# MOTIVATIONS FOR LOCAL CLIMATE PROTECTION MEASURES IN THE TRANSPORT SECTOR

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## ABSTRACT

The goals of this contribution are to disclose the motivations of cities which underlie their climate protection strategies in the transport sector and to analyze the influence of city-specific factors on the associated decision-making processes. A most similar systems design is used for case studies in three major German cities (Frankfurt, Stuttgart, Munich), which have differently advanced climate protection programmes in the transport sector. Our research revealed that the main motivation for local measures which contribute to climate protection in the transport sector is rarely the reduction of GHG emissions. Local problems are dominating transport policies. We notice that cities are not always aware of specific local factors and of how these factors influence the outcomes of their transport policies. Another very important lesson learned from our analysis is that the methods for measuring and comparing the success of urban climate protection need substantial progress.

*Keywords: urban transport, climate change, cities, policy, mitigation*

## INTRODUCTION

The ongoing urbanisation processes in all regions of the world have been subject to research and planning practice for a long time. As one quintessence of the evidence gained about urbanisation (increasing share of population living in cities in the future, cities as centres of social and technological progress, etc.), it can be stated that the development of the cities strongly determines the development of the whole world in the 21st century. This is also the case for the issue of climate change mitigation. Transport is one of the areas which account for a major share (roughly 20%) of the worldwide greenhouse gas (GHG) emissions. And it is an area which could, theoretically, be effectively addressed by mitigation actions in cities as the high concentration of dwellings and workplaces favours non-motorized transport modes and the provision of attractive and efficient public transport services. Thus, although being often regarded in their role as major polluters (due to the concentration of people and

industries), cities and their development are rather a chance to establish efficient and effective measures for climate change mitigation (Dodman 2009).

However, compared to other areas, efforts in reducing GHG emissions in the transport sector have not been very successful so far. A prevailing car-oriented understanding of mobility, which is also spreading in developing and emerging countries as they become wealthier, is quoted as the main cause for the failing of climate change mitigation in the transport sector (Chapman 2007, Miranda/da Silva 2012). Additionally, it is often stated that - despite the existing knowledge of urban climate change mitigation options in the area of transport and best practice guides - it would be important for cities to find their own personalized strategy to reduce GHG emissions taking into account their specific factors, such as their unique conditions and problems (e.g. Banister 2011, Marsden/Stead 2011). Yet, the question remains unanswered, which exactly those factors are and how they do or should influence local GHG reduction strategies.

The first goal of this contribution is to disclose the motivations of cities which underlie their climate protection strategies in the transport sector. As climate change is a global problem and the contribution to GHG emission reduction is a typical “commons” problem (Lutsey/Sperling 2008), we assume that cities have individual motivations for their strategies which are based on local factors. In a comparative case study with three cities in Germany we analyze city-specific factors and their influence on the motivation for local climate protection strategies and on the associated decision-making processes in the transport sector as well as the outcomes thereof in form of (more or less effective) GHG mitigation measures. Thus, we try to identify the reasons for strengths and weaknesses of GHG mitigation strategies and we give recommendations on how to improve the process of strategy formulation taking into account the city-specific factors.

This article is structured as follows: In section two, our approach for identifying and classifying city-specific influencing factors - based on Ostrom’s IAD framework - is presented. Subsequently, we compare strategies and measures for climate protection taken in the three examined cities and we assess the climate-friendliness of the cities with regard to urban transport. In the following two sections, we present results from a literature review and expert interviews regarding the underlying motivations in the cities and influencing city-specific factors. Based on that, we discuss several issues discovered, such as a very limited comparability, missing links between actions and evaluation instruments and different motivations for GHG mitigation strategies. Implications for strategy improvements, necessary mind shifts and further research are given in the conclusions.

The contents of this article are based on the results of an ongoing, interdisciplinary research project at Technische Universitaet Darmstadt (TU Darmstadt) which investigates the policies and politics of climate change mitigation in several fields of interest conducted by researchers from the field of economics (housing, energy efficiency), social sciences (regional governance, politics of climate change, competition and cooperation between cities) and engineering (urban development, transport). This project is funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation).

# THEORETICAL CONCEPT AND METHODOLOGY

## Background and Motivation

The incitements for conducting this research project on climate protection policies in cities are the aforementioned negative developments of the GHG emissions of the transport sector and a research gap concerning city-specific factors which influence GHG mitigation actions in cities and the underlying motivations.

In the transport sector, improvements in drive technology (e.g. more efficient engines, electric vehicles) and alternative fuel have been indentified to have the biggest potential to reduce GHG emissions. Though, neither is vehicle technology an area that can be addressed by local policies nor is it sufficient to reduce the total $CO_2$ emissions to the necessary extent (Chapman 2007). An analysis of the GHG inventories of German cities reveals that despite the diffusion of more efficient engines, which reduce the emissions per distance travelled, the total $CO_2$ emissions in the transport sector have risen or remained almost unimproved in the last years (see below). In developed countries such as Germany or other European countries where at least larger cities usually offer good alternatives to individual motorised transport in form of well established public transport systems or bicycle networks the savings through improved technologies are overcompensated by a rising number of vehicle miles travelled, especially in the area of commercial traffic. New concepts in logistics and also consumer behaviour are the drivers of the developments in commercial traffic (IEA/OECD 2009: pp. 272). As regards private trips within cities, slight improvements towards a more climate-friendly mobility (using modal share as an indicator) can be observed for some cases (as observed e.g. in the examined cities in this case-study). On the other hand, modern lifestyles in affluent societies are usually connected with a high mobility budget regarding trip length, an increasing number of leisure trips, and large-distance trips (Millard-Ball/Schipper 2011, Holden 2007: pp. 3). Even though these issues concern transport outside cities to a large extent, the situation in cities is far away from being consistent with GHG mitigation goals.

This contribution emphasizes the role of city-specific factors for the implementation of climate protection measures. It is often pointed out that a city should adapt GHG mitigation strategies to fit local conditions (see above). It seems obvious that cities cannot just copy measures from a set of best-practice guidelines or other cities´ strategies but they have to choose actions and tailor programmes which fit to their individual characteristics. What is missing so far is a systematic and comprehensive analysis of (1) which of those city-specific factors are relevant for local transport policies and (2) how they can influence the implementation of GHG reduction strategies, actions and outcomes. With regard to formal and technical aspects, the influence of specific factors can be straightforward: For example, a hilly topography is usually unfavourable for the usage of conventional bicycles and therefore should be taken into account if the promotion of cycling is intended. Superordinate legislation can be an obstacle for the implementation of specific measures: For example, a congestion charging is not possible for German cities under current legislation. The interrelations between political and socioeconomic factors and climate protection actions and their success

are more complicated. These factors do not only influence the outcomes but also the formulation process of action plans and policies.

We go further and postulate that in each city there is a unique prevailing understanding of how mobility in the city should look like, of existing problems in the area of transport, and of possible solutions fitting to the problems. This understanding is usually (unconsciously) shared by a majority of political actors and also citizens. It is a reflection of all city-specific factors as a whole.

This holistic understanding is of special importance as city governments have to frame their climate protection programmes in a local context since climate change is a common global problem (see above). Even if there are binding national targets for cities to reduce their GHG emissions, it is still necessary to derive a mitigation strategy which e.g. will allocate certain reduction targets to the different sectors (transport, energy supply, heating, etc.); this process is based again on the aforementioned common understanding and interpretation of problems, relevant actors, solutions, etc.

## Hypotheses and Objectives

In the area of transport, our main objective is to find explanations for the mostly ineffective strategies of cities to reduce GHG emissions in the transport sector and to formulate recommendations for a more successful implementation of climate protection programmes. Based on our concepts which highlight the importance of city-specific factors and understandings, we also aim to improve the transport planning process to allow a more distinctive consideration of individual characteristics of the cities.

Our main working hypothesis to be disproved has been formulated in a provocative way: The motivation behind local climate protection programmes in the transport sector is not primarily to reduce GHG emissions but more to improve the outside image of the city and to raise self-legitimation, i.e. to present the city as future-oriented and liveable. As a consequence, the actions contained in the programmes are not a very effective selection for the respective cities to reduce GHG emissions. They reflect existing competences and forms of problem-solving which are based on city-specific factors and common understandings of mobility. In order to implement more effective strategies it is hence not only important to adapt the programmes much better to the circumstances of the specific city but it is also necessary to identify “deficiencies” in the city-specific common understandings which constrain the formulation of effective GHG mitigation strategies.

The basis for our hypotheses are observations and experiences we gained in previous numerous research and consulting projects in German cities. In particular, we observed that (1) despite different organisational structures, political programmes and constellations we could not identify an overall outstanding city in terms of GHG mitigation; (2) that the cities´ transport administrations were very busy with dealing with very concrete and local problems such as traffic noise or congestion; (3) that single outstanding transport policies could mostly

be traced back to the efforts of one person or a small group of actors in local administrations, which we consider as a city-specific factor.

From our working hypothesis we derived four research questions for the first phase (see below) of our analysis.

1. Are there significant differences between the investigated cities regarding GHG mitigation actions which are widely put into practice?

2. What is the performance of the investigated cities regarding GHG mitigation in the transport sector?

3. What is the influence of local climate protection programmes on that performance, i.e. which actions are implemented to reduce GHG emissions in the first place and which actions are initiated by local climate protection programmes?

4. Which city-specific factors influence the implementation and the performance of local climate protection programmes in the transport sector and how is this influence exerted?

## Methodology

In order to address the broad spectrum of disciplines and theories within the research project, the IAD-framework developed by Elinor Ostrom (Ostrom et al. 1994) is used as a brace for the whole interdisciplinary research group. It must be mentioned that for our purpose we do not regard the framework as an explanatory model for local policies. Neither, our approach is related to the rational choice institutionalism, the paradigm the IAD framework was originally developed for. We are using the framework in a rather simple manner to structure and coordinate the work of the research group. The advantages of the framework for our project are (1) that city-specific factors can be systematically allocated to the given attribute groups; (2) that it can clearly be enhanced to fit to our approach; (3) that it is unspecific enough to address all involved disciplines and (4) that the framework is well known across the involved disciplines and therefore appropriate for interdisciplinary research.

In the IAD-framework (see figure 1) the outcome of the decision-making process is influenced by factors which are divided into three groups: **Attributes of the physical world** are in our case factors such as the existence of severe environmental impacts of traffic (noise, pollution) or special infrastructure. **Attributes of the community** can be constellations in city politics or the membership of cities in topic-specific networks/commodity teams. **Rules in-use** are formal and informal standards of conduct, i.e. legally binding superordinate laws but also, for example, agreements on when and to which extent traffic models are used for planning purposes.

We extend the model by two elements. As explained above, we do not understand the city-specific factors as influencing decisions and outcomes of cities' GHG mitigation policies

separately, but they are forming an understanding which reflects the cities' characteristics as a whole. This understanding translates problems and policy options into the local context. Secondly, we add a fourth category of **attributes of the actors** highlighting the assumed importance of important actors or groups of actors and their qualitative characteristics (education, political power, integration in networks etc.), factors which Ostrom originally assigned to the "attributes of the community". Actors may have influence on attributes of the community (e.g. administrative structures) but they can also be influenced by the city-specific factors.

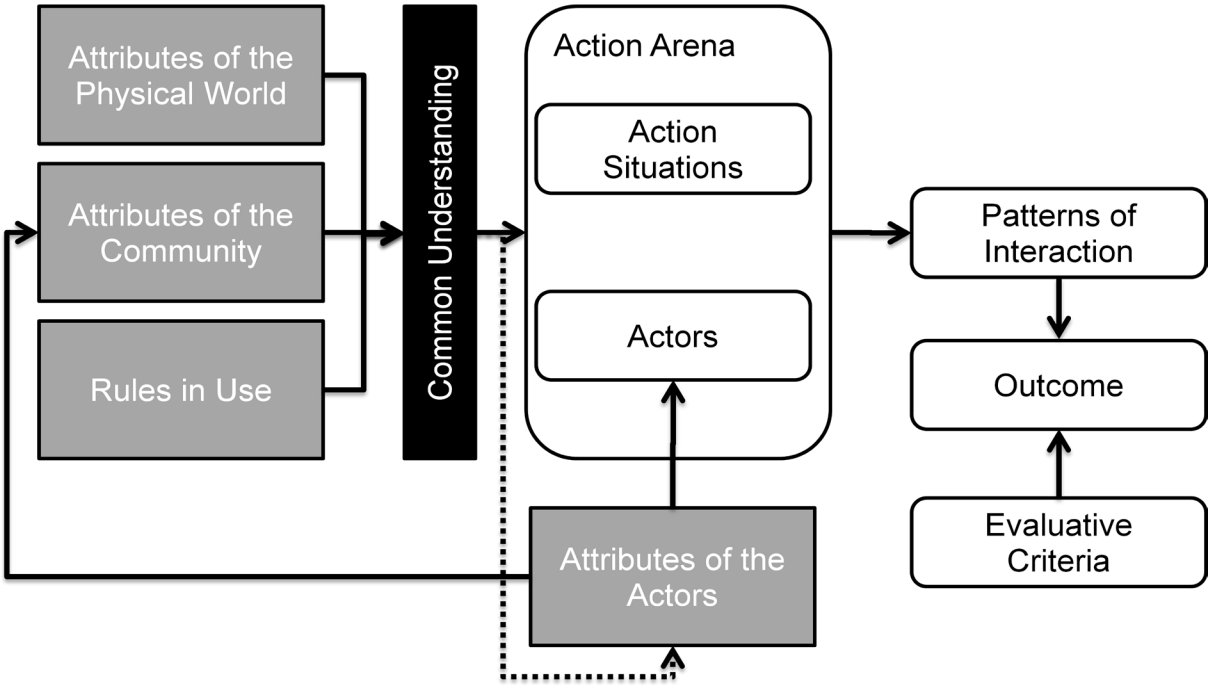


Figure 1 – Adapted IAD-Framework, source: Ostrom et al. (1994)

The adapted IAD-framework forms the basis for our analyses in the three study cities.

## Project Structure

The research project follows a small-N case-study design. The German cities to be analysed – *Frankfurt am Main*, *Stuttgart*, and *Munich* - are most similar cases with a significant variation of the dependent variable, i.e. the cities are of similar size, importance, financial power etc. However, they pursue different policies regarding mitigation of GHG emissions. The dependent variables for the sample were the climate protection programmes. The differences in reality and the outcome of the programmes are subject to our research.

The first phase of the project is structured as follows (figure 2): As a first step, we conducted an in-depth analysis of all important official documents of the cities on transport and climate protection. These include climate protection programmes, transport master plans, public transport master plans, environmental protection and sustainability programmes, and other documents related to climate protection. In all three cases, the cities are embedded in regional planning associations. Therefore, related regional documents were examined, too.

The time frame was chosen from the 1990s until today, though it should be mentioned that most climate protection programmes were published after 2000, and that master plans are updated only in large intervals. Hence, most of the documents reviewed were published between 2005 and today. The goal of this step was to identify which actions cities take to reduce GHG emissions in the transport sector, what the scope of these actions is, and what the reasons are for taking these actions (and why other measures are not utilised). In parallel, possible city-specific factors were derived from theory, literature, and the document analysis. The documents were also scanned for key figures which allow for performance measurements of each city regarding reduction of GHG emissions and for possible interview partners.

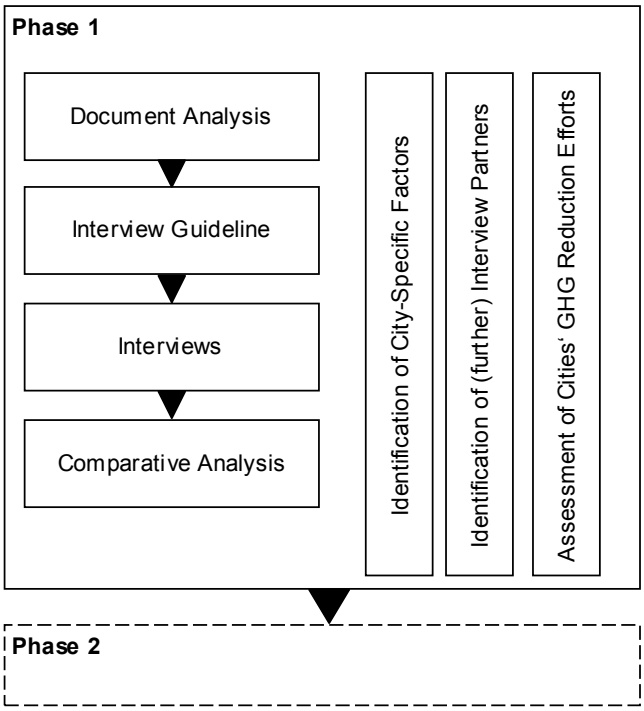


Figure 2 – Project Structure

Based on the results of the document analysis and the adapted IAD-framework, a common interview guideline was developed. The guideline covers all identified areas of possible influencing factors and all involved scientific disciplines. Thus, interviews conducted by researchers from one discipline provide information for the whole group, and the results are comparable. A first series of 12 interviews was held with administration officials, representatives of local interest groups, and external experts in each of the three cities.

The results were systematically compared and are the basis for the second phase of the project, in which - inter alia - a second series of interviews, a network analysis, and a detailed analysis of the qualities of important actors are planned. The results of the first phase are presented in the following sections of this article.

# CLIMATE PROTECTION IN THE STUDY CITIES

## The Study Cities

Before comparing their GHG mitigation efforts, the three cities are portrayed briefly.

*Frankfurt am Main* is the fifth largest city in Germany (680,000 inhabitants). It is located at the centre of the polycentric Rhein-Main region (app. 5.5 million inhabitants). Due to its central position in Germany, *Frankfurt* is the main German transport hub (road, rail and air transport). It is Germany's financial centre but also location of numerous companies from other industries. *Frankfurt* was among the last three candidates for the European Green Capital award 2012.

*Stuttgart* is the capital of the Federal State of Baden-Württemberg and the main centre of Germany's automotive industry. It is the sixth largest city in Germany (610,000 inhabitants) and has a very hilly topography, which leads to problems for the transport network as well as for the environmental situation (see below). *Stuttgart* is the centre of a metropolitan area with 5.3 million inhabitants, to which it is institutionally connected through a commonly elected legislative and administrative regional body.

*Munich* (1.35 million inhabitants) is the capital of the Federal State of Bavaria, Germany's third largest city and one of its most important cultural and commercial centres. It is the major transport hub in southern Germany for road, rail and air transport. The city is relatively compact with a flat profile and a rural urban hinterland.

## Applied Strategies to Reduce Transport-related GHG Emissions

As mentioned above, the three cities superficially pursue different climate protection strategies. The key aspects of these strategies are outlined here before we discuss possible preliminary answers to the research questions.

*Frankfurt* has been publishing climate protection programmes since the 1990s. However, the transport sector has not been addressed in these programmes so far. The last version (IFEU 2008) solely states the need to include the transport sector and it provides a first GHG inventory of this area (see below). The analysis of other relevant documents revealed multiple actions of the city contributing to reduce GHG emissions. Examples are the acquisition of efficient natural-gas and electric vehicles for the city-owned fleet, the extension of the transit network and programmes to promote cycling and low-carbon neighbourhoods. But most of these actions are being taken by different actors (transport association, urban planning department, municipal utilities), and in the related documents almost no linkage to climate protection is given. The actions neither seem to be coordinated. The observations of a previous study (Kern et al. 2005) on local climate policies in general are confirmed: climate protection in *Frankfurt* is almost exclusively driven by the energy department, whose actions concentrate on energy efficiency of buildings. This is also apparent in some documents on

transport published by the energy department in which GHG reduction is misleadingly mixed up with the reduction of particulate matter pollution. Nevertheless, the city was one of the finalists for the European Green Capital award in 2012. Although almost no explicit motivations regarding GHG emissions in the transport sector are visible in official documents, pursuing other compatible goals can definitely help to protect the climate, too. An outcome-based evaluation of the cities' climate protection achievements is therefore necessary (see following chapter).

The City of *Stuttgart* was a pioneer in including the transport sector in a local climate protection programme. The first edition of 1997 already came up with detailed assessments of effectiveness and costs of a wide range of measures. The city has built up an own department called "climatology" with a long lasting expertise in issues of local air pollution due to its problematical topography. The core of the city is surrounded by hills from three cardinal directions, which negatively effects air exchange. This specific factor is also emphasized frequently in official city documents. Although local air pollution issues can also have other implications than the reduction of GHG emissions, the climatology department is in charge of this field as well. Other relevant city documents (transport master plan, environmental goals) are well coordinated with the climate protection programme. Regarding transport, the programme itself includes primarily measures to promote cycling, to improve the attractiveness of public transport, and soft measures such as establishing an agency providing consulting on mobility issues for citizens. Measures such as an intensified extension of the transit network and services are not recommended referring to the high costs (City of Stuttgart 1997). Other actions (e.g. improved signal coordination for better traffic flow) do not seem to be motivated by climate protection efforts in the first place (see section on interview results). For *Stuttgart*, the analysis of official documents provides several indications on the motivations for local climate protection measures. Only in a few cases is climate protection is the main reason for taking an action, even if all listed measures help to reduce GHG emissions. The documents are quite honest regarding additional costs which the city is not willing to bear in order to reduce GHG emissions.

*Munich* published its first integrated climate protection programme in 2010. Singular issues concerning climate protection had already been addressed before. The contents for the transport sector are largely based on a non-binding study of 2004 (Öko-Institut e.V. 2004) which proposed a catalogue of different measures to reduce GHG emissions in the transport sector. The main actions included in the programme are again the promotion of cycling through constructional and soft measures, the extension of the transit network, and the usage of fuel-efficient vehicles (cars but also trams), and energy-efficient traffic lights in the municipal stock (City of Munich 2010). Other documents, e.g. the transportation master plan, do not refer to the programme as they were mostly published earlier. However, we could only find few references to climate protection in these documents. A special feature in *Munich* is the set-up of a local climate alliance with topic-specific forums in which local companies and interest groups can discuss climate change issues. In a later stage, members of the climate alliance will have to set-up and reach GHG reduction goals in order to keep their membership.

For a systematic summarising classification of the local strategies we use the CUTE-matrix (Comparative Study on Urban Transport and the Environment) (WCTRS/Institute for Transport Policy Studies 2004) complemented by the categories for types of local engagement for climate protection introduced by Bulkeley/Kern (2006), which accentuate the role of the city for each measure (table 1).

Table I – CUTE Matrix

| CUTE MATRIX | | Strategies | | |
|---|---|---|---|---|
| | | Avoid | Shift | Improve |
| | | Reduce transport demand | Reduce emissions per unit transported | Reduce emissions per kilometre |
| Role of the City | Self-governing | | | • efficient city-owned vehicles (f,S,M) (cars, buses, trams, collection vehicles)<br>• energy efficient traffic lights/ street lightning (M) |
| | Governing by authority | • low carbon neighbourhoods, traffic calming (f,S)<br>• transit oriented development (m) | • bicycle route network development (f,S,M)<br>• parking management (S, m) | • extend speed monitoring (S)<br>• improve traffic flow (ITS, signal control, infrastructure) (S)<br>• promotion of electric vehicles (f,S,m) |
| | Governing by provision | | • transit development/ acceleration (f,S,M)<br>• attractive transit fare programmes (e.g. employee ticket) (f,S)<br>• improve transit accessibility (S)<br>• increase/ improve car and/ or bike sharing facilities (S, m) | • install natural gas filling stations (f) |
| | Governing through enabling | • car-free days (f)<br>• personal mobility consulting, promote car pooling (S) | • cycling promotion (f,S,M)<br>• emission information in internet journey planners (m)<br>• promotion of climate-friendly leisure travel (m)<br>• | • driver education (fuel saving) (f,S) |

Explanation: (F/f) measure implemented in Frankfurt; Stuttgart (S/s), Munich (M/m)
S: measure included in climate protection programme
s: major measure included in other city programmes/plans or cooperations with third-party actors

All three study cities are members of the climate alliance of cities and obliged themselves to reduce their GHG emission to 50% of the 1990 value by 2030. For the transport sector, the cities rely to a large extent on the same measures. Although these measures contribute to the reduction of GHG emissions, this is often not explained in the official documents. This suggests that the motivations for the implementation of measures to reduce GHG emissions are primarily others than climate protection. It is interesting that all three cities strongly emphasize the promotion of cycling for intra-urban transport. Also *Stuttgart*, whose topographic profile is unfavourable for cycling has made strong efforts in this area and already won prizes for its cycling programme. A possible reason could be that cities consider

the promotion of cycling (or "Governing through enabling" in general) as an option that promises significant changes in modal split for relatively low investments.

After the analyses of the local plans and documents we can state that the existence and also the contents of climate protection programmes have only limited informative value for the achievements of the cities in reducing their GHG emissions. The programmes can include actions which were actually planned for other reasons. Although GHG emissions are reduced, this means that the additional benefit of the programmes can be mariginal and there is actually no change to the status-quo regarding the general transport policies and strategies of the cities. These implications were considered when designing the interview guideline to be further addressed in the interview phase.

In order to compare the cities and to draw conclusions about climate protection programmes and the underlying motivations it is necessary to first assess the cities' efforts. A possibility for a deeper "input-oriented" analysis would be a comparison of the financial resources used for climate protection measures. Yet, the complexity and opacity of municipal budget makes it almost impossible to allocate the spending to specific actions. Additionally, a clear distinction between measures to reduce GHG emissions and others would be necessary which again could lead to non-transparent results as many measures have multiple impacts on traffic and its environmental effects. We decided to compare the cities by indicators which measure the outcome of climate protection measures, which also raises several issues, as a next step.

The results of this assessment are of special interest against the background of the cities' strategies which turned out to be more similar than expected.

## Achievements in Climate Protection

A set of 8 indicators was chosen to describe the achievements of the three study cities regarding GHG emission reduction in the transport sector (table 2). The assessment of the climate friendliness of cities (or their sustainability in a broader sense) regarding transport is an own research field. Multiple indices and key indicators have been developed and are being discussed (Miranda/da Silva 2012). One problem is that cities use different methodologies to generate data (e.g. modal-split surveys, length of cycle routes), which leads to a limited comparability. On the other hand, there are standardized methods available which are often used to calculate GHG inventories and which should ensure comparable results. These methods, however, are derived from national GHG inventory methods, and they rely mostly on aggregated data which is often not available at the city level (Dodman 2009). This leads to a bias when comparing cities with these indicators as cities are partly unable to influence the input data (see conclusions).

As the problem of assessment cannot be solved within our project, we take 8 indicators to describe the climate friendliness of the cities. Even though one indicator alone may be biased, we think that with the whole set it is possible to draw a viable picture of the achievements of cities in climate protection. Some indicators may be correlated. Since the

data is not completely comparable and comes from different sources, values of related indicators can be confirmed. Data on the lengths of bicycle route networks were excluded due to obviously completely different measurements. All three cities have a very well developed and comprehensive public transport network.

Table 2 – Indicators for achievements in climate protection

| **Indicator** | **Frankfurt** | **Stuttgart** | **Munich** |
|---|---|---|---|
| $CO_2$ emissions per capita (transport related); city data | 2.4 t (2005)<br>2.6 t (1995) | 2.1 t (2010)<br>2.3 t (2005)<br>2.3 t (2000)<br>2.7 t (1995) | 1.7 t (2010)<br>1.7 t (2005)<br>1.6 t (2000)<br>1.5 t (1995) |
| $CO_2$ emissions per capita (road transport); federal state emission inventory (results for city) | 1.92 t (2005)<br>2.03 t (2000) | 1.23 t (2008)<br>1.34 t (2000) | n/a |
| Modal Split; city data<br>car / motorized %<br>transit %<br>bike %<br>walk % | 2008; 2003<br>34.0; 38.0<br>23.0; 23.0<br>13.0; 9.0<br>30.0; 30.0 | 2011; 1998<br>44.1; 45.0<br>24.2; 22.0<br>5.3; 6.0<br>26.4; 27.0 | 2008; 2002<br>37.0; 41.0<br>21.0; 21.0<br>14.0; 10.0<br>28.0; 28.0 |
| population density (per km² settlement area); federal statistics | 4,693 (2009) | 5,712 (2009) | 5,646 (2009) |
| commuters (in and out) per capita; own calculation based on federal statistics | 0.58 (2010)<br>0.54 (2000) | 0.43 (2010)<br>0.43 (2000) | 0.33 (2010)<br>0.33 (2000) |
| cost for public transport in € (monthly pass; single fare) | 78.50; 2.50 (2012) | 73.50; 2.60 (2012) | 66.40; 2.50 (2012) |
| heavy vehicle ban (city through traffic) | - (2012) | > 3.5 t (2012) | > 3.5 t (2012) |
| registered vehicles per 1000 inhabitants; own calculation based on federal statistics | 503 (2010)<br>581 (2005)<br>545 (2000) | 507 (2010)<br>598 (2005)<br>563 (2000) | 521 (2010)<br>631 (2005)<br>660 (2000) |

Considering the chosen indicators, *Munich* scores best of the three study cities. Transport related $CO_2$ emissions are the lowest in all used datasets, although the city has not been able to reduce them since the 1990s. The modal share of bicycle traffic has increased to a high level and the fraction of trips covered by motorized traffic has declined. Additionally, the number of commuters in *Munich* is relatively low, i.e. compared to the other cities many people working in *Munich* also live in the city (and vice versa). *Stuttgart* has the highest share of car use but has been able to reduce the transport related $CO_2$ emissions. *Frankfurt* has also been able to raise the modal share of bicycle traffic significantly. According to city

officials, the number of bike users is continuously growing with a current share of 14% for *Frankfurt* and 17% for *Munich*, but there are no official statistics available yet. The *Munich* cycling campaign was also highlighted in the interviews conducted in the city (see next section). *Stuttgart* was not able to overcome its disadvantageous topography. Despite the efforts made in the promotion of cycling the modal share of bicycle traffic remains static.

Another interesting point is that $CO_2$ emissions are rank-correlated with the number of commuters. The particular high number of commuters in *Frankfurt* also came up in the interviews. The number of registered cars has reached a similar level in all three cities. This number is used as a main input data in an in Europe widely used GHG inventory tool, which we consider as very problematic. Neither are the cities able to influence the number of registered cars nor does this number have to say anything about the climate-friendliness of the intra-urban transport (see conclusions).

We observed an admitted helplessness of the cities interpreting the development of the GHG emissions in the transport sector. All official documents conclude that without a major change in engine technology or in mobility behaviour only a small reduction of emissions is possible - far away from the 50% goal. The importance of technological improvements and the limited impact of city policies on GHG emissions in the transport sector are accordingly pointed out in the climate protection programmes, which is in line with current research results (see above).

Regarding the motivations of cities to implement climate protection programmes and the importance of those programmes the analysis of the given indicators cannot prove that longer running programmes or programmes with a wider scope lead to a better performance in GHG emission mitigation.

The information gained in the document analysis and the comparative assessment of the climate friendliness of the cities was the basis for the interviews conducted in the study cities. In these interviews, the preliminary results were to be reviewed and the role of city-specific factors for local climate policy was to be elaborated.

# INTERVIEW RESULTS

## Strategies

The statements given in the interviews confirmed the results of the detailed document analysis that the actions taken to reduce GHG emissions in the three study cities are more similar than the climate protection programmes suggested. All interview partners stressed the promotion of transit and non-motorized transport modes as very important measures. The increasing dissemination of e-bikes (interestingly counted among non-motorized modes) is considered as highly supportive in this respect and thus supported by the cities (see section on specific factors). However, there are mentionable particularities. *Munich* introduced a parking charge scheme which covers not only the city centre but also the inner

residential areas; sometimes, this scheme is also called the “Munich Congestion Charging”. The scheme was introduced in 1999 due to severe problems caused by parking commuter vehicles in residential and mixed-use areas. It was inter alia proposed by *Munich* University of Technology. The City of Vienna had introduced a similar concept which served as an example. The introduction of the area-wide parking charge caused a major shift from motorized individual transport to public rail transport in the hinterland-city relations. Interviewees in *Stuttgart* also credited road user charging in the city area with a high potential impact on modal choice and thus GHG emission reductions. Yet, a legal basis for the introduction of a local road user charge does not exist so far, which was criticised in the interviews.

Differences exist in the communication strategies. In *Frankfurt* and *Munich*, the interview partners pointed out their public participation initiatives. *Frankfurt* holds assemblies in order to inform about projects and to gather ideas from citizens. The main purpose is to raise the acceptance for transport-related measures and projects. A specific connection of the participation initiatives to climate protection cannot be observed. By contrast, the arrangements for public participation in *Munich* are explicitly designed to raise awareness and support for GHG emission reduction. Sponsorships of important actors for specific areas shall raise responsibility for reaching GHG reduction targets. In *Munich*, this organisational feature is well established in the city’s political system and also used in other policy fields (e.g. on transport related issues which are not regarded as relevant for climate protection (BMW Group/City of Munich 1995)).

## Motivations

Interviewees in all three study cities admitted that **climate protection is almost never the main reason for actions listed in the climate protection programmes.** Traffic problems with local impacts are clearly dominating in everyday business. Nevertheless, city officials in all three cities claimed to consider climate protection in their work wherever possible and that this can be actually a benefit of the programmes. The impacts or - in other words - the additional benefits of the climate protection programmes are assessed as low. Interviewees in *Frankfurt* even consider such concepts as unnecessary since modern local transport policies were climate-friendly anyway. In other interviews it is agreed that climate protection programmes contain to a large extent measures which were already planned before for other reasons and which are politically opportune. One interviewee revealed that the programmes are often utilized to get extra money for already planned measures pointing out positive effects on GHG emissions. Consequently, GHG reduction targets or actions plans are not used as an internal controlling tool in any of the cities. All interviewed persons also agree on the statement that the influence of local policies on GHG emissions in transport is very low.

The interviewees were asked why the cities are engaged in climate protection in general despite the low influence of local policies in the transport sector. In *Frankfurt* and *Munich* a positive public presentation of the city and its image as a liveable and leading city with ambitious standards also in an international context was named as a major motivation. Also, climate protection programmes are regarded as politically opportune in Germany. In

*Stuttgart*, the interviews revealed that *climate* is always associated with the concrete local air pollution problems. The problem of GHG emissions is integrated in this policy area of air pollution. Therefore, the motivation in *Stuttgart* is more tangible than in the other study cities.

Goal conflicts are identified by all interviewees with regard to political and economical interests. This is also a reason why preferably measures which "do not affect car drivers" are being implemented. For example, a road user charging in *Munich* is disclaimed by politicians pointing to the existing parking management scheme, although experts are recommending an implementation. Surprisingly, financing of measures is not a major issue in this context, which could be explained by the relatively good financial situation of the study cities compared to others in Germany and Europe. More technical goal conflicts between other environment-related goals and climate protection were only indentified by experts in *Stuttgart*. These conflicts came up due to rerouting effects caused by restrictions on inner city roads which are part of anti-pollution strategies. The city obviously practices a detailed emission and demand modelling in this field.

## Specific factors

The previous passages already presented information on the distinctive factors of the study cities which probably influence the climate protection policies and their outcomes. The interviews provided additional information from the perspective of local experts. The high number of commuters is considered as a major problem in the area of transport in *Frankfurt*. This appraisal is consistent with the statistical figures on the commuter per citizen ratio (see table 2). Other specific external factors were not explicitly mentioned in the interviews. Another factor, which was revealed in the document analysis, is the dominance of the energy department, which could explain the nonexistence of a climate protection programme in the transport sector (whether it may be necessary or not).

*Stuttgart* is the city with the most preeminent characteristics in this comparison. Many transport-related environmental problems arise from the topographic conditions which restrain air circulation. The city has had problems with air pollution since the automobile-boom in the last century, and therefore created a special administrative department for local air pollution issues. It became very clear in the interviews that due to this tradition all emission-related problems (including $CO_2$) are considered from the perspective of local air pollution (understanding). The climatology department is the key player in all questions concerning emissions and pollutions. It has exclusive knowledge and coordinates all actions in this area. The motivation for taking actions to reduce GHG emissions is always being connected to local air pollution issues. This constellation is favourable in the first place as the awareness for environmental issues in general is very high. The city was the first to set up a climate protection programme in transport. However, the blending of GHG emissions with local pollution problems can cause goal conflicts (see above). Another consequence of *Stuttgart's* hilly topography is that cycling throughout the city becomes inconvenient. Nevertheless, the city has put a lot of effort into the promotion of cycling and apparently ignored the factor of topography to some extent. There was almost no effect on the modal

share of cycling. The city now hopes that the dissemination of e-bikes will solve the problem ("With e-bikes, the city becomes flat.").

The other study cities were more successful in promoting cycling and considering city-specific factors in this field. The cycling campaign in *Frankfurt* is called "bike and business" and specially designed for employees working in the bank and service industry companies which are located in the city centre. The interviewees in *Munich* pointed out the compactness (see table 2) and flat topography of the city as a specific factor and that it was therefore especially suitable for cycling.

Another crucial point revealed in the interviews in *Frankfurt* and *Munich* is the importance of key players in the city administrations and their background. The head of the energy department in *Frankfurt* is the cities' main authority in all questions concerning climate protection. Employees of the transport administration stated that a mixture of employees with backgrounds in engineering and other sciences (namely geography) was favourable for addressing climate-related issues since non-engineers often had a better understanding for global or environment-related problems. In *Munich* similar statements were given. The cycling campaign is notably pushed by a geographer in the city administration. Engineers were attested to pursue generally a demand-oriented solution instead of aiming at influencing transport demand. After all, the assumed importance of key actors in our concept was confirmed in the interviews in *Frankfurt* and *Munich*.

# CONCLUSIONS AND OUTLOOK

The first phase of our research project revealed that the main motivation for local measures which contribute to climate protection in the transport sector is rarely the reduction of GHG emissions in the first place. Local problems are dominating transport policies. We assumed that climate protections strategies have to be reasoned in a local context. The local context in turn is dependent on specific characteristics of cities. The role of climate protection programmes for transport planning in the study cities turned out to be very limited. Their role consists mainly in supporting the cities' presentation as modern and liveable, in raising awareness for climate issues, and as an additional financial resource to implement already planned measures which also contribute to GHG emission reduction. The last two points are actually very favourable but, as the figures given in table 2 indicate, the contribution is not sufficient to sustainably reduce GHG emissions in the transport sector.

Our analysis also suggests that city-specific factors can influence the outcome of specific transport policies and that the awareness and consideration of such factors can lead to a more successful implementation. This is straightforward for relatively obvious factors such as topography or special socio-economic audiences in cities. The impact of factors such as the educational background of administration employees, which came up in the interviews, is more difficult to identify. The analysis of these impacts will be subject to the second phase of the research project.

An important conclusion at this point is that it is too easy to state that cities have to adapt generic climate protection measures to local conditions. Instead, we conclude that the cities themselves are not always aware of what their special characteristics are and how they influence the outcomes of their transport policies. In some cases, cities even neglect some specific external influencing factors (mostly belonging to the category “attributes of the physical world” in the IAD framework). The impact of internal factors such as administrative structures (“attributes of the community/actors”) is usually not taken into account at all, even if the possible impacts are known. The existence of a local understanding of specific issues could be observed most distinctively in *Stuttgart* where emission problems are always considered from the perspective of local air quality.

Another very important lesson learned from our analysis is that the methods for measuring the success of climate protection programmes need substantial progress. Today´s state of the art, the use of different unstandardised indicator sets or standardised GHG inventory methods, allows only limited evaluations of different strategies and comparisons of cities. More serious is the problem that current GHG inventory tools are not sensitive for most of the transport-related measures which can be implemented by cities (e.g. improvement of transit services). Therefore, these measures could eventually be regarded as not relevant to achieve the set reduction targets, measured in tons $CO_2$ per capita by the inventory tools. In fact, there is an incentive for cities to implement measures in other areas which directly influence the inventory but actually lead to lower GHG emission reductions. The cause leading to these issues is that the used inventory models are usually polluter-based, i.e. the emissions caused by citizens of a city are credited to the cities GHG stock, no matter where the emissions take place. However, cities are only able to influence the transport system on their own territory (for more information on these issues see Marsden/Rye 2010, Krause 2011). Therefore, using $CO_2$ reduction targets as a controlling instrument for administrations and thus increasing the importance of climate protection programmes is hardly possible. Possible reactions of cities to such misleading incentives will also be examined in the second phase of the research project. We will not be able to address the problem of the local GHG inventory models used but we strongly recommend a stronger engagement of research in this area to not leave this field to companies that sell black-boxes.

Although generalized conclusions from our case studies must be drawn very carefully, the results seem to be meaningful for many other cities which are trying to tackle their problems with transport-related GHG emissions. In addition to the examination of the aforementioned issues an increase of the number of cases for specific parts of the analysis is also aimed for in the second project phase. The authors are strongly motivated to continue their interdisciplinary research in this field and to learn more about the individual factors which influence the formulation and success of GHG reductrion strategies in different cities.

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## Major Documents Analysed

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Stuttgart: Climate Protection Programme (1997) and amendments (2000, 2002, 2007), Transport Development Plan (2010), Public Transport Plan (2009), City Development Concept (2006), policy proposals of external partners, various council decisions, city information brochures, city reports, internet documents, newspaper articles.

Munich: Climate Protection Programme (2010), Transport Development Plan (2006), Regional Public Transport Plan (2004), proposals and studies of external partners (2004, 2009), various council decisions, city information brochures, city reports, internet documents, newspaper articles.