OECD Project

Decoupling Economic Growth and Transport Demand

Case Study Austria

Intermediate Report

November 2003

joint study by

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Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft
Abteilung V/5 – Verkehr, Mobilität, Siedlungswesen und Lärm
Abteilung V/10 – Umweltökonomie und Energiepolitik
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Executive Summary

The link between economic growth and transport

In the past economic growth and transport demand developed highly correlated in Austria (see Figure 0.1).

Growth in passenger (in terms of person-kilometres) and freight transport (in terms of ton-kilometres) was mainly due to air and road transport (see Figure 0.2 and Figure 0.3). The increase in the relative importance of road and air transport can be attributed to various factors, in particular to changes in relative prices, infrastructure characteristics, and changes in economic structure and economic welfare.
Transport is responsible for a considerable share of total energy consumption in Austria. Road transport – responsible for the lion’s share within that – is operating almost exclusively on the basis of non-renewable fossil fuels. Technological progress has not been sufficient so far to reverse the trend of growing absolute energy demand in transport.

Transport is a major cause of detrimental environmental and health effects. It puts pressure on biodiversity, especially along the routes of the main infrastructure networks. It is also a major contributor to air pollution, which directly affects human health. Emissions of CO₂ and particulate matter increased over the last decade in Austria at alarming rates. Transport is the main cause for human exposure to noise in Austria. Finally, it also poses the serious threat to be involved in an accident with all associated negative effects.

The ultimate objective in human development is neither economic growth nor transport itself. Economists use the term “welfare” to denote the objective society seeks to achieve. In the discussion of “decoupling” the question thus is how much of the “good” we can get (such as standard of living) without too much of the detrimental effects being triggered (such as pollution or congestion).

For the interlinkage between economic growth and transport demand we do find that some degree of decoupling is a necessary condition for economic growth rather than a barrier to it. Decoupling thus is no punishment on us, but a tool to make life better.

The notion of decoupling and its indicators

Before analysing the notion ‘decoupling of transport’ further, it seems useful to define the term ‘transport’ and its position in the system of national accounting in Austria. To be able to explicitly link transport activities to decoupling and sustainability it is a prerequisite to distinguish between transport in a narrow sense (sector ‘Transport, Storage and Communication’) and transport in a broader sense (all transport related contributions of numerous economic activities and sectors). It often seems advisable to choose the broader definition of transport to really assess the economic as well as the environmental performance of transport.

The efficiency argument appears in the discourse of ecological modernisation and of dematerialisation of economic activities. Most often, the debate is carried out under the label ‘decoupling’. The term ‘decoupling’ in general refers to breaking the link between economic growth and environmental pressures and related impacts. Some authors argue that decoupling is a ‘natural’ process in all economic activities. One aspect of decoupling appears at the aggregate level where structural change, a move of economic activities from resource intensive primary industries to service activities, would also support efficiency gains in terms of resources used per unit of GDP. This debate has been operationalized by using Kuznets curves which provide a framework for relating an
economic indicator (GDP/capita) to an indicator for environmental impact.

One concept to empirically assess environmental pressures is Material- and Energy Flow analysis (EUROSTAT 2001). This accounting framework distinguishes two sources of inputs of material and energy that are the domestic environment and trade. On the output side wastes and emissions as well as exports are accounted for. Besides offering a full set of data describing the all physical activities of an economy some indicators have crystallized in the political debate (EUROSTAT 2002). These indicators include Direct Material and Energy Input, Domestic Material and Energy Consumption and Direct Processed Output.

The aggregate trends are made up by sector dynamics of which the transport sector is one important intermediary activity. Regarding transport two kinds of decoupling effects might appear. First of all, the sheer amount of transport might increase/decrease in comparison to GDP. This would be measured using standard transport indicators such as tkm and pkm and relate them to GDP (tkm/GDP, pkm/GDP). We call these direct effects between transport and the economy, which do not explicitly address environmental pressures. To be able to identify environmental pressures related to transport activities we would have to identify the share of materials and energy flows related to transport activities. Another important transport related environmental issue is land sealing by transport infrastructure.

In principal, an indicator quantifies and simplifies phenomena and helps to understand complex realities. It quantifies and aggregates data that can be measured and monitored to determine whether change is taking place. Most approaches to environmental and sustainability indicators rely on the Pressure-State-Response (PSR) scheme of the OECD (1994). The PSR scheme implies that pressures generate changes in the state of the environment, which in turn might lead to environmental policy responses whenever unfavourable situations in the state of the environment are observed. The PSR scheme has been extended by two categories, driving forces and impacts. Doing this, OECD arrives at the Driving Force-Pressure-State-Impact-Response Framework (DPSIR).

Debate about climate change prevention and the relative contribution of transport activities to greenhouse gas emissions added to the demand for work on transport and the environment. Therefore one part of the OECD work programme on environmental indicators deals with transport-environment indicators. Especially road transport has been identified as having the largest influence on the environment by far and is therefore a focus of most of the OECD environmental indicators work.

1 EUROSTAT (2001), Economy-wide material flow accounts and derived indicators. A methodological guide, European Commission, Luxembourg
4 NSTR: Nomenclature uniforme de marchandise pour les statistique de transport – Standard Goods Nomenclature for Transport Statistics
5 Herry Consult GmbH (2003), Güterverkehrsprognose für Niederösterreich 2020, Amt der Niederösterreichischen Landesregierung, no public status, Vienna
**Analysis of the sector leisure and its transport implications**

Leisure covers a large portion of lifetime. It is both responsible for substantial transport volume and also an important economic factor not only in Austria. Because of the sheer importance of leisure in transport and the economy it is important to assess its decoupling potential.

Leisure is most often understood as a concept of residual time: the time an individual can freely spend according to its wishes. Leisure time in Austria is increasing. The motives for leisure activities are manifold. The main motives for leisure activities are to socialise, to satisfy the demand for variation and the desire to experience nature and to exercise. Common leisure activities in Austria are watching TV, listening to the radio, sports or socialising with friends. Many of these activities are at-home activities.

A general trend in leisure is to experience something out of the ordinary. This is particularly true during holidays, when it is common to leave home to make experiences that cannot be made at home. Each year approximately half of the Austrians enjoy a holiday trip including at least 3 overnight stays, whereby almost two thirds of these trips lead to foreign destinations.

Leisure transport accounts for a considerable share of overall transport demand in Austria. Estimates of its share range as high as 55% of total person-kilometres spent for leisure purposes. This transport demand mainly is a derived one, although especially for men making a trip just to be on ones way is not uncommon. The dominant transport mode for leisure trips is the private car. It is perceived an all-round mode.

Leisure is not only a fraction of time but also an aspect of consumption. Almost 30% of individual monthly spending by Austrians is for leisure purposes.
1 Introduction

This document constitutes the first intermediate report of the Austrian case study on the OECD decoupling project. It was prepared as a basis for the respective OECD progress meeting on December 3-5, 2003. The results are drawn from the first two months of project research.

2 The link between economic growth and transport

There exists a clear link between economic growth, a crude indicator for the development of human well-being of a society, and transport demand. Transport activity affects economic growth and human well-being directly and indirectly. An overview of this interrelation accompanied with empirical evidence from Austria is presented in the following.

2.1 Transport demand and economic growth in Austria – links in both directions

Transport facilitates the access to jobs, education, recreational facilities and markets. Thus transport plays an important role in the economy.

A key to understanding transport demand is to know that it is primarily a derived demand. Transport hardly occurs for its own characteristics but mainly to satisfy the needs of people to change location and the needs of businesses i.e. to move goods or materials. Therefore an increase in economic activity (represented by an increase in GDP) and the subsequent increase in the demand for goods is also often considered to lead to an increase in transport demand (e.g. Cole 1987, 15).

2.1.1 The correlation of economic and transport development in Austria

Transport demand and GDP have developed highly correlated in the past in Austria, an observation that can be made on a national (see Figure 2.1) and on a per capita level (see Figure 2.2).
The overall passenger transport demand in Austria was rising substantially in the period from 1950 to 2001 with an average growth rate of 3.6% a year, reaching a level of almost 14500 pkm (person-kilometres) per person a year. This growth is driven mainly by motorised individual transport (MIT) and air transport. Air passenger transport was growing at an average rate of more than 13% per year in the period from 1950 to 2001 (see Figure 2.3). Nevertheless the share of air passenger transport in overall transport demand was still less than 7% in 1999 (BMLFUW 2003). Motorised individual transport (MIT) is dominating passenger transport (see Figure 2.4) which is mainly an effect of the enormous growth rates beginning in the 50s. Passenger car transport increased by more than 2400% from 1950 to 1999, while non-motorised transport was decreasing by more than 60% (see Figure 2.5). An interesting observation is that the average passengers transported per car stayed virtually constant at a level around 1.4 in the period from 1991 to 2001 (BMLFUW 2003) although the average size of Austrian households decreased from 2.58 to 2.41 in the same period (BMVIT 2002, 4).
Freight transport volumes were growing at an average annual rate of 3.2% in the period from 1950 to 1990 and increased to a growth rate of 4.3% in the period from 1991 to 2001, a rate almost twice as high as GDP growth in that decade (BMLFUW 2003). Freight transport growth is mainly due to road freight transport. In the period from 1991 to 2001 it exhibited an average annual growth rate of almost 5%, while rail freight transport was growing at a rate of around 3% (see Figure 2.6). Starting from a very low basis, the average annual growth in air freight transport in the period from 1950 to 2001 was more than 12% (see Figure 2.7).

Overall freight transport activity (without pipelines) in Austria in 2001 was 48.3 billion tkm (tonne-kilometres). Despite the massive growth in air freight transport, freight transport in Austria is dominated by road freight transport with a share of almost 60% (see Figure 2.8). This dominance is particularly strong in domestic freight transport where the share was more than 75% in 2001 (BMLFUW 2003).
The correlation between transport and economic growth according to a different data basis

While the data basis BMLFUW (2003) covers the period 1950 to 2001 for both transport and environmental transport impacts, for a shorter time period and for the former category of data (transport), there is an alternative data basis available for Austria: BMVIT (2002).

Using BMVIT (2002), the relationship between transport and economic development is depicted in Figure 2.9 and Figure 2.10. Using these figures, we can conclude, that, first, road transport is stronger linked with economic growth than rail transport, and, second, that rail transport reacts overproportionally to recession or low rates of economic growth. Further, the strong variation in rail transport demand (the waves in Figure 2.10) must be caused by other reasons as well than just differences in economic growth.

2.1.2 The development of components potentially explaining transport demand

There are various reasons for the observable transport trends. One reason for the steep increase in road freight transport is the change in the structure of the industrial sector. Bulk goods such as ore or coal that are suitable for rail or inland waterway transport are
getting less important whereas the share of high-value goods, that are predominately transported by road transport because of lower loads and the requirement for fast and direct transport, in overall output is increasing (Baum and Kurte 2002, 16).

A main reason for the higher increase in road freight transport relative to rail transport may be seen in the transport policy of the 70s, 80s and 90s that fostered road transport. Road freight transport (in tkm) was growing at an average annual rate of less than 5% in the period from 1991 to 2001 while road freight mileage (in vehicle-km) displayed an average growth rate of more than 7% (see Figure 2.11), indicating that goods transported are getting lighter. This might be the case because the goods transported are getting increasingly time-sensitive and less suitable for mass transport (i.e. just-in-time production is gaining in importance) and due to changes in the spatial concentration of production (i.e. reduced plant numbers and increased plant specialisation). Another reason is the shift to smaller vehicles especially in inland transport and for transport between Austria and accession countries for which no contingents are required. In the period from 1991 to 2001 road freight transport with light duty vehicles (<3.5t) increased by almost 10% p.a. while the annual increase for heavier duty vehicles was less than 5% (BMLFUW 2003). The value of the internationally traded goods in freight transport is also increasing which might be an indicator for the higher value of the goods transported (see Figure 2.12).

Prices are a further an important determinant of transport demand (Cole 1987, 16). While prices for diesel fuel in USD at 1995 prices and purchasing power parities fell by more than 30% in Austria in the period from 1980 to 2000 (OECD 2002, 23), passenger road mileage by vehicles with Diesel engines increased more than tenfold (increase in overall motorised passenger road mileage more than 80%) and freight road mileage by vehicles with Diesel engines increased by more than 170% (increase in overall road freight mileage more than 130%) (BMLFUW 2003). Fuel prices, as an essential part of operating costs in MIT are especially important for passenger transport demand as private owners of motorised vehicles often only take operative costs into account when choosing their means of transport.

Further, individual income also influences transport demand (Cole 1987, 17f). Increases in income generally increase transport activity: freight transport activity because more goods are being purchased and passenger transport activity because more income allows individuals to purchase more vehicles and make more and longer trips e.g. for leisure purposes. Overall vehicle ownership was increasing at an average annual rate of more than 6% in the period from 1950 to 2001. The growth rate in private car ownership was even higher in that period. Ownership was growing at a rate of 9% (see Figure 2.13). Despite the strong increase in the stock of cars between 1950 and 2001, there is no obvious trend in annual road mileage per car (see Figure 2.14) (BMLFUW 2003).
The link between economic growth and transport

Characteristics and qualitative aspects such as speed of the service, reliability, safety, comfort and flexibility are particularly important when deciding the transport mode for a trip (Cole 1987, 180). In freight transport new trends in production like just-in-time production make these aspects even more important. Transport infrastructure development might give an indication on which modes of transport do fulfil these characteristics. In the last decades motorways were the only transport infrastructure growing at a significant rate (see Figure 2.15). An increase at this high level cannot be observed for the overall road infrastructure, facing only moderate but continuous increases (BMLFUW 2003).

2.1.3 The impact of economic growth on transport demand in Austria

It is widely accepted that economic growth fosters growth in transport demand. This is purely a consequence of the fact that economic growth means an increase in economic activity – so more goods are being produced and consumed. Transport demand is mainly derived.

Transport and GDP developed highly correlated in past (see Figure 2.1). There is no doubt that transport development can partly be explained by the pure impact of economic growth on transport demand. But the 1990s also saw a change in the organisation of the international division of labour – a change that was to some extent a result of better transport infrastructure. International division of labour is particularly important for a small economy like Austria where international trade enables to access bigger markets and thus to utilise economies of scale. The access to bigger markets also leads to more diversity of goods and hence more derived transport demand. In Austria trade volumes and GDP were growing at a faster rate until 1995 when Austria joined the European Union. Thereafter trade volumes started to grow at an even faster rate (see Figure 2.16). So trade is an important determinant of freight transport. In 2001 freight transport without pipeline transport due to Austrian foreign trade activities accounted for approximately 40% of freight transport [in tkm] in Austria whereas the share of transit was around 25% (BMLFUW 2003).
The link between economic growth and transport

2.1.4 The impact of transport improvements on economic growth in Austria

Apart from the impact of economic growth on transport demand, the parallel growth of GDP and transport also led to the belief that “transport infrastructure is an essential condition for economic growth and prosperity due to the increase in accessibility and as a result in competitiveness” (see BMVIT 2002, 42). The main line of argument is that transport improvements lead to an increase in labour and capital productivity due to increased competition and enhanced division of labour. The improvement in the transport system leads to time saving, improved accessibility, etc. and subsequently to economic growth and an increase in employment and prosperity (Izquierdo 2003, 33).

But this does not hold unambiguously. The evidence of such a mechanism has to be particularly doubted in a developed, post-industrial economy like Austria. Berechman (2002, 107ff) questions the importance of transportation improvements for economic growth on several grounds. He argues that in modern post-industrial economies knowledge and the innovation potential are thought to be the main contributors to economic growth (see also Figure 2.17). He acknowledges the importance of changes in production methods that are partly possible only because of an efficient transport infrastructure but indicates that progress in information and communication technologies are more important in that respect.

Berechman (2002, 107ff) also points out that the share of work-related trips is decreasing (see Figure 2.18 for the distribution of trips per purpose in Austria in 1995) - mainly a consequence of changes in leisure activity patterns and changes in the demographic structure of society (see Figure 2.19). Hence improvements in transportation have less an effect on productivity than on non-work related travel quality.
Infrastructure investment is also seen as a means to improve accessibility and attract target industries. The existence of a reasonable degree of transport infrastructure is of course necessary to attract businesses. But Berechman (2002, 130ff) illustrates that regional policy has more powerful instruments to do that. And even if industries are lured, the effects are often mainly regional with only a slight impact on economic growth on a national level.

2.1.5 Conclusions on the interrelation between transport and economic growth in Austria

Economic growth means an increase in the economic activity and thus it does increase derived transport demand. An increase in transport demand is a general consequence of economic growth but increases in industrial production and international trade volumes seem to be particularly important in this respect (Meersman and Van der Voorde 2003, 33).

On the other hand it is transport investment that may foster economic growth. In principle there are two ways how this may work: (a) an increase in efficiency in the goods market because of a greater market and hence more competition and (b) an increase in labour productivity because the size of the effective labour market increases (see e.g. Prud’Homme 2002, 97).

But these mechanisms do not take place inevitably. Some conditions have to be met. First of all transport investment has to increase accessibility e.g. via the elimination of a transport bottleneck. Pure expansion does not necessarily do that. On the contrary it may even lead to an increase in both traffic and congestion and hence a decrease in accessibility. Investment in infrastructure also does not automatically enhance competition. This depends on the characteristics of the particular market in question. So whether transport investment does lead to economic growth or not does depend on the specific economic conditions in the markets concerned.

Transport investment also takes place in individual projects. So it is the specific form of investment that is crucial. Further, policy design such as institutional settings and the legal system play a key role (Berechman 2002, 130f).

If all these conditions are met transport growth will foster economic growth. But this still does not answer the question whether it is the best way of investment. If knowledge and information play the most prominent role in determining international competitiveness and economic growth, it is possibly better to invest in education and research.

The exact impact of transport on economic growth is controversial. But there are effects of transport growth that are very clear – effects on the human health and the environment. The extent of these effects is a consequence of the fact that transport is not charged at full cost at the moment.

2.2 Negative effects of transport growth

To satisfy transport needs requires energy and causes emissions. The extent of these effects depends to a large extent on the prevailing specifics such as modal split and technologies in use in the current transport system.

In 2001 transport operation was responsible for 27.7% of energy consumption in Austria. Only 4% of this energy consumption was due to rail transport, while the share of road transport was 87%, a share that had been as low as 22% in 1950. The share of energy consumption for air transport was 9% in 2001 - the result of an average annual increase in direct energy used in air transport of almost 10% between 1950 and 2001 (BMLFUW 2003). In the last 50 years energy consumption due to transport increased by more than 550%, while freight transport [tkm] increased by roughly 450% and passenger transport [pkm] by roughly 500%. So despite technical progress in that period, energy consumption in the transport sector grew more than transport performance – a development that is solely attributable to air and road transport (see Figure 2.20) (BMLFUW 2003).
Most of the energy used in transport is in the form of non-renewable fossil fuels, which accounted for 96% of direct energy required in 2001 (BMLFUW 2003).

Apart from the direct energy required for the operation transport, the transport sector is also responsible for energy consumption due to the construction and operation of infrastructure and the production, maintenance and disposal of vehicles. Including indirect energy requirements, public transport requires less than a third of the energy a car and less than a fourth of the energy an airplane requires for one person-kilometre. In freight transport the respective energy requirements for road and air transport are even more to the disfavour when higher compared to rail or inland water transport (BMUJF 1997, 13f).

The high amounts of energy used in transportation, particularly the high share of non-renewable energy, lead to severe environmental and health pressures.

2.2.1 Negative environmental effects of transport

The negative environmental impacts of transport stem from the extraction of raw materials required for the transport system that can have serious detrimental effects on existing ecosystems and from the pressure on the limited assimilation capacity of nature as a sink for emissions.

Air pollution is one of the direct effects from the combustion of fossil fuels used as primary energy source in transport. Although most transport related air pollutants declined in absolute amount since the 1950s, transport still is a main source of pollution (see Figure 2.21). In 1995 it was responsible for 61% of the NOx-emissions and 44% of the VOC-emissions in Austria. For some pollutants such as CO2 or particulate matter the emissions from transport were still increasing in the period from 1990 to 2001. Despite Austria’s commitments according to the Kyoto protocol, CO2 emissions from transport rose by 45% from 1990 to 2001. Road transport was responsible for more than 85% of CO2-emissions from transport in 2001 (BMLFUW 2003).

Transport infrastructure requires land. Land use for transport accounts for 2% of land in Austria – with severe environmental effects. Transport infrastructure leads to soil hardening and toxic contamination. It causes the fragmentation of land and subsequent pressures on biodiversity. Rail transport exhibits the lowest land use per pkm respectively tkm in Austria (BMUJF 1997, 24).

Environmental impacts of transport do also depend on the time and location of transport activity. The environmental pressures are highest along the routes of the main infrastructure networks. This is particularly worrying if such transport corridors pass through areas that are especially environmentally sensitive. In Austria road freight transport across the Alps represents such a situation.
2.2.2 Negative health effects of transport

Transport has various negative environmental effects. These negative environmental effects can have an indirect impact on human health and well-being, e.g., due to extreme weather events\(^7\) that are to some extent a consequence of global warming that again is partly an effect of human transport patterns. But transport also affects human health directly.

Some air pollutants have direct effects on health. CO for example causes cardiovascular diseases and a short-term increase in particulate matter leads to "increased mortality, increased admissions to hospital for respiratory and cardiovascular diseases, increased frequency of respiratory symptoms and use of medication by people with asthma, and reduced lung function" (Dora and Phillips 2000, 19f). Particulate matter in high concentrations occurs mainly in urban areas where the relative contribution of road transport is higher (WHO 1999, 11). The emissions in particulate matter from transport in Austria were increasing by 11% from 1990 to 2001 (BMLFUW 2003). The estimated share of air pollution costs caused by transport is roughly 50% (WHO 1999, 13).

Transport is the major cause for human exposure to noise, particular so road traffic is (see Figure 2.22). Noise has negative effects on communication, school performance, sleep and temper, as well as cardiovascular effects and can lead to hearing impairment (Dora and Phillips 2000, 9). The external environmental costs from road transportation including noise costs, pollution costs, health costs and climate costs in 2000 in Austria added up to 4861 Mio. (Herry and Sedlacek 2003, 114).

Additionally to the negative health impacts of transport from air pollution and noise, transport also poses a relatively high risk to be involved in an accident that might lead to injuries or mortalities. Road accidents are the most significant cause of all transport accidents in number of deaths and with respect to death rates per kilometre travelled (Dora and Phillips 2000, 14). In Austria the number of fatalities from road accidents is declining both in absolute numbers and per capita since the middle of the 70s (see Figure 2.23), while the number of road accidents itself did not decrease continuously: it was 56491 in 1961 compared to 56265 in 2001. The risk to get involved in a road accident is highest for car passengers. Non-motorised road users are least protected, they accounted for 18% of road accident fatalities in 2001 (BMLFUW 2003). In 2000 the external road accident costs in Austria amounted to 4861 Mio. (Herry and Sedlacek 2003, 114).

Transport can also have effects on mental health and wellbeing. Accidents, especially fatal accidents, often cause posttraumatic stress disorder for survivors. Congestion restricts movement, and leads to stress high blood pressure and frustration. Current patterns of MIT also changed the spatial structure of housing and working, leading to disruption of social communities (Dora and Phillips 2000, 25ff).

2.3 Rationale for decoupling

\"The growth in motorized mobility has been mostly positive. It has facilitated and even stimulated just about everything regarded as progress. It has helped expand intellectual horizons and deter starvation. It has allowed efficient production and the ready distribution required for widespread consumption. Comfort in travel is now commonplace, as is access to the products of distant places. But there have been costs – mostly environmental costs – that are eroding the benefits.\"
The link between economic growth and transport

Pollution from transport and from many other sources is leading to serious environmental degradation and negative impacts on human health.”

BMLFUW and OECD 2000, 13

Economic growth with all its positive effects is closely linked to transport demand. Transport itself is responsible for a wide range of positive effects, but current transport patterns also have serious negative impacts. So to allow economic growth that is not thwarted by negative growth impacts requires decoupling.

Sensibly decoupling cannot only mean a decoupling of transport demand from economic growth but a decoupling of economic growth from negative transport impacts. In principle this can be achieved by different means like changes in the modal split in passenger and freight transport, technological measures\(^8\) or the decoupling of transport demand and economic growth, although it is neither necessary nor sufficient.

The aim of decoupling economic growth from negative transport impacts does not further deal with important negative effects that might directly stem from economic growth but acknowledges that the historically given close link between economic growth and negative transport impacts has to be tackled.

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\(^8\) Historically technological progress led to relative decoupling in many cases but due to changes in demand this was not sufficient for an absolute decoupling.

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3 The notion of decoupling and its indicators

3.1 Definition of the transport sector in Austria

Before analysing the notion ‘decoupling of transport’, it seems to be useful to define the term ‘transport’ and its position in the system of the national accounting of Austria.

Transport can be defined as the sum of all outdoor movements from one place to another (Fiedler 1992) or as the forwarding of persons, goods and messages in space (Kaspar 1977).

To be able to explicitly link transport activities to decoupling and sustainability it is a prerequisite to distinguish from transport in a narrow sense and transport in a broader sense. Transport in a narrow sense concerns exclusively sector 8 ‘Transport, Storage and Communication’ of the system of national accounts (see Figure 3.1). This sector is subdivided by mode of transportation, i.e.

- Land transport
- Transport via pipelines
- Water transport
- Air transport
- Supporting and auxiliary transport activities: activities of travel agencies

Such a narrow definition would obviously not enable us to enhance our understanding of the aggregate effect to the economy transport activities have.

There are several other sectors of the national economy that provide important contributions to the transport sector (see Figure 3.1) such as

- the ‘manufacturing sector’, which comprises among other things the production of means of transportation and of other transport equipment;
- the ‘construction sector’, which is responsible for setting up all transport infrastructure such as motorway, roads, bridges, and tracks;
- the ‘whole sale and retail trade sector’, which includes the maintenance and repair of transport vehicles and additionally organises the distribution of fuels to power transport activities;
- the sector ‘real estate, renting and business activities’ includes the renting of
motor vehicles, and finally
- the sector ‘private households with employed persons’ is beside other activities dealing with the traffic demand of all private individuals.

As immediately can be seen the narrow and the broad definition of transport determine the value added and the related environmental pressures of the sector. While the narrow definition would only recognise the value added of sector 8, transport and energy input as well as emissions from fuels as environmental pressures, the broad definition would summarize all transport related contributions of numerous economic activities (sectors) to value added and would, on the environmental dimension, include much higher amounts of energy and matter flows (including emissions) and transport related land use change.

For this reason it often seems advisable to choose the broader definition of transport to really assess the economic as well as the environmental performance of transport.

Figure 3.1 distinguishes between the two definitions of transport where the dark shadowed rectangles make reference to the narrow definition, the light shadowed rectangles to the broader understanding of transport activities. Usually, the SNA follows the OENACE classification. However, some of the energy and environmental statistics before 1995 use the older Austrian classification scheme (Betriebssystematik 1968) which has been replaced by OENACE.

As an example of the differences between OENACE and Betriebssystematik 68 we show the sector classification used by the energy balance of 1994, which was classified into 43 sectors. These 43 sectors are combinations of the BS68 (Betriebssystematik 68), and can therefore provide a vague comparison to the OENACE systematic (Ahamer et al. 1998).

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9 OENACE is the Austrian version of the European economic classification NACE Rev 1.1 of the European Union.
The notion of decoupling and its indicators

Since 1990, results from empirical studies allowed to reformulate the growth-critique into an efficiency critique. In this new paradigm subject to critique is the useless squander of resources because of inefficient use. The argument is, that if energy and materials intensity in production and distribution rise significantly, than, even assuming economic growth, resource use can be diminished. This is the hope that has been set into a possible ‘efficiency revolution’ such as more slogan-like stated in the prominent Factor 4 argument (Weizsäcker et al. 1995, 235). As many case studies show, the margin for efficiency gains is indeed considerable (Jänicke and Weidner 1995) and for energy use even amounts to 50% of recent use.

The efficiency argument appears again in the discourse of ecological modernisation and of dematerialisation of economic activities. Most often, the debate is led under the headline ‘decoupling’. The term ‘decoupling’ in general refers to breaking the link between economic growth and environmental pressures and related impacts. Decoupling occurs when the growth rate of an environmental pressure is less than that of its economic driving forces over a given period.

Some authors (Selden and Song 1994, Rothman and De Bruyn 1998, Barbier 1997) argue that decoupling is a ‘natural’ process in all economic activities. Economic companies would always aim at reducing input costs which would, at the same time, reduce the amount of resources which are a cost-factor. This would lead into a win-win situation, where the firms would gain economically while the environment would be spared. Of course, measures taken by the state could considerably enforce such a preferable situation.

Another aspect of decoupling appears at the aggregate level where structural change, a move of economic activities from resource intensive primary industries to service activities, would also support efficiency gains in terms of resources used per unit of GDP. In the scientific debate we distinguish relative from absolute decoupling. While the first refers to efficiency gains which, due to compensatory effects of growing over all consumption include growing resource utilization the latter refers to an absolute reductions of resource use while GDP grows.

This debate has been operationalized by using Kuznets curves which provide a framework for relating an economic indicator (GDP/capita) to an indicator for environmental impact (see Ecological Economics, Vol. 25/2, 1998). The Kuznets curve which first was introduced by Simon Kuznets for relating economic growth to questions of distribution and later adapted for environmental questions assumes that while economies grow environmental impacts will grow accordingly. However, from a certain turning point on further growth would allow for reducing environmental impacts (see Figure 3.2).

In earlier studies, the Environmental Kuznets Curve approach was applied to the relationship between income and toxic emissions (Selden and Song 1994) where the Kuznets effect could be proofed because more efficient production technologies and end-of-pipe technologies for emissions reduction as well as waste treatment typically involve the economic capacity to invest in such activities. More recent case studies explored macro-changes in environmental quality resulting from economic growth, for example, induced by trade liberalisation (Cole 2000, Grossman et al. 1995), and arising from changes in transition economies (Zylicz 1994, Tisdell 1993).

Basically, it can be said that aggregate indicators for resource use as well do not proof the Kuznets hypothesis because efficiency gains are overcompensated by effects of overall growth. The same is true for emissions which are not subject to technical solutions such as CO₂. Although this method has significant deficiencies because it can lead to wrong conclusions and it ignores some relevant factors to sustainable development, it is still a basic theory and relating to the environment debate. Arguments supporting this view are for instance the fact that consumers prefer less material intensive services, that less demand for new infrastructure exists and that more recycling of energy intensive materials is possible. But there is an ongoing discussion on concepts related to decoupling (Ayres 1989, Jänicke et al. 1989, Grübler 1994; Holmberg and Karlsson 1999).

In any case ‘decoupling’ presents a multifaceted concept: which is sometimes measured as total material flows and sometimes the focus is put on specific compounds, sometimes it is measured in absolute terms (in kg) and sometimes in relative terms (e.g., in relation to GDP). The concept of decoupling is attractive for its simplicity. Graphs represent a rising GDP compared with the progress of for example pollutant emissions. But the decoupling concept has no automatic link to the environment’s capacity to sustain, absorb or resist pressures of various kinds.
3.2.2 Decoupling on the level of the national economy of Austria

In this part we will discuss aggregate trends of decoupling for Austria using state of the art environmental pressure indicators and relating them to economic growth. One concept to empirically assess environmental pressures is Material- and Energy Flow analysis (EUROSTAT 2001). This accounting framework distinguishes two sources of inputs of material and energy that are the domestic environment and trade. On the output side wastes and emissions as well as exports are accounted for. Besides offering a full set of data describing the all physical activities of an economy some indicators have crystallized in the political debate (EUROSTAT 2002). These indicators include Direct Material and Energy Input, Domestic Material and Energy Consumption and Direct Processed Output.

The direct material input (DMI) to the Austrian economy (see Figure 3.3) increased from 117 million metric tons in 1970 to 184 million metric tons in 2000. This 57 percent increase was induced mostly by a rise in structural minerals and by an increased amount of imports, which have more than doubled since 1970 (EUROSTAT 2002). Since GDP did grow at an even faster rate (from 118.000 Mio in 1970 to 267.000 Mio in 2000) significant decoupling between overall resource utilization and economic growth occurred. However, decoupling in this respect was not a steady process: While efficiency gains in the decade 1970-80 were smallest with only 5% over the whole period, the 1980s envisaged 16% reduction in materials intensity. Efficiency gains slowed down since the 1990s and lay at 12% in the last decade (1990-2001).

While DMI is an indicator for overall materials mobilization, DMC is a rough proxy for apparent domestic consumption by deducting exports from DMI. However, Domestic Consumption does not equal what economists would mean by this term, because DMC includes both final consumption and intermediate consumption for production of domestic and foreign final goods. Efficiency gains described for DMI hold true also for DMC where the first decade (1970-80) saw lesser gains in efficiency than the following decades. Although materials efficiency (DMI/GDP, DMC/GDP) rises considerably absolute numbers of DMI/DMC also grow. Hence, we classify these effects as relative decoupling.
Materials entering the economic process at the end of the day (after passing the whole chain of production, distribution, consumption) end up in the environment again as waste and emissions. This is what the output indicator Direct Processed Output describes. DPO distinguishes among three different types of material outputs (World Resources Institute 2000).

- Firstly, the output of toxic emissions, which can be reduced by end-of-pipe technologies that shift the destination of output materials from one gateway to another (i.e. instead of ending up in the air they are captured by filters which are deposited).
- The second type of material flows are represented by the bulk input materials which are usually not toxic, nevertheless they are creating environmental pressure because of their huge quantities. Demolition waste from construction could be an example here.
- The last group of emissions is CO₂ from fossil fuels that are strongly related to the input side. Although CO₂ is not toxic per se vast amounts are altering the earth’s climate. Decoupling CO₂ output from GDP growth can most likely be achieved only by reducing inputs.

Acknowledging those different types of flows we distinguish between CO₂ and all other waste and emissions when discussing efficiency gains.
All in all Austria has managed to somewhat stabilizing overall DPO despite a growth in GDP. This has been achieved by structural effects and technological innovation. It seems that in the 1980s environmental policy did also contribute to reduced environmental pressures, which was lesser the case since 1995 when Austria joined the EU.

The amount of Direct Input of technical energy (DEI) as energy which is necessary to produce one unit GDP decreased by 13% since 1970.

Looking at Domestic Energy Consumption (DEI minus exports) the situation becomes even more favourable in terms of decoupling. While growth of DEC in the 1970 (27%) was stabilized in the following period (2% growth) since 1990 the absolute amount of energy domestically used even decreased by 4%. Therefore, during the last decade (1990-00) the Austrian economy achieved absolute decoupling between energy use and GDP (see Figure 3.8).

### 3.2.3 Decoupling of the transport sector

So far, we have discussed trends of decoupling at the aggregate level showing developments in materials and energy use opposite economic growth. Apparently, aggregate trends are made up by sector dynamics of which the transport sector is one important intermediary activity. Depending of whether we choose a narrow or a broader definition of transport related economic activities transport has a different share in the above outlined aggregate trends (see section 3.2.2).

It is quite obvious that there is a kind of correlation between economic growth (measured by GDP) and the demand for transport. Demand for freight transportation is generated by the production and the distribution of goods. Demand for goods again is influenced by the general economic situation.

Decoupling of transport focuses on the analysis of growth rates of GDP and growth rates of indicators describing passenger and freight transport demand. Thus decoupling of the evolution of transport demand from the evolution of GDF has taken place, if transport
The notion of decoupling and its indicators

Demand takes a growth path with lower growth rates than GDP. In the last decades, transport performance time series data have shown an upward trend in Western European countries (ECMT 1999).

Regarding transport two kind of decoupling effects might appear. First of all, the sheer amount of transport might increase/decrease in comparison to GDP. This would be measured using standard transport indicators such as tkm and pkm and relate them to GDP (tkm/GDP, pkm/GDP). We call these direct effects between transport and the economy, which do not explicitly address environmental pressures. To be able to identify environmental pressures related to transport activities (whether narrowly or broader defined) we would have to identify the share of materials and energy flows related to transport activities.

Less straightforward is the contribution of transport to materials input and domestic materials consumption because MFA data is typically not available by sector. The reason is that most MFA studies regard the economy as a black box.

Nevertheless, it seems convincing that an increase in material input into a country’s economy, reflected in Direct Material Input, at the same time boosts the volume of transport – especially freight transport - in this country. Fischer-Kowalski (forthcoming) points out that from the moment of entry of material such as agricultural products, timber, mineral ores or fossil energy carriers into the economic process, these materials will be transported from one actor to the next, from producers to traders to consumers (either domestic or foreign) and finally to waste deposits. If all material inputs would be directly delivered to their final destination, so Fischer-Kowalski, the volume of freight loaded on transport vehicles would be equal to Direct Material Input. Although this situation seems implausible we can deduct that the volume of freight loaded on transport is a kind of function of DMI and the length of the production-consumption chain. However, there will be an attempt made to quantify transport related material flows at a later stage of this project.

For energy the identification of environmental pressures related to transport activities could be done straightforwardly by comparing energy consumption of the transport sector (narrow definition) to overall energy consumption.

Doing this, we see that energy used in the transport sector in Austria increased from an amount of 112,561 TJ in 1970 to 300,891 TJ in the year 2000. While 1970 the consumption of energy for the transport sector amounts about 13 % of the overall DEC of Austria, 2000 an increase of the transport sector energy consumption to 24 % in relation to the overall energy consumption took place (see Figure 3.9).

Energy policy has focused on technology to reduce fuel use per kilometre in new cars or improve traffic to reduce fuel use per kilometre in the stock. One reason why despite these efficiency gains decoupling was limited is that technical fuel efficiency improvements in the transport sector were cancelled out by rising overall transport demand.

During the oil crises of 1973/1974 and 1979, policy makers tried to convince people to switch from private cars to public transport. Apart from these efforts only few political attempts have been made to restructure travel. Consequently the overall impact of structural change has raised travel energy use significantly because changes in the characteristics of cars have been for the most part energy-intensive, although policies aimed at enhancing fuel efficiency (IEA 1997).

As already said, CO₂ is the most important part of overall emissions. Hence, comparing emissions of the transport sector (narrow definition) with emissions of other sectors it is possible to identify different dynamics. While the amount of CO₂ emissions of the industry sector decreased from 27 kt in 1980 to 23 kt in 1998, the CO₂ emissions of the transport sector grew continuously. The CO₂ emissions of the transport sector increased from more than 12 kt in 1980 to 18 kt in 1998, a growth of 45%. Despite this significant increase, the share of transport related CO₂ of overall CO₂ has decreased.
The notion of decoupling and its indicators

Even though CO\textsubscript{2} is the most important part of overall emissions, it seems to be interesting to have a look at further emissions such as SO\textsubscript{2}, CO and NO\textsubscript{x}.

SO\textsubscript{2} develops from burning sulphurous fuels.

Figure 3.10: CO\textsubscript{2} emissions of some important sectors 1980 and 1998, Austria
Source of data: ÖSTAT 2001

Figure 3.11: SO\textsubscript{2} emissions of the transport sector in comparison to the overall SO\textsubscript{2} emissions, Austria
Source of data: ÖSTAT 2001

Figure 3.12: CO emissions of the transport sector in comparison to the overall CO emissions, Austria
Source of data: ÖSTAT 2001

Figure 3.13: NO\textsubscript{x} emissions of the transport sector in comparison to the overall NO\textsubscript{x} emissions, Austria
Source of data: ÖSTAT 2001

Figure 3.10 illustrates that SO\textsubscript{2} emissions decreases significantly since 1988. One reason
for this clear reduction is above all the reduction of the sulphur in mineral oil products and the installation of de-sulphurization plants. The SO\textsubscript{2} emissions caused by the transport sector in relation to the overall SO\textsubscript{2} emissions are very low and moreover shows a clear decrease of SO\textsubscript{2} emissions of the transport sector, which again resulted from technological improvements.

Figure 3.12 describes a constant decrease of CO emissions in general and also of the CO emissions of the transport sector, which decreased faster than the overall CO emissions. While in 1989 the transport sector caused nearly 40\% of the CO emissions in Austria a decade later in 1998 only 27\% of the CO emissions stem from transport activities.

Finally, also NO\textsubscript{X} emissions in Austria have been reduced significantly, where the transport sector contributes to around 55\% of overall NO\textsubscript{X} emissions (Figure 3.13).

To summarize, emissions related policies were successful in situations where technological fixes could solve the problem such as for CO, SO\textsubscript{2} and NO\textsubscript{X}. However, emissions not being responsive to end of the pipe strategies such as CO\textsubscript{2} can only be reduced if inputs would decrease significantly.

Another important transport related environmental issue is land sealing by transport infrastructure.

If we consider the share of transport related land use of permanent settlement area (Dauersiedlungsraum)\textsuperscript{10} it is rather small with 2\%.

Moreover, the transport infrastructure network, in principal, has been finalized in the 1970 and therefore, since than enlargements are rather small.

Despite being small in overall amount and transport infrastructure contributes to other environmentally destructive effects such as fragmentation, reduction in habitat size and prevention of migration of species thereby being a major driver of biodiversity loss.

\textsuperscript{10} Permanent settlement area (Dauersiedlungsraum) is the total area exclusive Alpine regions, water area and forest area.
create more integrated and comprehensive systems of sustainability indicators (for example: OECD 1994, Munasinghe and Shearer 1995, Moldan et al. 1997).

Concerning the aim of sustainable development, which focuses on long term trends, comprehensive and causal oriented indicators seem necessary. According to this, indicators of sustainable development have to meet three main criteria (Bossel 1996, Moldan et al. 1997):

- **simplification**: the indicators supply information on the functioning of systems which are too complex to be assessed or measured directly, as long as there is no lost of central aspects;
- **quantification**: this requires the availability of data of adequate quality;
- **communication**: indicators should clearly illustrate the attainment or the lapse of a declared aim;

Indicators present information in quantitative form and allow the description of complex social, political, public or natural processes. Thus, they can be seen as an empirical model of reality (Bossel 1996, Hammond et al. 1995). In general, indicators for monitoring progress towards sustainable development reflect some model of the interaction between societies and their natural environment.

The performance of socio-economic systems by means of indicators such as GDP, unemployment rates and income distribution has a long tradition. There are two ways of extending the standard economic accounting framework in order to account for environmental aspects of the economic process. The first approach involves expanding the System of National Accounts (SNA) by integrating ecological aspects into a corrected GNP value. In this case, environmental damages, ecological impacts of the economy and losses of resource stocks are “monitarized”. The second approach involves the construction of environmental satellite systems to the SNA. This creates a close link between the SNA and a set of environmental indicators reflecting the overall environmental performance of the economy (United Nations 1993, Uno and Bartelmus 1998).

Several important points have to be kept in mind when using indicators:
- Without good data, based on monitoring, it is not possible to develop indicators
- Performance measures imply that targets need to be set (i.e. something against which performance can be compared)
- Different people living in different places have different values. Indicators must therefore be able to take into account different locations, people, cultures and institutions
- Sets of indicators evolve over time
- Sets of indicators are seldom, if ever, complete

3.3.2 A review of the PSR and the DPSIR scheme

A review by the German Scientific Council on the Environment (SRU, 1998) revealed that most approaches to environmental and sustainability indicators rely on the Pressure-State-Response (PSR) scheme of the OECD (1994). The PSR scheme considers three levels of analysis of environmental problems:

- **pressure indicators**: these are the pressures that a society exerts on the environment (e.g. emissions)
- **state indicators**: they illustrate the state of the environment (e.g. water quality, state of woodlands, air quality and such), these indicators should be designed to give an overview of the situation of the environment and its development over time
- **response indicators**: they describe a societies efforts to improve the environment by changing its own behaviour towards the environment (e.g. reduction of emissions)

The PSR scheme implies that pressures generate changes in the state of the environment, which in turn might lead to environmental policy responses whenever unfavourable situations in the state of the environment are observed. The PSR scheme is currently widely used by regional, national and international organisations (e.g. UNO, ...
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ECE, OECD, EU).

It is important to notice, however, that human activities themselves cannot be understood as a pressure on the environment such as is described in the OECD scheme (Figure 3.15). Pressures on the environment are effects caused by socio-economic activities such as for instance industrial production or transport activities. To acknowledge this, the PSR scheme has been extended by two categories, that are driving forces and impacts. Doing this, OECD arrives at the Driving Force - Pressure - State - Impact - Response Framework (DPSIR). The new scheme assumes that environmental pressures originating from socio-economic forces (Drivers) - demographic, economic, institutional and technological - cause significant changes in the state of the environment. Whenever the processing and functioning capabilities of ecosystems are affected, welfare losses most likely occur due to changes in productivity, health, amenity and other values (Impacts). Policy response mechanisms should then be triggered in order to overcome the observed impacts, in a continuous and adaptive feedback process aimed to re-establish a balance between socio-economic activities and natural resources.

The Driving Force - Pressure - State - Impact - Response Framework (DPSIR) provides an overall, well accepted and internationally agreed systematic for analysing socio-economic environmental problems.

- **Driving forces**: added value (GDP), disposable income, price
- **Pressures** on the environment: energy and matter flows, emissions and wastes, appropriation of net primary production
- **State** of the environment: quality of air, water and soils
- **Impacts on human health and eco-systems functioning**
- **Responses**: various policy measures, such as regulations, information and taxes.

One difficulty with the DPSIR system is that it assumes responses would only take place when impacts are observable. However, providing a set of pressure indicators to directly monitor these pressures would allow for a short-cut to directly respond to the pressures.

### The DPSIR Framework

For Reporting on Environmental Issues

- **Drivers**
  - e.g. Industry
  - e.g. Transport
- **Pressures**
  - e.g. Polluting Emissions
- **State**
  - e.g. Air, Water, Soil Quality
- **Impacts**
  - E.g. health, biodiversity loss, Economic Damage
- **Responses**
  - e.g. Clean Production, public Transport, Regulations, Taxes Information, etc.

**3.3.3 The application of sustainability indicators to transport policies**

Work on environmental indicators in the OECD has been ongoing since 1989/1990. The OECD environmental indicators programme recognises that there is no universal set of indicators, but several sets exist, corresponding to specific purposes.

The OECD work includes several types of environmental indicators:

- OECD Core Set of environmental indicators, which represents a minimum set
- several sets of sector indicators, to promote integration of environmental concerns policy making at the level of sectors
- indicators derived from environmental accounting, to promote on the one hand the integration of environmental concerns into economic policies and sustainable use and on the other hand to promote the sustainable management of natural resources.
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OECD CORE SET OF ENVIRONMENTAL INDICATORS

Environmental issues

Major socio-economic and sectoral indicators

General indicators

supplemented with:

OECD sets of sectoral indicators

- Transport
- Energy
- Agriculture
- Household consumption
- ...

Environmental accounting

- Environmental expenditure
- Natural resource use
- ...

All these indicator sets are closely related to each other. The most important sectoral indicators are part of the core set and most times they are derived from resource accounting.

In principle, pressure and societal response indicators can be considered at a sectoral level. Data availability permitting, such a dis-aggregation is one tool in analysing the environmental pressures exerted by sectors. For social responses, government responses could be distinguished from those of the business sector or private households. Therefore indicators on the sector level seem to be useful for reviewing the integration of environmental and sector policies.

The OECD, when adapting the DPSIR concept to sector, in our view, waters down the accuracy of the approach. OECD argues that a sector approach requires different classification departing from the original approach performance. We think it would be more fruitful to stick to the DPSIR framework by identifying sectoral Driver-Pressures-etc. but acknowledging overall economic trends as framework conditions for the sector.

Debate about climate change prevention and the relative contribution of transport activities to greenhouse gas emissions added to the demand for work an transport and the environment. Therefore one part of the OECD work programme on environmental indicators deals with transport-environment indicators. Especially road transport has been identified as having by far the largest influence on the environment and is therefore a focus of most of the OECD environmental indicators work.

In 1994, the OECD initiated a project on Environmentally Sustainable Transport (EST) to reconcile transport with environmental and sustainable development objectives. This project attempts to demonstrate how an environmental framework for strategies to achieve EST should look like, considering environmental issues that manifest their effects at different geographic scales (global, regional, local).

As part of the EST project, the following six criteria were developed as being the minimum required to address the wide range of transport-related health and environmental impacts. These six criteria concern CO₂, NOₓ, VOCs, Particulates, Noise and Land use.

The framework used for developing transport-environment indicators is based on the above mentioned Pressure State Response (PSR) model taking into account the specificities of the transport sector. The indicators are structured around three themes:

- **Transport trends and patterns of environmental significance**: These interactions cover direct pressures on the environment such as resource and land use, emissions to the air and the water, waste issues and safety issues.
- **Interactions with the environment**: The proposed indicators relate to environmental damage and social costs, economic instruments such as prices, taxes and subsidies and trade aspects.
- **Economic and policy aspects of the transport and environment interface**: the proposed indicators relate to environmental damage and social costs, economic instruments such as prices, taxes and subsidies and trade aspects.

Figure 3.17: OECD environmental indicators sets

Source: OECD 1999

Figure 3.18 presents all transport-environment indicators identified in the OECD set.
Freight transports closely links to economic activity and to patterns of production and land use. It is influenced by developments of international trade, by consumer demands and by increasing use of modern communication technologies. The environmental effects of traffic depend on the transport mode, its energy efficiency, the type of fuel used and the rate of increase in related traffic volumes. Changes in the modal split of transport are important determinants of the efficiency of environmental and transport policies. Road traffic accounts for many of the environmental implications, for example increased atmospheric pollution, noise accidents, congestion and consumption of energy resources.

The indicators relate to:

- The passenger transport by mode is expressed in passenger-km of the modes railways, private cars and taxis, busses and coaches.
- Freight transport for the modes rail, road and inland waterways are expressed in tonne-km.
- Road traffic volumes are expressed in annual vehicle-km, traffic intensities are expressed in per unit of GDP, per capita and per unit of road network length.

**Infrastructures**: The capacity of transport infrastructure, their accessibility and geographical distribution play an important role in the modal split of transport. Decisions concerning transport infrastructures are closely related to land use planning, to local economic development and to trade flows. Transport infrastructure exerts pressures on the environment through the consumption of space and the physical transformation of the environment. Land use for transport infrastructure may be in conflict with other land uses. Sustainable action in transport sector requires integration of land use and transport planning.

The indicators relate to:

- The density of the road network expressed in km per unit area of national territory gives a rough indication of the space consumed by road infrastructure.
- Motorways length and density is expressed in km and per unit area of national territory.
- Also rail network length and density is expressed in km and per unit area of national territory.

**Vehicles**: An increasing number of vehicles means increasing potential sources of air pollution, noise, fuel consumption, and so on. In general, vehicle stocks are related to socio-economic developments and to related consumption patterns.

The indicators for road motor vehicles relate to:

- Trends in vehicle stocks and intensities expressed as number of vehicles per unit of GDP, per capita and per road network length.
The notion of decoupling and its indicators

Energy use: The structure of energy consumption by transport is directly related to the composition of pollutant emissions.

The indicators relate to:

• Final energy consumption by transport expressed in Mtoe and relative contribution of transport to total final energy consumption and related per unit of GDP and per capita
• Structure of transport energy consumption by mode expressed in percent
• Structure of road fuel consumption by type of fuel
• Road fuel consumption intensities per traffic volume and per vehicle

Air pollution: Emissions from the transport sector represent a high proportion of overall man-made emissions in industrialised countries. The main pollutants emitted directly by motor fuel combustion are CO, CO₂, NOₓ, VOCs and particulate matter. So transport contributes to atmospheric pollution at local.

The indicators relate to:

• Total, CO, NOₓ, VOC, particulates and SOₓ emissions, their relative contribution to total man-made emissions, emission intensities per capita and per unit GDP
• Emissions of CO₂, CO, NOₓ VOC, SOₓ and particulates from road transport and related intensities per unit of traffic volume

Risk and safety: Accident risks mainly arise from the daily operation of transport modes. Road accidents represent high social costs related to material damage and to injuries and deaths. Road safety is determined by numerous factors, such as the volume of traffic, the state of vehicles, the state and capacity of infrastructure, behaviour of drivers.

The indicators relate to:

• The number of road casualties and related changes
• The number of victims per volume of traffic per vehicle km and related changes
• The number of victims per motor vehicle and related changes

Pricing and taxation: Pollution, accidents and congestion cause a number of negative environmental and social side effects leading to external costs. Internalisation of these external costs through the use of economic or regulatory instruments is a key element of policies aimed at fostering sustainable development.

Prices play a major role as an instrument of information and are important determinants of consumer behaviour. Fuel prices which rise relative to other goods tend to reduce demand for fuels, stimulate energy saving and may influence the fuel structure of energy consumption.
4 Sectoral analysis

NSTR group 9 (machinery, transport equipment, manufactured articles and miscellaneous articles) is a sector not only responsible for very high values in absolute ton-kilometres but also exhibits high growth rates. Leisure is both responsible for substantial transport volume and is also an important economic factor not only in Austria. Because of the sheer importance of leisure in transport and the economy it is important to assess its decoupling potential.

4.1 Analysis of the transport sector "Machinery, Transport Equipment, Manufactured Articles and Miscellaneous Articles"

Within the first sector, a transport sector with a high share of long distance road freight transport and a high growth of transport performance within the last years and also in the future should be analysed.

4.1.1 Selection of the Sector

The development of the different freight transport sectors (NSTR: Nomenclature uniforme de marchandise pour les statistique de transport – Standard Goods Nomenclature for Transport Statistics) has to be analysed to select a sector.

Figure 4.1 shows the selection path of finding the sector to be analysed.

4.1.1.1 Generation of the Relevant Input Data

Gross Value Added of Economic Sectors

One has to have data about the real gross value added for a certain amount of years in the past to analyse the development of the different economic sectors.

Statistik Austria publishes the real gross value added in the Statistical yearbook for Austria. In the current yearbook for 2003 the real gross value added is presented from 1988 to 2001 at 1995 prices according to concept ESVG 95 (see Figure 4.2). This data can be directly used for the analysis.
Transport Performance by NSTR Groups

The setup of a data set which contains a time series of transport performance per NSTR Group and transport has to be done with the help of different data sources. Statistik Austria publishes overviews about freight transport in Austria (transport volume, transport performance) every year. This overview is based on the yearly survey that Statistik Austria carried out among all companies transporting freight. Since 1995 the data includes only transports of Austrian companies for road transport. Before this date also the transport of Non-Austrian companies was included. But before 1995 the total road transport was included only every 5 years, all the other years only long distance freight transport was included.

Other sources which contain data by NSTR over a long period are not known. The Federal Ministry for Transport, Innovation and Technology published a compendium with relevant current traffic and transport data in 2003 (Herry 2003). The information about transport performance in Austria by transport mode is presented in this publication for 1999, including also the transport performance from Non-Austrian companies. This is the most current official published data about transport performance in Austria.

A transport performance time series per NSTR group cannot be drawn directly with the help of the above mentioned resources but it is possible to calculate such a time series using some assumptions. The total transport performance per mode in Austria has to be taken at first (see Figure 4.3).

Figure 4.4: Development of gross value added at 1995 prices by economic sectors 1988 - 2001
Source of data: Statistik Austria (2002a)

Department of Economics
University of Graz
IFF-Social Ecology
Herry Consult

Figure 4.3: Freight transport performance Austria, 1999
Source of data: Herry (2003)

The transport performance per NSTR-group is calculated for 1999 with the information about transport performance per NSTR of Austrian companies in 1999 and the assumption that the share of NSTR of Non-Austrian companies is the same for the two relevant transport modes road and rail and for the different types of transport. Annual changes of transport performance within those years where the data provide the same information of transport are calculated with the help of the different information (only for Austrian companies, for total traffic, only for long distance traffic). Then this yearly growing factors are linked. Time series starting with 1999 for the relevant transport mode, the relevant transport type and for all NSTR-groups are estimated for 1988 to 2000 by doing this procedure.

Freight transit is not estimated because this type of traffic cannot be linked with the development of the Austrian economy. Figure 4.4 shows the development of the sum of road and rail performance (inland transport, import, export) per NSTR-group.
Figure 4.4: Transport performance by NSTR groups 1988 - 2000 road and rail, domestic, import and export

Sources of data: Statistik Austria (1988 –2001), Herry (2003), own calculations

Figure 4.5 summarises the main working steps to create times series for transport performance per NSTR group.

4.1.1.2 Analysis of Freight Transport Sectors

We consider the domestic, the import and export transport performance of the road and railway freight transport in Austria for the years 1988 until 2000 divided by the NSTR commodities at first (see Figure 4.6).
Figure 4.6: Domestic, import and export transport performance of the road and rail freight traffic in Austria for the years 1988 until 2000 divided by the NSTR commodities

Sources of data: Statistik Austria (1988 –2001), Herry (2003), own calculations

The three “highest” polygons are for manufactured goods (above all), “crude and manufactured minerals, building materials” and agricultural products of which the first and the last polygon is increasing.

Now, we are looking at the domestic, the import and export transport performance of the railway freight transport in Austria for the years 1988 until 2000 divided by the NSTR commodities (see Figure 4.7).

Figure 4.7: Domestic, import and export transport performance of rail freight traffic in Austria for the years 1988 until 2000 divided by the NSTR commodities

Sources of data: Statistik Austria (1988 –2001), Herry (2003), own calculations

The commodity groups manufactured articles and agricultural products have the highest performances. Moreover, these groups are the only ones which show a clear increase.

On the road (see Figure 4.8) the commodity group “manufactured articles” and – in difference to the above situation – the NSTR group 6 “crude and manufactured minerals, building materials” have the highest performance on the road (see Figure 4.8). The manufactured articles decreasing are until the beginning of the 90s and after that strongly increasing. “Agricultural products and live animals” and “foodstuffs and animal fodder” are less of volume but increasing over the time.
Now, we consider the transport performance of domestic road freight traffic in Austria (see Figure 4.9).

The two highest transport performances are given by the "crude and manufactured minerals, building materials" and the manufactured articles, of which the development of the mineral group is rather constant over time, but the development of the manufactured articles is – as in the above discussed situations – "at the end" strongly increasing.

The situation concerning the import and export transport is the following (see Figure 4.10):

In this case only the manufactured articles are on a high quantitative level, and since the early 90s – again – strongly increasing in their development.

Let us now compare the development of transport performance with the domestic and bilateral rail traffic: at first with the domestic transport (see Figure 4.11).
In difference to the respective transport on the road, agriculture products are on the top (at least until the end of the 90s and with a moderate growth). The transport performance of manufactured goods is overtaking the agriculture products at the end of the 90s (with a steep increase). Almost all other goods have a declining development, partly on a low quantitative level.

For the bilateral rail freight traffic refer to Figure 4.12.

The situation of the transport performance is slightly similar to the situation on the road, with the exception of the agriculture products which are now - beginning with the early 90s – increasing, and even have a strong growth at the end of the 90s.

After having considered the development of the transport performances in absolute terms we draw our attention to the indexed examination.

We consider the indexed domestic, import and export transport performance of the rail and road freight traffic in Austria for the years 1988 until 2000 divided by the NSTR commodities at first (see Figure 4.13).
Figure 4.13: Indexed development of the domestic, import and export transport performance of the railway and road freight traffic in Austria for the years 1988 until 2000 divided by the NSTR commodities

We get convex polygons of the zero level for the “crude and manufactured minerals, building materials”, the fertilizers and the petroleum products. All other products have an increasing indexed development, especially the agriculture products and manufactured articles.

Figure 4.14 shows the development of the indexed domestic, import and export transport performance of the road freight traffic in Austria:

This development is – at least for some freight groups – not as smooth as for road and rail transport, above all, for the commodity “solid mineral fuels” which has a big peak in 1993 and is strongly decreasing thereafter. The mentioned peak is based on the domestic development of the solid mineral fuels (see Figure 4.15). The strongest development is observable for agriculture products and the group “ores and metal waste”. The manufactured goods are having a strong positive development since 1992.

The same relationship – but for the domestic transport performance, only, is shown in Figure 4.15:
Figure 4.15: Indexed development of the domestic transport performance of the road freight traffic in Austria for the years 1988 until 2000 divided by the NSTR commodities

Sources of data: Statistik Austria (1988–2001), Herry (2003), own calculations

One can clearly see the more oscillated “curves”, especially for the solid mineral fuels. Following freight groups do have negative developments: “crude and manufactured minerals, building materials”, fertilizers, petroleum products, solid mineral fuels and metal products (at the end of the considerate period).

The same relationship – but for the import and export transport performance, only, shows Figure 4.16:

Figure 4.16: Indexed development of the import and export transport performance of the road freight traffic in Austria for the years 1988 until 2000 divided by the NSTR commodities

Sources of data: Statistik Austria (1988–2001), Herry (2003), own calculations

One can see that almost all freight groups have a positive index development, especially ores and metal waste (but very oscillating), and petroleum products.

Let us see the indexed railway development. Figure 4.17 shows the indexed development of the domestic, import and export transport performance of rail freight traffic in Austria for the years 1988 until 2000 divided by the NSTR commodities.
Figure 4.17: Indexed development of the domestic, import and export transport performance of the rail freight traffic in Austria for the years 1988 until 2000 divided by the NSTR commodities

Sources of data: Statistik Austria (1988 –2001), Herry (2003), own calculations

The three “highest” freight groups are the metal products, manufactured goods and agricultural products. Especially, the solid mineral fuels have a negative development.

From the indexed development of the import and export transport performance of the rail freight traffic in Austria shown in Figure 4.18 one can observe that the polygons are more loosely arranged:

Figure 4.18: Indexed development of the import and export transport performance of the rail freight traffic in Austria for the years 1988 until 2000 divided by the NSTR commodities

Sources of data: Statistik Austria (1988 –2001), Herry (2003), own calculations

That means that the “curves” for the respective domestic transport should be pressed more together as Figure 4.19 shows:

Figure 4.19: Indexed development of the domestic transport performance of the rail freight traffic in Austria for the years 1988 until 2000 divided by the NSTR commodities

Sources of data: Statistik Austria (1988 –2001), Herry (2003), own calculations

Finally, we exhibit the cumulative absolute increase of the domestic, import and export
transport performance of road freight traffic in Austria (see Figure 4.20) and for the rail freight (see Figure 4.21).

4.1.1.3 Selected Sector

It is possible to select a relevant sector for further analysis with the help of the above analysis of the Transport Performance of the transport sectors (NSTR-groups).

The different figures of the chapter above show that in most of the cases (different transport modes, different relevant transport types) NSTR group 9 (machinery, transport equipment, manufactured articles and miscellaneous articles) has the highest or one of the highest growth rates between 1988 and 2000. Moreover this NSTR group is the sector where not only the growth is very high but also the absolute value of ton-kilometres.

This is the reason why NSTR group 9 (machinery, transport equipment, manufactured articles and miscellaneous articles) is chosen for further analysis and comparison with the development of the economy.

The following figures (see Figure 4.22, Figure 4.23, Figure 4.24) line out the transport performance of NSTR group 9 (machinery, transport equipment, manufactured articles and miscellaneous articles).
4.1.2 Analysis of the NSTR Group 9 (Machinery, Transport Equipment, Manufactured Articles and Miscellaneous Articles)

The aim of the following analysis is to find whether there exists a connection between the transport performance of this freight transport sector and the economy or not. If there is a connection it is analysed how strong it is.

For this it is necessary to find out which economic sectors produce transport that belongs to NSTR group 9.

4.1.2.1 Definition of the Relevant Economic Sectors

A company survey (about 10,000 companies, return rate about 5%) has been made within the project "Freight Transport Forecast for Lower Austria" (Herry Consult 2003, commissioned by the federal government of Lower Austria). The information what goods (NSTR) the companies are dispatching and receiving was one of the outputs of this survey.

Goods of the NSTR group 9 are dispatched or received by companies of the following economic sectors:

- mining and quarrying,
- manufacturing,
- construction,
- wholesale and retail trade: repair of motor vehicles, motorcycles and personal and household goods and
- hotels and restaurants.

Figure 4.25 gives information about the distribution of the transport volume (dispatch and receipt) of the NSTR group 9 to the affected economic sectors (OENACE) (a result of the company survey in 2002).
These five economic sectors had the following development (measured in gross value added at 1995 prices – see Figure 4.26):

In a first step it is possible to show the development of the transport performance of NSTR group 9 via indices opposite the development of the relevant economic sectors by adding the gross value added of all relevant sectors.

Figure 4.28 shows the result of this procedure:
This picture shows that both rail and road freight transport performance of NSTR group 9 is growing faster than the economic sectors linked with this NSTR group at least since 1993.

The problem of this comparison is that the curve of the development of the relevant economic sectors does not consider the different share of these sectors contributing to the transport performance of NSTR group 9.

The contribution of the five relevant sectors to the transport volume of NSTR group 9 is shown in Figure 4.25. It is necessary to estimate the contribution shown in Figure 4.25 but for transport performance instead of transport volume to show the comparison once more but weighted with the contribution. Assuming that the average transport distances within NSTR group 9 do not differ between the different economic sectors “producing” transport, the share presented in Figure 4.25 stays the same also for the transport performance.

Considering these shares Figure 4.28 changes as shown in the next figure.

The result of the final step for the comparison is not very different to the result shown in Figure 4.28.

4.2 Analysis of the sector leisure and its transport implications

Leisure covers a large portion of lifetime. It is not only time to relax but for many people even the purpose of life: work is carried out only to live – this serves as motto for many. Leisure is also responsible for a major share in passenger transport and is an important economic factor.

4.2.1 Leisure time

Leisure is a term used for a complex set of activities for different purposes that take part at different times of a day and year. As leisure activities vary across persons, also the
perception does of what is considered to be 'leisure'. Some authors point out that leisure can basically be whatever people consider it to be (e.g. Gershuny and Fisher 2000, 624f).

Nevertheless, in the following we will narrow down some perceptions on leisure.

The approach most often used to define 'leisure' is to understand leisure as a concept of residual time. A typical representation of that view is given by Meurs and Kalfs (2000, 128) for whom leisure time is "all the time a person does not devote to ensuring their future welfare in a broad sense. This means that activities carried out to obtain income, to keep a household in order and to look after the person's physical well-being cannot be considered as taking part in free time. Free time is therefore more limited than time that is not spent doing paid work. In other words, quite apart from "official" work time, time spent on necessary chores also has to be left out of the concept of free time. It can be seen from this that the concept of "enjoyment" should be the *sine qua non* of any viable definition of free time". This definition represents the typical understanding of leisure as time people can freely spend according to their wishes. The range of leisure activities is manifold. It covers activities from reading a book or watching television to travelling to distant places in order to experience unfamiliar landscapes and cultures. As Knoflacher (2000, 64) specifies, leisure activities include "talking and socialising with family and friends, visits, games, making music, sports, using the media, cultural activities, walking, cycling, visiting churches and graveyards, excursions and travel." The variety of different leisure activities that are common and often practised by one and the same person are an indication of the fact that leisure activities have to satisfy different needs respectively wishes. Main motives for leisure activities are to socialise, to satisfy the demand for variation and the desire to experience nature and to exercise. Apart from leisure time and working time, with the latter also including commuting time, a day also consists of obligations time: the time required for the necessities of life like sleeping, personal hygiene, eating, etc. (Knoflacher 2000, 64). However, the distinction between leisure, as free time, obligations time and working time is not straightforward in many cases. Turning hobby into profession, many people enjoy their work. Eating out is often a pleasant option when meeting friends and not just the satisfaction of a physical need. Many people enjoy shopping. And many activities in the free time are not undertaken purely because they are fun. The increase in people doing sports regularly that could be observed in the last decade in Austria is likely to be more a consequence of the increased health consciousness than of rapid changes in personal preferences. Many activities can be classified both leisure and necessity, depending on the context and personal preferences and a working definition of leisure requires making compromises: not everything enjoyable is leisure and not everything done in free time is mainly enjoyable.

### 4.2.2 Leisure activities

Leisure activities are the manifestation of the attempt to meet needs people feel that are not adequately satisfied in their working and obligations time. These needs or wishes differ according to individual, social and cultural aspects. Motives for leisure activities centre on relaxation, escapism, social contact, self-actualisation and intellectual stimulation. While personal preferences and social values play an important role, the working and obligations times are also important determinants for demands in the leisure time. People facing many routines in their jobs are more likely to look for adventure and action in their leisure time than people in jobs that are very hectic. Apart from that there is a general trend in social values towards 'experiences' observable. Opaschowski (2000, 21) claims that the main reason behind the growing current trends in leisure activities is the fear of people to miss out on something. So more and more people feel the urge to do things they have not done before or visit places they have not seen before – they seek to make new experiences. The rising importance of events can also be seen from this perspective. This development is enforced by the break-up of traditional social links (Knoflacher 2000, 79). Leisure activities undertaken represent a certain lifestyle, but they do not solely depend on wishes and requirements. They are particularly constrained by income and time availability. Social values and individual preferences are responsible for the needs that ought to be satisfied in leisure. The combination with time and income constraints lead to the leisure activities actually conducted.

Leisure activities are likely to look different on working-days, weekends and during vacation, where some leisure activities are more typical than others and different motives for the choice of the leisure activity dominate. In general all three categories of leisure time have in common that their amount available increased in the past. A working year included 6 weeks of non-working time in 1990, a rise from 1.8 weeks in 1950. Weekly leisure in 1990 was 2 days compared to 1.5 days in 1950 and daily leisure time increased from 1.5 hours in 1950 to 4.1 hours in 1990 (BAT/LBI in Rauh, Regner und Zellmann 1998, 12). This increase in leisure time in the past decades is an effect of the decrease in working time and - due to technical progress - obligations time.

Leisure activities can be performed either at home or outside home. The profile of activities is very diverse but some are very common: watching TV or listening to the radio is part of almost all Austrian's leisure activities. Information programmes are most popular in TV and radio (Zeidler 2000b, 673ff). Sports is also very popular. Sports activities that are performed regularly by most Austrians are cycling, swimming, hiking and skiing (Zeidler 2000a, 10ff). Further popular leisure activities are socialising with friends, going for a walk respectively window shopping, excursions, visiting relatives and gardening (Zeidler 1999, 1068ff). Looking at the trends that are observable from the
sectoral analysis

While most of the activities mentioned above are undertaken at home or in distances not to far from home, during holidays it is common to leave home to possibly make experiences that cannot be made at home, according to Knoflacher (2000, 70) a consequence of the increase in prosperity, of urbanisation, motorisation and the increase in leisure time. In the period from November 2001 to October 2002, 48.0% of Austrians made at least one holiday trip with more than 3 overnight stays away from home, a share that was as low as 30.3% in 1972. In 2002 64% of these trips led to foreign destinations compared to the 44% in 1972. Considering holiday trips with more than 3 overnight stays abroad, the target destination was in Europe for 89.0%. The main purpose of the holidays was the beach sojourn (see Figure 4.30) (Laimer and Schreiber 2003, 614ff). In the period from November 2001 to October 2002, 30.1% of Austrians made at least one short holiday trip involving one up to three overnight stays away from home, 76.7% of these trips led to destinations in Austria. Generally short and long holiday trips increased, with target destinations ever farther visited (Schreiber and Laimer 2003, 723ff). Regarding overall leisure activities there is a clear trend to more leisure activities further away from home. The social value of distant places is high: it is prestigious to travel far. This can be observed for weekday leisure, weekend leisure and holidays (Knoflacher 2000, 68ff).

4.2.3 Leisure transport

4.2.3.1 Leisure spent increasingly outside home

Leisure time is predominately spent at home. But the share of leisure spent away from home is increasing. Because leisure away from home implies transportation, leisure transport is increasing accordingly. Relying on different definitions of leisure transport, studies for Austria do find the share of leisure transport in total transport mileage for the year 1995 up to 55% (Knoflacher 2000, 57). The most comprehensive mobility survey specifies the share of leisure in total mileage for weekdays for the same base year at 18% (Herry and Sammer 1999, 66). Also for weekdays, but for the share of leisure trips in the total number of trips the range for Austria is found between 21% to 33% (Am der OÖ Landesregierung in Rauh, Regner und Zellmann 1998, 9, respectively). When we differentiate the share of leisure trips across the week, we find that this share is significantly higher on Sundays (see Figure 4.31). While it is noteworthy, that the shares stated in Figure 4.31 are also strongly dependent on the definition of leisure trips their stronger importance on Sundays could be regarded a general result.

Figure 4.30: Main purpose of holiday trips that involved at least 3 overnight stays away from home 2002, Austria
Source of data: Laimer and Schreiber (2003)

Figure 4.31: Trips per purpose 1995, Austria
Source of data: Amt der OÖ Landesregierung, VCÖ in Rauh, Regner und Zellmann (1998)
Note: does only include trips away from home of Austrians in Austria
The general trend is not only that more leisure activities are carried out away from home but also that the destinations are ever farther away. This does not only bring about increasing transport, but the causation also runs the other direction. The increase in leisure transport is a consequence of changes in the transport system. Transportation is getting cheaper and transport speeds are generally increasing (however, congestion is partly reversing the latter trend). This directly reduces the main restrictions for leisure activities: income and time. To close the loop, the increased use of the cheaper and faster transport options does again lead to a feedback in the transport system (Knoflacher 2000, 67).

4.2.3.2 The primary motive for leisure transport is destination-driven

Leisure transport is a consequence of leisure activities. However not all leisure trips represent derived demand. In general three different motives for leisure transport can be differentiated: the wish to go to some specific destination, just to be on one’s way and the urge to leave home. In a study by Gstalter (2003, 111f) the wish to go to some specific destination was identified to be the most important reason for leisure transport by far. It accounted for 69.3% of journeys, followed by 24.6% of the trips mainly motivated by the desire just to be on one’s way and only 6.1% motivated by the urge to leave home. This is surprising as in the light of the so-called ‘escape’-hypothesis, the last motive would be expected to play a more prominent role. The ‘escape’-hypothesis basically states that an uncomfortable home is the reason for many leisure activities away from home, a view that has been justified by observations like the one that the leisure distance for people with a garden and a car is significantly lower than that of people with a car but without a garden (Heinze 2000, 24). Given the findings of Gstalter, observations like that could be interpreted differently: people who spend most leisure time at home might attach great importance on their homes. Thus different lifestyles might be more important in explaining differences in individual leisure transport than differences in the living environment.

The motives for leisure trips may seriously be structured according to other categories. For one such structure a gender distinction is available, which points out that the reasons for leisure trips differ significantly between women and men (see Figure 4.32).

![Figure 4.32: Reasons for leisure trips by men and women](Source of data: Knoflacher (2000))

4.2.3.3 Transport itself as a leisure activity

A substantial share of leisure trips are leisure activities themselves e.g. cycling or hiking. Many people like driving their car and although it might not be the main reason for a trip it can well be something that enhances the motivation to go somewhere for a different reason. So there often exists an intrinsic value of travelling (Heinze 2000, 32).

4.2.3.4 Leisure transport change not only by leisure sector policy

The majority of leisure trips, however, represent derived demand. Yet, this does not imply that the transport volume could only be changed by an influence on the leisure activities themselves. It is obviously true that, if more leisure time is spent at home derived transport demand from leisure decreases ceteris paribus. But the settlement structure does also considerably influence both leisure transport demand levels and modal choice (Meier 2000, 31).

4.2.3.5 Modal choice in leisure transport

People who live in peripheral areas tend to rely on individual transport more often to meet friends in restaurants, bars, sports halls or for the cinema. Generally the
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localisation of the leisure location relative to the living location and the provision of different transport alternatives are crucial for the modal split in leisure transport for many common leisure activities (Meier 2000, 31). Leisure transport can be characterised by the same observation found for labour and shopping transport: structural shortcomings have to be overcome by mobility.

There are other impacts apart from settlement structure and existence of public transport why the dominant transport mode for leisure transport varies. To visit big events where masses of people have to be at a specific place at a specific time, public transport dominates because parking space is usually scarce and expensive and public transport services are arranged. In urban areas public transport in general plays a major role for people that want to meet friends or family. The car is perceived as an all-round mode and overall it is dominating leisure transport. This is also an effect of decreasing fuel costs and the fact that parking is mainly free (Knofflacher 2000, 73). The prevailing trend that people tend to make more and shorter holidays increases the transport demand for car and air transport.

Leisure transport is very complex because of the diverse motives for leisure and the resulting diversity in leisure activities. Leisure transport was therefore also considered to be highly spontaneous and flexible. The degree of spontaneity of leisure transport basically depends on the actual activity and its specifics. Given opening hours, beginning times, etc. require some degree of planning and so these activities are not highly spontaneous (Gstalter 2003, 113) and are therefore not necessarily carried out by individual transport. Tourism transport is in general not spontaneous. Nevertheless the car is the dominate mode for holiday trips by Austrians (see Figure 4.33). Considering holiday trips abroad, for the first time in 1993 more people used an airplane than a car (Laimer and Schreiber 2003, 628).

### 4.2.3.6 Indirect transport implications

Additionally to the transport activity caused by leisure directly, leisure is also responsible for freight transport. Using a simple input-output consideration, the demand for goods used in leisure activities could be linked to the respective freight transport in that sector and freight transport for that sector’s intermediate inputs. What may be more important here however, are the economic implications of leisure activities trickling down the leisure product value added chain.

### 4.2.4 The economic sector "leisure"

Leisure depicts a multi-layered complex phenomenon. Apart from understanding leisure as a concept of time, it can also be understood as an aspect of consumption (Gershuny and Fisher 1999, 7). Leisure does not only cover the largest fraction of individual lifetime but also a substantial part of private consumption. A definition of leisure can therefore be based on the purpose of individual consumption. Considering COICOP (Classification of Individual Consumption According to Purpose), leisure covers communication, recreation and culture, restaurants and hotels and to some extent transport. Considering the fact that in 1995 leisure was responsible for 55% of transport mileage in Austria it will be assumed that a share of 55% of transport costs are attributable to leisure. Thus 29% of monthly spending for individual consumption per capita in Austria in 1999/2000 (see Figure 4.34) was for leisure purposes. In 1994/1995 this share had been 26.3% only (Statistik Austria 2002b, 54).

![Figure 4.33: Transport mode for holiday trips 2002, Austria](source)

Source of data: Laimer and Schreiber (2003)
4.2.5 Decoupling Analysis

Passenger transport for leisure purposes has a very particular position within the decoupling discussion.

This segment of transport is often very loosely connected to particular economic consequences. Yet, it may even be a reverse relationship than what we would first think of in the decoupling discussion. Let us make this point using the example of tourism transport: Many tourist regions have recognised the negative – primarily due to transport implications – effects of day-tourism on the recreational value of their longer-term guests. At the same time day-tourists do have only a marginal direct economic value-added impact on their destination regions. Therefore, for many regions and significant shares of their day-tourism it is likely that reduction in day-tourism (and thus reduction in transport volumes) is accompanied by a positive economic impact (increase in long-term guest’s number and length of stay). Obviously, this example is but one on a scale of degree (and sign) of interlinkage between leisure transport and economic growth. The analysis is to explore the interlinkage across the whole range, emphasising crucial examples of focal points across this range.
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