Environmental Research Plan of the
German Federal Minister of the
Environment, Nature Conservation and Reactor Safety

Local Agenda 21 – Model Project
Sustainable environmentally compatible mobility in cities and regions

Sub-project 1:
Production of a catalogue of technical and planning quality goals

R+D Project 298 96 111/01

Final report
(Shortend version)

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16. Summary The remit of the R+D project envisages for Sub-project 1 the development of an integrated catalogue of goals with quantified quality targets for sustainable communal and regional mobility (quality goal catalogue). The aim is to create a range of instruments that will allow regions and local authorities to determine their own situation with respect to traffic and transport in relation to the quality goals and to implement measures to reduce deficits as far as possible. The Final Report Part 1 "Basics" of Sub-project 1 contains a review of the research topic and the basics necessary for the projects. Furthermore, the areas of sustainability mobility are determined. The Final Report Part 2 contains the definition of the goals and the derivation of indicators. The short version provides the key results from the long version.		
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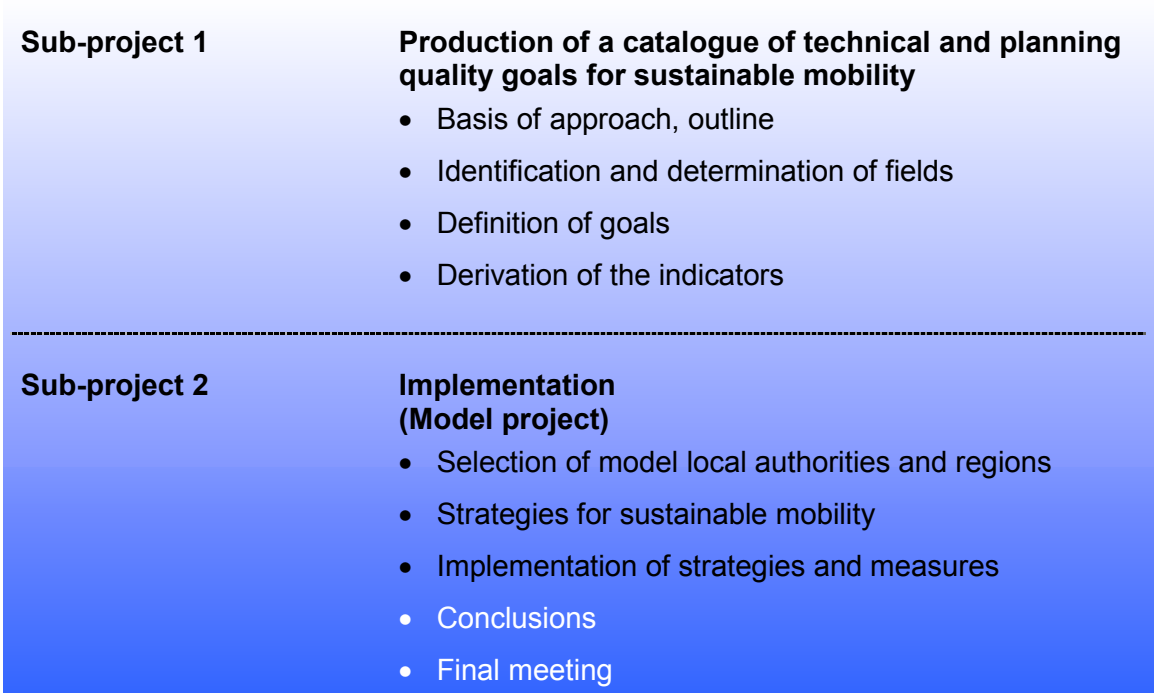
Part 1
Basics of sustainable development and mobility

1 Introduction

The working group consisting of BPI-Consult GmbH (BPI) and Planungsbüro Richter-Richard (PRR) was commissioned by the German Federal Environmental Agency to carry out a research and development project "Local Agenda 21 – Model project Sustainable environmentally compatible mobility in cities and regions, Sub-project 1: Production of a catalogue of technical and planning quality goals for sustainable mobility" (FKZ-No. 298 96 111/01). The duration of the sub-project 1 was from December 1999 until April 2001. In parallel, a sub-project 2 also began in 2000. In Sub-project 2, the aim was to test the goals and indicators developed in Sub-project 1 for selected model local authorities and regions. The individual steps of the project were as follows:

Figure 1: Steps and approach for the model project



The Final Report, part 1 "Basics“ for the Sub-project 1 reflects the state of progress as of 24 July 2001. In contains a review of the research topic and the basics points necessary for the completion of the project work. On the basis of this, the Final Report 2 then deals with and discusses the "Goals and indicator systems for sustainable mobility".

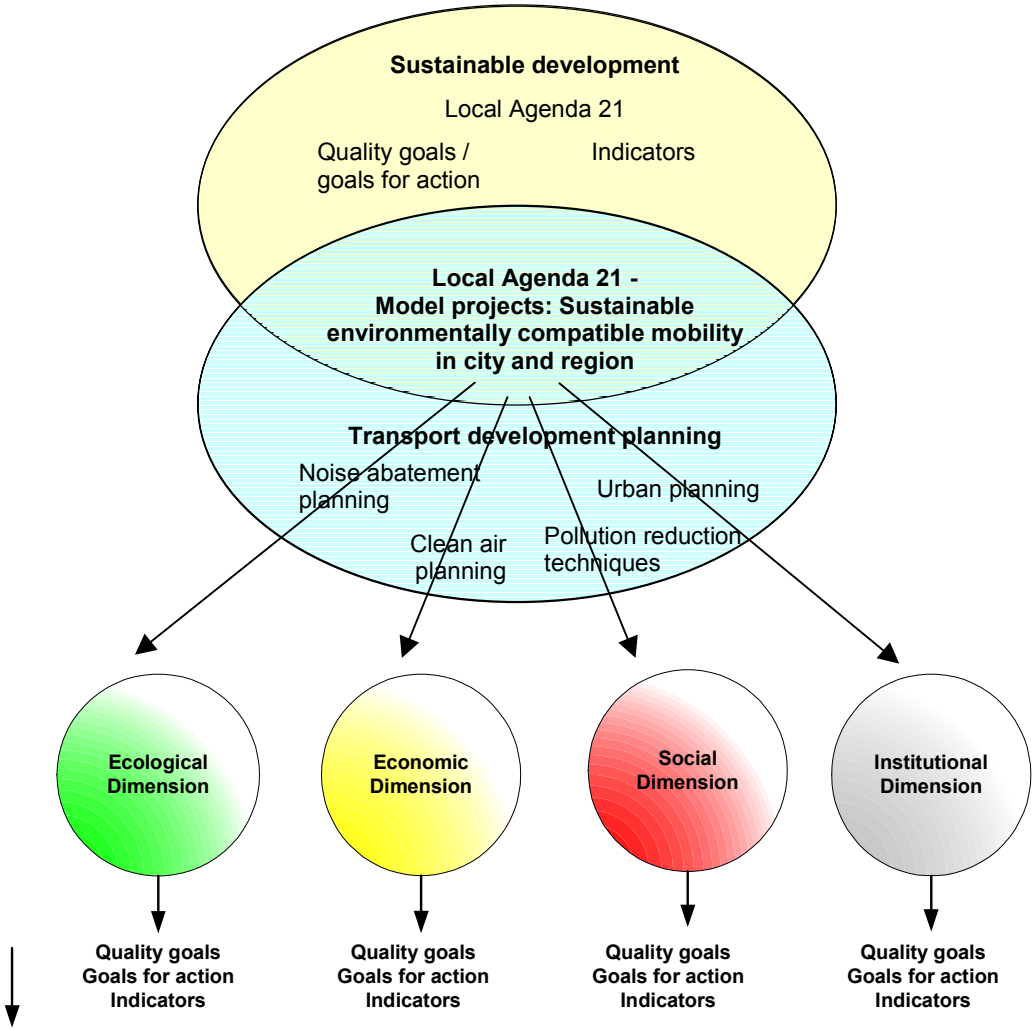
The remit for the research project involves for Sub-project 1 the development of on integrated systems of goals with quantified targets for the quality of sustainable mobility in local authorities and regions (quality goal catalogue). The intention is to develop a range of instruments that will enable local authorities and regions to determine their position regarding transport in relation to the quality goals, on to perfect measures to reduce any deficits.

A feature of the project is the broad, interdisciplinary approach, given that the discussion of sustainable development and the Local Agenda 21 has very often been narrow, with little exchange with the local authority planners of transport developments. A further characteristic of the processing is the continued use of a top-down approach. This involves a methodological approach on the basis of sustainable development and its dimensions

(ecology, economy, social and institutional) that defines the specific target, fields and quality goals, in order to derive the indicators from these.

The overlap between the Local Agenda and transport planning, and the top-down approach for the individual dimensions are shown in Figure 2.

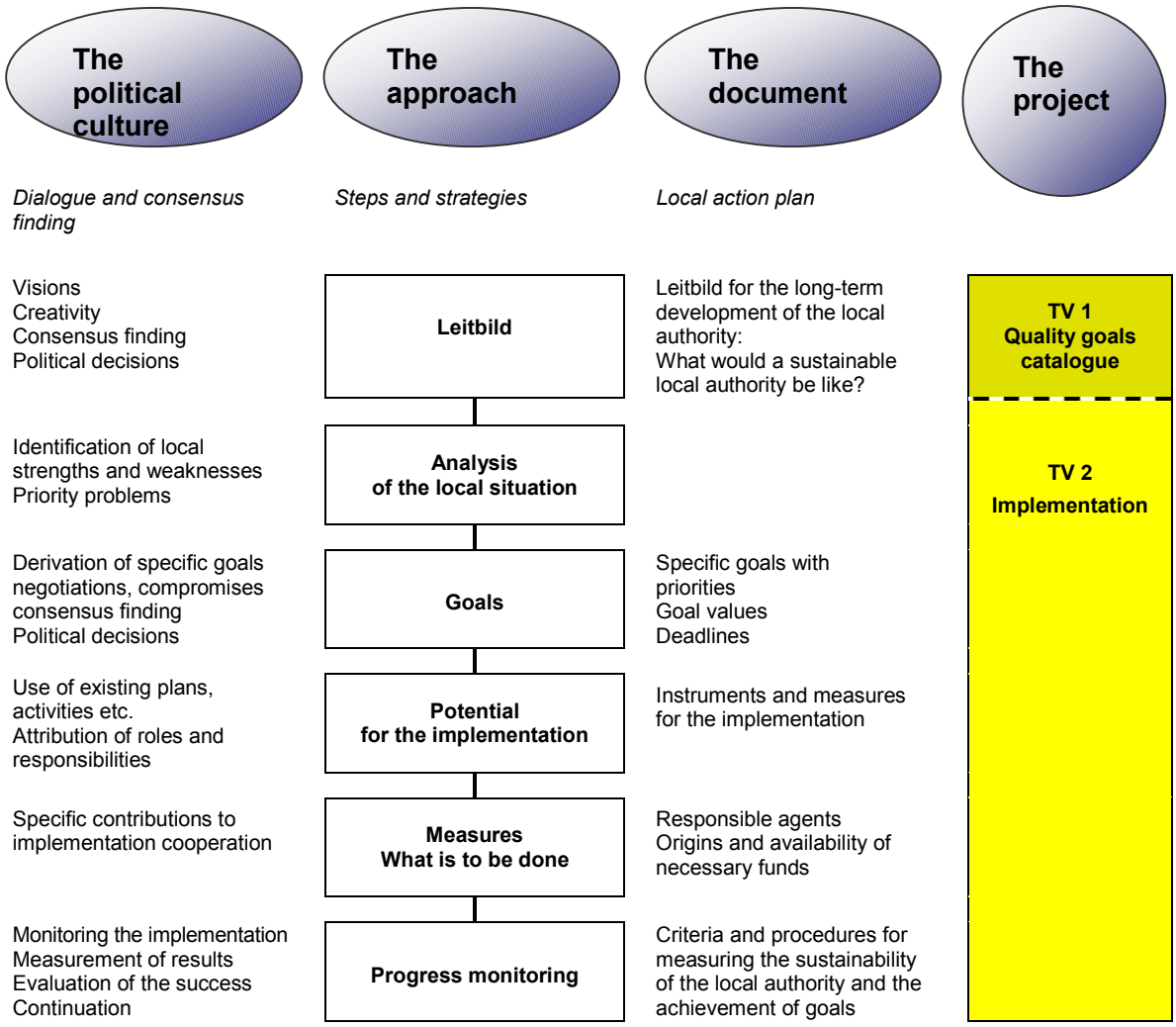
Figure 2: The project between the sustainability discussion and transport planning



2 Local Agenda 21 and traffic planning - Definitions and developments

In this chapter the concepts relating to sustainable development are defined. This is then followed by a review of the history of transport planning from the early Sixties through to the beginning of the research project. Another important aspect for the project are the principles of the German Local Agenda 21, which are outlined. The important components of the Local Agenda 21 are related to the research project in the following figure.

Figure 3: Components of a Local Agenda 21



Source: BMU 1998a, Handbuch LA 21, p. 26, amended.

For the research project the following development tendencies were given special priority with relation to the Local Agenda 21 and described in more detail:

- Need for increased discussion of goals in the Local Agenda
- Determination of uniform, comparable quality standards
- Development of sustainability indicators for the measurement and evaluation of the results on the way to sustainability

- Relationship and standing of the Local Agenda in relationship to other local authority instruments is frequently unclear
- Lack of strategies for the combination of sustainable mobility and Local Agenda 21
- Trend towards an increased orientation towards individual topics

2.1 Final conclusions for the "Local Agenda 21 – Model project: Sustainable environmentally compatible mobility in city and region"

The following key conclusions can be drawn from the basic considerations for the further steps:

- It is agreed that the Local Agenda 21 must include not only environmental but also economic and social aspects. Institutional considerations are a novel aspect, but these are increasingly also being considered

- Public participation and the associated communication with the local authority officials are a key element of the Local Agenda process. This consultation and discussion process demands goals and indicators that can be understood by the public.

- Transport is a key area of action for most Local Agendas.

- It is unclear how exactly mobility or transport can be transferred to the various dimensions of sustainable development (ecology, economy, social, institutional).

- In view of the existing deficits in linking sustainable mobility and Local Agenda, there is a need for recommendations relating to the content and methodology for the integration in the Local Agenda of goals, indicators, and also measures and projects relating to mobility.

- It is very important to develop sustainability indicators with which the success of the Local Agenda process towards sustainability can be assessed, and by means of which local authorities can be compared. Similar to the approaches at international and national levels, it is necessary to have transferable approaches as a methodological framework that allows the local authorities to set up their own indicator systems.

- The recommendation is to draw up a catalogue of 10 - 15 key goals or indicators that are relevant for the majority of local authorities. In addition, a group of some 10 - 15 optional goals and indicators should be developed that can be introduced in a Local Agenda where this is suitable for the local situation.

- Experience shows that it is often difficult to convince those involved to accept the theoretically best goals and measures. The preferences of the public and politicians are often not sustainable. Therefore in the development of new tools it is important to pay attention to possible strategies that can lead to an improved transfer of the expert conclusions about sustainable mobility to the addresses in the Local Agenda process.

3 Sustainable development

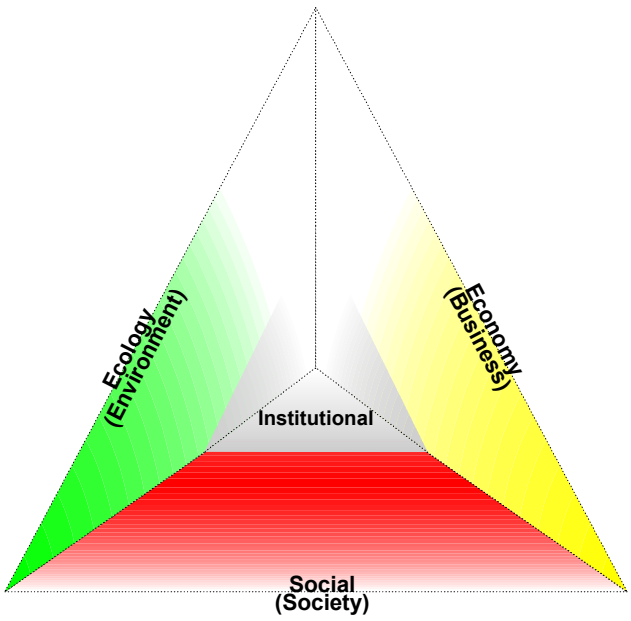
Chapter 3 gives an overview of the key elements of sustainable development. Where it seems necessary, attention is focussed on local matters or the field of mobility, but most of the comments are generally applicable. Their use for the field of sustainable mobility in local authorities and regions will follow in Chapter 4.

3.1 Dimensions and basic principles

A description of the various dimensions of sustainable development in this section is followed by the goals and indicators in sections 3.2 and 3.3.

In the discussion it has become usual to sub-divide sustainable development into ecological, economic, and social dimensions. Recently an additional institutional dimension has also been proposed. These dimensions are usually operationalised in the form of management rules, guidelines, or basic principles.

Figure 4: The dimensions of sustainable development



As the illustration shows, the dimensions are frequently referred to using the synonyms environment (ecology), business (economy) and society (social). The dimension institutional is a collective concept including primarily information as well as co-determination and implementation processes.

Ecological dimension:
The ecological dimension dominates the discussions about sustainable development. This can be seen from the numerous publications and strategy papers that focus on environmental questions. In the ecological dimension it is accepted that the traditional ideas about the links between development and economic growth must in future be based on ecological principles. According to the Advisory Council on Environmental Matters (Rat von

Sachverständigen für Umweltfragen)[1] this means for sustainable, environmentally compatible development:

- The rate of use of a resource should not exceed its rate of regeneration or the rate of substitution of all its functions (resource conservation).

- The release of substances should not exceed the capacity of the environment to absorb these.

The operationalisation of the ecological dimension of sustainable development can be summarised under the basic principles of regeneration, substitution and adaptability (cf. also the overview table in section 4.3).[2] Further modifications and additions would be possible.

Economic dimension

In contrast to the ecological dimension, there is not yet a clear specification of the economic dimension of sustainable development.[3] The main difficulty lies in the traditional orientation of economic concepts of development, which are frequently incompatible with fundamental ecological and social principles.

This applies in particular for neo-classical theories. Criticism of these is based on the basic tenet of neo-classical growth theory that maintains that even for sustainable development the economic per capita consumption should be maintained or even increased.[4] The key evaluation criterion is the macroeconomic benefit. Insufficient attention is paid to limited nature of the environmental resources, the interactions between ecological and environmental systems, and the resultant threats of destabilisation of the overall system.[5]

Despite the criticism, it is generally accepted that the economic dimension has its place in the sustainability discussion. The economic dimension of sustainable development involves above all two basic principles (cf. the overview table in Section 4.3), firstly securing the economic living conditions in both the short and long-term, and secondly the efficient organisation of economic processes. Efficiency here determined in terms of economic fundamentals such as the minimisation of fixed and shared costs, covering costs after allowing for all the inputs, and with respect to transport in particular the individual economic efficiency (100 % cost recovery for each form of transport). The interests of the ecological and social dimensions are to be taken into account.[6] Here the cost/benefit calculations should take external costs and benefits into consideration. These basic principles also imply in the context of sustainable development that the economic processes and activities contribute to the satisfaction of individual and social needs and at the same time do not permanently damage the quality of the natural environment.

In accordance with the principles of sustainability an economic process can therefore be classed as efficient if the consumption of resources is as low as possible while maintaining social equality and achieving the best possible economic results.

Social dimension

The social dimension of sustainability can be understood as a system of basic social values that form the basis for peaceful co-existence in solidarity. Priorities are the maintenance of the system of social security and the participation and just distribution of social wealth in

1). RSU 1994, Tz. 11 (p. 47).
2). Also BMU 1998d, p. 6.
3). Compare with the presentation of the various approaches by CANSIER 1995, p. 6 ff., GEISENDORF et al. 1998, p. 11 ff.; SURBURG 2000.
4). RADKE, ZAU 4/1995, p. 532 ff. (535).
5). WACKERNAGEL/REES 1997, p. 66; BRÖSSE/LOHMANN, ZAU 4/1994, p. 456 ff. (460).
6). ABGEORDNETENHAUS VON BERLIN 1999, p. 47*;* BILLING 1996, p. 53 ff. (54); DEUTSCHER BUNDESTAG 1998, p. 39.

combination with the possibility for free personal development. In addition, work, health, education and the promotion of co-existence of different groups are key elements of these basic social values.[7]

At the centre of the discussion of the social dimension is the concept of equality. Looking at the various attempts to explain this, it is possible to identify priorities in terms of time, space, and content. With a temporal emphasis, it is possible to distinguish between current problems of equality and questions of equality of coming generations.[8] The spatial component aims at the equalisation of differing living conditions, for example between town and country.[9] There are also other problems relating to the question of equality that could be mentioned.[10] Approaches that attempt to approach problems of equality systematically differentiate between equality relating to needs, performance, and possessions.[11]

Institutional dimensions (information, co-determination and implementation processes)
From various sides [12] a fourth institutional dimension is introduced into the discussion of sustainable development in addition to ecology, economy and the social. This concentrates on the processes relating to information, decision-making and implementation. There is a need for institutions and procedures that are oriented towards cooperation, participation and co-determination. Whereas the first three dimensions attempt to make sustainability comprehensible in terms of the contents, the institutional dimension highlights the level of implementation. At the same time it also has an content-related character, since the ideas of participation and co-determination are a key element of the Agenda 21 and in this sense also flow into the ecological, economic and social dimension.

In contrast to the dimensions ecology, economy and social, the various aspects of this dimension are difficult to gather together under one heading. The choice of "Institutional" should therefore be seen as a compromise. It is used here because it has established itself in the discussion.

3.2 Goals

This section begins by looking back over the developments in Germany from the early stages in about 1986 and through into the 1990s. This is then followed by a sectoral examination of the topics in the local authorities and in the transport area.

It is noticeable that so far few local authorities have been able to present results showing more than a general treatment of quality goals. And there have been hardly any investigations of the state of development of approaches to environmental quality goals by local authorities in Germany.

The development trends for approaches to environmental quality goals are towards establishing links with the activities of the Local Agenda 21. As a component of the Local Agendas, quality goals are a key element of the current activities in the field of informal local environmental protection.[13] The expectations placed on a Local Agenda 21 process are in principle comparable with the demands placed on the establishment of environmental quality aims. The Agenda 21 places additional demands because of its social and economic targets, but the necessary process steps such as discussing models, setting specific targets and

7). WALTER, ZAU 3/1997, p. 402 ff. (410); ABGEORDNETENHAUS VON BERLIN 1999, p. 47.
8). ZEITLER 1999, p. 24 f.
9). RENN o. J., p. 17 ff. (17); LfU BW o. J. (a), p. 7.
10). E.g. a question frequently raised in LA 21 procedures is gender equality, PETERS, UVP-report 5/99, p. 243 ff. (244).
11). HUBER 1995, p. 87.
12). E.g. ABGEORDNETENHAUS VON BERLIN 1999, p. 48; BMU 2000.
13). For details SURBURG 2000.

priorities through to a programme of action are, however, very similar to those of the environmental quality approach.[14]

The development of a target approach for the area of transport is in line with the growing tendency to set up target systems for individual sectors of environmental policy and causes of environmental pollution (traffic, agriculture, tourism, etc.).[15] This development is similar to the increasing orientation in the Local Agenda to individual topics. Sectoral goal systems are also the logical extension of recent advances in the development of aims and indicators. These can be described as follows:

- The experience with strategies for local authority environmental quality aims have shown that a goal system that only addresses objects needing protection and exposure to pollution can only be of limited effectiveness, since it will be necessary to establish concrete links to the responsible agents (local authorities, industry, etc.) for each case individually. Transferring the link with specific activities and polluters to the level of measures to be taken does not solve the problem, but merely exposes the lack of quality aims related to the individual sources of pollution. It is necessary to develop a strategy of goals for conservation and exposure to pollution for which complementary goals for sources of pollution can also be defined.

  It follows from this that without goal systems for polluters it is not possible to derive demands for specific measures that are to be taken.

- The development of sectoral goal strategies also reflects a trend in environmental policies, observable since the mid-1990s, towards the definition of gaols for actions that serve as intermediate stages for a longer-term quality goal. These goals for action should target primarily the polluters.

In the literature, the Pressure-State Response (PSR) approach and the Driving Force Pressure State Impact Response model (DPSIR[16]) have been favoured as indicator systems by some authors. Using these aids it is possible to differentiate between the indicators for the polluters and the emissions side on the one hand, and on the other hand for the status and pollution levels. Such a distinction can also be made in the definition of quality aims, at least for the ecological dimension. But both internal discussions and the Experts Workshop held on 10 May 2000 have shown that these models raise more questions than they answer. In the following no specific reference is made to them. This reflects the current trend in both the national and international discussion.

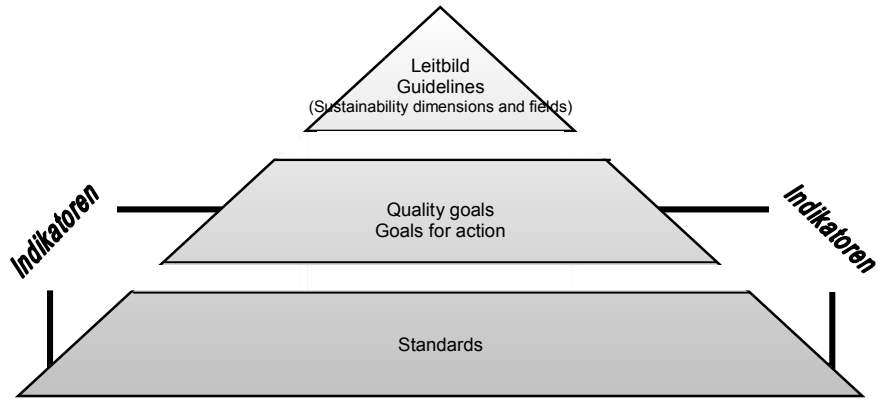
3.2.1 Definitions of concepts

The discussion of the sustainability aims is still largely about environmental goals. A very wide range of different concepts are used, as a result of which it is very often unclear today what they are actually intended to mean, and how the various terms are distinguished from one another. With the aim of clarifying the way various key concepts are used in this report, the following definitions are provided on the basis of various sources, mostly related to environmental problems.[17]

14). DICKHAUT 1997b.
15). This development is currently also supported by scientific advisors, RSU 2000. The reports of the Sachverständigenrat are no longer preceded by a situation analysis, but environmental quality aims for the selected policy areas.
16). In some cases without the impact level the model is referred to as DPSR.
17). FÜRST et al. 1992, SURBURG 1993 und 2000, RSU 1998, DEUTSCHER BUNDESTAG 1998.

Sustainability goal
Sustainability goal is a general concept covering the various levels of goals in the dimensions ecology, economy, social and institutional. Sustainability goals can be general (e.g. for the local development) as well as sectoral (e.g. for the development of local transport). The key levels of goals are the leitbild, guidelines, quality goals, aims for action and standards. All levels involve the integration of expert knowledge with political or social values and attitudes.

Figure 5: Links between the various target levels



Source: After RSU 1998, p. 51.

Leitbild, guidelines, basic principles (basic principles of dimensions and basic principles of the areas)
A leitbild is a very general goal such as sustainable development or sustainable mobility. Guidelines are derived from these and thus represent the next, more specific level. In the research project the basic principles of the dimensions correspond to the leitbild and the basic principles of the areas correspond to the guidelines.

Quality goals
Quality goals are derived from the more general targets (guidelines and basic principles). They show the desired state or the desirable development for a specified topic field. Quality goals can be expressed verbally, as well as in terms of derived quantitative values.

The definition of quantitative quality goals is preferable since this offers control possibilities from case to case. However, it will not be possible to establish relevant values in all cases, especially where goals cannot be quantified. The definition of quantitative goals can be based on suitable standards, or codes of practice.

Quality goals are not usually differentiated over time, since this is the only way to allow them to be implemented by a wide range of local authorities. Local specification follows by means of goals for action.

Goals for action
Goals for action have two characteristics. Firstly they are defined locally for a specific case. That is the local authority defines the level of quality that they wish to achieve. Secondly, they are given a time frame, so that the goals for action represent stepping stones on the way to quality goals.

Furthermore, the goals for action also offer an opportunity to adopt targets to suit local conditions. This applies in particular to the goals for action that are related to environmental, and planning considerations. Goals for action are the basis for the development of strategies and the use of the necessary instruments.

Intermediate goals
Intermediate goals are used in the definition of very demanding quality goals, in analogy to the goals for action mentioned above, to specify the steps on the way to reaching a quality goal with long-term orientation. However, in contrast to goals for action, intermediate goals are initially without spatial and temporal specifications, like quality goals.

Standards and minimum standards
Standards represent quantitative specifications of legal requirements and general legal concepts, and other regulations and codes of practice. It is therefore a general term covering different ways of specifying values which may not necessarily be related to precautionary measure or sustainability. The term minimum standard is not therefore a quality goal in the sense defined above, by the specification of a value on the way towards a more demanding quality goal.

Quality goal strategy
Quality goal strategies bring together the basic principles, quality goals, goals for action and standards in a harmonised goal system. The goals can be grouped for specific objects or expressed systematically and hierarchically (tree structure). The quality goal approach allows links to be mage to the instruments, measures and the Local Agenda projects.

The system of various goal levels needs to be adapted to suit the local situation.

3.2.2 Systematic organisation of sustainability goals (and indicators)

A systematic presentation of the sustainability goals (and indicators) is possible using the following criteria:

- the three or four dimensions of sustainable development (environmental, economic, social and institutional dimensions) [18] and
- the organisational criteria of each sector (e.g. mobility).

3.2.2.1 Differentiation according to the dimensions of sustainable development

Environmental goals
Environmental goals, involving both technical and political-normative elements, include environmental quality goals, environmental action goals, environmental standards, as well as the overriding general principles. The research project is concerned mainly with environmental quality goals. There are many more goal recommendations for the environmental dimension than for the other three dimensions.

In the course of the discussion of environmental quality goals there has been a movement away from the very restricted consideration of conservation and exposure to pollution.[19] They seem to have been found to be too limited for real needs in the environmental sector. In particular in the discussion of environmental policies the concept of environmental quality goals is used in a wider sense than was originally intended. This suggests that environmental goals should be defined to take account of both impacts and origins - as already described in the consideration of development trends.[20]

18). SURBURG 2000, p. 74 f.
19). C.f. 2.3.1.
20): C.f. 2.3.1.

Economic goals
As with environmental goals, the economic goals can also be classified as quality goals and goals for action. In view of the different approaches adopted, it is necessary to find a lowest common denominator for definitions. In this sense, economic quality goals can be taken to maintain the wealth of an economy while maintaining the desirable economic functionality of the economic area under consideration of environmental and social concerns.[21] It is also recommended to adopt as a basis for economic goals the maintenance of market functions and competition in economic sectors.[22]

Economic goals for action specify the necessary steps to reach the economic quality goals.

Social goals
On the basis of the social dimension of sustainable development as described above, social goals address social value sets, such as codified for example in legal frameworks. Apart from guaranteeing basic social needs, it is also important to secure health, education, employment, work safety, provisions for old age, and the distribution of income and property. Social quality goals serve to specify the general social goals. On the basis of long-term social problems that have been identified, they describe target states for the social dimension of sustainability with relation to the social system and social rights of the individual.

Social goals for action specify the steps that are necessary to reach the situations described in social quality goals.[23]

Institutional goals
Institutional goals define the instruments, strategies, forms of organisation or procedures with which public participation and co-determination can be established.

3.2.2.2 Differentiation according to the organisational criteria (dimensions and areas) of each sector (e.g. mobility)

This differentiation cannot be provided in general terms. It is specified in Chapter 4 for the mobility sector.

3.2.3 Determining quality goals and goals of action

On the basis of the considerations already outlined, the report includes further details regarding the specification of quality goals and goals of action, both in terms of content and methodology. These summarised comments should be understood as proposals and guidelines for the definition of the content of goals.

Quality goals
- Derivation of the quality goals from the basic principles of the sustainability dimension and area
- Quality orientation is the basis of the goal definition
- Aim for specific formulations

Goals for action
- Derivation of the goals for action from the recommendations for the quality goals
- Take account of pragmatic considerations

21). After WALTER, ZAU 3/1997, p. 402 ff. (412).
22). DEUTSCHER BUNDESTAG 1998, p. 39; BILLING 1996, p. 53 ff. (54).
23). DEUTSCHER BUNDESTAG 1998, p. 41; WALTER, ZAU 3/1997, p. 402 ff. (409).

- Identification of public with "subjective" goals for action
- Spatial aspect
- Time-related aspect

Goal strategy
- Hierarchical structure
- Restricted number of quality goals and goals for action
- Integration in Local Agenda 21
- Differentiation in polluter and emission-related quality goals and impact-related goals

3.3 Indicators

Recently, the attempt has been made to use indicators so that sustainability or sustainable development can be measured, and thus to stimulate the discussion between the various participants in a local authority, as well as allowing comparisons with other localities. Overall the current situation is very heterogeneous. The sets of indicators chosen depend generally on the conditions in each community, the social groups involved, and the availability of data. It is to be welcomed that in the Local Agenda the indicators used are often relatively straightforward, and can be easily comprehended by the public.

It is an open question whether the local authorities will in future orient themselves more towards existing national and international indicator catalogues, or the on-going indicator projects for local authorities[24], or whether they will favour solutions they have developed themselves. Increased attention is being paid in the indicator discussion to interlinkages,[25] that is the areas where the four dimensions overlap and interact. Developments here are still at an early stage.

3.3.1 Definition of concepts

In the literature,[26] the concepts used include indicator systems, index, key indicators, environmental indicators, sustainability indicators and indicators. Indicators are defined as measured or calculated quantities, either taken individually or in relevant indicator systems that allow representational comments to be made about a situation. They have a descriptive nature and are value-free, allowing the retrospective description of a development over time. Where indicators are linked with political or social foals, they have an increased monitoring function in the sense of the measurement of the degree to which goals have been achieved.

3.3.2 Approach to the derivation of indicators

Steps towards developing an indicator system
An indicator system can be set up in the following steps:

- Establish the theory

First it is necessary to establish the theoretical premises (definitions, assumptions, cause and effect relationships, etc.) that are suited for the description of the past, current and future situation and developments.

- Choosing the indicators

On the basis of the theoretical premises, it is then possible to decide which indicators to use.

24). For the large number of examples: GEMEINDE VATERSTETTEN 1999; ICLEI 1998, ZIPF, UKÖB 20/1999.
25). BMU 2000.
26). E.g. FÜLGRAFF/REICHE 1992; BORN 1997; BMU 2000; ERDMENGER 2000.

- Setting up an indicator system

The various indicators can then be brought together in an indicator system.

Criteria and requirements for the selection of the indicators

After looking through the relevant information and documentation, a decision has to be taken about the indicators that come into question. It is not possible to make any general comments about the choice of indicators. However; certain criteria and aspects can be defined on the basis of which a selection can be made:

Figure 6: Overview of the relevant criteria for the selection of indicators

• Link to quality goals
• Suitability, availability of data, efforts for data acquisition
• Reproducibility
• Continuous availability of data
• Key indicators to limit overall numbers of indicators
• Interlinkage of indicators to register general aspects
• Subjective perception of relevance
• Political importance

4 Sustainability and mobility

Following the project approach, the field of sustainable mobility can be specified as the subset defined by the overlapping of sustainability and mobility, or of the fields of action of integrated urban planning and transport planning. In order to determine this, the following graduated approach is adopted:

1. Firstly, the main fields of action and objects of study of integrated urban and transport planning are identified (Section 4.1.2).

2. On the basis of the principles of the sustainability dimensions (Section 3.1), the basic principles of sustainable mobility are derived. The dimensions and fields of sustainable mobility can then be identified (Section 4.1.2).

3. In the Final Report 2 quality goals are specified for these fields of sustainable mobility.

4.1 Mobility

4.1.1 Definition

The concept of mobility can refer both to the ability to move if one chooses to ("potential mobility") and to the actual movements ("realised mobility") of people or goods to a destination, for one or more purposes, generating traffic.[27]

Potential mobility includes the possibility of choosing the destination, and the purpose of a trip. Though mobility can generate traffic, the two should not be confused. To maintain a given level of mobility, it may be necessary to have very different transport inputs.[28]

Transport and traffic are flexible terms and depend on a variety of factors, such as cultural and economic development, destinations, the available means of transport, the nature and capacity of the transport infrastructure, and the levels of traffic, the costs involved, the available income, the available time, and not least the knowledge about available alternatives.[29]

Mobility can be valued for itself, but it is usually a means to an end, i.e. the movement from one place to another is linked with an intended action at the destination. The closer the starting point and destination are together, the less traffic is generated for the same mobility.

4.1.2 Fields of action and topics of observation for integrated urban and traffic development planning

The aspects to be taken into consideration for local and regional mobility are known from experience with integrated urban and transport planning. Basically these are:

- Environment and health
- Resources (soil, nature, climate)
- Transport systems
- Settlement structure
- Public participation, and
- Integrated planning

27). DIEWITZ/KLIPPEL/VERRON, Internationales Verkehrswesen 3/1998, p. 72 ff. (72). Also UMWELTBUNDESAMT 1998, p. 82.
28). UMWELTBUNDESAMT 1998, p. 82.
29). RSU 1994, p. 235 (Tz. 610).

These topics will be taken into consideration in the following specification of the fields of sustainable mobility, inasmuch as they conform with the basic principles of sustainable development.

4.2 Dimensions and fields of sustainable mobility

On the basis of the considerations presented in Chapter 3 and Section 4.1 2, in the following the ecological, economic, social and institutional dimensions and fields are determined for sustainable mobility.

4.2.1 Ecology (environment)

The environmental dimension of sustainable mobility has to be based on the principles of regeneration, substitution and adaptability already mentioned. This means that the rate of consumption of renewable and non-renewable resources by traffic should be reduced to the levels of substitution or regeneration, and that the rate of environmental pollution (e.g. exhaust emissions*)* will not exceed the ability of the environment to absorb these. Interactions are often shown as simple cause and effect relationships. The cause in this context is traffic, and its impact is felt in various ways (use of land, intersecting areas, exhaust emissions, resource depletion, etc.) by air, soil, water, biosphere, etc. In order to specify further the environmental dimension of sustainable mobility, these interconnecting aspects must be bundled to produce key fields. the main aspects for sustainable mobility from an environmental perspective are noise, air, energy and climate, land-use, nature conservation, and resource depletion. These areas can be described as follows:

- **Noise**

It is generally agreed that noise emissions represent one the central problem fields where relatively little progress has yet been made.[30] Noise pollution arises above all where busy roads run close to residential areas. Noise impacts are considered here on the basis of the environmental dimension, with respect to their effects on humans (as part of the ecosystem), and the need to protect their health. However, noise also has obvious economic and social implications.

- **Air**

Air pollution and the importance of clean air is a well-established aspect of the environmental consideration of transport. The specific concern is the pollution emitted by traffic that can be directly harmful for people. The goal is this to protect human health from pollution and harmful impacts. In addition to such direct effects, there can also be indirect impacts (e.g. due to the absorption of heavy metals by crops). This can also lead directly or indirectly to negative effects for plants, soil, or water. The focus here is placed on direct harmful effects for people as a result of pollution from traffic.

Although air is classified in the environmental dimension here, it too also has effects on the economic and social dimensions.

- **Fossil fuels and climate**

This field refers to the consumption of fossil fuels and the associated CO_2-emissions, with the associated climatic implications (greenhouse effect). The use of non-renewable fossil fuels and the generation of greenhouse gases is clearly one of the key consideration with respect to sustainable mobility. However, there is relatively little scope for influence at the local and regional levels.

30). Typicallly: WICKE 2000, p. 13, who refers to noise abatement as the orphan of German environmental policy.

Energy and climate goals also reach beyond the environmental dimension.

- **Land use and surface sealing**

Land is used for the installation of the transport infrastructure. This has resultant effects not only on soil. water, plants, etc., but also has implications for people (areas for settlements, land sealing, and recreational areas). In view of its multiple effects, land-use is of considerable significance.[31]

In addition to the environmental relevance, land-use also has considerable social and economic importance. The question of traffic avoidance in urban planning is dealt with in the social dimension.

- **Nature conservation**

A further important field of action is nature conservation, which is closely connected to land-use. In nature conservation, the key consideration for local authorities is the protection of valuable biotopes and areas of special interest from the harmful effects of traffic (air, noise, land-use).

- **Use of materials and resources**

At a local level this field is related to the use of raw materials such as construction materials (aggregate, sand) for building roads and transport infrastructure. There is however, little that can be done about this at the local or regional levels, so that this field plays only a marginal role in the present context.

4.2.2 Economy (Business)

As described already, the key aspects of the economic dimension are the short and long-term stabilisation of the economic living conditions and the efficient organisation of economic processes, while taking into consideration environmental and social concerns. For sustainable mobility, the fields of commercial traffic, foodstuff production close to consumers, and cost truth have been selected.

Of course, the economic dimension also has much wider significance, as has already been mentioned variously in the discussion of the environmental dimension in Section 4.2.1.

- **Commercial traffic**

Commercial traffic is necessary to transport goods as an essential element of the economy. Following the basic principles of sustainable development, efficient commercial transport is not only characterised by smooth operation, but also meets mobility needs while generating the minimum levels of traffic and utilising the means of transport with the lowest environmental impact. This can require innovative forms of supply and new approaches to logistics. This might be reloading centres, regional rail companies (able to respond to customer wishes), and logistics centres and sub-centres, as well as special city-logistics.

31). EWEN 1998.

- **Foodstuff production close to consumers**

Regional and local production and supply can have important transport implications. From an economic point of view, efficiency can be determined by means of price.[32] However, if this is the only criterion used, then forms of transport often come out top only because the prices are the result of an extreme division of labour.

From an environmental point of view, it seem preferable to give priority to production forms that are located closer to the customer so that transport levels are reduced In most cases it will be necessary to subsidise such local or regional producers in various forms, so that the goods can compete in terms of price (cf. also UBA project "Regionale Wirtschaftskreisläufe").

This field also has implications for the social and environmental dimensions.

- **Cost truth**

A further aspect of the economic dimension is the attribution of the costs that are actually involved in making products available, the so-called cost truth. There is little that can be done at local or regional levels about this, since it is largely a matter for national government and the European Union (e.g. tax legislation, subsidies). However, in some areas real costs can be influenced or indeed determined, such as fare prices for public transport, or parking charges in central areas.

4.2.3 Social (society)

The aim in the social dimension is to ensure that mobility needs are satisfied fairly for the current and future generations. Key elements are:

- Allowing all social groups to have the mobility to take part in social life. This usually means that it should be possible to reach the locations of core functions (living, working, education, etc.) on foot or by public transport within a reasonable time.
- A fair distribution of mobility provisions, and
- The potential to use transport systems without suffering injury.

In order to meet these requirements, the following aspects are important:

- **Securing necessary mobility for all**

The transport system establishes the precondition for meeting mobility needs. A system must be set up that meets these needs with the lowest environmental impact. Such a transport system will be based on the necessary level of transport by means of private motor vehicles, but apart from this, a mix of public transport, bicycle riding and walking will be promoted in order to offer all social groups approximately the same opportunities. For a sustainable development the necessary transport infrastructure for such a system should be established.

A transport system based on sustainability must of necessity involve more than just a high quality infrastructure, but also provide a well-distributed system of transport and services. The quality is achieved by convenience, reliability, and attractive pricing for public transport.

- **Quality of streets as places for rest and recreation**

Social equality means also that the quality of residential areas must be ensured for all social groups. This is expressed above all in this context by the quality of public spaces as places for rest and recreation. Aspects can be the amount of greenery, design, and the allocation of areas for various purposes, so that individual groups are not disadvantaged. The

32). SPILLMANN/WALTER/HILTY 1999; ERNST BASLER & PARTNER 1998, ABGEORDNETENHAUS VON BERLIN 1999.

neighbourhood has an important social dimension in the form of close open spaces, playground, socialisation areas, in particular in heavily built-up areas.

- **Traffic avoidance in urban development**

The control of settlement structures must be a task for regional planning and the local zoning plans. For example, more attention must be given to the effects on the flow of traffic when allocating areas for commercial uses. The encouragement of innovative ideas (e.g. shared commercial parks between towns), mixed-use areas (offering short access distances) can also have a contribution to make. Consideration at an early stage of aspects such as the layout of the public transport network, or the reduction of land-use for roads can have a considerable effect on settlement structures.

Obviously, there are also considerable economic and environment effects here and not only social ones.

- **Health and welfare**

An important aspect of social sustainability relating to the use of transport systems is the health and physical welfare of those using it. Safety is a crucial element. There will be a need to introduce measures here as long as people are harmed or killed in traffic accidents.[33] The risks involved must be reduced.

The effects on health of aspects such as noise and air pollution are considered in Section 4.2.1.

4.2.4 Institutional (Information, co-determination, and implementation processes)

In the institutional dimension, there are various forms of involvement of local transport planners and decision-makers offering a basis for goal definitions. For the planning process, co-determination is possible primarily by means of integrated planning, in particular with integrated transport development planning, since this is open for public participation. Co-determination offers increased opportunities for the participation of associations, societies, etc. in the established political institutions (committees, council meetings, etc.). Support should also be given for informal discussion forums, such as round tables, or LA 21 working groups.

All these various aspects cannot really be classified under only a few headings. Even the categories used, "planning instruments", "transparency of local administration" and "public participation" are linked to each other, because the planning process involves public participation.

Sustainable mobility in the four dimensions can therefore be summarised as below:

33). BIP/IÖW 1997.

Figure 7: Overview of dimensions and fields of sustainable mobility

Dimensions	Fields of sustainable mobility
Ecology	Noise
	Air
	Fossil energy and climate
	Land use and surface sealing
	Nature conservation
	Use of materials and resources
Economy	Commercial traffic
	Foodstuff production close to consumers
	Cost truth
Social	Securing necessary mobility for all
	Quality of streets as places for rest and recreation
	Traffic avoidance in urban development
	Health and welfare
Institutional	Planning instruments
	Transparency of actions of local authorities
	Public participation

4.2.5 Interlinkages

So far, each field of sustainable mobility has been allocated to one of the sustainability dimensions. But the discussion in Section 4.2 has shown that such an allocation can seem arbitrary in some cases. As already pointed out on occasions, there are close links between the dimensions, so that

- The fields in the environmental dimension have links to the economic and social dimensions.
- The fields in the economic dimension have links to the environmental and social dimensions.
- The fields in the social dimension have links to the environmental and economic dimensions.
- The institutional dimension has links to all environmental, economic and social dimensions.

4.3 Links to relevant documents

The fields of sustainability determined here are in agreements with the proposals relating to sustainable development and sustainable mobility in various key documents. An overview table is produced in the project showing links to the following documents:

- "Charter of Aalborg" (1994)
- "Lisbon Plan of Action" (1996)
- "Vancouver Principles" for sustainable transport of the OECD-Conference (1996)
- "Hanover Declaration of the Third European Conference on Sustainable Cities & Towns (2000)
- "Berlin Declaration" of Urban 21 (2000)

Part 2

Goal and indicator systems for sustainable mobility

5 Goal system for sustainable mobility

On the basis of Final Report 1, the quality goals for the sustainability dimensions environment (ecology), economy, social and institutional are established. Links between the individual dimensions are described, corresponding to the various interlinkages established in Final Report 1.

The interlinkages between the dimensions, fields and quality goals can be seen in overview in the following table.

Figure 8: Interlinkages between the quality goals for sustainable mobility and the fields and dimensions

Dimension	Field	Quality goals		
		Ecology	**Economy**	**Social**
Ecology	Noise	(see dimension)		
	Air			
	Fossil fuels and climate			
	Land-use and sealing			
	Nature conservation			
	Use of resources and materials			
Economy	Commercial traffic		(see dimension)	
	Foodstuff production close to consumers			
	Cost truth			
Social	Securing necessary mobility for all - Public transport - Cycling - Pedestrian traffic - Modal split			(see dimension)
	Quality of streets as areas for leisure and recreation			
	Traffic avoidance in urban planning			
	Health and welfare			
Institutional	Planning instruments			
	Transparency of local administration			
	Public participation			

Importance of quality goals for the fields

Very important

Moderately important

Less important

Corresponds to the dimension

Overall, the fields and quality goals are limited by the real scope for action of local authorities. In accordance with the remit, the goal system concentrates primarily on the fields in which the local administrations have the most scope for action. For the areas in which

there is relatively little scope, on the other hand, quality goals are only defined when they are felt to be crucial for achieving sustainable mobility.

5.1 Environment

In the environmental dimension quality goals are to be defined for Noise, Air, Fossil fuels and climate, Land-use, Nature conservation, and use of materials.

5.1.1 Noise

Noise was identified as one of the central problem fields for sustainable mobility. This is not only annoying and unpleasant, but exposure over long periods can lead to illness. Noise can cause tension, and acts as a stress factor. Even moderate loud noise can impede communication, rest, and relaxation as well as concentration at work. The effect of noise can be described as follows:

- During the day, outdoor mean levels above 50 - 55 dB(A) can be expected to lead to increasing mental and social discomfort.
- Outdoor mean levels above 65 dB(A) during the day also pose the additional risk of cardiovascular illness. According to the Umweltbundesamt one person in six suffered from continual noise levels during the day due to traffic of more than 65 dB(A).[34]
- Sleep is disturbed by values outside in excess of 45 dB(A). (This corresponds to the orientation value for urban planning defined in German Standard DIN 18005 for residential areas.

Noise quality goals were defined as follows:

Figure 9: Quality goals for the field of Noise

Quality goals	
descriptive	**quantitative**
• No traffic noise which can lead to an increased risk of cardiovascular illness	• ≤ 65 dB(A) outdoors during the day
• Avoidance of traffic noise, which can lead to sleep disturbances	• ≤ 45 dB(A) outdoors during the night
• No disturbance of communication outdoors and in public places by traffic noise	• Outside ≤ 50 dB(A) during the day • On pavements and open spaces ≤ 55 dB(A) during the day[35]

The quantitative quality goals refer to streets with corresponding use profiles.

Interlinkages with other dimensions are described in the research project with examples for the economic and social dimensions.

34). UBA 1997a, p. 18; also BMU 1998; BABISCH, ZfL 3/2000, p. 95 ff. (100).
35). UBA 1985.

5.1.2 Air

Air pollution damages people's health. High concentrations of outputs can be found in particular in conurbations. Since the early 1990s there has been a general decline of in air pollution in Germany attributable to traffic, due in particular to the introduction of catalytic converters and improved fuel, (unleaded petrol, lower concentrations of benzoate and sulphur). This has also brought with it a reduction in the emissions of volatile hydrocarbons (HC), nitrogen oxides (NO_x) and diesel soot. However, at current and predicted traffic levels, it will not be possible to achieve the reductions in nitrogen oxides and diesel particulates that are felt to be necessary for the protection of health and the ecosystems.[36]

In view of the size of the harmful effects and the corresponding need for action, it was felt that for the project it was particularly important to define quality goals for the leading components nitrogen dioxide (NO_2) and soot. Quality goals for ozone were not specified further.

The basis for the quantitative quality goals are the values defined in the literature. Variously referred to as benchmarks, guidelines, orientation values, limits, etc. [37], these are based on various tolerance levels and health hazards. From the many existing recommendations and proposals, those were taken which are oriented in terms of precaution, and which largely allow air quality to be assessed on a scientific basis.

Figure 10: Quality goals for the field Air

Quality goals	
descriptive	**quantitative**
• No health threat due to low-level ozone, nitrogen oxides or volatile organic compounds.	Exposure levels [38]: • Nitrogen dioxide(NO_2): 1.9 µg/m³ (Annual mean) • *Intermediate goal: 10 µg/m³ rural areas (annual mean), 25 µg/m³ conurbation (annual mean)*
• No carcinogenic threat due to traffic emissions	
• *(Intermediate goal:)* Maximum carcinogenic load not higher than in rural areas (1 : 5 000))	Exposure level [39]: *Soot: 0.8 µg/m³ (annual mean)*

The quantitative quality goals are based on the values defined in the literature. Nitrogen dioxide is a harmful gas and due to its high solubility and its reactions with water it affect mucus membranes and bronchial surfaces even at low concentrations, and is absorbed to 80 - 90 %. This obviously leads to the formation of nitric acid or corresponding salts. Nitrite or nitrate is found as a metabolite in the blood, which can have an indirect influence on the lung structure. Due to the metabolites it is necessary to specify long-term values.

If the experimentally determined threshold values are used, and taking into account the usual uncertainty factors, then one obtains as a quality aim for nitrogen dioxide an annual mean value of 1.9 µg/m³.[40] Since this cannot realistically be achieved in the short- and medium-term, it is necessary to specify intermediate goals oriented on current levels. Such as goal could be to halve the current levels. This would mean keeping below an annual mean value of 10 µg/m³ for rural areas, and 25 µg/m³ in conurbations.[41] "Rural areas" is taken to refer to

36). UBA 1998, p. 96.
37). Cf KÜHLING 1995.
38). Procedure in accordance with 23. BImSchV, Annexes I + II
39). Measurements in accordance with 23. BImSchV, Annexes I + II and TA Luft.
40). KÜHLING/PETERS 1994a, p. 261.
41). KÜHLING/PETERS 1994a, S. 258: Annual mean values in rural areas: 15-20 µg/m³. Annual mean in cities and conurbations: 40-60 µg/m³.

local administrations with numbers of residents < 100 000. "Conurbation areas" are metropolitan authorities with ≥ 100 000 residents.

Determining air quality standards for carcinogenic air-borne substances faces the problem that, in contrast to toxic air pollutants no limit doses can be specified on a scientific basis, below which there was no risk. Therefore the goal for carcinogenic substances must be to reduce their levels as much as possible. The long-term goal should be to reach current rural air standards in built-up areas, which would still involve a residual carcinogenic risk of approx., 1 : 5000. The German Länderausschuss für Immissionsschutz (LAI) has defined exposure levels on this basis. Following their findings a limit annual mean value for soot was set at 0.8 µg/m³.[42] as a long-term goal and at 4,0 µg/m³ as a short-term goal.

Interlinkages with other dimensions are described in the research project with examples for the economic and social dimensions.

5.1.3 Fossil fuels and climate

Local authorities and regions have little influence on the use of fossil fuels. They can only use transport policies to influence the use of motor vehicles and so reduce CO_2-emissions.

Figure 11: Quality goals for the field Climate

Quality goals	
descriptive	**quantitative**
• Contribution of local communities to climate protection and the reduction of CO_2 emissions	Emission percentages: • Reduction of CO_2-emissions by 12 % for the period 2001 to 2005 • Reduction of CO_2-emissions by 30 % for the period until 2025

An important element in the reduction in emissions of greenhouse gases is the reduction in CO_2 release. In the formulation of quality goals there is generally no distinction made between the individual emitter groups. As a result, traffic emissions form part of the overall levels in the CO_2-reduction strategy. The goals found in literature are generally similar.[43]

Interlinkages with other dimensions are described in the research project with examples for the social dimension.

5.1.4 Land use and surface sealing

In Germany in the mid-1990s the land covered by transport infrastructure accounted for approx. 5 % of the total area (approx. 4.6 % in the new Federal Laender, 5.1 % in the old Federal Laender). The trend is towards an increase in this proportion.[44]

The use of land is of significance in various dimensions of sustainable development. It is of special importance in the environmental dimension in view of the negative effects the increased land use has on many aspects of the environment.

42). UBA 1997a, p. 14; KÜHLING 1994b, p. 17.
43). ABGEORDNETENHAUS VON BERLIN 1999, p. 225; UBA 1997a, p. 12, with references to the decisions of the relevant comittees.
44). UBA 1998, p. 98.

Figure 12: Quality goals for the field Land use

Quality goals	
descriptive	**quantitative**
• Careful use of land	• Road area per inhabitant $\leq$ 7 m^2 (after [45])
• *Intermediate goal:* *No additional use of land for transport infrastructure without compensation elsewhere, with improvement rather than new construction and compensation of increases in one place by reduction in another*	• *Ratio of new construction (sealing) to removal 1 : 1*
• Best use of existing transport infrastructure with traffic guidance and control	

The quantitative quality goal for road surface area of $\leq$ 7 m^2 / inhabitant will require empirical examination, because there is no existing goal definition.

Interlinkages with other dimensions are described in the research project with examples for the economic and social dimensions.

5.1.5 Nature conservation

An investigation of existing environmental quality goals[46] shows that there are a wide range of proposals for descriptive quality goals for nature conservation, but inadequate back-up with quantitative goals and standards.[47] Standards that are proposed include general minimum sizes biotopes or areas for lead species. However, these cannot usually be interpreted without a scientific background. More comprehensible are the targets for priority nature conservation areas, such as "x % of the local area".

Figure 13: Quality goals for the field Nature conservation

Quality goals	
descriptive	**quantitative**
• Keeping a sufficient distance between roads and valuable biotopes or areas of scientific interest	• Minimum distance away from biotopes or areas of scientific interest
• Linking of open spaces to form large areas and no further intersecting	• Minimum area for animal species

Interlinkages with other dimensions are described in the research project with examples for the economic and social dimensions.

45). IWU 1994.
46). FÜRST et al. 1992.
47). The situation is completely different for water and soil, where the number of scientific standards is much greater than these environmental quality aims , cf. FÜRST et al. 1992, p. 194.

5.1.6 Use of materials and resources

All transportation systems involve the use of various substances and materials (e.g. cement, sand). And the products arrive at come stage at the end of their life-cycle, and have to be disposed of.

Figure 14: Quality goals for the field Use of materials and resources

Quality goals	
descriptive	**quantitative**
• Protection of resources with the choice of building materials for transport infrastructure and areas	• The proportion of recycling material used for road surfaces is 100 %

The quantitative quality goal corresponds closely with the goal for land use of only building new roads if sealing is removed from an equal area elsewhere. The materials removed from old roads should be recycled and reused for the new construction.

Interlinkages with other dimensions are described in the research project with examples for the economic dimension.

5.2 Economy

5.2.1 Commercial traffic

Since commercial road traffic has increased disproportionately over recent years, making it increasingly difficult to avoid traffic jams and delays, a priority goal for commercial traffic is to ensure that the distances travelled and environmental pollution are as low as possible, for example by measures to use loading capacity as efficiently as possible.

Figure 15: Quality goals for the field Commercial traffic

Quality goals	
descriptive	**quantitative**
• Ensuring the most efficient commercial transport possible with minimum environmental impacts	• No quantification possible

5.2.2 Local production and consumption of foodstuffs

Figure 16: Quality goals for Local production and consumption of foodstuffs

Quality goals	
descriptive	**quantitative**
• Production of foodstuffs close to consumers in order to avoid transport and to shift traffic use towards the environmental options (walking, bike, bus)	• No quantification possible

The aim of the quality goal is to produce and market foodstuff close to the consumer. This is not only of benefit in reducing and transferring traffic, but is also beneficial for near-natural agriculture.

Interlinkages with other dimensions are described in the research project with examples for the environmental dimension.

5.2.3 Cost truth

Cost truth is of considerable importance for the development of sustainable mobility. However, it is hardly possible to influence this at regional or local levels. The only option available to directly influence costs locally is with charges for parking. At the regional level it may be possible to influence the costs for public transport. Initial experience in Germany with tenders for services show that it is possible to achieve the same standards for lower prices, or improved standards for the same price. The cost truth for comparisons between private and public transport can therefore converge from two directions and open new possibilities for local transport planning.

Figure 17: Quality goals for the field Cost truth

Quality goals	
descriptive	**quantitative**
• No hidden subsidies for private transport (for the individual user)	• No quantification possible

Interlinkages with other dimensions are described in the research project with examples for the environmental and social dimensions.

5.3 Social

In the social dimension of sustainable mobility, goals are to be defined for Securing necessary mobility for all, Quality of streets as places for rest and recreation, Traffic avoidance in urban development and health and welfare.

5.3.1 Securing necessary mobility for all

Securing mobility for all means that the transport of socially disadvantaged groups must also be ensured. It means that if possible everybody should be able to use public transport. This requires that vehicles run regularly, at acceptable prices. Furthermore, there are requirements regarding comfort, punctuality, bus stops, cleanliness and safety.

In addition to public transport, pedestrian traffic and cycling are also important for securing mobility for all. These are also two forms of movement that are virtually free of emissions. Nor is it necessary to seal additional surfaces for pedestrians and bicycles. They therefore meet the demands for sustainability and can in particular contribute towards reaching the quality goals of the environmental dimension.

5.3.1.1 Public transport

The definition of the quality goals for public transport involves three fields:

- Widespread access

- Actual availability (frequency, routing, connections)
- Comfort and service

A quality goal should be that public transport should be readily accessible from all sources and destination points. The characteristic quantity for this is the access radius around a stop. A radius of 300 m in inner-cities and 400 m in suburbs and small towns[48,49] are accepted and widely used values. In various transport development plans and noise abatement plans (e.g.[50]) a radius of 150 m is used in built-up areas. In the sense of strict sustainability a radius of 150 m is used for central stops in towns and cities, and 300 m in small towns and rural areas.

The real availability of public transport is the result of frequency, routing, and connections. As a quality goal, it is proposed that it should be possible to reach destinations for certain basic purposes by public transport within a reasonable time. For routes and frequencies it is not possible to define any absolute quantitative quality goals. Instead, intermediate goals are set. In addition to these fixed details for normal services, it is also possible to develop flexible services as an alternative for times and areas where there is low demand.

Figure 18: Quality goals for the field Public transport

Quality goals	
descriptive	**quantitative**
• Establishing a good and fairly distributed public transport system	• 100% coverage of all destination and source points • Access radius of a stop 150 m in towns and cities, 300 m in small towns and rural areas
• Good accessibility by public transport of destinations necessary for basic functions	• Definition of frequencies for work-days: Inner-city: Every 5 minutes Towns: Every 10 minutes Small towns, suburbs: Every 20 mins. Rural regions: Every 30 minutes.[51] Augmented with special services
• Provision of comfortable infrastructure facilities for public transport with information system and modern vehicles	

Interlinkages with other dimensions are described in the research project with examples for the economic and environmental dimensions.

5.3.1.2 Bicycle mobility

In order for bicycles to make their full contribution it is important to have a comprehensive, functional and convenient infrastructure for cyclists. Quality goals are therefore the extent of the bikeway network and high-standard network for cycling. Additional infrastructure is also necessary, such as special sign-posting, bicycle stands.

Figure 19: Quality goals for the field Bicycle mobility

Quality goals	
descriptive	**quantitative**
• Comprehensive network for cycling	• No quantification appropriate

48). BSV 2000, p. 49.
49). VORNEHM 1994, p. 48.
50). PRR 1995.
51). For further quantitative quality goals see: VÖV 1981, p. 16.

• High quality network for cycling, of sufficient width and with additional infrastructure	• Width for conventional bikeways[52]: One-way: 2.50 m Two-way : 3.00 m

The specified widths are for bike lanes along conventional streets allowing for bikes overtaking and passing each other. Other provisions - such as dedicated bikeways, bike-only streets, access through pedestrian zones, traffic-calmed areas, etc.) also fulfil the quality goals described without the need for quantitative goals to be formulated.

5.3.1.3 Pedestrian traffic

It is assumed that a sufficient network of pavements is available. The question is then primarily whether these are wide enough, suitable for the disabled, and with sufficient provisions for safe crossing at regular points. Since everybody goes on foot for at least a part of every journey, everybody can benefit from provisions for pedestrians. Quality goal is a complete footpath network of a high standard.

Figure 20: Quality goals for the field Pedestrian traffic

Quality goals	
descriptive	**quantitative**
• Complete network for pedestrian traffic	
• High standard footpath network, sufficiently wide	Footpath width: 3.50 m • 2.50 m (Minimum standard) • With combined mobility and open space functions: 6.00 m

The quality goals apply for the minimum footpath width in cases where two people with bags pass (2.50 m), a pair meet with a third pedestrian (3.50 m), or where there are leisure activities on pavements (6.00 m).

5.3.1.4 Modal split

The modal split is a parameter that reflects the long-term effects of a sustainable mobility development within an existing system. It describes the means of transport that are selected, that is whether people's behaviour is more or less sustainable. This is based on all measures in all areas. The goal here is an environmentally-acceptable modal split, in order to achieve a steady shift from the use of private vehicles to the environmental mix. The quantitative goal gives the target values derived from the quality goals in Switzerland (e.g. Zurich 30 % private / 70 % environmental mix). The quantitative quality goal distinguishes between small, medium and large settlements. On the basis of investigations[53], the intermediate quantitative targets are expressed in terms of the ownership of private cars.

Small town, rural area:	500 cars/1000 inhabitants
Towns, city suburbs:	400 cars/1000 inhabitants
City, conurbation:	300 cars/1000 inhabitants

52). UBA 1997a, p. 35.
53). SPERLING/VAUBAN e. V./ÖKO-INSTITUT e. V. 1999.

Figure 21: Quality goals for the field Modal Split

Quality goals	
descriptive	**quantitative**
• Environmentally acceptable modal split	• Proportion of environmental mix (for internal trips) in the modal split: Cities and conurbations 70 % Towns, suburbs 60 % Rural areas 50 % • No. of cars registered /1000 inhabitants: Cities / conurbations 300 cars Towns, suburbs 400 cars Rural areas 500 cars

5.3.2 Quality of roads and streets as places for rest and recreation

The quality of public spaces along streets and roads as places for rest and recreation determines to a considerable extent the quality of a district. Streets and places should be maintained or restored as social spaces for people, or newly created. The key factors in this respect are the allocation of space in streets to various uses, and the traffic load and the resultant noise levels.

The allocation of road space is subject to economic, ecological, and spatial constraints which must be taken into account when formulating the quality goals. For this reason the individual widths of bikeway, pavement, and the minimum road width, and other desirable components such as green areas, cannot be added to form the definition of a new quality goal. The space would rarely be available in any built-up area.

The ideal places to spend time are places or streets that are free from traffic, but also areas with effective traffic calming measures are used extensively in particular by children for playing. It is therefore desirable that there should be the highest possible proportion of these types of street.

In addition to the traffic burden, other important criteria for the assessment of the quality for recreation are the width on either side of the road, the waiting times when crossing the road, the quality of the paving, the trees and the volume of green.[54]. Although there is some controversy about a general goal definition - both qualitative and also quantitative - involving the presence of trees, and this is usually rejected in particular by representatives of agencies for the protection of historic monuments, it is important to take into consideration the character that greenery can give to a district. As a quality goal it was therefore specified that green elements should be present - in particular in the form of trees.

The evaluation of infra-red aerial images of Berlin's inner-city showed that a spacing of 13 m between trees lining streets is appropriate for trees, and compatible with the image of the city. This has been incorporated in a corresponding city planning recommendation[55], and has been adopted here as a quantitative quality goal.

Other, non-quantifiable and subjective factors, including aesthetic and visual elements also influence the perceived quality of a street as a place to spend time. It is in the nature of the qualitative criteria of social mobility that they cannot be quantified.

54). BMRBS 1992, Part 5, p. 161.
55). PAUEN-HÖPPNER 1994, p. 54.

Figure 22: Quality goals for Quality of streets as places for rest and recreation

Quality goals	
descriptive	**quantitative**
• Appropriate layout of streets in residential areas	• Ratio of width available for pedestrians, cyclists, green strips and landscaping to the width for cars in residential areas at least 1.0 (i.e. 1 : 1)[56]
• High proportion of pedestrian areas and areas with traffic calming	• No quantification possible
• Urban speed limits $\leq$ 30 km/h	• Speed limit 20 mph on all urban roads
• Trees and other green elements along streets giving it character	• 15 trees (both sides) per 100 m of street

Interlinkages with other dimensions are described in the research project with examples for the economic and environmental dimensions.

5.3.3 Traffic avoidance in urban development

Settlement structures have a considerable influence on mobility and the generation of traffic. For new planning and the re-planning of existing settlement areas, special attention should be paid to questions of site allocation, the allocation of uses, and the density of construction. In particular when it comes to planning business parks and similar sites, the demands of the companies on the transport infrastructure and the location of the company should be harmonised by specific intervention in the allocation of sites. In The Netherlands, for example, the ABC Method [57] has been developed, which follows the principle of grouping trade and industry in terms of its accessibility requirements and to arrange the transport infrastructure to suit their profiles.

Another way of reducing traffic levels is the strategy of ease of access and short trips. In particular, housing, supply of daily goods, and leisure and recreation should be near one another. The creation of a town with short trips requires above all a mix of different uses in a compact settlement structure, with development of the central area, so that people can meet a variety of basic needs in one vicinity, or at least without generating high levels of traffic. The quality goal must be reflected both in at the level of urban development planning and transport development planning as well as at the level of detailed planning.

Figure 23: Quality goals for the field Traffic avoidance in urban development

Quality goals	
descriptive	**quantitative**
• Strategic planning of business areas with an allocation of uses in accordance with the demands they make on the transport infrastructure (e.g. with the ABC method)	• No quantification possible
• Mixed uses in the planning of new settlement areas (easy access)	• Maximum walking distance to supply outlets for everyday goods: 600 m (equals about 10 mins walk)

Interlinkages with other dimensions are described in the research project with examples for the economic and environmental dimensions.

56). IWU 1994, p. 51
57). APEL/STEIN 1998, Chap. 3.3.9.4.

5.3.4 Health and welfare

Maintaining human health and welfare is the highest of human endeavours. In the consideration of sustainable mobility the safety of the so-called weaker members of society in inner-city traffic are treated as a priority. The fields of action are the creation of sufficient convenient and safe crossing points on all streets and roads that are not suitable for mixed use (> 2000 cars/24 hours), and the introduction of blanket speed limits in towns of 20 mph.

Figure 24: Quality goals for the field Health and welfare

Quality goals	
descriptive	**quantitative**
• Maintaining health and welfare	• 0 % killed , 0 % injured
• *Intermediate goal: Convenient and safe opportunities to cross streets*	
• *Intermediate goal: Low speed limits in all built-up areas*	• *Speed limit on roads in built-up areas 20 mph*

Interlinkages with other dimensions are described in the research project with examples for the economic and environmental dimensions.

5.4 Institutional

5.4.1 Planning instruments

Suitable for the integration of sustainability goals are firstly informal planning and programme that are not established in legislation. These include in particular traffic development planning, which should be developed taking the specified sustainability goals into consideration, or communal environmental development plans.[58]

Secondly, sustainability goals as listed in previous dimensions can be achieved by including requirements in zoning plans. In particular the goals of traffic avoidance in urban development or mixed uses and efficient use of land for infrastructure could be achieved by inclusion in zoning plans.

Figure 25: Quality goals for the field Planning instruments

Quality goals	
descriptive	**quantitative**
• Integration of goals of sustainable mobility in urban planning, transport planning, and environmental planning (e.g. traffic development plan, Noise abatement plan, Local traffic plan)	• No quantification appropriate
• Inclusion of environmentally compatible building and transport strategies in zoning plans	• No quantification appropriate

Interlinkages with other dimensions are described in the research project with examples for the environmental dimension.

58). SURBURG 2000, UVP-report 1/2000, p. 25 - 29.

5.4.2 Transparency of communal actions

The transparency of the actions of local administrations is a precondition for the acceptance of political decision by the public. Transparency does not only mean the early presentation of political plans but also the accessibility of data. The results are cooperation between the administration and public.

The need for the early public presentation of political plans and proposals means that PR work is of considerable importance for the success of sustainable traffic planning. The point is not the number of information events held for the public, nor the quantity of paper that is distributed, but the quality and honesty with which planning intentions are presented. Public opinion must be based on detailed, well-presented information. Political interests and the subjective views of individuals should not dominate the process. The ways in which members of the public can influence planning must be clearly defined.

Figure 26: Quality goals for the field Transparency of communal actions

Quality goals	
descriptive	**quantitative**
• Carrying out a soundly-based PR campaign • Allowing access to all local authority data	• No quantification appropriate

5.4.3 Public participation

The idea of sustainability requires early public participation, possibly in "new forms". These could include:

- Round tables:
- Future workshops:
- Public surveys :
- Future conferences, public discussion forums:
- Reports by or on behalf of lay groups and individuals:
- Transfer of communal tasks:

Figure 27: Quality goals for Public participation

Quality goals	
descriptive	**quantitative**
• Public participation in planning processes	• No quantification appropriate
• Support for public forums and action groups of the Local Agenda 21	• No quantification appropriate

Interlinkages with other dimensions are described in the research project with examples for the economic and social dimensions.

5.5 Summary of the goal system

The quality goals introduced in this chapter are summarised below in Chapter 3.

6 Indicator system for sustainable mobility

Members of the public and decision-makers at the local level should be able to use simple indicators to assess their local authority with respect to the extent to which sustainability targets have been reached.

Depending on the area in question, the following two indicator structures can be used:

- The indicator shows the percentage of cases for which the quality goal has been reached (Example: 80% of residents are exposed to noise levels at night below that which would disturb their sleep)

- The indicator shows the percentage of cases for which the quality goal has been reached and in addition the degree and frequency of deviations (Example 80% of residents are not exposed to noise levels at night that disturb their sleep, for 10% this level is exceeded by at least 10 dB(A), for 5% by at least 15 dB(A))

In the second and third cases above an indicator should then be used that gives more detail than the S-Indicator. This usually involves more investigation input, and probably qualified personnel. But it is then possible to find out in detail how far away from the quality goal one is. In particular these indicators are usually able to show spatial variations, so that priorities can be set for a strategy of action. These indicators are referred to here as "**Differentiated Indicators**" (D-Indicators).

The indicators give the extent to which goals have been reached, i.e. the percentage of cases that have reached the quality goals. Various reference values are required which should be readily available as a data set:

- Number of inhabitants
- Overall surface area of the local authority
- Settled area
- Total area of traffic infrastructure
- Total length of streets
- Total area of all streets

When selecting the indicators the availability of data plays a crucial role. In the interests of quality results and cost reduction, it is advisable to base the indicator system on the database available in the local community (D-indicators).

If the required data is not available, then it is necessary to use a survey method that can also be applied by Agenda 21 initiatives. The screening indicators obtained using these simpler methods lead to straight yes/no responses (quality goal met / not yet met).

6.1 Ecology/Environment

6.1.1 Noise

The quantitative quality goals clearly specify what is required of the indicators in the field of Noise. It is necessary to monitor all the given exposure levels.

When calculating noise then it is necessary to include the traffic level (vehicles/day), the proportion of goods vehicles, the travelling speeds, road surfaces, and the road construction. A simplified screening indicator is provided by the daily traffic load in combination with the maximum permissible speed and the quality goal of 65 dB(A). However, it is then only possible to assess within limits the effect of measures, since other parameters such as reductions in vehicle emissions are not included.

D-Indicator: Proportion of residents with mean outdoor noise levels below 45 dB(A) at night (threshold for disturbed sleep), < 55 dB(A) by day outdoors (impaired communications, < 65 dB(A) tags (health hazard)

The length of the corresponding sections of road can be used as an alternative indicator.

S-Indicator: Proportion of roads in residential areas with loads not exceeding 2000 vehicles / day and a speed limit of 20 - 30 mph

Proportion of roads in residential areas with loads not exceeding 4.000 vehicles / day and a speed limit of not more than 20 mph

(Corresponds to outdoor noise levels during the day below 65 dB(A) (health hazard threshold)

This simple S-Indicator can be calculated by means of a four-hour afternoon survey (3.00 p.m. - 7.00 p.m.) and the count is then multiplied by 3.5 [59] to obtain a full-day count. This is not difficult for members of the public or the administration to carry out.

These indicators relate only to road noise. Addition noise pollution from rail traffic or aeroplanes should be considered descriptively.

6.1.2 Air

The quantitative quality goals in this case also provide clear criteria for the identification of indicators, such as threshold levels of exposure.

D-Indicator: Proportion of residents exposed to NO_2 levels below 1.9 μg/m³ (annual mean) or below 10 μg/m³ in rural areas (annual mean) or below 25 μg/m³ in conurbations (annual mean)

Proportion of residents exposed to annual mean soot levels in air of less than 0.8 μg/m³

The length of the corresponding sections of road can be used as an alternative indicator

The levels of harmful airborne substances should be monitored continuously at various locations. This involves considerable amounts of equipment. However, once these are available, the continuous measurements do not entail too much work. In order to establish sustainability indicators it is possible to use alternative or additional methods for calculating the exposure to pollution, such as the CITAIR program developed for the Federal Environmental Agency.

59). FGSV 1992.

6.1.3 Fossil fuels and climate

The measurements for the indicators recommended by experts in the literature

- CO_2 emissions by traffic in kg pre inhabitant per annum [60] [61]
- Per-capita use of fossil fuels by motor traffic [62]

are not usually carried out at local level, but nationally. It makes no sense to interpolate these results locally, since this could not describe the local progress defined as the quality goal, but only the effects at the local level of the overall development in Germany.

In large municipalities it is possible to determine the intensity of road vehicle traffic and the CO_2 emissions with emission factors (see for example the CITAIR program developed for the Federal Environmental Agency). Then the development of CO_2 emissions can be used directly as an indicator.

D-Indicator: CO_2 emissions [tonnes/inhabitant p.a.] of traffic

For small and medium-sized authorities which are not able to afford the costly procedures on a regular basis, a simple indicator is more appropriate. Since the CO_2-emission is roughly proportional to fuel burnt in car engines, the consumption of fuels can be used as an indicator.

S-Indicator: Fuel sold [tonnes/resident] (as total or with diesel separately, if appropriate with calculated CO_2 emissions) in the area in question

Fuel sales can be established by surveying petrol stations or though the local authority.

6.1.4 Land use and surface sealing

The quantitative quality goals provide the criteria for establishing indicators for the development of land use, and 'measuring' the development a land areas under use and surface sealing.

- Proportion of total area that is sealed or used for transport[63]
- Proportion of total area that is sealed[64]
- Actual increase in sealed and transport area [hectares per annum][65]
- Actual increase in the degree of soil sealing [66]

It is also possible to allocate "used areas" to people as "land users".

- Residents per hectare of road area [67]
- Sealed road surface per resident [m²/resident][68]

As indicator it is possible to use the road surface area per resident. Since it can be difficult to determine the actual area covered by roads in built-up areas, the length of the streets system can be used as an indicator.

60). DEUTSCHE UMWELTHILFE 2000.
61). BLACH/ IRMEN 1999.
62). ÖKO-INSTITUT e.V. 1999.
63). DEUTSCHE UMWELTHILFE 2000.
64). DEUTSCHE UMWELTHILFE 2000.
65). BBR 1999.
66). BBR 1999.
67). DEUTSCHE UMWELTHILFE 2000.
68). BSV 2000.

S-Indicator: Road area per inhabitant in comparison with the quality goal (7 m²/ resident)
Alternatively: Length of road per inhabitant [km per capita])

In order to determine the data for this indicator all the transport areas in the community should be evaluated regarding their degree of sealing (e.g. this will differ between a paved area on sand and an asphalt-covered road). Such an evaluation is very time-consuming. However, in future landscape plans will increasingly cover all the local authority area, so that the necessary information will be available.

D-Indicator: Increase (or decrease) in the actual degree of sealing [%] as a result of traffic and transport measures

6.1.5 Nature conservation

In order to determine the extent to which roads cut through sites and to establish minimum distances to be observed from areas that should not be disturbed, it is necessary to have the expert assessment of ecologists.

On the basis of specifications from landscape ecology about the minimum size of certain types of biotopes, it is possible to define the minimum distance that certain types of disturbance should have from such sites, and also to demonstrate the effects of roads cutting through sites for various types of organism, as well as to determine the areas of sites enclosed by transport routes [69].

6.2 Economy

6.2.1 Commercial traffic

In local authorities or regions with infrastructure for various types of transportation, then as an indicator, the distribution of goods between the various modes of transport would sow the degree of sustainability of commercial transport.

D-Indicator: Modal split of commercial traffic

Determining this indicator involve extensive surveys and interviews with business companies, and would involve a considerable input.

6.2.2 Foodstuff production close to the consumers

In order to give members of the public or Agenda Initiatives an idea of the distances covered by goods, a certain range of goods can be examined from time to time. For example, on a walk round a market, traders could surveyed to determine the overall number of goods on offer in comparison to the number of goods from the region. This can be used to determine the proportion of regional supplies of fruit or vegetables, etc.

6.2.3 Cost truth

The quality goal for this field is only described. Therefore no indicator is specified.

69). BLACH/IRMEN 1999.

6.3 Social

6.3.1 Ensuring necessary mobility for all

6.3.1.1 Public transport

This goal field is the one with the most detailed proposals for indicators in the indicator systems already developed. In accordance with the quality goals defined, three areas must be distinguished for the evaluation of the quality of public transport:

- Area coverage
- Real availability
- Comfort

The measure for the indicators here is reaching the quantitative quality goals:

- Area coverage :
  The defined quality goal is related to the number of residents with access to public transport. The numbers of people living within a radius of 150 m from a stop in cities and towns and within a 300 m radius in towns and rural regions [%] [70] must be determined as accurately as possible (ideally for each building). This can be very time consuming.

  D-Indicator: Proportion of inhabitants in a 150 m radius around stops in cities and large towns and in a 300 m radius in all other settlements [%]

  Therefore as a reference value for the S-Indicator the settlement area is used. This can be determined using a street map and a pair of compasses very easily.

  S-Indicator: Proportion of the settlement area within 300-m from a public transport stop [%][71]

- Real availability :
  The achievement of the quality goals can be checked by members of the public on the basis of timetables. However, it would only be possible to check all public transport services for smaller towns. In larger towns, the tests would have to be restricted to selected routes (e.g. in key settlement areas).

  S-Indicator: Observance of the quality goals for public transport frequency [% of the length of line]

This S-Indicator takes into consideration the local features of each community. Changes in service frequency as a result of new timetables can easily be determined. However, an objective comparison with other communities is hardly possible.

- Comfort

In comparison with the other two factors, comfort is less important within the context of public transport. But the quality goal does refer to the appreciation of the public transport service in the community and it is also easy for the lay-public to test. Therefore an additional S-Indicator (e.g. proportion of stops up to standard, proportion of buses with low entry points, average age of vehicles) can check that the quality goal is reached.

70). DEUTSCHE UMWELTHILFE 2000.
71). BBR 1999.

6.3.1.2 Bicycle mobility

In the literature, the indicators for the assessment of the quality goal "Network for bicycle mobility" refer only to the overall length.

- Length of bike lanes and bikeways compared with the length of all roadways[72] [%]
- Per capita length of cycle network [m per resident][73]
- Length of the cycling provisions in accordance with Public Highway Regulations (StVO) of 1997 [km][74]

As the S-Indicator, allowing comparisons between communities, the per capita length of cycle network in comparison to the overall road network is chosen, since this can be determined easily using a street map. and changes in the network can just as easily be taken into consideration. Since there are not usually separate provisions for cyclists in low-speed limit areas and areas with traffic calming, these should be included in the calculation or noted separately.

S-Indicator: Length [km] of cycle network (including 20 mph zones and areas with traffic calming) as a proportion of the entire road network

If there is to be a detailed evaluation of the existing infrastructure, then it is a good idea to classify cycling provisions in accordance with Public Highway Regulations (StVO). The length [m] and proportion [%] of the various classes can then serve as the D-Indicator, and this can be checked at regular intervals.

D-Indicator: Length [m] and percentage of the overall network [%] of the officially designated bicycle routes, and streets with traffic calming and reduced speeds

6.3.1.3 Pedestrian traffic

Parallel to cycle mobility, quality goals were also formulated for pedestrian traffic. In previous indicator systems, this aspect was usually ignored. The only aspect considered was safety crossing the road [number of crossing aids][75]. Since these are already very common, it does not represent a useful criterion for assessing quality goals. In addition to safety, the key aspect is to increase to attractiveness of walking. Therefore the width of the footpath is chosen for the indicator.

The quality goals relating to footpath width were defined in terms of user needs. Since these are not easy to determine for members of the public or Agenda Groups, a simple S-Indicator was proposed of a minimum width of 2.50 m.

S- Indicator: Proportion of the total pathway network (including paths other than pavements and also pedestrian zones) with a minimum width of 2.50 m [%]

In order to receive detailed information, before using a D-Indicator it is necessary to classify all streets in terms of the needs of pedestrians in each case. Three categories are distinguished [76] (cf. quality goals):

72). DEUTSCHE UMWELTHILFE 2000.
73). BBR 1999.
74). ARBEITSGRUPPE LOKALE AGENDA 21 DER CARL VON OSSIETZKY UNIVERSITÄT OLDENBURG 1998.
75). ARBEITSGRUPPE LOKALE AGENDA 21 DER CARL VON OSSIETZKY UNIVERSITÄT OLDENBURG 1998
76). SRL/FUSS e.V. 2000

A: Main shopping areas with space for window-shopping, play, and communication areas, play equipment, benches, waiting areas at public transport stops, in addition to pedestrian use: width of pavement 6.00
B: Important pedestrian traffic axis: pavement width 3.50 m to allow two people to pass by a third person
C: Other pavements: Minimum width 2.50 m to allow pedestrian carrying baggage to pass by each other

This then gives the following D-Indicator:

D-Indicator: Proportion of the pathways with a minimum width of 6.00 m (A), 3.50 m (B) or 2.50 m (C) [%]

6.3.1.4 Choice of means of transport - Modal split

The quality goals defined in 1.3.1.3 require that the modal split consist to 70 %, 60 % or 50 % of the environmental mix, depending on the size of the community, and include a straight yes / no indicator (goal achieved or not achieved).

If the goal has not been fully achieved, it is possible to determine the degree of progress, and by determining the modal split at regular intervals it is possible to obtain clear information about the development towards more or less sustainable mobility. Determining the modal split does involve a lot of work, especially when household interviews are involved, so that it can only serve as a D-Indicator unless such investigations have already been conducted in the recent past.

D-Indicator: Proportion of environmental forms of mobility (including shared transport) in the modal split, deviation from target value

Simple screening indicators are frequently cited in this context such as

- Number of cars /1000 inhabitants[77,78] or
- Number of car registrations /year. [79]

However, when using the number of cars /1000 inhabitants as S-Indicator the emphasis should not be on the number as such, but on its evaluation in relation to the quality goals, differentiated according to the size of the community, so that the indicator here also indicated the degree to which the goals has been achieved

S-Indicator: Deviation of the number of cars /1000 inhabitants from the target value [%]. (Target value : Small towns and rural areas: 500 cars/1000 inhabitants, towns and suburbs: 400 cars/1000 inhabitants, cities and conurbations: 300 cars/1000 inhabitants

By regularly determining the indicator, the developments in the community can be observed, which helps the Agenda-Initiatives to see if progress is being made on the way towards shifting the modal split.

77). FEST 2000
78). ARBEITSGRUPPE LOKALE AGENDA 21 DER CARL VON OSSIETZKY UNIVERSITÄT OLDENBURG 1998.
79). HAPPE 1999.

6.3.2 Quality of roads and streets as places for rest and recreation

The quantitative quality goal, a ratio of width of footpath, bikeway, and green verge to the actual road width of at least 1.0 (1 : 1) in mainly residential areas, sets a straight yes / no indicator for reaching this goal. The progress made towards the goal can be seen from the ration of streets that fulfil and do not yet fulfil the requirements.

D-Indicator: Proportion of roads through predominantly residential areas with a ratio of width of pavement, bikeway and green strip to actual road surface of at least 1.0 (1 : 1) [%] for all roads with mainly residential character

The goal of "a higher proportion of areas with traffic calming measures or where motor vehicles are excluded" leads naturally to an indicator that expresses the corresponding proportion in relation to the overall road area in the community:

D- Indicator: Proportion of overall road area with traffic calming measures or exclusion of motor vehicles [%][80]

In order to calculate this proportion correctly, it must be related to the overall area, that is not only the length of roads but also the width. However; since this involves a considerable amount of work with surveys and calculations, when the work is done by members of the public or Agenda Initiatives, the street length can be used as an S-Indicator instead:

S-Indicator: Proportion of length of overall road network where traffic calming measures and have been introduced or where cars are excluded [%]

Corresponding to the quantitative quality goal the trees along roadsides have to be counted. This can be established fairly easily and accurately (e.g. using aerial photographs), so that it can serve as both S- and D-Indicator:

S- and D-Indicator: Length [m] or proportion [%] of roads with at least 15 trees /100 m

6.3.3 Traffic avoidance in urban development

Since the defined quality goal for the planning of commercial area cannot be measured, and simple yes / no indicator is proposed, which shows whether a community has a way of designating commercial land under aspects of sustainability (e.g. ABC-method):

S-Indicator: Is a suitable method used for the sustainable designation of land for commercial uses? (For example ABC-Method).

In order to check the quality goal of ease of access and short trips it is possible to look at the quantitative goal formulations for new planning of settlement areas, since the existing areas in the community will hardly be able to change the existing mix of uses. As a test for the existing situation regarding sustainable urban development, however, it is possible to check the quality goal for existing settlements. A simple test can be carried out by the Agenda-Initiatives, if the area of the settlement within a 600 m radius to supply outlets is used rather than the number of residents:

S-Indicator: Proportion of settlement area within a 600 m radius of retail outlets for every-day goods [%]

D-Indicator: Proportion of inhabitants within a 600 m radius of retail outlets for every-day goods [%]

80). DEUTSCHE UMWELTHILFE 2000

Regular determination of the indicator value can show whether the urban development is moving towards more sustainability.

6.3.4 Health and welfare

Accepted indicator for this area is the number of accident victims [fatalities /1000 inhabitants][81] or the number of accidents involving injuries [82].

Indicator: Number of severely injured traffic accident victims per 1000 inhabitants
Number of deaths in traffic accidents per 1000 inhabitants

Various demands have been raised to ensure that roads can be crossed conveniently and safely, though these are in part contradictory and involve different indicators:

- Increase in the number of crossing aids
- Shorter waiting times for pedestrians
- Safer traffic light cycles for pedestrians

It is possible to carry out complicated calculations of the suitability of urban roads for crossing (cf.[83]), but these exceed the framework of Local Agenda 21. Therefore no indicators are given for this area.

The introduction of reduced speed limits in built-up areas (30 km/h) is expressed in the literature either in relation to the overall area of the community or to the overall transport network:

- Proportion of reduced speed limit areas in settlement area [%][84]
- Length of reduced speed limit zones [km] in relation to overall road network [%][85]

However, the link to the settlement area makes little sense in terms of improving road safety, since this would not take into account all the roads with normal speed limits. The considerations should also take into account other roads with different forms of speed reduction.

S-Indicator: Proportion of the all roads with reduced speed limits, or traffic-calming [% of total road length]

Since the local administration has the statistics about length and types of road, the indicator can be determined by the administration or by Agenda-Initiatives, so that it is classed as an S-Indicator.

81). BBR 1999.
82). ÖKO-INSTITUT e.V. 1999.
83). BSV 2000.
84). BBR 1999.
85). ARBEITSGRUPPE LOKALE AGENDA 21 DER CARL-VON-OSSIETZKY-UNIVERSITÄT OLDENBURG 1998.

6.4 Institutional

6.4.1 Planning instruments

Since the quality goals only involve the use of existing planning instruments, it is only possible to use **yes / no indicators**, as responses to the following questions:

- Is there an integrated traffic development plan, yes/no?
- Is there a noise abatement plan, yes/no?
- Are there local authority standards for the sustainable development of zoning plans, yes/no?

6.4.2 Transparency of communal actions

Since quantification of the quality goals is not sensible in this sector either, yes/no indicators are used in answer to the following questions:

- Is public participation also carried out even when this is not legally required, yes/no?
- Is there effective cooperation between local administration and the public (Agenda initiatives), yes/no?
- Do all members of the public have access to all the local authority data, yes/no?
- Is the success of the actions of local authorities evaluated, yes/no?

6.4.3 Public participation

The quantification of public participation by means of indicators must be viewed critically. In the literature, the following indicators are priorities

- Number of participation processes [86,87,88]
- Sum of the funds made available [89]
- Number of active participants in the Agenda 21 process [90] or the
- Numbers of hours of input [91]

but these reveal nothing about the quality of participation. Obviously however there is considerable interest in demonstrating the participation and the satisfaction with the scope for participation by means of indicators, because in addition to those already mentioned there are many other proposals:

- Number of information activities of the administration [92]
- Number of members of public questioned about their satisfaction [93]
- Number of plebiscites [94]
- Number of articles about the Local Agenda 21 in the local press[95]

86). FEST 2000.
87). ARBEITSGRUPPE LOKALE AGENDA 21 DER CARL-VON-OSSIETZKY-UNIVERSITÄT OLDENBURG 1998.
88). BBR 1999.
89). BBR 1999.
90). BBR 1999.
91). FEST 2000.
92). BBR 1999.
93). BBR 1999.
94). ARBEITSGRUPPE LOKALE AGENDA 21, CARL-VON-OSSIETZKY-UNIVERSITÄT OLDENBURG 1998.
95). FEST 2000.

Despite the wide range of suggested indicators, no indicator is selected for this area, because the evaluation of the quantity allows no statement about the quality.

7 Summary of the goal and indicator catalogue

The goal and indicator system for sustainable mobility can be summarised in tabular form as follows:

Field	Quality goals		Indicators	
	descriptive	**quantitative**	**S-Indicator**	**D-Indicator**
Noise	• No traffic noise which can lead to an increased risk of cardiovascular illness	≤ 65 dB(A) outdoors during the day	• Proportion of roads in residential areas with loads not exceeding 2000 vehicles / day and a speed limit of 20 - 30 mph • Proportion of roads in residential areas with loads not exceeding 4000 vehicles / day and a speed limit of not more than 20 mph.	• Proportion of residents with noise levels below the health quality limit (≤ 65 dB(A) during the day, (The length of the corresponding sections of road can be used as an alternative indicator).
	• No traffic noise that can disturb sleep	≤ 45 dB(A) outdoors at night		• Proportion of residents with noise levels below 45 dB(A) (The length of the corresponding sections of road can be used as an alternative indicator).
	• No disturbance of outdoor communication including roads by road traffic noise	• Outdoors ≤ 50 dB(A) during the day [96] • public space ≤ 55 dB(A) during the day		• Proportion of residents with noise levels below 55 dB(A) on pavements and in public spaces (The length of the corresponding sections of road can be used as an alternative indicator).

96). UBA 1985.

Field	Quality goals		Indicators	
	descriptive	quantitative	S-Indicator	D-Indicator
Air	• No health threat due to low-level ozone, nitrogen oxides or volatile organic compounds.	Exposure levels [97]: • Nitrogen dioxide(NO_2): 1.9 µg/m³ (Annual mean) • *Intermediate goal: 10 µg/m³ rural areas (annual mean), 25 µg/m³ conurbation (annual mean)*		• Proportion of residents exposed to NO_2 levels below 1.9 µg/m³ (annual mean) or below 10 µg/m³ in rural areas (annual mean) or below 25 µg/m³ in conurbations (annual mean) (The length of the corresponding sections of road can be used as an alternative indicator)
	• No carcinogenic threat due to traffic emissions			
	• *Intermediate goal: Maximum carcinogenic load not higher than in rural areas (1 : 5 000)*	Exposure level [98]: *Soot: 0.8 µg/m³ (annual mean, long-term goal) and 4,0* µg/m³ *(annual mean, short-term goal)*		• Proportion of residents exposed to annual mean soot levels in air of less than 0.8 µg/m³ and less than 4,0 µg/m³ (The length of the corresponding sections of road can be used as an alternative indicator)
Fossil fuels and climate	• *Intermediate goal: Contribution of local communities to climate protection and the reduction of CO_2 emissions*	*Emission percentages:* • *Reduction of CO_2-emissions by 12 % for the period 2001 to 2005* • *Reduction of CO_2-emissions by 25 % for the period until 2025*	• Fuel sold [tonnes/resident] (as total or with diesel separately, if appropriate with calculated CO_2 emissions) in the area in question	• Annual CO_2-emissions [t/resident] by traffic

97). Procedure in accordance with 23. BImSchV, Annexes I + II
98). Measurements in accordance with 23. BImSchV, Annexes I + II and TA Luft.

Field	Quality goals		Indicators	
	descriptive	**quantitative**	**S-Indicator**	**D-Indicator**
Land use and surface sealing	• Careful use of land	• Road area per inhabitant ≤ 7 m^2 (after [99])	• Road area per inhabitant in comparison with the quality goal (7 m²/ resident) (OR: Length of road per inhabitant [km per capita])	
	• *Intermediate goal: No additional use of land for transport infrastructure without compensation elsewhere, with improvement rather than new construction and compensation of increases in one place by reduction in another* • Best use of existing transport infrastructure with traffic guidance and control	• *Ratio of new construction (sealing) to removal 1 : 1*		• Increase (or decrease) in the actual degree of sealing [%]
Nature conservation	• Keeping a sufficient distance between roads and valuable biotopes or areas of scientific interest	• Minimum distance away from biotopes or areas of scientific interest (see Annex 1)		
	• Linking of open spaces to form large areas and no further intersecting	• Minimum area for animal species (see Annex 2)		
Use of materials and resources	• Protection of resources with the choice of building materials for transport infrastructure and areas	• The proportion of recycling material used for road surfaces is 100 %		
Commercial traffic	• Ensuring the most efficient commercial transport possible with minimum environmental impacts	• No quantification possible		• Modal split of goods transport

99). IWU 1994.

Field	Quality goals		Indicators	
	descriptive	quantitative	S-Indicator	D-Indicator
Local production and consumption of foodstuffs	• Production of foodstuffs close to consumers in order to avoid transport and to shift traffic use towards the environmental options (walking, bike, bus)	• No quantification possible		
Cost truth	• No hidden subsidies for private transport (for the individual user)	• No quantification possible		
Securing necessary mobility for all				
Public transport	• Establishing a good and fairly distributed public transport system	• 100% coverage of all destination and source points • Access radius of a stop 150 m in towns and cities, 300 m in small towns and rural areas	• Proportion of the settlement area within 300-m from a public transport stop [%]	• Proportion of inhabitants in a 150 m radius around stops in cities and large towns and in a 300 m radius in all other settlements [%]
	• Good accessibility by public transport of destinations necessary for basic functions	• Definition of frequencies for work-days: Inner-city: Every 5 minutes Towns: Every 10 minutes Small towns, suburbs: Every 20 mins. Rural regions: Every 30 minutes .[100] Augmented with special services	• Observance of the quality goals for public transport frequency [% of the length of line]	
	• Provision of comfortable infrastructure facilities for public transport (see Annex 3), with information system and modern vehicles			

100). For further quantitative quality goals see: VÖV 1981, p. 16.

Field	Quality goals		Indicators	
	descriptive	quantitative	S-Indicator	D-Indicator
Bicycle mobility	• Comprehensive network for cycling	• No quantification appropriate	• Length [km] of cycle network (including 20 mph zones and areas with traffic calming) as a proportion of the entire road network	• Length [km] and proportion of entire network [%] of the various cycle way types defined in the highway regulations (StVO), 20 mph zones, and traffic-calmed areas
	• High quality network for cycling, of sufficient width and with additional infrastructure	• Width for conventional bikeways[101]: One-way: 2.50 m Two-way : 3.00 m		
Pedestrian traffic	• Complete network for pedestrian traffic			
	• High standard footpath network, sufficiently wide	• Footpath width: 3.50 m • 2.50 m (Minimum standard) • With combined mobility and open space functions: 6.00 m	• Proportion of the total pathway network with a minimum width of 2.50 m [%]	• Proportion of the pathways with a minimum width of 6.00 m (A), 3.50 m (B) or 2.50 m (C) [%]
Modal Split	• Environmentally acceptable modal split	• Proportion of environmental mix (for internal trips) in the modal split: Cities and conurbations 70 % Towns, suburbs 60 % Rural areas 50 % • No. of cars registered /1000 inhabitants: Cities / conurbations 300 cars Towns, suburbs 400 cars Rural areas 500 cars	• Deviation of the number of cars /1000 inhabitants from the target value [%] • *(Target value : Small towns and rural areas: 500 cars/1000 inhabitants, towns and suburbs: 400 cars/1000 inhabitants, cities and conurbations: 300 cars/1000 inhabitants*)	• Proportion of environmental forms of mobility (including shared transport) in the modal split, deviation from target value

101). UBA 1997a, p. 35.

Field	Quality goals		Indicators	
	descriptive	**quantitative**	**S-Indicator**	**D-Indicator**
Quality of roads and streets as places for rest and recreation	• Appropriate layout of streets in residential areas	• Ratio of width available for pedestrians, cyclists, green strips and landscaping to the width for cars in residential areas at least 1.0 (i.e. 1 : 1)[102]		• Proportion of roads through predominantly residential areas with a ratio of width of pavement, bikeway and green strip to actual road surface of at least 1.0 (1:1) [%]
	• High proportion of pedestrian areas and areas with traffic calming	• No quantification possible	• Proportion of all roads of streets where traffic calming measures and have been introduced or where cars are excluded [%]	• Proportion of overall road area with traffic calming measures and exclusion of motor vehicles [%]
	• Urban speed limits ≤ 20 mph	• Speed limit 20 mph on all urban roads		
	• Trees and other green elements along streets giving it character	• 15 trees (both sides) per 100 m of street	• Length [m] or proportion [%] of roads with at least 15 trees / 100 m	• Length [m] or proportion [%] of roads with at least 15 trees /100 m
Traffic avoidance in urban development	• Strategic planning of business areas with an allocation of uses in accordance with the demands they make on the transport infrastructure (e.g. with the ABC method)	• No quantification possible	• Is a suitable method used for the sustainable designation of land for commercial uses? (For example ABC-Method).	
	• Mixed uses in the planning of new settlement areas (easy access)	• Maximum walking distance to supply outlets for everyday goods: 600 m (equals about 10 mins walk)	• Proportion of settlement area within a 600 m radius of retail outlets for every-day goods [%]	• Proportion of inhabitants within a 600 m radius of retail outlets for every-day goods [%]

102). IWU 1994, S. 51

Field	Quality goals		Indicators	
	descriptive	**quantitative**	**S-Indicator**	**D-Indicator**
Health and welfare (traffic safety)	• Maintaining health and welfare	• 0 % killed, 0 % injured	• Number of severely injured traffic accident victims per 1000 inhabitants • Number of deaths in traffic accidents per 1000 inhabitants	
	• *Intermediate goal: Convenient and safe opportunities to cross streets*			
	• *Intermediate goal: Low speed limits in all built-up areas*	• *Speed limit on roads in built-up areas 20 mph*	• Proportion of all roads with reduced speeds, or traffic-calming [% of total road length]	
Planning instruments	• Integration of goals of sustainable mobility in urban planning, transport planning, and environmental planning (e.g. traffic development plan, Noise abatement plan, Local traffic plan)	• No quantification appropriate	• Is there an integrated traffic development plan, yes/no? • Is there a noise abatement plan, yes/no?	
	• Inclusion of environmentally compatible building and transport strategies in zoning plans (examples of Guidelines, see Annex 4)	• No quantification appropriate	• Are there local authority standards for the sustainable development of zoning plans, yes/no?	

Field	Quality goals		Indicators	
	descriptive	**quantitative**	**S-Indicator**	**D-Indicator**
Transparency of communal actions	• Carrying out a soundly-based PR campaign • Allowing access to all local authority data	• No quantification appropriate	• Is public participation also carried out even when this is not legally required, yes/no? • Is there effective cooperation between local administration and the public (Agenda initiatives), yes/no? • Do all members of the public have access to all the local authority data, yes/no? • Is the success of the actions of local authorities evaluated, yes/no?	
Public participation	• Public participation in planning processes	• No quantification appropriate		
	• Support for public forums and action groups of the Local Agenda 21	• No quantification appropriate		

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Richtlinien

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