



EU Transport GHG: Routes to 2050?

Potential for less transport-intensive paths to societal goals

Arno Schrotten (CE Delft)
Ian Skinner (TEPR)
Linda Brinke (CE Delft)
Huib van Essen (CE Delft)

20 November 2011 **Draft**

Partners



Transport and
Environmental
Policy
Research

TNO innovation
for life

This project is funded by the European Commission's Directorate-General Climate Action



Potential for less transport-intensive paths to societal goals

Arno Schrotten (CE Delft) Ian Skinner (TEPR)
Linda Brinke (CE Delft)

20 November 2011
Draft

Suggested citation: Arno Schrotten, Ian Skinner, Linda Brinke et al. (2011) *Potential for less transport-intensive paths to societal goals*. Task 4 paper produced as part of a contract between European Commission Directorate-General Climate Action and AEA Technology plc; see website www.eutransportghg2050.eu

This paper is the copyright of the European Commission and has been prepared under a contract between the European Commission and AEA Technology plc dated 16 December 2010 (contract 070307/2010/579469/SER/C2). This project work follows on from previous work under European Commission contract ENV.C.3/SER/2008/0053, which completed in June 2010. This paper has been prepared by one of the partners in the project, i.e. AEA Technology plc (lead), CE Delft, TNO or TEPR (as indicated above). The contents of this paper may not be reproduced in whole or in part, nor passed to any organisation or person without the specific prior written permission of the European Commission. AEA Technology plc and its partners accept no liability whatsoever to any third party for any loss or damage arising from any interpretation or use of the information contained in this paper, or reliance on any views expressed therein.

Contact details

Nikolas Hill

AEA
The Gemini Building, Fermi Avenue
Harwell, Didcot
OX11 0QR
United Kingdom

T +44 (0)870 190 6490
E EUTransportGHG2050@aeat.co.uk
E Nikolas.Hill@aeat.co.uk

Ian Hodgson

Transport and Ozone Unit
Climate Action Directorate General
European Commission
CLIMA.C.2 Brussels
Belgium

T +32 (0)2 298 6431
E Ian.Hodgson@ec.europa.eu

Project

www.eutransportghg2050.eu

Partners

www.aeat.co.uk
www.cedelft.nl
www.tno.nl
www.tepr.co.uk

Executive Summary

To be completed for final draft

DRAFT

Table of Contents

Executive Summary	iii
1 Introduction	1
1.1 Topic of this paper.....	1
1.2 The contribution of transport to GHG emissions.....	1
1.3 Background to the project and its objectives	4
1.4 Background and purpose of the paper	6
1.5 Structure of the paper	7
2 Decoupling of transport and GDP growth.....	9
2.1 Introduction	9
2.2 Defining decoupling.....	11
2.2.1 A decoupling indicator.....	11
2.2.2 Data and measurement issues.....	12
2.2.3 Rebound effects.....	13
2.3 Empirical evidence on decoupling in the EU.....	14
2.4 Possible drivers of decoupling freight transport.....	16
2.4.1 Identifying drivers of decoupling.....	16
2.4.2 Relative importance of different decoupling drivers	22
2.5 Possible drivers of decoupling passenger transport	24
2.5.1 Identifying possible causes	24
2.5.2 Relative importance of different decoupling drivers	29
2.6 Discussion on decoupling EU, US and Asia	29
2.6.1 Differences in passenger transport intensity.....	30
2.6.2 Differences in freight transport intensity	33
2.7 Policy implications.....	34
2.8 Conclusions on decoupling transport growth from GDP growth.....	36
3 Alternative welfare measures and their implications for transport	37
3.1 Introduction	37
3.2 Moving beyond GDP	38
3.2.1 Literature review	39
3.2.2 Potential implications for transport	44
3.3 A more fundamental transition to a sustainable economy.....	47
3.3.1 Literature review	48
3.3.2 Potential implications for transport	51

- 3.4 Conclusions53
- 4 Conclusions and policy recommendations 55**
- 4.1 Routes to less transport-intensive prosperity growth55
- 4.2 Policy implications.....56
- References 57**

DRAFT

List of Tables

Tables in the main body of the report

Table 2.1:	Estimated impact of the possible causes of decoupling in the UK	23
Table 2.2:	Average annual growth (percent) for the factors explaining growth in freight transport, 1981 to 1997	23
Table 2.3:	Maximum technical mitigation potential of passenger transport in the EU-27 ...	27
Table 2.4:	Modal split (percent) of freight transport in the EU, the USA and Japan (2003)	34
Table 3.1:	Main features of selected “alternative” indicators	42
Table 3.2:	Potential impact of using “alternative indicators” on transport	45

DRAFT

List of Figures

Figures in the main body of the report

Figure 1.1	EU27 greenhouse gas emissions by sector and mode of transport, 2007	2
Figure 1.2	Business as usual projected growth in transport's GHG emissions by mode...	3
Figure 1.3	EU overall emissions trajectories against transport emissions (indexed).....	4
Figure 2.1:	EU27 reference scenario for EC impact assessments	11
Figure 2.2	Decoupling of freight transport in Europe	14
Figure 2.3:	Decoupling of passenger transport in Europe	15
Figure 2.4:	Trends in air passenger transport demand and GDP	16
Figure 2.5:	Resource productivity in EU-27	18
Figure 2.6:	The cost advantage of US steel producers over China (2008)	21
Figure 2.7:	Travel time (hours pppy), distance (miles pppy) and journeys (pppy) in the UK	26
Figure 2.8:	Growth rates in GDP, total freight and passenger transport	30
Figure 2.9:	Total motorized travel activity in selected countries 1970-2006/2007	31
Figure 2.10:	Relationship between GDP per capita and motorised modal share.....	32
Figure 2.11:	Vehicle ownership and wealth in OECD regions (1970-2000)	32
Figure 2.12:	Road freight intensity and GDP per capita (1970-2000).....	34
Figure 3.1:	Approach taken.....	39

Glossary¹

BAU	Business as usual, i.e. the projected baseline of a trend assuming that there are no interventions to influence the trend.
BEV	Battery electric vehicle, also referred to as a pure electric vehicle, or simply a pure EV .
Biofuels	A range of liquid and gaseous fuels that can be used in transport, which are produced from biomass. These can be blended with conventional fossil fuels or potentially used instead of such fuels.
Biogas	A gaseous biofuel predominantly containing methane which can be used with or instead of conventional natural gas. Biogas used in transport is also referred to as biomethane to distinguish it from lower grade/unpurified biogas (e.g. from landfill) containing high proportions of CO₂ .
Biomethane	Biomethane is the term often used to refer to/distinguish biogas used in transport from lower grade/unpurified biogas (e.g. from landfill) used for heat or electricity generation. Biomethane is typically purified from regular biogas to remove most of the CO₂ .
CNG	Compressed Natural Gas. Natural gas can be compressed for use as a transport fuel (typically at 200bar pressure).
CO ₂	Carbon dioxide, the principal GHG emitted by transport.
CO ₂ e	Carbon dioxide equivalent. There are a range of GHGs whose relative strength is compared in terms of their equivalent impact to one tonne of CO₂ . When the total of a range of GHGs is presented, this is done in terms of CO ₂ equivalent or CO ₂ e.
DG TREN	European Commission's Directorate-General on Transport and Energy. This DG was split in 2009 into DG Mobility and Transport (DG MOVE) and DG Energy.
Diesel	The most common fossil fuel, which is used in various forms in a range of transport vehicles, e.g. heavy duty road vehicles, inland waterway and maritime vessels, as well as some trains.
EEA	European Environment Agency.
EV	Electric vehicle. A vehicle powered solely by electricity stored in on-board batteries, which are charged from the electricity grid.
FCEV	Fuel cell electric vehicle. A vehicle powered by a fuel cell, which uses hydrogen as an energy carrier.
GHGs	Greenhouse gases. Pollutant emissions from transport and other sources, which contribute to the greenhouse gas effect and climate change. GHG emissions from transport are largely CO₂ .
HEV	Hybrid electric vehicle. A vehicle powered by both a conventional engine and an electric battery, which is charged when the engine is used.
ICE	Internal combustion engine, as used in conventional vehicles powered by petrol, diesel, LPG and CNG .
Kerosene	The principal fossil fuel used by aviation, also referred to as jet fuel or aviation turbine fuel in this context.
Lifecycle emissions	In relation to fuels, these are the total emissions generated in all of the various stages of the lifecycle of the fuel, including extraction, production,

¹ Terms highlighted in bold have a separate entry.

	distribution and combustion. Also known as WTW emissions .
LNG	Liquefied Natural Gas. Natural gas can be liquefied for use as a transport fuel.
LPG	Liquefied Petroleum Gas. A gaseous fuel, which is used in liquefied form as a transport fuel.
MtCO _{2e}	Million tonnes of CO_{2e} .
Natural gas	A gaseous fossil fuel, largely consisting of methane, which is used at low levels as a transport fuel in the EU.
NGV	Natural Gas Vehicle. Vehicles using natural gas as a fuel, including in its compressed and liquefied forms.
NO _x	Oxides of nitrogen. These emissions are one of the principal pollutants generated from the burning of fossil and biofuels in transport vehicles.
Options	These deliver GHG emissions reductions in transport and can be technical or non-technical.
Petrol	Also known as gasoline and motor spirit. The principal fossil fuel used in light duty transport vehicles, such as cars and vans. This fuel is similar to aviation spirit also used in some light aircraft in civil aviation.
PHEV	Plug-in hybrid electric vehicle, also known as extended range electric vehicle (ER-EV). Vehicles that are powered by both a conventional engine and an electric battery, which can be charged from the electricity grid. The battery is larger than that in an HEV , but smaller than that in an EV .
PM	Particulate matter. These emissions are one of the principal pollutants generated from the burning of fossil and biofuels in transport vehicles.
Policy instrument	These may be implemented to promote the application of the options for reducing transport's GHG emissions .
TTW emissions	Tank to wheel emissions, also referred to as direct or tailpipe emissions. The emissions generated from the use of the fuel in the vehicle, i.e. in its combustion stage.
WTT emissions	Well to tank emissions, also referred to as fuel cycle emissions. The total emissions generated in the various stages of the lifecycle of the fuel prior to combustion, i.e. from extraction, production and distribution.
WTW emissions	Well to wheel emissions. Also known as lifecycle emissions .

1 Introduction

1.1 Topic of this paper

This paper is one of a series of reports drafted under the *EU Transport GHG: Routes to 2050 II* project. This paper focuses on the potential for less transport-intensive paths to societal goals. Two perspectives are considered. First, it has been assessed whether transport demand can be decoupled from GDP growth and how this could be realized. Second, the implications on transport of applying alternative macro-economic approaches to measure prosperity (e.g. green GDP) have been assessed. Finally, based on the findings from the assessment of these two perspectives policy implications for the decarbonisation of transport are formulated.

This paper will be presented in draft form to a Focus Group meeting in November 2011. Based on the discussion at the meeting and possible comments and further evidence that will be received this paper will be updated.

1.2 The contribution of transport to GHG emissions

Transport is responsible for around a quarter of EU greenhouse gas emissions making it the second biggest greenhouse gas emitting sector after energy (see figure below). Road transport accounts for more than two-thirds of EU transport-related greenhouse gas emissions and over one-fifth of the EU's total emissions of carbon dioxide (CO₂), the main greenhouse gas. However, there are also significant emissions from the aviation and maritime sectors and these sectors are experiencing the fastest growth in emissions, meaning that policies to reduce greenhouse gas emissions are required for a range of transport modes².

While greenhouse gas emissions from other sectors are generally falling, decreasing 15% between 1990 and 2007, those from transport have increased by 36% in the same period. This increase has happened despite improved vehicle efficiency because the amount of personal and freight transport has increased.

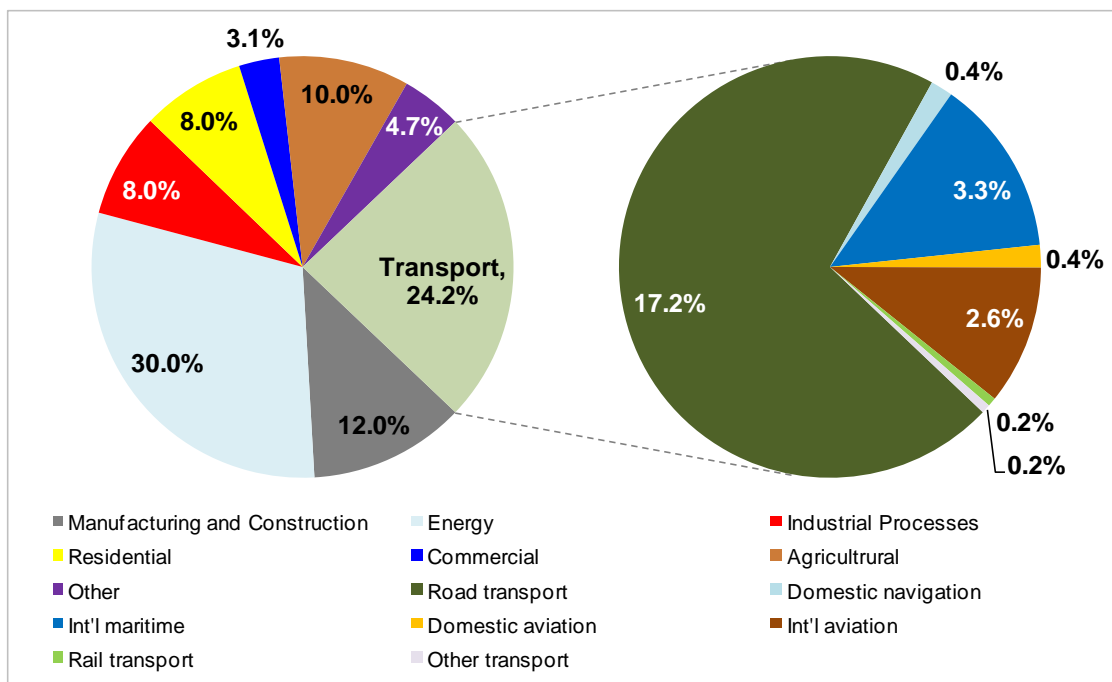
In the run-up to the Conference of the Parties of the UN Framework Convention on Climate Change in December 2009, the leaders of the EU's Member States called for significant reductions in global greenhouse gas (GHG) emissions:

“The European Council calls upon all Parties ... to agree to global emission reductions of at least 50%, and aggregate developed country emission reductions of at least 80-95%... It supports an EU objective, in the context of necessary reductions according to the IPCC by developed countries as a group, to reduce emissions by 80-95% by 2050 compared to 1990 levels.”³

² EC DG Climate Action (2010): http://ec.europa.eu/clima/policies/transport/index_en.htm

³ *Presidency Conclusions*, Brussels European Council, 29/30 October 2009; see <http://register.consilium.europa.eu/pdf/en/09/st15/st15265.en09.pdf>

Figure 1.1 EU27 greenhouse gas emissions by sector and mode of transport, 2007



Source: EC DG Energy (2010)⁴

Notes: International aviation and maritime shipping only include emissions from bunker fuels

The key role that transport has to play in this long-term economy-wide aspiration was underlined by European Commission President Barroso in his *Political Guidelines for the next Commission*⁵ where he emphasised the need to maintain the momentum towards a low carbon economy and towards decarbonising the transport sector in particular. In March 2010, the Commission, as part of its *Europe 2020* strategy⁶, announced that it would make proposals to decarbonise transport, and in doing so linked the need to decarbonise transport with the wider sustainable growth agenda.

These high level political statements set the framework within which the original *EU Transport GHG: Routes to 2050* project was undertaken. One of the main aims of this project was to provide information and analysis to assist the Commission with its early thinking on a co-ordinated approach to reducing the GHG emissions of all modes of transport.

The increasing political importance that is being attached to decarbonising transport reflects the fact that, of all the economy's sectors, transport has proved to be one of the most problematic in terms of reducing its GHG emissions. As mentioned earlier, since 1990, GHG emissions from transport, of which 98% are carbon dioxide (CO₂), had the highest increase in percentage terms of all energy related sectors⁷. Furthermore, transport's GHG emissions are predicted to continue to increase, without additional measures, to over 2,000 MtCO₂e by 2050. This increase is shown in the next figure, with a split by mode of transport. The figure is an output from an Excel-based illustrative scenarios tool (IST) called SULTAN (**S**ustainable **Le** **Tr**ANsport), which was developed under the previous project in order to identify the GHG reductions that transport could potentially deliver by 2050.

An increase of the order projected in the next figure would leave transport's GHG emissions 74% higher in 2050 than they were in 1990 (when the sector's emissions were nearly 1,200

⁴ Based on historic data from DG Energy (2010) *EU energy and transport in figures Statistical Pocketbook 2010* Luxembourg, Publications Office of the European Union, 2010. Publication and data available for download at: http://ec.europa.eu/energy/publications/statistics/statistics_en.htm

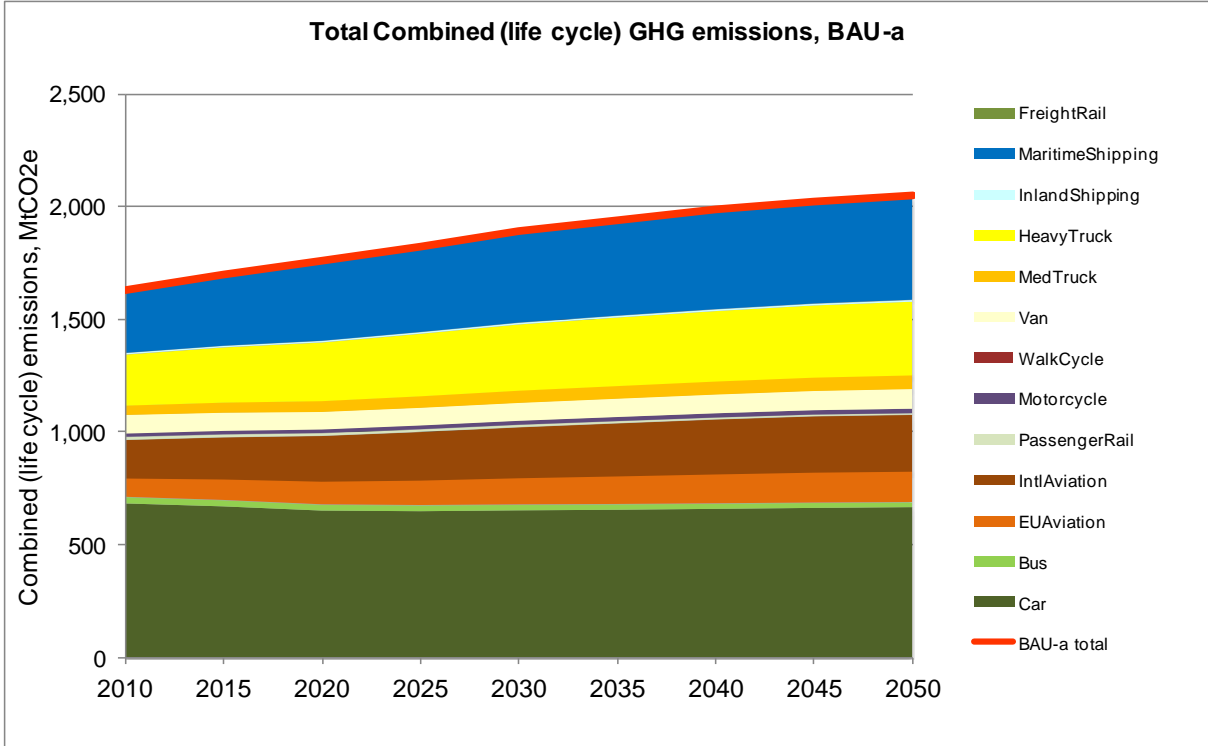
⁵ Barroso, J (2009) *Political Guidelines for the next Commission*, September 2009, Brussels

⁶ European Commission (2010) *Europe 2020: A strategy for smart, sustainable and inclusive growth* COM(2010)2020, Brussels 3.3.2020.

⁷ DG TREN (2000) *Energy and transport in figures 2008-2009*

MtCO₂e) and around 25% above 2010 levels. Significant emissions increases between 2010 and 2050 are projected for road freight (for which an increase of more than 45% is projected), aviation (more than 50%) and maritime (more than 65%) without additional policy instruments. Whilst GHG emissions from cars are still projected to contribute the most to the sector's GHG emissions in absolute terms in 2050, their emissions are projected to have declined slightly from 2010 levels, as anticipated improvements in the energy efficiency of vehicles negate projected increases in demand.

Figure 1.2 Business as usual projected growth in transport's GHG emissions by mode



Source: SULTAN Illustrative Scenarios Tool, developed for the EU Transport GHG: Routes to 2050 project

Notes: International aviation and maritime shipping include estimates for the full emissions resulting from journeys to EU countries, rather than current international reporting which only include emissions from bunker fuels supplied at a country level (which are lower).

The figure above shows the baseline, as projected by SULTAN. This is consistent with the range of results from other models and tools, although many of these only project to 2030⁸. Clearly, the predicted continued growth in the EU-27's GHG emissions from transport has the potential to prevent the EU meeting the long-term GHG emission reduction targets that the European Council supports, if no action is taken to reduce these emissions.

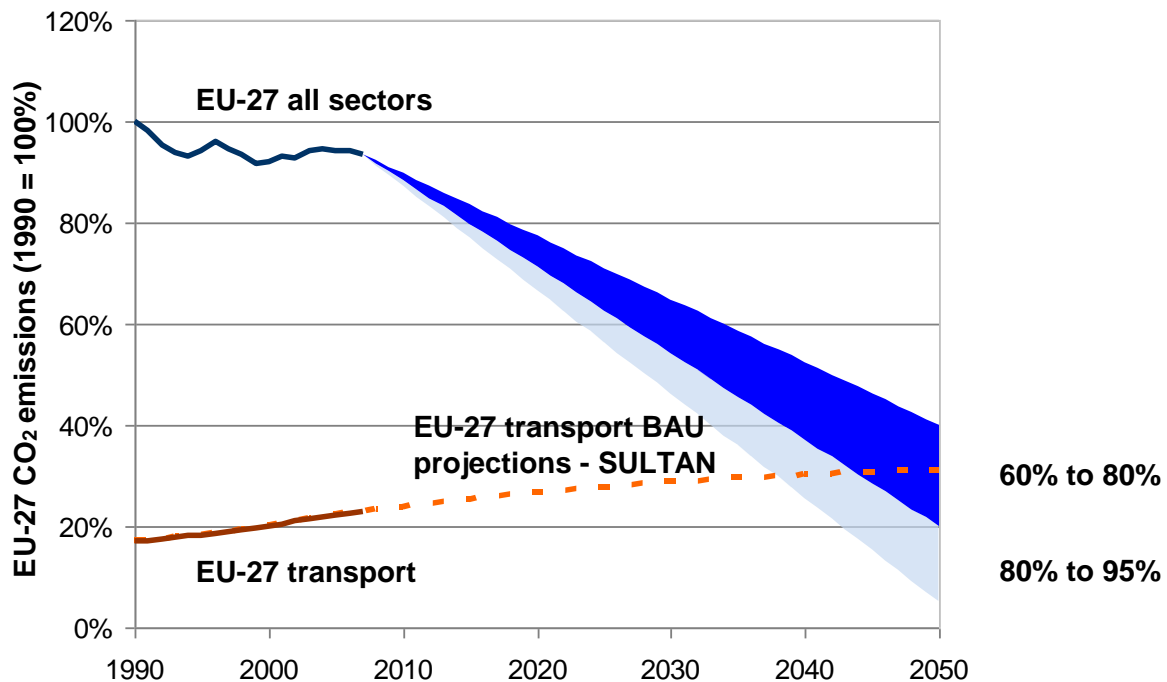
Figure 1.3 demonstrates that on current trends, transport emissions could be around 30% of economy-wide 1990 GHG emissions by 2050⁹. Whilst simplistic, in that it assumes linear reductions, the figure demonstrates that there is clearly a need for additional policy instruments to stimulate the take up of technical and non-technical options that could potentially reduce transport's GHG emissions. The EEA believes that all available policy instruments need to be used to achieve the ambitious GHG reduction targets¹⁰.

⁸ See Appendix 19 SULTAN: Development of an Illustrative Scenarios Tool for Assessing Potential Impacts of Measures on EU transport GHG for details of the assumptions used and approach taken in the SULTAN Illustrative Scenarios Tool to projecting business as usual GHG emissions; also see <http://www.eutransportghg2050.eu>

⁹ The emissions included in this figure – for both the economy-wide emissions and those of the transport sector – include emissions from international aviation and maritime transport, in addition to emissions from “domestic” EU transport.

¹⁰ EEA (2009) *Towards a resource-efficient transport system – TERM 2009: indicators tracking transport and environment in the European Union*, EEA Report No2/2010, Copenhagen.

Figure 1.3 EU overall emissions trajectories against transport emissions (indexed)



Source: EC DG Energy (2010) and SULTAN Illustrative Scenarios Tool¹¹

1.3 Background to the project and its objectives

EU Transport GHG: Routes to 2050 II is a 15-month project funded by the European Commission's DG Climate Action and started in January 2011. The context of the project is still the Commission's long-term objective for tackling climate change. The scope of the first project was very ambitious, and the outputs from the study were very detailed and have already proved to be of great value to the European Commission and to industry, governmental and NGO stakeholders. However, there were a number of topic areas where it was not possible within the time and resources available for the study team to carry out completely comprehensive research and analysis. In particular, as the project evolved, both the study team and the Commission Services became aware that there were a number of themes and topic areas that would benefit from further, more detailed research. This new project is a direct follow-on piece of research to the previous *EU Transport GHG: Routes to 2050?* study, building on the research and analysis carried out for that study and complementing other work carried out for the latest Transport White Paper. In particular, the outputs from this new study will help the Commission in prioritising and developing the key future policy measures that will be critical in ensuring that GHG emissions from the transport sector can be reduced significantly in future years.

Therefore, the key objectives of the *EU Transport GHG: Routes to 2050 II* are defined as to build on the work carried out in the previous project to:

- Develop an enhanced understanding of the wider potential impacts of transport GHG reduction policies, as well as their possible significance in a critical path to GHG reductions to 2050.
- Further develop the SULTAN illustrative scenarios tool to enhance its usefulness as a policy scoping tool and carry out further scenario analysis in support of the new project;

¹¹ Projections based on data from the SULTAN Illustrative Scenarios Tool (BAU-a scenario) and historic data from DG Energy (2010) *EU energy and transport in figures Statistical Pocketbook 2010* Luxembourg, Publications Office of the European Union, 2010.

- Use the new information in the evaluation of a series of alternative pathways to transport GHG reduction for 2050, in the context of the 50-70% reduction target for transport from the European Commission's Roadmap for moving to a competitive low carbon economy in 2050¹²;

As before, given the timescales being considered, the project will take a quantitative approach to the analysis where possible, and a qualitative approach where this is not feasible. The project has been structured against a number of tasks, which are as follows:

- **Task 1:** Development of a better understanding of the scale of co-benefits associated with transport sector GHG reduction policies;
- **Task 2:** The role of GHG emissions from infrastructure construction, vehicle manufacturing, and ELVs in overall transport sector emissions;
- **Task 3:** Exploration of the knock-on consequences of relevant potential policies;
- **Task 4:** Exploration of the potential for less transport-intensive paths to societal goals;
- **Task 5:** Identification of the major risks/uncertainties associated with the achievability of the policies and measures considered in the illustrative scenarios;
- **Task 6:** Further development of the SULTAN tool and illustrative scenarios;
- **Task 7:** Exploration of the interaction between the policies that can be put in place prior to 2020 and those achievable later in the time period;
- **Task 8:** Development of a better understanding of the cost effectiveness of different policies and policy packages;
- **Task 9:** Stakeholder engagement: organisation of technical level meetings for experts and stakeholders;
- **Task 10:** Hosting the existing project website and its content;
- **Task 11:** Ad-hoc work requests to cover work beyond that covered in the rest of the work plan.

As in the previous project, stakeholder engagement is an important element of the project. The following meetings have been undertaken/are being scheduled:

- A large stakeholder meeting was held in on 29th June 2011, at which this project was introduced to stakeholders, along with the presentation of interim results.
- A series of four Technical Focus Group meetings. The first two were held on 4th May 2011. The next two will be held on 28th November 2011.
- A second large stakeholder meeting at which the draft final findings of the project will be presented and discussed, anticipated to be held in February 2012.

As part of the project a number of papers will be produced, all of which will be made available on the project's website in draft and then final form, as will all of the presentations from the project's meetings.

¹² Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, A Roadmap for moving to a competitive low carbon economy in 2050, COM(2011) 112 final. Available from DG Climate Actions website at: http://ec.europa.eu/clima/policies/roadmap/index_en.htm

1.4 Background and purpose of the paper

This paper, “*Potential for less transport-intensive paths to societal goals*”, explores alternative development paths that could be less transport intensive, but still deliver increasing levels of prosperity. Reducing transport demand is often expected to have an adverse impact on economic growth and the competitiveness of the EU, and hence policies aimed to reduce transport demand are often highly controversial. However, one of the main conclusions from the previous *EU Transport GHG: Routes to 2050* study was that meeting long term targets in the range of 80-95% GHG reduction is not possible without curbing transport growth. In the impact assessment of the recent EC Transport White paper, it is assumed for the Business-As-Usual scenario that transport growth and GDP growth will decouple (see also section 2.1). In this context it is interesting to look for development paths which combine a reduction in transport demand and a growth in prosperity levels.

The search for less transport intensive growth paths is in line with the Commission’s strategy for smart, sustainable and inclusive growth, as presented in ‘Europe 2020’ (see Box 1). In the transition to a green economy in the longer-term, the Commission sees an important role for decoupling of welfare growth from energy and resource use.

Box 1 Europe 2020 – A strategy for smart, sustainable and inclusive growth

The most important piece of EU legislation that sets the economic and wider framework for EU policy-making in the next 10 years is ‘Europe 2020’, which is subtitled “A strategy for smart, sustainable and inclusive growth”¹³. This was published in March 2010 as a successor to the previous Lisbon Strategy and was endorsed by EU Heads of State in June 2010. The Strategy is seen as an important element in facilitating the transition to a green economy in the longer-term, as it establishes objectives and targets for 2020. The “smart” element of the Strategy focuses on knowledge and innovation, while the “sustainable” element talks about promoting resource efficient, greener and more competitive growth. The “inclusive” element involves achieving high employment and delivering economic, social and territorial cohesion. The ultimate aim of the ‘sustainable growth’ priority is to decouple economic growth from energy and resource use. EU actions under the priority emphasise the competitive advantage attainable from the employment of green technologies, the need to implement emission reduction commitments and the importance of strengthening resilience to climate risks, as well as the financial and energy security related benefits of meeting energy targets.

In the context of ‘sustainable growth’, Europe 2020 makes an explicit link between sustainable growth and key environmental themes, as it argues that attaining such growth would help the EU ‘to prosper in a low-carbon, resource constrained world while preventing environmental degradation, biodiversity loss and unsustainable use of resources’. The Strategy also commits the Commission to establishing a vision of the ‘changes required to move to a low carbon, resource efficient and climate resilient economy by 2050’. All EU policies, instruments, legal acts, and financial instruments are intended to be mobilised in pursuit of the Strategy’s objectives.

The Strategy has been followed by seven ‘flagship initiatives’ that aim to stimulate action in each area, including in the context of a “Resource efficient Europe”. The aim under this initiative is to support the shift towards a resource efficient and low-carbon economy (COM(2011)21)¹⁴.

The issue of less transport intensive growth paths can be studied from two perspectives. The first perspective is seen from within the currently dominant paradigm of economic growth. The focus would be on reducing the transport-intensity of growth as it is currently measured, i.e. decoupling transport growth from GDP growth. Issues to be discussed are: causes of

¹³ European Commission 2010. Communication from the Commission - Europe 2020: A strategy for smart, sustainable and inclusive growth, (COM(2010)2020), 3/3/2010, <http://ec.europa.eu/eu2020/pdf/COMPLETE%20EN%20BARROSO%20%20%20007%20-%20Europe%202020%20-%20EN%20version.pdf>

¹⁴ European Commission 2011. Resource Efficiency Flagship Initiative. COM(2011)17, Brussels, http://ec.europa.eu/resource-efficient-europe/pdf/resource_efficient_europe_en.pdf

decoupling, empirical evidence on decoupling of transport and GDP growth in the EU27, explanations of differences in decoupling rates between countries, and policies to achieve decoupling.

A second, wider perspective starts from alternative definitions of economic growth or even strives for prosperity without growth. Currently, Gross Domestic Product (GDP) is the overriding indicator of economic growth. The use of this indicator has been criticised, in part due to concerns that its focus on including economic activity that can be easily monetised omits a range of factors that contribute to wider societal goals. For example, external effects of transport, like air pollution and traffic accidents, do negatively affect social welfare but do not lower GDP growth. Therefore various alternative measures of growth have been developed which also take (some of) these broader welfare impacts into account. However, some researchers argue that even these adapted growth indicators do not go together with a sustainable economy in the long run. A sustainable economy needs to operate within ecological limits (e.g. maintaining a certain level of natural capital) and should therefore strive for prosperity without growth.

It is clear that both the alternative definitions of economic growth and the alternative macro-economic approach of realising prosperity will have major impacts on the transport sector. In this paper a high-level assessment of these transport implications is provided. Based on this assessment policy implications for the decarbonisation of transport are formulated.

[At the present time \(mid November 2011\), this report presents the draft findings from the work of this task. These draft findings will be presented at the Focus Group Meeting on 28 November 2011 in Brussels. The work will be finalised on the basis of the comments received at this meeting in December 2011.](#)

1.5 Structure of the paper

In the remainder of this paper we will first discuss the issue of decoupling transport growth from GDP growth (Section 2). We will explore ways to decouple transport GDP growth, assess empirical evidence on this issue and explain possible differences in decoupling rates between continents. In Section 3 we discuss the issue of less transport intensive growth from a wider perspective by exploring the impacts of both alternative definitions of economic growth and an alternative macro-economic approach of realising prosperity on transport. Finally, in Section 4 we have formulated conclusions and recommendations for policy making.

2 Decoupling of transport and GDP growth

Objectives:

The purpose of this sub-task was to:

- Explore possible ways to decouple transport from GDP growth
- Assess empirical evidence for decoupling transport and GDP growth in the EU27
- Explain possible differences in decoupling rates between continents

Summary of Main Findings

⇒ To complete following November Focus Group

⇒ ...

⇒ ...

2.1 Introduction

A good transport system is generally regarded as an important prerequisite for a well-developed economy. For example, a substantial share of European development support to Africa has been invested in transport infrastructure. Transport is important because it allows for a steady supply of inputs for producers, as well as a means to get products to the market. Especially in the beginning of the industrialization era, the possibility to transport goods was a prerequisite for large-scale manufacturing industries (Freige, 2007).

In Europe, we have evolved from an economy in which villages were self-sustaining to a more service-oriented economy in which goods are imported from other countries and continents. Therefore, it is not surprising that developments in GDP and transport have gone hand in hand: “*The connection between transport and output is not a direct one but rather intertwined with its influence on production structures and processes, location and plant size decisions, distribution structures and processes and other characteristics of industrial organization*” (Freige, 2007). The most important drivers of transport growth in recent decades have been globalization and trade liberalization, the international division of labour, the popularity of Just-In-Time (JIT) delivery, strong income growth, increased participation of women in the labour market and decreases in transportation costs (Ballingall *et al.*, 2003).

In short, the relationship between transport volume and economic growth runs through the following channels:

- 1) Investments in transport infrastructure alter the relative advantage of different locations in terms of accessibility costs, which influences economic opportunities.
- 2) In the short term, this leads to a different choice of routing and changes in travel volume. In the longer term, location decisions of household and companies are influenced, together with prices of real estate and land.
- 3) Channels 1 and 2 result in changes in economic indicators such as factor productivity and output (Freige, 2007).

A similar analysis or causal relationship can be drawn the other way around, from changes in economic opportunities to transport volume. Such changes in economic opportunities could include a reduction of import tariffs, changes in fuel prices and changes in labour costs, all of which can influence transport volume. The direction of the causal relationship between transport and GDP has not been identified yet (Ballingall *et al.*, 2003).

The strong link between transport and the economy has led some to claim that “*restricted mobility is inevitably a brake on development, in every sense*” (quoted in Pastowski, 1997: 11). Furthermore, since freight transport is in fact derived demand for the products transported, freight transport is sometimes presented as a side-effect of factors which are simply beyond our control.

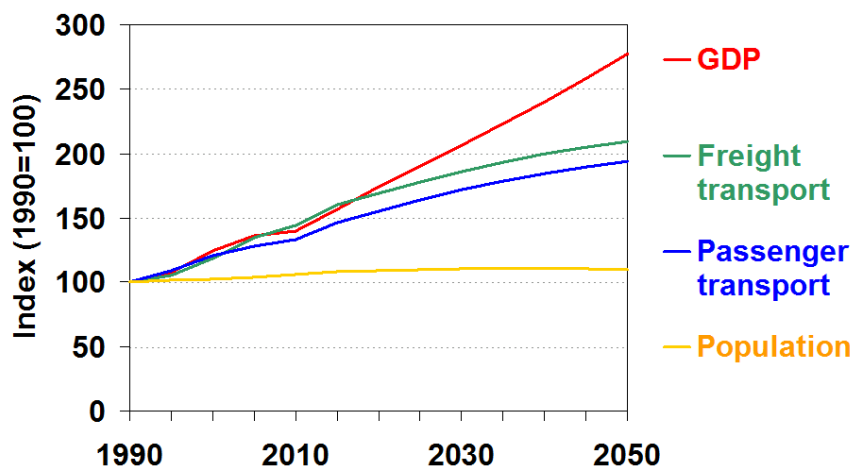
With increased attention on climate policy, the discourse has changed somewhat. Even though it is acknowledged that transport has brought us much wealth, decoupling has recently become a policy objective. For example, the OECD considered decoupling environmental pressure from economic growth to be one of its main objectives in the first decade of the 21st century (OECD, 2002). For transport this could be realized in two ways. Firstly, by decoupling environmental pressure from transport growth (e.g. by improving the fuel efficiency of vehicles); and secondly, by decoupling transport growth from economic growth. The importance of the first approach is undisputed and currently widely applied in European policy-making. The second road to decoupling is more controversial. However, there are both environmental and economic arguments for this type of decoupling (Ballingall *et al.*, 2003):

- 1) The environmental argument is that a reduction of external costs (such as CO₂ emissions, noise, air pollutants) could be achieved while maintaining economic growth.
- 2) The economic argument is that more goods can be produced with the same amount of transport, which is an efficiency argument.

It should be noted that in both cases the aim is to maintain economic growth while transport volume reduces. In the remainder of this chapter we will focus on the decoupling of transport growth from economic growth (see also section 2.2).

The underlying causes of decoupling (or the lack thereof) are not entirely clear, while understanding these cases is a necessity for estimating the potential for decoupling in the future. Figure 2.1 illustrates this point clearly, as it shows the EU27 reference scenario for the impact assessments of the recent EC Transport White Paper. After 2015, growth developments in GDP on the one hand, and in freight and passenger transport on the other hand, clearly diverge in this reference scenario. The projections in transport demand growth that are behind this scenario for the White Paper, were based on data provided by Member States. Apparently, to achieve its climate objectives the EC deems it necessary that transport growth and GDP growth decouple and assumes that decoupling takes place autonomously. However, if growth developments in GDP and transport turn out to be very similar (as they have in the past, particularly for freight), then decarbonisation efforts in the transport sector would have to increase more than is assumed in the White Paper. Therefore, understanding decoupling is very important, and this paper aims at contributing to this understanding.

Figure 2.1: EU27 reference scenario for EC impact assessments



Source: Šturc (2011)

In the following sections we explore whether transport can be decoupled from GDP growth. Both the decoupling of passenger and freight transport will be discussed. First we will discuss the concept of decoupling in Section 2.2. How should decoupling be defined, what are the data requirements for an analysis of decoupling and what are possible rebound effects? In Section 2.3 we present empirical evidence from the last decade on the growth of transport and GDP in the EU to explore whether trends of decoupling could be found. An overview of possible ways to realize decoupling of freight transport and GDP growth is given in Section 2.4. In addition, the GHG mitigation potential of these ways to realize decoupling is assessed, including possible rebound effects and carbon leakage effects. The same is done for passenger transport in Section 2.5. In Section 2.6 the empirical evidence on decoupling of transport and GDP growth will be discussed, including differences in decoupling rates between the EU, the US and Asia. Section 2.7 discusses policy implications. Finally, the conclusions of this chapter are presented in Section 2.8

2.2 Defining decoupling

In general, decoupling entails a weakening of the link between transport volume and GDP. In this section, we will elaborate on the different possible ways of measuring decoupling. In Section 2.2.1 we describe different decoupling indicators. Data and measurement issues are discussed in Section 2.2.2. Finally, rebound effects are discussed in Section 2.2.3.

2.2.1 A decoupling indicator

Decoupling is a concept which is closely linked to transport intensity. Transport intensity is defined as the ratio of gross mass movement to GDP (Tight *et al.* 2004). The rate of decoupling (percent) can be defined as the annual change in the transport intensity of the economy. When transport intensity decreases, it means that GDP is growing faster than transport volume and therefore decoupling is taking place. If gross mass movement declines in absolute terms while GDP increases, this is usually called *strong* (or absolute) decoupling. If it declines in relative terms to GDP, it is referred to as *weak* (or relative) decoupling (Ballingall *et al.*, 2003; OECD, 2002).

When researchers or policy makers discuss decoupling, they do not necessarily refer to the same specific phenomenon. The following list contains the main indicators used to identify decoupling in the literature. In all five cases, a decline in the ratio constitutes decoupling.

- 1) The ratio of tonne kilometres to GDP;
- 2) The ratio of passenger kilometres to GDP;
- 3) The ratio of vehicle kilometres to GDP;
- 4) The ratio of CO₂ emissions from transport to GDP; and
- 5) The ratio of energy consumption of transport to GDP.

In this paper, we focus on the first two indicators of decoupling, because these two represent the demand for transport best. The demand for transport entails the desire to transport one person or a tonne of goods over a particular number of kilometres. The reason for our focus on demand for transport is that the other variables determining indicators 3, 4 and 5 (load factor, energy efficiency) have already been discussed in other papers of the EU Transport GHG: Routes to 2050? project. They also receive much attention in transport research. Instead of investigating the technicalities of transport organisation, we want to look at the issue from a more fundamental point of view:

Can future GDP growth occur without being accompanied by a similar growth in transport? In other words, can we achieve less transport-intensive economic growth?

2.2.2 Data and measurement issues

Analysing decoupling is impossible without reliable statistics. Following the literature review, there are three important data and measurement issues with respect to decoupling:

- Limited data availability;
- International transport is often not included in the statistics; and
- Reliable statistics from developing countries are not available.

These are discussed in more detail below.

Limited data availability

To calculate decoupling, one would ideally like to use gross mass movement that is necessary to produce all goods in the country being considered. However, in practice no such data are available¹⁵. In general, transport data is either based on all movements on national territory or on all movements by vehicles registered in the reporting country. Both types of data are used, as a second-best option, to calculate decoupling indicators. However, this may result in misleading results; for example, if transport data based on all movements by domestic vehicles is used to calculate the decoupling indicator, a shift to cabotage (transport which fully takes place on national territory but is carried out by foreign companies) has a positive impact on the decoupling indicator, although no actual decoupling has taken place. For the UK, imperfect statistics have been identified as an important explanation for observed decoupling (McKinnon, 2006). By interpreting decoupling figures it is therefore important to consider thoroughly the applied (transport) data.

International transport is often not included in the statistics

In terms of passenger transport, the issue is that international air travel is not included in the national passenger transport statistics. Air travel has become a popular mode of leisure transport and not taking into account air travel leads to a serious underestimation of transport volume. Furthermore, Finnish citizens increasingly use slower waterborne modes for tourist trips to the Baltic states, which is also not covered by the national statistics (Tapio, 2003). In the case of freight transport, a serious misrepresentation of the national transport statistics is caused by the omission of maritime transport and, to a lesser extent, air transport.

Availability of reliable statistics from developing countries

¹⁵ This is not to say that it would not be possible to construct such data, as the methods are similar to those used to construct the National Accounts (Peters et al., 2011).

Reliable statistics on emissions and transport volume are difficult to produce by Western Europe, let alone by developing countries. This is a problem because nowadays, much industrial activity no longer takes place on European soil. In line with IPCC accounting rules of reporting only *territorial* emissions, many developed countries have reported stabilized emissions. However, many goods are imported from other countries, and the corresponding transport emissions are to a large extent missing from the analysis (Peters *et al.*, 2011). The traded products have to be transported to the importing countries - which entails long-distance transport - and intermediate goods have to be transported to the production location in the country of production (short distance transport). Both observations render problems in terms of measuring decoupling. Emissions from aviation and maritime transport from for example China to Europe are not governed by the Kyoto Protocol. Attempts to agree on efforts to stabilize emissions through the UN aviation and maritime bodies ICAO and IMO have not been successful until now. Secondly, developing countries are not subject to binding commitments under the Kyoto Protocol. Therefore, the transport that results from the increased production of goods in developing countries is not monitored nor governed. Thus, the estimate of decoupling in European countries is likely to be too high.

2.2.3 Rebound effects

In transport economics, unintended behavioural responses (rebound effects) to policy changes as well as technological and economic developments receive much attention. Rebound effects can also be expected in the case of decoupling. Suppose, for example, that a large employer such as a federal government decides that employees who come to work by bicycle receive a large bonus and this induces many people to come by bicycle. Previously, half of them came to work by car, which implies a saving in fuel expenses for these employees. This results in an increase in disposable income for these employees (in addition to the effect of the bonus) and it is likely that a substantial share of this additional disposable income will be spent on goods. Consequently, the transport of these goods involves additional freight transport. In other words, there is an interaction effect between passenger transport and freight transport. For total transport, this means that there is a rebound effect, since the effect on total transport is smaller than the initial effect on passenger transport.

The existence of rebound effects becomes even clearer when a distinction between production and consumption transport is made (Ballingall *et al.*, 2003). Production transport “involves activity related to the production of goods and services and essential household sector activities”. It covers the transport of intermediate and final goods to production locations and customers, as well as essential household operations such as the commute to work and to the supermarket. Consumption transport on the other hand includes all transport for non-essential purposes (i.e. leisure). Firms and households¹⁶ have an incentive to minimise production transport, because it constitutes an input (and hence a cost) to production. If total transport volume of production transport in a country goes down because of improved productivity, total value added (and GDP) rises if prices remain constant. Since changes in household income are closely related to changes in GDP, disposable incomes of households will also rise and hence household consumption and consumption transport. So in the end, the reduction in total transport volumes is lower than the initial reduction in production transport. This illustrates that there are clear interaction effects within the transport sector, and rebound effects for the transport sector as a whole.

Another question that could be asked is whether less transport always results in fewer GHG emissions. Take for example the impact of teleworking, which has the potential of producing the same economic output with less transport (assuming working from home does not lead to

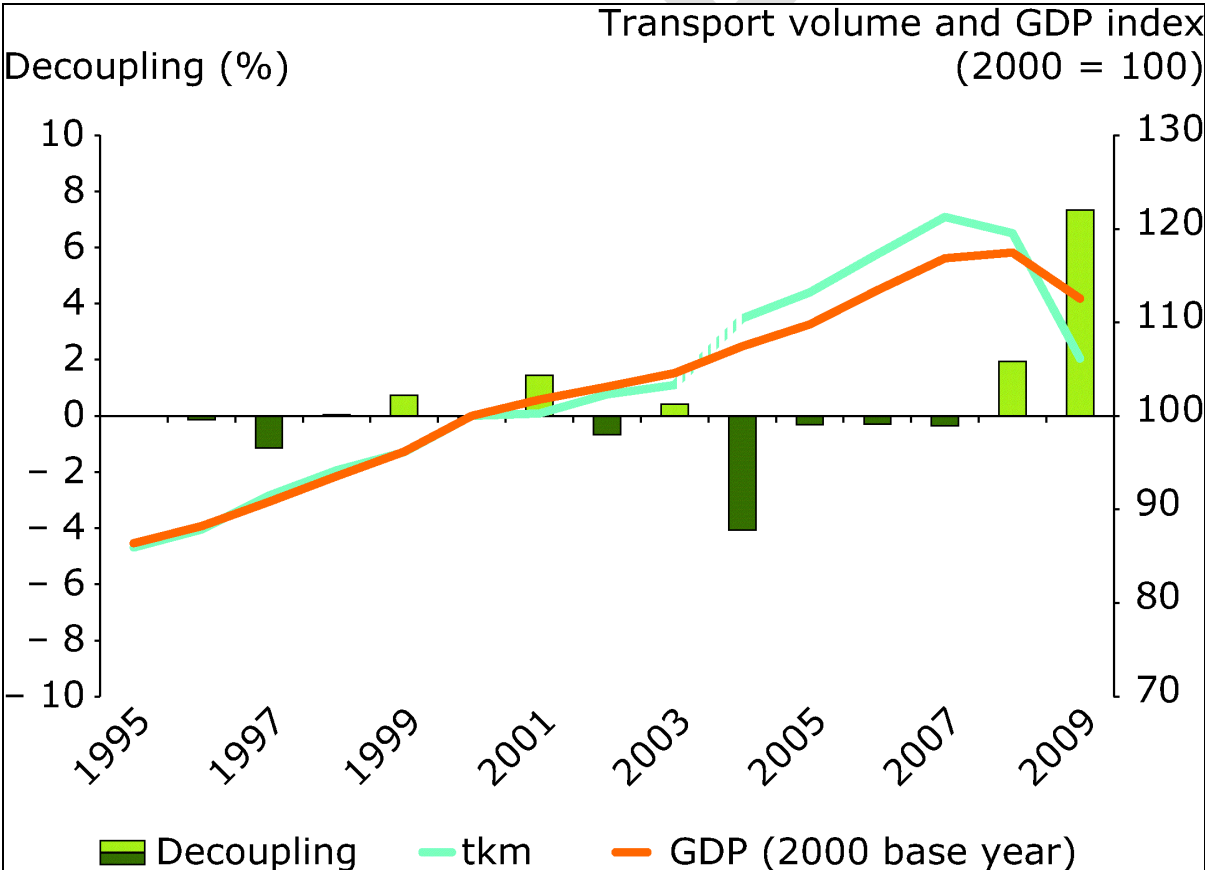
¹⁶ For households, production transport means the transport that is essential for this person to be economically active. This includes the trip to work, as well as shopping for essentials such as food.

a decrease in productivity). In Paper 5 of the previous *EU Transport GHG: Routes to 2050? study* (Van Essen et al., 2009), it was concluded that the reduction potential of teleworking depends on the average commuting distance as well as CO₂ emissions from working at home. In a case study for the Netherlands, it was found that with a commuting distance of 45 km (one way), the net effect of working from home is a CO₂ reduction of about 40%, taking into account the average heating over the year. However, if the commuting distance is small and the house badly insulated, it is well imaginable that a reduction in passenger transport results in an increase in CO₂ emissions.

2.3 Empirical evidence on decoupling in the EU

Before discussing possible causes of decoupling in sections 2.4 and 2.5, it is interesting to look at evidence on decoupling in the EU. Figure 2.2 shows recent developments in freight transport and GDP for the period 1995-2008. It follows that up to 2003, GDP growth and transport growth have been very much in line. Between 2003 and 2004 the figures diverge quite strongly, which according to the EEA (2011) can be attributed to a methodological change. Unfortunately, no correction figures exist. In the period 2004-2006, 'coupling' is taking place, while in 2008-2009 there is decoupling. According to EEA (2011) it is likely that the recent decoupling is a temporary result of the economic recession.

Figure 2.2 Decoupling of freight transport in Europe

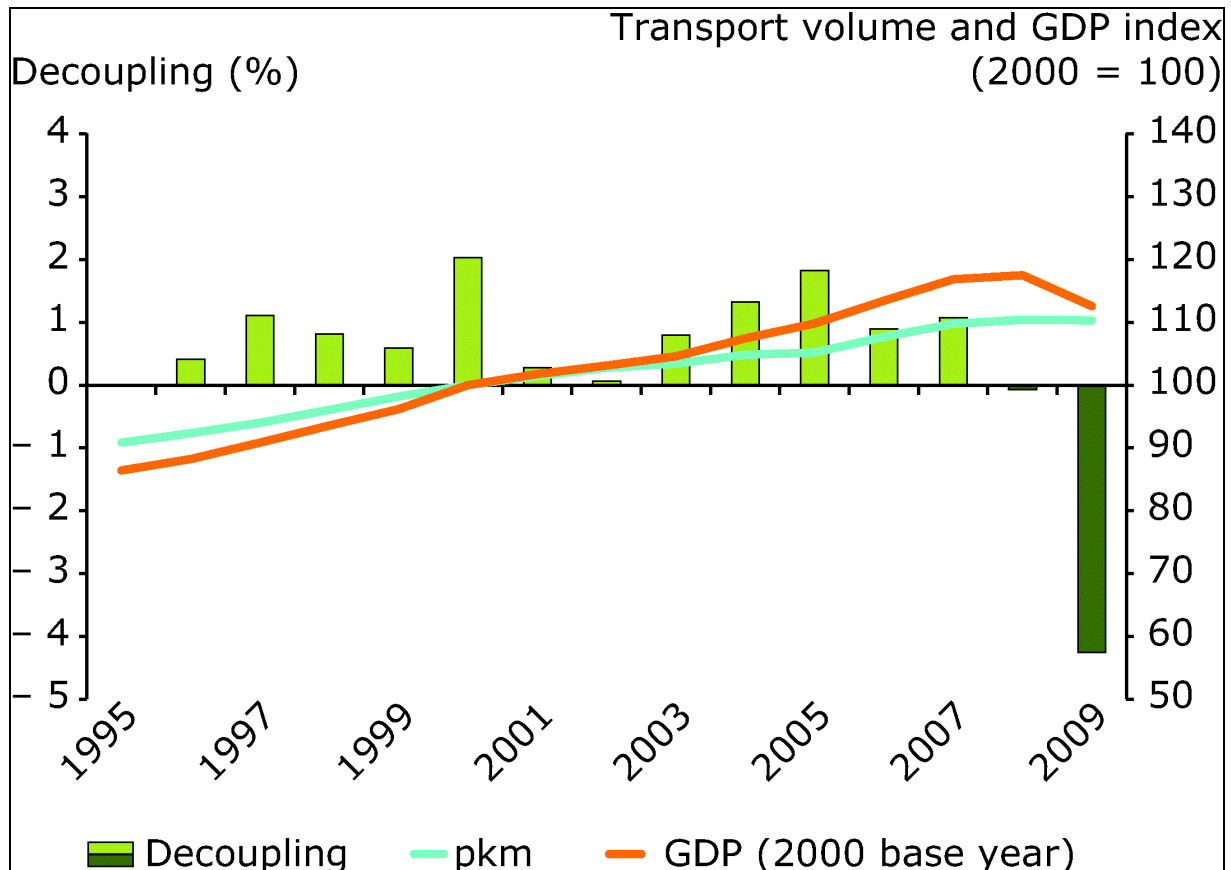


Source: EEA, 2011

Notes: The data cover road, rail and IWT for the EEA members (EU-27 + Iceland, Liechtenstein, Norway, Switzerland and Turkey). The green bars indicate decoupling, while the red bars indicate 'coupling'

Figure 2.3 shows recent developments in passenger transport and GDP for the period 1995-2008. From the figure, it can be concluded that in the period 1995-2007, decoupling of land-based passenger transport growth and GDP has taken place. The average annual decoupling is very close to 1%, which means that the transport intensity of the economy declines by 1% every year. In recent years a coupling of passenger transport demand and GDP growth has taken place, which is likely to be the consequence of the economic crisis (sharp decrease in GDP).

Figure 2.3: Decoupling of passenger transport in Europe

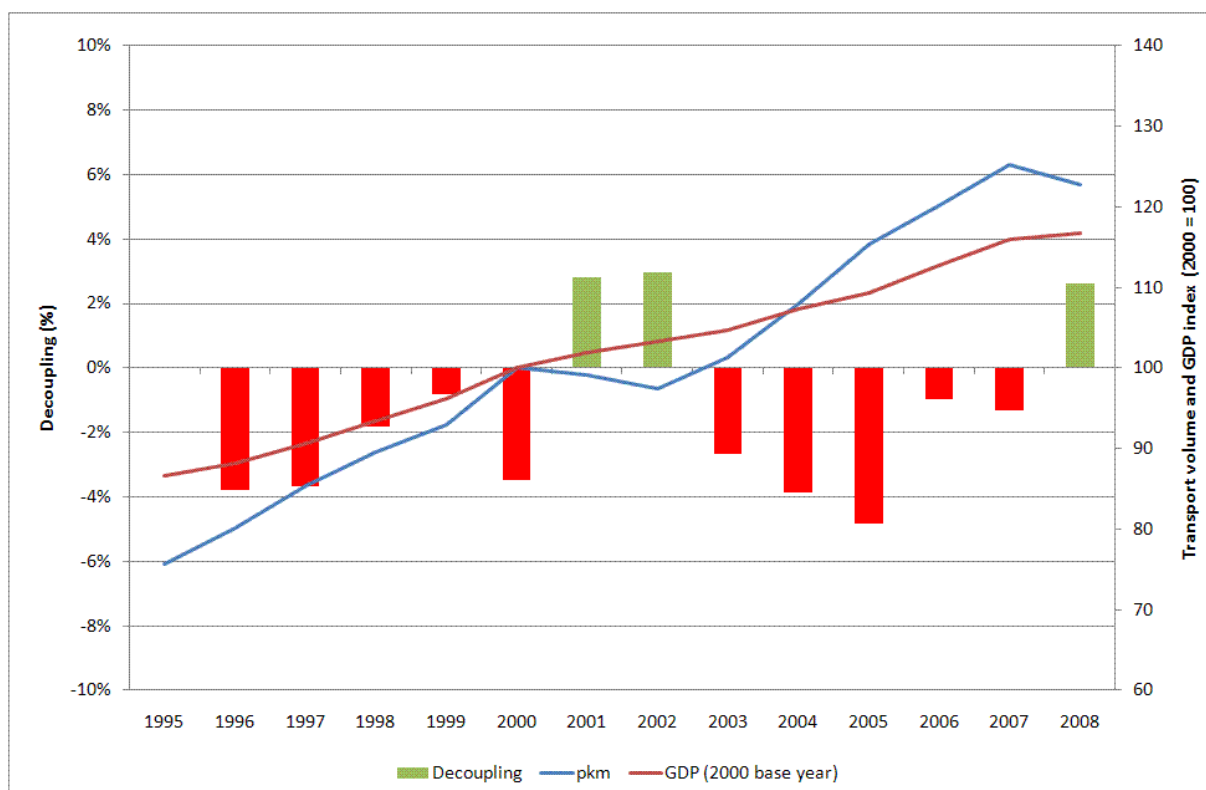


Source: EEA, 2010

Notes: The green bars indicate decoupling, while the red bars indicate 'coupling'. The data cover road, rail and buses for the EEA members (EU-27 + Iceland, Liechtenstein, Norway, Switzerland and Turkey).

It should be noted that aviation is not included in Figure 2.3, since data for air passenger travels are deemed unreliable (because EU Member States do not agree on how to attribute the pkm of international intra-EU flights). However, EEA (2010) do present a figure on the trends in both aviation passenger demand and GDP, based on provisional data on aviation passenger demand for domestic and intra-EU flights from DG Move. From the figure it can be concluded that in general aviation demand in Europe grows faster than GDP growth. It is not clear whether this growth in aviation demand under the decoupling of land-based passenger transport demand and GDP growth in the years up to 2008.

Figure 2.4: Trends in air passenger transport demand and GDP



Source: EEA, 2010

Notes: The green bars indicate decoupling, while the red bars indicate 'coupling'. The aviation passenger demand data are provisional estimates from the European Commission DG Move for domestic and intra-EU27 aviation.

2.4 Possible drivers of decoupling freight transport

The relationship between freight transport and GDP works two ways: the volume of freight transport influences the level of GDP, and the level of GDP influences the volume of freight transport. Particularly the former link between freight transport and GDP limits the potential of decoupling of freight transport growth and GDP growth. A reduction in the amount of freight transport will in many cases result in less efficient production processes and hence less GDP growth. However, according to the literature there may be a number of ways to decouple freight transport from GDP growth, which will be discussed in the remainder of this section.

2.4.1 Identifying drivers of decoupling

In this section, we will elaborate on three fundamental drivers of decoupling:

- Dematerialisation of the economy;
- Reduction of the spatial range of material flows; and
- Optimisation of transport organisation (Schleicher-Tappeser *et al.*, 1998).

The third driver has traditionally received the most attention in the literature on decoupling, as well as in the previous *EU GHG Transport: Routes to 2050?* study (Skinner *et al.*, 2010). After all, this driver is the most easily influenced by policy measures. Here, the main focus will be on the first two drivers.

Dematerialisation of the economy

A dematerialisation of the economy means reducing the amount of materials used in the production process, thereby reducing the need for freight transport (Ballingall *et al.*, 2003).

There are two main possible drivers of dematerialisation: a restructuring of the economy towards less transport intensive industries; and using less or lighter goods in the production process while maintaining the value of the goods produced.

Economic restructuring

Agricultural and manufacturing industries produce physical output, which has to be transported to customers. On the other hand, the service industry produces fewer tangible goods and therefore generates less transport.

Changes in the composition of the economy influence both GDP growth and transport growth. A change from a primary industry-based economy (agriculture) to a manufacturing industry-based economy is likely to result in GDP growth and transport growth, since manufactured products usually have a higher added value and a larger consumer market than agricultural products. However, moving from a manufacturing industry-based economy to a service-based economy is likely to lead to a lower growth rate in transport but a stable or higher GDP growth rate. The reason is that the service sector is less (freight) transport-intensive. In the so-called 'information society':

“Economic wealth is mainly created by information activities and often at different places than material production” (Schleicher-Tappeser et al., 1998).

It should be noted that a transition to a service-based economy is likely to involve leakage effects, since the manufacturing industries move to other countries. In these countries a growth in transport is to be expected, and on a global level, transport is likely to remain stable or increase. However, no empirical evidence exists on leakage effects.

European economies have all experienced a transition towards service-based economies. According to McKinnon (2006), the effect of a change in the composition of GDP on transport in the UK has been significant, although the effect could not be quantified because UK transport statistics do not distinguish between sectors. In Denmark, the redistribution of production across industries has contributed significantly to the reduction in the growth of freight transport (Kveiborg and Fosgerau, 2005). The study employs a decomposition method to calculate the relative contributions of factors to the growth in freight traffic (average annual growth: 1.94%). The change in the composition of the production across industries has had a downward effect on freight transport growth of -0.78 percent point. Hence, the production has shifted towards less transport intensive industries. The influence of changes in the composition of commodities *within* industries has been small, explaining only +0.05 percent point in annual freight transport growth (Kveiborg and Fosgerau, 2005). For Germany, it has been estimated that the elasticity of the transport intensity to the share of the tertiary (service) sector is -0.3. In other words, an increase in the share of services in the economy by 1% leads to a decrease of 0.3% in the transport intensity (Pastowski, 1997).

Thus, it is likely that a change in the composition of the economy has put a downward pressure on the growth in freight transport in European countries. The move towards a service-based economy is not likely to be reversed in the near future. But whether it will contribute to decoupling in the future is very difficult to predict, especially since leakage effects are likely to play a role.

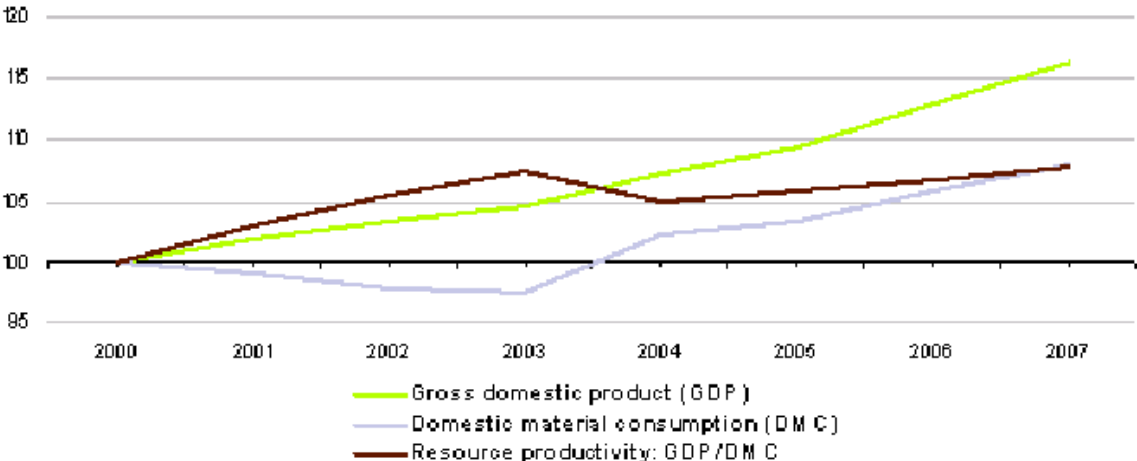
Reducing weight

The Domestic Material Consumption (DMC) of an economy measures the total weight of materials consumed in a country. A reduction in DMC relative to GDP can be achieved through product miniaturisation, replacing heavy materials by lighter materials and the digital transport of information and entertainment (Ballingall *et al.*, 2003).

GDP is expressed in monetary terms, while tonne-kilometre data are by definition expressed in tonnes (per kilometre). Therefore, if goods become more expensive in real terms (adjusted for inflation) while the weight of the goods remains the same, this causes a divergence between GDP and tonne-kilometre trends. With respect to so-called 'value densities' (the value/weight ratio), there have been conflicting pressures in the market. Products are increasingly becoming sophisticated (hence, more expensive) while at the same time, market liberalization and productivity gains are having a downward pressure on prices (McKinnon, 2006). Unfortunately, data on value density are quite unreliable because they are imputed from trade statistics.

In the EU-27 countries, a reduction in DMC relative to GDP has taken place between 2000 and 2007, and this is expected to have contributed to decoupling (see Figure 2.5). But, according to McKinnon (2006), the importance of weight reduction for decoupling in the UK in earlier years has been small, as the average value density in the UK increased only slightly from 1985-1995. On the other hand, average value densities have contributed negatively to decoupling in Denmark; they explain 0.36 percentage point of the annual growth rate of 1.94% in freight transport. The average value density played a large role in the years 1981-1983, but on average there has only been a small tendency for the weight of products to increase per monetary unit (Kveiborg and Fosgerau, 2005).

Figure 2.5: Resource productivity in EU-27



Source: Eurostat (2011)

The potential for dematerialisation in the future is very difficult to determine, since global production processes are difficult to influence. Schleicher-Tappeser *et al.*, (1998) estimate the potential for dematerialisation policies until 2020 as follows:

- 5% for substitution of material products by services;
- 5% for increased durability of products;
- 5% for miniaturisation.

Unfortunately, this is only a rough estimate as there is no explanation in the paper on how these estimates have been arrived at.

Reduction of the spatial range of material flows

The second mechanism that might contribute to decoupling of freight transport is the reduction of the spatial range of material flows. This would mean that the past trend of production and supply chains becoming more dispersed comes to a halt.

In the globalisation process, differences in factor costs have played a major role. Labour is likely to be the most important factor costs in this respect. The continuing quest for the lowest labour costs has shifted production of labour-intensive products in recent decades from Western Europe to Asia and Eastern Europe. Sometimes, rising labour costs have caused production to shift from one country to another within periods of only a few years. An example of this is the textile production, which in the second half of the twentieth century has first shifted from Europe to Japan, then to Hong Kong, Taiwan and South Korea, and more recently, to China, Vietnam and Cambodia (Economist, 2011). Production chains have become more spread out globally, as raw materials and intermediate inputs are sourced from all over the world.

Not only wage differences have influenced the globalization process, but also trade liberalization and transport costs. With respect to the former, significant decreases in average import tariffs can be observed, as worldwide average tariffs dropped from 8.6% to 3.2% in the period 1960-1995 (Hummels, 2007). However, the influence of trade liberalization has not reached full potential yet. One recent study concludes that full trade liberalization could lead to another 5.8% growth in the value of trade, and twice this rate when expressed in kilograms (Hummels, 2009). Trade growth will mainly take place in goods such as agriculture that are currently the most protected. Due to liberalization, trade with distant trading partners will grow at the expense of nearby partners, such as other EU countries. As a result, emissions may grow as much as 10%.

Regarding transport costs, especially the costs of air transport have fallen sharply, with a factor 10 between 1955 and 2004. On the other hand, the cost of maritime shipping have decreased somewhat but a steep decline in costs is not evident from the data (Hummels, 2007). The author concludes that transport costs may have played a more modest role in the growth in international trade than commonly assumed by economic historians.

Below, we discuss a number of ways through which this pattern of globalisation could be broken.

Reduction in the number of links in the supply chain

Reducing the number of links in the supply chain contributes to decoupling, since usually the different steps in the production process and supply chain occur at different locations. The handling factor is a measure of the number of separate freight journeys in between the source of the raw material and the point of sale (McKinnon, 2003).

The process of vertical disintegration in some manufacturing sectors - meaning that non-core activities are subcontracted to other companies - has influenced the number of links in the supply chain positively. On the other hand, many retail businesses have streamlined the transport of products to the point of sale, involving fewer distribution centres. The direction of the influence of the handling factor is therefore ambiguous, which could explain the lack of a clear trend in its value (McKinnon, 2003).

In Denmark, the observed reduction in the handling factor indicates that logistical chains have become smoother because goods are involved in fewer trips by truck. However, data quality is an issue because data are derived from different sources and do not include border-crossing journeys (Kveiborg and Fosgerau, 2005). In the UK, data on handling factors

exists only for the period 1985-1995 and in this period, the average handling factor remained stable or even increased (McKinnon, 2006).

The number of links in the supply chain is sometimes enhanced by legislation encouraging transport (Pastowski, 1997). An example of such legislation is the EC regulation protecting the monopoly that certain regions have on carrying the name of that particular region (e.g. Parma ham, feta cheese), which encourages transport because similar products could just as well be produced close to the consumer. The transport of pigs from the Netherlands to Italy and back again as hams would become superfluous.

Spatial structure of the supply chain

In the past decades, the average length of haul or the total length of the different links in the supply chain has been rising steadily. Within Europe, the growth rate in the average length of haul has been 1.5-2.0% per year, causing about two-thirds of the growth in road tonne kilometres in Europe. Three causes can be identified (McKinnon, 2003):

- Wider sourcing of supplies and expansion of market areas;
- Centralisation/concentration of production, warehousing and terminal capacity; and
- Development of hub-satellite systems, in which freight is concentrated in 'satellite depots', transported to a 'hub' and then via other hubs and satellite depots transported to the point of sale.

However, there is a cut-off point after which the benefits of spatial concentration (economies of scale in production, lower stockholding required) no longer outweigh the additional transport costs (McKinnon, 2006). Furthermore, it seems there are other (long-term) trends in factor costs that might influence the spatial structure of the supply chain, of which the most important ones are:

- Labour cost differences are expected to even out; and
- Transport costs will probably rise .

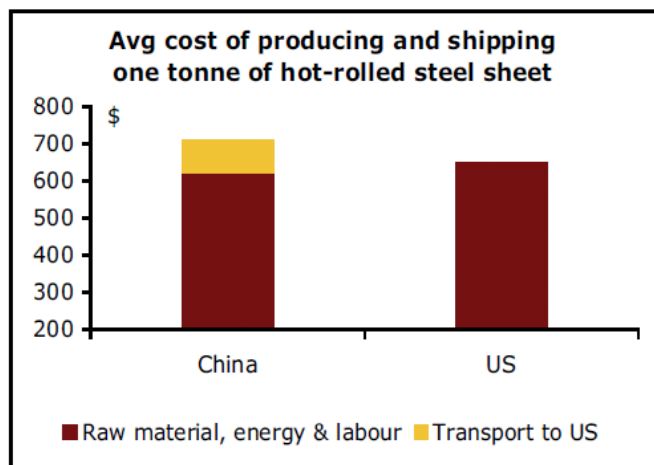
With respect to labour costs, the globalization process will in the long run at least partly even out international wage differentials. For example, in China, increased demand for labour is creating upward pressure on labour costs. Increasing labour costs, combined with other important economic variables such as rising transport costs, may turn the tide in favour of local production processes. This may increase demand for textiles from Mexico (in case of the US) and from Eastern Europe (in case of the EU) instead of textiles from Asia. However, this process is not expected to have a large influence in the coming decades, as there are still many countries in Asia and Africa where wages are very low. Only in the long run (up to 2050), the decrease in global wage differentials may be an important process to be considered.

Secondly, the following quote illustrates the importance of transport costs:

“In a world of triple-digit oil prices, distance costs money. And while trade liberalization and technology may have flattened the world, rising transport prices will once again make it rounder” (Rubin and Tal, 2008).

Rubin and Tal (2008) provide an illustrative example of how transport costs affect the competitive advantage of local industries. In 2008, for the first time in more than a decade, steel produced in the US was cheaper than steel produced in China. Although the latter has a small production cost advantage, the transportation costs have an opposite effect on the market price of steel in the US (Figure 2.6).

Figure 2.6: The cost advantage of US steel producers over China (2008)



Source: Rubin and Tal, 2008

Transport costs are influenced by oil prices, but also by environmental legislation such as the inclusion of aviation in the EU ETS from January 2012 onwards. Moreover, a worldwide carbon tax would not only influence total demand, but also the distribution of transport over the different transport modes. If such a tax is implemented, maritime transport is likely to gain market share at the expense of aviation due to the higher carbon intensity of air transport. Especially the faster modes of transport would thus become more expensive, which impacts globalisation especially for those sectors where maritime transport is no real alternative (for example the cut-flower sector). Especially those sectors are likely to see spatial spread if a carbon tax is introduced.

Although there is no doubt that pricing measures influence decisions on the spatial structure of production and supply chains, some critical notes have been placed by McKinnon (2003). He notes that the cost trade-offs that companies face in structuring production and distribution systems cover not only transport, but also manufacturing, inventory, warehousing and handling. Therefore, “tilting these cost trade-offs sufficiently to induce a return to more localised and decentralised patterns of production and distribution would require very large increases in transport costs (generally in excess of 100%)”. McKinnon (2003) cites research on the possibility of decentralising the production chains of strawberry yoghurt and cars, which could lead to reductions in freight transport of about 70% for these products. However, it is noted that this would increase consumer prices, as inputs/intermediary products used in production are no longer chosen on the basis of price, but on availability in the region. In the case of car assembly, at least a 5-fold increase in transport costs would be needed to arrive at such a vertical integration at the regional level.

Furthermore, on a more local level one could argue that spatial concentration will eventually come to an end as infrastructure networks become more and more congested, as congestion constitutes in fact a rise in transport costs. This argument has been made for the UK, where the level of congestion on motorways has increased by 16% between 1998 and 2002 (McKinnon, 2006). In the 1980s, spatial concentration was very strong, but between 1998 and 2003, spatial concentration has increased only marginally. This points to the decreasing importance of spatial concentration, which is in line with the stabilisation of the average length of haul for road freight in the same period (*Ibid.*). However, in Denmark trip lengths have been increasing up to now and they have been responsible for 0.72 percentage points of the annual growth in tonne kilometres (Kveiborg and Fosgerau, 2005).

To conclude, a recent report by the Boston Consulting Group (2011) identifies seven industry clusters (including transportation goods and electrical equipment) that are most likely to reach a “tipping point” around 2015. At this point, China’s decreasing cost advantage will

lead companies to rethink their production location of goods meant for sale in the US. In a substantial number of cases, companies will shift production back to the US or to closer-by Mexico. However, the production will only partly return to the US, as some production will move to other cheap labour countries such as Cambodia.

If the increase in the degree of spatial concentration is stabilized or reversed, transport will reduce from a global perspective. This may result in decoupling if the reduction in transport is not undone by an even bigger decrease in GDP growth.

Optimisation of transport organisation

The third mechanism regarding freight transport is the optimisation of transport organisation, which has some overlap with the second mechanism, the reduction of the spatial range of material flows. It should be noted that our definition of decoupling involves tonne kilometres, not vehicle kilometres. Some measures improving the optimisation of transport organisation that follow from the literature would reduce vehicle kilometres but not tonne kilometres. A further liberalisation of the cabotage legislation - which reduces empty running of trucks, barges, etc - is an example of such an optimisation. A second example is an increase in vehicle load factors.

Optimisation of transport organisation could be realised by the use of computerised vehicle routing and scheduling (CVRS) software. By implementing such equipment, travel distances could be reduced by around 5 to 10%, or even 20% (McKinnon, 2003). However, the widespread adoption of computer software in recent years makes it likely that these benefits have already been reaped to a large extent.

Secondly, SACTRA (1999) notes that when road capacity is scarce (e.g. the infrastructure network is congested), there may be economic benefits from reallocating road capacity by reserving space for vehicles with high occupancy rates or putting in place selective bans on certain vehicles (lorries) on certain times of the day. The efficiency of transport could improve, resulting in local economic benefits. The empirical evidence on economic benefits concerns local cases, however, no evidence exists on a national level.

2.4.2 Relative importance of different decoupling drivers

To conclude, it is very interesting from a policy perspective to consider the relative weight of the possible drivers of decoupling freight transport. McKinnon (2006) provides possible causes of the observed decoupling of road freight transport (tonne kilometres) in the UK in the period 1997-2004 and attempts to test empirically to what extent the hypothesized causes have indeed influenced decoupling. Table 2.1 lists the relative contribution of these variables. In some cases, the contribution is expressed in a percentage while in more uncertain cases, the contribution is discussed only qualitatively. It follows from Table 2.1 that the main drivers of decoupling in the UK have been the increased penetration of the haulage market by foreign operators, the erosion of industrial activity to other countries, the decline in the share of road transport in the freight market, and a diminishing rate of spatial concentration. However, the first three drivers do not constitute decoupling from a global point of view. Other decoupling drivers that have been discussed so far in Section 2.4.1 that have a significant impact according to McKinnon, are changes in the composition of GDP and domestic supply chains becoming fully extended (spatial concentration on a local scale). Dematerialisation and a reduction in the average number of links in the supply chain have not played a large role in decoupling.

Table 2.1: Estimated impact of the possible causes of decoupling in the UK

Possible cause of decoupling	Relative contribution
Dematerialisation of the economy	
Dematerialisation	Little
Change in the composition of GDP	Significant
Reduction of the spatial range of material flows	
Reduction in the average number of links in the supply chain	Little
Diminishing rate of spatial concentration	Very significant
Domestic supply chains becoming fully extended	Significant
Optimisation of transport organisation	
Improvement in the efficiency of vehicle routing	Little
Statistical issues	
Change in the systems of statistical accounting	Very little
Decline in road's share of the freight market ¹⁷	22%
Increased penetration of UK haulage market by foreign operators ¹⁸	33%
Erosion of industrial activity to other countries	Very significant
Displacement of freight from trucks to vans ¹⁹	Little
Other	
Increase in the real cost of road freight transport	12%

Source: McKinnon (2006)

Leakage effects – erosion of industrial activity to other countries – could not be quantified by McKinnon (2006), but on a qualitative basis, leakage effects seems to be 'very significant'.

A different study that has attempted to quantify the importance of different freight transport drivers is the study by Kveiborg and Fosgerau (2005). Table 2.2 shows the results from this quantitative research on the contribution of different factors to the growth in freight transport. It follows that the two drivers of decoupling in Denmark have been the change in the production by industry (i.e. economic restructuring) and the decrease in the handling factor. The other factors contribute negatively to the decoupling of GDP and transport growth.

Table 2.2: Average annual growth (percent) for the factors explaining growth in freight transport, 1981 to 1997

Factor	Average annual growth (percent)
Total production	2.43
+ Production by industry	-0.78
+ Commodity mix within industries	0.05
+ Inverse value density	0.36
+ Handling factor (number of links in supply chain)	-1.05
+ Tonkm/ton (length of haul)	0.72
+ Misc. mark-up	0.20
= Tonne km	1.94

Source: Kveiborg and Fosgerau (2005)

To conclude, there is not much evidence supporting a decoupling of freight transport and GDP growth in the near future. From the quantitative and qualitative evidence for the UK and Denmark it follows that economic restructuring has been an important driver of decoupling in

¹⁷ The study studies freight transport by road, not by other modes

¹⁸ The increased penetration of the UK haulage market by foreign operators leads to decoupling because transport performed by foreign truck operators is not included in the UK national statistics.

¹⁹ Road tonne km statistics only cover freight transported by trucks with gross weights in excess of 3.5 tonnes

both countries, but at a global scale these national impacts are probably be (partly) undone by leakage effects. On the longer term a reduction in the spatial spread of supply chains may be possible due to expected increases in transport prices and diminishing wage differences between countries may contribute; these developments in freight transport patterns may result in decoupling if they are not undone by reductions in GDP growth.

2.5 Possible drivers of decoupling passenger transport

In this section, we discuss possible drivers of decoupling passenger transport from GDP growth. First of all, it should be noted that the relationship between passenger transport and GDP is different than that between freight transport and GDP. With respect to freight transport, this relationship works in two ways: the volume of freight transport influences the level of GDP, and the level of GDP influences the volume of freight transport. With respect to passenger transport the relationship works only one way: the level of GDP (and the disposable income of citizens) determines the volume of passenger transport. However, the relationship is not perfect in the case of business travel where additional transport might lead to a higher GDP. In the case of commuter traffic, the relationship only partly holds: when people are willing to travel further to their job, this leads to a more flexible labour market and all else equal, to a higher GDP. Since GDP growth is only to a small extent dependent on the amount of passenger transport the theoretical potential of decoupling passenger transport from GDP is significantly larger than for freight transport.

2.5.1 Identifying possible causes

In this section, we discuss four different (possible) drivers of decoupling passenger transport:

1. A changing consumption pattern
2. Digitisation
3. Urban redensification
4. Increased transport efficiency

A changing consumption pattern

People derive utility from consuming goods, including the consumption of transport. It is possible for people to change their consumption pattern by replacing the 'consumption' of transport by the consumption of other goods, which would result in a reduction in passenger kilometres (pkm). However, if preferences do not change then this would lead to a reduction in utility. In the literature, demand side policies such as kilometre charging have already gained much attention. Therefore, we focus on more structural, autonomous trends in the demand for passenger transport.

A few issues are relevant in this respect:

Income elasticities of passenger transport can be analysed to predict consumption patterns in the future. It is important to know whether income elasticities are smaller or larger than 1 (in other words, is transport a normal good or a luxury good?). When they are smaller than 1, income grows faster than transport and when they are larger than 1, the opposite occurs. Assuming that GDP is a good measure of national income, an income elasticity of less than 1 is expected to lead to decoupling.

For aviation, the long term income elasticities are estimated to lie around 1.4 (Gillen et al. 2004, in PBL and CE Delft, 2010), although there is some evidence that income elasticities

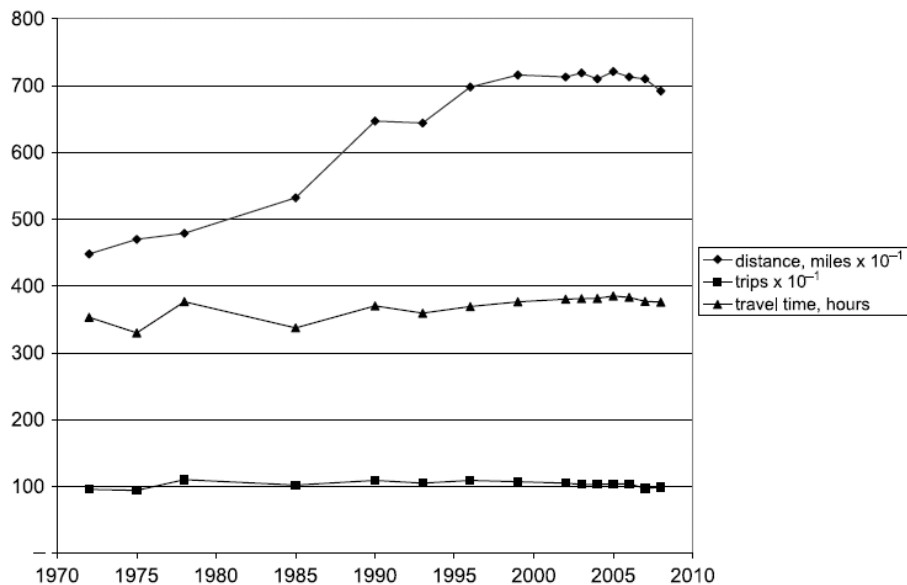
are decreasing. Still, they are larger than 1, which means that an increase in income of 1% leads to an increase in demand for air travel of 1.4%.

The average long term income elasticity with respect to car use is 0.73 according to one meta analysis of the literature (Hanly et al. 2002), Interestingly, another study by Dargay (2007) concludes that the long term relationship between income levels and car use might very well be asymmetrical, because the elasticity is higher for rising incomes (1,09) than for decreasing incomes (0,86). In other words, once people are used to driving their car, they will be reluctant to lower the use of the car, while with rising incomes car use increases faster than the income. The 'rising' income elasticity is the most relevant one, since incomes are on average rising in Europe. It must be noted though that the asymmetry of the elasticities is not always significant for different model specifications.

The implication of the above is that decoupling of passenger transport from GDP growth may probably not be expected in the near future. According to the literature on income elasticities car use is expected to grow approximately in line with the national income and aviation is expected to grow faster than national income (all else equal). However, it should be mentioned that income elasticities are derived based on historical data on passenger transport demand and income levels. Whether the same kind of patterns in the relationship between these two variables may be expected for the future is uncertain. Particularly with regard to car use saturation of car ownership may significantly change this relationship (see below).

The peak travel theory is also concerned with predicting future transport consumption patterns. Metz (2010) provides an interesting analysis of travel demand. He concludes on the basis of empirical research that in the past 35 years, the average travel time (1.1 hour per day), journey frequency (1000 trips per year), journey purposes and proportion of household income spent on travel have not changed much. The only factor that has notably changed is speed (and thus, average travel distance). Since access and choice increase with the square of travel speed, access and choice have increased considerably. In his paper, Metz refers to the access and choice of hospitals, doctors, school, supermarkets, among others. Since choice – like other goods - suffers from diminishing marginal utility, a saturation of demand is to be expected. An empirical analysis of the average distance travelled by passengers in UK points indeed at a peak in travel demand, see Figure 2.7 (Metz, 2010). Again, it should be noted that international aviation is not included in the UK statistics.

Figure 2.7: Travel time (hours pppy), distance (miles pppy) and journeys (pppy) in the UK



Source: Metz (2010)

Also Millard-Ball and Schipper (2010) conclude that from a theoretical perspective, it seems likely that a saturation point of demand for passenger travel exists, because the number of hours spent travelling stays constant (while assuming that the average speed will stabilize), public infrastructure investments are decreasing and the population is ageing. In their paper they conclude that decoupling of passenger transport and GDP seems indeed to have taken place in six industrialized countries (Japan, US, Canada, Australia, Sweden and the UK). However, international air travel is not included in the data used for the analysis.

The findings of Schäfer and Victor (2000) are in line with the two studies cited above, but they reach at a different conclusion on the saturation of demand. The reason is that in their research, international aviation is included and the time horizon (2050) is longer. The empirical evidence on the existence of a fixed travel **money** budget (% of income) across the world means that mobility should rise nearly proportional to income. The existence of a fixed travel **time** budget - which has been confirmed by various empirical studies - combined with an increase in the distances travelled implies that people travel by faster modes.

In their projections, Schäfer and Victor (2000) expect the average travel speed to increase over time, which is why in 2050 only the share of aviation in total transport will still be growing. In developed countries, the share of cars will have declined sharply by 2050. Whether saturation of demand will be reached at all (even in the far future) is not clear, according to Schäfer (2006). If the shift towards faster modes continues and technological innovation will result in ever-faster transport modes, a saturation point may never be reached. Otherwise, the point of saturation depends on the share in total transport and the speed of the fastest travel mode. Travel will then become increasingly luxurious since the travel money budget is expected to remain constant over time and the fastest mode is also the most expensive mode.

Digitisation

The digitisation of daily life, which includes e-commerce, teleworking, e-government and e-learning can contribute to decoupling. Nevertheless, it should be noted that digitisation

usually exhibits rebound effects. The direct effect of the behavioural changes is fewer passenger kilometres, but this effect may be offset by rebound effects, including:

- An increase in freight kilometres (in the case of e-commerce);
- Additional energy use due to heating of the home (in the case of teleworking); and
- People travelling more for other purposes, when a smaller share of the household budget is spent on shopping and commuter travel.

Teleworking and virtual meetings

By teleworking, we mean a shift of the work location from the company to the home, which can occur in the case of salaried employment or self-employment. Virtual meetings can take several forms. One option is audio or voice conferencing, in which participants talk to each other via a common phone number. In the case of web conferencing, participants follow a common presentation via the same website (in many cases accompanied by an audio conference). Finally, videoconferencing involves seeing each other via a video link.

Not all jobs are suitable for teleworking; in CE Delft et al. (2011b) it is estimated that this only holds for 50% of the cases. And even in these cases, employees are expected to be at work at least one day a week. Therefore the maximum mitigation potential²⁰ of teleworking is 40% of the commuting kilometres. In the case of virtual meetings, the maximum mitigation potential increases over time as technologies improve and they become more acceptable. The maximum potential is 40% in 2020 but this may increase to 90% in 2050 (CE Delft et al, 2011b).

Table 2.3 shows the maximum technical mitigation potential of both teleworking and virtual meetings. It follows that the total reduction potential in passenger kilometres of teleworking and virtual meetings is 9.4% in 2020 and 15.1% in 2050.

Table 2.3: Maximum technical mitigation potential of passenger transport in the EU-27

Measure	2020	2030	2050
Relative share pkm commuting in total number of pkm of passenger transport	13%	12%	12%
Relative reduction in passenger kilometres by applying teleworking	5.2%	4.8%	4.8%
Relative share pkm business trips in total number of pkm of passenger transport	11%	12%	12%
Relative reduction in passenger kilometres by applying virtual meetings	4.4%	7.2%	10.8%
Total potential reduction	9.4%	11.7%	15.1%

Source: Adapted from CE Delft et al, 2011b

E-commerce

E-commerce involves the sale of products via the internet. The products are delivered to the home by van or truck, which replaces passenger transport. The mitigation potential of e-commerce depends on the organisation of the storage and delivery, and the extent to which

²⁰ Reduction is achieved when adopted by the largest number of actors possible, taking into account technical and structural constraints (e.g. only 50 percent of the jobs could be performed at home). Rebound effects are not taken into account.

it replaces passenger transport. For example, making only daily delivery rounds for grocery products every day is more efficient than having six rounds every day. Furthermore, from an environmental point of view it is preferable to have only one delivery company delivering door-to-door in one neighbourhood. However, the recent liberalisation of mail delivery services has led to competition between different companies, each having their own warehouses, etc.

The mitigation potentials for the increased use of e-commerce following from various studies are quite uncertain (CE Delft et al., 2011a). A study by Siikavirta (2003) estimates that the maximum CO₂ mitigation potential of e-commerce in Finland is 9% (100% e-grocery shopping assumed). Ecofys (2008), however, estimates that the CO₂ abatement potential associated with a shift of 20% of daily household goods to e-commerce could be 12%. Both studies only take into account the direct effect on transport kilometres. Indirect effects and direct effects related to internet use, energy consumption by warehouses, etc. are not considered. Also rebound effects are not taken into account.

Urban redensification

A change in spatial planning (redensification) is one of the demand side policies for passenger transport mentioned by Ballingall et al (2005). The main goal of redensification is the reduction of short car trips, as they make up a large share of total passenger kilometres. The need for such trips would be reduced when all essential daily activities are within walking or cycling distance of each other. A green urban lifestyle (including an apparent decreased status value of the car) is one of the explanations offered by Tapio (2003) for the observed decoupling in Finland.

In the *EU GHG Transport: Routes to 2050?* project, Paper 8 (Kampman et al., 2009) the emission reduction potential of urban densification has already been discussed. There is no doubt that the spatial structure of a city influences the amount of CO₂ emissions per resident, including those from transport. In fact, some experts estimate the GHG emission reduction potential of urban densification to be around 5%. However, there is no written evidence to support this statement. Furthermore, it should be noted that changes in urban densification are typically very slow, since the life span of buildings is very long and the spatial structure of a city is therefore very static.

Increased transport efficiency

Increased transport efficiency for passengers is a fourth possible cause of decoupling. Much has been written about increasing transport efficiency (see for example Skinner et al. 2010). However, increasing the vehicle load factor (carpooling) would lead to a reduction in terms of vehicle kilometres, but not to a reduction in passenger kilometres. On the contrary, carpooling may even lead to a slight increase in the number of passenger kilometres because sometimes a detour is required to pick people up from their homes.

The increase in the efficiency of (vehicle) routing of passenger transport through the use of GPS is one possible way in which transport efficiency could increase. Other possible measures to increase transport efficiency when transport infrastructures are congested, are reallocation of road capacity (including more pedestrian zones and giving priority to high-occupancy vehicles) and some forms of parking control (SACTRA, 1999). As noted in the case of freight transport, there may be local economic benefits to these measures.

2.5.2 Relative importance of different decoupling drivers

In Section 2.5.1, we have identified four different (possible) drivers of decoupling passenger transport. In contrast to freight transport, it is very difficult to present an analysis of the importance of different decoupling drivers with respect to passenger transport. We will discuss the importance of the different drivers only qualitatively.

- A changing consumption pattern:
 - The decoupling potential of a changing consumption pattern is large, but very uncertain. Based on an analysis of income elasticities and the so-called peak travel theory, it is not likely that on the short to medium term consumption patterns are going to change significantly in terms of demand for passenger transport.
- Digitisation:
 - The digitisation of our economy (including e-commerce and teleworking) is already taking place, and is likely to continue in the future. The decoupling potential depends on technological developments, but is likely to be maximized at 10% (2020) to 15% (2050) of total passenger transport.
- Urban redensification:
 - Urban redensification is a potentially powerful driver of decoupling, but its importance in the coming decades will be low, since changes in urban planning only slowly come about. The spatial structure of a city is to a very large extent determined by its historical development pattern.
- Increased transport efficiency:
 - The potential of an increased transport efficiency cannot be quantified, but its importance as a decoupling driver seems to be low, because the use of GPS systems is already commonplace. Other efficiency measures are likely to reduce the environmental impact (e.g. CO₂) but not demand (passenger kilometres).

To conclude, the analysis presented in Section 2.5 shows no clear indications for decoupling of passenger transport, without policy intervention, in the near future. Although car use is expected to decouple from GDP growth, the resulting reduction in passenger transport demand is expected to be undone by a growth in aviation passenger transport. This picture is in line with the empirical evidence from the EEA as presented in section 2.3, which shows a decoupling of land-based passenger transport from GDP growth and a coupling between aviation and GDP growth in the EU over most of the last 15 years.

2.6 Discussion on decoupling EU, US and Asia

According to Ballingall et al. (2003), the literature on decoupling is very much limited to Europe, since this is where it has received the most attention as a policy objective. Still, a few studies discuss differences in decoupling of transport growth and GDP across the EU, US and Asia. The OECD (2006) provides an overview of trends in GDP and transport in the US and the EU from 1970 onwards. It concludes that in the US, a weak decoupling of passenger and freight transport has occurred in the period 1997-2003²¹. Also in the EU, a weak decoupling of passenger and freight transport has occurred²².

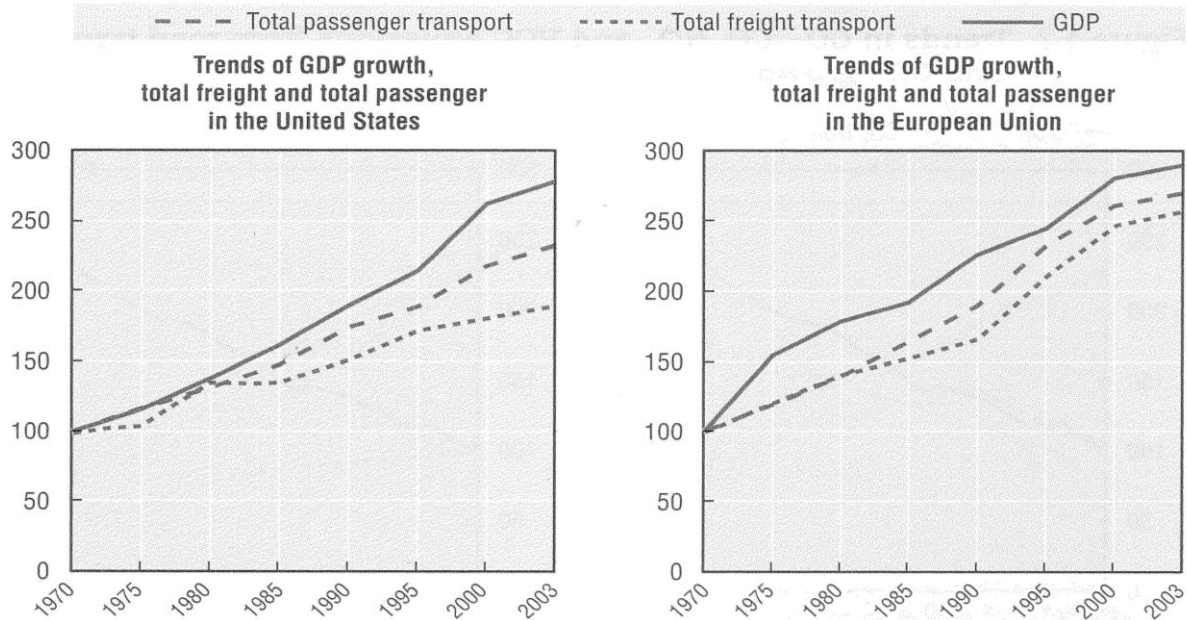
Figure 2.8 makes clear that from 1995 onwards, GDP, passenger transport and total freight transport in the U.S. have diverged, whereas in the EU they have converged. Over the whole period (1970-2003), decoupling in the U.S. has been stronger than in the EU. It should be

²¹ It is not clear whether maritime and international air transport are included in these statistics. The data are sourced from the Bureau of Transportation Statistics, which usually includes only domestic aviation in U.S. passenger miles (see Table 1-37: U.S. Passenger-Miles)

²² Since the statistics are sourced from the European Commission, it is likely that only domestic aviation is included in the statistics

noted though, that a large share of aviation in the US is domestic (due to the size of the country), whereas flying to another member state in the EU is considered to be international aviation. Therefore, the difference in decoupling between the US and the EU is likely to be even larger than shown in the statistics.

Figure 2.8: Growth rates in GDP, total freight and passenger transport



Source: OECD (2006)

It is important to remember that decoupling is strongly related to transport intensity and it entails a decrease in the transport intensity of an economy over time. Therefore, it is useful to look at differences in transport intensity between countries, to learn more about the causes of decoupling and – possibly - how to stimulate decoupling. Tight et al. (2004) conclude that “*differences in transport intensity between countries at similar levels of economic development show that there is no inevitable link between a particular level of GDP and a particular level of environmental load. [...] the adoption of ‘best practice’ by all would make a substantial difference to transport intensity*”. Here, we will look at differences in transport intensity of passenger transport and freight transport.

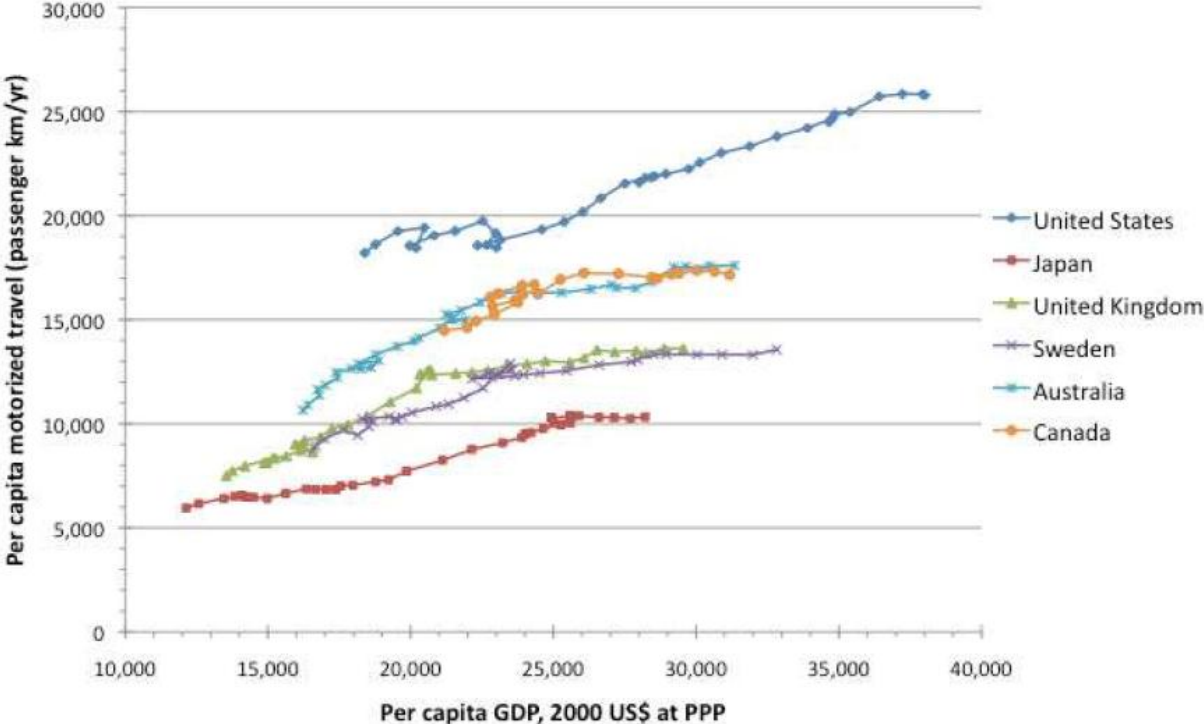
2.6.1 Differences in passenger transport intensity

Figure 2.9 presents evidence on passenger transport intensity for selected countries. The main conclusion from this figure is that in most countries the growth of transport intensity slows down if GDP grows. This implies a weak decoupling of passenger transport growth and GDP growth, which is in line with the findings from Section 2.5. If we compare the different countries, the United States is standing out, as it has by far the highest annual motorized travel and the least evidence of a weak decoupling of passenger transport and GDP growth.

Australia and Canada are the two most sparsely populated countries, which can explain the relatively high number of motorized passenger kilometres. The two countries are very similar in population density, GDP per capita and motorized travel. Japan is the most densely populated country in Figure 2.9, followed by the United Kingdom. What is interesting is that these two countries started off with very similar motorized travel rates, but in the following

years, motorization was significantly higher in the UK, even though they had almost equal levels of GDP per capita.

Figure 2.9: Total motorized travel activity in selected countries 1970-2006/2007



Source: Millard and Schipper (2010)

Figure 2.10, which shows the relationship between GDP per capita and the proportion of journeys undertaken by private vehicles for different cities, shows the same patterns as Figure 2.9. Motorized travel has the highest share in total transport demand in North America. The share of motorized transport in most European cities is significantly lower, while many Asian cities have an even lower share of motorized transport in total transport demand.

The OECD report does not provide an explanation for the differences between vehicle ownership between the EU and Japan. However, it is noted by Millard-Ball and Schipper (2010) that the following factors might influence vehicle ownership:

- Parking constraints, especially relevant for Japan, the UK and dense cities in the US
- Taxes on vehicle ownership, which play an important role in Japan and the EU
- Industrial and land-use policies discouraging motorization in Japan
- Ageing of the population
- Saturation of car ownership among people that do not live in the centre of large cities.

A second explanation for the differences in transport intensity between the EU, the US and Asia is probably urban planning (IEA, 2008). In fact, much has been written about differences in urban development between for example American cities suffering from urban sprawl and compact old European cities. Closely related to urban planning, also investments in public transport and other non-motorised transport infrastructure, as well as policies to discourage car use are important (IEA, 2008).

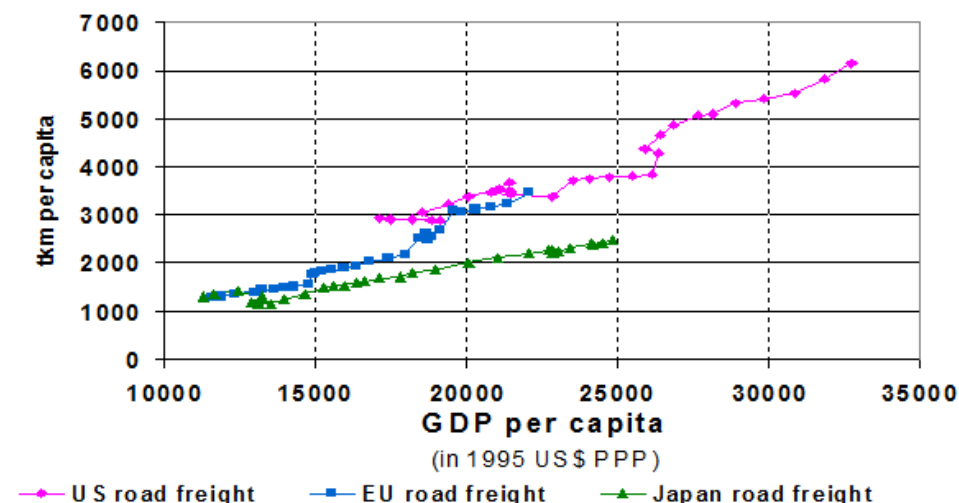
A third explanation for the differences in travel patterns between the US, the EU and Japan are, to some extent, differences in geography. The size of the country (and the share of the country suitable for habitation) determines the degree of concentration of human settlement, and in turn the average distance travelled on a yearly basis. Also social variables, like demography and historical development paths, seem important factors for influencing travel patterns (Millard-Ball and Schipper, 2010).

What may be missing in the literature is the influence of culture, although this is difficult to test empirically. For example, whether or not one has been brought to school by car as a young child is likely to influence one's attitude towards the car. In general, people in the US seem to have a more car-focused lifestyle than people in Europe and Japan.

2.6.2 Differences in freight transport intensity

Figure 2.12 shows developments in road freight intensity against GDP per capita. A first conclusion that can be drawn from this figure is that there is no indication of decoupling of freight transport and GDP growth. This is in line with the findings from section 2.4. Another conclusion from Figure 2.12 is that - at the same level of GDP per capita - road freight intensity is very similar for the US and the EU, while the intensity for Japan is significantly lower.

Figure 2.12: Road freight intensity and GDP per capita (1970-2000)



Source: OECD (2006)

However, since Figure 2.12 shows differences in road freight intensity, we have to take a look at the modal split of freight transport in Japan. Japan has the highest share of road in total transport, but still the lowest road freight intensity. Therefore the total freight transport intensity of Japan must also be low. In the US, the opposite is the case, the share of road transport in total transport is significantly lower than in the EU or Japan, but still it has the higher road freight transport intensity.

Table 2.4: Modal split (percent) of freight transport in the EU, the USA and Japan (2003)

	EU15	USA	Japan
Road	44	31	55
Rail	10	39	4
Inland navigation	3	8	0
Short-sea	39	7	41
Oil pipeline	3	14	0

The OECD (2006) does not provide explanations for the differences in freight transport intensity. Geography is likely to play a role, as the size of the US is much larger than Japan or an individual country in the EU. Therefore, business activity of companies operating nationwide is expected to be much more spatially dispersed in the US Japan and the EU.

2.7 Policy implications

The analyses presented in the sections above show that a significant decoupling of transport and GDP growth will probably not result from ‘autonomous’ developments. Therefore, to realize the decoupling objective as stated in the long-term EU strategy ‘Europe 2020’ (see Box 1 in Section 1.4) a policy intervention seems required. Since the (theoretical) potential of decoupling is larger for passenger transport than for freight transport targeting the policy intervention on passenger transport may be more efficient. Some main policy instruments that could be considered in this respect are:

- Economic instruments;
- Spatial planning policy;
- Speed limits; and
- Macro-economic policies.

Economic instruments

The analyses carried out in the previous sections showed that increasing transport prices could be an important driver of decoupling transport and GDP growth. Increasing transport prices provide firms incentives to reconsider the (spatial) structure of their supply chain and to optimise their transport. Consumers are stimulated to change their consumption patterns (less transport, more consumption of other goods), to make more use of ICT solutions (teleworking, e-commerce) and to increase their transport efficiency. In the longer term higher transport prices may even result in a densification of urban structures.

By internalising the external and infrastructural costs of transport (and removing transport subsidies) most transport prices will be increased, while at the same time they better reflect the actual costs caused by transport. This better alignment of prices and costs not only reduce the incidence of such external and infrastructure costs, but also can increase economic welfare and, in some cases, GDP. (e.g. the reduction of congestion may improve the efficiency of companies' supply chain and hence GDP). The latter is shown by SEO et al. (2008) for the implementation of a differentiated road user charge in the Netherlands. It was estimated that an introduction of a revenue-neutral²³ road user charge for all road users would result in ca. 15% less vkm and a GDP growth of € 1.86 billion (ca. 0.3%) in 2020. Strategies to internalise the external costs of transport are discussed in the IMPACT project (CE Delft et al., 2011). For all modes, most of the external costs (air pollution, noise, accidents, congestion) should preferably be internalised by a differentiated kilometre based charge, with the exception of CO₂ emissions. For the latter carbon content based fuel taxes or emission trading is recommended. More information on these policy instruments could be found in CE Delft et al. (2008) or Van Essen et al. (2010).

Spatial planning policy

The possibilities for decoupling transport from GDP growth are heavily dependent on the spatial structure of economic and social activities. As was discussed in section 2.4.1 changing the spatial structure of companies may be an effective way to realise decoupling of freight transport and GDP growth, while redensification of urban areas could contribute to the decoupling of passenger transport and GDP growth (see section 2.5.1). Moreover, the discussion on differences in decoupling between the US, the EU and Asia in section 2.6 also points out that spatial structure is an important explaining factor of differences in transport intensity. For these reasons, an integrated long term policy strategy for spatial planning, transport (infrastructure) and GHG reduction is recommended. Such an integrated approach could also be applied in the impact assessments (EIA, SEA, CBA) carried out for spatial and infrastructural projects, e.g. meaning that extra traffic generated due to travel time savings are included in the assessments of investments in new transport infrastructure (see Kampman et al., 2009).

Speed limits

The discussion on decoupling of passenger transport shows the important role of travel speed. Due to the existence of a fixed travel time budget of people, the increasing travel speed results in additional transport. Lowering average travel speeds, e.g. by lowering maximum speed limits, could therefore be an important way to decouple passenger transport from GDP growth. For more information on this topic, we refer to Kampman et al. (2009).

Macro-economic policies

As was shown in Section 2.4.1 the economic structure of a country/continent is an important driver of freight transport coupling to GDP growth. Changing this economic structure to less transport-intensive sectors, e.g. a shift from the manufacturing sector to the services sector, may result in a decoupling of freight transport and GDP growth for individual countries/continents. The restructuring of the economy could be realized by investment subsidies for service related companies, providing necessary infrastructure for these

²³ The introduction of the road user charge is combined with a reduction of the fixed vehicle tax levels..

companies (e.g. fast broadband internet connections), tax exemptions, etc. However, it is questionable whether these changes in economic structures result in a global decoupling of freight transport and GDP growth. Since physical and agricultural products still have to be produced, the shrink of manufacturing and agricultural sectors in the EU or individual Member States will likely result in a growth of these sectors in other parts of the world. In the end, this may even result in higher transport levels, since these products have to be transported over long distances to Europe. For this reason, implementing macro-economic policies to realize decoupling of transport and GDP growth should be implemented very carefully.

2.8 Conclusions on decoupling transport growth from GDP growth

In March 2010 the European Commission presented 'Europe 2020' which sets the economic and wider framework for EU policy making in the next 10 years. This strategy is an important element in facilitating the transition to a green economy in the longer term, and the ultimate aim is to decouple economic growth from energy and resource use. However, recent results from the European Environment Agency (EEA, 2011) shows comparable growth paths for freight transport and GDP for the period 1995-2003, while in the period afterwards particularly 'coupling' instead of decoupling has taken place. Comparable results for the relationship between freight transport growth and GDP growth are found for the US and Japan. For passenger transport the evidence on decoupling is less clear; on the one hand, EEA (2010) shows decoupling of land-based transport from GDP growth for the period 1995-2007, but on the other hand 'coupling' of air passenger transport and GDP growth has been reported for the same period. The relationship between growth in total passenger transport and GDP growth in the EU is unclear.

Based on the results presented in this chapter, the same patterns of transport growth and GDP growth as for the period 1995-2007 may be expected for the (near) future. Thus, no significant decoupling of freight transport from GDP growth is expected for the near future. For passenger transport, the weak decoupling of road passenger transport and GDP growth is expected to continue, but this development is expected to be (partly) undone by a fast growth of air travel transport.

The figures on realised and expected decoupling as presented in this chapter show that the Commission's objective to achieve a decoupling of transport and GDP growth is challenging. On the other hand, there is significant (at least theoretical) potential for decoupling, particularly with regard to passenger transport. To realise this potential, an in-depth understanding of drivers and possible ways to enhance decoupling are very important. With respect to the drivers of decoupling freight transport, reduction of spatial concentration (and hence more regional production) and changes in the composition of GDP (shift to less transport intensive economic structures) are identified in the literature as effective ways to realise decoupling. However, with regard to the latter option the possible existence of leakage effects should be carefully considered. For passenger transport, changing consumption patterns and urban redensification are identified as potentially powerful drivers of decoupling. However, autonomous reductions in the demand for transport are quite uncertain, while adapting urban structures will only be effective on the long term. Digitisation and improving transport efficiency, on the other hand, are drivers that could be effective on the short term, but their maximum impact on decoupling is limited.

The analysis carried out in this chapter shows that a significant decoupling of transport and GDP growth will probably not result from 'autonomous' developments in the drivers mentioned above. Therefore, the implementation of policy instruments seems required, of which economic instruments and spatial planning policy (in close alignment with transport (infrastructure) and GHG reduction policies) are considered as the most important ones.

3 Alternative welfare measures and their implications for transport

Objectives:

The purpose of this sub-task was to:

- *Provide insight in the implications of applying alternative measures of growth for the transport sector in general and the decarbonisation of transport*
- *Provide insight in the implications of applying an alternative macro-economic approach to achieve a sustainable economy for the transport sector in general and the decarbonisation of transport*

Summary of Main Findings

⇒ To be completed following Focus Group

⇒ ...

⇒ ...

3.1 Introduction

The aim of this section is to assess the potential implications on transport, in particular on efforts to reduce its GHG emissions, of taking more concrete steps towards delivering a more sustainable economy. Whereas in the previous section, the focus was on the possibilities of, and implications for, decoupling transport growth from economic growth, this section focuses on the potential implications on transport of macro-economic changes that are discussed in other academic and policy debates in the context of a more sustainable economy. In this respect, the work has two elements. In each case, the aim is to identify the potential implications for transport of:

- **Moving “beyond GDP”**, i.e. what the implications for transport might be if other “alternative” indicators were used to complement, amend or replace GDP as the most influential high level indicator of the state of the economy.
- **A more fundamental transition to a sustainable economy**, i.e. if, in addition to simply changing an indicator, more fundamental changes were made to the rules and principles that guide policy decisions.

The work is based on a literature review of the debate in these two areas, followed by an analysis of the potential implications for transport. The focus of the work was not on the detail of the “alternative indicators” that might be used to complement, amend or replace GDP, or on the detail of the “transition to sustainable economy”. Instead, the aim was to identify the important, relevant elements and implications of these approaches by the respective literature reviews; these are presented in Sections 3.2.1 and 3.3.1, respectively.

The aim of these approaches – either to adopt “alternative indicators” or to undertake a “transition to a more sustainable economy” – is effectively to change the framework within which policy decisions are made. The use of an “alternative indicator” would change the main macro-economic indicator that is currently used as a measure of “progress”, i.e. GDP, by amending it, replacing it, or developing a wider indicator set, that pays relatively more attention to environmental and social considerations. Such an approach does not have any direct implication for policy-making, but does change one of the main success criteria (i.e.

GDP) against which policies would be measured. Hence, as a result of the use of an alternative indicator, it is likely that policy-makers will, if not immediately then at least eventually, take account of the different implications of their policies on the new macro-economic indicator or the wider indicator set when making their decisions. In this respect, the adoption of an alternative indicator would have an indirect impact on policy making.

On the other hand, a “more fundamental transition to a sustainable economy” implies the need for broader reform, which could include the adoption of an alternative indicator. The broader reform might include, for example, the application of principles that could directly affect policy making, such as the user pays and the polluter pays. Broader reforms might also require changes in attitudes or behaviour, e.g. to our approach to work or desire to travel. Consequently, this transition requires wider, more concerted action.

Hence, the adoption of a complementary indicator to GDP, e.g. environmental accounts, implies less of a potential change than would “a more fundamental transition”. However, each of these different approaches requires, at least to some extent, that better account is taken of wider environmental and social considerations at the macro-economic level. In this way, they potentially change the macro-economic framework in which policy decisions are made by raising the profile of environmental and social considerations in the decision-making process. Hence, the adoption of these “alternative approaches” has the potential to lead to different frameworks for policy making and consequently to different economic structures. This is the basis for the assessment undertaken in this section.

Where transport is considered within the literature, this is noted in the respective literature reviews. However, where transport is mentioned it tends to be to note specific examples of transport that what would, or would not, be consistent with the new approach. The aim of the work was take the thinking with respect to transport beyond these simple examples and reflect on what the implications of adopting these “alternative approaches” might be for transport. Clearly, this will have to be based on a number of assumptions, which are clearly stated.

Given the budget allocated, and the scale of the subject being examined, the work undertaken in this task, and which is presented in sections 3.2.1 and 3.3.1, below, is only an additional contribution to the debate, not the final conclusion. However, the aim is to try to provide some further insights on what the implications of moving towards a “more sustainable economy” might mean for transport bearing in mind the wider context of the project, i.e. the need to significantly reduce transport’s GHG emissions.

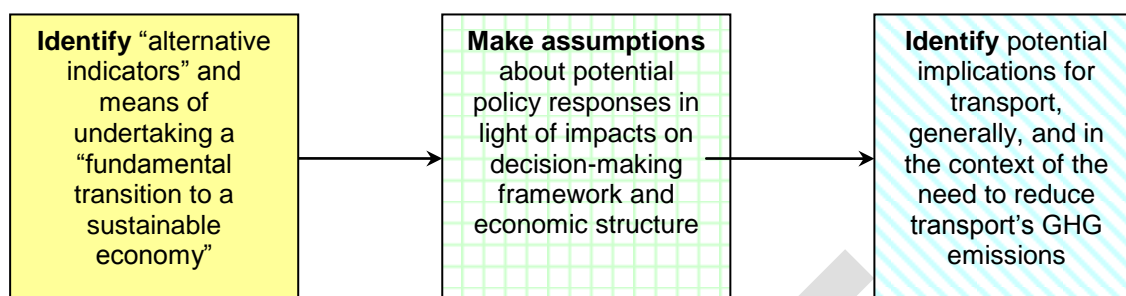
3.2 Moving beyond GDP

As noted in section 3.1, this section focuses on, first a literature of the potential “alternative indicators” that might be used to complement, adjust or replace GDP, followed by an assessment of the potential implications for transport. A diagrammatic representation of the approach adopted can be found in Figure 3.1. The important, relevant elements and implications of the alternative indicators were identified by the literature review (the yellow box in Figure 3.1) and are presented in Section 3.2.1. This briefly sets out why it is considered by some to be important to “move beyond GDP” and then provides an overview of potential indicators that have been discussed in this respect.

In order to identify what effect these different decision-making frameworks might have on transport policy, it has been necessary to make simple assumptions about these potential policy responses (i.e. the green, squared box in Figure 3.1). On the basis of these assumptions, the potential implications of adopting these “alternative indicators” for the transport sector generally, and in the context of the need to reduce transport’s GHG

emissions in particular, are identified (the blue, striped box in Figure 3.1). Section 3.2.2 presents the results of this assessment.

Figure 3.1: Approach taken



3.2.1 Literature review

There has been a lot of academic debate, and an increasing amount of policy work, on the subject of the benefits and inadequacies of the use of GDP and the potential to adopt “alternative indicators” to move beyond GDP. Within the resources allocated for this paper, it has not been possible to provide an overview of all the main discussion points and sources. However, fortunately it has been possible to draw on the background papers developed for the 2007 conference of the “Beyond GDP Initiative”²⁴. This conference, hosted jointly by the European Commission, European Parliament, Club of Rome, OECD and WWF, brought together academics and policy makers from around the world to discuss and debate the merits of the options for moving beyond GDP. This section draws on the papers developed for that conference²⁵. The intention of this section is not to consider how to move beyond GDP, but simply to present some of the arguments for and against going beyond GDP and to provide a brief overview of some of the key indicators that have been developed in this context.

GDP as welfare indicator

Goossens *et al* (2007)²⁶ underline that indicators, such as GDP, are an important tool for policy makers. In this respect GDP has many advantages, as it is simple, linear, can be applied universally and takes the “observable market prices” as its guiding principle. Consequently, it plays an important role in macroeconomic policy. However, the authors note that GDP should not be interpreted as a “general sustainable development and welfare measure”. Problems with GDP arise when it is confused with sustainable welfare growth by people and policy-makers. The authors note that, while there is a correlation, it is “highly conditional” and “void of substantial causality”. If an indicator aims to measure sustainable development and welfare, it must take account of non-market activities not covered by GDP, including reducing unemployment, free time and social interaction.

Similarly, Wesselink *et al* (2007)²⁷ note that GDP is often regarded as a proxy indicator of human development and well-being, but that the link between economic growth and social welfare is not straightforward. In this respect, they argue that GDP is limited, as it does not include factors that play an important role in well-being (both of people and of nature), such as non-market goods and services. It also focuses on activities, rather than assets, which can also be important particularly in the longer-term. Canoy and Lerais (2007)²⁸ note that

²⁴ www.beyond-gdp.eu

²⁵ For the original sources, those interested should refer to the Background Papers themselves.

²⁶ Goossens Y, Mäkipää A, Schepelmann P, van de Sand, I Kuhndtand, M and M Herndorf (2007) *Alternative progress indicators to Gross Domestic Product (GDP) as a means towards sustainable development* IP/A/ENVI/ST/2007-10, study provided for the European Parliament's Committee on the Environment, Public Health and Food Safety

²⁷ Wesselink B, J Bakkes, A Best, F Hinterberger and P ten Brink (2007) *Measurement Beyond GDP* Background document for the conference 'Beyond GDP', 19-20 November, Brussels

²⁸ Canoy M and F Lerais (2007) *Beyond GDP: Overview paper for the Beyond GDP conference*. Bureau of European Policy Advisers (BEPA), European Commission

Simon Kuznets, who first developed national accounts for the USA (which enabled the calculation of GDP), acknowledged its short-comings. He told US Congress that the welfare of the country could not be inferred from its national income. Canoy and Lerais suggest that one of the main problems with GDP is its apparent pre-dominance in policy making. They suggest that it has become very difficult to argue for a policy that increases well-being, but adversely affects GDP. As a result, policies that focus on improving well-being end up being “underrepresented” in the policy mix.

Alternative indicators of welfare

In response to these concerns, a number of “alternative indicators” to GDP have been developed. Generally, according to Goossens *et al*, these can be classified, as either:

- Adjusting GDP;
- Replacing GDP; or
- Supplementing GDP.

They argue that *adjusting* GDP has its advantages, as it requires converting more activities to monetary values in a way that is compatible with the activities already included in GDP. However, they note that in the short- and medium-term, such an approach seems unlikely to be adopted due to the potential difficulties of reaching a consensus about the monetary valuation of current non-market activities. They do not consider that *replacing* GDP is a realistic option, as GDP has many advantages and is generally useful, as long as its limitations are recognised. Hence, the report concludes that *supplementing* GDP would be the best option, so that other indicators could be used alongside GDP in order to put it into an “appropriate socio-ecological context”. Other authors, e.g. Canoy and Lerais, classify indicators in a similar way. In this report, we will not make a choice between these types of indicator; rather we will consider the implications of a selection of each type of indicator on transport.

Several of the “Beyond GDP” Background Papers present assessments of various indicators that have been developed that could be used to go beyond GDP. Goossens *et al* provide a useful summary of the main features of many of the indicators that they review, which can be used to develop assumptions for the assessment of the following section (see Figure 3.1). The relevant information for this assessment has been extracted and is presented in Table 3.1.

Within Table 3.1, the second stage of the assessment is also undertaken. Before discussing this assessment in any detail, it is first necessary to be clear about the assumptions that were made that underlie the assessments in the table. First, it is assumed that GDP is adjusted, replaced or supplemented only in the EU – the rest of the world continues to use the indicators that they currently use, e.g. unadjusted GDP. Hence, some of the indicators in Table 3.1 were not covered in the subsequent assessment presented in Section 3.2.2, as these would bring no added value if applied in the EU, largely because these indicators focus more on development and so are more appropriate for countries outside of the EU.

Second, the assumptions presented in Table 3.1 are necessarily simplified and based on our understanding of the indicators on the basis of the contents of the papers reviewed. In reality, the relationship is very likely to be much more complicated, but for the purposes of this assessment, such simplified assumptions are necessary. Assumptions have also been made for the particular types of indicator. For example, a set of assumptions relate to the way in which the indicator is adopted. When an indicator would be used to *adjust* GDP, it is assumed that the elements quoted under the “Main features of relevance” are included in the adjusted indicator. Where an indicator *replaces* GDP, it is assumed that this indicator is used instead of GDP, and so GDP is no longer used for policy-making.

When an indicator is used to *supplement* GDP, it is assumed that this indicator carries as much as weight as GDP in the policy-making process. If these supplementary indicators were adopted with the aim of delivering a sustainable economy and society, this would appear to be an appropriate assumption. Additionally, any assumption other than an equal weighting would make any meaningful assessment even more difficult. Of course, if weights were applied to any supplementary indicators that meant that environmental and social considerations were not considered to be equal to GDP, then the impacts of using these indicators would depend on the relative weights allocated to the various indicators.

The results of the second stage of the assessment are presented in the final column of Table 3.1. This aims to identify what the potential impact of adopting the respective indicator might be on the decision-making process, i.e. what factors would potentially receive a higher priority than they do under a system that focuses on GDP as its main indicator of the state of the economy and society.

DRAFT

Table 3.1: Main features of selected “alternative” indicators

Indicator	Source, used by	Main features of relevance	Relevance for EU	Assumptions about potential policy responses (if relevant for EU)
Indicators that could adjust GDP				
Genuine Progress Indicator (GPI) and Index of Sustainable Economic Welfare (ISEW)	Redefining Progress, USA	Corrects GDP by a series of monetised environmental and social factors; both adjust for income inequality and environmental degradation	Yes, potentially	More incentive to develop transport policies that: <ul style="list-style-type: none"> - Address income inequality - Contribute less to environmental degradation
Green GDP	State Environmental Protection Agency, China	Corrects GDP by a monetised environmental factors, including depletion of natural resources and environmental degradation	Yes, potentially	More incentive to develop transport policies that: <ul style="list-style-type: none"> - Contribute less to depletion of natural resources - Contribute less to environmental degradation
Genuine savings	World Bank	Provides estimates for savings (and wealth stocks) by considering environmental and social factors, including depletion of natural capital, loss of welfare from sickness and investment in human capital	Yes, potentially	More incentive to develop transport policies that: <ul style="list-style-type: none"> - Contribute less to depletion of natural resources - Invest in human capital - Reduce ill health
Indicators that could replace GDP				
Human Development Index	United Nations Development Programme	Combines traditional GDP data with social indicators	Limited relevance	Not applicable, as mainly focused on development
Ecological footprint or carbon footprint*	WWF and Carbon footprint network	Measures the ecological pressure of humanity on the biosphere	Yes, potentially	Focus would be on: <ul style="list-style-type: none"> - Reducing the ecological/carbon footprint of EU consumers
Happy Planet Index	New Economics Foundation, UK	Aggregates data on life satisfaction and expectancy with environmental footprint data in one index; it effectively multiplies the first two, then divides by the latter	Yes, potentially	Focus would be on: <ul style="list-style-type: none"> - Increasing life expectancy - Increasing life satisfaction - Reducing environmental footprint
Environmental Sustainability Index (ESI) and Environmental Performance Index (EPI)*	Yale University, USA and World Economic Forum	Tracks environmental sustainability and a society's capacity to improve its environmental performance over time	Yes, potentially	Focus would be: <ul style="list-style-type: none"> - Reducing depletion of natural resources - Reducing environmental degradation

Indicator	Source, used by	Main features of relevance	Relevance for EU	Assumptions about potential policy responses (if relevant for EU)
Regional Quality of Development Index (QUARS)	Sbilanciamoci!, Italy	Aggregates social, economic and environmental data in one index, including rights (e.g. social inclusion), equal opportunities and health, education and culture and participation, as well as the economy and the environment.	Yes, potentially	More incentive to develop transport policies that: <ul style="list-style-type: none"> - Give a higher priority to social issues, e.g. providing access and reducing inequality - Give a higher priority to reducing transport's environmental impact
Indicators that could supplement GDP (based on national accounts systems)				
System of Economic Environmental Accounts (SEEA)	UN, various statistical offices	Integrated environmental-economic "satellite" accounts	Yes, potentially	More incentive to develop transport policies that: <ul style="list-style-type: none"> - Give a higher priority to reducing transport's environmental impact
National Accounting Matrix including Environmental Accounts (NAMEA)	Various statistical offices	Satellite environmental accounting matrix to conventional economic input-output tables	Yes, potentially	More incentive to develop transport policies that: <ul style="list-style-type: none"> - Give a higher priority to reducing transport's environmental impact
System of Economic and Social Accounting Matrices and Extensions (SESAME)	Statistics Netherlands	Satellite account describing economic, social and environmental aspects of human activities in an integrated framework	Yes, potentially	More incentive to develop transport policies that: <ul style="list-style-type: none"> - Give a higher priority to social issues - Give a higher priority to reducing transport's environmental impact
Indicators that could supplement GDP (by setting social and environmental information in relation to GDP)				
Sustainable Development Indicators	Eurostat	Put GDP in the framework of other economic, social and environmental indicators	Yes, potentially	More incentive to develop transport policies that: <ul style="list-style-type: none"> - Give a higher priority to social issues - Give a higher priority to reducing transport's environmental impact
Decoupling indicators	Various statistical offices	Sets pressure indicators in relation to socio-economic driving forces with the aim of decoupling economic "goods" from environmental "bads"	Yes, potentially	More incentive to develop transport policies that: <ul style="list-style-type: none"> - Give a higher priority to reducing transport's environmental impact
Political and civil freedom indicators	Freedom House, UK	Provides an aggregated index of individual liberties based on expert judgements	No	Not applicable, as all EU countries ranked the same
Millennium Development Goals (MDG)	United Nations	Provide a system of goals and target for global development	No	Not applicable, as mainly focused on development

* These indicators have been retained in the position presented in the original paper, but might be more relevant when used to complement GDP (see the discussion in Section 3.2.2)
Source: Based on Table 6 of Goossens *et al* (2007), but also draws on the more detailed description in the main text of the paper, where necessary

3.2.2 Potential implications for transport

An overview of the assessment of the potential impact on transport from the adoption of the indicators listed in Table 3.1 is provided in Table 3.2. The first assessment – the potential impact on transport policy – is based on an assessment of the potential implications of the application to transport policy of the assumptions in the final column of Table 3.1. The final column of Table 3.2 notes the potential implications for transport's GHG emissions, as a result of the adoption of the respective indicators. The original intention was to develop separate tables for passenger and freight transport, but, as a result of the assumptions made in Table 3.1, few additional implications of interest were identified for freight transport. Hence, Table 3.2 covers the implications for transport policy generally.

The potential impact on transport policy presented in Table 3.2 is largely based on the relative change in the attention decision-makers would pay to environmental and social considerations, compared to economic considerations, as a result of the use of the adjusted, complementary or new indicator. Hence, the use of the **adjusted** indicators would increase the attention that decision-makers would give to environmental considerations and, in two cases, to social considerations. Hence, with respect to the environment, a higher consideration to, for example, the depletion of natural resources or environmental degradation, i.e. natural capital, has the potential to shift the focus of transport policy away from activities that cause more damage to the environment, such as longer distance travel, the use of transport generally and the construction of more transport infrastructure towards demand management and optimising the use of existing infrastructure and vehicles. This is due to the fact that such transport activities are more likely to degrade the environment or deplete natural resources, so would be more likely to act to decrease adjusted GDP. In this respect, transport policy could focus on enabling transport that had a greater likelihood of increasing adjusted GDP, i.e. transport that would provide high economic benefits to counteract the value of any adverse environmental impacts. This might result in, for example a focus on enabling transport of high economic value (e.g. moving high value freight).

However, where social considerations, such as reducing inequality, investing in human capital and reducing ill health, are given equal value in the adjusted GDP, any transport policy that led to adverse social impacts, e.g. increased inequality, decreased opportunity or increased adverse health effects, would reduce adjusted GDP. Hence, if social considerations were included in adjusted GDP, there could be an increased focus within transport policy on transport activities that have more potential to deliver social benefits, which could be local transport, particularly in disadvantaged areas, or those modes that make people more active, e.g. cycling and walking. On the other hand, action to reduce inequalities in the amount of travel that people undertake (either directly or through reducing inequalities in income) could result in policies to enable more travel by all modes, which could act to increase the demand for infrastructure and vehicles of all types.

The potential transport policy responses to indicators that could **replace GDP**, as defined by Goossens *et al*, are more varied, as some of the revised alternative indicators do not appear to have an economic or a social element. For example, using ecological (or carbon) footprints or ESI/EPI instead of GDP, would risk downgrading economic and social considerations at the expense of environmental considerations. In such cases, the most obvious policy response would be to reduce transport demand, and even the supply of infrastructure, in order to reduce the adverse environmental impacts of transport. However, taking such an approach would overlook the potential positive role that transport plays in relation to the economy and society. In this respect, it would seem more relevant to apply these two indicators to supplement rather than replace GDP. In this respect, the impact could be similar to the use of other complementary indicators that focus on the environment (see below).

Table 3.2: Potential impact of using “alternative indicators” on transport

Indicator	Potential impact on transport policy	Impact on CO ₂ emissions
Indicators that could adjust GDP		
Genuine Progress Indicator (GPI) and Index of Sustainable Economic Welfare (ISEW)	<ul style="list-style-type: none"> - Focus could shift on increasing opportunity and access of the less well off, which could stimulate local public transport - Increased attention to reducing inequalities (either within transport specifically or more generally) could increase the demand for travel - Increase attention on restricting the use of (more polluting) vehicles, which could increase the role of demand management - Focus moves from providing more infrastructure to optimising use of existing infrastructure and vehicles, in order to minimise environmental degradation 	- Unclear, as it would depend on the balance between the reduced demand arising from actions to improve the environmental performance of transport and any increases in demand resulting from action to reduce inequalities
Green GDP	<ul style="list-style-type: none"> - Increase attention on the use of (more polluting) vehicles, which could increase the role of demand management - Increase attention on the provision of infrastructure, which could stimulate measures to optimise use of existing infrastructure and vehicles 	- Reduced, as increased focus demand management and optimising of use of existing infrastructure and vehicles
Genuine savings	<ul style="list-style-type: none"> - Increase attention on the provision of infrastructure, which could stimulate measures to optimise use of existing infrastructure and vehicles - Focus could shift on increasing opportunity and access to education and economic opportunities, which could result in measures to improve local access (which could be private or public transport) - In the longer term, higher education and incomes could increase the demand for travel 	- Unclear, as it would depend on the balance between the reduced demand arising from actions to improve the environmental performance of transport and any increases in demand resulting from action to address social concerns
Indicators that could replace GDP		
Ecological footprint or carbon footprint	- Focus could shift to demand reduction, as the likely focus of action in the absence of economic and social considerations	- Reduced, as focus on demand reduction and environmental efficiency
Happy Planet Index	<ul style="list-style-type: none"> - Shift to maximising use of existing capacities to enable access and mobility, i.e. to increase social benefits of transport instead of economic benefits, per unit of environmental degradation - Potential pressures for more travel, if considered to be important to life satisfaction 	- Not clear, as policy could aim to increase ability to travel as long as this increases life satisfaction, but there will be restraints imposed by consideration of environmental degradation
Environmental Sustainability Index (ESI) and Environmental	<ul style="list-style-type: none"> - Efforts to reduce demand could increase to reduce pollution in the absence of economic and social considerations - Efforts to maximise use of existing infrastructure and vehicles could increase (in order to reduce depletion 	- Reduced, as focus on demand reduction and environmental efficiency

Indicator	Potential impact on transport policy	Impact on CO ₂ emissions
Performance Index (EPI)*	of natural resources)	
Regional Quality of Development Index (QUARS)	<ul style="list-style-type: none"> - Increased priority could be given to providing transport that enables access to local services, education and culture and employment, particularly for the more disadvantaged groups - More generally, increase access and participation could increase the demand for travel - Increased priority to demand reduction, and maximises use of existing infrastructure and vehicles 	<ul style="list-style-type: none"> - Unclear, as it would depend on the balance between the reduced demand arising from actions to improve the environmental performance of transport and any increases in demand resulting from action to address social concerns
Indicators that could supplement GDP (based on national accounts systems)		
System of Economic Environmental Accounts (SEEA)	<ul style="list-style-type: none"> - Increased priority to demand reduction, and maximises use of existing infrastructure and vehicles 	<ul style="list-style-type: none"> - Reduced, as increased focus demand management and optimising of use of existing infrastructure and vehicles
National Accounting Matrix including Environmental Accounts (NAMEA)	<ul style="list-style-type: none"> - Increased priority to demand reduction, and maximises use of existing infrastructure and vehicles 	<ul style="list-style-type: none"> - Reduced, as increased focus demand management and optimising of use of existing infrastructure and vehicles
System of Economic and Social Accounting Matrices and Extensions (SESAME)	<ul style="list-style-type: none"> - Increased priority could be given to providing transport that enables access to local services, education and employment - In the longer term, higher education and incomes could increase the demand for travel - Increased priority to demand reduction, and maximises use of existing infrastructure and vehicles 	<ul style="list-style-type: none"> - Unclear, as it would depend on the balance between the reduced demand arising from actions to improve the environmental performance of transport and any increases in demand resulting from action to address social concerns
Indicators that could supplement GDP (by setting social and environmental information in relation to GDP)		
Sustainable Development Indicators	<ul style="list-style-type: none"> - Increased priority could be given to providing transport that enables access to local services, education and employment - Increasing access and, in the longer term, higher education and incomes, could increase the demand for travel - Increased priority to demand reduction, and maximises use of existing infrastructure and vehicles 	<ul style="list-style-type: none"> - Unclear, as it would depend on the balance between the reduced demand arising from actions to improve the environmental performance of transport and any increases in demand resulting from action to address social concerns
Decoupling indicators	<ul style="list-style-type: none"> - Increased priority to demand reduction, particularly where this does not bring that much economic value (e.g. social passenger trips), and maximises use of existing infrastructure and vehicles 	<ul style="list-style-type: none"> - Not clear, as focus could be on prioritising some trips over others, although benefits from optimising of use of existing infrastructure and vehicles

Both of the remaining indicators that are suggested could replace GDP attempt to bring together environmental, social and, to a lesser extent, economic considerations in a composite indicator that could replace GDP. The Happy Planet Index attempts to bring life expectancy, life satisfaction and environmental footprint together within a single indicator. As Goossens et al note, rather than being a measure of “happiness”, it is more accurately a measure of the “environmental efficiency of supporting well-being”. Hence, the resulting transport policy might focus on increasing the amount of travel that could be undertaken for a particular amount of environmental degradation. In this respect, the policy might focus on optimising the use of the capacity of existing infrastructure and vehicles and focusing new infrastructure on the ability to deliver as much “satisfaction” as possible, including potentially long-distance travel. Finally, QUARS covers a range of social indicators, which could see a more social orientation of transport policy towards providing access and equality of opportunity, which could focus more on local transport that maximises access, particularly for disadvantaged groups. However, increasing access and participation has the potential to increase the demand for travel.

In relation to indicators that could be used to **complement GDP**, all of the indicators based on developing national accounts systems would give a higher priority to environmental considerations, while SESAME would also given a higher priority to social considerations. In this respect, the indicators potentially have similar implications for the development of transport policy as the indicators that would adjust GDP, with the main difference being that in the event of adverse social or environmental impacts, GDP itself would not be affected, but associated social and environmental indicators would decline. However, if these are given equal value to GDP, in line with one of the assumptions underlying the assessment, then the impact should be similar in that action to increase GDP would be undertaken. In other words, for those indicators that only cover environmental considerations, the focus would be on demand management and optimising the use of existing infrastructure and vehicles. For those indicators that also include social considerations, the focus could be on enabling transport in order to improve access and economic opportunities. A similar conclusion could be reached for sustainable development indicators.

Finally, if decoupling indicators were given equal value to GDP, the lack of a consideration of social concerns could result in a focus on transport of high added economic value, which has the potential to have negative social impacts, e.g. prioritising freight transport over passenger transport with little economic value, e.g. leisure and cultural trips, etc.

In relation to the potential impact of these alternative indicators on transport’s GHG emissions, those that only integrate the consideration of environmental concerns into the decision-making process have the potential to reduce transport’s GHG emissions as a result of a higher consideration in decision-making given to environmental protection. In most of such cases, GHG emissions reduction would result from actions to manage demand, improve the efficiency of the use of infrastructure and vehicles and the focus on local transport. However, where social considerations are also included in the alternative indicator, the impact on transport’s GHG emissions is less clear, as any action to improve access or reduce inequalities could stimulate transport policies that enable travel. In such cases, the impact on transport’s GHG emissions would depend on the net impact of the policies to address environmental and social considerations.

3.3 A more fundamental transition to a sustainable economy

In common with the consideration of moving beyond GDP, the work on the transition to a more sustainable economy focuses on a literature review, followed by an analysis of the potential implications for transport generally, and in the context of the need to reduce transport’s GHG emissions in particular. Within the scope of the resources available for this

report, it has not been possible to undertake a wide-ranging review of all relevant literature. Hence, we have chosen to focus on recent literature that represents contrasting perspectives of thinking about the future and of transport's role within in it. Additionally, the literature on which we focus draws on relevant, recent academic thinking, and recognises, at least to some extent, the environmental challenges, particularly climate change, that 21st century society faces. In this respect, the literature is in line with the emerging EU policy framework that places the need to address environmental challenges such as climate change and resource depletion at the heart of EU policy-making (see Box 1 in Section 1.4).

3.3.1 Literature review

As with concerns about the use of GDP as an indicator, an important concern of those who discuss different economic futures, or even different futures more generally, is to deliver social justice or reduce inequality and, usually, some degree of concern about the environment or delivering ecological sustainability. However, there are a wide range of views on what the future holds and what is needed to achieve it. At one end of the scale is an optimism that humanity's ability to innovate will lead to solutions to many of the world's environmental problems, as well as addressing inequality (see, for example, Ridley, 2010²⁹). On the other hand, some have begun to focus on "degrowth" and argue that the "folly of growth" must come to an end, e.g. see the "Barcelona Declaration" of the 2010 Degrowth Conference³⁰.

Neither of these examples discusses transport in any detail. Ridley argues against the use of biofuels due to their demand for land and suggests a heavy carbon tax (balanced by a cut in payroll taxes) would probably be the best way of ensuring that the best carbon reduction technologies emerge. The Barcelona Declaration lists ideas that could be part of a degrowth strategy, such as the abandonment of large-scale infrastructure, including that for high-speed transportation, and the "conversion of car-based infrastructure to walking, biking and open common spaces". The Declaration also considers that new redistributive taxes and taxes to discourage over-consumption of non-durable goods would be consistent with degrowth. Hence, while reducing social inequality is an underlying concern of both these schools of thought, the solutions are very different.

Dennis and Urry (2009) do focus on transport futures and draw on scenarios developed for the UK government under a "Foresight Programme". These scenarios were developed as a result of a review of the challenges facing transport in the 21st century (including climate change and the need to move beyond oil) and of the potential responses to these challenges³¹. They see the "car system" as one of a number of systems that is part of the wider, complex societal system. They develop their ideas in the context of an understanding about how complex systems work.

In looking at the future of transport from a technical perspective, the book covers many of the elements that were covered in the previous "*EU Transport GHG: Routes to 2050?*" project, i.e. alternative fuels, new materials, smart vehicles and "digitisation". The latter covers a range of technical solutions to monitor and manage the transport system, including more advanced transport concepts such as personal rapid transit³². However, the authors also identify a range of other trends that will influence how transport is used, e.g.:

- "De-privatising vehicles", as different models of ownership, such as car clubs and other mobility services, emerge.

²⁹ Ridley, M "*The Rational Optimist*" London: Fourth Estate

³⁰ <http://www.degrowth.org/Barcelona-2010-Declaration.119.0.html>

³¹ Dennis K and J Urry (2009) "*After the car*" Polity: Cambridge.

³² These are covered respectively, in Papers 2, 3, 5 and Report VI of the project; see <http://www.eurtransportghg2050.eu/cms/eu-transport-ghg-routes-to-2050-project-reports/>

- “New transport policies”, which covers similar ground, but is nowhere near as extensive in its coverage, as the policies for GHG reduction covered in the previous “*EU Transport GHG: Routes to 2050?*” project³³.
- “New living/work/leisure practices”, which includes more mixed development enabling people to live closer to their work and other amenities, and increased use of the internet to replace some trips.
- “Disruptive innovations”, which are potentially small innovations that have the potential to significantly alter the underlying system. One of the book’s main theses is that there is much disruptive innovation currently taking place with respect to transport, as people seek new ways to power, organise and experience travel, that has the potential to move towards a “post-car system”.

In this respect, many of the elements of a future transport system perceived by Dennis and Urry are consistent with the issues covered in the two “*EU Transport GHG: Routes to 2050?*” projects. However, the scenarios that the authors set out in the final chapter, all of which could be considered to be alternative low carbon futures, are far from being a positive outlook on potential low carbon futures. In presenting these scenarios, the authors argue that the future of the car in these scenarios is central to the future of economies and societies in the 21st century. They argue that the way in which personal mobility is addressed will in part determine the shape of the economy and society. The scenarios, which were initially developed as part of the original Foresight work, are:

- **Local sustainability**, which foresees a world where the focus of people’s lives becomes the local area, as a result of proactive attempts to strengthen and re-design local communities. The “car system” is replaced by a wide range of local forms of transport and movement, many of which are low carbon, and long distance travel is not common.
- **Regional warlordism**, in which wars over limited resources lead to resource shortages, an increasing lack of security and an “implosion” of transport. Long-distance travel would be rare and dangerous, with society reverting to living within walled cities.
- **Digital networks of control**, in which movement is monitored to manage the transport network and to ensure that carbon budgets are adhered to. Smart cards would be used to enable and regulate access to mobility, while virtual access would replace much physical travel. In this scenario, physical mobility would also be constrained, but the system itself would be costly to put in place.

While noting that it would effectively entail a reversal of the “advances” (Dennis and Urry’s inverted commas) of the last two centuries, the authors conclude that the first scenario, local sustainability, is the more preferable, but the least probable of the three scenarios presented. The need to constantly monitor and measure movement under the *Digital networks of control* scenario leads the authors to refer to such a scenario as “Orwellian”.

Hence, it is clear that there is a diverse range of views about what future society might, could and should look like, in light of concerns about transport’s role generally, and contribution to climate change, in particular. Transport’s role within this future society depends to some extent on the degree of optimism (or pessimism) of various authors and the extent to which they believe that today’s environmental challenges provide more of a challenge to our future development than the challenges that we have faced in the past.

Some work occupies a middle ground in that it argues that a different approach is needed to address the environmental challenges that we face, but argues that this is achievable if we reframe the way in which we seek to achieve society’s goals. For example, drawing on a

³³ See Papers 6 to 9, in particular at <http://www.eutransportghg2050.eu/cms/eu-transport-ghg-routes-to-2050-project-reports/>

report undertaken for the UK's Sustainable Development Commission (SDC)³⁴, Jackson (2009) argues for an overhaul of the current economic system in order to deliver a sustainable economy³⁵. One of his main arguments is that growth, as currently defined and measured (i.e. in terms of GDP), is one of the dilemmas of the current economic system: in its current form, it is unsustainable, as increased resource consumption and environmental costs compound disparities in social well being; while not growing leads to economic instability. In order to achieve the transition to a sustainable economy, he sets out 12 steps to deliver a different kind of capitalism. Rather than a radical overhaul of the underlying economic model, he argues that the model needs to be fixed by:

- **The development of ecological macro-economics**, which is important as there would be a need to understand the behaviour of economies subject to strict emission and resource limits (see below), as well as to explore different approaches to consumption, investment, employment and productivity growth.
- **Investment in jobs, assets and infrastructure** to enable the transition to a sustainable economy. As well as the target of such investment, the “ecology” of investments needs to change, i.e. its conditions, structure, rates and periods of return.
- **Increasing financial and fiscal prudence**. In this context, he notes the potential benefits of some of the proposals that have been put forward in response to the 2008 economic crisis.
- **Revising the national accounts**. This covers similar ground to Section 3.2.1, as he argues that GDP is at best a measure of how busy the economy is, and that it fails to account for a range of social and environmental costs, as well as non-market services. Consequently, there is a need for a more robust approach to measuring economic performance.

He also argues that there is a need for a different “social logic”, which requires:

- **Changes to working time policy**. He argues that a change to lower working hours is important, as the number of hours worked has a direct link to output. Additionally, a move to lower working hours has been sought in its own right for social reasons.
- **Tackling systematic inequality**. Existing inequalities undermine social capital, increase anxiety and lead to higher morbidity and less satisfaction with life, particularly in low income households. They also drive positional consumption, which is currently an important driver of the economy, and thus of the adverse effects of the current approach.
- **Measuring capabilities and flourishing**. In this context, capabilities refer to people's capability to eat, to be free from avoidable illness, to have access to meaningful work, to use their education, to access friends, etc. Whether an individual chooses to undertake these activities is up to them, but they should be capable of doing so if they wish. These are all elements of “flourishing”. However, such flourishing also has to respect ecological limits (see below). If such an approach were adopted, new ways of measuring prosperity would be needed, which could be included in revised national accounts.

With respect to the environment, Jackson argues that there is a need to recognise ecological limits by:

- **Identifying clear resource and emission caps and establishing reduction targets consistent with these caps**. He argues that the way in which the caps and targets that are being developed for carbon could be seen as an example of how this might be done for other environmental resources and damage. Mechanisms for

³⁴ The SDC was abolished in 2010.

³⁵ Jackson T (2009) “*Prosperity without growth: Economics for a Finite Planet*” London: Earthscan.

achieving the targets would need to be developed and integrated into the new economic framework.

- **Fiscal reform for sustainability.** This includes both the internalisation of external costs, as well as ecological tax reform to shift the burden of taxation from economic “goods” to ecological “bads”.
- **Support for the ecological transition in the developing countries.** The book recognises the need for (and benefits of) growth in the poorer, developing countries. It is clearly in the interest of all countries that such growth causes as little damage to the environment as possible, so he argues for robust funding mechanisms to assist developing countries to develop sustainably and within ecological limits. In this respect, he suggests expanding or replicating existing funding mechanisms, such as the Global Environment Facility.

While the book makes few references to transport, the report on which it draws makes some more references to transport³⁶. The report (and book) argues that there is a need for structural change to address the adverse impacts of the current system. In this respect the report cites the incentivisation of private transport over public transport and of motorists over pedestrians as two examples of the perverse effects of the current dominant structures, which encourage unsustainable behaviour. Consequently, solutions relating to transport include more investment in public transport and infrastructure that supports walking and cycling, as well as support for travel planning that encourages modal shift.

The papers by both Canoy and Lerais and by Wesselink *et al*, which were reviewed in Section 3.2.1, also mention the “capabilities” approach based on the work of Amartya Sen. They note that this approach aims to assess well-being by taking account of each individual’s living situation and their opportunities in life. While the approach is difficult to use as the basis for indicators, due to its focus on the individual, attempts have been made to use the approach to evaluate policies.

The type of ecological limits foreseen by Jackson are covered in greater detail by Lynas³⁷, who draws on the work undertaken by a developing strand of academic thinking that is concerned with the concept of “Planetary Boundaries”. Such an approach aims to identify the ecological limits that exist, based on the best available scientific knowledge. However, recognising the existence of such boundaries, Lynas argues, should not be taken to imply limits to growth in any way, only a recognition that such boundaries do exist and that they need to be respected. Not all of these boundaries are potentially relevant for transport, but some are. Of particular importance is the climate change boundary, but other boundaries are also relevant with respect to constructing infrastructure and producing biofuels (i.e. the land use and biodiversity boundaries) and in the context of pollution from transport (e.g. the nitrogen, toxics, and aerosols boundaries). In relation to transport, potential solutions to these issues proposed by Lynas are the electrification of transport (and the parallel decarbonisation of the electricity supply), with the use of biofuels only for aviation due to concerns about the land use boundary, in particular.

3.3.2 Potential implications for transport

Attempting to identify what the literature reviewed in the previous section might mean for transport cannot be undertaken in as consistent a manner as it was for the adoption of alternative indicators of welfare in Section 3.2.2. However, some potential implications can be drawn. The advocates of degrowth and Dennis and Urry’s preferred scenario both foresee a transport system in which travel is undertaken locally by low carbon modes, and where long-distance transport is comparatively rare. While such scenarios clearly have potential benefits from an environmental perspective, the implication is that environmental constraints

³⁶ Jackson T (2009) “Prosperity without growth? The transition to a sustainable economy” London: Sustainable Development Commission.

³⁷ Lynas M (2011) “The God Species: How the Planet can survive the age of humans” London: Fourth Estate.

imply that it is necessary to accept significant restrictions on society and the economy compared to those from which we currently benefit. These appear to be overly pessimistic scenarios for the future.

On the other hand, Ridley's belief in the capacity of humanity for innovation and a reliance on prices (i.e. the application of a carbon tax) to deliver any necessary low carbon solutions appears to take a simplistic perspective on policy. In the final report of the previous "*EU Transport GHG: Routes to 2050*" project, it was argued that there is a need to use a range of instruments, including both regulation and taxation, in order to overcome barriers to behavioural changes and to provide incentives to different stakeholders in order to decarbonise transport³⁸. Indeed, Lynas considers that Ridley pays insufficient attention to the environmental impacts of recent economic activity. On the other hand, Dennis and Urry's concerns about the "Orwellian" nature of their *Digital networks of control* scenario could probably be overcome with appropriate safeguards. Given the potential range of options for reducing transport's GHG emissions and the policy instruments for delivering these that were reviewed in the previous "*EU Transport GHG: Routes to 2050?*" project, it could even be concluded that such a digital, measured and monitored society is indeed a likely future scenario. However, few of these future scenarios have clear implications for transport. Ridley's carbon tax would lead to increased use of lower carbon modes and innovation in low carbon technology, while Dennis and Urry's *Digital* scenario would operate in a carbon-constrained world in which there would similarly be an incentive to use low carbon modes and innovate in low carbon technology.

Consequently, probably the most useful framework for the assessment of the implications for transport of a future, "more sustainable" economy is that set out by Jackson. Some elements of Jackson's vision have already been discussed elsewhere in this report. For example, one of Jackson's four economic steps was a revision of the national accounts, which was one of the alternative indicators covered in Section 3.2.2. Additionally, within Jackson's framework there are also a number of elements that are recognisable in the ongoing debate about improving the sustainability of the existing economic system. One example is the need for fiscal reform, which includes the internalisation of external costs, but also shifting the burden of taxation from economic "goods" to environmental "bads". Examples of this can be seen in the EU policy debate in recent years, e.g. enabling the internalisation of some of transport's external costs in the Eurovignette Directive and the 2011 Transport White Paper's stated intention to take this further. There are also echoes of the resource and emission caps proposed by Jackson in the EU's commitment to reduce GHG emissions, the setting of national emissions ceilings for air pollutants and references to a resource-constrained world in the Europe 2020 strategy (see Box 1 in Section 1.4). This latter strategy also talks about the use of green technologies, the need for which is underlined by Jackson when he calls for investment in jobs, assets and infrastructure that will enable the transition to a sustainable economy.

Other elements of Jackson's 12 points have potentially different implications for transport policy. For example, in order to deliver many of the social steps, there is the potential that transport demand might increase. Addressing existing inequalities, providing people with more leisure time as a result of spending less time working and "providing capabilities for flourishing" all potentially lead to an increased demand for transport. Whilst addressing inequalities could imply more investment in local, public transport in order for the disadvantaged to be able to have similar economic and social opportunities to the rest of society, more leisure time and focus on enabling people to "flourish" could increase demand for more, potentially longer distance, travel for leisure purposes, as well as demand for products from more distant areas of the planet.

³⁸ Skinner I, van Essen H, Smokers R and Hill N, 2010 *Towards the decarbonisation of EU's transport sector by 2050* Final report produced under the contract ENV.C.3/SER/2008/0053 between European Commission Directorate-General Environment and AEA Technology plc; see www.eurtransportghg2050.eu

However, the constraint in this respect is that any flourishing or activities undertaken in increased leisure time would have to be undertaken within ecological limits. In this respect, the development of an ecological macro-economics that aims to understand how economies would act when subject to ecological constraints is fundamentally important. Such a macro-economics is also needed to provide a framework within which decision-making could operate. In this respect, the limits, or boundaries, set out by Lynas are potentially relevant. As Lynas states, these boundaries do not necessarily restrict economic growth, but they will impact on the type of economic growth. Similarly, with respect to transport, the boundaries do not necessarily impose limits on transport, but policy makers would need to ensure that taken together the impact of transport and other economic and social activities would not take the planet beyond these boundaries. In this respect, there is likely to be an impact on the type of transport activities that would be preferred by policy.

To some extent, the potential impact on transport policy decisions of such a move towards a more sustainable economy is likely to be similar, but potentially more pronounced, than the potential implications of the use of the various alternative indicators in Section 3.2.2. An ecological macro-economics, ecological constraints and an increased attention to reducing inequalities could all potentially lead to a transport system that aims to maximise the use of existing infrastructure and vehicles, manage demand and invest more in infrastructure and technologies that contribute to a low carbon transport future. However, in the important difference is that such a framework would impose restrictions on the way in which social objectives were met, as these would have to be met within the planetary boundaries.

3.4 Conclusions

The assessment of the potential implications of the use of alternative indicators and wider moves towards a more sustainable economy reviewed in this section suggest that the implications for transport policy of such actions are likely to have a number of common elements. In hindsight, this might not be surprising. Concerns about the use of GDP as the main indicator of the state of the economy and society, along with more general discussions about the need to make the economy more sustainable, all have their origins in concerns that the current economic system pays insufficient attention to social and, particularly, environmental considerations. In this respect, potential alternative indicators and moves towards a more sustainable economy usually aim to redress this perceived imbalance by increasing the consideration of social and environmental factors in relation to economic factors. As was discussed in Section 3.2, it is still clearly important to take economic factors into consideration. However, as was assumed above, in order that the higher consideration of environmental and social factors have as much influence on decision-making as economic factors, these need to be given equal weight. Hence, the implications of these different approaches on transport policy making are all linked to the increased prominence of environmental and social considerations in transport policy decision-making.

For some of the alternative indicators discussed, such as those that would adjust GDP, this would happen naturally, as the adjusted indicator would include monetised environmental and usually social costs and benefits to enable everything to be included within one indicator. Of course, the extent to which all environmental and social considerations can be included in adjusted indicators depends on it being possible to reach an agreement on how to monetise all of the costs, which would not be straightforward. However, if it were possible to include all environmental and social considerations in an adjusted GDP, this indicator would decline unless the economic and social benefits from any transport policy outweighed any adverse environmental impacts.

The impact of those indicators that would replace GDP is more variable as the indicators themselves tend to vary more in their design and focus. Where these focus purely on the environment, there is a clear risk that there would be too much prominence placed on

environmental considerations to the detriment of the economy and of society (and of transport) if these indicators replaced GDP. Other indicators could even increase the amount of transport, where these increase the focus on social considerations. The impact of the use of indicators to complement GDP would probably have a similar impact as those indicators that would adjust GDP, as environmental and usually social considerations are given equal prominence to economic considerations in the decision-making process. With many of these indicators, the impact on transport's GHG emissions would depend on the net impact of any improvement on the environmental performance of transport resulting from a greater consideration of environmental impacts and the emissions resulting from any increase in the travel due to the consideration of social concerns.

Consequently, as a result of their increased attention to environmental and social considerations, most alternative indicators could have implications for the way in which transport policy develops, particularly its focus. More attention could be given to transport activities that deliver higher economic value, address social issues, improve the utilisation of existing infrastructure and vehicles, manage demand and deliver improved local transport. From the perspective of reducing transport's GHG emissions, paying increasing attention to environmental considerations would clearly act to reduce transport's GHG emissions, as many of activities proposed should deliver fewer emissions. However, where social considerations are also given an increased importance, there could be opposing pressures on transport's GHG emissions. In this respect, the impact of transport's GHG emissions of the use of alternative indicators on their own would not necessarily be beneficial as a result of the consideration of social concerns.

In this respect, the framework proposed by Jackson is probably most useful. The focus of policy development changes from economic growth to providing capabilities for people to flourish within ecological limits or planetary boundaries. In this respect, a new ecological macro-economics is needed within which policy decisions would be taken. Within this context, the indicators of economic performance are amended to include environmental and social considerations. To some extent, the approach is a development of elements of the developing policy process. For example, some notion of ecological limits is already present in policy, such as the targets to reduce GHG emissions and the recognition by Europe 2020 that the future will be resource-constrained. Additionally, other elements of Jackson's framework are already emerging, such as the internalisation of external costs, ecological fiscal reform and increasing investment in elements of a low carbon economy.

4 Conclusions and policy recommendations

4.1 Routes to less transport-intensive prosperity growth

In 2010 the European Commission presented the 'Europe 2020 Strategy', which sets the economic and wider framework for EU policy-making in the next 10 years. An important objective of this strategy is to realise a smart, sustainable and inclusive growth, which would facilitate the transition to a green economy in the longer-term. Realising less transport-intensive growth paths of prosperity could contribute to this ambition of the Commission.

In this paper we have explored various alternative routes that could be less transport intensive, but still deliver increasing levels of prosperity. A first route is decoupling transport growth from GDP growth. Theoretically, there is a large potential from less transport-intensive GDP growth, particularly in the case of passenger transport; since most passenger transport is consumption instead of production transport³⁹, reducing the amount of passenger transport will not directly harm GDP growth. The decoupling potential for freight transport is smaller, particularly because freight transport is an important driver of economic growth as it facilitates regional specialisation. Reducing the amount of freight transport will therefore in many cases result in less efficient production processes and hence less GDP growth. However, improving the transport efficiency or reducing the average weight of goods transported are possible ways to decouple freight transport from GDP growth. Also an increased spatial concentration of the supply chain may contribute to decoupling, under the condition that the reduction in transport demand is larger than the potential reduction in the economic efficiency of the supply chain. Finally, a restructuring of the economy (e.g. a shift to a more service oriented economy) is also a possible way for decoupling, but from a global scale most of its potential is likely to be undone by leakage effects (increased transport demand in other parts of the world).

Although there is significant potential for decoupling transport and GDP growth from (at least) a theoretical perspective, this potential has hardly been realised over the last few decades. Only evidence for land-based passenger transport for decoupling been found for the EU27, but this is (at least) partly undone by the relatively high growth of air passenger transport. Without additional policies, no significant decoupling of transport and GDP growth can be expected in the short-term.

Another potential route to less transport-intensive prosperity growth could be delivered by redefining the measurement method of prosperity. By using an alternative indicator to complement, amend or replace GDP, the influence of GDP (as currently defined) as the most influential high level indicator of the state of the economy could be counterbalanced by giving relatively higher consideration to social and environmental factors. The impact on transport's GHG emissions would depend on the net impact of any improvement on the environmental performance of transport resulting from a greater consideration of environmental issues, balanced by the emissions resulting from any increase in the travel due to the consideration of social concerns. The use of an alternative welfare indicator may result in decoupling transport growth from GDP growth if it results in a reduction of unproductive transport. However, the increased consideration of environmental issues will often also lead to a decrease in productive transport and hence lower GDP growth rates, while the increased consideration of social issues may result in an increase in consumption transport and hence a coupling of transport and GDP growth.

³⁹ Production transport "involves activity related to the production of goods and services and essential household sector activities". It covers the transport of intermediate and final goods to production locations and customers, as well as essential household operations such as the commute to work. Consumption transport on the other hand includes all transport for non-essential purposes (i.e. leisure).

A third route to less transport-intensive prosperity growth would be to introduce a more fundamental change of the macro-economic framework of society by not only using another welfare indicator, but also making more fundamental changes to the rules and principles that guide policy decisions. In this respect, the framework proposed by Jackson is judged to be most useful. It focuses on providing capabilities for people within ecological limits. Compared to the other routes it provides stricter constraints to human actions and hence transport, challenging the consumer sovereignty which is one of the key elements of the current macro-economic framework. However, it also provides the best protection for societal and environmental resources, which will, among other things, be indicated by lower GHG emission levels of transport.

4.2 Policy implications

The various routes to less transport-intensive growth paths may require different transport policy strategies. As was discussed in Chapter 2 implementing pricing instruments (road charges, fuel taxes) to internalise the external and infrastructure costs of transport are proven ways to reduce transport demand without harming both social welfare and economic growth. Other interesting policy strategies to stimulate the decoupling of transport from GDP growth are the implementation of an integrated long term policy strategy for spatial planning, transport (infrastructure) and GHG reduction, and lowering speed limits. To improve the effectiveness of these instruments (in terms of realising decoupling) they may be mainly targeted on passenger transport, since the potential for decoupling is larger for passenger transport than for freight transport.

The policy implications of using alternative welfare indicators depend heavily on the type of indicator that is considered. Indicators particularly focussing on environmental considerations require policies stimulating the purchase and use of more fuel efficient vehicles, including policies affecting transport demand. The policies may (partly) be the same as the ones stimulating decoupling transport from GDP growth (although they may be more ambitious, resulting in higher tax levels, lower speed limits, etc.), but also instruments meant to increase the fuel efficiency of vehicles (e.g. vehicle regulation, purchase taxes) should be considered. However, if also social considerations are taken into account by alternative welfare indicators, also policy instruments increasing accessibility (e.g. investments in public transport, road infrastructure investments) may be considered.

A more fundamental transition to a sustainable economy requires probably the most far-reaching policy intervention in the transport sector. Many of the policy instruments mentioned above could be considered (and hence are explicitly mentioned in Jackson's vision on a sustainable economy). But in addition to these instruments, policy instruments guaranteeing that transport demand will grow within environmental boundaries are required (e.g. emission trading systems, CO₂ budgets etc).

References

The Boston Consulting Group, Made in America, Again: Why Manufacturing Will Return to the U.S., August 2011

Ballingall, John, Doug Steel and Phil Briggs,(2003), Decoupling economic activity and transport growth: the state of play in New Zealand

Cappelli, Agostino, Alessandra Libardo, Silvio Nocera (2005), The Relations Between Regional Economic Development And Evolution Of Transport Demand In Italy

CE Delft, Fraunhofer ISI, LEI (2011a), Behavioural climate change mitigation options and their appropriate inclusion in quantitative longer term policy scenarios, First Interim Report: Review of the Evidence

CE Delft, Fraunhofer ISI, LEI (2011b), Behavioural climate change mitigation options and their appropriate inclusion in quantitative longer term policy scenarios, Second Interim Report: Quantification of measures and analysis of policy options

Dargay, J.M. (2007) The effect of prices and income on car travel in the UK. Transportation Research Part A, Volume 41, p. 949-960.

Feige, Irene, Transport, Trade and Economic Growth — Coupled or Decoupled? An Inquiry into Relationships between Transport, Trade and Economic Growth and into User Preferences concerning Growth-oriented Transport Policy, Mobilitätsverhalten in der Freizeit 2007, DOI: 10.1007/978-3-540-68299-8

Ecofys (2008), The potential global CO2 reductions from ICT use: Identifying and assessing the opportunities to reduce the first billion tonnes of CO2, Report for WWF Sweden

Economist (2011) Good darnig, Vietnam: Rising costs in China are sending more buyers to South-East Asia

European Environmental Agency (2010), Towards a resource-efficient transport system: TERM 2010 indicators tracking transport and environment in the European Union

European Environmental Agency (2011), Laying the foundations for greener transport. TERM 2011: transport indicators tracking progress towards environmental targets in Europe

Eurostat (2011) domestic material consumption
[http://epp.eurostat.ec.europa.eu/statistics_explained/index.php?title=File:Index_of_resource_productivity,_EU-27_\(1\)_\(2000%3D100\).png&filetimestamp=20110404152141](http://epp.eurostat.ec.europa.eu/statistics_explained/index.php?title=File:Index_of_resource_productivity,_EU-27_(1)_(2000%3D100).png&filetimestamp=20110404152141)

van Essen, Rijke, Verbraak, Quak and Wilmlink (2009) Modal split and decoupling options Paper 5 produced as part of contract ENV.C.3/SER/2008/0053 between European Commission Directorate-General Environment and AEA Technology plc; see website www.eutransportghg2050.eu

Feige, Irene, Transport, Trade and Economic Growth — Coupled or Decoupled? An Inquiry into Relationships between Transport, Trade and Economic Growth and into User Preferences concerning Growth-oriented Transport Policy, Mobilitätsverhalten in der Freizeit 2007, DOI: 10.1007/978-3-540-68299-8

Gillen, D.W., Morrison, W.G. en Stewart, C. (2004) Air travel demand elasticities: Concepts, issues, and measurement. http://www.fin.gc.ca/consultresp/Airtravel/airtravStdY_e.html

Gray, David, Jillian Anable, Laura Illingworth and Wendy Graham (2006), Decoupling the link between economic growth, transport growth and carbon emissions in Scotland, Report for the Scottish Executive

Hanly, M., Dargay, J. en Goodwin, P. (2002) Review of income and price elasticities in the demand for road traffic. ESRC TSU publication 2002/13. ESRC Transport Studies Unit Centre for Transport Studies, University College, Londen, Engeland.

Hummels, David (2007) Transportation Costs and International Trade in the Second Era of Globalization, *Journal of Economic Perspectives* 21 (2007) pp. 131-154

Hummels, David (2009) How Further Trade Liberalization Would Change Greenhouse Gas Emissions from International Freight Transport, draft version prepared for June 2009 OECD meeting "Global Forum on Trade and Climate Change"

IEA (2008) Energy Technology Perspectives 2008, Part 3: Energy technology status and outlook

Kampman et al (2009) *Infrastructure and spatial policy, speed and traffic management* Paper 8; see website www.eutransportghg2050.eu

Kveiborg, Ole and Mogens Fosgerau (2005), Decomposing the decoupling of freight traffic growth and economic growth, Danish Transport Research Institute

McKinnon, Alan (2003), Influencing company logistics management, published in ECMT: Managing the Fundamental Drivers of Transport Demand, 2003

McKinnon, Alan (2006), The Decoupling of Road Freight Transport and Economic Growth Trends in the UK: An Exploratory Analysis

Metz, David(2010) 'Saturation of Demand for Daily Travel', *Transport Reviews*, 30: 5, 659 — 674, First published on: 11 May 2010

Millard-Ball, Adam and Lee Schipper, ARE WE REACHING "PEAK TRAVEL"? TRENDS IN PASSENGER TRANSPORT IN INDUSTRIALIZED COUNTRIES, 12th WCTR, July 11-15, 2010 – Lisbon, Portugal

Niederl, Andreas, Karl Steininger, Max Herry, Norbert Sedlacek, Veronika Gaube and Heinz Schandl (2003) Decoupling Economic Growth and Transport Demand Case Study Austria, Intermediate Report, OECD Project

OECD (2002), Indicators to Measure Decoupling of Environmental Pressure from Economic Growth

OECD (2006), Decoupling the Environmental Impacts of Transport from Economic Growth

Pastowski, Andreas (1997), Decoupling Economic Development and Freight for Reducing its Negative Impacts, Wuppertal Papers No. 79

PBL and CE Delft (2010), Effecten van Prijsbeleid in Verkeer en Vervoer: Kennisoverzicht

Peters, Glen P., Jan C. Minx, Christopher L. Weber, and Ottmar Edenhofer (2011) Growth in emission transfers via international trade from 1990 to 2008, PNAS

Schäfer, Andreas and David Victor (2000), The future mobility of the world population, *Transportation Research Part A* 34, 171-205

Schäfer Andreas (2006), Long-Term Trends in Global Passenger Mobility, U.S. *Frontiers of Engineering Symposium*, September 21-23, 2006

Schleicher-Tappeser, Ruggero, Christian Hey, Peter Steen (1998), Policy approaches for decoupling freight transport from economic growth, 8th World Conference on Transport Research, Paper no. 650, Topic Area E5

Siikavirta et al. (2003), Effects of E-Commerce on Greenhouse Gas Emissions: A case study of grocery home delivery in Finland

Skinner I, van Essen H, Smokers R and Hill N (2010) Towards the decarbonisation of EU's transport sector by 2050 see www.eutransportghg2050.eu

Standing Advisory Committee for Trunk Road Assessment, SACTRA (1999), *Transport and the economy*

Šturc, Marek (2011), Transport White Paper, Climate Roadmap & quantitative modelling results, EU Transport GHG: Routes to 2050 II - 1st stakeholder conference

Rubin, Jeff and Benjamin Tal, Will Soaring Transport Costs Reverse Globalization? CIBC WORLD MARKETS INC. *StrategEcon* - May 27, 2008

Tapio, Petri (2003), Decoupling has begun in Finland: Economic growth, traffic volume growth and the CO2 policy of EU15 and Finland 1970-2001

Tight, M.R., P. Delle Site and O. Meyer-Rühle, Decoupling Transport from Economic Growth: Towards Transport Sustainability in Europe

Van Essen, Rijke, Verbraak, Quak and Wilmink (2009) *Modal split and decoupling options* Paper 5: see website www.eutransportghg2050.eu



The Gemini Building
Fermi Avenue
Harwell International Business Centre
Didcot
Oxfordshire
OX11 0QR

Tel: 0870 190 1900
Fax: 0870 190 6318

www.aeat.co.uk