$3^{èmes}$ Journées d'Etudes du Pôle Européen Jean Monnet

« Activités humaines, risques et dommages écologiques »

Faculté de Droit-Economie-Administration

Université de Metz

19 & 20 novembre 2002

Impact of Transport on Health and Environment in Germany

Jens Borken

Institut für Verkehrsforschung
Deutsches Zentrum für Luft- und Raumfahrt e.V.
Rutherfordstr. 2, D-10999 Berlin, Allemagne
http://ivf.dlr.de
Jens.Borken@dlr.de

Résumé:
For the first time a systematic, comprehensive and at the same time quantitative analysis of transport's impact on health and environment is presented for the south-western state of Baden-Württemberg/Germany. A priority list of relevant impacts is identified based on the 'distance to target', transport's 'specific contribution' and the 'ecological relevance' of the problem. Despite a significant growth in transport volume, the emissions of most air pollutants will go down strongly until 2010.

Immediate problems remain for soot emissions, noise and accidents. In the long run however transport's impact on land use and its (fossil) energy consumption, with the resulting emission of carbon dioxide, move to determine the agenda. In as much as society's demand for transport continues to grow these problems are set to accumulate and to dominate the future agenda.

Mots-clés : Transport, environment, health, impact assessment.

1 Introduction, background and definitions

What are the most important impacts of transport on health and environment in Germany? I.e., what (environmental) problems related to transport need attention now and until 2010? This paper presents method and results to answer this question.

Although we focus on transport here, the method is general and can be readily transferred to other sectors of society. Therefore in passing we also give some reflections on the method how the impact can be identified and ranked in a comprehensive manner. That we take a sectoral approach is a concession to the established political arena which is segmented accordingly, although we will later see that the environmental and health problems are rather cross-cutting traditional sectoral policies.

Vehicle technology, and legislation which determines it, is quite homogeneous in the European Union. Member states have differing fleet composition, driving behaviour and transport volume resulting in differing absolute values but basically the same trends apply[1]. Furthermore the natural mechanisms that we focus on are the same everywhere. Therefore the results derived for Germany can be transferred to other EU member states.

As transport we consider all operations of motorised vehicles (cars, vans, lorries, busses, motorised two-wheelers; electrically and diesel driven trains; inland vessels and air craft) within Germany (or Baden-Württemberg, respectively). To be on an equal basis the provision for the different transport fuels (gasoline, diesel, jet-fuel and electricity) are included in the analysis; i.e. the complete life cycle of the transport energy from the extraction of the primary resources (predominantly mineral oil), their transport, raffination, distribution and final utilisation in the respective vehicle is taken into consideration[2], as is standard in life cycle analysis. Manufacture and maintenance of the vehicles or the infrastructure are not accounted.

2 Identify most important impacts on health and environment

To identify the most important problems for human health and the environment one needs,

- a comprehensive understanding of all possible impacts and
- needs a measure how to select (and possibly rank) the most relevant problems.

One standard method will briefly be presented and then applied to transport in Germany. Already at this point we note that a measure necessitates target values, which usually have to be set and accepted by society (or politics, respectively), not by science.

Categories of health and environmental impact

A standard method to account for the health and environmental impact of a product or service is Life Cycle Analysis (LCA). A comprehensive list of environmental impact categories has recently been internationally codified[3]. This list sets the scope of our analysis yet needs to be adapted to the transport case, in particular adequate parameters need to be selected for each impact category. For example to assess transport's impact on the carcinogenic risk usually three substances (out of several hundreds) are selected, namely the exhaust emission rate or ambient concentration of soot, of benzene and, as lead component for many hydrocarbons, benzo(a)pyren (BaP)[4]. Table 1 summarises the standard environmental impact categories of LCA theory and the transport specific parameters used for the analysis.

- For some categories more comprehensive measures are known, but only those specific to transport have been chosen. For example, many substances contribute to the destruction of the ozone layer; however for transport only N_2O is of any relevance[5]. Likewise, transport contributes to the acidification and eutrophication of soil and inland water predominantly indirectly, namely through the deposition of air pollutants emitted in combustion processes.
- In consequence, when the specific contribution of transport e.g. to stratospheric ozone depletion or acidification shall be assessed, not only transport's share of the total (anthropogenic) N_2O emissions but

[1] Cf. EEA 2001: TERM indicators and statistical compendium.

[2] For details on method and up-to-date data: Borken et al., 1999

[3] DIN EN ISO 14.040ff. Life cycle analysis / Ökobilanz

[4] By contrast, for an assessment of the carcinogenic potential of e.g. tobacco one would select different components of the smoke.

[5] Neglecting to some extent the ODP of (old) air conditioners, which might still contain CFCs.

of the ozone depletion potential of all substances is relevant, and likewise transport share to all acidifying substances.

- Some measures / parameters serve as an approximation to describe the impact category, as for example the size of unfragmented land is a proxy for natural land potentially rich in biodiversity. This situation is usually due to insufficient understanding of causalities or lack of data for a better parameter.

<table>
<tr><th>Impact category</th><th>Transport specific impact parameter</th></tr>
<tr><td>Resource consumption</td><td>Cumulated primary energy consumption (fossil, nuclear, renewable)</td></tr>
<tr><td>Protection of soil and landscape</td><td>Area covered by settlements and transport infrastructure
Size of (un-)fragmented area</td></tr>
<tr><td>Global warming</td><td>Emission of CO_2</td></tr>
<tr><td>Stratospheric ozone depletion</td><td>Emission of N_2O</td></tr>
<tr><td>Acidification</td><td rowspan="5">Predominant impact pathway by different air pollutants:
- Emission of SO_2 and NO_x
- Emission of NMVOC (among others benzene and BaP), NO_x/NO_2, soot and $PM_{10/2,5}$ (or their ambient concentration)
- Emission of NO_x and VOC (or ambient concentration of ozone)</td></tr>
<tr><td>Eutrophication</td></tr>
<tr><td>Eco toxicity</td></tr>
<tr><td>Human toxicity</td></tr>
<tr><td>Photosmog</td></tr>
<tr><td>Noise</td><td>Level of noise emission
Population / area affect by noise levels</td></tr>
<tr><td>Accidents*</td><td>Transport fatalities (deaths, severely injured)</td></tr>
<tr><td colspan="2">NMVOC: Non-methane volatile organic compounds. VOC: Volatile organic compounds. BaP: Benzo(a)pyren; lead substance for the large group of (carcinogenic) polycyclic aromatic hydrocarbons. $PM_{10/2,5}$: Particulate matter with aerodynamic diameter of 10/2,5 µm or below.
*: Accidents are not a standard impact category in life cycle analysis, but an important transport impact on human health.</td></tr>
</table>

Table 1: General categories of health and environmental impact as used in Life Cycle Analysis and impact parameters pertinent to transport.

Selection criteria

Having identified the range of health and environment problems that could be related to transport it is necessary to determine their actual importance and to focus (public) attention and (political) action. This needs criteria and data. The German Environmental Protection Agency (UBA, Berlin) has proposed three equivalent criteria to determine the importance of an environmental problem or polluter[6]:

- The distance between the current state and the target value;
- the specific contribution of the polluter investigated, i.e. its strength relative to all other polluters;
- the overall ecological relevance of the problem in question, e.g. whether it is locally confined or a global pollution.

No mechanism has been defined for the overall assessment of these three criteria, and wisely so. As every assessment is subjective it is proposed to discuss the pros and cons of a ranking openly. Thereby the argumentation and the underlying values become more transparent and either convincing to a user or accessible for his own assessment. Examples of this approach will be given when applied to transport in Germany.

3 Results for transport in Germany, today and in future

We have applied the method outlined above to transport in Germany[7]. For the calculation of energy consumption and pollutant emissions of all transport modes, past, current and future, we have used the official German modelling instrument TREMOD[8]. Several recent investigations, mostly for the German Environmental Protection Agency and the Ministry for Transport and Environment of the State of Baden-

[6] UBA 1995a, 1995b

[7] I'm indebted to my former collegues at IFEU – Institut für Energie- und Umweltforschung Heidelberg. Most of the results presented here have been developed during my work there.

[8] IFEU 2000, for Baden-Württemberg also IFEU 1999.

Württemberg, form the basis for the results presented here[9]. Quantitative data refer to Baden-Württemberg, as this State has set comprehensive and quantitative target values for both, environment and transport[10]. At the national level the political debate on targets is still on.

All demands to reduce transport's environment and health impacts are in the face of growing traffic: Transport volumes are dominated by road transport with 80 percent share for passengers (passenger-kilometres) and 60 percent share for freight (ton-kilometres). Distances and volumes are expected to rise until 2010 compared to 1990 by about 32 percent for passenger and 46 percent for freight, mostly driven by road and air transport[11].

Table 2 summarises the results: For each impact category the target set by the State of Baden-Württemberg for 2010 is given, the current state and the projection until 2010 with respect to this target and the specific contribution today. The results of the analysis are diverse: Some targets, mostly concerning air quality, are likely to be attained in future; for some this remains to be seen and others will clearly be missed.

Transport specific impact parameter	**Target**	**Distance to target**	**Trend**	**Specific contribution**
Consumption of (fossil) primary energy carriers	+100% regenerative energy carriers	Large	Increase	~25%
Sealing of land	Below 6,75 ha/day	Large	Stagnant	High
Fragmentation of rural land	Patches larger 100 km²	Large	Stagnant	High
Emission of carbon dioxide (CO_2)	-10% (2005 to 1987)	Large	Increase	~30%
Emission of N_2O	No	-	Stagnant	~13%
Emission of nitrous oxides (NO_x)	-60% (2005 to 1987)	No	Decrease	66%
Emission of volatile organic compounds (VOC)	-70% (2005 to 1987)	No	Decrease	~50%
Emission of soot	-80% (2005 to 1996)	Large	Decrease	~100%
Emission of benzene	-60% (2005 to 1996)	No	Decrease	>90%
PM_{10} concentration	<40 µg/m³ (annual average)	Small	Stagnant	Medium
Ozone levels	< 110 µg/m³ (8h average)	Small	Stagnant	Medium
Noise levels	< 65/55 dB(A) day/night	Small	Stagnant	High
Transport fatalities (deaths or severely injured)	Reduce by 30%	No	Decrease	High

Targets for PM_{10} and ozone from EU legislation.
Source: Borken & Höpfner 2001b

Table 2: Transport specific impact parameters, targets, distances, trends and specific contribution of transport in Baden-Württemberg.

Targets safely attained – no distance

Transport is the dominant emitter of nitrous oxides (NO_x), of volatile organic compounds in general (VOC) and of benzene in particular. The transport specific emission reduction targets, which have been set to protect *human health* and to protect against *eutrophication* and *acidification*, will be met by 2010. Road transport has more than 90% share for each of the pollutants and will reduce its emissions strongly due to improved fuels and more effective emission after-treatment following European legislation. The number of *transport fatalities* appears to decrease strongly; yet still about 9.000 dead or severely injured persons are to expected on roads.

Targets maybe attained – distance small

PM_{10} levels can be above the target value of 40 µg/m³ at road sides, in urban and rural areas mostly below. However due to the potentially severe health risk related to ambient concentrations of fine particles the European Commission discusses to half this target value by 2010. If so, then larger areas would not attain. Transport's contribution is, due to transformation of the particles in the atmosphere, hard to assess. All issues related to fine particles are currently subject to intensive research. Hence this issue needs careful coverage.

[9] IFEU 1998, 1999, 2000, 2000b, 2001. Borken & Höpfner 2001a, 2001b.

[10] Verkehrsministerium Baden-Württemberg 1995; Umwelt- und Verkehrsministerium Baden-Württemberg 2000.

[11] Verkehrsministerium Baden-Württemberg 1995, IFEU 1999.

The situation is ambiguous for *photosmog* (ground-level ozone) and *noise*: For both impact categories it is characteristic, that they are influenced by a number of sources. Ozone is formed in a non-linear reaction from precursors (among others, nitrous oxides (NO_x) and volatile organic compounds (VOC)) under the influence of sunlight. An attribution to individual sources is difficult because it would need to solve a hen-egg-dilemma: Are volatile organic compounds from forests or industrial emissions causal for ozone formation or vice versa, have transport emissions triggered the whole mechanism. Although ozone peak levels have fallen in the past, which can be attributed to the successful reduction of precursor emissions, the long term average value of ozone is rising. In consequence the dose related target values (product of ozone level times its duration) will not be attained, with resulting harm or risk to vegetation (agriculture) and human health.

Noise levels are a complicated aggregate of sounds emitted by a range of sources and there is no scientific method to date to assess e.g. transport's share. However transport noise is publicly perceived as the dominant nuisance. Technical improvement at the vehicle (e.g. better insulation of engine chamber and low-noise tires) will be offset by the expected increase in transport volume. And passive measures, as noise barriers or traffic diversions, can only help to contain the most critical spots. Hence, similar to ozone, while peak levels might fall the general background noise is expected to rise in level and to grow furthermore into previously silent areas.

Targets not attained – distance large

Transport poses problems for all impact categories, with exemptions for air quality: The reduction target for soot emissions, which is the dominant factor of the transport related inhalatory *carcinogenic risk* and which is almost entirely emitted from vehicles' combustion engines, will not be met before 2015 and only when heavy duty vehicles will be equipped with particulate filters[12]. Transport's *greenhouse gas emissions* are expected to grow, largely driven by increases from road freight and air transport. Analogous, transport's energy consumption will rise and no significant uptake of regenerative fuels is expected.

Continued sealing of land is expected, not least driven by transport growth, which often entails an increase in transport infrastructure and intimately related with the extension of urban areas. Growth rates are far beyond what is regarded necessary for a protection of the soil itself as well as resource, for *natural habitats and landscape*. It is important to note that not only the sealing itself, but also side effects like pollutant emissions and noise[13] can severely curtail the use of land for man, fauna and flora. Moreover transport infrastructure continues to fragment rural areas. Only 4% of Baden-Württemberg's area is has patches larger than 100 km^2 and are not fragmented by a road or railway; only six unfragmented areas can be found that have a size larger than 100 km^2, largely forests and mountainous areas. This limits *habitats* severely with subsequent pressure on *biodiversity*.

4 Ranking of transport's impacts

Given the number of impacts, their diverse impact mechanisms and future development a further ranking is desirable. This will be down from a health and environment point of view here applying the criteria of 'distance to target', 'specific contribution' and 'ecological relevance'.

Distance to target

A first classification has already been achieved with respect to the *'distance to target'*. Where the target will be safely met (and probably attained afterwards), no further action is needed. The respective impact parameters (transport fatalities, NO_x, VOC and benzene emissions) are given lowest priority. Medium priority is assigned to PM_{10}, ozone and noise, highest to the other impact parameters, where the distance to target is largest.

Specific contribution

Next, the *'specific contribution'* of transport is medium or high for all impact parameters. We do not further classify, except for stratospheric ozone depletion. With 13% of the total transport emissions of N_2O are low. No transport specific targets have been set. The respective emissions are by far dominated by industry sources and agriculture. Consequently this impact category is given lowest priority.

[12] Likewise the equipment of diesel cars with particle filters would result in a substantial reduction of the carcinogenic risk.

[13] 60% of the state's area is considered not calm any more, due to road transport.

Ecological relevance

For impacts that do not attain the targets we analyse their *'ecological relevance'*: As customary in (German) environmental law[14] we distinguish between

- a damage or its risk (=potential damage) and
- whether human health directly or the natural environment would be affected.

An *acute damage to human health* is given for soot and noise in places with the highest concentrations. Soot particulates pose the single largest carcinogenic inhalatory risk. Ambient concentrations in urban areas often exceed greatly the target value of 1,5 µg/m³. Due to the nature of cancer this poses an immediate health threat. Ambient noise levels above 65 dB(A) during the day[15] and above 55 dB(A) during the night increase the risk of a heart attack. Current levels of PM10 and ozone are to be considered a *health risk*.

Acute damage to the environment results from the excessive ozone concentrations harmful not least to agricultural crops, by the continued sealing and fragmentation of land by transport infrastructure and settlement. Whether global warming is yet an acute damage (to environment, but also quickly to man) or 'only' a risk, is a matter of taste. The continued depletion of energy resources however is classified as a *risk*.

5 Summary and outlook

Combining all three criteria we derive the following priority list of transport's health and environmental impacts (table 3):

Ecological relevance (priority)	Human health		Environment	
Transport specific impact parameter	**Danger**	**Risk**	**Danger**	**Risk**
Target not attained - distance large				
Emissions of soot	X			
Sealing and fragmentation of land			X	
Emissions of carbon dioxide (CO_2)			X	
Consumption of (fossil) primary energy carriers				X
Target potentially attained - distance small				
(Traffic) Noise levels above 65/55 dB(A) day/night	X	X		
PM_{10} concentration below 40 µg/m³ (annual average)		X		
Ozone levels above 110 µg/m³ (8h average)		X	X	
Target safely attained – no distance				
Transport fatalities (dead or severely injured)	X			
Emissions of nitrous oxides (NO_x)		X		X
Emissions of volatile organic compounds (VOC)		X		X
Emissions of benzene		X		
Emission of N_2O				X

Table 3: Priority list of environmental and health impacts of transport according to distance to target, specific contribution and ecological relevance.

Following the (political) targets set for transport, health and environment the reduction of soot emissions, traffic noise and transport fatalities should have highest priority in order to protect against an acute danger to human health. Preventive action should further address PM_{10} and ozone concentrations.

However transport's impact on land use, i.e. land sealing and fragmentation, and its (fossil) energy consumption, with the resulting emission of carbon dioxide, moves to determine the agenda in the long run. These impacts not only have the largest distance to target, but also have a negative trend. Technical solutions are either not ready, very expensive or promise only minor changes. For substantial improvements the traffic volume must be addressed, this means reduced[16], be it by more efficient organisation, a shift of transport modes, the reduction of distances or trips.

[14] Koch 2002, p. 80

[15] Day: 6-22h; night: 22-6h.

[16] Compare e.g. case studies and conclusions: OECD 2000; UBA 2001, which highlight the same environmental issue.

In summary, measures need to be extended to address the immediate problems: Soot emissions, noise and accidents. But much more effort is needed to control the aggravating and underlying long term problems: Energy consumption and land use. In as much as society's demand for transport, both passenger and freight, continues to grow these problems are set to accumulate and to dominate the future agenda.

6 Bibliography

Borken & Höpfner 2001a: Umwelt- und Verkehrsindikatoren für Baden-Württemberg – Eignung von TERM? Vorstudie im Auftrag des Umwelt- und Verkehrsministerium Baden-Württemberg. Heidelberg 2001.

Borken & Höpfner, 2001b: Anwendung von TERM-Indikatoren in der Verkehrsplanung. Im Auftrag der Umwelt- und Verkehrsministerium Baden-Württemberg, Heidelberg 2001.

Borken, Patyk & Reinhardt, 1998: Basisdaten für ökologische Bilanzierungen. Einsatz von Nutzfahrzeugen in Transport, Landwirtschaft und Bergbau. Vieweg Verlag, Wiesbaden/Braunschweig 1999.

DIN EN ISO 14.040 Life cycle analysis

EEA 2001: European Environment Agency (Ed.): TERM 2000 - Transport and Environment Reporting Mechanism. Kopenhagen, 2001.

EU 1998: Europe's Environment: Statistical Compendium for the Second Assessment. Compiled jointly by Eurostat, European Commission and the European Environment Agency. Luxembourg 1998.

IFEU 1998: Lambrecht, Udo; Regine Vogt, Ulrich Höpfner: Zeitlicher Verlauf der Immissionen und Emissionen des Straßenverkehrs – Die Situation in Baden-Württemberg und an anderen Standorten. Im Auftrag des Ministerium für Umwelt und Verkehr Baden-Württemberg, Heidelberg/Stuttgart 1998.

IFEU 1999: Lambrecht, Udo et al.: Emissionen des Verkehrs in Baden-Württemberg 1990 bis 2020 - Aktualisierung und Erweiterung der Emissionsberechnung für den GVP Baden-Württemberg. Heidelberg 1999.

IFEU 2000: Daten- und Rechenmodell: Schadstoffemissionen aus dem motorisierten Verkehr in Deutschland 1980 - 2020, Erstellung der Software TREMOD – Transport Emission Estimation Model; im Auftrag des UBA (UFOPLAN-Nr. 105 06 057); ab 1993; dazu Kooperationsabkommen mit dem Verband der Automobilindustrie, Frankfurt, mit dem Mineralölwirtschaftsverband, Hamburg; mit der Deutschen Bahn AG, mit der Bundesanstalt für Straßenwesen (BASt) u. a.

IFEU 2000b: Lambrecht, Udo und Ulrich Höpfner: Mögliche Diskrepanzen bei der Bestimmung von Partikeln - Untersuchung zum Zusammenhang zwischen Emissionsberechnung und Immissionskonzentration. Heidelberg 2000.

IVT & IWW 1995: Wissenschaftliche Begleituntersuchungen zum Generalverkehrsplan Baden-Württemberg. Im Auftrag des Verkehrsministerium Baden-Württemberg, Band 1, Juni 1995.

Koch; Hans-Joachim (Ed.): Umweltrecht. Luchterhand, Neuwied 2002

OECD 2000: Organisation for Economic Cooperation and Development (Ed.): est! Environmentally Sustainable Transport – Futures, strategies and best practices. Synthesis Report, Paris 2000.

UBA 1995a: Umweltbundesamt (Ed.): Ökobilanz für Getränkeverpackungen. UBA-Texte 52/95, Berlin 1995

UBA 1995b: Umweltbundesamt (Ed.): Methodik der produktbezogenen Ökobilanzen – Wirkungsbilanz und Bewertung. UBA-Texte 23/95, Berlin 1995

UBA 2001: Umweltbundesamt (Ed.): Dauerhaft umweltgerechter Verkehr – Deutsche Fallstudie zum OECD Projekt Environmental Sustainable Transport (EST), Berlin 2001.

Umwelt- und Verkehrsministerium Baden-Württemberg (Ed.): Umweltplan Baden-Württemberg. Stuttgart 2000

Verkehrsministerium Baden-Württemberg (Ed.): Generalverkehrsplan Baden-Württemberg. Stuttgart 1995.

7 Appendix:

Quantitative targets and data:

Impact category and transport targets for Baden-Württemberg 2010	Distance to target today and trend until 2010	Specific contribution of transport today[1)]
Acidification, eutrophication, eco- and human toxicity and photosmog: For transport translated into the following air quality targets: Reduce transport's emission of ...		
NO_x by –60% (2005 to 1987)	-(64-66)% (2010 to 1990)	Ca. 66% of total
VOC by -70% (2005 to 1987)	-80% (2010 to 1990)	Ca. 50% of total
Benzene by -60% (2005 to 1996)	-(70-75)% (2005 to 1996)	>90% for benzene; ca. 30% for BaP
Soot by -80% (2005 to 1996)	-(54-50)% (2005 to 1996)	almost 100% of total
Ozone concentration (not source specific) To protect human health: <360 µg/m³ (1h, alarm value); <180 µg/m³ (1h, information value). To protect vegetation: <200 µg/m³ (1h); <65 µg/m³ (24h).	Days with levels >180 µg/m³ all over the country. **Trend:** Reduction of peak values; increase of average values and dose (annual average about 35-40 µg/m³ in urban areas and twice as much in rural areas).	Contribution to ozone precursors: ca. 66% of NO_x and ca. 50% of VOC emissions
Resource consumption (overall)		
Double share of renewable primary energy carriers (ca. 2,4 % in 1996) and for electricity production	Transport runs to more than 98% on mineral oil as primary energy carrier. **Trend:** +(10 to 18)% increase in primary energy consumption. No likewise extension of regenerative energy carriers.	ca. 25% of primary and ca. 30% of final energy consumption
Protection of soil and landscape (overall)		
Reduction of land use (sealing) until 2010, e.g. according to federal target down to about 6,5-6,75 ha/day in 2010. Conservation of unbuilt areas, indigenous biotopa and all indigenous species in sufficient size and quality.	About 13% of land are urban areas or transport infrastructure, mostly sealed. Between 89 and 96% of surface area fragmented by transport infrastructure, i.e. less than 100 km². **Trend:** Extension of urban areas and transport infrastructure by about 11 ha/day. Further fragmentation expected.	>40% of settled area is transport infrastructure. Transport infrastructure causal for fragmentation.
Global warming		
Transport's CO_2 emissions: -10% (2005 to 1987)	+(6-14)% (2010 to 1990)	ca. 30% of total CO_2
Noise (overall, not source specific):		

Outdoor noise:
max. 65 dB(A);
max. 55 dB(A) until 2010/2015 (day);
max. 45 dB(A) until 2010/2015 (night).
Conservation of low noise / noise free areas
	Population affected by traffic noise:
	>65 dB(A): 15%;
	>55 dB(A): 50% (day) / 17% (night);
	>45 dB(A): 50% (night)
	Share of noisy area (extra-urban):
	>60 dB(A): ca. 5,5%; >40 dB(A): ca. 60%
	Trend:
	Potentially reduction of peak levels, but no general improvement expected.
		Difficult to quantify individual sources:
		Traffic noise is perceived as dominant annoyance.

1) Most recent available data (usually up to 2000) Target values as stated in 'Umweltplan Baden-Württemberg' (2001) and ‚Generalverkehrsplan Baden-Württemberg' (1995); for photosmog the values refer to the European Air Quality Directive 92/72/EEC. Source: Borken & Höpfner, 2001b.		