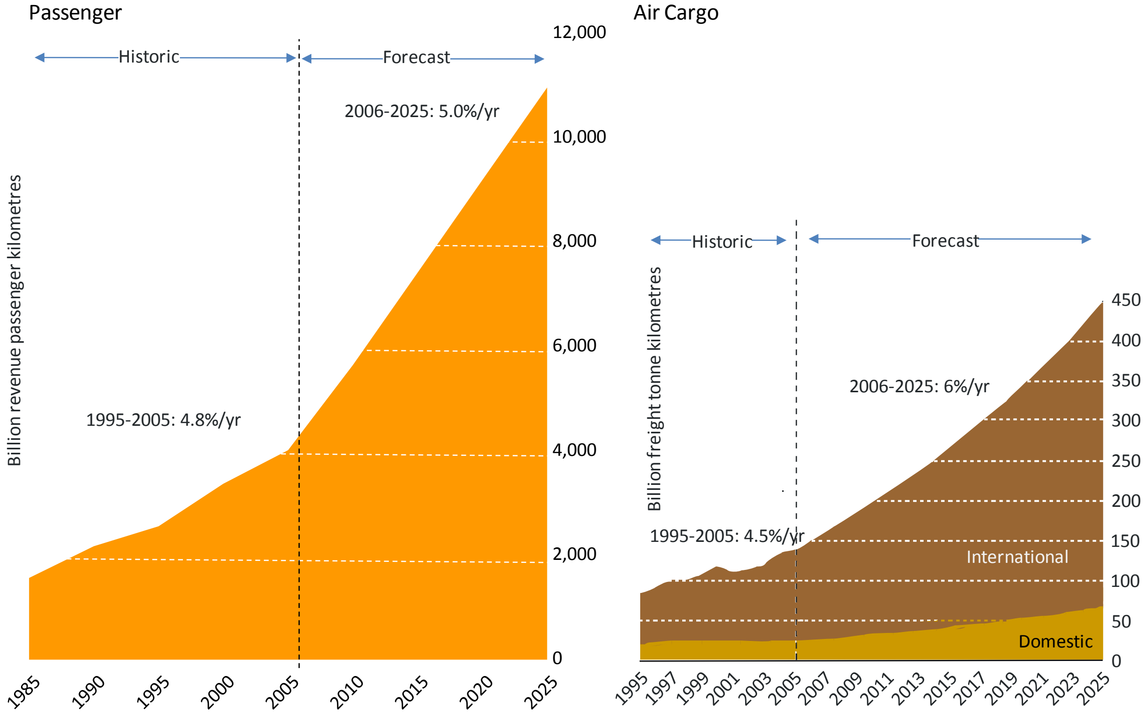
Figure 2.4: Past Trend and Projection of LDV Passenger and Truck Tonne Kilometres and Fuel Economy





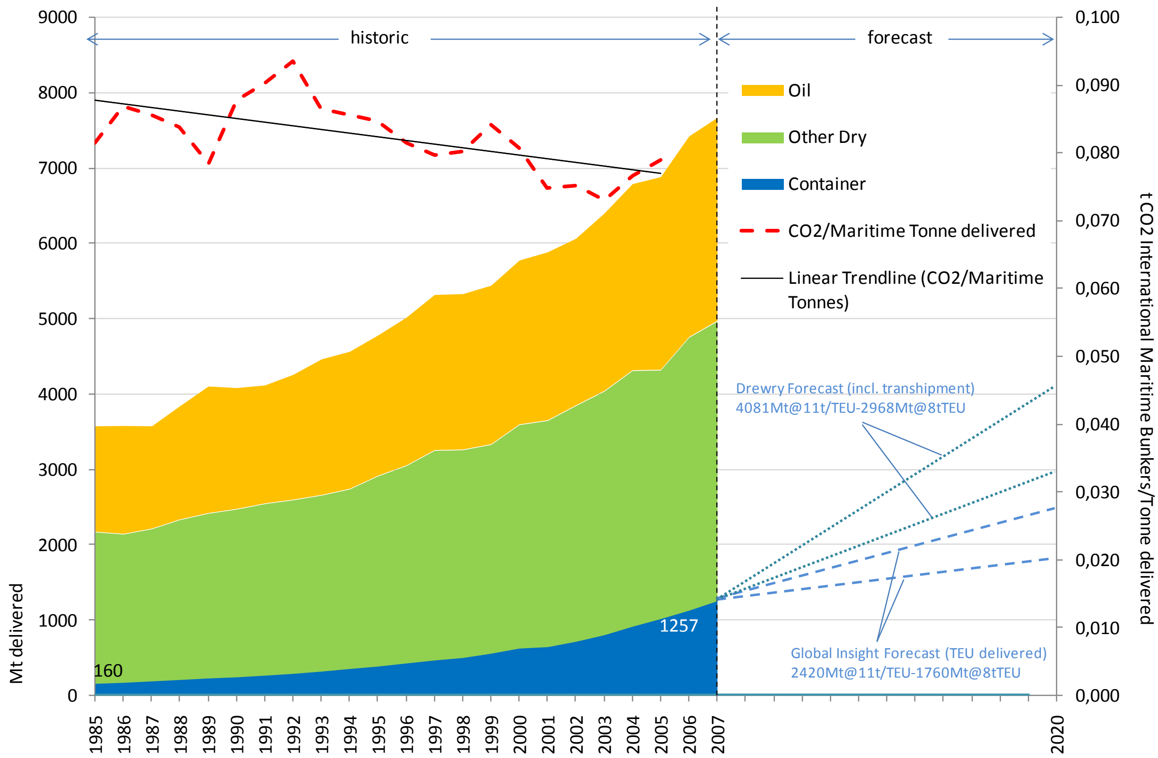
Source: IEA Mobility Model: reference scenario

Figure 2.5: Historical Trends and Projected Future Growth of Passenger Air Travel and Freight Cargo



Source: Boeing "Current Market Outlook, 2007" for passenger, Airbus Industries "Global Market Forecast 2006-2025" for air cargo.

Figure 2.6: Historic Trends in Maritime Transport and Projected Growth of Maritime Containers



Source: Clarksons, Global Insight, Drewry, IEA, TEU conversion factors from M. Carlier (ANAVE) and J. Corbett (U. of Delaware)

International maritime activity has also grown significantly and, for several key sectors, is projected to continue to grow strongly in the future. The United Nations Conference on Trade and Development estimates that world seaborne trade reached 49,374 tonne kilometres in 2006 (UNCTAD, 2007). Figure 2.6 displays trends in maritime activity (measured in tonnes delivered from 1985 to 2007 and projected trends for trade in containerised cargoes to 2020. Total maritime trade has doubled from 1985 to 2007, total containerised trade has grown eight-fold over the same period and currently represents 16% of all maritime trade by weight (and a much larger share by value). Depending on the weight carried per container unit, trade in containers measured by deliveries is projected to more-or-less triple from 2000 to 2020. In terms of container movements including transhipments, Drewry forecasts a more than six-fold rise from 2000 to 2020. This growth has important GHG repercussions as the average installed power on container vessels is higher than on most other types of vessels and given the speeds at which container vessels travel, increased container vessel activity will result in greater maritime CO2 emissions than might otherwise have been expected based on past fleet structure. Nonetheless, in aggregate, energy use per tonne delivered[17] by sea has generally followed a decreasing trend from 1985 to 2007 with the advent of more efficient engines and vessels.

2.3.2 Drivers of Transport Activity: Cars

Trends in overall passenger travel vary among countries as illustrated in Figure 2.7-A with large low-density countries displaying higher overall levels of passenger travel than smaller, high density countries. The former also tend to have higher shares of domestic air travel. While overall population density matters for inter-urban travel, it plays less of a role in urban areas where average urban trip length varies less among industrialised countries (UITP, Urban Mobility Database).

Road transport, and in particular, automobiles account for a dominant share of transport GHG emissions in most ITF countries (and many other rapidly developing non-ITF economies). The drivers behind increased motorisation and automobile travel have been and will likely continue to be key factors to understand and address in any transport-sector GHG policy.

As income and personal expenditures rise, people have switched from slower less flexible modes to faster more flexible modes of transport. This means that people have generally moved from trains and buses (and from cycling and walking in developing countries) to cars and airplanes (in developing countries, the movement is first to more affordable motorised two-wheelers). Figure 2.7-B illustrates this trend. Greater wealth has led to higher rates of car motorisation and greater car motorisation has led to increased household travel. The principal reason for this is that, given limited travel time budgets, increased speed has largely served to "buy" greater travel distance.

Not all countries display the same level of car travel as personal consumption rises. A mix of factors come into play to explain these differences including population density, household structure and demographic characteristics, levels of income, rates of income growth, availability of alternatives as well as baseline motorisation rates. Concerning the latter point, it should be stressed that two-wheeler and car motorisation will likely continue to grow in many countries and especially so in developing countries as these have rates of car (or two-wheeler) ownership that are much below what might be considered a saturation point of .7-.8 cars per capita[18].

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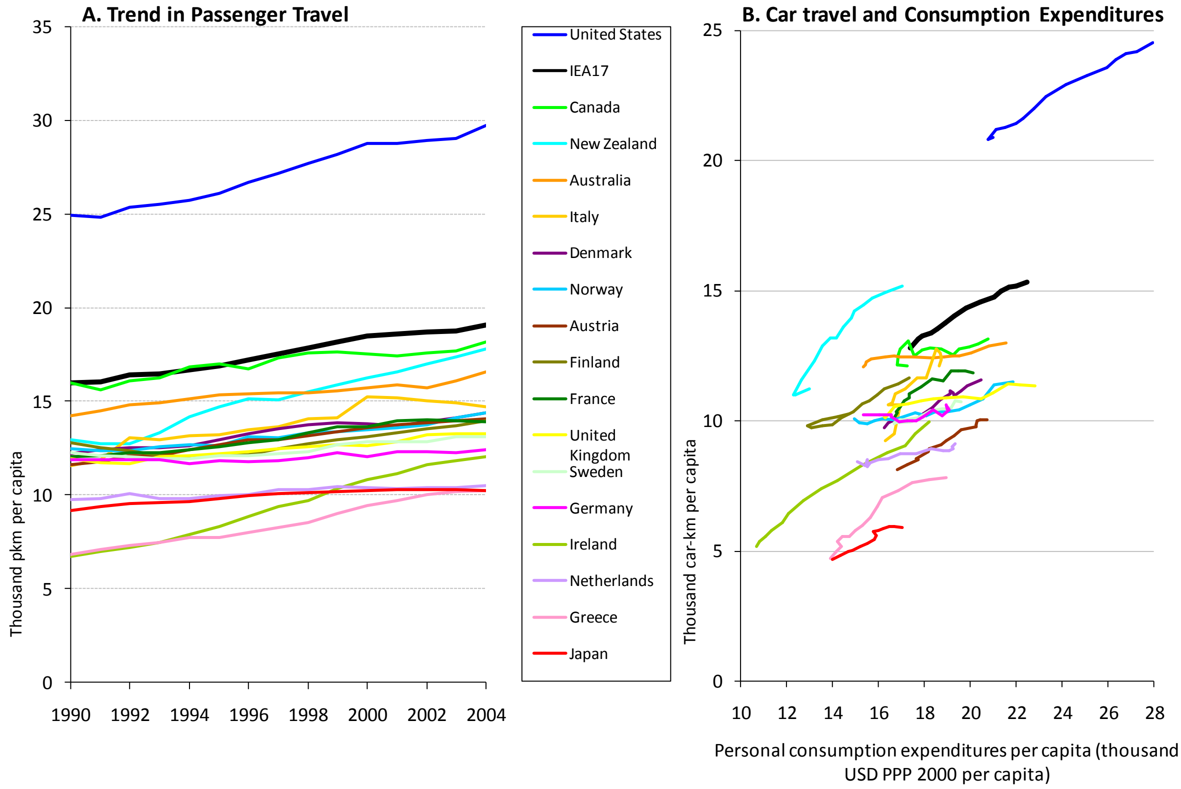
[17] Here measured by proxy using CO2 emissions from international maritime bunkers divided by the total number of tonnes delivered in any given year.

[18] This "saturation" seems to have been reached in the United States but it is unclear whether such a point could or should be met given the tremendous impacts such a level of car ownership might have on resource use and,

Another important factor to consider when trying to understand the drivers behind the projected growth in transport activity is the cost of travel. This can be broken down into the "fixed" costs associated with vehicle purchase, costs of parking and maintenance and vehicle registration and taxes and the "variable" costs of travel associated with travel time and fuel cost per kilometre travelled. The latter has important repercussions for those GHG policies that target fuel efficiency since the practical outcome of these policies is to reduce the kilometre cost of travel, all things held equal.

Figure 2.7 A and B: Passenger Travel and Personal Consumption Expenditure Growth



Source: Data from IEA, "Energy Use in the New Millennium: Trends in IEA Countries" (2007)

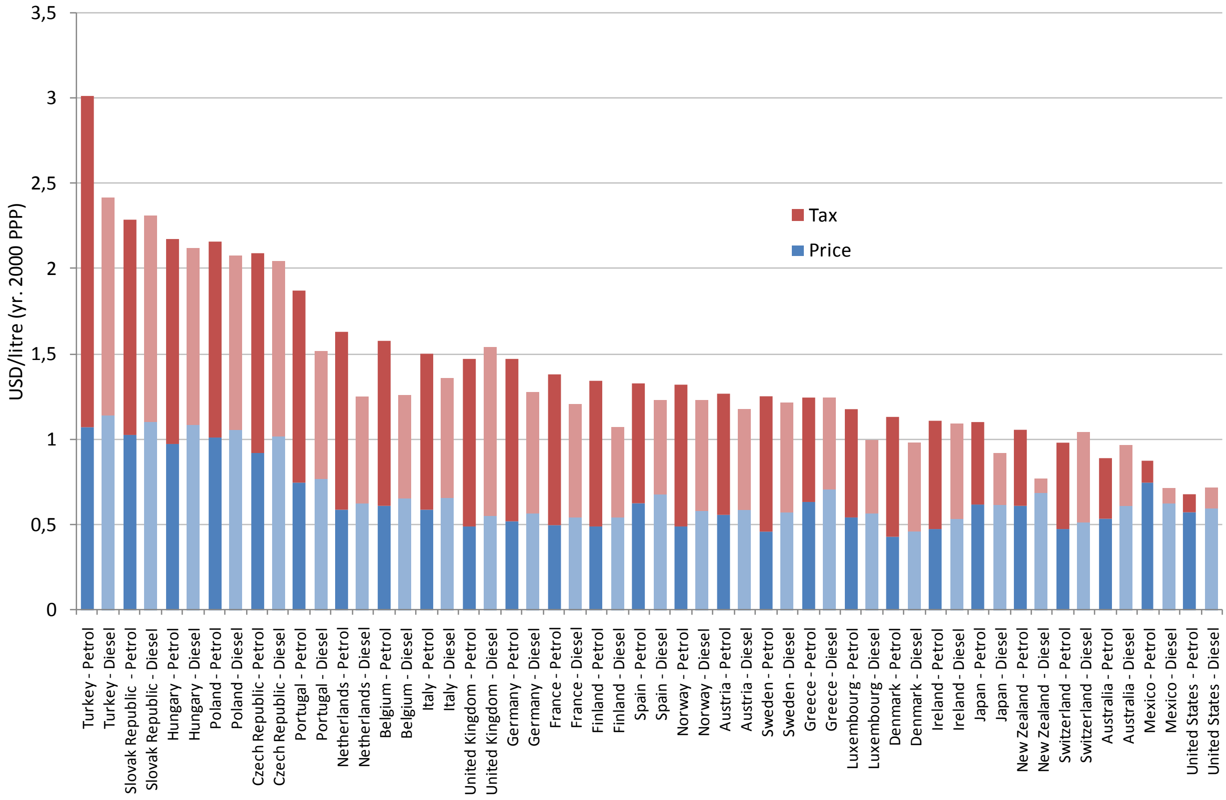
The key question is how reactive consumers are to different levels of travel costs and, more importantly, to changes in the cost of travel. When vehicle purchase, operating and ownership costs are high, or when they increase, do consumers react by reducing travel and if so – to what extent? Or do they find other ways of compensating for high travel costs by investing in greater fuel efficiency, switching to smaller vehicles, etc. Likewise, when costs are low or when they decrease, do consumers travel more- if yes, how much more? The answer is complex, especially across such a broad range of countries as the ITF.

The first thing to note is that countries display different travel cost structures. For instance, Figure 2.8 displays the different price (for households) for gasoline and diesel along with the relative share of taxes. Recent research confirms that there is a robust inverse relationship between fuel prices and fuel economy – though determining strict causality is challenging (Schipper, 2007). Generally, high fuel costs and high fuel tax rates also correlate well to lower road transport CO2 emissions, but the former are bundled with many

consequently, prices. It is also not clear that such a point could ever be reached in countries with high population and low road network density.

other explanatory factors such as density and availability of alternatives to the car such that, without better data than most countries currently collect, clearly demonstrating the impact of each factor is difficult.

Figure 2.8 Diesel and Gasoline Prices and Taxation: 2006



Source: IEA database on Energy Prices and Taxation

How consumers react to changing travel costs, and in particular, to changing fuel costs helps to better understand how prices impact levels of transport activity. For passenger travel, the empirical evidence indicates that the elasticities for demand for fuel and travel are substantially below one, albeit with important regional differences (ITF, "The Cost and Effectiveness of Policies to Reduce Vehicle Emissions", 2008). Low fuel use and travel demand elasticities are more pronounced in the United States where the short-term and long term elasticity of demand for fuel is low and getting lower over time (e.g. -0.2-0.3 - Small and Van Dender, 2007). On the other hand, the price elasticity for fleet average fuel economy has been found to be much higher (-0.5-0.7 - Small and Van Dender, 2007) implying that consumers have reacted to higher fuel prices by investing in more fuel efficient vehicles rather than decreasing their travel. European countries report higher fuel and travel demand elasticities and thus may be more reactive to changes in fuel and travel prices – although the high level of fuel taxation in these countries also serves to insulate fuel prices from changes in oil prices. There are, however, important uncertainties in understanding consumer's reactions to changes in fuel prices (e.g. how do increases in fuel costs impact the use of each vehicle in multi-vehicle households or the real on-road fuel economy of vehicles) and these require much finer travel surveys and data than most countries currently gather (Schipper, 2007).

The case of dieselisation in some European countries, for instance, provides some insights to household reactions to changes in relative fuel prices. Because diesels are more efficient than gasoline engines, several countries have sought to promote these over gasoline vehicles, not least by decreasing taxes on to make diesel less expensive than gasoline as can be seen in figure 2.8 (though, in most cases, reduced diesel taxation was originally intended to insulate commercial carriers and farmers from high fuel prices and, in some cases, to promote car manufacturers specialising in diesels). Section 2.6 will discuss the impacts of dieselisation more broadly but the price differential itself plays an important role in the distances that diesel cars are driven. On average, diesel cars are driven 40-80% further than gasoline cars in Europe. There are a number of reasons for this, not least of which is that the price difference in fuel and the longer durability of diesels leads to a certain amount of self-selection by fleet drivers, taxis, etc.... who gravitate towards these vehicles because they already drive more than the average consumer and can thus realise important savings (Schipper, 2007). For instance, new diesel drivers in France averaged 15000 km per year vs. 12000 km per year for the average gasoline driver between 1995 and 2000. However, rather than simply substituting "gasoline" kilometres by less expensive "diesel" kilometres and thus pocketing the savings, new diesel drivers increased their car travel and emissions and they *still* saved money. On average, switching from a gasoline to diesel car led to 27% more distance driven, 20% more energy consumed (in gasoline equivalent units) and a decrease of 21% in fuel expenditures (Hivert, 2007).

2.3.3 Drivers of Transport Activity: Trucks

Truck activity and GDP are linked as well and to explain the relationship between the growth of freight transport and GDP growth, the TKM/GDP ratio can also be broken down into two components: Tonnes/GDP and the distance these tonnes are carried (KM).

The ratio between production in terms of value and in terms of tonnage (Tonnes/GDP) is the result of both:

- The average value per ton produced (or rather its converse), which is closely linked to the share of GDP of the different economic sectors and also to the technology of the products considered (for example, steel sheet metal replaced by plastics)

- And the number of times that each tonne of final product is moved within the production chain, i.e. the handling factor (average number of hauls per tonne), which reflects both the specialisation of production companies and also the consolidation of consignments during transport;

And an average distance of each tonne per journey (KM), which is explained by geographical specialisation (liberalisation of trade, comparative advantages of regions and countries) and the relative price of transport in comparison with the price of other factors of production.

The European REDEFINE project has sought to measure the links between economic activity and road freight traffic in five European countries, in the form of ratios. As a result, it also takes modal split into account so as to obtain road traffic alone. The table below shows the trend of freight transport in five European countries, expressed as a % of tkm, on the basis of the production trend (% in constant Euros).

Table 2.1 shows that, although road transport increased significantly in all countries considered (between + 33 and + 60 % in tkm between 1985 and 1995), there were very different explanations for this growth across countries, which experienced contrasting trends: production in tonnes fell in the United Kingdom but increased in the other countries; the handling factor decreased in Sweden and to a lesser extent in Germany but rose elsewhere, and the length of haul increased everywhere but relatively little in Germany. These contrasting trends across countries produced the same result in all these countries, i.e. a very significant increase in road freight transport expressed in tkm, substantially higher (except in Sweden) than the trend for the value of production.

Table 2.1: Drivers of road freight traffic trend in Europe between 1985 and 95 (%)

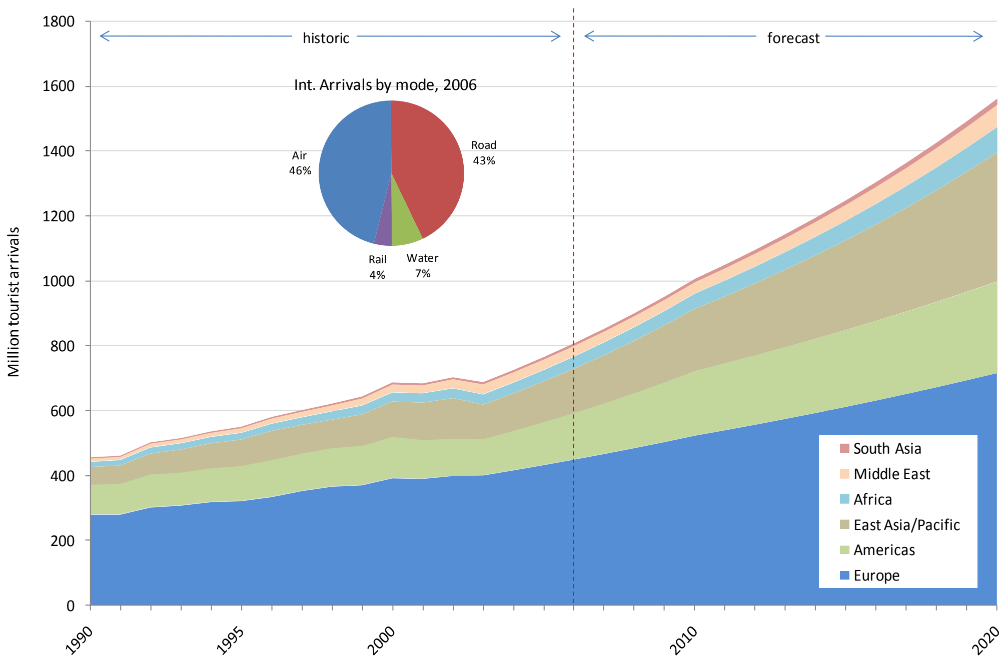
	Germany	Netherlands	UK	Sweden	France
Value of production	14	17	-4	82	28
Value density	-2	-3	-32	51	23
Production in tonnes	16	21	-7	21	4
Modal split	20	0	1	11	11
Products transported by road	33	21	1	34	14
Handling factor	-2	3	18	-20	2
Average length of haul	4	29	24	37	36
Road Tkm	33	60	46	48	57

Source: REDEFINE project

2.3.4 Drivers of Transport Activity: International Aviation

For international aviation (as well as for domestic aviation in large countries), the rise in international tourism is a main factor to consider. Figure 2.9 shows the historic trend and forecast for international tourism as measured by number of arrivals in different world regions. Road and air travel are equally important in terms of mode used for travel for international tourism arrivals but the rate of growth of long-haul travel (currently 16% of all international tourism arrivals) has generally been greater than that of intra-regional travel – and the former is more dependent on air travel than the latter. Because international tourism travel by air involves much greater distances travelled, this is not unimportant from a climate change perspective, especially when considering the added climate impacts of aviation emissions outlined earlier. Still, however, the bulk of tourism and leisure travel takes place on the road when factoring in domestic tourism.

Figure 2.9 International Tourism: Historic Trends and Forecast 1990-2020

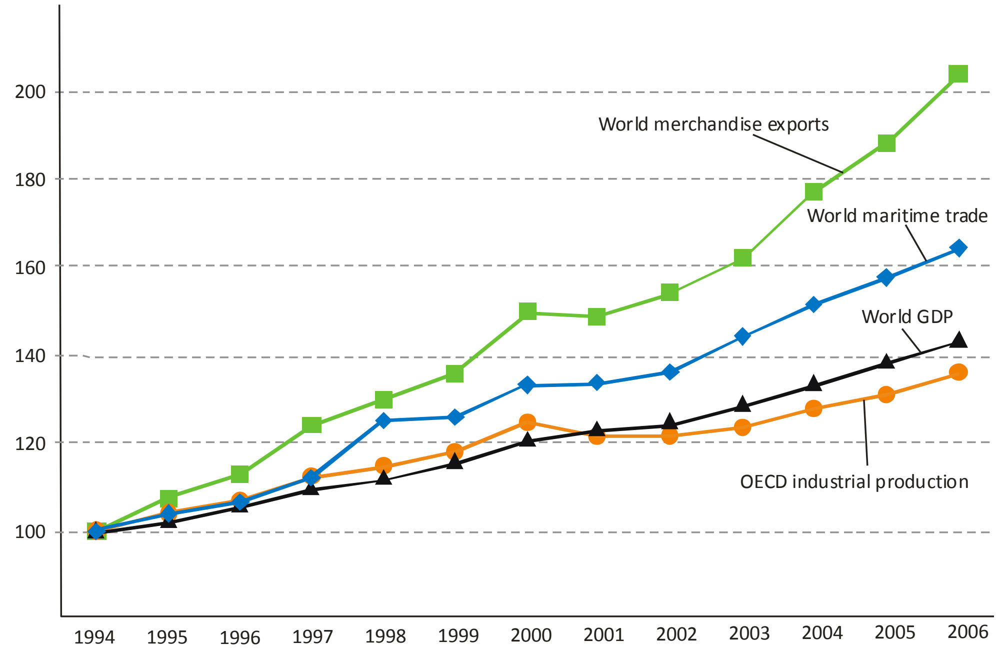


Source: World Tourism Organization: Tourism Vision 2020

2.3.5 Drivers of Transport Activity: International Maritime Transport

For international maritime transport[19], growth in activity has generally followed, and oftentimes outstripped GDP growth (see Figure 2.10). While international trade continues to drive maritime activity, the latter is no longer principally driven by output in OECD countries but, rather, from many emerging export markets such as China. In 2006, world merchandise trade grew by 8% - double the rate of world GDP growth – contributing to robust growth in container trades that carry much of the world's manufactured output between continents as well as much of the value of seaborne trade (Drewry Shipping Consultants estimate that over 70% of the value of world seaborne trade is currently carried by maritime container). Maritime trade will also continue to grow in tandem with rising demand for oil, coal, steel and other primary resources by China and, to a lesser extent, India. This demand has already led to more distant sourcing of these resources (e.g. China has started to source iron ore from Brazil and Africa as Australian output has reached a plateau) leading to increased GHG emissions. China has also recently become a net importer of coal which will have as a knock-on effect to make past importers of Chinese coal in the region such as Japan, Korea, Chinese Taipei turn to more-distant Australian and Indonesian coal and thus increase GHG emissions for regional maritime coal deliveries.

Figure 2.10 Growth in Maritime Trade, World Trade and GDP (Indexed): 1994-2006



Source: UNCTAD, Review of Maritime Transport, 2007

2.4 Mode Share

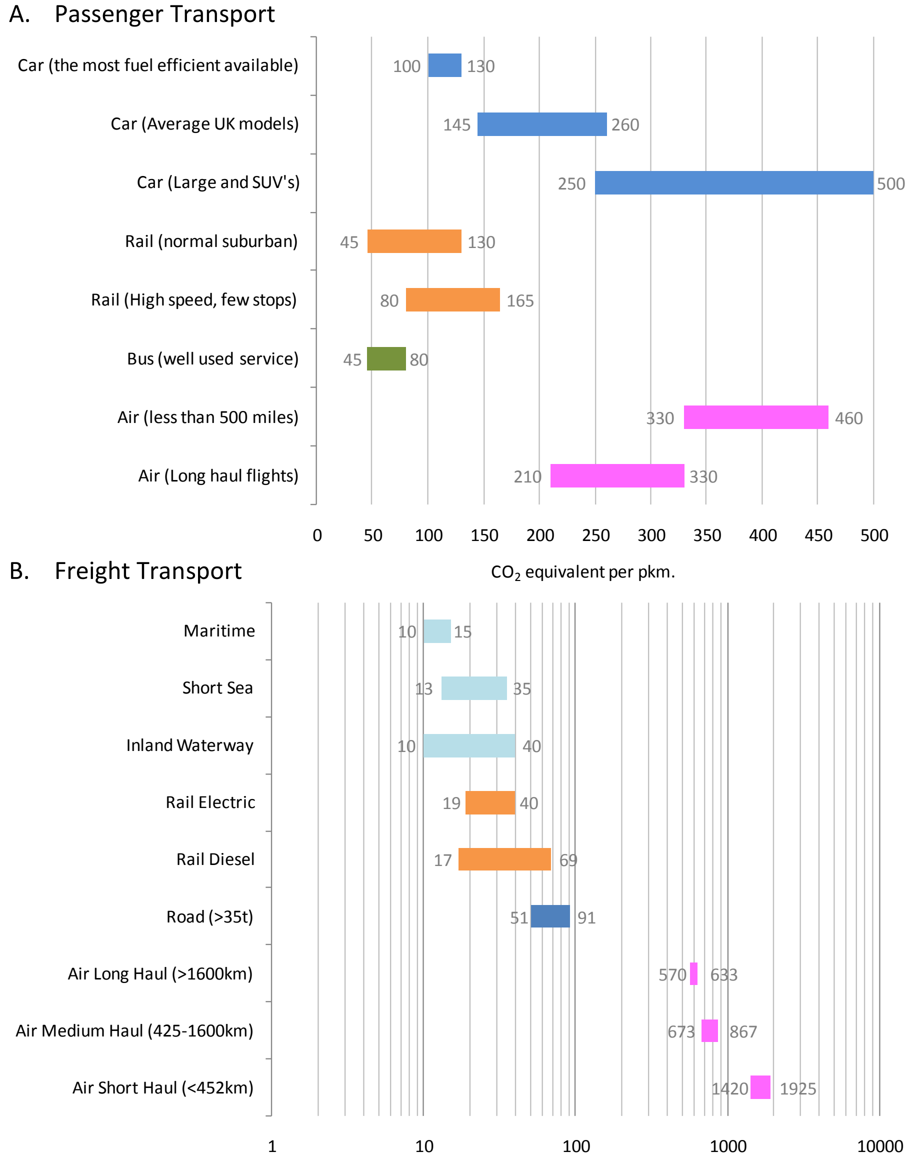
Modes differ in their energy use and CO2 emissions per unit of transport work accomplished and thus the relative share of cars, public transport, rail, air, and shipping has an incidence on the overall emissions of transport-sector GHGs. Indeed, in some regions, shifting from more energy intensive to less energy

[19] The United Nations Conference on Trade and Development (UNCTAD) publishes a yearly review of Internatioonal Maritime Transport. The 2007 edition - "Review of Maritime Transport, 2007" serves as the basis for this section.

intensive modes has been an express policy focus – albeit one which has met with limited success in many instances.

Figure 2.11-A shows the relative CO2 emissions per passenger kilometre for different modes and Figure 2.11-B shows the same for freight tonne kilometres (log scale). Load factors factor heavily in calculating these emission intensities and explain the similarity between the mid-to-upper end of the range of car emissions and the lower end of aviation emissions. Well-used urban bus transport, urban and high speed rail compare favourably in terms of CO2 emissions per passenger kilometre but these modes represent relatively small shares of overall travel in most ITF countries. At lower load factors, these modes compare poorly with fuel efficient cars

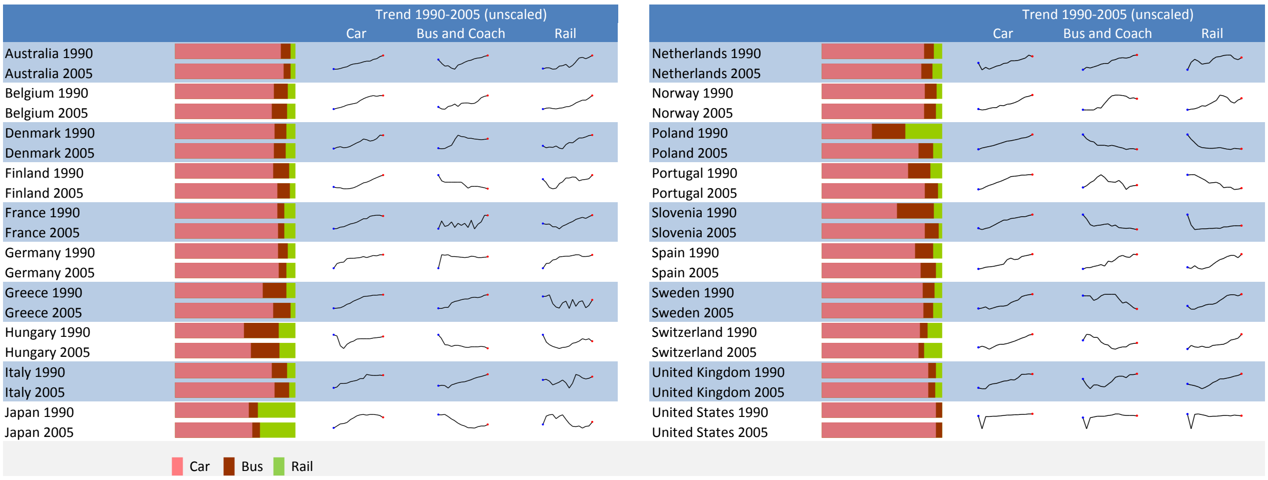
Figure 2.11 A-B: CO2 Intensity by Passenger and Freight Mode (CO2 eq. per pkm or tkm)



Source: Aviation Environment Federation, 2007 "How does Air Compare?" and McKinnon, private communication

Waterborne freight and rail transport compare favourably to road transport in terms of CO2 emission per tonne kilometre but the latter has gained share in most ITF countries – with some important exemptions. They are not a substitute for large parts of road transport markets and this limits the potential for emissions mitigation through modal shift.

Figure 2.12: Passenger Mode Share and Historic Trend by Mode (pkm) in Selected ITF Countries



Source: Data from International Transport Forum

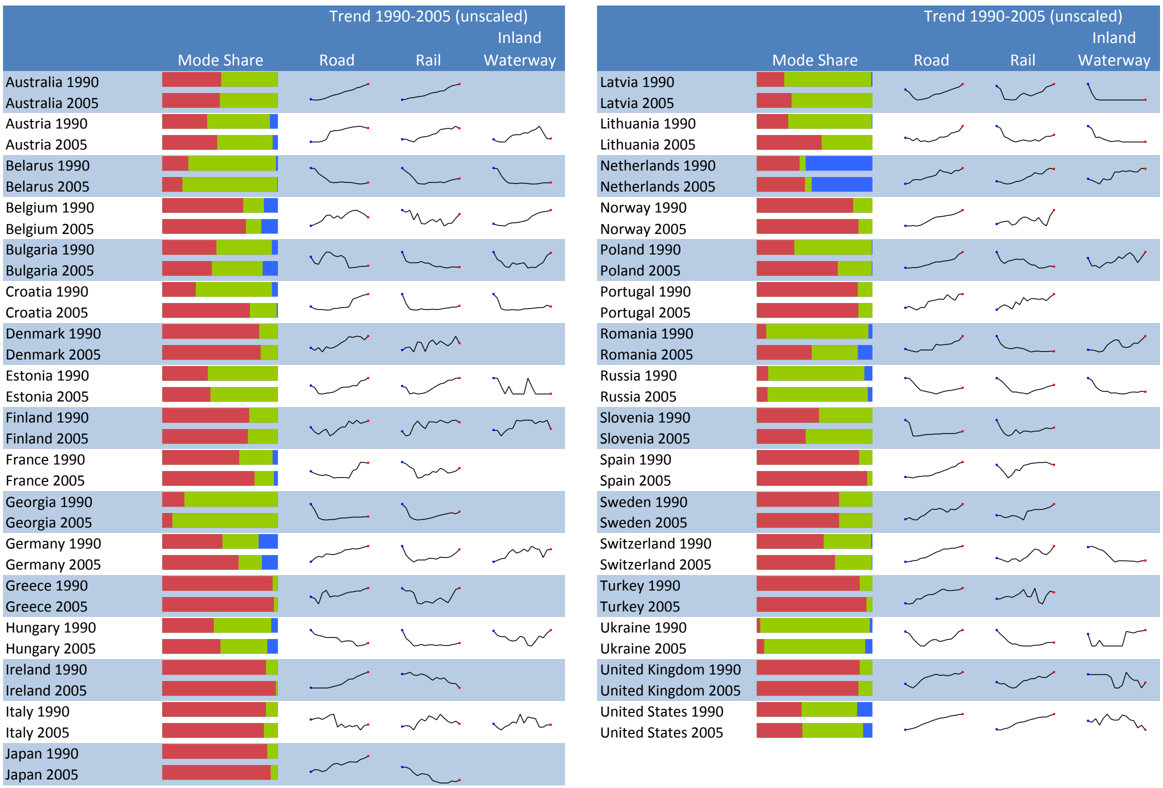
Figure 2.12 displays relative mode share and historic trend for passenger transport modes in terms of passenger kilometres travelled across selected ITF countries. It excludes air travel as well as important segments of urban public transport (e.g. metro and urban bus services in many countries) but nonetheless shows the importance of car travel in all almost all of the countries considered. Japan is an important exception in that extensive and well developed suburban and inter-urban rail combined with constrained opportunities for car travel (due to congestion as well as high purchase, operating and parking costs in urban areas) has led to higher-than-average rail use, although the overall share of rail in Japanese passenger transport has decreased. Belgium, Denmark France, Germany and Switzerland have experienced modest increases in the share of rail travel but in most other countries, even where the *volume* of rail travel has increased, its overall *share* has decreased to the advantage of the car. Many but not all Economy in Transition (EIT) states of the former Eastern bloc and Soviet Union have seen dramatic shifts in their modal distribution, largely in favour of increased car travel and decreased bus and rail travel with Poland representing an extreme case.

Figure 2.12 does not fully capture the distribution of urban travel among passenger transport modes. Figure 2.13 shows this distribution by number of daily trips taken by each mode for a selected number of cities worldwide. It relates a more nuanced picture of the relative importance of car travel in that it captures the importance of walking and cycling -- especially in more densely populated cities. Nonetheless, when accounting for distances travelled, private motorised modes represent the greatest part of urban travel as well. Another point to bear in mind regarding urban mode share is that the modal distribution of trips varies within urban areas as well. High density urban cores display lower levels of car trips and higher levels of public transport use. Low density suburbs display the inverse – and growth in kilometres-travelled is often higher than the urban average in those peripheral areas. For instance, car ownership (here, a proxy for mode share) by households in the greater Paris metropolitan ranges from .94 to 1.2 to 1.5 and finally to 1.55 in the urban core, close suburbs, peripheral suburbs and rural areas, respectively (Hivert, 2007).

Figure 2.13: Urban Travel Mode Share in Selected World Cities by Number of Daily Trips Taken

Source: UITP Mobility Database

Figure 2.14: Freight Mode Share and Historic Trend by Mode (tkm) in Selected ITF Countries



Source: International Transport Forum data

A final factor to consider when looking at mode share in urban areas is to recall that speed has most often served to "buy" greater travel distance and that travel distance allows households to take advantage of lower housing costs (and a larger pool of potential jobs) for a constant travel time. Indeed, high density urban areas in Europe, Asia and some cities in North America[20] often display elevated housing prices. Faster travel allows households to select either larger dwelling size for a constant budget or to reduce housing costs for a constant dwelling size. In either case, car travel has typically been more suited for the lower density areas that households move to given the difficulty public transport faces in providing adequate levels of service in these zones.

Figure 2.14 displays relative mode share and historic trend for freight transport in terms of tonne kilometres for a select number of ITF countries. As with passenger transport, many countries have experienced an increase in the share of road (truck) transport to the detriment of other modes. However, within non-EIT ITF countries, Australia and the United States represent important exemptions where rail represents approximately half of all tonne-kilometres and is gaining share to the detriment of road transport or inland waterways. This trend is linked to the long travel distances in these countries and to the type of goods in the national freight mix (with an important representation of heavy bulk goods such as coal, ores and grain), as well as to the lack of passenger rail services competing for the same network. Within EU-15 countries, rail has remained stable or, more often, lost share to trucks, despite many pro-active support policies. For EIT countries, the trends are more varied. Most of these countries display much higher overall shares of rail transport compared to the EU-15 which reflects historic investment decisions. Some countries have seen rail and/or inland waterway gain share against trucks (Bulgaria, Belarus, Russia and Georgia) while others have experienced a decline in the share of rail freight transport – sometimes quite dramatically as in Poland.

2.5 Transport Energy Intensity, Energy Efficiency and GHG Intensity

Against the backdrop of rising transport volume and increased GHG emissions, there is a strong and sustained trend for reduced energy use (and, consequently of GHG emissions) per unit of transport work accomplished. This trend is present across all modes and is most pronounced for aviation which has seen the largest reduction in the amount of energy expended per passenger kilometre. Likewise, the amount of transport GHG emitted per unit of overall economic output has steadily decreased across all modes. Obviously, given the overall rise in transport energy use and GHG emissions, these gains have not been sufficient to counter the increases in activity and have, at best, reduced the rates of growth in energy use and GHG emissions that might otherwise have occurred.

2.5.1 Aggregate Transport Energy and GHG Intensity

Figure 2.15 displays the changes in aggregate transport energy intensity (expressed in Mj per passenger kilometre, excluding international air travel) experienced by the 17 principal energy-using IEA members[21]. It also displays the annual rate of change for 1990-2004 as well as the annual rate of change for 2000-2004 and projects these out to 2020 using a simple linear trend projection. The countries are ranked according to their 2004 energy use per passenger kilometre values. The table brings out the large variation in levels of energy use per passenger kilometre across countries ranging from a high of 2.21 Mj/pkm the United States in 2004 to a low of 1.28 Mj/pkm in Italy in the same year. These differences can partly be explained by modal split (with the highest energy intensity countries displaying above average share of

[20] Many cities in North America display an inverse trend with high-density core areas characterised by lower income households and depressed housing prices.

[21] Data and analysis in this section are largely drawn from IEA, 2007 unless otherwise noted.

aviation for domestic travel) but the bulk of the differences emerge from different energy intensities for individual modes and of cars in particular.

Japan and the Netherlands have displayed counter-trends and have seen energy use per passenger kilometre rise from 1990 to 2004 (although it has dropped in recent years in Japan and stabilised in the Netherlands). For Japan, the change can be explained by a falling share of rail travel and an increase in the energy intensity of cars until recent years. For the Netherlands, the explanation resides in an unchanging level of car energy intensity combined with higher motorisation levels.

Overall, energy use per passenger kilometre for all modes combined (excluding international aviation) has decreased by 0.5% per year from 1990 to 2007. Absent this improvement in the use of energy for passenger transport, energy use in 2007 for this group of countries would have been 7% higher than it was. (for freight transport, the corresponding figure is greater at 9%). Countries differ in their annual rates of improvement as well ranging from a 1.6% per year *increase* in the amount of energy expended per passenger kilometre to the UK with a -1.1% decrease per annum. Taking only the performance over 200-2004, shows a slightly different picture with several reversals of past trends. A number of countries whose energy intensity had been dropping from 1990-2004 have seen this trend turn around in recent years (e.g. United States, Ireland, Finland, Greece and Italy). Japan has seen a reversal of its 1990-2004 trend while the Netherlands has not displayed any significant shift from its previous trend.

Figure 2.15: Aggregate Transport Energy Intensity and Projections for 17 IEA Countries

	Energy Intensity (Mj/Pkm)			CAGR	2020 in relation to	CAGR	relation to 1990
	1990	Trend 1990-2004	2004	1990-2004	1990 using 1990-2004 CAGR (+/-)	2000-2004	(projecting 2000-2004 CAGR)
United States	2.400		2.208	-0.595%	-16.4%	0.004%	-8.0%
Canada	2.440		2.181	-0.801%	-21.4%	-0.345%	-15.4%
Australia	2.285		2.098	-0.608%	-16.7%	-1.587%	-28.9%
IEA17	2.044		1.949	-0.341%	-9.7%	-0.132%	-6.7%
New Zealand	2.040		1.842	-0.729%	-19.7%	-0.534%	-17.1%
Ireland	1.822		1.771	-0.201%	-5.9%	0.414%	3.9%
Sweden	1.821		1.757	-0.254%	-7.3%	0.918%	11.7%
Germany	1.839		1.728	-0.445%	-12.5%	-0.376%	-11.6%
Netherlands	1.619		1.723	0.446%	14.3%	0.451%	14.4%
Japan	1.345		1.684	1.619%	61.9%	-0.720%	11.5%
Finland	1.751		1.563	-0.807%	-21.6%	0.207%	-7.7%
Greece	1.544		1.527	-0.080%	-2.4%	0.860%	13.4%
Norway	1.661		1.444	-0.997%	-26.0%	-1.309%	-29.6%
United Kingdom	1.631		1.401	-1.079%	-27.8%	-2.453%	-42.3%
Denmark	1.431		1.376	-0.277%	-8.0%	-1.536%	-24.9%
Austria	1.466		1.308	-0.816%	-21.8%	-1.191%	-26.4%
France	1.372		1.294	-0.419%	-11.8%	-0.662%	-15.2%
Italy	1.336		1.287	-0.265%	-7.6%	0.856%	10.4%
		-20% 1990-2020=		-0.741%			

Source: Data from IEA, "Energy Use in the New Millennium: Trends in IEA Countries" (2007)

Looking out to 2020 using a very simple linear projection of past trends, we see that these countries in aggregate would realise a 9.7% decrease in passenger transport energy intensity from 1990 and five countries would realise more than a 20% decrease from 1990. Projecting only 2000-2004 trends, again, five countries would experience greater than 20% reductions in passenger transport energy intensity (though not all the same countries as before) and that the UK would theoretically reach an energy intensity reduction of 42%.

Figure 2.19: Transport CO2 Intensity of the Economy and Volume by ITF Region: 1990-2005

CO2 Intensity and absolute emissions	1990	Trend 1990-2005	2005	CAGR 1990-2005	2020 in relation to 1990 using 1990-2005 CAGR (+/-)	CAGR 2000-2005	2020 in relation to 1990 using 2000-2005 CAGR (+/-)
OECD							
Transport CO2/gdp	0.149		0.134	-0.693%	*-18.84%*	-0.917%	*-21.54%*
Road Transport CO2/gdp	0.111		0.102	-0.591%	*-16.30%*	-0.806%	*-18.97%*
Air Transport CO2/gdp	0.018		0.017	-0.555%	*-15.37%*	-1.491%	*-26.57%*
Transport CO2 (Mt)	3118.22		4066.56	1.786%	*70.08%*	1.201%	*55.99%*
Road Transport CO2 (Mt)	2329.28		3084.84	1.891%	*75.40%*	1.315%	*61.10%*
Air Transport (Mt)	376.28		501.09	1.928%	*77.34%*	0.615%	*45.99%*
ITF							
Transport CO2/gdp	0.153		0.135	-0.819%	*-21.86%*	-0.981%	*-23.75%*
Road Transport CO2/gdp	0.110		0.101	-0.620%	*-17.02%*	-0.928%	*-20.79%*
Air Transport CO2/gdp	0.019		0.017	-0.903%	*-23.81%*	-1.544%	*-30.88%*
Transport CO2 (Mt)	3589.17		4407.74	1.379%	*50.81%*	1.399%	*51.26%*
Road Transport CO2 (Mt)	2593.30		3281.91	1.582%	*60.16%*	1.453%	*57.13%*
Air Transport (Mt)	444.23		538.68	1.293%	*47.04%*	0.822%	*37.11%*
EU 27							
Transport CO2/gdp	0.111		0.108	-0.188%	*-5.50%*	-0.243%	*-6.28%*
Road Transport CO2/gdp	0.082		0.077	-0.438%	*-12.34%*	-0.628%	*-14.81%*
Air Transport CO2/gdp	0.011		0.013	1.494%	*56.04%*	0.131%	*27.40%*
Transport CO2 (Mt)	949.28		1248.32	1.842%	*72.93%*	1.618%	*67.30%*
Road Transport CO2 (Mt)	707.10		895.56	1.588%	*60.41%*	1.226%	*52.06%*
Air Transport (Mt)	91.55		154.70	3.559%	*185.54%*	1.999%	*127.41%*
ITF EU 15							
Transport CO2/gdp	0.113		0.109	-0.229%	*-6.65%*	-0.366%	*-8.55%*
Road Transport CO2/gdp	0.084		0.077	-0.575%	*-15.88%*	-0.878%	*-19.65%*
Air Transport CO2/gdp	0.011		0.014	1.644%	*63.11%*	0.278%	*33.14%*
Transport CO2 (Mt)	865.64		1131.03	1.799%	*70.72%*	1.240%	*57.19%*
Road Transport CO2 (Mt)	639.73		793.48	1.446%	*53.84%*	0.720%	*38.12%*
Air Transport (Mt)	86.3		149.05	3.710%	*198.29%*	1.894%	*128.86%*
ITF EU New + Cyprus							
Transport CO2/gdp	0.089		0.092	0.224%	*6.94%*	1.620%	*31.60%*
Road Transport CO2/gdp	0.072		0.080	0.743%	*24.85%*	1.638%	*42.57%*
Air Transport CO2/gdp	0.006		0.004	-1.529%	*-37.02%*	0.918%	*-8.98%*
Transport CO2 (Mt)	83.64		117.29	2.280%	*96.65%*	5.764%	*225.00%*
Road Transport CO2 (Mt)	67.37		102.08	2.809%	*129.59%*	5.782%	*252.08%*
Air Transport (Mt)	5.25		5.65	0.491%	*15.82%*	5.033%	*124.79%*
ITF N. America							
Transport CO2/gdp	0.213		0.174	-1.346%	*-33.40%*	-1.218%	*-32.09%*
Road Transport CO2/gdp	0.158		0.137	-0.954%	*-25.00%*	-0.733%	*-22.44%*
Air Transport CO2/gdp	0.029		0.021	-2.103%	*-47.14%*	-2.783%	*-52.39%*
Transport CO2 (Mt)	1777.38		2253.57	1.595%	*60.76%*	1.124%	*49.94%*
Road Transport CO2 (Mt)	1321.60		1778.27	1.998%	*81.05%*	1.621%	*71.25%*
Air Transport (Mt)	244.670		276.380	0.816%	*27.60%*	-0.478%	*5.13%*
ITF Asia-Pacific							
Transport CO2/gdp	0.099		0.102	0.145%	*4.44%*	-1.389%	*-17.15%*
Road Transport CO2/gdp	0.076		0.075	-0.114%	*-3.36%*	-1.593%	*-22.74%*
Air Transport CO2/gdp	0.005		0.008	2.435%	*105.80%*	3.131%	*127.81%*
Transport CO2 (Mt)	369.55		522.94	2.342%	*100.24%*	0.808%	*59.66%*
Road Transport CO2 (Mt)	283.10		385.36	2.077%	*85.29%*	0.600%	*48.89%*
Air Transport (Mt)	19.83		39.39	4.682%	*294.57%*	5.429%	*339.01%*
ITF (other)							
Transport CO2/gdp	0.173		0.102	-1.797%	*-41.95%*	-1.902%	*-42.88%*
Road Transport CO2/gdp	0.099		0.075	-1.682%	*-39.88%*	-2.518%	*-47.11%*
Air Transport CO2/gdp	0.025		0.008	-2.831%	*-57.75%*	-1.979%	*-51.83%*
Transport CO2 (Mt)	495.05		522.94	-1.632%	*-38.96%*	3.243%	*26.09%*
Road Transport CO2 (Mt)	282.67		385.36	-1.517%	*-36.78%*	2.595%	*16.76%*
Air Transport (Mt)	72.12		39.39	-2.668%	*-55.57%*	3.163%	*6.33%*

Source: Data from IEA – CO2 Emissions from Fuel Consumption: 1971-2005

Above, we assessed aggregate transport energy use and emissions per unit of work in terms of passenger or tonne kilometres. This gives us an understanding of how well countries are carrying out the transport task in terms of physical performance parameters (Mj/pkm). Another approach that measures efficiency is to assess how much transport energy use it takes to produce one unit of economic output. As a proxy for this, Figure 2.16 displays the transport CO2 intensity of GDP in ITF regions from 1990 to 2005 along with trends in the volume of emissions (expressed in Mt) for comparison. It also displays the road transport and air transport (including international aviation allocated on the basis of country of sale of fuel) CO2 intensity per unit of regional economic output. As in figure 2.15, it also displays annual rates of change for 1990-2005 and for 2000-2005 and, using a simple linear projection, projects these out to 2020.

Such GHG intensity data is necessarily broad and cannot guide specific policy interventions as it glosses over a number of bundled contributory factors. Nonetheless, it does serve as a useful yardstick against which to compare regional trends. In all regions except among the newest EU members and Asia-Pacific, the transport CO2 per unit of GDP has decreased – that is, economies have reduced the amount of transport CO2 emissions associated with each unit of GDP. In the case of the newest members of the EU, the effect is linked to fast growth and a switch to road transport. In Asia-Pacific, the observed increase in CO2 emissions per unit of GDP is linked to the performance of the Japanese road sector which saw increased emissions through the early 2000's. Similar trends are also seen for the intensity of road transport which is not surprising given the predominance of this sector in overall transport CO2 emissions.

The air transport CO2 intensity of ITF regions shows a slightly different trend as the amount of CO2 emitted by aviation (domestic and international combined) per unit of GDP has generally fallen across regions with three important exceptions: The EU-27 – and especially the EU-15 States – and the Asia-Pacific region. Such a finding may be linked, at least in the EU, to the rapid rise in air travel that has outstripped economic growth. This may be linked to decreasing costs for air travel as low-cost airlines have increasingly competed with traditional airlines and have spurred overall growth in air travel.

Projecting out to 2020 using a very simple linear projection of the annual rate of change from 1990-2005, one can see that theoretically, the ITF as a whole will experience a 22% improvement in transport GHG intensity (and thus, by proxy – a 22% improvement in energy intensity per unit of economic output all things held equal) from 1990. The OECD would achieve a 19% reduction in terms of transport-sector CO2 emitted per unit of GDP and the EU-27 only a 5.5% reduction (compared to a 33% reduction for North America) – but this also reflects the lower volume of transport CO2 emissions per unit of GDP as compared to the OECD average. The corresponding figures if only projecting the annual rate of change for 2000-2005 are -24%, -22%, -6% and -32% for the ITF as a whole, for the OECD, for the EU-27 and for North America, respectively.

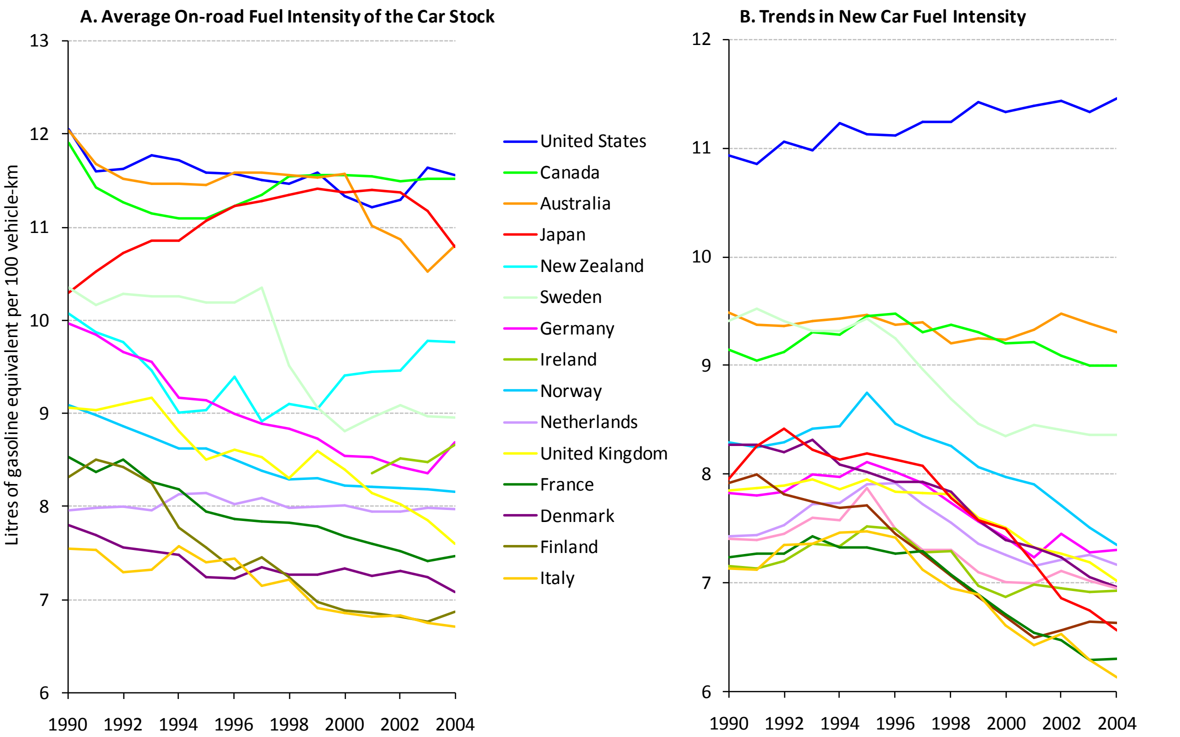
2.5.2 Car Energy and Fuel Intensity

Given the importance of cars in overall transport CO2 emissions, it is important to see how specific and aggregate fuel economy and energy efficiency has evolved for these over recent years.

Measuring, collecting and analysing fuel economy data across the ITF membership is not a straightforward task and one that is made even more difficult through the lack of systematic and comparable data collection. Even in those countries that do collect fuel economy data, different methodologies and survey frequencies can sometimes mask important trends and features. As well, there is a persistent and under-reported gap between new vehicle fuel economy and actual on-road fuel economy which can be attributed to congestion, different driving styles, use of embarked equipment not tested in official fuel economy test cycles (air conditioners, electric motors for windows and seats, etc.) and levels of equipment maintenance. This gap is significant – on the order of 20% -- and is changing as technologies and traffic conditions change. This means that estimates of fuel economy-related policies that only account for official test cycle data will over-estimate the impact of policies and under-estimate the role for interventions targeting components that are off of the official test-cycle (Schipper, 2007).

Figure 2.17-A shows the average "on-road" fuel intensity of the car stock in the main IEA countries from 1990 to 2004. The fuel intensity of cars in Europe declined on average during the 1990's as vehicles became equipped with electronic control systems and consumers opted for higher fuel economy in reaction to high and growing fuel prices. Increased sales of direct injection diesel vehicles after 2000 further contributed to the decline in fuel used on average per kilometre travelled by cars. In Japan, rising congestion and decreased travel speeds contributed to a deterioration of on-road fuel economy – a trend since reversed in recent years. The fuel intensity of North American cars remained generally above that of other countries – a fact linked to the composition of the North American car fleet and its high share of passenger light-duty trucks and sports utility vehicles (SUVs).

Figure 2.17 A-B: Average On-Road Fuel Intensity (Car Stock) and New Car Fuel Intensity, 1990-2005

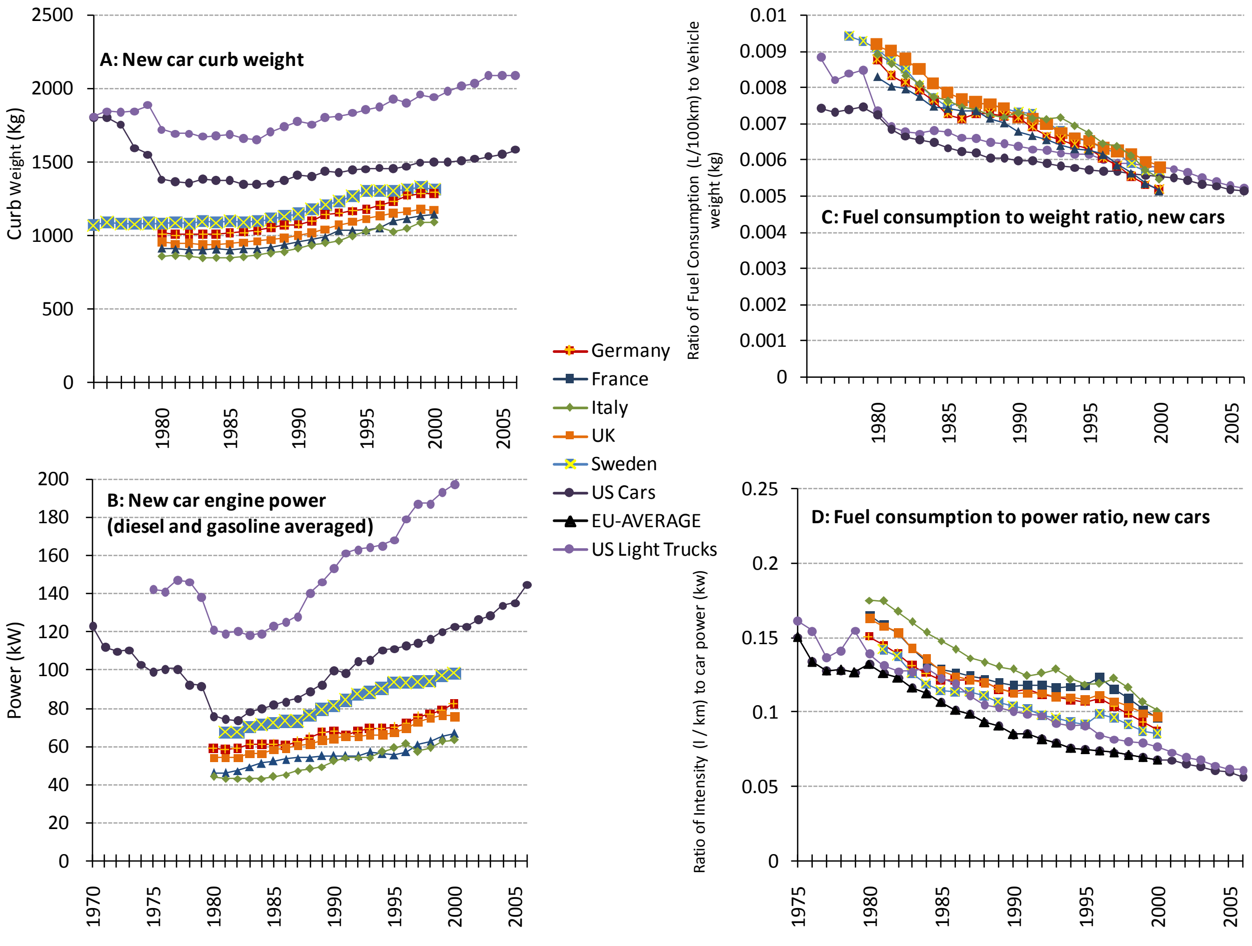


Source: IEA, "Energy Use in the New Millennium: Trends in IEA Countries" (2007)

Test cycle data on the fuel intensity of new cars better captures the role of technological changes in bringing about improved fuel economy. Figure 2.17-B displays trends in new car fuel economy from 1990 to 2004. In Japan, the accelerated decline in the fuel intensity of new cars since 2000 is largely due to the introduction of the "Top-runner" programme which sets the fuel economy standard for any given vehicle class as that of the best performing vehicles within that class five years later. In Europe, a small increase in fuel intensity of new cars in the early 1990 was reversed as direct injection diesels spread through significant portions of the car fleet and as manufacturers sought to meet their voluntary agreement with the European Commission to reduce CO2 emissions to 140 g/km by 2008-2009. In contrast, average fuel economy in North America deteriorated – largely due to the increased sales of light-duty trucks and SUVs which are both heavier and consume more fuel per kilometre travelled. As well, over the same period there was no regulatory pressure to decrease average fuel intensity of new vehicles sold in the American market, unlike Europe and Japan – although this is now changing as new rules for light-duty trucks have been agreed and new fuel economy regulations for cars are being discussed.

In nearly all OECD countries, fuel savings stemming from improved engines and drive trains have been used not to reduce fuel use but to increase vehicle size and weight (Figure 2-18). Not all countries display similar levels of new vehicle weight and power but most display the same trend – albeit with the possible exception of Japan where the current high share of micro-cars (over 30% of new purchases after 2000) may represent a trend-break (Schipper, 2007). Figure 2-18 C and D confirm that the amount of energy required to provide a set power output or to move a set amount of vehicle weight has decreased over time but that as weight and power have increased, greater engine and drive train efficiency has allowed consumers to increase their *personal* utility as measured by proxy via greater weight and power.

Figure 2-18 Trends in New Car Weight and Power in Selected Countries



Source: Lee Schipper, EMBARQ - personal communication

2.5.3 Truck Energy and Fuel Intensity

The same challenges faced in the calculation of fuel intensity and energy efficiency of the cars also confronts the truck fleet. Two further complications are that energy efficiency and GHG intensity calculations that are made in reference to tonne kilometres do not account for the fact that many conveyances are not constrained by weight but rather, by cubic volume. Additionally, gathering data on fleet usage is made more difficult in that a substantial amount of truck travel takes place within a firm and thus data can be difficult to access.

Trucks have displayed an average decrease in energy intensity of 0.8% per year (IEA-17 countries) from 1990 to 2004. Disparities exist among countries however with improvements in energy intensity being recorded in Australia, Austria, Canada, Germany, Japan, New Zealand, Norway Sweden and the United States. Finland, the Netherlands, the United Kingdom and Italy all experienced an increase in truck energy intensity over the same period. Average truck freight energy efficiency figures are impacted by a number of factors including load factors, trip distance and commercial service cycle, vehicle fuel economy, driving behaviour and traffic conditions, regulatory requirements and the quality of infrastructure. Of these, the first is of paramount importance in explaining changes in truck energy intensity per tonne kilometre as can be seen in the Japanese experience (box in Chapter 3). Decreasing load factors in the Netherlands, Italy and the United Kingdom help to explain their increased energy use per truck tonne kilometre (IEA, 2006).

2.5.4 Maritime Transport: Energy and Fuel Intensity

Fuel efficiency is a major concern to vessel owners and operators – at least when bunker prices are high – and can represent up to one third of vessel operating costs (Stopford, 1997). Figure 2.16 shows that shipping has experienced a 3% increase in energy efficiency from 1985 to 2005 – and a 10% increase from 1990 to 2005 using CO2 emissions per tonne delivered as a proxy for energy efficiency. This continues a general trend towards increased fuel efficiency for vessels since the early 1970's. At that time, sharp increases in fuel prices (+ 950% from 1970 to 1985) spurred the accelerated scrapping of fuel-consuming steam turbines and the uptake of more fuel efficient vessels (Stopford, 2007 and Endresen, 2008). Improvements in engine, hull and propeller design have all contributed to increased fuel efficiency and marine engines now represent what are arguably the most fuel-efficient internal combustion (diesel) engines in the world (Corbett, 2007). Further operational improvements targeting anti-fowling treatment of ship hulls and, occasionally, reduced ship speed also contributed to fuel efficiency improvements. However, the latter strategy, while highly effective (e.g. reducing operating speed by 2-3 knots below design speed could potentially halve the daily fuel consumption of the world cargo fleet – Endresen, 2008), is closely linked to both freight rates and bunker fuel prices. For any level of freight rate and bunker price, there is an optimal speed that owners and crew will seek (Endresen, 2007). This means that when freight rates are high, speed and emissions will generally increase.

However, as with cars, in many cases the potential for improved fuel savings has gone not to reduce fuel use *per se* but to allow an increase in the power and size and speed of vessels– particularly in the fast growing container ship sector. Globalization has produced longer shipping routes, and containerization serves just-in-time (or at least on-time) liner schedules; both of these drivers motivated economic justification for larger and faster ships which require greater power to perform their service. Introduction of the fastest, largest ships first occurred on the most valuable trade routes (e.g., serving North America and Europe) where economics most justified the higher performing freight services. Increasingly over the past two decades, ships serving all routes became faster and larger through intentional expansion and aging fleet transition from prime routes to secondary markets. Moving more cargo will likely require more power and more energy, even with anticipated thermal efficiency improvements for new engines (Corbett, 2007).

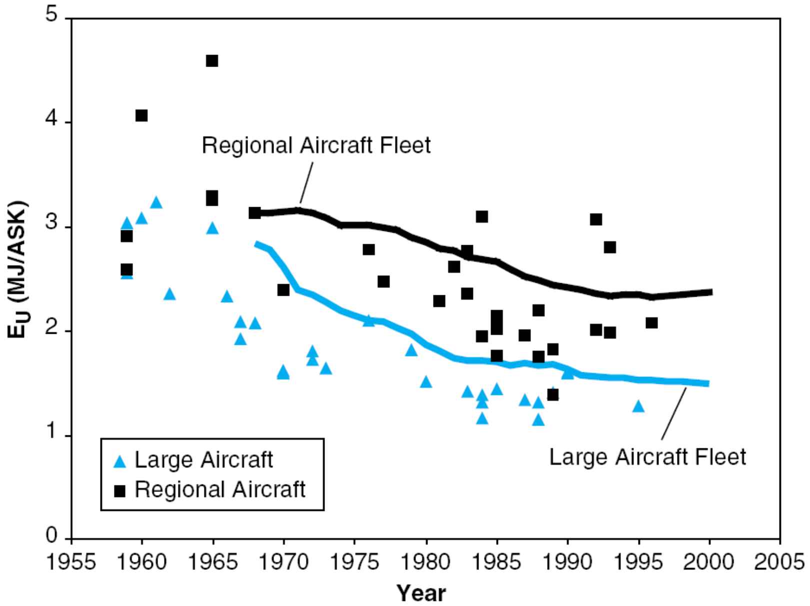
2.5.5 Aviation: Energy and Fuel Intensity

As with shipping, aircraft operators are particularly sensitive to fuel efficiency improvements since fuel costs can represent up to 20% of operating costs for modern passenger jets (IPCC, 2007 based on ICAO data). This has spurred considerable improvement in the energy efficiency of modern jets to the point where the most recent long-haul aircraft compare favourable in terms of CO2 emissions per passenger kilometre with small cars. Future generations of jets will likely continue this trend albeit at lower rates of improvement than have been experienced from 1960 to 2000.

Aircraft are credited with a 70% increase in fuel efficiency from 1960 to 2000 translating into a near-continuous improvement in fuel efficiency (Peeters, 2005 and IPCC, 1999). However, this figure is based on a non-representative baseline (e.g. the DH Comet 4), accounts for available seats and not passenger kilometres, and considers mainly long-haul aircraft – where pressure is greatest to reduce fuel consumption as the share of fuel in overall weight increases with design range (Peeters, 2005). Figure 2-19 compares the specific energy use of long haul vs. short-haul regional jets per available seat kilometre showing that the latter, which represent a small but rapidly growing share of overall air passenger kilometres are typically less fuel efficient than the former.

The 70% improvement figure also says little about the difference in aircraft fuel efficiency per available seat at any one time (which can vary by more than 70% between the most and least efficient aircraft) nor about the typical passenger seating configurations or load factors used which can have an important bearing on fuel use per passenger kilometre (and can vary by as much as a third). Finally, the 70% improvement figure ignores the fact that pre-1960 turbo prop aircraft were as fuel efficient per available seat as the average jet of 2005[22], albeit with greatly reduced speed and payload (Peeters, 2005).

Figure 2-19: Energy Use per Available Seat Kilometre: Regional vs. Long-haul Aircraft



Source: Babikian, 2002

If we take as a baseline the first widespread commercial jet – the Boeing 707 as a baseline, we see that long-haul aircraft have improved their fuel efficiency by 55% from 1960 to the early 2000's. IATA finds a relatively higher rate of fuel efficiency improvement at 24% from 1990 to 2006 (IATA, 2007). One study

[22] … and were nearly twice as inefficient as the jets that replaced them – which begs the question why did airlines opt for these aircraft. One reason is that turbo-props consumed aviation gasoline which cost more to produce than the kerosene that fuelled the jets. Increased speeds (40-80% higher) and payload also made these relatively fuel inefficient jets attractive (Peeters, 2005)

investigating historic trends in aircraft fuel efficiency (Lee et al., 2001) find that the improvements can be attributed in the following manner:

- 69% of overall fuel efficiency improvement from 1960 to 2000 came from reducing fuel burn per unit of engine thrust,

- 27% came from aerodynamic improvements, and

- The remaining fuel efficiency improvements stemmed from other factors (e.g. scale effects of larger aircraft)

The study also found that weight reduction made no contribution to increased fuel efficiency. Weight reduction is now clearly on the design agenda for new generations of aircraft with the uptake of advanced carbon-fibre materials for structural elements of new long haul jets from both Airbus and Boeing. Weight reduction can also be a source of fuel savings for existing aircraft (e.g. by reducing the amount of water carried, reducing the weight of fittings and not painting aircraft.

Finally, Lee et al. found that the rate of average fuel efficiency improvement has not been constant over time having slowed in more recent years. This is an understandable and typical evolution as cheap fuel-saving options become rarer over time. For engines, the fuel efficiency gains arising from switching from turbojets or low bypass ratio turbofans to second-generation high bypass ratio engines were much larger than from switching from the latter to third generation engines.

Non-aircraft related operational changes have also helped reduce the fuel intensity of air travel including better airport taxiway management, reduced power taxiing, using auxiliary power generation units while on the ground and better flight routing while in the air. Congestion at airports and along major flight routes, along with inflexible flight path rules, however, limits the potential for overall fuel savings from aviation. Finally, when measuring fuel use per passenger kilometre, higher seating densities and load factors can contribute greatly to better fuel economy.

2.6 Fuels and Fuel Carbon Content

The transport sector is almost entirely dependent on fossil fuels – mainly oil -- although there have been some small inroads made by biofuels in recent years. This may change in the future but at present, the main difference in the carbon intensity of road fuels lies between gasoline and diesel fuel.

Diesel fuel is more energy dense than gasoline and thus produces 15% more CO2 per litre. Diesel engines, however, are more efficient (direct injection diesel engines are 20-40% more efficient than comparable gasoline engines) and thus, on paper at least, diesel cars should deliver 10-20% less CO2 emissions per vehicle[23]. Some countries have therefore promoted diesel cars as a way of realising important GHG reductions. Schipper (Schipper, 2007) investigates the extent to which this potential is fulfilled "on the road".

Table 2-2 shows the characteristics of diesel cars and diesel car markets in two major European markets.

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[23] Refining diesel fuel also produces marginally less than CO2 than refining gasoline.

Table 2-2 Characteristics of Diesel Cars and Diesel Car Markets in Germany and France

		France		Germany	
New Diesel Cars/SUVs		**1995**	**2005**	**1995**	**2005**
Share of sales	%	46.5%	69.1%	14.6%	42.6%
Test fuel economy (FE)	L/100km	6.60	5.60	6.5	6.5
FE relative to gasoline	%	88.0%	83.6%	85.5%	86.4%
CO2/km rel. to gasoline	%	104%	99%	101%	102%
Stock of Diesel Cars/SUVs					
Share of stock	%	26.5%	46.6%	13.7%	20.0%
Yearly distance driven	Km/car	20627	16736	17980	19470
Distance, rel. to gasoline	%	178%	164%	144%	180%
On-Road					
Diesel fuel economy (FE)	L/100km	6.67	6.43	7.47	6.82
Diesel FE rel. to gasoline	%	78.6%	83.9%	81.7%	81.7%
Diesel CO2/km rel. to gasoline	%	92.7%	99.0%	96.4%	96.4%

Source: Schipper, 2007 using ADEME(2006), Verkehr in Zahlen (2007) and DIW (2007) data

Schipper's analysis, confirmed by other sources (Hivert, 2008 and Ademe, 2006) finds the following reasons for the relatively small CO2 reduction performance of diesels:

- Matched-pair analysis shows that diesel cars are, on average, heavier than their gasoline counterparts and their engines were larger in part to provide more torque.

- The fact that new German diesels produce, on average, more CO2 per kilometre than gasoline cars reflects the greater share of diesel SUV sales in that country.

- Diesel cars are also, as stated earlier, driven more than their gasoline equivalents.

Compared to other countries, however, the increased penetration of diesels in France and Germany does explain part of the relative national differences in overall fuel efficiency given that they do provide a small efficiency advantage. This has been estimated to be on the order of 6% from 1995 to 2004 than if diesel shares had remained constant at their 1995 levels (Schipper and Zacharides, 2007 priv. com.).

Chapter Summary

⇒ 2005 per capita emissions of CO_2 from transport among ITF countries varied from 6.6 tonnes in the USA to 0.2 tonnes in Armenia. Average per capita emissions of transport CO_2 are 3.1 tonnes for ITF countries which is considerably higher than the per capita emissions of the principal CO_2-emitting non-ITF countries

⇒ Generally, the creation of more wealth per capita in ITF countries has been accompanied by rising per-capita CO_2 emissions from transport activity. The average GDP intensity of transport CO_2 emissions for international Transport Forum Countries is 0.14 kg of CO_2 per dollar of GDP.

⇒ The amount of CO_2 emitted from transport activity results from the interplay between travel volume, mode share, energy intensity of travel and carbon intensity of fuels. Transport GHG mitigation policies should address all four areas.

⇒ There is a strong and sustained trend for reduced energy use (and, consequently of GHG emissions) per unit of transport work accomplished. Overall, energy use per passenger kilometre for all modes combined (excluding international aviation) has decreased by 0.5% per year from 1990 to 2007, at the same time trucks have displayed an average decrease in energy intensity of 0.8% per year.

⇒ However, given the overall rise in transport energy use, these gains have not been sufficient to counter the increases in activity and have, at best, reduced the rates of growth in energy use and GHG emissions that might otherwise have occurred. Also, a number of countries whose energy intensity had been dropping from 1990-2004 have seen this trend turn around in recent years.

Road Passenger and Freight Transport: Drivers and Trends

⇒ Cars are the predominant energy user and source of CO_2 emissions for passenger transport representing 88% of energy use and nearly as high a share of CO_2 emissions in 2004. Rail and bus travel accounts for a diminishing share of passenger transport energy use – principally because people have switched from these modes to cars and air. For freight transport, trucks represent the largest energy user and source of CO_2 emissions, growing from 77% to 82% of final freight transport energy use.

⇒ Greater wealth has led to higher rates of car motorisation and greater car motorisation has led to increased household travel. The principal reason for this is that, given limited travel time budgets, increased speed has largely served to “buy” greater travel distance.

⇒ Car passenger kilometres are projected to more-or-less double from 2000 to 2050 world-wide. However, this growth is projected to be accompanied by decrease of about a third of the sales-weighted average fuel economy of new vehicles over the same period.

⇒ Demand for car travel is conditioned by a number of factors, including the rising incomes and the relative cost of travel. Consumers in the United States have seemed react to higher fuel prices by investing in more fuel efficient vehicles rather than decreasing their travel. European countries may be quicker to adjust demand for car travel to changes in fuel and travel prices.

⇒ In Europe, a small increase in fuel intensity of new cars in the early 1990 has reversed since then while average fuel economy in North America has steadily deteriorated – largely due to the increased sales of light-duty trucks and SUVs.

⇒ In nearly all OECD countries, fuel savings stemming from improved engines and drive trains have been used not to reduce fuel use but to increase vehicle size and weight.

Aviation Passenger and Freight Transport: Drivers and Trends

⇒ Air travel (both passenger and freight) is projected to more than double from 2005 to 2025 – a trend which has important repercussions given the additional climate impacts of aviation discussed in the previous chapter.

⇒ Long-haul aircraft have improved their fuel efficiency by 55% from 1960 to the early 2000’s. This rate of improvement has not been constant but has slowed over time. These improvements have come mainly from engine and aerodynamic improvements. Weight reduction has historically not played a major role in fuel efficiency gains for aviation although this is changing rapidly with current and future generation long-haul aircraft.

⇒ Non-aircraft related operational changes have also helped reduce the fuel intensity of air travel including better airport taxiway management, reduced power taxiing, using auxiliary power generation units while on the ground and better flight routing while in the air. Congestion at airports and along major flight routes, along with inflexible flight path rules, however, limits the potential for overall fuel savings from aviation.

Maritime Transport: Drivers and Trends

⇒ Total maritime trade has doubled from 1985 to 2007, total containerised trade has grown eight-fold over the same period and currently represents 16% of all maritime trade by weight (and a much larger share by value). Trade in containers is projected to more-or-less triple from 2000 to 2020. This growth has important GHG repercussions as the average installed power on container vessels is higher than on most other types of vessels and given the speeds at which container vessels travel, increased container vessel activity will result in greater maritime CO2 emissions than might otherwise have been.

⇒ For international maritime transport, growth in activity has generally followed, and oftentimes outstripped GDP growth and the volume of maritime tone kilometers has tended to rise in reaction to longer maritime voyages brought about by changes in global trading patterns.

⇒ Shipping has experienced a 3% increase in energy efficiency from 1985 to 2005 – and a 10% increase from 1990 to 2005 using CO2 emissions per tonne delivered as a proxy for energy efficiency. This continues a general trend towards increased fuel efficiency for vessels since the early 1970's.

⇒ In many cases the potential for improved fuel savings has gone not to reduce fuel use *per se* but to allow an increase in the power and size and speed of vessels– particularly in the fast growing container ship sector.

3 INITIAL REVIEW OF TRANSPORT-SECTOR GREENHOUSE GAS MITIGATION STRATEGIES

3.1 Analysis of current strategies

The following analysis of strategies is based essentially on the fourth national reports published pursuant to article 12 of the Climate Convention[24]. National transport GHG mitigation strategies have also been analysed in a review undertaken by the ECMT in 2006 “Cutting Transport CO2 Emissions: What Progress?”. The UNFCCC reports that some countries/regions have put in place comprehensive “transport” GHG reduction strategies[25] but most countries include transport GHG reduction measures in broader national GHG reduction strategies. We summarise the main transport components of these plans below.

1. The strategies are based around the same measures

The reports take into account measures which can be grouped into six main categories, and recoup partially the activity/modal share/energy efficiency/fuel categories defined previously:

⇒ *promotion of public transport, cycling and walking for local journeys - the link between town planning and local travel*

The promotion of partnerships with local authorities to establish local travel policies as a major part of public transport, cycling and walking features in many reports (Austria, Belgium, Canada, Finland, Germany, Greece, Italy, Spain, Japan, New Zealand, Poland, Portugal, Slovenia, United Kingdom, Turkey). These local strategies sometimes include the introduction of restricted circulation areas (Italy), low emission zones or urban tolls to restrict motor traffic. Car or bicycle sharing, car pooling may also be part of these local strategies.

Promotion of public transport is linked to better information (Ireland) and development of public transport quality and availability (Canada, Dublin in Ireland, Portugal in Lisbon and Porto, Latvia in Riga, France through dedicated infrastructure and regional railways, Denmark through faster public transport). The existence of school journey plans, company journey plans, travel plans for major events encourage this behaviour.

Some countries encourage daily travel other than by car through fiscal measures such as income tax relief for non car-commuting households (Germany, Belgium, Canada) or corporation tax relief for financing public transport season tickets (Finland).

Several countries (Australia, Germany, Denmark, Ireland, Finland) emphasise the relationship between town planning and demand for local transport, and engage in more integrated urban and transport planning.

⇒ *modal shift and improvements in freight transport*

24 They can be found at the following address: http://unfccc.int/national_reports/annex_i_natcom/submitted_natcom/items/3625.php

25 e.g. Scotland, New Zealand, ...

Modal shift from road to rail, waterways or maritime transport and the promotion of combined transport have been adopted in several national reports as one way to reduce greenhouse gas emissions caused by transport (Austria, Belgium and Estonia through rail, Denmark through combined transport and rail, France, Japan, Poland through waterways, Portugal, Switzerland).

Germany and Netherlands underline the improvement due to railway network interoperability and opening of track rights to new companies.

To improve the energy efficiency of road freight, several national strategies call for agreements with transport professionals (Australia, Canada, United States, Japan), who are encouraged to measure and reduce their emissions and experiment innovations.

⇒ *energy efficiency*

Energy efficiency relies on voluntary agreements (Australia, European Union, Canada) or regulation (Japan, United States). At present, these provisions mainly target private cars: only Japan has introduced regulations concerning heavy goods vehicles. Germany also emphases the importance of efficient car equipment.

Changes are envisaged to move from voluntary agreements to regulation (European Union in 2012) or to make existing regulations stricter (2010 and 2011 in the United States and Canada for cars and light trucks). Some countries promote research in fuel efficiency for cars at the same time (France, Germany, United Kingdom).

Practically all the countries have introduced labelling of consumption of new vehicles sold, to guide purchasing behaviour towards more energy efficient vehicles.

The introduction of vehicle testing (Bulgaria, Cyprus, Estonia, and, in the future, Greece), regulation of taxis life span (Greece), scrap premiums (Canada, Cyprus, France, Portugal) help to eliminate the oldest and least energy efficient vehicles.

Many countries have also introduced feebate schemes (Canada, France, Netherlands), incentives for purchase of fuel efficient vehicles (Belgium), or annual registration tax for private and company cars (Austria, United Kingdom, Denmark, Iceland, Ireland, Liechtenstein, Sweden, Switzerland ...) which reward lower-emitting cars.

Several countries (Germany, Austria, Belgium, Denmark, Ireland, Finland, Netherlands, Switzerland,...) have introduced eco-driving programmes, or speed limits (Denmark, Poland) or strengthened drivers licensing tests (France, Netherlands) which have the effect of reducing emissions and fuel consumption through less aggressive driving. Public awareness (Germany, Netherlands, Poland) may go beyond ecodriving to encourage other behavioral changes decreasing GHG emissions.

Some countries have relied on public procurement (Australia, France, Czech Republic ...) in order to help the uptake of less fuel intensive vehicles and to create economies of scale for manufacturers. Netherlands, for instance, has put in place a comprehensive policy regarding public procurement of low-emitting vehicles as part of its approach bringing together key actors in transport and government to sign action-oriented memorandums of understanding. Germany has invited tenders for 30,000 to 40,000 “clean” vehicles for public fleets and some large partner private fleets. Belgium has also drafted green procurement rules.

Fuel efficiency might also addressed for railways and aviation: Canada has signed two "memorandum of understanding" with the corresponding professional associations.

⇒ *use of fuel less carbon intensive fuels*

The vast majority of countries resort to biofuels to reduce CO2 emissions from transport. The introduction of biofuels is facilitated through tax relief and/or compulsory quotas. Biofuels today represent only a small percentage (10% maximum in 2010) of fuels used. Many countries stress that the spread of biofuels should be linked to robust sustainability criteria and many expect much from second generation biofuels.

Some countries are also promoting other types of fuels, such as natural gas (Australia, Canada), biogas (Austria) or liquefied propane gas (Belgium), sometimes with concomitant concerns about reductions in local pollution in urban areas.

⇒ *Infrastructure charging and internalisation of external costs*

Several countries (Germany, Austria, Switzerland) have introduced infrastructure charging or envisage doing so (Netherlands, United Kingdom). Those charges which have been introduced concern mostly heavy goods vehicles. Those which are envisaged address road congestion. Norway has already authorized local authorities to implement road pricing in order to collect funds for new infrastructure. The cost of operating such systems is a concern of their promoters.

Bulgaria, Turkey, Germany, Luxemburg, Malta, Sweden have decided to increase taxes on motor fuels, while the European Union has retained minimal levels of tax on these fuels. Switzerland and Norway have introduced climate tax which has had the effect of increasing the tax on fuels.

The idea of quotas and carbon trading also features in some national strategies. Canada is working in such a system for industrial companies, which would be rewarded when they do more than their regulatory obligations, put in place projects which result in a reduction in GHG or finance mechanisms for clean development.

⇒ *Improving infrastructure*

Although several countries mention the improvement of infrastructure as a transport GHG reduction measure (through decreased congestion and travel time), few provide quantified analysis of the impacts of such a strategy. Better traffic conditions (Spain, Estonia, Greece, Ireland, Iceland, Poland, Czech Republic, Romania, Slovenia), reduction of traffic jams through new infrastructure or better management relying on new technologies (Austria, Belgium, Canada, United States, Japan, Malta) are reflected in lower unit consumption per kilometre, but may have a "rebound effect" and increase the number of kilometres traveled, and the energy consumption of transport. This effect is different among countries with a relatively low rebound being reported for the USA and higher induced travel impacts for Europe.

Other infrastructure related measures include road signaling improvement plans in Cyprus and Greece, improved port-hinterland rail connections in Belgium, Portugal and Romania and expanding the high speed rail network in France.

2. The UNFCCC reports hardly mention international transport or adapting to climate change

⇒ *International transport*

While international maritime transport and international air transport each represent between 1.5 and 2% of global CO_2 emissions from fossil fuel, they are hardly mentioned in the national GHG reports – principally because these sectors are not included in the Kyoto protocol and thus are not a focus of national concern for Kyoto Annex I parties. The Netherlands report is an exception when it states the role of the Netherlands in work carried out under the aegis of the ICAO and the IMO. Although it hardly mentions it in its report, the European Union also plans to include emissions from international flights in the mechanism for exchange of emissions quotas.

The EEA report « Climate for a transport change » focuses one chapter on air transport. International aviation grows rapidly for the EU leading to a 73% increase of CO_2 emissions from international aviation between 1990 and 2005. Air transport outside the EU 25 accounts for 60% of these emissions. Improvements in fuel efficiency of aircraft and better air traffic management have not offset this traffic growth. By 2020, the projected CO_2 emissions associated with air transport departing from the EU are 284 Mt CO_2.

⇒ *Adapting to climate change*

Adapting to climate change is mentioned by all the countries, for it is one of the chapters of the national communications under the Climate Convention. However, few countries mention transport in this chapter; the foreseeable consequences of global warming in infrastructure and the necessary adaptations are less important than they can be in other sectors such as management of water resources, agriculture or health.

Germany, the United States, Finland and the United Kingdom mention adaptation in the context of the transport sector. The United States published in March 2008 a rather comprehensive report on transport adaptation to climate change[26]. Finland highlights the influence of climatic change on embankments and the maintenance of infrastructure (anti-skid treatments).

26 http://www.trb.org/news/blurb_detail.asp?id=8794

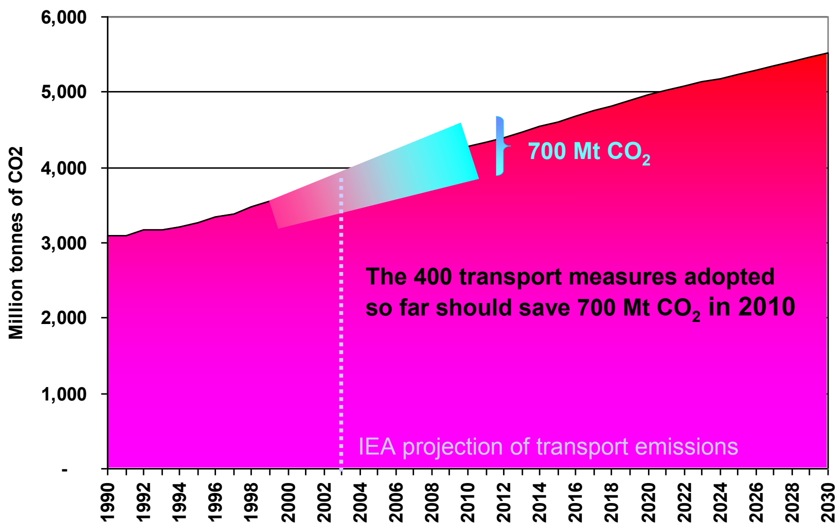
3. The reports envisage increases in greenhouse gas emissions from transport up to 2010

The forecasts of the United States, Japan and the European Union are summarised in the following table (in Mt CO2eq) :

Table 3.1 CO2 Emission Forecasts for USA, Japan and the EU

	Current transport situation	Transport situation in 2010	Transport situation in 2020	Overall trend for CO2 emissions (all sectors)
United States	1850 (2004)	1980-2066 MteCO2 in 2012 with or without measures	2108-2266 MteCO2 in 2020 with or without measures	7074 MteCO2 in 2004, 7709 to 8330 MteCO2 in 2020
Japan	260 (CO2 2003)	259- 250 (CO2 2010) with or without additional measures		1174 MteCO2 in 2002, 1056 MteCO2 in 2010, more or less the level in 1990
European Union	990 (GHG 2005 CO2 eq EU 27) 880 (GHG 2005 CO2 eq EU 15)[27]	949 Mt CO2 eq according to EU 27 member states projections.	1091 Mt CO2 eq for EU 27 assuming a 15% growth and no further reduction measure 871 MtCO2 eq assuming improvement in fuels and passenger vehicle efficiency	Reduction of 6.8 to 9,3 % in 2010 compared to 1990

Figure 3.1 Potential impact of policies identified on projected transport emissions for OECD/ECMT region



Note: The figure is only intended to give an approximate indication of the significance of the abatement measures discussed. Some of the measures identified may have been included in the business as usual projection shown, and the slope of the curve for emissions with abatement incorporated is difficult to determine from the present analysis.

Source: ECMT based on World Energy Outlook 2004, IEA.

27 EEA Report 1/2008

The 2006 ECMT report “Cutting Transport CO2 Emissions: What Progress” clearly illustrates that existing and planned transport GHG mitigation measures will not be sufficient to stabilise, let alone decrease, transport CO2 emissions . The maximum savings International Transport Forum countries might achieve by 2010 is perhaps 700 Mt, somewhat over half the projected increase in transport sector CO_2 emission (from 1990 levels).

A few other conclusions can be drawn:

- It is more difficult to control greenhouse gas emissions in the transport sector than in other sectors. Worldwide, global emissions of CO2 increased 25% from 21,024 to 26,320 MtCO2 between 1990 and 2004. In the same period, energy demand for the transport sector increased by 37%. In the United States of America, the corresponding rates are 19% and 28% . In Japan, compared with the situation in 1990, transport has seen a decline of 5% between 2002 and 2010, from +20% to +15% while the other sectors are declining more rapidly, with the residential and commercial sector falling from +33% to +11%, industry from -2% to -9%, energy production from 0 to -16%. In the European Union, the transport sector grows by 30% in 2010 compared with the situation in 1990 while all sectors together show a reduction of 7 to 9% depending on whether one takes Europe as 15 or 25 States.

- The situation is very disparate from country to country, and the geographical context is not enough to explain these differences.

- Planned GHG mitigation measures allow reductions by 2010 which can be estimated at between 5 and 10% compared with the situation if nothing changes, with all the difficulties inherent in such an estimate.

- Overall, greenhouse gas emissions from transport do not diminish over the period up to 2010. Additionally, they have little chance of doing so by 2020. This can be explained both by the considerable inertia of the sector (a motor vehicle has a lifespan of 15 years, houses, offices, shops and industrial plant which give rise to travel have a longer lifespan) and by the growth of transport due to the rising population and growth in wealth.

- Some countries – notably Japan (see box), Germany and France, however, have been able to stabilise and or decrease transport GHG emissions even whilst undergoing economic growth.

4. Detailed analyses of transport emissions are scarce

⇒ *the impact of the various measures on emissions is rarely detailed*

It is difficult to forecast future emissions of greenhouse gases from transport. First, one must be able to make projections of the number of vehicles, their energy efficiency, the price of fuel and the number of kilometres driven. The relationships between these elements are often drawn from past records and do not include breaks in the pattern. The majority of national reports do not give details of corresponding calculations, for example of the elasticities taken into account.

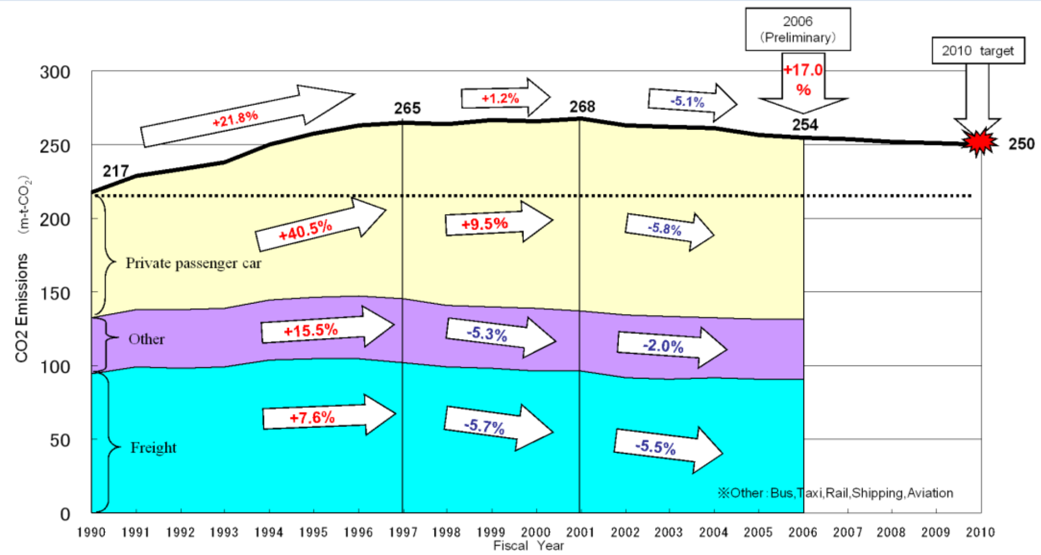
The EEA report "GHG emission trends and projections in Europe 2007" explains that the main driving force for rising emissions is the number of kilometer driven by passenger cars and trucks. For freight transport, the increased proportion of trucks also plays a role.

Fossil fuel combustion intensity limits emission growth. For the EU 27, the biofuels directive is expected to reduce emissions by 33 MteCO2 in 2010, whereas the ACEA agreement is expected to reduce them by 20 MteCO2. Modal shift measures and passenger car labelling impacts are negligeable. By 2020, the EU fuels directive is expected to decrease emissions by 95 Mt eCO2 and the passenger vehicle efficiency legislation is assumed to provide a 125 MteCO2 decrease.

Transport Sector GHG Reduction in Japan

Overall CO2 emissions in Japan have risen by 6.4% from 1990 to 2006 against a Kyoto target of a 6% reduction in CO2 emissions. Transport-sector CO2 emissions which represent about 20% of total CO2 emissions have risen as well -- +17% from 1990 to 2006. Absent any supplementary measures, the Government projected that transport sector emissions would rise to 274 Mt by 2010. In response, the Government in 2002 adopted a series of specific and absolute targets for each sector for 2010. For transport, the target is 250 Mt of CO2 representing a 15.1% increase over 1990. Figure A shows the trend in from transport CO2 emissions from 1990 to 2006. From a peak of 268 Mt in 2001 these have dropped every year since reaching 254 Mt in 2006.

Figure A: Trend in Transport CO2 Emissions for Japan 1990-2006



In order to achieve the 250 Mt target, the Government identified four categories of measures or "wedges" that could deliver a 6.7% reduction from 2001 levels to the 2010 target. These relate to freight transport, vehicle technology and use, congestion and traffic flow management and Public transport and ITS investment. Figure B shows the relative size of each reduction "wedge". The Japanese fuel efficiency "Top-runner" standard was excluded from these "additional" measures as it was already in place at the time but it should be noted that absent the "Top-runner" programme, transport emissions were forecast to rise to 295 Mt by 2010. Actual emissions have been below the trend-line leading to 250 Mt in 2010 and thus the government has discussed strengthening the target to 240 Mt by that date which represents a 10.4% reduction from the 2001 peak and a 10.5% increase over 1990.

Government analysis of transport CO2 emissions trends in Japan has found that the following reasons for the drop in CO2 emissions:

Decrease in vehicle travel

Vehicle-kilometers have decreased since 2003 in Japan. Freight vehicle-kilometers (vkm) have been decreasing since 1995, and those of passenger transport have been decreasing since 2003 (see Figure C). This decrease in vkm has taken place in a context of economic growth and thus the past few years have witnessed a decoupling of vehicle travel to GDP.

Increase in Truck Load factors

The drop in freight vkm is imputable to an increase in truck load factors. One of the principal reasons for this has been the shift from own transport within firms to commercial for-hire transport by external carriers. Surveys have shown that own-carriage operations average load factors are .3 tonnes per trip whereas commercial for-hire carriers average load factors are approximately 3.6ton per trip.

Figure B: Estimate of Effort necessary to reach Transport CO2 Target

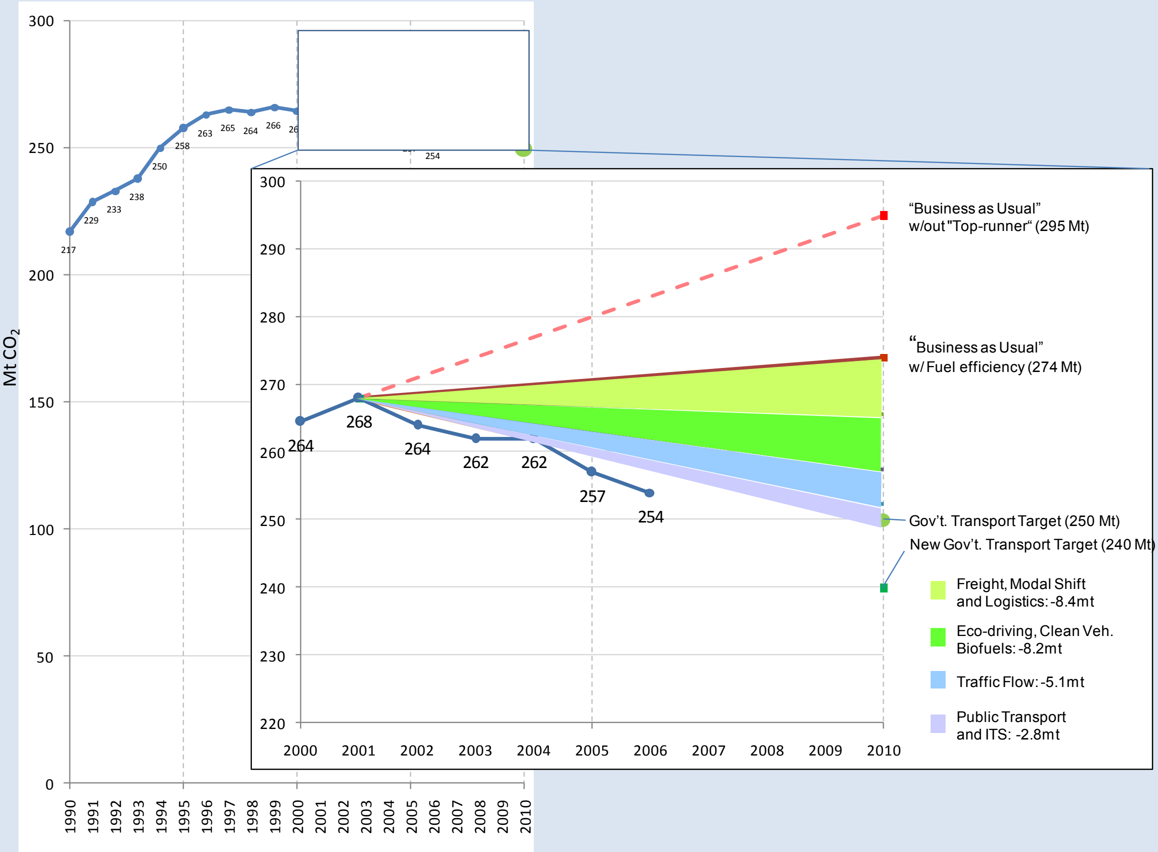


Figure C: Freight and Passenger Vehicle kilometers and GDP 1993-2006

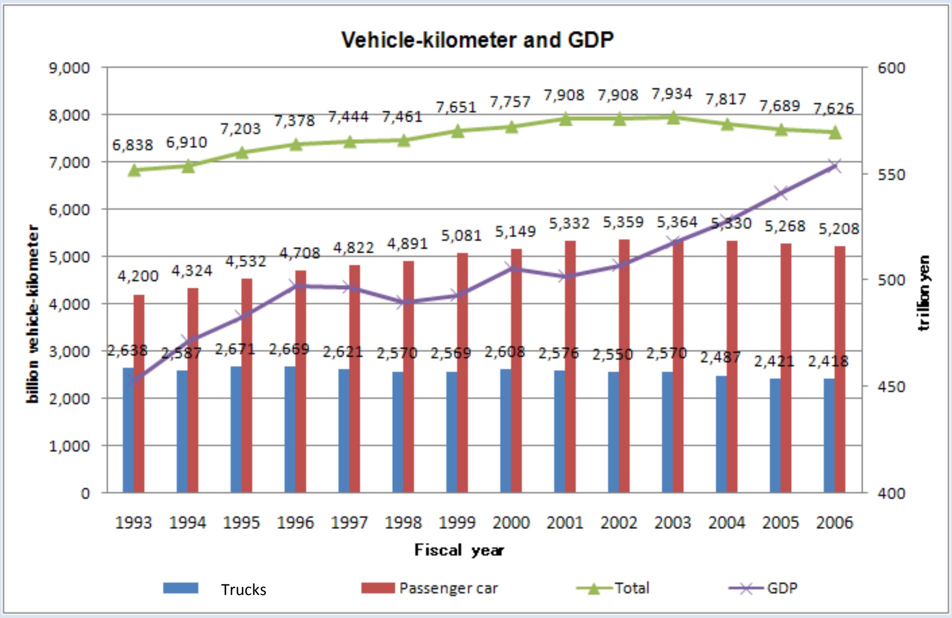
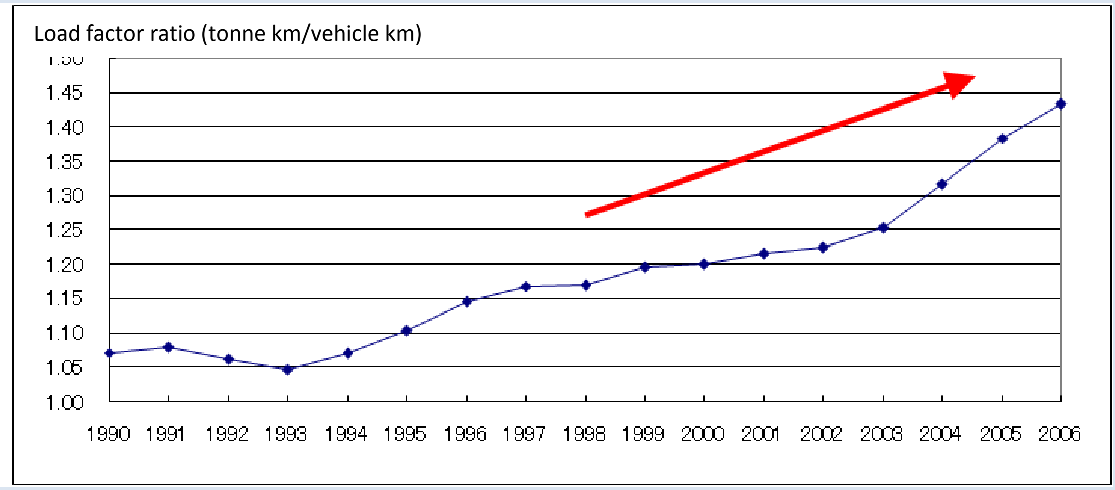


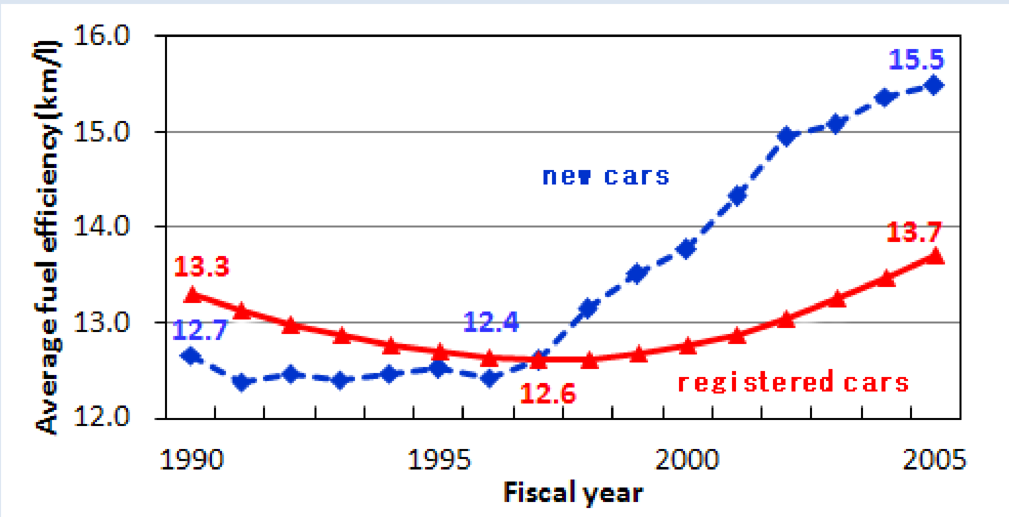
Figure D: Increase in Truck Load Factors: 1990-2006



Development and dissemination of fuel-efficient vehicles

Another factor contributing to the decrease of CO2 emissions has been the improvement of fleet-wide vehicle fuel efficiency. Figure E shows the improvement of fuel economy for both new cars and the fleet as a whole. Fuel efficiency of new cars has improved since 1996, which has also increased the fuel economy of the fleet as a whole as these vehicles gradually represent a larger share of the whole. In particular, the increased share of low-emission and very small vehicles (micro-cars) has improved the emission profile of the overall fleet.

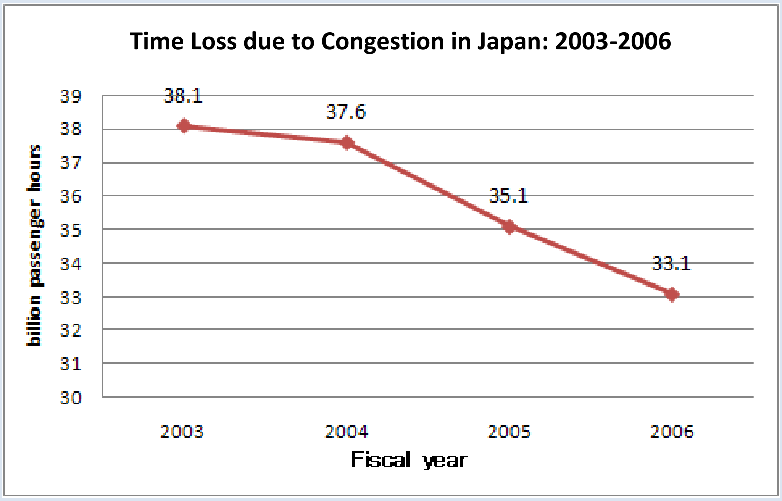
Figure E: New Vehicle and Fleet-wide Fuel Economy: 1990-2005



Improved Traffic Flow

Figure F shows that time loss caused by traffic congestion decreased 13% from 2003 to 2006 in Japan. Abatement of severe traffic congestion smoothes traffic flow, increases running speed of vehicles and contributes to a decrease of fuel use and CO2 emissions – up to a certain speed (approximately 70 km/hr.) after which emissions increase again. The relief of chronic and severe congestion in Japan has thus contributed to a decrease in fuel use and CO2 emissions.

Figure F: Congestion Relief in Japan: 2003-3006



Sources:

Figure A, B, C, D. F: Ministry of Land, Infrastructure, Transport and Tourism, Japan

Figure E: Agency for Natural Resources and Energy, Japan

The ECMT report assessed the number and the impact of different measures as summarised in Table 3.2. The impacts are presented as percentages of the 2002 transport sector CO_2 emissions from the country concerned. Columns two and three in the table indicate the number of countries and the number of policies being pursued in the different impact type categories. All plausible policies are included in this table – where abatement estimates are not available they have been estimated on the basis of the "percentage impacts" achieved by other similar policies.

Table 3.2: Average "impact" of policies based on countries' projections of expected CO2 savings in 2010.

Impact Type	Number of Countries with Active Policies	Number of Active Policies with quantifiable impacts	Number of Active Policies with quantified estimate	Average "Percentage Impact" (including estimates for planned and discontinued policies)	CO2 Savings from Active Policies in 2010 (Million tonnes)**
Carbon Intensity	31*	43	11	1.57%	102
Demand	5	7	4	1.63%	12
Fuel Efficiency – Technical	28*	60	15	3.39%	323
Fuel Efficiency – On-road	20*	31	11	1.85%	114
Modal Shift***	28	51	14	1.21%	67

** The EU is included as if it were a single country where the policy was introduced across Member States through an EU Directive.*

*** Note that this column includes abatement from policies that were not quantified by national governments but for which ECMT was able to estimate abatement.*

**** Promotion of walking and cycling is included under the heading modal shift; 12 countries report such policies, whilst all 28 include policies to promote motorised modes.*

In terms of the number of policies being pursued, countries place improving technical fuel efficiency and optimising the modal mix on an equal footing. Policies to reduce carbon intensity and to improve on-road fuel efficiency have also been given a prominent role, while reducing demand is largely overlooked.

The large number of modal shift policies is believed to be the result of following a "co-benefits approach" to CO_2 abatement policy in the transport sector. That is, governments have selected abatement policies that also contribute to the achievement of other transport policy goals (or wider other government objectives), in particular access to low cost public transport and reducing congestion. This is a sensible approach to public policy and, indeed, was part of the recommendations of ECMT's 1997 review of CO_2 emissions from transport. The present situation may, however, reflect an over-emphasis on the co-benefits approach. Modal shift policies tend to achieve only a third the impact of a fuel efficiency policy and three quarters of the impact of a carbon intensity policy.

⇒ *the economic costs of measures is only mentioned in the Netherlands report*

While the economic cost of measures may be an important element in their viability, it is almost never mentioned, except in the Netherlands report.

Chapter Summary

⇒ The promotion of partnerships with local authorities to establish local travel policies as a major part of public transport, cycling and walking features in many national transport GHG mitigation strategies. As do modal shift policies seeking to shift traffic from road to rail, waterways or maritime transport and the promotion of combined transport.

⇒ The large number of modal shift policies is believed to be the result of following a “co-benefits approach” to CO_2 abatement policy in the transport sector. The present situation may, however, reflect an over-emphasis on the co-benefits approach. Modal shift policies tend to achieve only a third the impact of a fuel efficiency policy and three quarters of the impact of a carbon intensity policy

⇒ Many countries also target improved fuel economy. At present, these provisions mainly target private cars: only Japan has introduced regulations concerning heavy goods vehicles. Germany also emphases the importance of efficient car equipment.

⇒ The vast majority of countries resort to biofuels to reduce CO2 emissions from transport. Biofuels today represent only a small percentage (10% maximum in 2010) of fuels used. Many countries stress that the spread of biofuels should be linked to robust sustainability criteria and many expect much from second generation biofuels.

⇒ Several countries (Germany, Austria, Switzerland) have introduced infrastructure charging or envisage doing so (Netherlands, United Kingdom). Those charges which have been introduced concern mostly heavy goods vehicles. Those which are envisaged address road congestion.

⇒ Although several countries mention the improvement of infrastructure as a transport GHG reduction measure (through decreased congestion and travel time), few provide quantified analysis of the impacts of such a strategy.

⇒ International maritime transport and international air transport are hardly mentioned in the national GHG mitigation strategies – principally because these sectors are not included in the Kyoto protocol and thus are not a focus of national concern for Kyoto Annex I parties. The European Union plans to include emissions from international flights in the mechanism for exchange of emissions quotas.

⇒ However, few countries address the issue of adaptation to climate change for the transport sector.

⇒ The best current assessment of the impact of transport GHG mitigation policies indicates that existing and planned transport GHG mitigation measures will not be sufficient to stabilise, let alone decrease, transport CO2 emissions . The maximum savings International Transport Forum countries might achieve by 2010 is perhaps 700 Mt, somewhat over half the projected increase in transport sector CO_2 emission (from 1990 levels).

⇒ Overall, greenhouse gas emissions from transport will likely not diminish over the period up to 2010. Additionally, they have little chance of doing so by 2020. This can be explained both by the considerable inertia of the sector (a motor vehicle has a lifespan of 15 years, aircraft and ships up to 40 years) and by the growth of transport due to rising population and growing wealth.

⇒ Some countries – notably Japan (see box), Germany and France, however, have been able to stabilise and or decrease transport GHG emissions even whilst undergoing economic growth.

APPENDIX 1: COMPOSITION OF WORLD REGIONS USED IN THIS REPORT

EU-15 (countries belonging to the EU prior to May 1, 2004)

⇒ Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland (Republic of), Italy, Luxembourg , Netherlands , Portugal , Spain, Sweden, United Kingdom

EU-New (The 12 countries having joined the EU since May 1, 2004)

⇒ Bulgaria, Cyprus[28], Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia

International Transport Forum - North America

⇒ Canada, Mexico, United States

International Transport Forum - Asia Pacific

⇒ Australia, Japan, Korea, New Zealand

International Transport Forum - Other

⇒ Albania, Armenia, Azerbaijan, Belarus, Bosnia-Herzegovina ,Croatia, FYR Macedonia, Georgia, Iceland, Moldova, Montenegro ,Norway, Russia, Serbia ,Switzerland ,Turkey ,Ukraine

10 Top CO2 Emitting non International Transport Forum Countries

⇒ China (including Hong Kong), India, Islamic Republic of Iran, Indonesia, South Africa, Brazil, Saudi Arabia, Chinese Taipei, Thailand, Kazakhstan

Rest of World

28 Southern part of the island as there is no single authority representing the whole of the island.

APPENDIX 2: NATIONAL TRANSPORT-RELATED AND GHG EMISSIONS DATA

These tables contain detailed data on Greenhouse Gas (GHG) emissions and carbon dioxide (CO2) emissions from fossil fuel combustion in member countries of the International Transport Forum.

A number of data sources are used in these tables:

Population and GDP data are from the International Energy Agency. GDP data is expressed in purchasing power parity (2000 $).

Data on transport volumes (passenger-kilometres and tonne-kilometres) are collected from national administrations by the Statistics division of the International Transport Forum.

Data on motorisation rates comes from the World Bank.

Data on Greenhouse Gas Emissions (and CO2 emissions in particular) come from national reports to the United Nations Framework Convention on Climate Change (UNFCCC) and from the International Energy Agency.

International Energy Agency (IEA) energy figures are based on the default methods and emissions factors from the Revised 1996 IPCC (Intergovernmental Panel on Climate Change) Guidelines for National Greenhouse Gas Inventories.

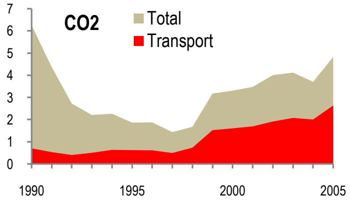
Important Cautionary Note:

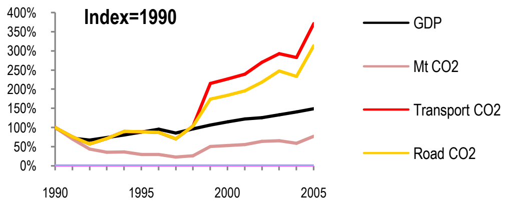
There are many reasons why the IEA estimates may not be the same as the numbers that a country submits to the United Nations Framework Convention on Climate Change (UNFCCC), even if a country has accounted for all of its energy use and correctly applied the IPCC Guidelines. In addition, the IEA presents CO2 emissions calculated using both the IPCC Reference Approach and the IPCC Tier 1 Sectoral Approach. In some of the non-OECD countries, there can be large differences between the two sets of calculations due to various problems in some energy data. As a consequence, this can lead to different emission trends between 1990 and 1999 for certain countries. For more details, visit the IEA web-site.

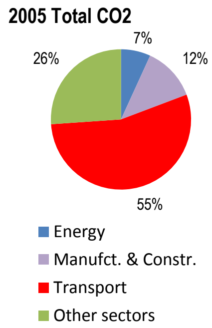
Albania

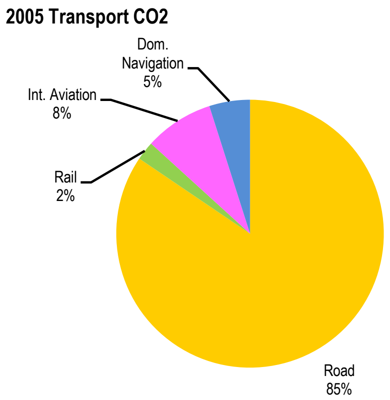
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	23%	4.83	23%	1.47	51%	0.31
Transport CO2	272%	2.64	291%	0.84	149%	0.18
Road CO2	214%	2.23	230%	0.71	111%	0.15
Aviation CO2		0.22		0.07		0.01
Shipping CO2		0.13		0.04		0.01









Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	3.29	3.13	3.06	3.07	3.08	3.09	3.11	3.13	-5%	-0.33%
GDP (billion 2000 US$, PPP)	9.93	8.73	11.38	12.18	12.53	13.25	14.03	14.80	49%	2.70%
Road passenger km (million pkm)	2174	4955	5299	5370	6065	6495	6481	6925	219%	8.03%
Road freight tonne km (million tkm)	1779	2140	2199	2256	2380	2569	2838	3243	82%	4.08%
Road pkm/capita	661	1583	1732	1749	1969	2102	2084	2212	235%	8.39%
Road freight tkm/$ of GDP)	0.18	0.25	0.19	0.19	0.19	0.19	0.20	0.22	22%	1.35%
Motorisation (Cars/1000 inhabitants)	..	19	37	43	48	57	..	..	..	..
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	6.26	1.87	3.31	3.48	4.01	4.12	3.71	4.83	-23%	-1.71%
IEA transport CO2 (Mt CO2)*	0.71	0.63	1.61	1.70	1.92	2.08	2.01	2.64	272%	9.15%
Transport as a percentage of total	*11.3%*	*33.7%*	*48.6%*	*48.9%*	*47.9%*	*50.5%*	*54.2%*	*54.7%*		
Road	0.71	0.63	1.31	1.39	1.55	1.76	1.66	2.23	214%	7.93%
Rail	0.00	0.00	0.10	0.09	0.09	0.09	0.09	0.06	..	..
Domestic Aviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	..	..
International Aviation	..	..	0.13	0.14	0.14	0.15	0.18	0.22	..	..
Domestic Navigation	0.00	0.00	0.07	0.07	0.14	0.09	0.07	0.13	#DIV/0!	..
International Maritime	..	..	..	..	..	..	..	..	..	..
Other Transport	0.00	0.00	0.00	0.01	0.00	-0.01	0.01	0.00	..	..
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
UNFCCC Transport GHG (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
Transport as a percentage of total	..	..	..	..	..	..	..	..		

*includes international aviation and shipping

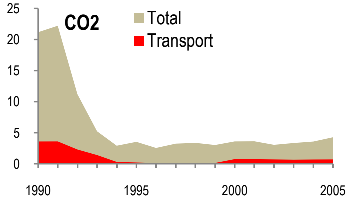
Armenia

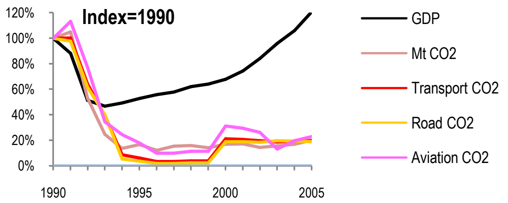
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

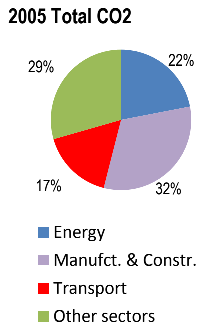
EU | N.Am | Asia-Pac | Other ITF

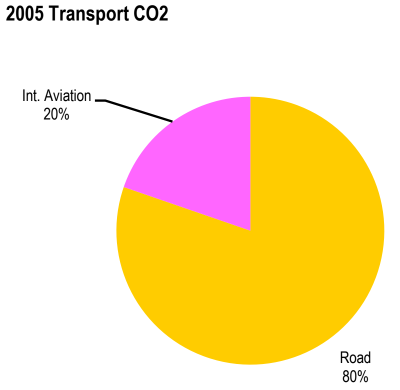
4.3 Mt

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	80%	4.28	76%	1.37	83%	0.31
Transport CO2	80%	0.71	77%	0.24	84%	0.05
Road CO2	81%	0.57	78%	0.19	84%	0.04
Aviation CO2	77%	0.14	73%	0.05	81%	0.01
Shipping CO2		0		0.00		0.00









Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	3.55	3.23	3.08	3.07	3.05	3.04	3.03	3.02	-15%	-1.07%
GDP (billion 2000 US$, PPP)	10.99	5.80	7.45	8.16	9.24	10.54	11.64	13.27	21%	1.26%
Road passenger km (million pkm)	..	..	1437	1678	1813	1959	..	..	..	..
Road freight tonne km (million tkm)	..	..	1696	1673	1530	1739	1635	1688	..	..
Road pkm/capita	..	..	467	547	594	644	..	..	..	..
Road freight tkm/$ of GDP)	..	..	0.23	0.21	0.17	0.16	0.14	0.13	..	..
Motorisation (Cars/1000 inhabitants)	..	..	..	..	..	..	..	..	..	..
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	21.19	3.54	3.61	3.63	3.06	3.35	3.59	4.28	-80%	-10.11%
IEA transport CO2 (Mt CO2)*	3.60	0.22	0.76	0.75	0.71	0.67	0.70	0.71	-80%	-10.26%
Transport as a percentage of total	*17.0%*	*6.2%*	*21.1%*	*20.7%*	*23.2%*	*20.0%*	*19.5%*	*16.6%*		
Road	2.99	0.11	0.57	0.57	0.55	0.59	0.58	0.57	-81%	-10.46%
Rail	..	..	..	..	..	..	..	..	..	..
Domestic Aviation	..	..	..	..	..	..	..	..	..	..
International Aviation	0.61	0.11	0.19	0.18	0.16	0.08	0.12	0.14	-77%	-9.35%
Domestic Navigation	..	..	..	..	..	..	..	..	..	..
International Maritime	..	..	..	..	..	..	..	..	..	..
Other Transport	..	..	..	..	..	..	..	..	..	..
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
UNFCCC Transport GHG (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
Transport as a percentage of total	..	..	..	..	..	..	..	..		

*includes international aviation and shipping

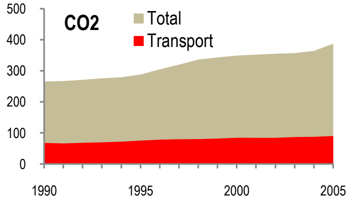
Australia

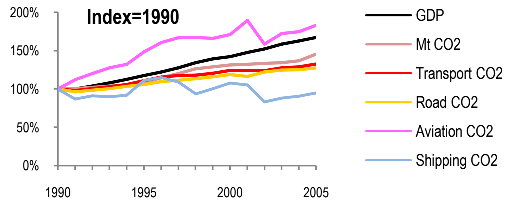
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

EU | N.Am | Asia-Pac | Other ITF

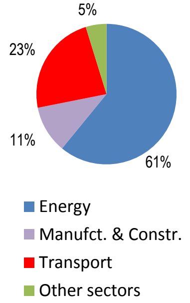
387.6 Mt

Change 1990-2005	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	46%	387.56	22%	18.4	13%	0.61
Transport CO2	33%	90.45	11%	4.42	21%	0.15
Road CO2	28%	70.2	7%	3.43	24%	0.11
Aviation CO2	83%	13.55	54%	0.66	10%	0.02
Shipping CO2	5%	3.82	20%	0.19	43%	0.01

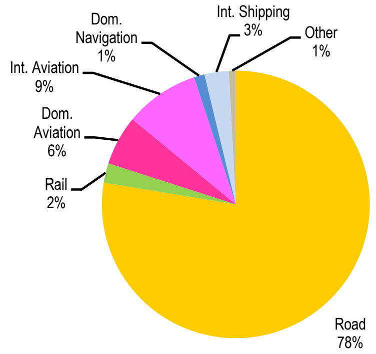




2005 Total CO2



2005 Transport CO2



Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	17.17	18.19	19.27	19.53	19.75	19.98	20.20	20.47	19%	1.18%
GDP (billion 2000 US$, PPP)	368.85	433.35	524.59	544.35	561.51	584.26	599.90	616.75	67%	3.49%
Road passenger km (million pkm)	218378	237241	260398	259671	269220	272497	283515	289157	32%	1.89%
Road freight tonne km (million tkm)	178239	212890	270070	277410	300360	315210	327890	338826	90%	4.38%
Road pkm/capita	12719	13042	13513	13296	13631	13638	14035	14126	11%	0.70%
Road freight tkm/$ of GDP)	0.48	0.49	0.51	0.51	0.53	0.54	0.55	0.55	14%	0.86%
Motorisation (Cars/1000 inhabitants)	447	476	506	504	511	519	526	532	19%	1.17%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	266.04	288.43	349.45	352.21	355.31	357.22	364.24	387.56	46%	2.54%
IEA transport CO2 (Mt CO2)*	68.10	75.67	84.74	84.56	84.46	87.06	87.78	90.45	33%	1.91%
Transport as a percentage of total	*25.6%*	*26.2%*	*24.2%*	*24.0%*	*23.8%*	*24.4%*	*24.1%*	*23.3%*		
Road	54.91	58.25	65.40	63.92	67.13	68.51	68.80	70.20	28%	1.65%
Rail	1.74	1.55	1.82	1.84	1.51	1.55	1.66	2.13	22%	1.36%
Domestic Aviation	3.10	5.24	5.50	6.05	5.45	5.88	6.00	5.43	75%	3.81%
International Aviation	4.30	5.76	7.16	7.97	6.30	6.87	6.93	8.12	89%	4.33%
Domestic Navigation	1.99	1.82	1.51	1.79	1.07	1.27	1.04	1.16	-42%	-3.53%
International Maritime	2.04	2.66	2.83	2.45	2.28	2.28	2.62	2.66	30%	1.78%
Other Transport	0.02	0.39	0.52	0.54	0.72	0.70	0.73	0.75	3650%	27.33%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	424.73	453.27	507.80	519.57	520.87	523.28	532.44	535.26	26%	1.55%
UNFCCC Transport GHG (Mt CO2 eq.)*	68.35	76.61	84.75	83.67	84.49	84.21	88.31	90.25	32%	1.87%
Transport as a percentage of total	*16.1%*	*16.9%*	*16.7%*	*16.1%*	*16.2%*	*16.1%*	*16.6%*	*16.9%*		

*includes international aviation and shipping

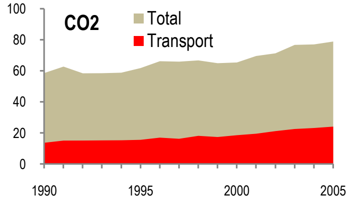
Austria

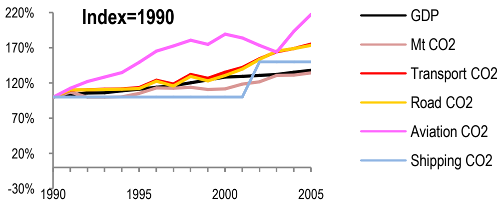
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

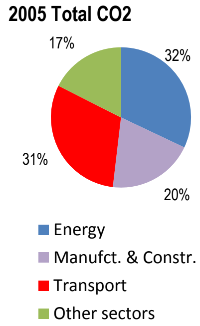
EU | N.Am | Asia-Pac | Other ITF

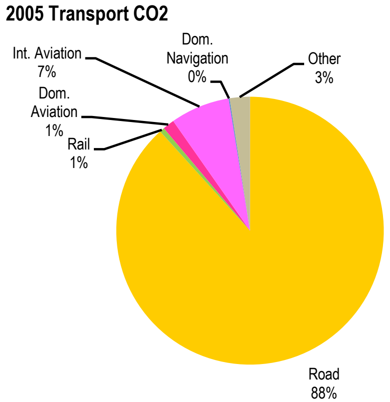
78.9 Mt

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	35%	78.91	25%	9.37	3%	0.31
Transport CO2	76%	24.13	64%	2.93	27%	0.10
Road CO2	74%	21.3	62%	2.59	26%	0.09
Aviation CO2	118%	2.07	103%	0.25	58%	0.01
Shipping CO2	50%	0.03	40%	0.00	8%	0.00









Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	7.68	7.95	8.01	8.04	8.08	8.12	8.18	8.23	7%	0.46%
GDP (billion 2000 US$, PPP)	178.87	199.11	230.12	232.03	234.02	236.57	242.35	247.30	38%	2.18%
Road passenger km (million pkm)	67722	70880	..	..	..	..	..	..	..	..
Road freight tonne km (million tkm)	29730	37406	43763	45079	45766	45049	44628	43486	46%	2.57%
Road pkm/capita	8818	8916	..	..	..	..	..	..	..	..
Road freight tkm/$ of GDP)	0.17	0.19	0.19	0.19	0.20	0.19	0.18	0.18	6%	0.38%
Motorisation (Cars/1000 inhabitants)	389	452	511	520	493	499	502	505	30%	1.75%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	58.62	61.81	65.42	69.59	71.31	76.74	77.05	78.91	35%	2.00%
IEA transport CO2 (Mt CO2)*	13.74	15.63	18.60	19.56	21.23	22.59	23.23	24.13	76%	3.83%
Transport as a percentage of total	*23.4%*	*25.3%*	*28.4%*	*28.1%*	*29.8%*	*29.4%*	*30.1%*	*30.6%*		
Road	12.26	13.78	16.05	17.13	18.85	20.28	20.73	21.30	74%	3.75%
Rail	0.18	0.14	0.14	0.13	0.14	0.14	0.14	0.14	-22%	-1.66%
Domestic Aviation	0.10	0.08	0.11	0.12	0.12	0.25	0.30	0.34	240%	8.50%
International Aviation	0.85	1.34	1.69	1.63	1.53	1.31	1.54	1.73	104%	4.85%
Domestic Navigation	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	50%	2.74%
International Maritime	..	..	..	..	..	..	..	..	..	..
Other Transport	0.33	0.27	0.59	0.53	0.56	0.58	0.49	0.59	79%	3.95%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	79.95	81.64	82.81	86.70	88.22	94.27	92.73	95.03	19%	1.16%
UNFCCC Transport GHG (Mt CO2 eq.)*	13.62	16.20	19.75	20.86	22.63	24.33	25.15	26.07	91%	4.42%
Transport as a percentage of total	*17.0%*	*19.8%*	*23.8%*	*24.1%*	*25.7%*	*25.8%*	*27.1%*	*27.4%*		

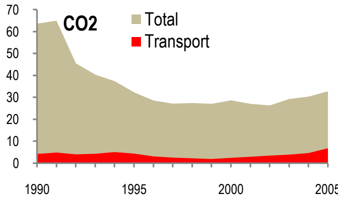
*includes international aviation and shipping

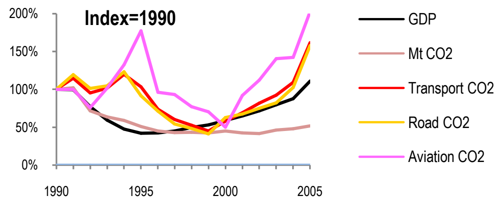
Azerbaijan

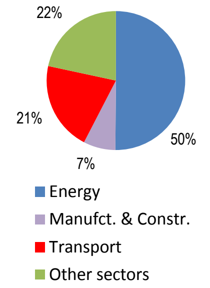
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

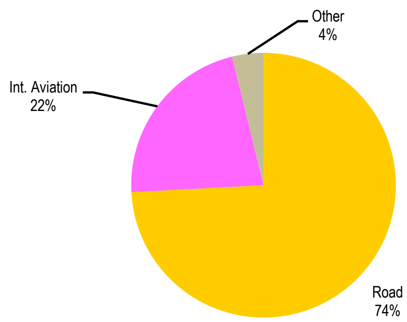
32.8 Mt

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	48%	32.78	58%	3.73	55%	0.84
Transport CO2	61%	6.81	38%	0.81	46%	0.18
Road CO2	58%	5.05	35%	0.60	43%	0.13
Aviation CO2	103%	1.5	73%	0.18	83%	0.04
Shipping CO2		0		0.00		0.00









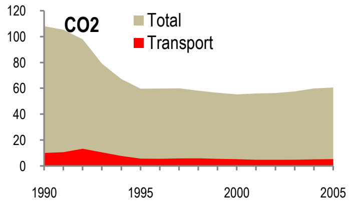
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	7.16	7.69	8.05	8.11	8.17	8.23	8.31	8.39	17%	1.06%
GDP (billion 2000 US$, PPP)	33.82	14.16	19.92	21.89	24.21	26.92	29.66	37.44	11%	0.68%
Road passenger km (million pkm)	7480	4664	9153	9442	9603	9861	10279	10892	46%	2.54%
Road freight tonne km (million tkm)	43716	5271	10822	12894	14409	15834	16510	19037	-56%	-5.39%
Road pkm/capita	1045	607	1137	1164	1175	1198	1237	1298	24%	1.46%
Road freight tkm/$ of GDP)	1.29	0.37	0.54	0.59	0.60	0.59	0.56	0.51	-61%	-6.03%
Motorisation (Cars/1000 inhabitants)	36	36	41	42	43	49	53	57	57%	3.06%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	63.64	32.31	28.65	27.07	26.34	29.28	30.35	32.78	-48%	-4.33%
IEA transport CO2 (Mt CO2)*	4.22	4.36	2.44	2.91	3.45	3.89	4.61	6.81	61%	3.24%
Transport as a percentage of total	*6.6%*	*13.5%*	*8.5%*	*10.7%*	*13.1%*	*13.3%*	*15.2%*	*20.8%*		
Road	3.20	2.92	2.00	2.15	2.39	2.63	3.27	5.05	58%	3.09%
Rail	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	..	..
Domestic Aviation	..	..	..	..	..	..	..	..	..	..
International Aviation	0.74	1.31	0.37	0.68	0.83	1.04	1.05	1.50	103%	4.82%
Domestic Navigation	..	..	..	..	..	..	..	..	..	..
International Maritime	..	..	..	..	..	..	..	..	..	..
Other Transport	0.28	0.09	0.07	0.08	0.23	0.22	0.29	0.26	-7%	-0.49%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
UNFCCC Transport GHG (Mt CO2 eq.)*	.	.	.	.	.	.	.	.	..	..
Transport as a percentage of total	..	..	..	..	..	..	..	..		

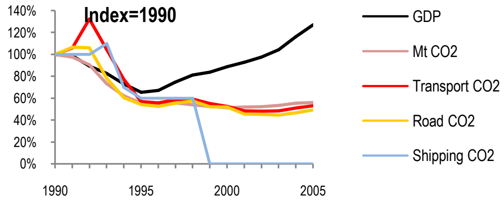
*includes international aviation and shipping

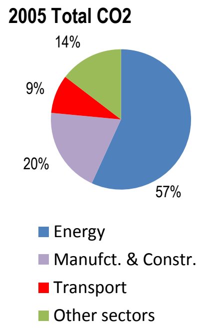
Belarus

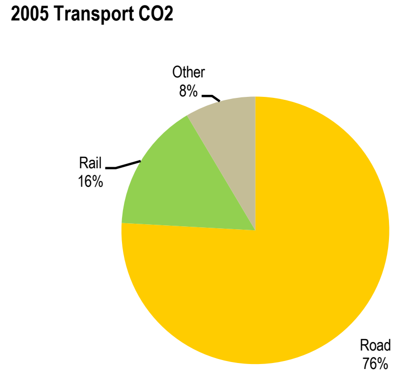
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	44%	60.71	41%	6.21	56%	0.88
Transport CO2	47%	5.39	45%	0.55	58%	0.08
Road CO2	51%	4.09	49%	0.42	61%	0.06
Aviation CO2		0		0.00		0.00
Shipping CO2	100%	0	100%	0.00	100%	0.00









Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	10.19	10.19	10.01	9.97	9.93	9.87	9.82	9.78	-4%	-0.27%
GDP (billion 2000 US$, PPP)	54.17	35.37	48.03	50.30	52.84	56.56	63.04	68.86	27%	1.61%
Road passenger km (million pkm)	19787	9308	9235	9493	9090	9800	9747	..	..	..
Road freight tonne km (million tkm)	99596	35182	40433	38481	42173	46217	49626	51092	-49%	-4.35%
Road pkm/capita	1942	913	923	952	915	993	993	..	..	..
Road freight tkm/$ of GDP)	1.84	0.99	0.84	0.77	0.80	0.82	0.79	0.74	-60%	-5.87%
Motorisation (Cars/1000 inhabitants)	59	92	142	147	156	168	174	181	205%	7.72%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	108.05	59.80	55.39	56.13	56.41	57.70	59.98	60.71	-44%	-3.77%
IEA transport CO2 (Mt CO2)*	10.14	5.76	5.33	4.91	4.88	4.92	5.18	5.39	-47%	-4.13%
Transport as a percentage of total	*9.4%*	*9.6%*	*9.6%*	*8.7%*	*8.7%*	*8.5%*	*8.6%*	*8.9%*		
Road	8.29	4.49	4.30	3.77	3.74	3.70	3.87	4.09	-51%	-4.60%
Rail	1.59	1.11	0.73	0.82	0.71	0.73	0.77	0.84	-47%	-4.16%
Domestic Aviation	..	..	..	..	..	..	..	..	..	..
International Aviation	..	..	..	..	..	..	..	..	..	..
Domestic Navigation	0.10	0.06	0.00	0.00	0.00	0.00	0.00	0.00	-100%	-99.99%
International Maritime	..	..	..	..	..	..	..	..	..	..
Other Transport	0.16	0.10	0.30	0.32	0.43	0.49	0.54	0.46	187%	7.29%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	132.97	73.15	69.99	68.39	68.42	70.03	74.57	75.81	-43%	-3.68%
UNFCCC Transport GHG (Mt CO2 eq.)*	18.60	5.03	3.29	3.30	4.41	4.12	4.66	4.65	-75%	-8.83%
Transport as a percentage of total	*14.0%*	*6.9%*	*4.7%*	*4.8%*	*6.5%*	*5.9%*	*6.2%*	*6.1%*		

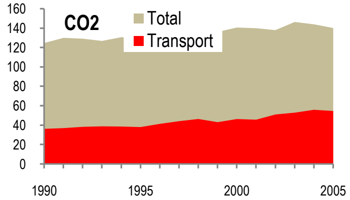
*includes international aviation and shipping

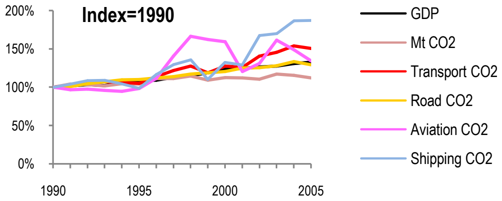
Belgium

Total CO2 from Fuel Combustion including International Air and Maritime (2005)

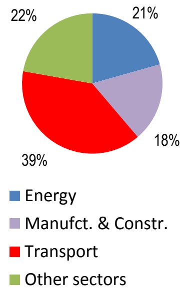
140.2 Mt

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	12%	140.17	2%	10.67	22%	0.38
Transport CO2	51%	54.69	43%	5.22	13%	0.19
Road CO2	29%	25.32	23%	2.42	3%	0.09
Aviation CO2	34%	3.95	28%	0.38	1%	0.01
Shipping CO2	87%	25.22	78%	2.41	41%	0.09

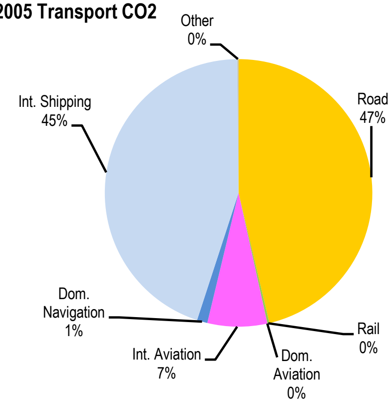




2005 Total CO2



2005 Transport CO2



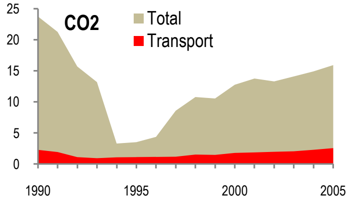
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	9.97	10.14	10.25	10.28	10.33	10.37	10.42	10.47	5%	0.33%
GDP (billion 2000 US$, PPP)	221.28	239.48	273.16	276.02	280.17	282.73	290.05	293.67	33%	1.90%
Road passenger km (million pkm)	92158	104228	119400	121470	123960	124730	126800	126960	38%	2.16%
Road freight tonne km (million tkm)	46875	61528	67634	69514	70470	67655	65561	62124	33%	1.90%
Road pkm/capita	9244	10279	11649	11816	12000	12028	12169	12126	31%	1.83%
Road freight tkm/$ of GDP)	0.21	0.26	0.25	0.25	0.25	0.24	0.23	0.21	0%	-0.01%
Motorisation (Cars/1000 inhabitants)	383	421	456	461	463	465	468	470	23%	1.38%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	124.74	129.86	140.68	139.95	138.01	146.42	143.99	140.17	12%	0.78%
IEA transport CO2 (Mt CO2)*	36.32	38.14	46.41	45.73	51.11	52.97	55.94	54.69	51%	2.77%
Transport as a percentage of total	*29.1%*	*29.4%*	*33.0%*	*32.7%*	*37.0%*	*36.2%*	*38.8%*	*39.0%*		
Road	19.60	21.59	23.66	24.54	24.58	25.14	26.21	25.32	29%	1.72%
Rail	0.22	0.24	0.19	0.17	0.10	0.13	0.13	0.13	-41%	-3.45%
Domestic Aviation	0.02	0.20	0.15	0.12	0.05	0.23	0.22	0.01	-50%	-4.52%
International Aviation	2.92	2.70	4.54	3.43	3.80	4.52	4.16	3.94	35%	2.02%
Domestic Navigation	0.41	0.81	0.68	0.59	0.67	0.82	0.37	0.69	68%	3.53%
International Maritime	13.05	12.45	17.14	16.77	21.87	22.06	24.79	24.53	88%	4.30%
Other Transport	0.10	0.15	0.05	0.11	0.04	0.07	0.06	0.07	-30%	-2.35%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	162.90	168.69	169.12	167.36	175.63	174.83	175.63	171.16	5%	0.33%
UNFCCC Transport GHG (Mt CO2 eq.)*	37.53	39.01	46.36	45.84	56.34	53.10	55.29	53.73	43%	2.42%
Transport as a percentage of total	*23.0%*	*23.1%*	*27.4%*	*27.4%*	*32.1%*	*30.4%*	*31.5%*	*31.4%*		

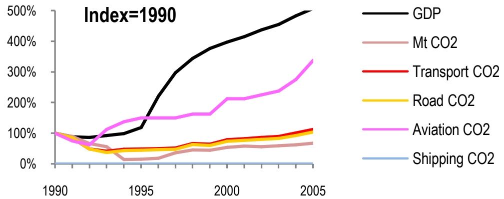
*includes international aviation and shipping

Bosnia-Herzegovina

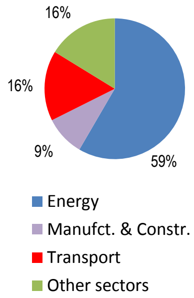
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	33%	15.93	26%	4.08	87%	0.62
Transport CO2	12%	2.57	24%	0.66	78%	0.10
Road CO2	4%	2.29	14%	0.59	80%	0.09
Aviation CO2	238%	0.27	272%	0.07	33%	0.01
Shipping CO2		0		0.00		0.00

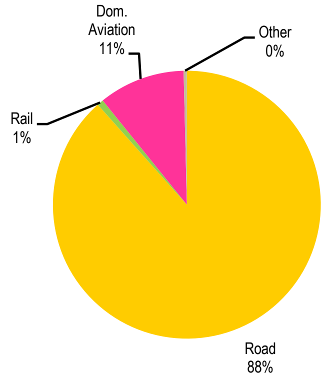




2005 Total CO2



2005 Transport CO2

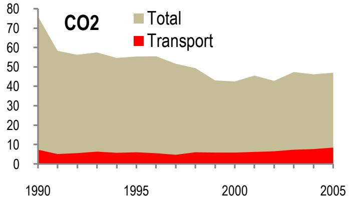


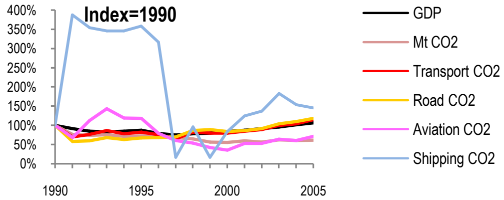
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	4.31	3.42	3.85	3.90	3.92	3.92	3.91	3.91	-9%	-0.65%
GDP (billion 2000 US$, PPP)	5.08	6.05	20.20	21.09	22.21	23.10	24.53	25.75	407%	11.43%
Road passenger km (million pkm)	2737	112	1198	1207	1184	1212	1186	1204	-56%	-5.33%
Road freight tonne km (million tkm)	7075	71	458	494	520	557	582	618	-91%	-15.00%
Road pkm/capita	635	33	311	309	302	309	303	308	-52%	-4.71%
Road freight tkm/$ of GDP)	1.39	0.01	0.02	0.02	0.02	0.02	0.02	0.02	-98%	-23.72%
Motorisation (Cars/1000 inhabitants)	..	..	..	..	..	..	..	..	..	..
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	23.77	3.53	12.77	13.77	13.31	14.11	14.92	15.93	-33%	-2.63%
IEA transport CO2 (Mt CO2)*	2.29	1.12	1.80	1.88	1.98	2.06	2.30	2.57	12%	0.77%
Transport as a percentage of total	*9.6%*	*31.7%*	*14.1%*	*13.7%*	*14.9%*	*14.6%*	*15.4%*	*16.1%*		
Road	2.21	0.99	1.62	1.69	1.77	1.85	2.05	2.29	4%	0.24%
Rail	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.02	..	..
Domestic Aviation	0.00	0.12	0.17	0.17	0.18	0.19	0.22	0.27	..	..
International Aviation	0.08	..	..	..	..	..	..	..	..	..
Domestic Navigation	..	..	..	..	..	..	..	..	..	..
International Maritime	..	..	..	..	..	..	..	..	..	..
Other Transport	0.00	0.00	-0.01	0.00	0.01	0.00	0.01	-0.01	..	..
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
UNFCCC Transport GHG (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
Transport as a percentage of total	..	..	..	..	..	..	..	..		

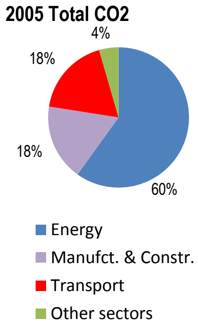
*includes international aviation and shipping

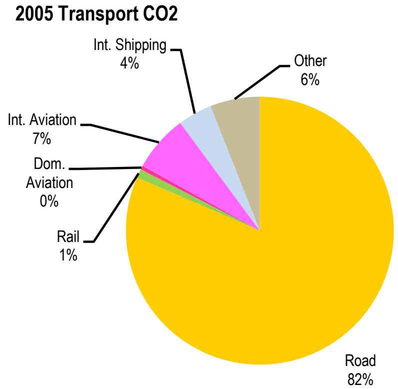
Bulgaria

Change 1990-2005*		Mt 2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	38%	47.05	31%	5.96	43%	0.74
Transport CO2	15%	8.49	29%	1.10	7%	0.14
Road CO2	18%	6.92	33%	0.89	11%	0.11
Aviation CO2	29%	0.62	20%	0.08	33%	0.01
Shipping CO2	46%	0.35	64%	0.05	36%	0.01









Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	8.72	8.40	8.06	7.91	7.87	7.82	7.78	7.74	-11%	-0.79%
GDP (billion 2000 US$, PPP)	58.18	50.96	48.88	50.88	53.37	55.78	58.95	62.20	7%	0.45%
Road passenger km (million pkm)	30430	11508	13879	14510	15966	12954	11093	11355	-63%	-6.36%
Road freight tonne km (million tkm)	30143	28300	9374	8918	9415	10926	11423	12092	-60%	-5.91%
Road pkm/capita	3490	1370	1722	1834	2029	1657	1426	1467	-58%	-5.61%
Road freight tkm/$ of GDP)	0.52	0.56	0.19	0.18	0.18	0.20	0.19	0.19	-62%	-6.33%
Motorisation (Cars/1000 inhabitants)	151	196	247	264	276	295	313	328	117%	5.30%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	76.12	55.41	42.57	45.58	42.88	47.42	46.24	47.05	-38%	-3.16%
IEA transport CO2 (Mt CO2)*	7.40	6.09	5.92	6.27	6.59	7.40	7.72	8.49	15%	0.92%
Transport as a percentage of total	*9.7%*	*11.0%*	*13.9%*	*13.8%*	*15.4%*	*15.6%*	*16.7%*	*18.0%*		
Road	5.84	3.96	4.90	5.08	5.37	6.10	6.41	6.92	18%	1.14%
Rail	0.33	0.24	0.12	0.10	0.10	0.09	0.09	0.09	-73%	-8.30%
Domestic Aviation	0.14	0.01	0.06	0.14	0.08	0.07	0.06	0.04	-71%	-8.01%
International Aviation	0.73	1.02	0.25	0.32	0.38	0.49	0.47	0.58	-21%	-1.52%
Domestic Navigation	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.00	-100%	-99.99%
International Maritime	0.18	0.85	0.20	0.30	0.33	0.44	0.37	0.35	94%	4.53%
Other Transport	0.12	0.00	0.39	0.33	0.33	0.21	0.32	0.51	325%	10.13%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	118.39	88.54	67.67	68.20	65.21	70.69	69.88	70.82	-40%	-3.37%
UNFCCC Transport GHG (Mt CO2 eq.)*	12.78	8.37	6.44	6.80	7.14	8.12	8.27	9.03	-29%	-2.28%
Transport as a percentage of total	*10.8%*	*9.5%*	*9.5%*	*10.0%*	*11.0%*	*11.5%*	*11.8%*	*12.8%*		

*includes international aviation and shipping

Canada

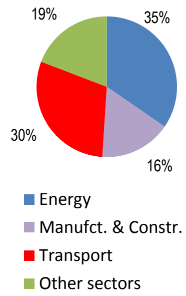
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

EU | N.Am | Asia-Pac | Other ITF

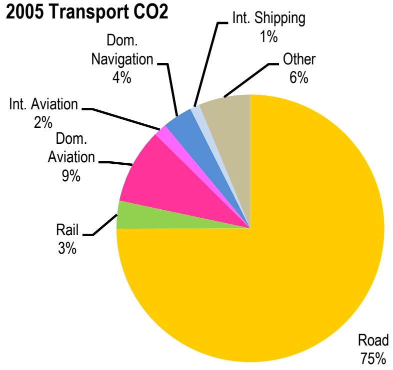
553 Mt

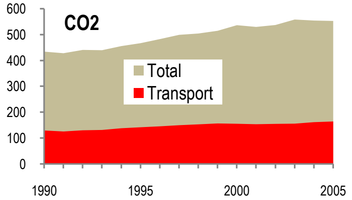
Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	27%	553.02	10%	17	15%	0.55
Transport CO2	27%	164.66	9%	5.10	16%	0.17
Road CO2	29%	123.42	10%	3.82	15%	0.12
Aviation CO2	36%	17.54	16%	0.54	10%	0.02
Shipping CO2	4%	7.83	10%	0.24	31%	0.01

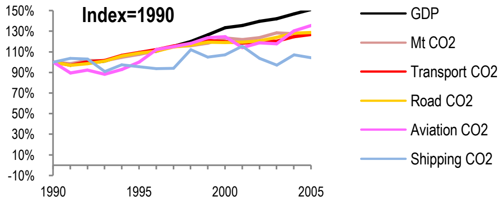
2005 Total CO2



2005 Transport CO2







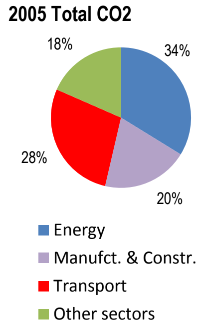
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	27.70	29.30	30.69	31.02	31.37	31.67	31.97	32.27	16%	1.02%
GDP (billion 2000 US$, PPP)	654.75	713.05	873.06	888.64	914.81	931.48	962.21	990.45	51%	2.80%
Road passenger km (million pkm)	..	..	..	..	..	..	..	..	..	..
Road freight tonne km (million tkm)	..	..	..	..	..	..	..	..	..	..
Road pkm/capita	..	..	..	..	..	..	..	..	..	..
Road freight tkm/$ of GDP)	..	..	..	..	..	..	..	..	..	..
Motorisation (Cars/1000 inhabitants)	456	450	549	550	559	561	561	562	23%	1.40%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	434.36	467.15	536.60	529.94	537.34	558.48	554.50	553.02	27%	1.62%
IEA transport CO2 (Mt CO2)*	129.84	142.26	155.82	154.05	155.34	156.23	161.93	164.66	27%	1.60%
Transport as a percentage of total	*29.9%*	*30.5%*	*29.0%*	*29.1%*	*28.9%*	*28.0%*	*29.2%*	*29.8%*		
Road	95.94	104.39	114.41	114.46	115.89	119.16	123.03	123.42	29%	1.69%
Rail	6.32	5.72	5.87	5.77	5.23	5.21	5.30	5.57	-12%	-0.84%
Domestic Aviation	10.24	10.39	13.08	11.54	12.62	13.12	14.14	14.99	46%	2.57%
International Aviation	2.70	2.58	3.08	3.22	2.77	2.14	2.71	2.55	-6%	-0.38%
Domestic Navigation	4.62	3.99	4.69	5.07	5.05	5.70	6.12	5.95	29%	1.70%
International Maritime	2.88	3.18	3.35	3.60	2.73	1.58	1.92	1.88	-35%	-2.80%
Other Transport	7.14	12.01	11.34	10.39	11.05	9.32	8.71	10.30	44%	2.47%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	606.17	656.66	734.67	727.20	732.55	755.18	758.97	758.40	25%	1.50%
UNFCCC Transport GHG (Mt CO2 eq.)*	159.12	174.18	196.29	193.45	194.69	197.56	204.55	209.24	31%	1.84%
Transport as a percentage of total	*26.3%*	*26.5%*	*26.7%*	*26.6%*	*26.6%*	*26.2%*	*27.0%*	*27.6%*		

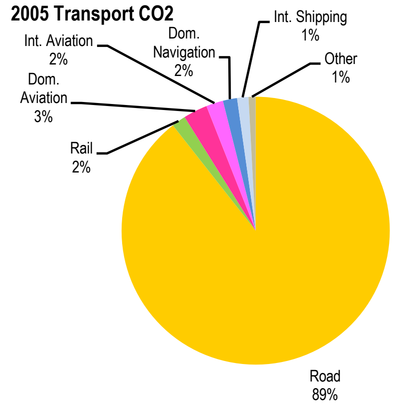
*includes international aviation and shipping

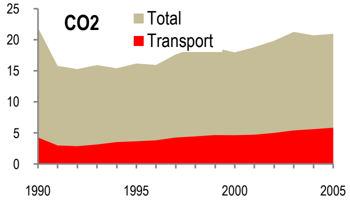
Croatia

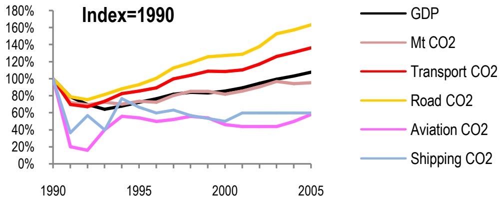
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	5%	20.97	3%	4.67	11%	0.4
Transport CO2	36%	5.85	47%	1.32	27%	0.11
Road CO2	63%	5.23	76%	1.18	52%	0.10
Aviation CO2	42%	0.29	38%	0.07	46%	0.01
Shipping CO2	40%	0.18	35%	0.04	44%	0.00









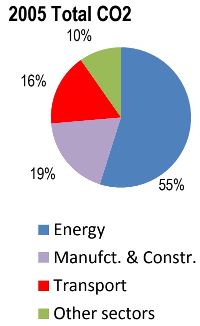
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	4.78	4.67	4.50	4.44	4.44	4.44	4.44	4.44	-7%	-0.49%
GDP (billion 2000 US$, PPP)	47.89	34.69	41.03	42.83	45.23	47.63	49.44	51.55	8%	0.49%
Road passenger km (million pkm)	7004	4052	3331	3478	3557	3716	3390	3403	-51%	-4.70%
Road freight tonne km (million tkm)	13489	3741	5336	10093	11266	12451	13332	14056	4%	0.27%
Road pkm/capita	1465	868	740	783	801	837	764	766	-48%	-4.23%
Road freight tkm/$ of GDP)	0.28	0.11	0.13	0.24	0.25	0.26	0.27	0.27	-3%	-0.22%
Motorisation (Cars/1000 inhabitants)	166	152	250	269	280	291	301	312	87%	4.28%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	21.98	16.19	17.98	18.82	19.86	21.28	20.72	20.97	-5%	-0.31%
IEA transport CO2 (Mt CO2)*	4.29	3.67	4.65	4.73	5.02	5.42	5.62	5.85	36%	2.09%
Transport as a percentage of total	*19.5%*	*22.7%*	*25.9%*	*25.1%*	*25.3%*	*25.5%*	*27.1%*	*27.9%*		
Road	3.20	2.98	4.07	4.12	4.41	4.89	5.04	5.23	63%	3.33%
Rail	0.13	0.10	0.09	0.09	0.09	0.09	0.10	0.10	-23%	-1.73%
Domestic Aviation	0.35	0.09	0.13	0.16	0.16	0.15	0.16	0.17	-51%	-4.70%
International Aviation	0.15	0.18	0.10	0.06	0.06	0.07	0.09	0.12	-20%	-1.48%
Domestic Navigation	0.15	0.10	0.09	0.09	0.11	0.11	0.11	0.10	-33%	-2.67%
International Maritime	0.15	0.10	0.06	0.09	0.07	0.07	0.07	0.08	-47%	-4.10%
Other Transport	0.16	0.12	0.11	0.12	0.12	0.04	0.05	0.05	-69%	-7.46%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	31.87	22.86	25.99	27.13	28.32	29.99	30.19	30.68	-4%	-0.25%
UNFCCC Transport GHG (Mt CO2 eq.)*	4.47	3.75	4.81	4.91	5.21	5.61	5.79	6.06	36%	2.05%
Transport as a percentage of total	*14.0%*	*16.4%*	*18.5%*	*18.1%*	*18.4%*	*18.7%*	*19.2%*	*19.7%*		

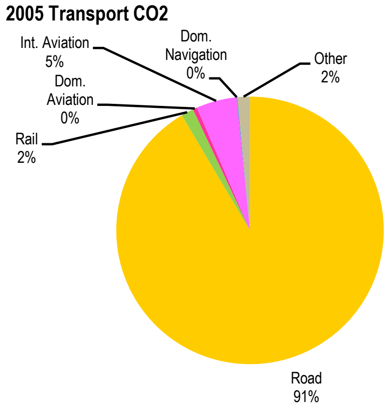
*includes international aviation and shipping

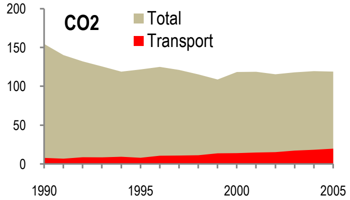
Czech Republic

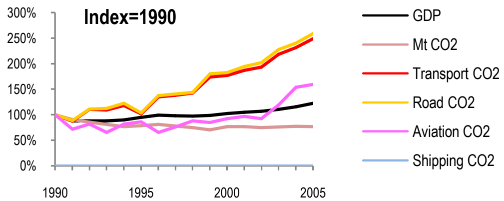
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*		Mt 2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	23%	119.09	22%	11.54	38%	0.65
Transport CO2	149%	19.83	152%	1.94	103%	0.11
Road CO2	159%	18.14	162%	1.77	111%	0.10
Aviation CO2	60%	1.07	62%	0.10	30%	0.01
Shipping CO2		0.02		0.00		0.00







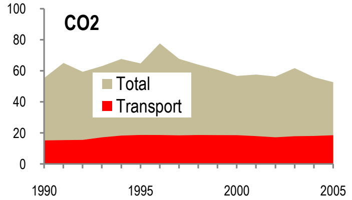


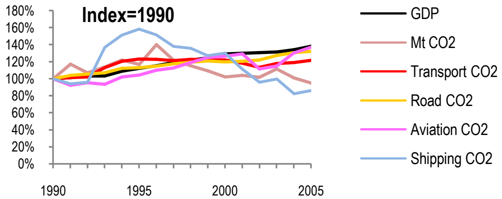
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	10.36	10.33	10.27	10.22	10.20	10.20	10.21	10.23	-1%	-0.08%
GDP (billion 2000 US$, PPP)	148.56	141.55	152.37	156.12	159.08	164.81	171.75	182.19	23%	1.37%
Road passenger km (million pkm)	0	65473	73291	74078	74958	76809	76086	77248	..	..
Road freight tonne km (million tkm)	0	60321	58917	56508	63174	64755	63413	61351	..	..
Road pkm/capita	0	6338	7136	7248	7349	7530	7452	7551	..	..
Road freight tkm/$ of GDP)	0.00	0.43	0.39	0.36	0.40	0.39	0.37	0.34	..	..
Motorisation (Cars/1000 inhabitants)	228	301	335	345	358	363	374	387	69%	3.58%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	154.63	121.88	118.59	118.87	115.66	118.15	119.70	119.09	-23%	-1.73%
IEA transport CO2 (Mt CO2)*	7.96	8.13	14.10	14.91	15.39	17.37	18.45	19.83	149%	6.27%
Transport as a percentage of total	*5.1%*	*6.7%*	*11.9%*	*12.5%*	*13.3%*	*14.7%*	*15.4%*	*16.7%*		
Road	7.00	7.27	12.78	13.63	14.16	15.96	16.81	18.14	159%	6.55%
Rail	0.00	0.00	0.33	0.31	0.33	0.33	0.31	0.30	..	..
Domestic Aviation	0.00	0.00	0.12	0.15	0.11	0.18	0.14	0.10	..	..
International Aviation	0.67	0.58	0.50	0.50	0.51	0.62	0.89	0.97	45%	2.50%
Domestic Navigation	0.00	0.00	0.02	0.03	0.01	0.01	0.02	0.02	..	..
International Maritime	..	..	..	..	..	..	..	..	..	..
Other Transport	0.29	0.28	0.35	0.29	0.27	0.27	0.28	0.30	3%	0.23%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	196.83	154.84	149.37	149.87	144.50	148.13	147.95	146.56	-26%	-1.95%
UNFCCC Transport GHG (Mt CO2 eq.)*	8.08	10.17	11.88	13.02	13.48	14.65	16.74	18.46	129%	5.67%
Transport as a percentage of total	*4.1%*	*6.6%*	*8.0%*	*8.7%*	*9.3%*	*9.9%*	*11.3%*	*12.6%*		

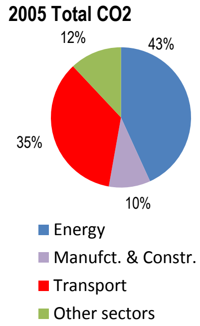
*includes international aviation and shipping

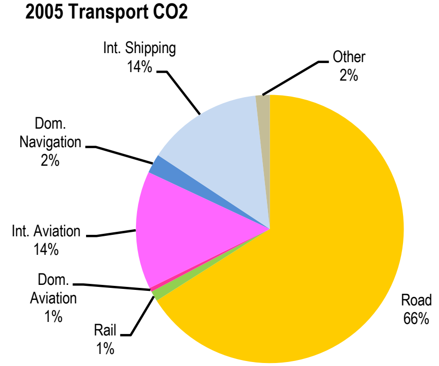
Denmark

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	5%	52.75	11%	8.77	33%	0.29
Transport CO2	22%	18.57	16%	3.43	12%	0.11
Road CO2	32%	12.26	25%	2.26	4%	0.07
Aviation CO2	37%	2.73	30%	0.50	1%	0.02
Shipping CO2	14%	3.03	18%	0.56	38%	0.02









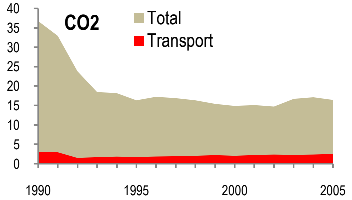
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	5.14	5.23	5.34	5.36	5.38	5.39	5.40	5.42	5%	0.35%
GDP (billion 2000 US$, PPP)	119.07	133.65	153.86	154.94	155.66	156.74	159.68	164.43	38%	2.18%
Road passenger km (million pkm)	59460	61672	65217	64466	64886	65784	67605	67402	13%	0.84%
Road freight tonne km (million tkm)	13155	14420	17715	17543	18066	18151	17940	18150	38%	2.17%
Road pkm/capita	11568	11792	12213	12027	12061	12205	12519	12436	8%	0.48%
Road freight tkm/$ of GDP)	0.11	0.11	0.12	0.11	0.12	0.12	0.11	0.11	0%	-0.01%
Motorisation (Cars/1000 inhabitants)	309	321	347	349	351	352	355	363	17%	1.06%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	55.48	64.82	56.76	57.64	56.38	61.78	55.96	52.75	-5%	-0.34%
IEA transport CO2 (Mt CO2)*	15.24	18.75	18.61	18.01	17.26	17.95	18.12	18.57	22%	1.33%
Transport as a percentage of total	*27.5%*	*28.9%*	*32.8%*	*31.2%*	*30.6%*	*29.1%*	*32.4%*	*35.2%*		
Road	9.27	10.49	11.12	11.17	11.31	11.79	12.12	12.26	32%	1.88%
Rail	0.30	0.31	0.23	0.21	0.21	0.22	0.22	0.23	-23%	-1.76%
Domestic Aviation	0.22	0.18	0.12	0.12	0.10	0.09	0.08	0.09	-59%	-5.78%
International Aviation	1.77	1.90	2.40	2.45	2.12	2.20	2.51	2.64	49%	2.70%
Domestic Navigation	0.48	0.57	0.36	0.36	0.44	0.42	0.38	0.43	-10%	-0.73%
International Maritime	3.04	5.01	4.22	3.56	2.94	3.09	2.52	2.60	-14%	-1.04%
Other Transport	0.16	0.29	0.16	0.14	0.14	0.14	0.29	0.32	100%	4.73%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	75.35	84.50	76.40	77.31	75.48	81.03	74.83	70.78	-6%	-0.42%
UNFCCC Transport GHG (Mt CO2 eq.)*	15.44	19.01	19.18	18.52	17.73	18.44	18.42	18.85	22%	1.34%
Transport as a percentage of total	*20.5%*	*22.5%*	*25.1%*	*24.0%*	*23.5%*	*22.8%*	*24.6%*	*26.6%*		

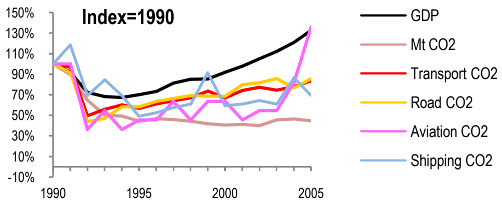
*includes international aviation and shipping

Estonia

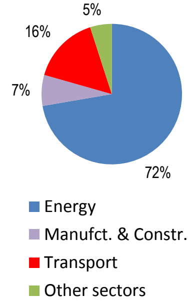
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	55%	16.46	49%	11.85	67%	0.86
Transport CO2	16%	2.57	3%	1.90	37%	0.14
Road CO2	14%	1.87	0%	1.39	35%	0.10
Aviation CO2	36%	0.15	59%	0.11	3%	0.01
Shipping CO2	31%	0.41	19%	0.30	48%	0.02

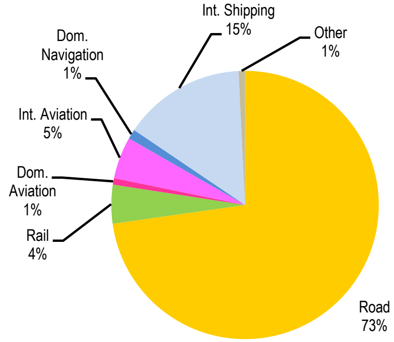




2005 Total CO2



2005 Transport CO2



Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	1.57	1.44	1.37	1.36	1.36	1.35	1.35	1.35	-14%	-1.00%
GDP (billion 2000 US$, PPP)	13.96	9.81	12.86	13.69	14.68	15.66	16.89	18.54	33%	1.91%
Road passenger km (million pkm)	4454	2048	2630	2461	2330	2297	2468	2716	-39%	-3.24%
Road freight tonne km (million tkm)	11489	5395	12118	13202	14123	16113	17485	18280	59%	3.14%
Road pkm/capita	2837	1422	1920	1810	1713	1701	1828	2012	-29%	-2.27%
Road freight tkm/$ of GDP)	0.82	0.55	0.94	0.96	0.96	1.03	1.04	0.99	20%	1.21%
Motorisation (Cars/1000 inhabitants)	154	266	339	299	295	321	349	366	137%	5.93%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	36.79	16.36	14.91	15.14	14.75	16.73	17.15	16.46	-55%	-5.22%
IEA transport CO2 (Mt CO2)*	3.07	1.74	2.06	2.28	2.38	2.29	2.39	2.57	-16%	-1.18%
Transport as a percentage of total	*8.3%*	*10.6%*	*13.8%*	*15.1%*	*16.1%*	*13.7%*	*13.9%*	*15.6%*		
Road	2.18	1.27	1.50	1.74	1.78	1.87	1.67	1.87	-14%	-1.02%
Rail	0.17	0.11	0.14	0.13	0.16	0.00	0.12	0.12	-29%	-2.30%
Domestic Aviation	..	..	..	..	..	..	..	0.02	..	..
International Aviation	0.11	0.05	0.07	0.05	0.06	0.06	0.09	0.13	18%	1.12%
Domestic Navigation	0.02	0.01	0.02	0.04	0.01	0.00	0.03	0.03	50%	2.74%
International Maritime	0.57	0.28	0.33	0.32	0.37	0.36	0.48	0.38	-33%	-2.67%
Other Transport	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0%	0.00%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	43.30	22.80	19.61	19.96	19.53	21.61	22.02	21.46	-50%	-4.57%
UNFCCC Transport GHG (Mt CO2 eq.)*	3.62	1.86	2.01	2.28	2.43	2.37	2.57	2.62	-28%	-2.13%
Transport as a percentage of total	*8.4%*	*8.1%*	*10.2%*	*11.4%*	*12.4%*	*11.0%*	*11.7%*	*12.2%*		

*includes international aviation and shipping

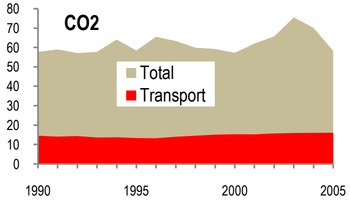
Finland

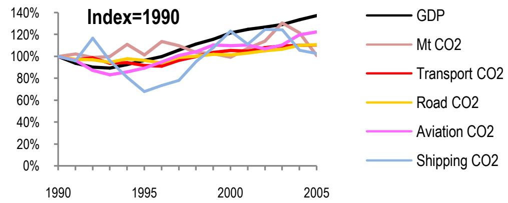
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

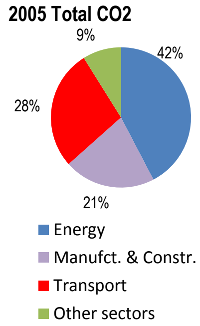
EU N.Am Asia-Pac Other ITF

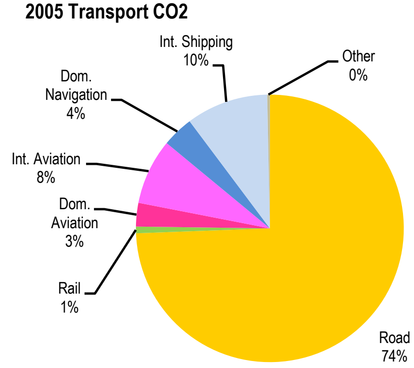
58.3Mt

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	1%	58.3	4%	10.57	27%	0.36
Transport CO2	10%	16.14	5%	3.07	20%	0.11
Road CO2	11%	12.01	5%	2.29	19%	0.08
Aviation CO2	23%	1.74	16%	0.33	11%	0.01
Shipping CO2	3%	2.21	2%	0.42	25%	0.01







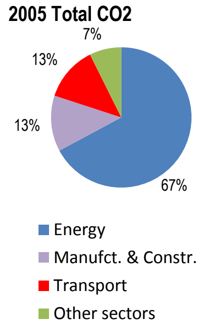


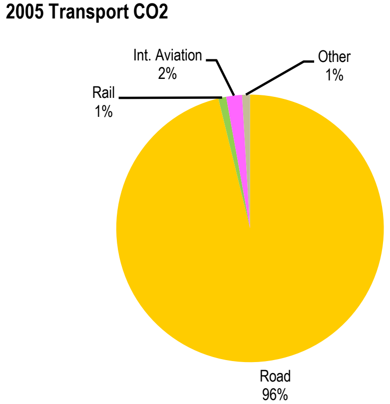
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	4.99	5.11	5.18	5.19	5.20	5.21	5.23	5.25	5%	0.34%
GDP (billion 2000 US$, PPP)	111.17	107.01	135.08	138.65	140.92	143.42	148.45	152.80	37%	2.14%
Road passenger km (million pkm)	59700	58000	63400	64700	66000	67260	68545	69450	16%	1.01%
Road freight tonne km (million tkm)	33827	31708	37941	36635	37845	37051	37553	37594	11%	0.71%
Road pkm/capita	11964	11350	12239	12466	12692	12910	13106	13229	11%	0.67%
Road freight tkm/$ of GDP)	0.30	0.30	0.28	0.26	0.27	0.26	0.25	0.25	-19%	-1.41%
Motorisation (Cars/1000 inhabitants)	389	372	412	416	422	437	449	463	19%	1.17%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	57.77	58.48	57.33	62.05	65.77	75.53	70.16	58.30	1%	0.06%
IEA transport CO2 (Mt CO2)*	14.61	13.40	15.39	15.32	15.78	16.00	16.10	16.14	10%	0.67%
Transport as a percentage of total	*25.3%*	*22.9%*	*26.8%*	*24.7%*	*24.0%*	*21.2%*	*22.9%*	*27.7%*		
Road	10.84	10.45	11.00	11.18	11.40	11.56	11.94	12.01	11%	0.69%
Rail	0.20	0.19	0.15	0.14	0.13	0.13	0.14	0.13	-35%	-2.83%
Domestic Aviation	0.41	0.37	0.50	0.48	0.45	0.46	0.42	0.46	12%	0.77%
International Aviation	1.01	0.90	1.06	1.09	1.07	1.11	1.28	1.28	27%	1.59%
Domestic Navigation	0.36	0.41	0.53	0.58	0.64	0.65	0.64	0.61	69%	3.58%
International Maritime	1.79	1.05	2.12	1.81	2.04	2.02	1.63	1.60	-11%	-0.75%
Other Transport	0.00	0.03	0.03	0.04	0.05	0.07	0.05	0.05	#DIV/0!	#NUM!
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	73.88	73.52	73.19	78.06	80.45	88.47	83.89	72.21	-2%	-0.15%
UNFCCC Transport GHG (Mt CO2 eq.)*	15.70	14.17	16.31	16.25	16.72	16.97	17.13	17.12	9%	0.58%
Transport as a percentage of total	*21.3%*	*19.3%*	*22.3%*	*20.8%*	*20.8%*	*19.2%*	*20.4%*	*23.7%*		

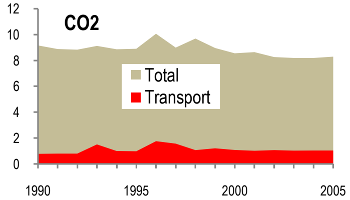
*includes international aviation and shipping

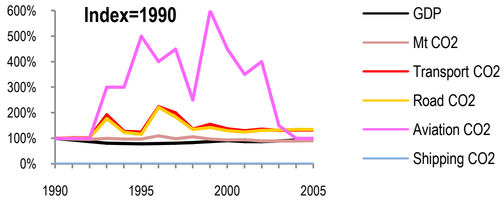
FYR of Macedonia

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	9%	8.3	15%	4.07	7%	0.64
Transport CO2	33%	1.05	25%	0.52	36%	0.08
Road CO2	35%	1.01	27%	0.50	38%	0.08
Aviation CO2		0.02	6%	0.01	2%	0.00
Shipping CO2		0		0.00		0.00









Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	1.91	1.96	2.01	2.02	2.02	2.03	2.03	2.03	6%	0.41%
GDP (billion 2000 US$, PPP)	13.33	10.51	12.16	11.61	11.71	12.04	12.53	13.03	-2%	-0.15%
Road passenger km (million pkm)	1492	971	774	831	1042	1344	1110	1087	-27%	-2.09%
Road freight tonne km (million tkm)	2958	1343	1303	2773	3027	4503	4430	4465	51%	2.78%
Road pkm/capita	781	495	385	411	516	662	547	535	-31%	-2.49%
Road freight tkm/$ of GDP)	0.22	0.13	0.11	0.24	0.26	0.37	0.35	0.34	54%	2.94%
Motorisation (Cars/1000 inhabitants)	121	146	149	153	152	148	123	125	3%	0.20%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	9.17	8.91	8.56	8.65	8.27	8.20	8.20	8.30	-9%	-0.66%
IEA transport CO2 (Mt CO2)*	0.79	0.99	1.09	1.03	1.08	1.04	1.05	1.05	33%	1.91%
Transport as a percentage of total	*8.6%*	*11.1%*	*12.7%*	*11.9%*	*13.1%*	*12.7%*	*12.8%*	*12.7%*		
Road	0.75	0.87	0.97	0.94	0.98	0.99	1.01	1.01	35%	2.00%
Rail	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-50%	-4.52%
Domestic Aviation	..	..	..	..	..	..	..	..	..	..
International Aviation	0.02	0.10	0.09	0.07	0.08	0.03	0.02	0.02	0%	0.00%
Domestic Navigation	..	..	..	..	..	..	..	..	..	..
International Maritime	..	..	..	..	..	..	..	..	..	..
Other Transport	0.00	0.01	0.02	0.01	0.01	0.01	0.01	0.01	..	..
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
UNFCCC Transport GHG (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
Transport as a percentage of total	..	..	..	..	..	..	..	..		

*includes international aviation and shipping

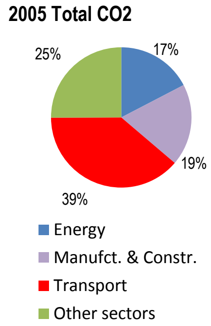
France

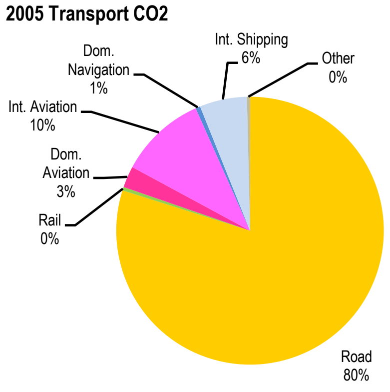
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

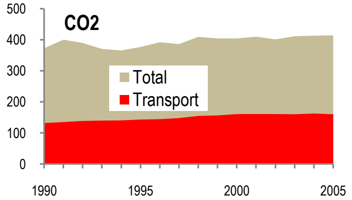
EU N.Am Asia-Pac Other ITF

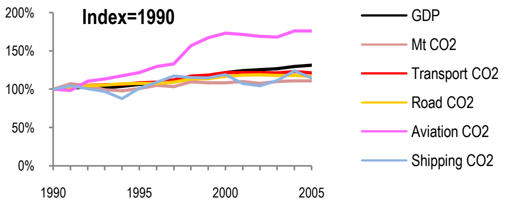
414.3Mt

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	11%	414.35	1%	6.19	18%	0.23
Transport CO2	21%	160.43	13%	2.56	8%	0.09
Road CO2	17%	128.13	8%	2.04	11%	0.08
Aviation CO2	76%	20.94	63%	0.33	34%	0.01
Shipping CO2	15%	10.09	6%	0.16	13%	0.01









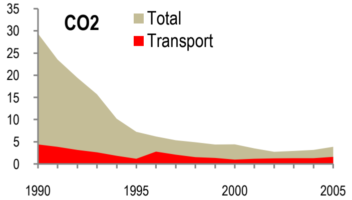
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	58.17	59.42	60.71	61.12	61.53	61.93	62.32	62.70	8%	0.50%
GDP (billion 2000 US$, PPP)	1290.53	1371.70	1574.81	1604.01	1620.49	1638.11	1676.10	1695.97	31%	1.84%
Road passenger km (million pkm)	627300	681700	742600	768900	775700	781300	780900	771300	23%	1.39%
Road freight tonne km (million tkm)	191660	233568	270351	269801	267796	266155	271426	262573	37%	2.12%
Road pkm/capita	10784	11473	12232	12580	12607	12616	12530	12301	14%	0.88%
Road freight tkm/$ of GDP)	0.15	0.17	0.17	0.17	0.17	0.16	0.16	0.15	4%	0.28%
Motorisation (Cars/1000 inhabitants)	405	422	462	470	474	477	477	..	..	..
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	373.04	377.17	404.53	410.11	401.54	411.64	413.29	414.35	11%	0.70%
IEA transport CO2 (Mt CO2)*	132.18	143.35	160.98	161.27	161.10	160.48	162.76	160.43	21%	1.30%
Transport as a percentage of total	*35.4%*	*38.0%*	*39.8%*	*39.3%*	*40.1%*	*39.0%*	*39.4%*	*38.7%*		
Road	109.63	118.12	128.11	129.98	130.38	129.27	129.55	128.13	17%	1.04%
Rail	1.22	1.21	1.16	0.77	0.79	0.75	0.74	0.67	-45%	-3.92%
Domestic Aviation	2.22	2.62	4.84	6.21	5.38	4.48	4.32	4.15	87%	4.26%
International Aviation	9.67	11.87	15.78	14.20	14.70	15.54	16.60	16.79	74%	3.75%
Domestic Navigation	0.79	0.91	1.02	0.93	0.91	0.91	0.91	0.91	15%	0.95%
International Maritime	8.01	7.99	9.48	8.52	8.28	8.92	10.03	9.18	15%	0.91%
Other Transport	0.64	0.63	0.59	0.66	0.66	0.61	0.61	0.60	-6%	-0.43%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	584.21	580.62	588.27	589.31	580.91	584.39	586.83	583.57	0%	-0.01%
UNFCCC Transport GHG (Mt CO2 eq.)*	138.44	150.52	166.25	168.57	169.38	169.96	172.95	170.99	24%	1.42%
Transport as a percentage of total	*23.7%*	*25.9%*	*28.3%*	*28.6%*	*29.2%*	*29.1%*	*29.5%*	*29.3%*		

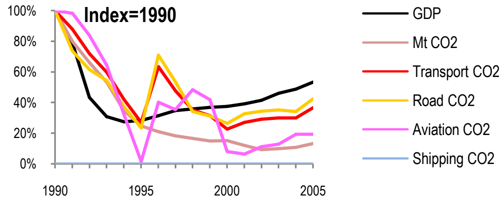
*includes international aviation and shipping

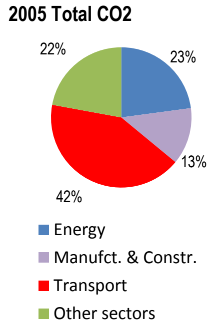
Georgia

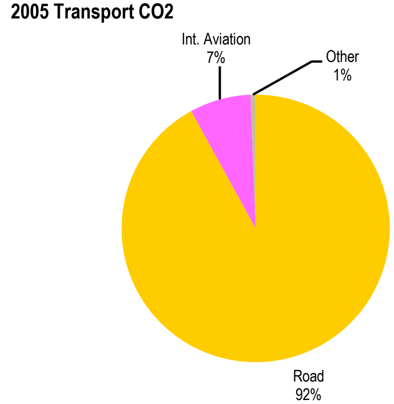
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	87%	3.9	84%	0.84	76%	0.28
Transport CO2	63%	1.63	55%	0.36	31%	0.12
Road CO2	57%	1.5	48%	0.34	20%	0.11
Aviation CO2	81%	0.12	76%	0.03	64%	0.01
Shipping CO2						









Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	5.46	5.03	4.72	4.67	4.61	4.57	4.52	4.47	-18%	-1.32%
GDP (billion 2000 US$, PPP)	25.14	7.10	9.43	9.88	10.42	11.58	12.26	13.40	-47%	-4.11%
Road passenger km (million pkm)	..	..	..	..	..	..	..	..	..	..
Road freight tonne km (million tkm)	13411	1376	6234	7146	7911	8303	7793	9313	-31%	-2.40%
Road pkm/capita	..	..	..	..	..	..	..	..	..	..
Road freight tkm/$ of GDP)	0.53	0.19	0.66	0.72	0.76	0.72	0.64	0.70	30%	1.78%
Motorisation (Cars/1000 inhabitants)	88	72	52	53	55	56	..	..	..	..
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	29.44	7.27	4.45	3.53	2.77	2.96	3.19	3.90	-87%	-12.61%
IEA transport CO2 (Mt CO2)*	4.43	1.20	1.01	1.20	1.29	1.33	1.33	1.63	-63%	-6.45%
Transport as a percentage of total	*15.0%*	*16.5%*	*22.7%*	*34.0%*	*46.6%*	*44.9%*	*41.7%*	*41.8%*		
Road	3.52	0.83	0.93	1.15	1.21	1.24	1.20	1.50	-57%	-5.53%
Rail	0.11	0.20	0.03	0.00	0.00	0.00	0.00	0.00	-100%	-99.99%
Domestic Aviation	..	..	..	..	..	..	..	..	..	..
International Aviation	0.62	0.01	0.05	0.04	0.07	0.08	0.12	0.12	-81%	-10.37%
Domestic Navigation	..	..	..	..	..	..	..	..	..	..
International Maritime	..	0.16	..	..	..	..	..	..	..	..
Other Transport	0.18	0.00	0.00	0.01	0.01	0.01	0.01	0.01	-94%	-17.53%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
UNFCCC Transport GHG (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
Transport as a percentage of total	..	..	..	..	..	..	..	..		

*includes international aviation and shipping

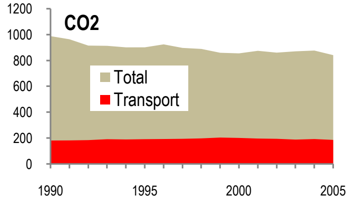
Germany

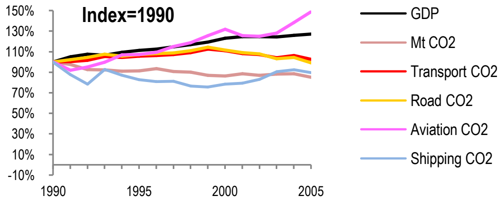
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

EU | N.Am | Asia-Pac | Other ITF

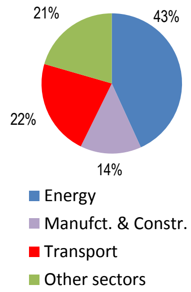
841.8Mt

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	15%	841.78	19%	9.86	33%	0.38
Transport CO2	3%	186.84	1%	2.27	19%	0.09
Road CO2	1%	150.21	4%	1.82	22%	0.07
Aviation CO2	49%	25.56	43%	0.31	17%	0.01
Shipping CO2	10%	8.89	14%	0.11	29%	0.00

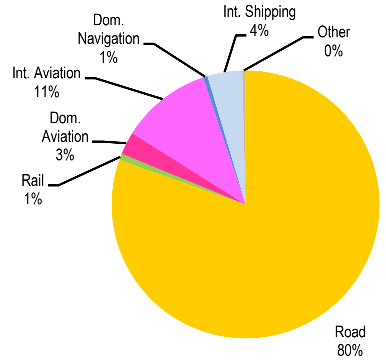




2005 Total CO2



2005 Transport CO2

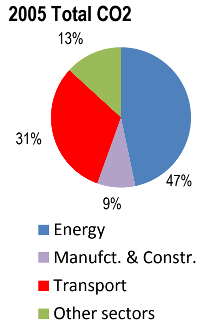


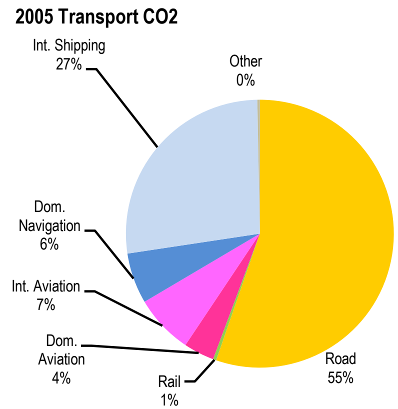
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	79.36	81.66	82.19	82.34	82.48	82.52	82.50	82.46	4%	0.26%
GDP (billion 2000 US$, PPP)	1706.54	1902.56	2101.35	2127.41	2127.41	2123.41	2149.89	2169.43	27%	1.61%
Road passenger km (million pkm)	649800	883800	900300	921300	938900	935400	956254	953059	47%	2.59%
Road freight tonne km (million tkm)	339540	386754	439698	445699	440861	444320	470056	486372	43%	2.42%
Road pkm/capita	8188	10823	10954	11189	11383	11335	11591	11558	41%	2.32%
Road freight tkm/$ of GDP)	0.20	0.20	0.21	0.21	0.21	0.21	0.22	0.22	13%	0.80%
Motorisation (Cars/1000 inhabitants)	387	495	521	532	538	541	546	550	42%	2.38%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	988.50	902.05	855.61	875.05	861.03	871.31	877.20	841.78	-15%	-1.07%
IEA transport CO2 (Mt CO2)*	182.09	192.33	202.05	197.29	195.33	189.42	193.41	186.84	3%	0.17%
Transport as a percentage of total	*18.4%*	*21.3%*	*23.6%*	*22.5%*	*22.7%*	*21.7%*	*22.0%*	*22.2%*		
Road	151.31	162.52	169.08	165.32	163.15	156.13	158.26	150.21	-1%	-0.05%
Rail	2.96	2.31	1.82	1.83	1.72	1.60	1.52	1.46	-51%	-4.60%
Domestic Aviation	4.12	3.74	4.59	4.37	4.34	4.44	4.79	5.15	25%	1.50%
International Aviation	13.04	14.65	18.03	17.20	17.14	17.55	18.97	20.41	57%	3.03%
Domestic Navigation	2.06	1.74	0.88	0.85	0.74	0.74	0.74	1.00	-51%	-4.70%
International Maritime	7.85	6.47	6.90	7.01	7.51	8.23	8.42	7.89	1%	0.03%
Other Transport	0.75	0.90	0.75	0.71	0.73	0.73	0.71	0.72	-4%	-0.27%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	1247.58	1116.23	1044.61	1061.20	1042.33	1056.72	1051.52	1030.73	-17%	-1.26%
UNFCCC Transport GHG (Mt CO2 eq.)*	184.17	199.35	209.15	204.98	203.78	198.39	199.47	194.96	6%	0.38%
Transport as a percentage of total	*14.8%*	*17.9%*	*20.0%*	*19.3%*	*19.6%*	*18.8%*	*19.0%*	*18.9%*		

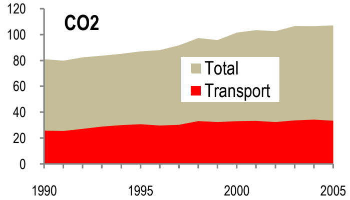
*includes international aviation and shipping

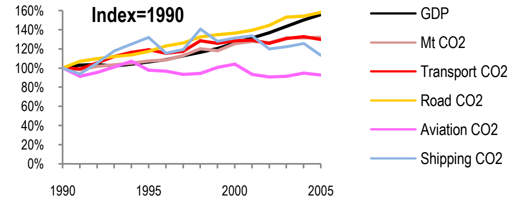
Greece

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	32%	107.14	26%	8.62	13%	0.34
Transport CO2	30%	33.53	21%	3.02	17%	0.12
Road CO2	58%	18.54	47%	1.67	2%	0.07
Aviation CO2	7%	3.63	14%	0.33	40%	0.01
Shipping CO2	13%	11.13	5%	1.00	27%	0.04









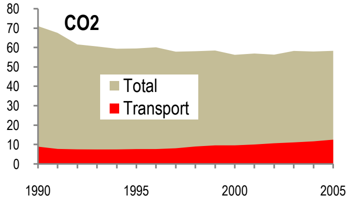
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	10.34	10.63	10.92	10.95	10.99	11.02	11.06	11.10	7%	0.47%
GDP (billion 2000 US$, PPP)	181.36	192.95	228.60	238.83	248.12	260.16	272.46	282.62	56%	3.00%
Road passenger km (million pkm)	24233	31452	40458	41083	41811	42029	42596	42484	75%	3.81%
Road freight tonne km (million tkm)	13095	12662	14717	14803	15027	15156	16065	16474	26%	1.54%
Road pkm/capita	2344	2959	3705	3752	3804	3814	3851	3827	63%	3.32%
Road freight tkm/$ of GDP)	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	-19%	-1.42%
Motorisation (Cars/1000 inhabitants)	168	207	293	313	332	348	368	388	131%	5.74%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	81.04	87.09	101.61	103.51	102.68	106.63	106.58	107.14	32%	1.88%
IEA transport CO2 (Mt CO2)*	25.82	30.81	33.16	33.38	32.48	33.76	34.34	33.53	30%	1.76%
Transport as a percentage of total	*31.9%*	*35.4%*	*32.6%*	*32.2%*	*31.6%*	*31.7%*	*32.2%*	*31.3%*		
Road	11.71	13.76	15.98	16.34	16.92	17.95	18.06	18.54	58%	3.11%
Rail	0.20	0.14	0.13	0.13	0.13	0.13	0.13	0.13	-35%	-2.83%
Domestic Aviation	1.48	1.21	1.57	1.33	1.22	1.17	1.24	1.24	-16%	-1.17%
International Aviation	2.43	2.61	2.50	2.33	2.33	2.40	2.47	2.39	-2%	-0.11%
Domestic Navigation	1.80	1.73	1.56	2.13	1.92	1.90	2.13	2.05	14%	0.87%
International Maritime	8.03	11.26	11.36	11.03	9.89	10.13	10.22	9.08	13%	0.82%
Other Transport	0.17	0.10	0.06	0.09	0.07	0.08	0.09	0.10	-41%	-3.48%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	119.32	127.20	145.76	146.78	145.36	150.57	151.10	151.10	27%	1.59%
UNFCCC Transport GHG (Mt CO2 eq.)*	26.23	31.32	33.80	34.04	33.19	35.15	35.77	35.77	36%	2.09%
Transport as a percentage of total	*22.0%*	*24.6%*	*23.2%*	*23.2%*	*22.8%*	*23.3%*	*23.7%*	*23.7%*		

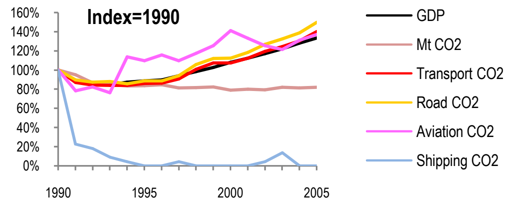
*includes international aviation and shipping

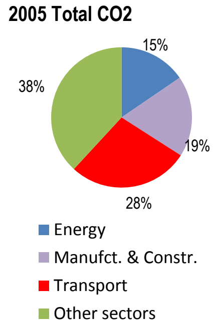
Hungary

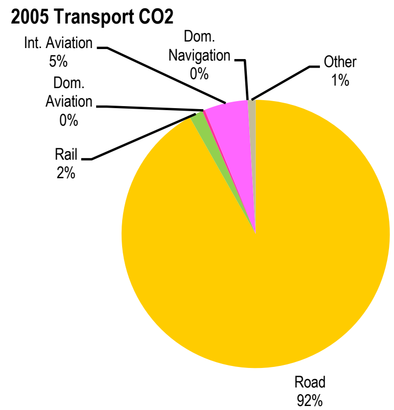
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	18%	58.34	16%	5.72	38%	0.37
Transport CO2	40%	12.58	44%	1.25	5%	0.08
Road CO2	50%	11.55	54%	1.14	12%	0.07
Aviation CO2	37%	0.7	41%	0.07	3%	0.00
Shipping CO2	100%	0	100%	0.00	100%	0.00









Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	10.37	10.33	10.21	10.19	10.16	10.13	10.11	10.09	-3%	-0.18%
GDP (billion 2000 US$, PPP)	116.70	103.54	126.04	131.19	136.89	142.53	149.47	155.82	34%	1.95%
Road passenger km (million pkm)	71104	64542	64622	64506	64702	64965	64858	64159	-10%	-0.68%
Road freight tonne km (million tkm)	39265	26777	25156	25743	24940	25445	27042	28191	-28%	-2.18%
Road pkm/capita	6857	6248	6329	6330	6368	6413	6415	6359	-7%	-0.50%
Road freight tkm/$ of GDP)	0.34	0.26	0.20	0.20	0.18	0.18	0.18	0.18	-46%	-4.05%
Motorisation (Cars/1000 inhabitants)	188	217	232	244	259	274	280	286	53%	2.86%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	71.08	59.55	56.28	56.96	56.36	58.29	57.98	58.34	-18%	-1.31%
IEA transport CO2 (Mt CO2)*	8.98	7.73	9.65	10.09	10.73	11.18	11.71	12.58	40%	2.27%
Transport as a percentage of total	*12.6%*	*13.0%*	*17.1%*	*17.7%*	*19.0%*	*19.2%*	*20.2%*	*21.6%*		
Road	7.71	6.84	8.67	9.15	9.77	10.21	10.71	11.55	50%	2.73%
Rail	0.53	0.32	0.27	0.26	0.25	0.24	0.23	0.21	-60%	-5.99%
Domestic Aviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	..	..
International Aviation	0.51	0.56	0.72	0.68	0.64	0.62	0.67	0.66	29%	1.73%
Domestic Navigation	0.22	0.00	0.00	0.00	0.01	0.03	0.00	0.00	-100%	..
International Maritime	..	..	..	..	..	..	..	..	..	..
Other Transport	0.01	0.01	-0.01	0.00	0.06	0.08	0.10	0.12	1100%	18.02%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	98.61	79.77	77.97	79.65	77.63	80.87	79.81	80.91	-18%	-1.31%
UNFCCC Transport GHG (Mt CO2 eq.)*	8.93	7.72	9.59	9.83	10.30	10.65	11.18	12.92	45%	2.50%
Transport as a percentage of total	*9.1%*	*9.7%*	*12.3%*	*12.3%*	*13.3%*	*13.2%*	*14.0%*	*16.0%*		

*includes international aviation and shipping

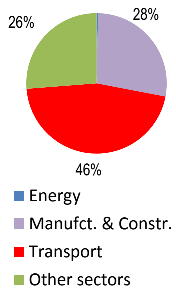
Iceland

Total CO2 from Fuel Combustion including International Air and Maritime (2005)

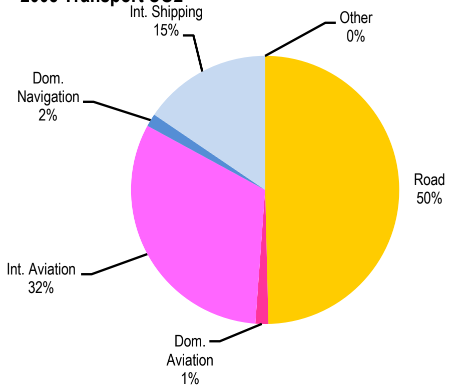
2.8 Mt

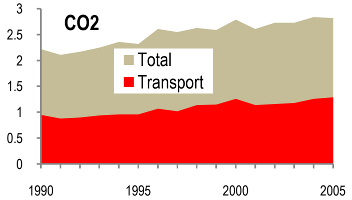
Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	27%	2.82		7.46	27%	0.22
Transport CO2	36%	1.29	18%	4.30	14%	0.13
Road CO2	19%	0.64	3%	2.13	25%	0.06
Aviation CO2	72%	0.43	49%	1.43	10%	0.04
Shipping CO2	38%	0.22	19%	0.73	12%	0.02

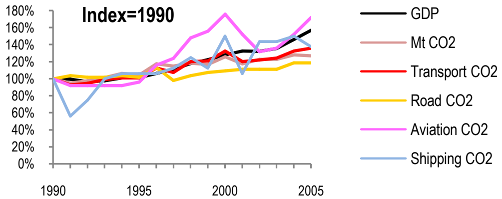
2005 Total CO2



2005 Transport CO2







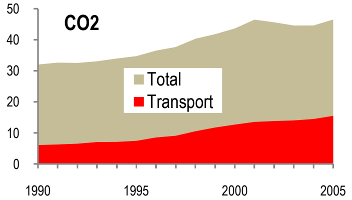
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	0.26	0.27	0.28	0.29	0.29	0.29	0.29	0.30	15%	0.96%
GDP (billion 2000 US$, PPP)	6.38	6.46	8.16	8.46	8.43	8.66	9.32	10.02	57%	3.06%
Road passenger km (million pkm)	3004	3467	4250	4458	4583	4711	4855	5145	71%	3.65%
Road freight tonne km (million tkm)	..	..	..	..	..	..	..	..	..	..
Road pkm/capita	11554	12841	15179	15372	15803	16245	16741	17150	48%	2.67%
Road freight tkm/$ of GDP)	..	..	..	..	..	..	..	..	..	..
Motorisation (Cars/1000 inhabitants)	460	441	568	551	558	576	603	623	35%	2.04%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	2.22	2.32	2.79	2.61	2.73	2.73	2.84	2.82	27%	1.61%
IEA transport CO2 (Mt CO2)*	0.95	0.96	1.26	1.14	1.16	1.18	1.26	1.29	36%	2.06%
Transport as a percentage of total	*42.8%*	*41.4%*	*45.2%*	*43.7%*	*42.5%*	*43.2%*	*44.4%*	*45.7%*		
Road	0.54	0.55	0.59	0.60	0.60	0.60	0.64	0.64	19%	1.14%
Rail	..	..	..	..	..	..	..	..	..	..
Domestic Aviation	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	-33%	-2.67%
International Aviation	0.22	0.21	0.41	0.35	0.31	0.32	0.36	0.41	86%	4.24%
Domestic Navigation	0.06	0.03	0.02	0.02	0.02	0.02	0.02	0.02	-67%	-7.06%
International Maritime	0.10	0.14	0.22	0.15	0.21	0.21	0.22	0.20	100%	4.73%
Other Transport	0.00	0.00	-0.01	-0.01	0.00	0.01	0.00	0.00	..	..
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	3.67	3.52	4.32	4.17	4.21	4.13	4.28	4.12	12%	0.76%
UNFCCC Transport GHG (Mt CO2 eq.)*	0.93	1.00	1.29	1.17	1.20	1.21	1.31	1.17	25%	1.51%
Transport as a percentage of total	*25.3%*	*28.4%*	*29.9%*	*28.1%*	*28.4%*	*29.3%*	*30.7%*	*28.3%*		

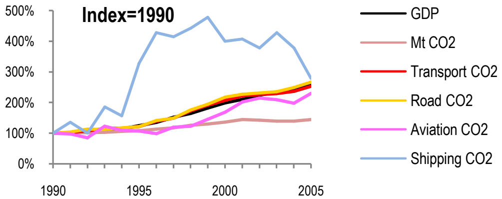
*includes international aviation and shipping

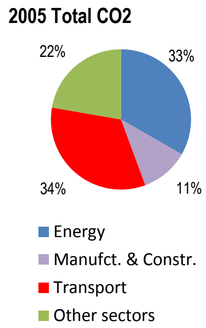
Ireland

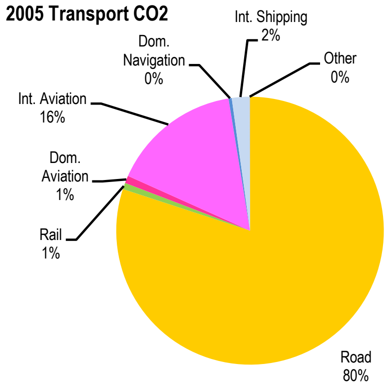
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	45%	46.54	20%	10.55	45%	0.31
Transport CO2	154%	15.52	114%	3.74	1%	0.11
Road CO2	167%	12.42	126%	2.99	4%	0.09
Aviation CO2	130%	2.58	95%	0.62	10%	0.02
Shipping CO2	179%	0.39	136%	0.09	8%	0.00







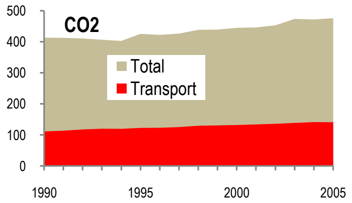


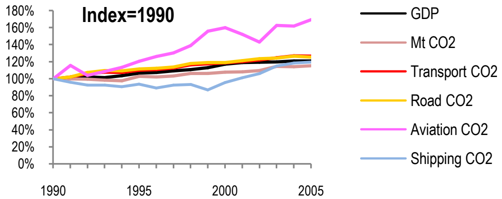
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	3.51	3.60	3.80	3.86	3.93	3.99	4.06	4.15	18%	1.12%
GDP (billion 2000 US$, PPP)	55.01	69.00	109.64	116.05	123.05	128.33	133.86	141.26	157%	6.49%
Road passenger km (million pkm)	..	..	..	..	..	..	..	..	..	..
Road freight tonne km (million tkm)	5719	6095	12839	12921	14874	16296	17688	18455	223%	8.12%
Road pkm/capita	..	..	..	..	..	..	..	..	..	..
Road freight tkm/$ of GDP)	0.10	0.09	0.12	0.11	0.12	0.13	0.13	0.13	26%	1.53%
Motorisation (Cars/1000 inhabitants)	229	278	351	363	373	383	395	406	78%	3.90%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	32.05	34.75	43.66	46.50	45.65	44.61	44.63	46.54	45%	2.52%
IEA transport CO2 (Mt CO2)*	6.12	7.48	12.71	13.57	13.85	14.05	14.51	15.52	154%	6.40%
Transport as a percentage of total	*19.1%*	*21.5%*	*29.1%*	*29.2%*	*30.3%*	*31.5%*	*32.5%*	*33.3%*		
Road	4.65	5.65	10.11	10.57	10.77	10.96	11.61	12.42	167%	6.77%
Rail	0.15	0.15	0.12	0.12	0.12	0.13	0.12	0.12	-20%	-1.48%
Domestic Aviation	0.05	0.05	0.10	0.12	0.12	0.12	0.11	0.14	180%	7.11%
International Aviation	1.07	1.15	1.79	2.15	2.28	2.23	2.11	2.44	128%	5.65%
Domestic Navigation	0.08	0.09	0.08	0.06	0.06	0.06	0.06	0.06	-25%	-1.90%
International Maritime	0.06	0.37	0.48	0.51	0.47	0.54	0.47	0.33	450%	12.04%
Other Transport	0.06	0.02	0.03	0.04	0.03	0.01	0.03	0.01	-83%	-11.26%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	56.50	60.89	71.41	73.60	71.74	71.61	71.27	72.75	29%	1.70%
UNFCCC Transport GHG (Mt CO2 eq.)*	6.31	7.84	13.23	14.16	14.45	14.68	15.20	16.27	158%	6.52%
Transport as a percentage of total	*11.2%*	*12.9%*	*18.5%*	*19.2%*	*20.1%*	*20.5%*	*21.3%*	*22.4%*		

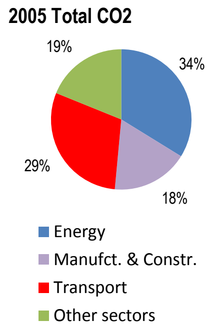
*includes international aviation and shipping

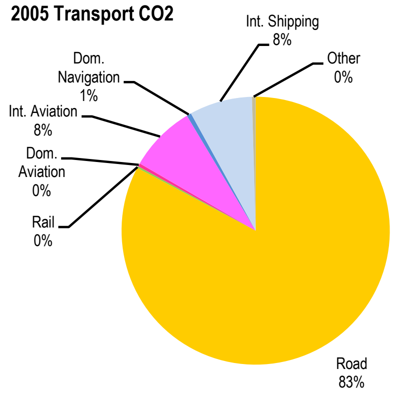
Italy

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	15%	476.08	11%	7.76	6%	0.3
Transport CO2	27%	141.19	23%	2.41	5%	0.09
Road CO2	26%	116.86	22%	2.00	4%	0.08
Aviation CO2	69%	11.91	64%	0.20	40%	0.01
Shipping CO2	20%	11.49	16%	0.20	1%	0.01









Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	56.72	56.84	56.94	56.98	57.16	57.61	58.18	58.53	3%	0.21%
GDP (billion 2000 US$, PPP)	1259.12	1341.22	1473.99	1500.45	1505.59	1506.14	1522.19	1521.65	21%	1.27%
Road passenger km (million pkm)	606549	701860	820079	813276	808678	809307	815891	809598	33%	1.94%
Road freight tonne km (million tkm)	210745	229162	194888	189990	193878	176384	192264	195159	-7%	-0.51%
Road pkm/capita	10694	12348	14403	14273	14148	14048	14024	13832	29%	1.73%
Road freight tkm/$ of GDP)	0.17	0.17	0.13	0.13	0.13	0.12	0.13	0.13	-23%	-1.76%
Motorisation (Cars/1000 inhabitants)	483	533	572	583	590	596	584	592	23%	1.36%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	413.33	425.76	445.09	446.49	453.25	473.96	472.04	476.08	15%	0.95%
IEA transport CO2 (Mt CO2)*	111.52	122.91	132.26	134.09	136.19	138.93	141.64	141.19	27%	1.59%
Transport as a percentage of total	*27.0%*	*28.9%*	*29.7%*	*30.0%*	*30.0%*	*29.3%*	*30.0%*	*29.7%*		
Road	93.11	104.02	110.68	112.88	115.16	115.64	117.92	116.86	26%	1.53%
Rail	0.62	0.61	0.44	0.38	0.39	0.42	0.37	0.31	-50%	-4.52%
Domestic Aviation	0.49	1.04	0.53	0.27	0.28	0.43	0.48	0.54	10%	0.65%
International Aviation	6.54	7.43	10.73	10.43	9.78	11.01	10.91	11.37	74%	3.76%
Domestic Navigation	1.18	1.36	0.64	0.80	0.74	0.90	0.78	0.78	-34%	-2.72%
International Maritime	8.43	7.65	8.56	8.91	9.44	10.15	10.61	10.71	27%	1.61%
Other Transport	1.15	0.80	0.68	0.42	0.40	0.38	0.57	0.62	-46%	-4.03%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	525.42	539.98	563.35	569.10	569.86	586.56	592.04	594.41	13%	0.83%
UNFCCC Transport GHG (Mt CO2 eq.)*	112.52	124.84	136.25	138.32	141.24	144.37	147.18	146.37	30%	1.77%
Transport as a percentage of total	*21.4%*	*23.1%*	*24.2%*	*24.3%*	*24.8%*	*24.6%*	*24.9%*	*24.6%*		

*includes international aviation and shipping

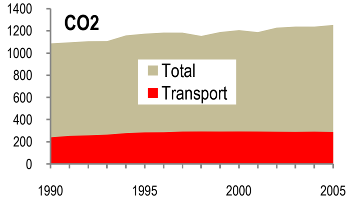
Japan

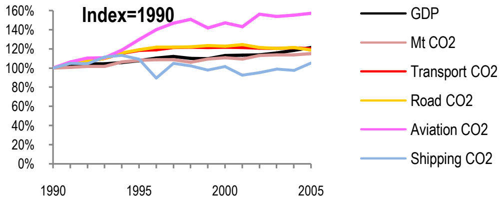
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

EU | N.Am | Asia Pac | Other ITF

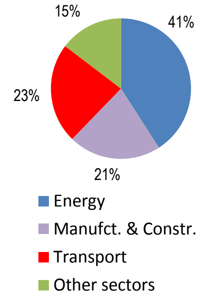
1239.2Mt

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	15%	1254.47	11%	9.5	5%	0.35
Transport CO2	20%	289.5	16%	2.27	1%	0.08
Road CO2	19%	224.24	15%	1.76	2%	0.06
Aviation CO2	57%	32.38	52%	0.25	30%	0.01
Shipping CO2	5%	31.1	2%	0.24	13%	0.01

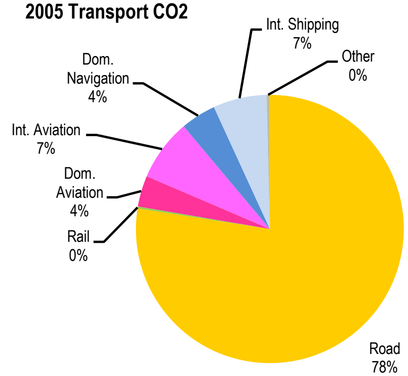




2005 Total CO2



2005 Transport CO2



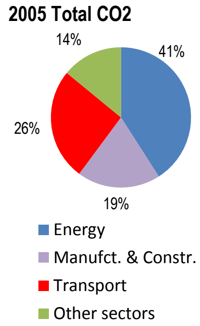
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	123.48	125.47	126.84	127.15	127.44	127.71	127.75	127.76	3%	0.23%
GDP (billion 2000 US$, PPP)	2859.69	3081.92	3234.16	3246.61	3250.95	3308.70	3384.87	3473.78	21%	1.31%
Road passenger km (million pkm)	853060	917419	951251	954293	955413	954186	947563	933005	9%	0.60%
Road freight tonne km (million tkm)	301440	319749	335254	335265	334159	344656	350108	357979	19%	1.15%
Road pkm/capita	6908	7312	7500	7505	7497	7472	7417	7303	6%	0.37%
Road freight tkm/$ of GDP)	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	-2%	-0.15%
Motorisation (Cars/1000 inhabitants)	283	356	416	421	428	432	438	447	58%	3.10%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	1088.06	1175.85	1207.77	1189.79	1229.87	1239.55	1239.21	1254.47	15%	0.95%
IEA transport CO2 (Mt CO2)*	241.11	285.84	293.90	293.35	291.65	290.34	292.19	289.50	20%	1.23%
Transport as a percentage of total	*22.2%*	*24.3%*	*24.3%*	*24.7%*	*23.7%*	*23.4%*	*23.6%*	*23.1%*		
Road	188.68	224.87	231.67	234.67	229.45	227.64	229.59	224.24	19%	1.16%
Rail	0.95	0.84	0.72	0.69	0.68	0.65	0.67	0.67	-29%	-2.30%
Domestic Aviation	7.24	10.39	10.72	10.76	10.97	11.10	10.70	10.84	50%	2.73%
International Aviation	13.34	16.34	19.61	18.71	21.22	20.56	21.26	21.54	61%	3.25%
Domestic Navigation	12.80	13.80	14.05	13.57	13.72	13.35	12.19	12.36	-3%	-0.23%
International Maritime	16.76	18.54	16.02	13.83	14.49	15.93	16.67	18.74	12%	0.75%
Other Transport	1.34	1.06	1.11	1.12	1.12	1.11	1.11	1.11	-17%	-1.25%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	1303.19	1382.21	1384.73	1356.28	1392.03	1398.12	1396.51	1401.91	8%	0.49%
UNFCCC Transport GHG (Mt CO2 eq.)*	246.70	294.69	301.18	300.34	298.09	296.52	297.77	295.11	20%	1.20%
Transport as a percentage of total	*18.9%*	*21.3%*	*21.7%*	*22.1%*	*21.4%*	*21.2%*	*21.3%*	*21.1%*		

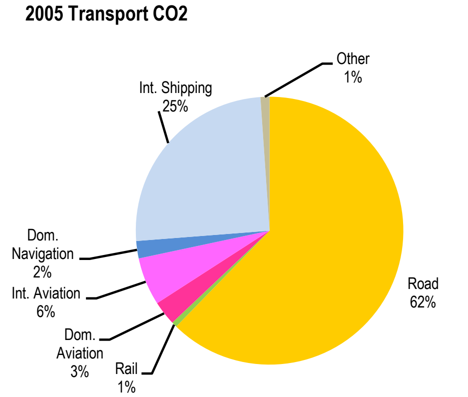
*includes international aviation and shipping

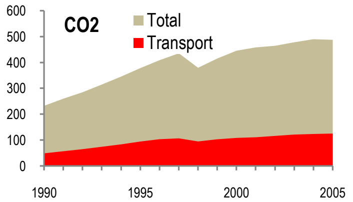
Korea

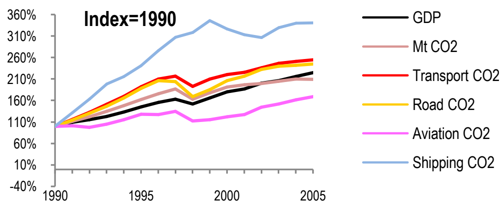
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	109%	487.78	75%	9.3	11%	0.47
Transport CO2	155%	125.73	126%	2.60	13%	0.13
Road CO2	145%	78.33	118%	1.62	9%	0.08
Aviation CO2	69%	10.96	50%	0.23	25%	0.01
Shipping CO2	241%	34.25	203%	0.71	51%	0.04







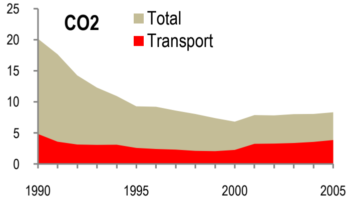


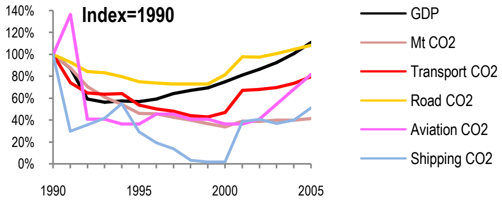
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	42.87	45.09	47.01	47.35	47.62	47.85	48.08	48.29	13%	0.80%
GDP (billion 2000 US$, PPP)	425.79	620.16	768.29	797.76	853.37	879.80	921.41	957.92	125%	5.55%
Road passenger km (million pkm)	..	..	..	..	..	..	..	..	..	..
Road freight tonne km (million tkm)	..	..	..	..	..	..	..	..	..	..
Road pkm/capita	..	..	..	..	..	..	..	..	..	..
Road freight tkm/$ of GDP)	..	..	..	..	..	..	..	..	..	..
Motorisation (Cars/1000 inhabitants)	48	133	172	188	204	215	221	..	..	..
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	233.02	378.56	445.75	458.53	464.63	478.24	490.12	487.78	109%	5.05%
IEA transport CO2 (Mt CO2)*	49.34	94.86	108.85	111.40	116.60	121.81	123.99	125.73	155%	6.43%
Transport as a percentage of total	*21.2%*	*25.1%*	*24.4%*	*24.3%*	*25.1%*	*25.5%*	*25.3%*	*25.8%*		
Road	31.92	60.22	65.87	69.16	74.31	76.63	77.28	78.33	145%	6.17%
Rail	0.89	0.95	0.98	0.99	0.99	1.01	0.87	0.82	-8%	-0.54%
Domestic Aviation	5.65	6.28	6.21	6.33	6.60	6.25	6.57	3.70	-35%	-2.78%
International Aviation	0.84	2.05	1.70	1.96	2.76	3.60	3.93	7.26	764%	15.46%
Domestic Navigation	5.02	9.70	13.60	12.54	12.80	12.98	11.99	2.64	-47%	-4.19%
International Maritime	5.03	14.53	19.27	18.92	18.05	20.15	22.18	31.61	528%	13.04%
Other Transport	-0.01	1.13	1.22	1.50	1.09	1.19	1.17	1.37	-13800%	#NUM!
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
UNFCCC Transport GHG (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
Transport as a percentage of total	..	..	..	..	..	..	..	..		

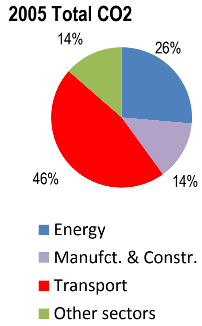
*includes international aviation and shipping

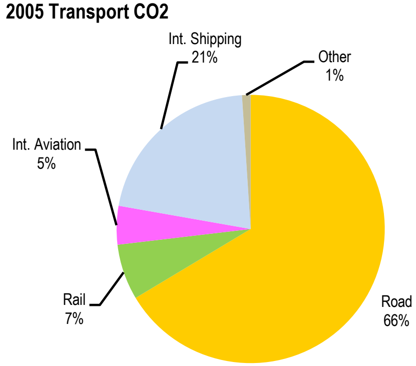
Latvia

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	59%	8.34	54%	3.19	64%	0.26
Transport CO2	20%	3.87	7%	1.68	28%	0.14
Road CO2	8%	2.57	26%	1.12	2%	0.09
Aviation CO2	18%	0.18	5%	0.08	26%	0.01
Shipping CO2	49%	0.82	41%	0.36	54%	0.03









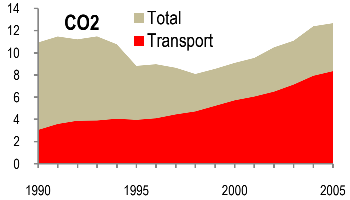
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	2.67	2.52	2.37	2.36	2.34	2.33	2.31	2.30	-14%	-0.99%
GDP (billion 2000 US$, PPP)	25.15	14.35	18.91	20.43	21.75	23.32	25.33	27.93	11%	0.70%
Road passenger km (million pkm)	5862	1835	2348	2305	2361	2550	2655	2891	-51%	-4.60%
Road freight tonne km (million tkm)	24683	16907	24565	27063	26251	27868	29179	31706	28%	1.68%
Road pkm/capita	2196	728	991	977	1009	1094	1149	1257	-43%	-3.65%
Road freight tkm/$ of GDP)	0.98	1.18	1.30	1.32	1.21	1.20	1.15	1.14	16%	0.98%
Motorisation (Cars/1000 inhabitants)	106	132	235	248	265	278	297	323	205%	7.71%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	20.18	9.30	6.83	7.89	7.84	8.04	8.07	8.34	-59%	-5.72%
IEA transport CO2 (Mt CO2)*	4.85	2.60	2.28	3.26	3.30	3.39	3.57	3.87	-20%	-1.49%
Transport as a percentage of total	*24.0%*	*28.0%*	*33.4%*	*41.3%*	*42.1%*	*42.2%*	*44.2%*	*46.4%*		
Road	2.37	1.78	1.93	2.32	2.31	2.39	2.48	2.57	8%	0.54%
Rail	0.54	0.24	0.21	0.21	0.22	0.25	0.26	0.26	-52%	-4.76%
Domestic Aviation	..	..	..	..	..	..	..	..	..	..
International Aviation	0.22	0.08	0.08	0.08	0.09	0.12	0.15	0.18	-18%	-1.33%
Domestic Navigation	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-100%	-99.99%
International Maritime	1.49	0.47	0.03	0.62	0.65	0.59	0.64	0.82	-45%	-3.90%
Other Transport	0.12	0.03	0.03	0.03	0.03	0.04	0.04	0.04	-67%	-7.06%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	28.22	13.05	10.16	11.48	11.45	11.55	11.54	11.92	-58%	-5.58%
UNFCCC Transport GHG (Mt CO2 eq.)*	4.81	2.72	2.38	3.40	3.43	3.54	3.71	4.03	-16%	-1.18%
Transport as a percentage of total	*17.1%*	*20.9%*	*23.4%*	*29.6%*	*30.0%*	*30.6%*	*32.2%*	*33.8%*		

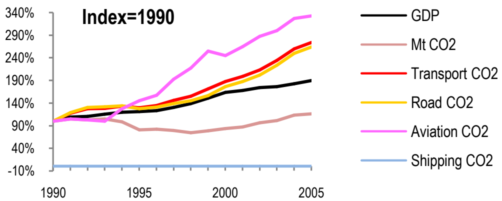
*includes international aviation and shipping

Luxembourg

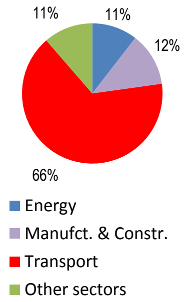
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	16%	12.68	10%	24.83	43%	0.44
Transport CO2	174%	8.35	126%	18.15	44%	0.32
Road CO2	164%	6.98	118%	15.17	39%	0.27
Aviation CO2	233%	1.33	175%	2.89	75%	0.05
Shipping CO2		0		0.00		0.00

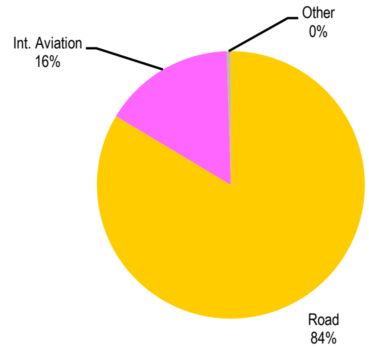




2005 Total CO2



2005 Transport CO2



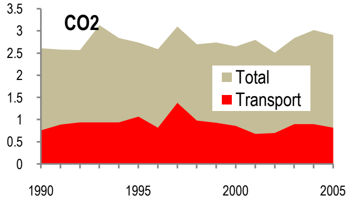
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	0.38	0.41	0.44	0.44	0.45	0.45	0.45	0.46	21%	1.28%
GDP (billion 2000 US$, PPP)	13.62	16.53	22.26	22.82	23.70	24.02	24.89	25.88	90%	4.37%
Road passenger km (million pkm)	..	..	..	..	..	..	..	..	..	..
Road freight tonne km (million tkm)	1428	1390	1454	1486	1566	1438	1503	1262	-12%	-0.82%
Road pkm/capita	..	..	..	..	..	..	..	..	..	..
Road freight tkm/$ of GDP)	0.10	0.08	0.07	0.07	0.07	0.06	0.06	0.05	-53%	-4.98%
Motorisation (Cars/1000 inhabitants)	483	559	618	638	638	652	667	661	37%	2.12%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	10.94	8.83	9.10	9.55	10.50	11.10	12.40	12.68	16%	0.99%
IEA transport CO2 (Mt CO2)*	3.05	3.96	5.72	6.06	6.50	7.14	7.93	8.35	174%	6.94%
Transport as a percentage of total	*27.9%*	*44.8%*	*62.9%*	*63.5%*	*61.9%*	*64.3%*	*64.0%*	*65.9%*		
Road	2.64	3.37	4.66	4.96	5.32	5.91	6.59	6.98	164%	6.70%
Rail	0.00	0.01	0.02	0.01	0.01	0.00	0.00	0.00	..	..
Domestic Aviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	..	..
International Aviation	0.40	0.58	0.98	1.06	1.15	1.20	1.31	1.33	233%	8.34%
Domestic Navigation	..	..	..	..	..	..	..	..	..	..
International Maritime	..	..	..	..	..	..	..	..	..	..
Other Transport	0.01	0.00	0.06	0.03	0.02	0.03	0.03	0.04	300%	9.68%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	13.09	10.35	10.52	10.88	11.92	12.43	14.08	14.05	7%	0.47%
UNFCCC Transport GHG (Mt CO2 eq.)*	3.19	4.15	6.14	6.48	6.78	7.45	8.56	8.79	176%	6.99%
Transport as a percentage of total	*24.4%*	*40.1%*	*58.4%*	*59.6%*	*56.9%*	*59.9%*	*60.8%*	*62.6%*		

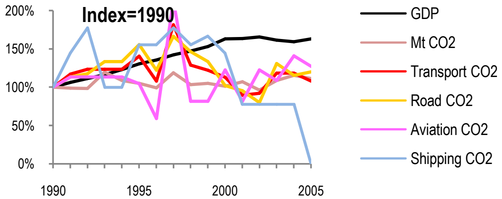
*includes international aviation and shipping

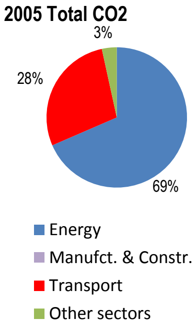
Malta

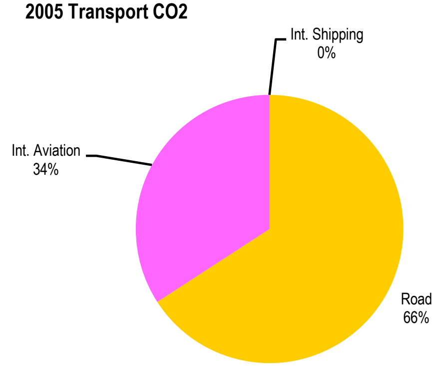
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	11%	2.91	2%	6.52	30%	0.38
Transport CO2	8%	0.82	3%	2.05	34%	0.12
Road CO2	20%	0.54	8%	1.35	27%	0.08
Aviation CO2	27%	0.28	15%	0.70	22%	0.04
Shipping CO2	100%	0	100%	0.00	100%	0.00









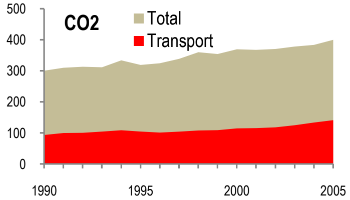
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	0.36	0.38	0.39	0.39	0.40	0.40	0.40	0.40	11%	0.70%
GDP (billion 2000 US$, PPP)	4.22	5.51	6.88	6.90	7.00	6.82	6.72	6.89	63%	3.32%
Road passenger km (million pkm)	..	..	..	..	..	..	..	..	..	..
Road freight tonne km (million tkm)	..	..	..	..	..	..	..	..	..	..
Road pkm/capita	..	..	..	..	..	..	..	..	..	..
Road freight tkm/$ of GDP)	..	..	..	..	..	..	..	..	..	..
Motorisation (Cars/1000 inhabitants)	303	524	541	562	568	590	..	..	..	..
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	2.61	2.74	2.65	2.80	2.51	2.84	3.02	2.91	11%	0.73%
IEA transport CO2 (Mt CO2)*	0.76	1.07	0.86	0.68	0.70	0.90	0.90	0.82	8%	0.51%
Transport as a percentage of total	*29.1%*	*39.1%*	*32.5%*	*24.3%*	*27.9%*	*31.7%*	*29.8%*	*28.2%*		
Road	0.45	0.70	0.46	0.43	0.36	0.59	0.52	0.54	20%	1.22%
Rail	..	..	..	..	..	..	..	..	..	..
Domestic Aviation	..	..	..	..	..	..	..	..	..	..
International Aviation	0.22	0.23	0.27	0.18	0.27	0.24	0.31	0.28	27%	1.62%
Domestic Navigation	..	..	..	..	..	..	..	..	..	..
International Maritime	0.09	0.14	0.13	0.07	0.07	0.07	0.07	0.07	-22%	-1.66%
Other Transport	..	..	..	..	..	..	..	..	..	..
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
UNFCCC Transport GHG (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
Transport as a percentage of total	..	..	..	..	..	..	..	..		

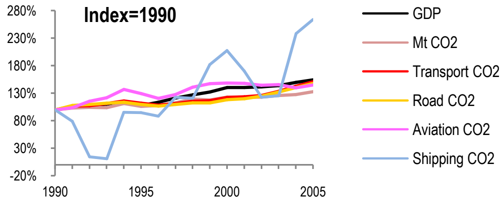
*includes international aviation and shipping

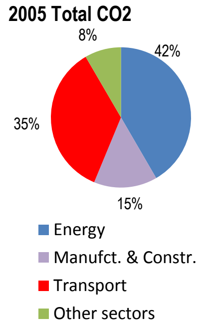
Mexico

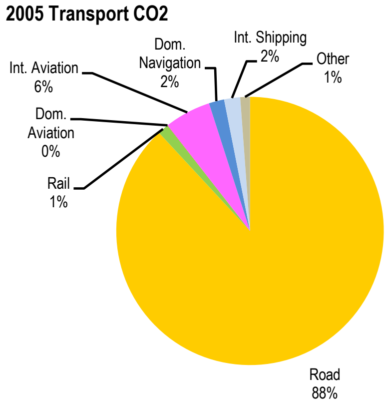
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	33%	400.05	2%	3.7	13%	0.4
Transport CO2	51%	141.41	16%	1.34	2%	0.14
Road CO2	48%	124.55	14%	1.18	4%	0.13
Aviation CO2	45%	7.95	12%	0.08	6%	0.01
Shipping CO2	164%	5.36	104%	0.05	71%	0.01









Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	81.25	90.16	98.66	100.05	101.40	102.71	104.00	105.30	30%	1.74%
GDP (billion 2000 US$, PPP)	637.66	687.92	897.16	896.87	903.79	916.36	954.49	982.69	54%	2.93%
Road passenger km (million pkm)	271512	383097	381700	389329	393200	399000	410000	422915	56%	3.00%
Road freight tonne km (million tkm)	108884	162827	194053	191901	192900	195200	199800	204217	88%	4.28%
Road pkm/capita	3342	4249	3869	3891	3878	3885	3942	4016	20%	1.23%
Road freight tkm/$ of GDP)	0.17	0.24	0.22	0.21	0.21	0.21	0.21	0.21	22%	1.32%
Motorisation (Cars/1000 inhabitants)	81	83	103	113	121	124	129	139	73%	3.70%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	300.69	319.19	369.60	367.69	370.56	378.38	383.72	400.05	33%	1.92%
IEA transport CO2 (Mt CO2)*	93.76	104.75	114.97	115.85	118.30	125.11	133.74	141.41	51%	2.78%
Transport as a percentage of total	*31.2%*	*32.8%*	*31.1%*	*31.5%*	*31.9%*	*33.1%*	*34.9%*	*35.3%*		
Road	84.20	92.42	99.47	101.28	104.93	111.57	118.02	124.55	48%	2.64%
Rail	2.06	1.78	1.69	1.60	1.64	1.69	1.81	1.89	-8%	-0.57%
Domestic Aviation	0.00	0.00	0.06	0.05	0.05	0.05	0.05	0.06	..	..
International Aviation	5.48	7.10	8.07	8.07	7.86	7.93	7.62	7.89	44%	2.46%
Domestic Navigation	..	..	..	..	..	..	2.42	2.62	..	..
International Maritime	2.03	1.92	4.21	3.46	2.49	2.55	2.42	2.74	35%	2.02%
Other Transport	-0.01	1.53	1.47	1.39	1.33	1.32	1.40	1.66	..	..
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
UNFCCC Transport GHG (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
Transport as a percentage of total	..	..	..	..	..	..	..	..		

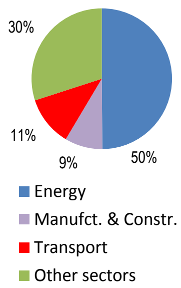
*includes international aviation and shipping

Moldova

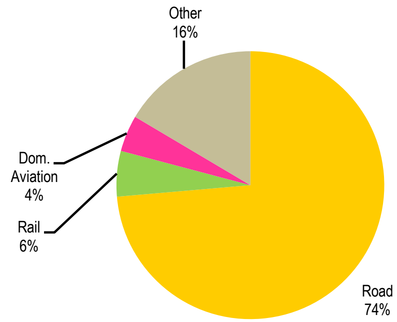
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

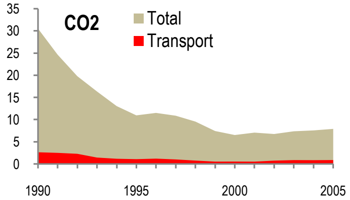
Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	74%	7.93	73%	1.89	48%	1.01
Transport CO2	66%	0.91	65%	0.22	32%	0.12
Road CO2	72%	0.67	71%	0.16	44%	0.09
Aviation CO2	83%	0.04	82%	0.01	65%	0.01
Shipping CO2		0		0.00		0.00

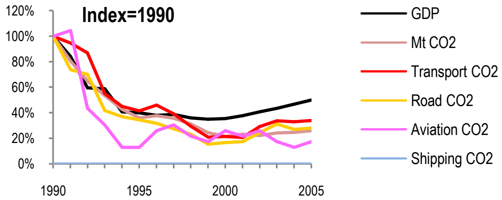
2005 Total CO2



2005 Transport CO2







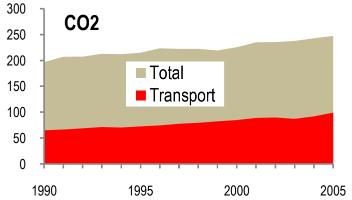
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	4.36	4.34	4.28	4.26	4.25	4.23	4.22	4.21	-3%	-0.23%
GDP (billion 2000 US$, PPP)	15.73	6.31	5.60	5.94	6.41	6.83	7.34	7.86	-50%	-4.52%
Road passenger km (million pkm)	4878	1163	1021	1068	1298	1640	1949	2077	-57%	-5.53%
Road freight tonne km (million tkm)	21405	4125	2539	3016	3866	4459	4959	5279	-75%	-8.91%
Road pkm/capita	1119	268	239	251	305	388	462	493	-56%	-5.31%
Road freight tkm/$ of GDP)	1.36	0.65	0.45	0.51	0.60	0.65	0.68	0.67	-51%	-4.60%
Motorisation (Cars/1000 inhabitants)	48	38	56	60	63	63	65	70	45%	2.52%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	30.56	10.98	6.55	7.09	6.78	7.39	7.59	7.93	-74%	-8.60%
IEA transport CO2 (Mt CO2)*	2.67	1.11	0.57	0.55	0.78	0.90	0.88	0.91	-66%	-6.92%
Transport as a percentage of total	*8.7%*	*10.1%*	*8.7%*	*7.8%*	*11.5%*	*12.2%*	*11.6%*	*11.5%*		
Road	2.40	0.83	0.40	0.42	0.59	0.75	0.65	0.67	-72%	-8.15%
Rail	..	0.09	0.03	0.03	0.07	0.04	0.05	0.05	..	..
Domestic Aviation	..	..	..	..	..	..	0.03	0.04	..	..
International Aviation	0.23	0.03	0.06	0.05	0.06	0.04	..	..	..	..
Domestic Navigation	..	..	..	..	..	..	..	..	..	..
International Maritime	..	..	..	..	..	..	..	..	..	..
Other Transport	0.04	0.16	0.08	0.05	0.06	0.07	0.15	0.15	275%	9.21%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
UNFCCC Transport GHG (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
Transport as a percentage of total	..	..	..	..	..	..	..	..		

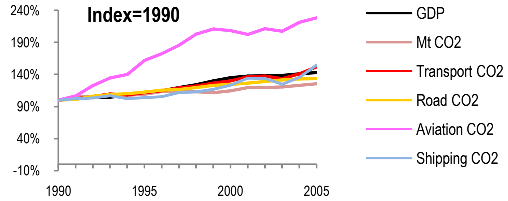
*includes international aviation and shipping

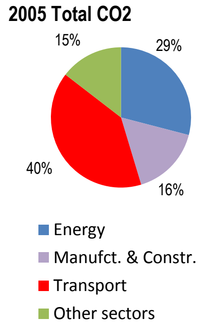
Netherlands

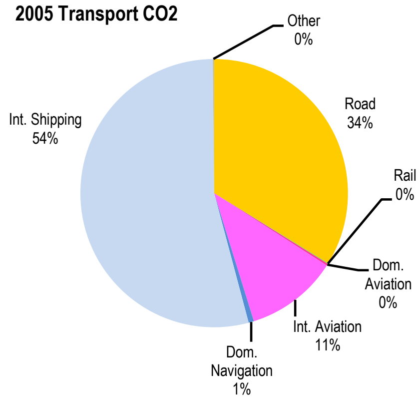
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	26%	247.64	6%	11.21	19%	0.38
Transport CO2	52%	99.33	39%	6.09	6%	0.21
Road CO2	33%	33.52	22%	2.05	7%	0.07
Aviation CO2	128%	11.28	109%	0.69	59%	0.02
Shipping CO2	55%	54.27	42%	3.33	8%	0.11









Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	14.95	15.46	15.92	16.04	16.15	16.22	16.28	16.32	9%	0.59%
GDP (billion 2000 US$, PPP)	334.31	370.64	451.93	460.64	460.99	462.54	471.57	478.78	43%	2.42%
Road passenger km (million pkm)	150400	145600	156553	157083	159627	161700	167549	164834	10%	0.61%
Road freight tonne km (million tkm)	66496	70479	83248	83078	81338	84163	87271	88036	32%	1.89%
Road pkm/capita	10060	9418	9834	9793	9884	9969	10292	10100	0%	0.03%
Road freight tkm/$ of GDP)	0.20	0.19	0.18	0.18	0.18	0.18	0.19	0.18	-8%	-0.52%
Motorisation (Cars/1000 inhabitants)	342	361	398	408	416	423	424	428	25%	1.51%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	197.04	215.16	225.79	235.26	235.62	237.88	242.98	247.64	26%	1.54%
IEA transport CO2 (Mt CO2)*	65.34	72.83	85.07	89.16	89.99	87.38	92.22	99.33	52%	2.83%
Transport as a percentage of total	*33.2%*	*33.8%*	*37.7%*	*37.9%*	*38.2%*	*36.7%*	*38.0%*	*40.1%*		
Road	25.11	28.21	31.27	31.77	32.46	33.03	33.45	33.52	33%	1.94%
Rail	0.12	0.13	0.14	0.13	0.13	0.12	0.14	0.10	-17%	-1.21%
Domestic Aviation	0.49	0.34	0.28	0.20	0.22	0.20	0.19	0.22	-55%	-5.20%
International Aviation	4.45	7.66	10.01	9.80	10.22	10.06	10.76	11.06	149%	6.26%
Domestic Navigation	0.54	0.53	1.02	0.99	0.94	0.87	0.89	0.64	19%	1.14%
International Maritime	34.53	35.85	42.25	46.17	45.91	42.99	46.68	53.63	55%	2.98%
Other Transport	0.10	0.11	0.10	0.10	0.11	0.11	0.11	0.16	60%	3.18%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	251.98	268.21	267.07	272.94	272.34	270.27	275.97	277.29	10%	0.64%
UNFCCC Transport GHG (Mt CO2 eq.)*	65.45	72.89	85.57	90.18	90.76	88.23	92.90	100.37	53%	2.89%
Transport as a percentage of total	*26.0%*	*27.2%*	*32.0%*	*33.0%*	*33.3%*	*32.6%*	*33.7%*	*36.2%*		

*includes international aviation and shipping

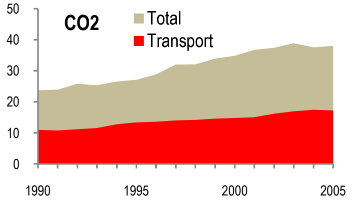
New Zealand

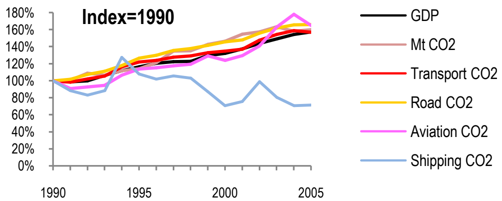
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

EU N.Am Asia-Pac Other ITF

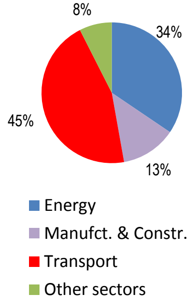
38.1Mt

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	60%	38.08	34%	8.51	6%	0.37
Transport CO2	57%	17.26	29%	4.21	0%	0.18
Road CO2	66%	12.59	36%	3.07	5%	0.13
Aviation CO2	65%	3.56	35%	0.87	5%	0.04
Shipping CO2	28%	0.73	41%	0.18	55%	0.01

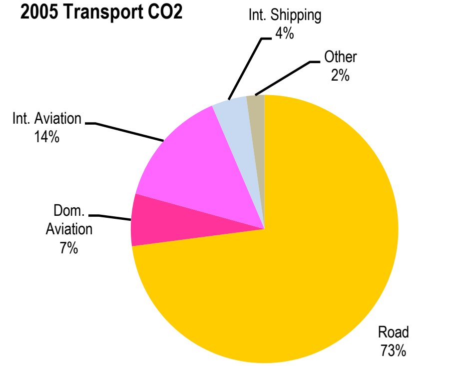




2005 Total CO2



2005 Transport CO2



Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	3.36	3.68	3.86	3.89	3.94	4.01	4.06	4.10	22%	1.34%
GDP (billion 2000 US$, PPP)	60.63	70.66	80.18	83.34	87.23	90.34	93.67	95.45	57%	3.07%
Road passenger km (million pkm)	..	..	..	..	..	..	..	..	..	..
Road freight tonne km (million tkm)	..	11205	18423	19166	19976	20950	22048	18378	..	..
Road pkm/capita	..	..	..	..	..	..	..	..	..	..
Road freight tkm/$ of GDP)	..	0.16	0.23	0.23	0.23	0.23	0.24	0.19	..	..
Motorisation (Cars/1000 inhabitants)	447	452	494	498	505	509	529	541	21%	1.28%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	23.78	27.14	34.87	36.78	37.44	38.90	37.58	38.08	60%	3.19%
IEA transport CO2 (Mt CO2)*	11.00	13.43	14.83	15.10	16.23	17.00	17.48	17.26	57%	3.05%
Transport as a percentage of total	*46.3%*	*49.5%*	*42.5%*	*41.1%*	*43.3%*	*43.7%*	*46.5%*	*45.3%*		
Road	7.59	9.61	11.07	11.22	11.83	12.29	12.58	12.59	66%	3.43%
Rail	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	..	..
Domestic Aviation	0.81	0.88	0.91	0.90	1.10	1.22	1.26	1.09	35%	2.00%
International Aviation	1.35	1.58	1.77	1.90	1.94	2.30	2.59	2.47	83%	4.11%
Domestic Navigation	..	..	..	..	..	..	..	..	..	..
International Maritime	1.02	1.10	0.72	0.77	1.01	0.82	0.72	0.73	-28%	-2.21%
Other Transport	0.23	0.25	0.36	0.31	0.35	0.37	0.33	0.38	65%	3.40%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	64.30	67.18	72.85	75.78	76.64	78.86	78.46	80.41	25%	1.50%
UNFCCC Transport GHG (Mt CO2 eq.)*	11.18	13.74	14.98	15.53	16.42	17.16	17.66	17.46	56%	3.02%
Transport as a percentage of total	*17.4%*	*20.5%*	*20.6%*	*20.5%*	*21.4%*	*21.8%*	*22.5%*	*21.7%*		

*includes international aviation and shipping

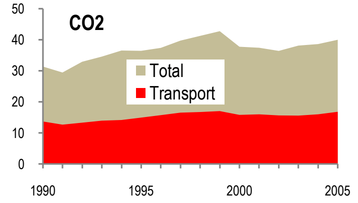
Norway

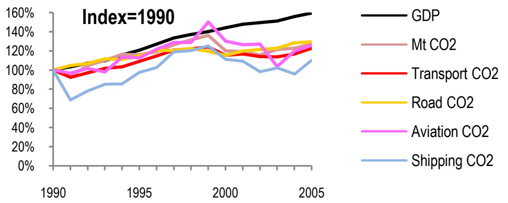
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

EU	N.Am	Asia-Pac	Other ITF

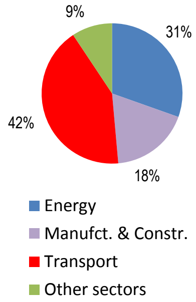
40Mt

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	27%	40.02	18%	8	16%	0.21
Transport CO2	23%	16.84	13%	3.65	23%	0.09
Road CO2	30%	10.04	19%	2.17	19%	0.06
Aviation CO2	26%	1.95	15%	0.42	21%	0.01
Shipping CO2	10%	4.78	1%	1.03	31%	0.03

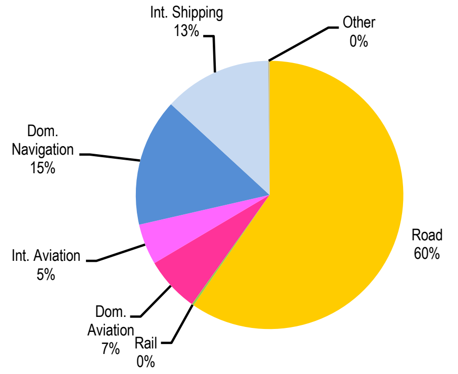




2005 Total CO2



2005 Transport CO2



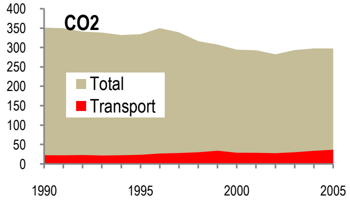
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	4.24	4.36	4.49	4.51	4.54	4.57	4.59	4.62	9%	0.57%
GDP (billion 2000 US$, PPP)	113.08	136.58	162.99	167.44	169.29	171.20	176.47	180.46	60%	3.17%
Road passenger km (million pkm)	47327	48482	53091	54162	55517	56344	56936	57547	22%	1.31%
Road freight tonne km (million tkm)	11919	16562	18277	18901	18901	19166	21704	22785	91%	4.41%
Road pkm/capita	11162	11120	11824	12009	12228	12329	12404	12456	12%	0.73%
Road freight tkm/$ of GDP)	0.11	0.12	0.11	0.11	0.11	0.11	0.12	0.13	20%	1.21%
Motorisation (Cars/1000 inhabitants)	380	386	412	415	418	423	431	439	16%	0.97%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	31.41	36.46	37.78	37.45	36.44	38.15	38.64	40.02	27%	1.63%
IEA transport CO2 (Mt CO2)*	13.72	14.96	15.84	16.02	15.67	15.61	16.03	16.84	23%	1.38%
Transport as a percentage of total	*43.7%*	*41.0%*	*41.9%*	*42.8%*	*43.0%*	*40.9%*	*41.5%*	*42.1%*		
Road	7.74	8.88	8.94	9.27	9.41	9.51	9.94	10.04	30%	1.75%
Rail	0.10	0.10	0.05	0.05	0.03	0.04	0.05	0.04	-60%	-5.93%
Domestic Aviation	0.26	0.62	0.93	0.85	0.75	0.97	1.12	1.12	331%	10.23%
International Aviation	1.29	1.13	1.09	1.11	1.22	0.64	0.74	0.83	-36%	-2.90%
Domestic Navigation	2.92	2.01	2.23	2.18	2.16	2.66	2.54	2.59	-11%	-0.80%
International Maritime	1.41	2.22	2.59	2.55	2.09	1.77	1.62	2.19	55%	2.98%
Other Transport	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	..	..
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	49.75	49.85	53.55	54.80	53.52	54.24	54.89	54.15	9%	0.57%
UNFCCC Transport GHG (Mt CO2 eq.)*	11.33	12.37	13.37	13.70	13.54	13.86	14.34	14.65	29%	1.73%
Transport as a percentage of total	*22.8%*	*24.8%*	*25.0%*	*25.0%*	*25.3%*	*25.5%*	*26.1%*	*27.0%*		

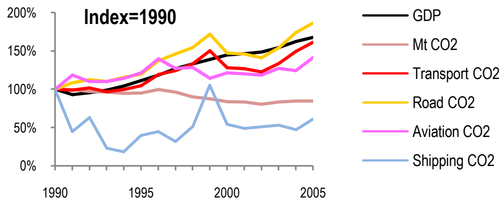
*includes international aviation and shipping

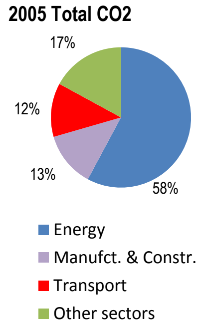
Poland

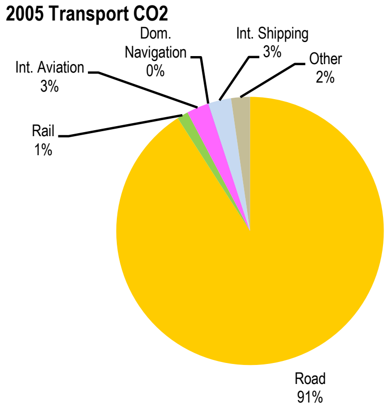
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	15%	297.82	15%	7.75	50%	0.62
Transport CO2	61%	36.93	61%	0.97	4%	0.08
Road CO2	87%	33.57	87%	0.88	11%	0.07
Aviation CO2	41%	0.99	41%	0.03	16%	0.00
Shipping CO2	39%	1.03	39%	0.03	64%	0.00









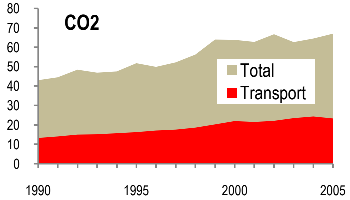
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	38.12	38.59	38.26	38.25	38.23	38.20	38.18	38.16	0%	0.01%
GDP (billion 2000 US$, PPP)	282.42	314.49	409.07	413.65	419.45	435.56	458.50	473.37	68%	3.50%
Road passenger km (million pkm)	114400	144724	181435	188696	196695	202396	211618	226614	98%	4.66%
Road freight tonne km (million tkm)	138744	133775	150565	147241	150045	160305	188670	196377	42%	2.34%
Road pkm/capita	3001	3750	4742	4933	5145	5298	5543	5939	98%	4.66%
Road freight tkm/$ of GDP)	0.49	0.43	0.37	0.36	0.36	0.37	0.41	0.41	-16%	-1.12%
Motorisation (Cars/1000 inhabitants)	138	195	261	275	288	294	314	..	..	..
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	351.48	334.51	294.65	293.18	282.75	293.73	297.88	297.82	-15%	-1.10%
IEA transport CO2 (Mt CO2)*	22.89	23.99	29.28	29.07	28.05	30.58	34.21	36.93	61%	3.24%
Transport as a percentage of total	*6.5%*	*7.2%*	*9.9%*	*9.9%*	*9.9%*	*10.4%*	*11.5%*	*12.4%*		
Road	17.98	21.53	26.48	26.28	25.38	27.69	31.31	33.57	87%	4.25%
Rail	2.46	0.88	0.52	0.51	0.49	0.51	0.51	0.50	-80%	-10.08%
Domestic Aviation	..	..	..	..	..	..	..	..	..	..
International Aviation	0.70	0.85	0.85	0.84	0.83	0.89	0.87	0.99	41%	2.34%
Domestic Navigation	0.34	0.06	0.02	0.01	0.01	0.00	0.00	0.01	-97%	-20.95%
International Maritime	1.35	0.61	0.90	0.82	0.85	0.90	0.80	1.02	-24%	-1.85%
Other Transport	0.06	0.06	0.51	0.61	0.49	0.59	0.72	0.84	1300%	19.24%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	487.37	454.39	406.83	403.76	388.90	403.34	398.31	400.69	-18%	-1.30%
UNFCCC Transport GHG (Mt CO2 eq.)*	29.95	31.75	35.81	34.87	34.45	35.25	36.67	38.35	28%	1.66%
Transport as a percentage of total	*6.1%*	*7.0%*	*8.8%*	*8.6%*	*8.9%*	*8.7%*	*9.2%*	*9.6%*		

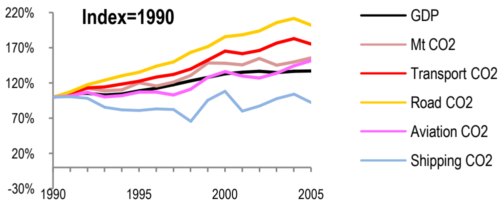
*includes international aviation and shipping

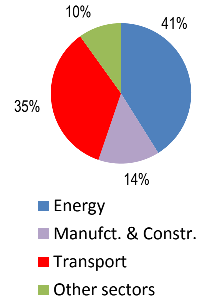
Portugal

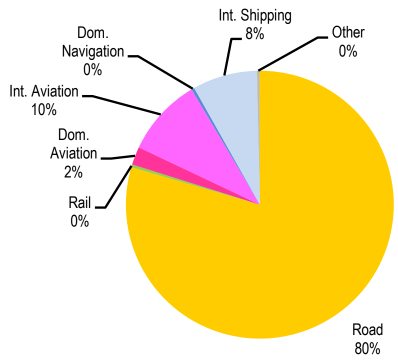
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	56%	67.05	51%	5.97	14%	0.32
Transport CO2	76%	23.38	66%	2.22	28%	0.12
Road CO2	102%	18.59	92%	1.76	47%	0.10
Aviation CO2	52%	2.72	44%	0.26	11%	0.01
Shipping CO2	8%	1.91	13%	0.18	33%	0.01









Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	10.00	10.03	10.23	10.29	10.37	10.44	10.50	10.55	6%	0.36%
GDP (billion 2000 US$, PPP)	141.37	153.84	187.94	191.73	193.19	191.03	193.30	194.07	37%	2.13%
Road passenger km (million pkm)	50800	74490	94204	95009	95580	96541	97809	97518	92%	4.44%
Road freight tonne km (million tkm)	12510	13138	17135	19312	17833	16713	19727	19847	59%	3.12%
Road pkm/capita	5080	7427	9209	9233	9217	9247	9315	9243	82%	4.07%
Road freight tkm/$ of GDP)	0.09	0.09	0.09	0.10	0.09	0.09	0.10	0.10	16%	0.97%
Motorisation (Cars/1000 inhabitants)	255	374	514	538	558	574	..	..	..	..
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	43.08	51.84	63.86	62.80	66.75	62.70	64.54	67.05	56%	2.99%
IEA transport CO2 (Mt CO2)*	13.32	16.33	22.03	21.56	22.15	23.54	24.40	23.38	76%	3.82%
Transport as a percentage of total	*30.9%*	*31.5%*	*34.5%*	*34.3%*	*33.2%*	*37.5%*	*37.8%*	*34.9%*		
Road	9.20	12.47	17.09	17.35	17.86	18.93	19.48	18.59	102%	4.80%
Rail	0.17	0.17	0.18	0.13	0.11	0.10	0.09	0.08	-53%	-4.90%
Domestic Aviation	0.25	0.37	0.69	0.52	0.45	0.46	0.46	0.51	104%	4.87%
International Aviation	1.54	1.55	1.75	1.81	1.83	1.94	2.13	2.21	44%	2.44%
Domestic Navigation	0.14	0.15	0.14	0.16	0.28	0.20	0.08	0.08	-43%	-3.66%
International Maritime	1.93	1.53	2.10	1.50	1.53	1.83	2.08	1.83	-5%	-0.35%
Other Transport	0.09	0.09	0.08	0.09	0.09	0.08	0.08	0.08	-11%	-0.78%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	63.12	74.59	86.31	87.29	91.97	86.88	88.91	90.22	43%	2.41%
UNFCCC Transport GHG (Mt CO2 eq.)*	13.24	16.92	23.46	23.55	24.13	24.07	24.33	24.64	86%	4.23%
Transport as a percentage of total	*21.0%*	*22.7%*	*27.2%*	*27.0%*	*26.2%*	*27.7%*	*27.4%*	*27.3%*		

*includes international aviation and shipping

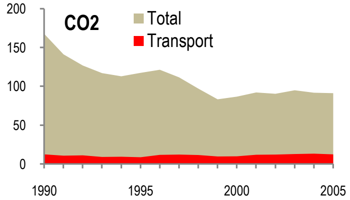
Romania

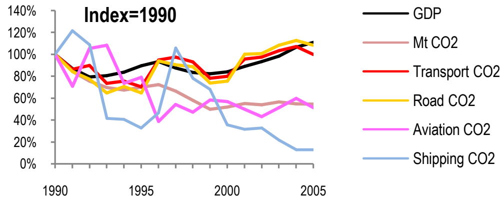
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

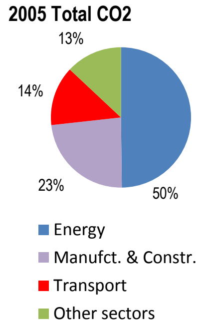
EU | N.Am | Asia-Pac | Other ITF

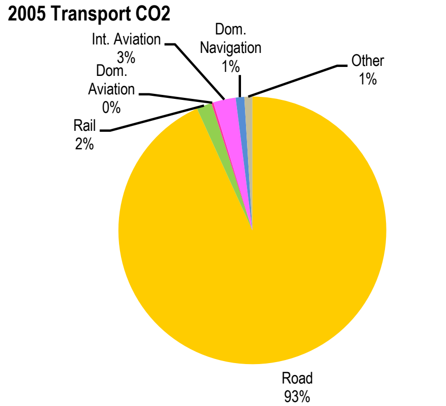
91.3Mt

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	46%	91.3	42%	4.2	51%	0.52
Transport CO2		12.53	7%	0.58	10%	0.07
Road CO2	8%	11.68	16%	0.54	2%	0.07
Aviation CO2	49%	0.37	45%	0.02	54%	0.00
Shipping CO2	87%	0.13	86%	0.01	88%	0.00









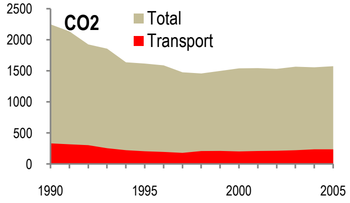
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	23.21	22.68	22.44	22.13	21.80	21.74	21.69	21.63	-7%	-0.47%
GDP (billion 2000 US$, PPP)	156.98	140.97	132.23	139.76	146.89	154.53	167.51	174.38	11%	0.70%
Road passenger km (million pkm)	24007	12343	7700	7073	5282	9443	9438	11812	-51%	-4.62%
Road freight tonne km (million tkm)	69613	37408	31887	33121	33894	35690	39266	43337	-38%	-3.11%
Road pkm/capita	1034	544	343	320	242	434	435	546	-47%	-4.17%
Road freight tkm/$ of GDP)	0.44	0.27	0.24	0.24	0.23	0.23	0.23	0.25	-44%	-3.79%
Motorisation (Cars/1000 inhabitants)	56	97	124	130	136	142	149	156	179%	7.09%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	167.62	117.50	86.86	92.23	90.51	95.05	91.91	91.30	-46%	-3.97%
IEA transport CO2 (Mt CO2)*	12.53	8.82	10.02	12.02	12.24	12.95	13.43	12.53	0%	0.00%
Transport as a percentage of total	*7.5%*	*7.5%*	*11.5%*	*13.0%*	*13.5%*	*13.6%*	*14.6%*	*13.7%*		
Road	10.77	6.99	8.16	10.78	10.85	11.68	12.15	11.68	8%	0.54%
Rail	0.03	0.89	0.92	0.46	0.61	0.54	0.62	0.23	667%	14.54%
Domestic Aviation	0.00	0.01	0.02	0.01	0.01	0.01	0.01	0.03	..	..
International Aviation	0.72	0.56	0.39	0.35	0.30	0.36	0.42	0.34	-53%	-4.88%
Domestic Navigation	1.01	0.33	0.36	0.32	0.33	0.22	0.13	0.13	-87%	-12.77%
International Maritime	..	..	..	..	..	..	..	..	..	..
Other Transport	0.00	0.04	0.17	0.10	0.14	0.14	0.10	0.12	..	..
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	248.73	186.97	138.58	143.00	150.57	157.51	160.06	153.65	-38%	-3.16%
UNFCCC Transport GHG (Mt CO2 eq.)*	8.73	8.65	9.69	11.27	12.18	12.27	14.69	12.05	38%	2.17%
Transport as a percentage of total	*3.5%*	*4.6%*	*7.0%*	*7.9%*	*8.1%*	*7.8%*	*9.2%*	*7.8%*		

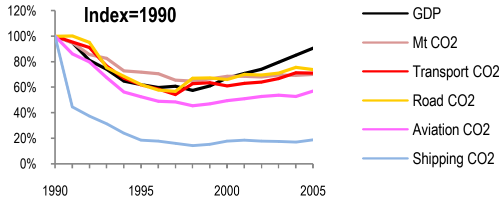
*includes international aviation and shipping

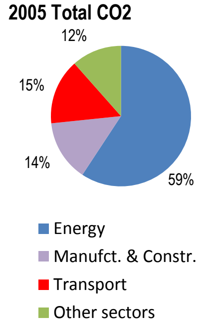
Russia

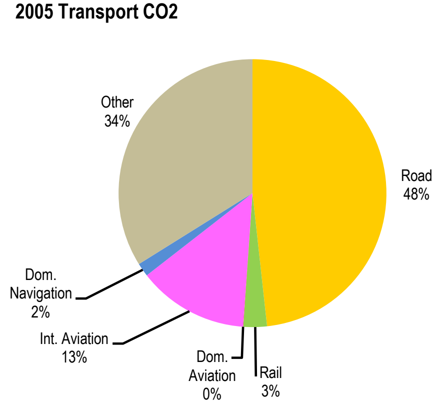
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO_2	30%	1575.44	27%	10.79	22%	1.12
Transport CO_2	29%	237.65	26%	1.66	21%	0.17
Road CO_2	26%	114.69	23%	0.80	18%	0.08
Aviation CO_2	43%	31.79	41%	0.22	37%	0.02
Shipping CO_2	81%	3.89	80%	0.03	79%	0.00







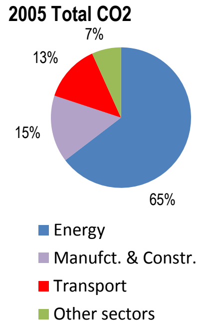


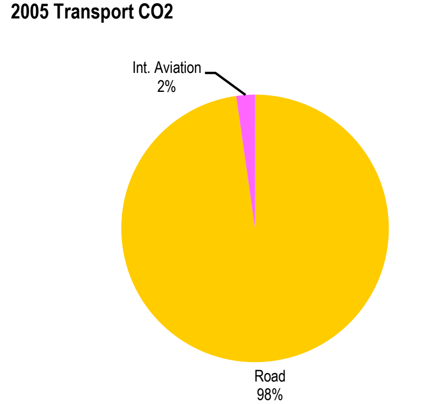
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	148.29	148.14	146.30	145.95	145.30	144.60	143.85	143.11	-3%	-0.24%
GDP (billion 2000 US$, PPP)	1522.99	946.06	1024.98	1077.18	1128.27	1211.18	1297.70	1380.75	-9%	-0.65%
Road passenger km (million pkm)	262152	188246	164369	154861	149914	138454	129436	96284	-63%	-6.46%
Road freight tonne km (million tkm)	4276002	2129557	2341894	2473485	2657937	2925424	3192426	3294068	-23%	-1.72%
Road pkm/capita	1768	1271	1124	1061	1032	957	900	673	-62%	-6.24%
Road freight tkm/$ of GDP)	2.81	2.25	2.28	2.30	2.36	2.42	2.46	2.39	-15%	-1.08%
Motorisation (Cars/1000 inhabitants)	60	96	138	145	154	161	167	178	194%	7.46%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	2249.21	1617.90	1540.97	1544.67	1532.45	1567.71	1558.07	1575.44	-30%	-2.35%
IEA transport CO2 (Mt CO2)*	333.69	206.25	203.76	210.68	214.19	223.35	237.72	237.65	-29%	-2.24%
Transport as a percentage of total	*14.8%*	*12.7%*	*13.2%*	*13.6%*	*14.0%*	*14.2%*	*15.3%*	*15.1%*		
Road	155.07	96.30	102.43	108.70	107.96	110.31	117.22	114.69	-26%	-1.99%
Rail	19.01	6.79	6.57	5.55	6.20	5.80	6.51	6.76	-64%	-6.66%
Domestic Aviation	1.06	0.25	0.10	0.11	0.11	0.11	0.11	0.11	-90%	-14.02%
International Aviation	54.68	29.00	27.51	28.30	29.36	29.84	29.30	31.68	-42%	-3.57%
Domestic Navigation	14.59	3.80	3.65	3.84	3.69	3.61	3.49	3.89	-73%	-8.44%
International Maritime	5.97	..	..	..	..	..	..	..	..	..
Other Transport	83.31	70.11	63.50	64.18	66.87	73.68	81.09	80.52	-3%	-0.23%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	2993.40	2112.19	2008.31	2023.51	2016.67	2084.44	2105.83	2151.21	-28%	-2.18%
UNFCCC Transport GHG (Mt CO2 eq.)*	335.46	202.21	199.58	206.39	209.95	218.97	233.77	203.24	-39%	-3.29%
Transport as a percentage of total	*11.2%*	*9.6%*	*9.9%*	*10.2%*	*10.4%*	*10.5%*	*11.1%*	*9.4%*		

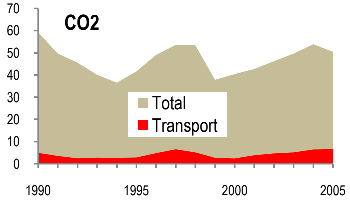
*includes international aviation and shipping

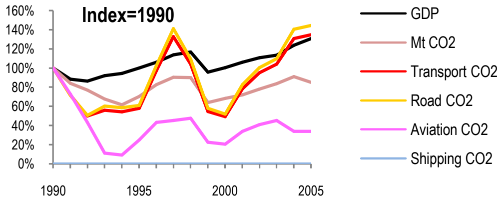
Serbia-Montenegro

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	15%	50.52	12%	6.25	35%	2.15
Transport CO2	35%	6.66	76%	0.83	3%	0.28
Road CO2	45%	6.51	89%	0.81	10%	0.28
Aviation CO2	66%	0.15	55%	0.02	74%	0.01
Shipping CO2		0		0.00		0.00









Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	10.53	10.55	8.14	8.12	8.12	8.10	8.09	8.06	-23%	-1.77%
GDP (billion 2000 US$, PPP)	17.86	17.91	17.96	18.96	19.77	20.25	22.13	23.39	31%	1.81%
Road passenger km (million pkm)	23264	12896	3056	4257	4086	3865	3676	4820	-79%	-9.96%
Road freight tonne km (million tkm)	19102	6299	3581	3784	4232	4313	4997	6242	-67%	-7.19%
Road pkm/capita	2209	1222	375	524	503	477	454	598	-73%	-8.34%
Road freight tkm/$ of GDP)	1.07	0.35	0.20	0.20	0.21	0.21	0.23	0.27	-75%	-8.84%
Motorisation (Cars/1000 inhabitants)	133	..	171	182	178	185	192	..	..	..
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	59.26	41.65	40.47	42.78	46.25	49.70	53.90	50.52	-15%	-1.06%
IEA transport CO2 (Mt CO2)*	4.94	2.86	2.43	3.87	4.70	5.15	6.47	6.66	35%	2.01%
Transport as a percentage of total	*8.3%*	*6.9%*	*6.0%*	*9.0%*	*10.2%*	*10.4%*	*12.0%*	*13.2%*		
Road	4.50	2.75	2.34	3.72	4.52	4.95	6.32	6.51	45%	2.49%
Rail	..	..	..	..	..	..	..	..	..	..
Domestic Aviation	..	..	..	..	..	..	..	..	..	..
International Aviation	0.44	0.11	0.09	0.15	0.18	0.20	0.15	0.15	-66%	-6.92%
Domestic Navigation	..	..	..	..	..	..	..	..	..	..
International Maritime	..	..	..	..	..	..	..	..	..	..
Other Transport	..	..	..	..	..	..	..	..	..	..
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
UNFCCC Transport GHG (Mt CO2 eq.)*	..	..	..	..	..	..	..	..	..	..
Transport as a percentage of total	..	..	..	..	..	..	..	..		

*includes international aviation and shipping

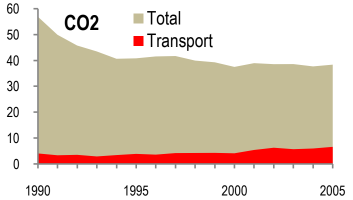
Slovak Republic

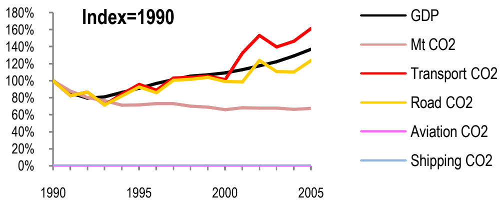
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

EU | N.Am | Asia-Pac | Other ITF

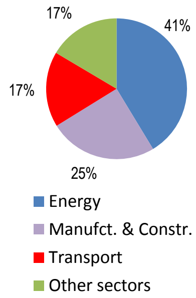
38.4Mt

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	33%	38.42	34%	7.11	51%	0.52
Transport CO2	62%	6.66	59%	1.24	18%	0.09
Road CO2	24%	5.1	22%	0.95	10%	0.07
Aviation CO2		0.16		0.03		0.00
Shipping CO2		0		0.00		0.00

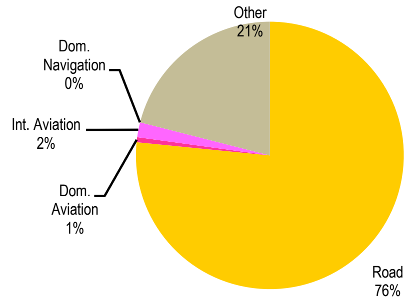




2005 Total CO2



2005 Transport CO2



Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	5.30	5.36	5.40	5.40	5.38	5.38	5.38	5.39	2%	0.11%
GDP (billion 2000 US$, PPP)	53.56	48.89	58.58	60.47	62.96	65.57	69.13	73.36	37%	2.12%
Road passenger km (million pkm)	0	29168	32364	32309	33214	32981	32214	33349	..	..
Road freight tonne km (million tkm)	0	41678	26958	25743	25906	27520	28940	32693	..	..
Road pkm/capita	0	5442	5993	5983	6174	6130	5988	6187	..	..
Road freight tkm/$ of GDP)	0.00	0.85	0.46	0.43	0.41	0.42	0.42	0.45	..	..
Motorisation (Cars/1000 inhabitants)	165	190	236	239	247	252	222	242	46%	2.58%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	56.96	40.86	37.54	39.00	38.61	38.64	37.74	38.42	-33%	-2.59%
IEA transport CO2 (Mt CO2)*	4.12	3.94	4.17	5.46	6.32	5.76	6.03	6.66	62%	3.25%
Transport as a percentage of total	*7.2%*	*9.6%*	*11.1%*	*14.0%*	*16.4%*	*14.9%*	*16.0%*	*17.3%*		
Road	4.12	3.82	4.09	4.07	5.11	4.57	4.55	5.10	24%	1.43%
Rail	..	..	..	..	..	..	..	..	..	..
Domestic Aviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	..	..
International Aviation	..	0.12	0.08	0.09	0.14	0.10	0.08	0.12	..	..
Domestic Navigation	..	..	..	..	..	..	..	..	..	..
International Maritime	..	..	..	..	..	..	..	..	..	..
Other Transport	0.00	0.00	0.00	1.30	1.07	1.09	1.40	1.40	..	..
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	72.18	52.66	47.49	50.72	48.82	49.17	48.68	47.96	-34%	-2.69%
UNFCCC Transport GHG (Mt CO2 eq.)*	5.16	4.49	4.38	5.00	5.14	5.26	5.55	6.52	26%	1.57%
Transport as a percentage of total	*7.1%*	*8.5%*	*9.2%*	*9.9%*	*10.5%*	*10.7%*	*11.4%*	*13.6%*		

*includes international aviation and shipping

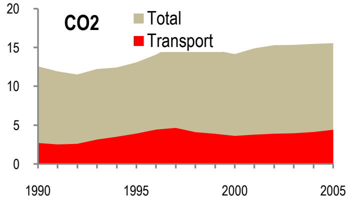
Slovenia

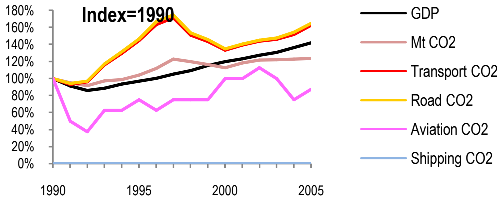
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

EU | N.Am | Asia-Pac | Other ITF

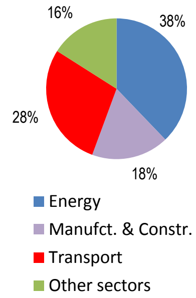
15.6Mt

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	24%	15.57	24%	7.75	13%	0.39
Transport CO2	63%	4.42	63%	2.21	14%	0.11
Road CO2	65%	4.3	65%	2.15	16%	0.11
Aviation CO2	13%	0.07	13%	0.04	38%	0.00
Shipping CO2		0		0.00		0.00

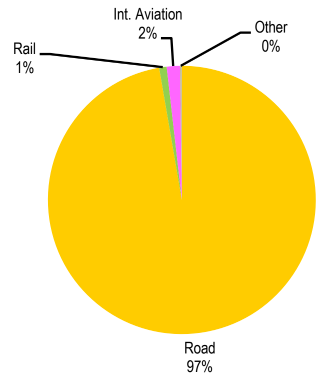




2005 Total CO2



2005 Transport CO2



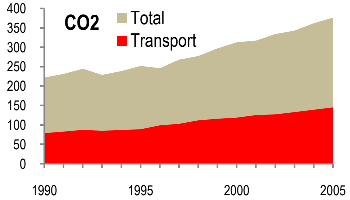
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	2.00	1.99	1.99	1.99	1.99	2.00	2.00	2.00	0%	0.00%
GDP (billion 2000 US$, PPP)	27.92	27.00	33.47	34.36	35.55	36.49	38.11	39.64	42%	2.36%
Road passenger km (million pkm)	19828	20451	23827	24194	24626	24777	25260	25570	29%	1.71%
Road freight tonne km (million tkm)	9096	4778	4794	4764	5023	5269	5416	5606	-38%	-3.18%
Road pkm/capita	9914	10277	11973	12158	12375	12389	12630	12785	29%	1.71%
Road freight tkm/$ of GDP)	0.33	0.18	0.14	0.14	0.14	0.14	0.14	0.14	-57%	-5.41%
Motorisation (Cars/1000 inhabitants)	294	357	436	444	451	457	468	486	65%	3.41%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	12.59	13.10	14.17	14.91	15.31	15.35	15.48	15.57	24%	1.43%
IEA transport CO2 (Mt CO2)*	2.72	3.93	3.63	3.79	3.91	3.97	4.13	4.42	63%	3.29%
Transport as a percentage of total	*21.6%*	*30.0%*	*25.6%*	*25.4%*	*25.5%*	*25.9%*	*26.7%*	*28.4%*		
Road	2.61	3.82	3.52	3.67	3.78	3.85	4.03	4.30	65%	3.38%
Rail	0.03	0.05	0.03	0.03	0.04	0.04	0.04	0.04	33%	1.94%
Domestic Aviation	..	..	..	..	..	..	..	..	..	..
International Aviation	0.08	0.06	0.08	0.08	0.09	0.08	0.06	0.07	-13%	-0.89%
Domestic Navigation	..	..	..	..	..	..	..	..	..	..
International Maritime	..	..	..	..	..	..	..	..	..	..
Other Transport	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	..	....
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	18.62	18.65	18.88	19.80	20.01	19.74	20.04	20.46	10%	0.63%
UNFCCC Transport GHG (Mt CO2 eq.)*	2.79	3.77	3.86	4.02	4.05	4.19	4.32	4.61	65%	3.41%
Transport as a percentage of total	*15.0%*	*20.2%*	*20.5%*	*20.3%*	*20.2%*	*21.2%*	*21.6%*	*22.5%*		

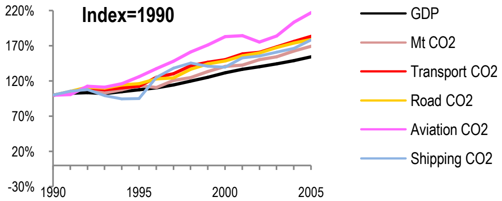
*includes international aviation and shipping

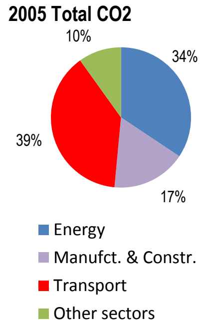
Spain

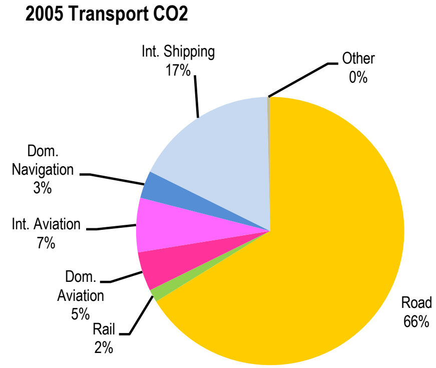
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	69%	376.43	48%	7.87	6%	0.34
Transport CO2	84%	145.36	65%	3.35	19%	0.15
Road CO2	79%	96.21	61%	2.22	16%	0.10
Aviation CO2	117%	16.39	95%	0.38	40%	0.02
Shipping CO2	79%	29.99	60%	0.69	16%	0.03









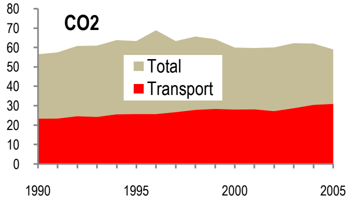
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	39.01	39.39	40.26	40.72	41.31	42.01	42.69	43.40	11%	0.71%
GDP (billion 2000 US$, PPP)	644.28	694.30	849.03	880.00	903.80	931.32	961.53	995.48	55%	2.94%
Road passenger km (million pkm)	207765	251189	330263	336520	362576	371137	383650	390973	88%	4.30%
Road freight tonne km (million tkm)	106358	118180	168350	181126	199569	206866	235014	245532	131%	5.74%
Road pkm/capita	5326	6377	8203	8264	8777	8834	8987	9009	69%	3.57%
Road freight tkm/$ of GDP)	0.17	0.17	0.20	0.21	0.22	0.22	0.24	0.25	49%	2.71%
Motorisation (Cars/1000 inhabitants)	308	361	433	446	453	445	458	467	52%	2.82%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	222.36	252.14	313.05	317.48	334.23	343.12	362.09	376.43	69%	3.57%
IEA transport CO2 (Mt CO2)*	79.09	89.04	118.98	125.55	127.39	133.19	139.29	145.36	84%	4.14%
Transport as a percentage of total	*35.6%*	*35.3%*	*38.0%*	*39.5%*	*38.1%*	*38.8%*	*38.5%*	*38.6%*		
Road	53.69	62.35	79.72	83.77	85.86	89.93	93.37	96.21	79%	3.97%
Rail	0.67	0.91	1.54	1.64	1.61	1.79	2.04	2.22	231%	8.31%
Domestic Aviation	4.11	3.30	5.48	5.45	5.08	5.32	5.89	6.87	67%	3.48%
International Aviation	3.44	6.23	8.33	8.48	8.16	8.56	9.49	9.52	177%	7.02%
Domestic Navigation	5.24	5.91	4.35	4.33	4.36	4.87	5.03	4.83	-8%	-0.54%
International Maritime	11.56	10.08	19.10	21.38	21.82	22.23	22.93	25.16	118%	5.32%
Other Transport	0.38	0.26	0.46	0.50	0.50	0.49	0.54	0.55	45%	2.50%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	302.46	334.80	412.01	414.85	432.40	440.55	457.92	475.63	57%	3.06%
UNFCCC Transport GHG (Mt CO2 eq.)*	72.63	83.45	114.60	121.32	123.69	129.10	134.88	140.31	93%	4.49%
Transport as a percentage of total	*24.0%*	*24.9%*	*27.8%*	*29.2%*	*28.6%*	*29.3%*	*29.5%*	*29.5%*		

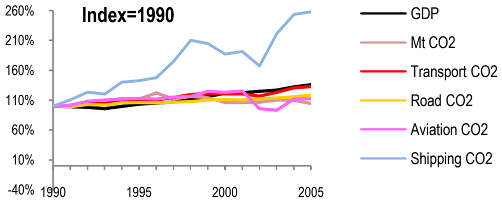
*includes international aviation and shipping

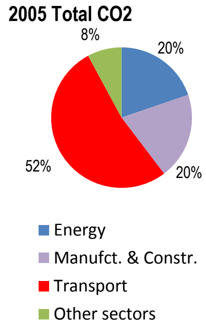
Sweden

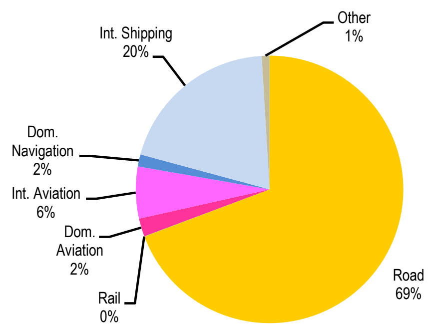
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	4%	59.04	9%	5.64	30%	0.19
Transport CO2	33%	30.97	26%	3.43	3%	0.11
Road CO2	18%	21.45	12%	2.38	13%	0.08
Aviation CO2	12%	2.62	7%	0.29	17%	0.01
Shipping CO2	158%	6.6	144%	0.73	89%	0.02









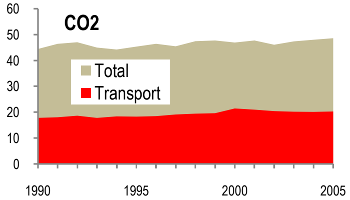
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	8.56	8.83	8.87	8.90	8.93	8.96	8.99	9.03	5%	0.36%
GDP (billion 2000 US$, PPP)	198.91	205.72	241.19	243.76	248.63	252.84	263.27	270.92	36%	2.08%
Road passenger km (million pkm)	95600	97300	101400	102000	104700	105400	105900	106100	11%	0.70%
Road freight tonne km (million tkm)	36091	38684	43775	42471	44208	44289	45860	48806	35%	2.03%
Road pkm/capita	11168	11019	11432	11461	11725	11763	11780	11750	5%	0.34%
Road freight tkm/$ of GDP)	0.18	0.19	0.18	0.17	0.18	0.18	0.17	0.18	-1%	-0.05%
Motorisation (Cars/1000 inhabitants)	421	411	451	452	453	455	458	460	9%	0.60%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	56.57	63.37	60.03	59.79	60.10	62.29	62.08	59.04	4%	0.29%
IEA transport CO2 (Mt CO2)*	23.36	25.74	28.09	28.18	27.25	28.76	30.48	30.97	33%	1.90%
Transport as a percentage of total	*41.3%*	*40.6%*	*46.8%*	*47.1%*	*45.3%*	*46.2%*	*49.1%*	*52.5%*		
Road	18.14	19.25	20.09	20.00	20.35	20.59	21.00	21.45	18%	1.12%
Rail	0.12	0.12	0.08	0.08	0.09	0.08	0.07	0.01	-92%	-15.27%
Domestic Aviation	1.22	0.81	0.73	0.74	0.62	0.60	0.68	0.68	-44%	-3.82%
International Aviation	1.11	1.82	2.14	2.18	1.61	1.57	1.92	1.94	75%	3.79%
Domestic Navigation	0.45	0.33	0.49	0.49	0.46	0.55	0.47	0.45	0%	0.00%
International Maritime	2.11	3.32	4.31	4.41	3.82	5.12	6.02	6.15	191%	7.39%
Other Transport	0.21	0.09	0.25	0.28	0.30	0.25	0.32	0.29	38%	2.18%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	75.81	78.76	75.11	75.60	75.76	77.92	78.09	75.66	0%	-0.01%
UNFCCC Transport GHG (Mt CO2 eq.)*	22.06	23.85	25.82	25.77	25.40	27.03	28.45	28.98	31%	1.84%
Transport as a percentage of total	*29.1%*	*30.3%*	*34.4%*	*34.1%*	*33.5%*	*34.7%*	*36.4%*	*38.3%*		

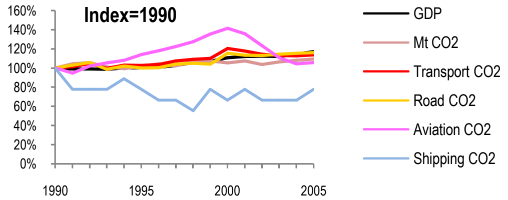
*includes international aviation and shipping

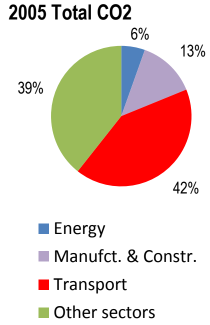
Switzerland

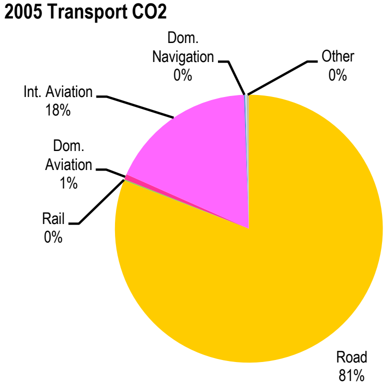
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	9%	48.63	1%	6	10%	0.19
Transport CO2	14%	20.33	3%	2.71	3%	0.09
Road CO2	16%	16.44	5%	2.19	1%	0.07
Aviation CO2	6%	3.74	4%	0.50	10%	0.02
Shipping CO2	22%	0.07	29%	0.01	34%	0.00









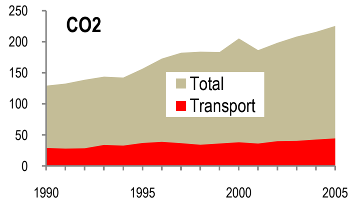
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	6.80	7.08	7.21	7.29	7.34	7.41	7.45	7.50	10%	0.66%
GDP (billion 2000 US$, PPP)	197.30	198.10	218.97	221.25	221.92	221.55	226.63	231.00	17%	1.06%
Road passenger km (million pkm)	78878	81061	85815	87316	89233	90734	92580	93648	19%	1.15%
Road freight tonne km (million tkm)	21213	24522	33075	33040	32543	32201	34248	36237	71%	3.63%
Road pkm/capita	11600	11449	11902	11978	12157	12245	12427	12486	8%	0.49%
Road freight tkm/$ of GDP)	0.11	0.12	0.15	0.15	0.15	0.15	0.15	0.16	46%	2.55%
Motorisation (Cars/1000 inhabitants)	439	456	492	498	504	507	512	515	17%	1.07%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	44.47	45.39	46.96	47.75	46.11	47.40	48.03	48.63	9%	0.60%
IEA transport CO2 (Mt CO2)*	17.85	18.34	21.49	21.03	20.46	20.23	20.16	20.33	14%	0.87%
Transport as a percentage of total	*40.1%*	*40.4%*	*45.8%*	*44.0%*	*44.4%*	*42.7%*	*42.0%*	*41.8%*		
Road	14.14	14.15	16.34	16.07	15.98	16.17	16.33	16.44	16%	1.01%
Rail	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0%	0.00%
Domestic Aviation	0.42	0.27	0.26	0.21	0.29	0.21	0.16	0.13	-69%	-7.52%
International Aviation	3.11	3.76	4.74	4.59	4.07	3.70	3.53	3.61	16%	1.00%
Domestic Navigation	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0%	0.00%
International Maritime	0.06	0.05	0.03	0.04	0.03	0.03	0.03	0.04	-33%	-2.67%
Other Transport	0.06	0.06	0.06	0.06	0.03	0.06	0.05	0.05	-17%	-1.21%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	55.85	54.74	56.42	56.99	55.68	56.26	56.50	57.16	2%	0.16%
UNFCCC Transport GHG (Mt CO2 eq.)*	17.70	17.84	20.48	19.91	19.44	19.19	19.08	19.21	9%	0.55%
Transport as a percentage of total	*31.7%*	*32.6%*	*36.3%*	*34.9%*	*34.9%*	*34.1%*	*33.8%*	*33.6%*		

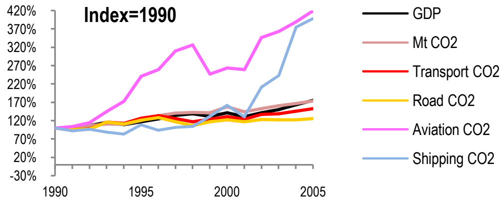
*includes international aviation and shipping

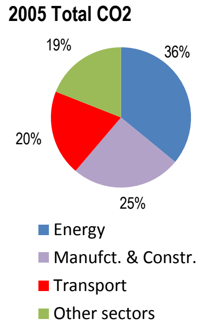
Turkey

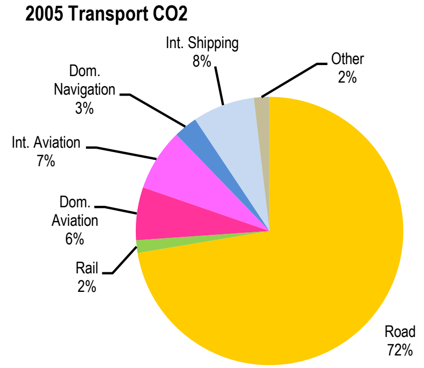
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	74%	225.6	33%	3.04	3%	0.39
Transport CO2	53%	44.56	19%	0.62	13%	0.08
Road CO2	26%	32.25	2%	0.45	28%	0.06
Aviation CO2	320%	6.17	227%	0.09	139%	0.01
Shipping CO2	298%	4.62	211%	0.06	127%	0.01









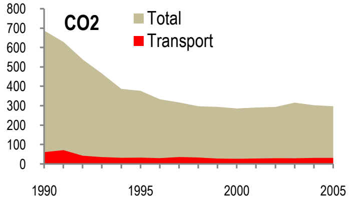
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	56.20	61.64	67.46	68.62	69.63	70.71	71.79	72.07	28%	1.67%
GDP (billion 2000 US$, PPP)	323.42	378.79	459.67	425.22	458.99	485.58	528.95	567.99	76%	3.83%
Road passenger km (million pkm)	..	..	..	..	..	..	..	..	..	..
Road freight tonne km (million tkm)	136153	124128	224581	202500	182826	171441	168587	178270	31%	1.81%
Road pkm/capita	..	..	..	..	..	..	..	..	..	..
Road freight tkm/$ of GDP)	0.42	0.33	0.49	0.48	0.40	0.35	0.32	0.31	-25%	-1.94%
Motorisation (Cars/1000 inhabitants)	29	50	66	66	66	66	75	80	173%	6.92%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	129.53	156.82	205.47	186.60	198.52	208.53	216.01	225.60	74%	3.77%
IEA transport CO2 (Mt CO2)*	29.18	37.16	38.34	36.25	40.11	40.55	42.70	44.56	53%	2.86%
Transport as a percentage of total	*22.5%*	*23.7%*	*18.7%*	*19.4%*	*20.2%*	*19.4%*	*19.8%*	*19.8%*		
Road	25.62	31.23	31.45	30.00	31.53	31.32	31.33	32.25	26%	1.55%
Rail	0.73	0.78	0.64	0.52	0.52	0.56	0.56	0.68	-7%	-0.47%
Domestic Aviation	0.92	2.73	2.28	2.22	2.44	2.58	2.74	2.84	209%	7.80%
International Aviation	0.55	0.81	1.60	1.59	2.65	2.76	2.98	3.33	505%	12.76%
Domestic Navigation	0.78	0.69	0.61	0.78	0.79	0.87	1.21	1.28	64%	3.36%
International Maritime	0.38	0.58	1.27	0.74	1.67	1.95	3.14	3.34	779%	15.59%
Other Transport	0.20	0.34	0.49	0.40	0.51	0.51	0.74	0.84	320%	10.04%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	170.19	220.86	278.92	260.96	268.85	284.14	293.81	..	..	..
UNFCCC Transport GHG (Mt CO2 eq.)*	26.29	33.28	35.52	35.59	36.63	38.41	41.23	..	..	..
Transport as a percentage of total	*15.4%*	*15.1%*	*12.7%*	*13.6%*	*13.6%*	*13.5%*	*14.0%*	..		

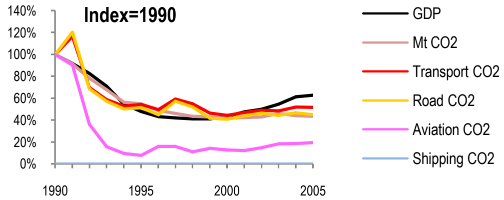
*includes international aviation and shipping

Ukraine

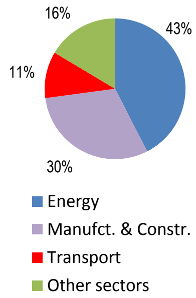
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	57%	297.97	52%	6.31	31%	1.03
Transport CO2	48%	31.88	43%	0.68	18%	0.11
Road CO2	55%	21.54	50%	0.46	28%	0.08
Aviation CO2	80%	1.24	78%	0.03	69%	0.00
Shipping CO2		0.41		0.01		0.00

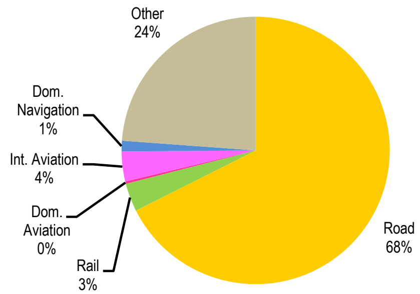




2005 Total CO2



2005 Transport CO2



Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	51.89	51.51	49.18	48.68	48.20	47.81	47.44	47.08	-9%	-0.65%
GDP (billion 2000 US$, PPP)	456.71	219.22	198.43	216.68	227.95	249.38	279.55	286.82	-37%	-3.05%
Road passenger km (million pkm)	90323	34789	28829	30959	79710	40131	47300	0	-100%	-99.99%
Road freight tonne km (million tkm)	722934	384229	382611	384112	399446	444195	478340	478025	-34%	-2.72%
Road pkm/capita	1741	675	586	636	1654	839	997	0	-100%	-99.99%
Road freight tkm/$ of GDP)	1.58	1.75	1.93	1.77	1.75	1.78	1.71	1.67	5%	0.34%
Motorisation (Cars/1000 inhabitants)	65	89	107	109	112	116	115	118	82%	4.06%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	687.22	377.31	286.59	291.31	294.37	316.31	303.34	297.97	-57%	-5.42%
IEA transport CO2 (Mt CO2)*	61.58	33.41	27.35	28.86	30.27	29.92	31.91	31.88	-48%	-4.29%
Transport as a percentage of total	*9.0%*	*8.9%*	*9.5%*	*9.9%*	*10.3%*	*9.5%*	*10.5%*	*10.7%*		
Road	47.79	24.59	19.47	20.85	22.18	21.14	22.34	21.54	-55%	-5.17%
Rail	2.46	1.14	0.78	0.73	0.81	0.87	1.17	1.09	-56%	-5.28%
Domestic Aviation	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.09	..	..
International Aviation	6.34	0.49	0.80	0.77	0.92	1.14	1.16	1.15	-82%	-10.76%
Domestic Navigation	..	..	..	..	..	..	..	0.41	..	..
International Maritime	..	..	..	..	..	..	..	..	..	..
Other Transport	4.99	7.18	6.29	6.50	6.34	6.75	7.22	7.60	52%	2.84%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	930.12	522.88	395.63	395.31	401.07	416.32	414.62	420.20	-55%	-5.16%
UNFCCC Transport GHG (Mt CO2 eq.)*	93.43	0.00	34.36	34.82	36.25	37.50	38.70	37.77	-60%	-5.86%
Transport as a percentage of total	*10.0%*	*0.0%*	*8.7%*	*8.8%*	*9.0%*	*9.0%*	*9.3%*	*9.0%*		

*includes international aviation and shipping

United Kingdom

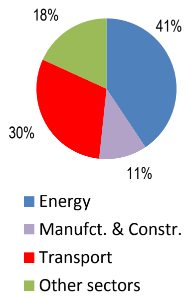
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

EU | N.Am | Asia-Pac | Other ITF

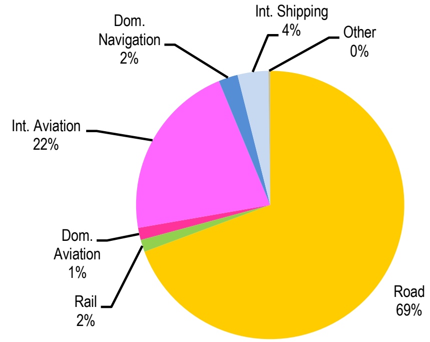
573.4Mt

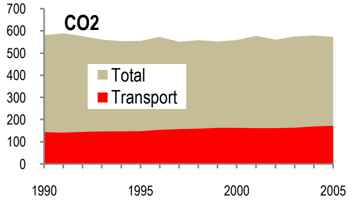
Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	2005
CO2	1%	573.38	10%	8.8	34%	0.31
Transport CO2	20%	172.6	14%	2.87	16%	0.10
Road CO2	10%	119.68	5%	1.99	23%	0.07
Aviation CO2	90%	39.6	80%	0.66	32%	0.02
Shipping CO2	13%	10.43	17%	0.17	39%	0.01

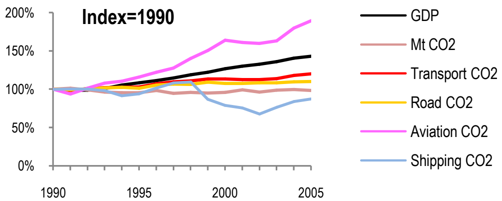
2005 Total CO2



2005 Transport CO2







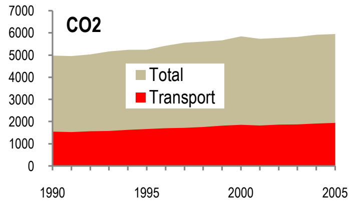
Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	57.24	58.03	58.89	59.11	59.32	59.55	59.84	60.22	5%	0.34%
GDP (billion 2000 US$, PPP)	1186.08	1287.66	1506.76	1542.21	1573.96	1615.92	1668.64	1699.55	43%	2.43%
Road passenger km (million pkm)	633590	661200	685600	700540	723600	724300	725900	723434	14%	0.89%
Road freight tonne km (million tkm)	159269	171313	183438	183292	183862	186594	187049	192957	21%	1.29%
Road pkm/capita	11069	11394	11642	11851	12198	12163	12131	12013	9%	0.55%
Road freight tkm/$ of GDP)	0.13	0.13	0.12	0.12	0.12	0.12	0.11	0.11	-15%	-1.11%
Motorisation (Cars/1000 inhabitants)	375	378	426	437	447	453	465	470	25%	1.52%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	581.25	555.39	558.77	578.22	560.92	575.00	579.39	573.38	-1%	-0.09%
IEA transport CO2 (Mt CO2)*	143.84	148.17	163.37	162.16	162.19	163.93	169.69	172.60	20%	1.22%
Transport as a percentage of total	*24.7%*	*26.7%*	*29.2%*	*28.0%*	*28.9%*	*28.5%*	*29.3%*	*30.1%*		
Road	108.57	110.23	116.92	116.66	117.99	117.80	119.04	119.68	10%	0.65%
Rail	1.96	1.92	2.31	2.40	2.39	2.41	2.53	2.53	29%	1.72%
Domestic Aviation	5.18	4.09	3.96	4.13	4.35	4.38	4.67	2.52	-51%	-4.69%
International Aviation	15.70	20.17	30.32	29.55	29.00	29.73	32.91	37.08	136%	5.90%
Domestic Navigation	4.00	3.53	2.90	2.04	2.05	3.60	3.50	4.02	0%	0.03%
International Maritime	7.92	7.70	6.51	6.96	6.00	5.52	6.52	6.41	-19%	-1.40%
Other Transport	0.51	0.53	0.45	0.42	0.41	0.49	0.52	0.36	-29%	-2.30%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	793.99	737.23	710.29	713.27	691.53	697.80	699.80	698.66	-12%	-0.85%
UNFCCC Transport GHG (Mt CO2 eq.)*	141.31	147.91	164.47	164.29	164.93	166.98	172.87	176.13	25%	1.48%
Transport as a percentage of total	*17.8%*	*20.1%*	*23.2%*	*23.0%*	*23.9%*	*23.9%*	*24.7%*	*25.2%*		

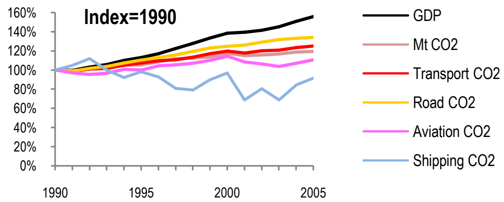
*includes international aviation and shipping

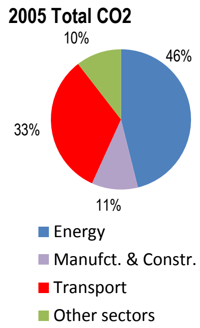
United States

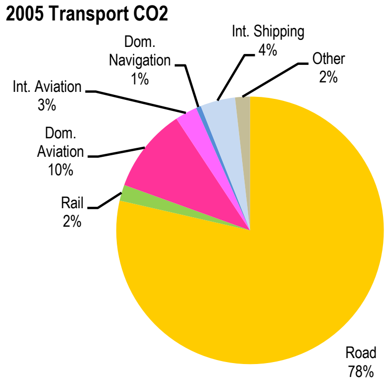
Total CO2 from Fuel Combustion including International Air and Maritime (2005)

Change 1990-2005*	Mt	2005	T per capita	2005	Kg/$2000 PPP	5951.1Mt 2005
CO2	19%	5951.13	1%	19.61	23%	0.53
Transport CO2	25%	1947.5	6%	6.56	20%	0.18
Road CO2	34%	1530.3	13%	5.16	14%	0.14
Aviation CO2	11%	250.89	6%	0.85	29%	0.02
Shipping CO2	8%	93.67	23%	0.32	41%	0.01









Transport and the Economy	1990	1995	2000	2001	2002	2003	2004	2005	1990-2005	% per year
Population (millions)	250.18	266.59	282.43	285.37	288.25	291.11	293.93	296.68	19%	1.14%
GDP (billion 2000 US$, PPP)	7055.00	7972.80	9764.80	9838.90	9997.60	10249.80	10651.70	10995.80	56%	3.00%
Road passenger km (million pkm)	3866922	3899426	4353881	4355726	4450661	4483127	4564468	4523955	17%	1.05%
Road freight tonne km (million tkm)	4072935	4757300	5283199	5377719	5446358	5455479	5620498	5655157	39%	2.21%
Road pkm/capita	15457	14627	15416	15263	15440	15400	15529	15249	-1%	-0.09%
Road freight tkm/$ of GDP)	0.58	0.60	0.54	0.55	0.54	0.53	0.53	0.51	-11%	-0.77%
Motorisation (Cars/1000 inhabitants)	744	728	753	777	766	765	..	777	4%	0.29%
CO2 Emissions										
IEA CO2 from fuel combustion (Mt CO2)*	4980.29	5245.68	5846.95	5736.41	5776.48	5822.58	5919.10	5951.13	19%	1.19%
IEA transport CO2 (Mt CO2)*	1553.78	1670.99	1860.25	1829.21	1868.73	1878.51	1918.26	1947.50	25%	1.52%
Transport as a percentage of total	*31.2%*	*31.9%*	*31.8%*	*31.9%*	*32.4%*	*32.3%*	*32.4%*	*32.7%*		
Road	1141.46	1262.67	1427.04	1438.71	1474.18	1506.21	1520.53	1530.30	34%	1.97%
Rail	32.63	32.87	31.06	30.22	31.43	31.58	33.74	37.68	15%	0.96%
Domestic Aviation	187.47	180.31	201.69	193.94	190.06	185.47	192.41	198.83	6%	0.39%
International Aviation	38.78	45.95	57.10	51.73	50.67	49.50	50.38	52.06	34%	1.98%
Domestic Navigation	11.16	9.59	9.77	8.61	9.15	9.52	9.26	11.56	4%	0.24%
International Maritime	91.05	90.84	89.25	61.73	73.23	60.80	77.17	82.11	-10%	-0.69%
Other Transport	51.23	48.76	44.34	44.27	40.01	35.43	34.77	34.96	-32%	-2.52%
GHG Emissions										
UNFCCC GHG emissions (Mt CO2 eq.)*	6343.85	6662.57	7228.03	7113.13	7137.19	7173.75	7287.88	7339.66	16%	0.98%
UNFCCC Transport GHG (Mt CO2 eq.)*	1577.82	1717.04	1913.93	1880.06	1923.55	1911.46	1974.68	2003.78	27%	1.61%
Transport as a percentage of total	*24.9%*	*25.8%*	*26.5%*	*26.4%*	*27.0%*	*26.6%*	*27.1%*	*27.3%*		

*includes international aviation and shipping