URBAN SHRINKAGE AND CHANCES FOR ADAPTATION TO CLIMATE CHANGE

Final Report

Training School at Bauhaus Dessau Foundation, Dessau

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CONTENTS

LIST OF ABBREVIATIONS

C	**C**ity
CC	**C**limate **C**hange
CCA	**C**limate **C**hange **A**daptation
D	**D**ensity
F	**F**unction
Lu	**L**and **U**se
M	**M**orphology
MC	**M**icro-**C**ity (quarter, smaller unit than city)
SC	**S**hrinking **C**ity/**C**ities
T	**T**echnology

1. PREFACE: COST TRAINING SCHOOL: « URBAN SHRINKAGE AND CHANCES FOR ADAPTATION TO CLIMATE CHANGE » – DESSAU

In the context of the European COST Action 'Cities Regrowing Smaller' (CIRES) a training school was held in Dessau, Germany from September 17th till 21st in 2012. The training school 'Urban Shrinkage and Adaptation to Climate Change' was the successor of the training school 'Mapping Urban Shrinkage', which was held in Dortmund in 2011. Besides tying in with the topic of further opportunities and methods to create a map showing urban shrinkage in Europe the objectives calling for the training school were manifold. The training school offered a chance to find new ideas and methodologies in research and combination of two recent discourses in spatial planning – climate change and shrinking cities. This includes a (new) methodological approach by consolidation of ecological indicators and socio-demographic indicators, to find strategies to deal with climate change in shrinking cities, and to learn about regeneration strategies and focus on environmental issues. Furthermore the training school offered a platform for exchange between the participating Early Stage Researchers from different European countries on a wider range of topics, and enhanced the establishment of a European network of Early Stage Researchers in the field of Shrinking Cities.

The COST Action CIRES is a network of more than 60 European researchers working on the topic of urban shrinkage in Europe. As the shrinking cities phenomena – a result of demographic, economic, political and physical transitions – is nowadays widespread throughout Europe, it is a future challenge to deal with considerably less populated but nevertheless liveable cities. Hence, the COST Action aims to foster knowledge on regeneration strategies in shrinking cities across Europe. Combining the two discourses of shrinkage and adaptation to climate change has not yet been vastly intensified. Therefore the training school offered a platform for discussion and working on finding a solution to measure the chances shrinking cities hold for adaptation to climate change and possibly connect this information to mapping urban shrinkage in Europe. During the training school the attending Early Stage Researchers – from Austria, Germany, Italy, Poland, Spain, Switzerland and Russia – focused on categorizing the research areas important for adaptation to climate change with regard to shrinking cities and collected a first set of specific indicators describing each category. Besides workshops and lectures a field trip to Dessau was done as well.

The training school was hosted by Dr. Babette Scurrell (Bauhaus Foundation Dessau) supported by Sandra Schmitz (TU Dortmund). Gertrude Penn-Bressel (UBA) held a lecture on 'Demographic change and Land-Take for Settlements and Transport – Monitoring and Indica-

tors'. Dr. Mark Fleischhauer (TU Dortmund) spoke about his recent work dealing with climate change, urban adaptation and the inter-linkage between climate and demographic change (synergies, conflicts). Dr. Marco Pütz (Swiss Federal Institute for Forest Snow and Landscape Research WSL, Birmensdorf, Switzerland) informed about the economic impact of climate change, proper classification of the problems, the influence of local authorities, engagement of the citizens and their awareness of the problem he encountered during his work on the topic in Switzerland. A discussion, together with Prof. Philipp Oswalt (Bauhaus Dessau Foundation), on the general aspects of urban shrinkage and adaptation to climate change completed the scientific exchange between the trainees and the senior researchers.

Different points of interest and topics became clear during the discussions and group work. These relate to the individual interests of the participants as well as to the different national notations and definitions within the broad spectrum of climate change adaptation and chances borne by shrinking cities. Therefore one elementary step was to define and classify different spaces within the urban area. The main focus has been laid on "settlement and traffic areas" as they were mostly discussed during the debate on shrinking cities and their chances for adaptation to climate change. With regard to socio-economic data similar difficulties arose like in the first Training School. Although it became very obvious that a European wide unique monitoring of demographic change and land take is nearly impossible.

An intensive discussion with different experts on both topics additionally showed, that linkages between climate change adaptation needs and needs for dealing with demographic change and shrinking cities exist, so do relations between measures for climate change adaptation and demographic change measures. Therefore, adaptation to climate change is a key challenge for cities and urban development and interactions of urban (climate) policies can lead to trade-offs or synergies, e.g. with issues of shrinkage. Recent demonstration projects and good practice examples show some first ideas on what this can look like in practice. Tools like the Stadtklimalotse (Germany) illustrate synergies and conflicts between climate change and other change related adaptation options and make them transparent.

The work during the training school showed explicitly that deciding on indicators to measure chances of shrinking cities to adapt to climate change is not a task easily to fulfil within a short time. It was more a first step towards defining a method for proving if there are special chances for climate change adaptation in shrinking cities. It was also a first approach for bridging the two debates in the search of a method, i.e. compiling a special set of instruments (tool set) designed to elaborate climate change adaptation possibilities in shrinking cities. The participants experienced diverse difficulties arising from joining and matching vari-

ous data sets and also different interpretation and definitions of indicators and notations between the different national contexts. But they also developed a high degree of enthusiasm to further work on this topic. The focus on shrinking cities has furthermore to be strengthened in upcoming research work. Nevertheless it became very obvious, that although other dimensions/ aspects (as social aspects) were not directly in the focus of the instruments/ tools developed, synergies and overlapping goals became apparent and emphasized the interdisciplinarity of this research topic.

Many more steps will be necessary and have been discussed and planned by the end of the week.

The Training School has met and fulfilled the objectives set at the beginning. The participants have intensively worked and gained new knowledge and experience on a new and emerging subject. They took the chance to find new ideas and methodologies in research and combination of two recent discourses in spatial planning: climate change and shrinking cities. Working together in groups, as well as intense and lively discussions and sharing ideas offered a platform for exchange between the participating Early Stage Researchers from different European countries on a wider range of topics. A European network of Early Stage Researchers in the field of Shrinking Cities has been started in 2011 and has been very well intensified during the recent Training School.

The training school was complemented by a field trip to Dessau's green zones established and promoted during the International Building Exhibition Urban Redevelopment Saxony-Anhalt 2010 in order to show an example of taking chances to adapt to climate change within a city faced with severe shrinkage and loss of economic activities. The Bauhaus Dessau Foundation as a COST CIRES-Partner is a forerunner in combining both discourses in experimental research and offered the participants a deep insight into this emerging topic.

2. URBAN SHRINKAGE AND ADAPTATION TO CLIMATE CHANGE

2.1. STATUS QUO IN RESEARCH

2.1.1. RESEARCH ON SHRINKING CITIES

The evolution and current state of the art on shrinking cities have been recently summarized in an article written by several members *of Shrinking Cities International Research Network* (SCiRN^{TM}) (Martinez-Fernández *et al*., 2012). The topic has gained growing attention in Europe and United States since 2005, when *Bauhaus Dessau Foundation* and *Kulturstiftung des Bundes* launched an international project called Shrinking Cities (Oswalt, 2005). It coined the term shrinkage and highlighted an unprecedented process: at the beginning of 21st century many cities all over the world had left behind a long history of demographic growth and had entered a phase of prolonged population loss. Although the research took into account different causes of shrinkage (deindustrialization, suburbanization, demographic changes and political transformations), it focused specifically on demographic change.

Shrinking Cities echoed a debate that in Germany for example had been going on since the 1990s and placed the topic at an international scale. The consequences of political restructuring, together with the global processes of suburbanization and reorganization of production, caused intense decay in East German cities and also raised important questions for urban planning. However, the debate has profoundly advanced in Germany since these early stages. During the 1990s "*shrinkage* was a political taboo in Germany" (Wiechmann, 2008: 435). Nevertheless, over the following years, not only political and social awareness emerged but also a number of significant and innovative strategies for shrinking cities' restructuring (Oswalt, 2005; Fachgebiet Städttebau, 2008; Wiechmann, 2008; Pallagst *et al*., 2009; Less is Future, 2010; Wiechmann & Pallagst, 2012).

By the *Shrinking Cities* project, the global nature of urban shrinkage phenomenon was finally recognized. It gradually led to the reinforcement of an interdisciplinary debate that today includes the fields of geography, sociology and urban planning as well as a reflection on experiments in urban practice.

In 2009, the journal *Progress in Planning* devoted a special issue to emerging research agendas in planning (Progress in Planning, vol.72, 2009). The topic "*Planning Shrinking Cities*" was featured in one chapter. That same year, the Institute of Urban and Regional Development (University of California, Berkeley) published a monograph in which the futures of shrinking

cities were analysed through case studies from different countries (Pallagst *et al*., 2009). In March 2012, the *International Journal of Urban and Regional Research* devoted an issue to the results of the symposium "*Shrinking Cities: Urban Challenges of Globalization*", which also focused on comparative analysis from different countries (International Journal of Urban and Regional Research, vol.36.2, March 2012). In June 2012, the journal *Built Environment* published a special issue on "*Understanding Shrinkage in European Regions*", including papers on both theory framework of shrinkage and case studies of European cities (Bontje & Musterd, 2012).

Two features seem to have characterized the debate since its beginnings:

- The widespread use of case study methodology reveals a specific way of understanding the city. It points to both, the idea of a plural world of shrinking cities based on local distinctiveness and to the possibilities of a local response to global changes. In this sense, it embodies a radical departure from previous approaches to urban decline based on cyclical models (Hirsch, 1967; Norton and Rees, 1979; Markusen, 1985; Friedrichs, 1993).
- Secondly, it regains links between theory and practice. European studies on shrinking cities have established new ties between the analysis of decline and the strategies to overcome it.

These researches did not only show the ability of urban planning to intervene in the process of shrinkage, but also stressed the innovations of these new restructuring strategies. In 2005, Philipp Oswalt pointed out the idea of "*weak planning*" and the use of "*soft tools*" to tackle the problems of shrinking cities (Oswalt, 2005: 16). Recent studies have supported this idea and highlighted the need to move away from growth-oriented urban models towards flexible strategies and comprehensive planning at a regional scale. Today, several authors have already suggested a "*paradigm shift in planning*" (Wiechmann, 2008; Hollander *et al*., 2009; Pallagst *et al*., 2009; Wiechmann & Pallagst, 2012).

In 2005, the project "*Shrinking Cities*" had raised the question "*are there also benefits from the de-urbanization of cities*?" (Oswalt, 2005: 187). Since then, the debate has significantly evolved and today there are many authors who seem to consider shrinkage as a potential to come up with new urban models (Fachgebiet Städtebau, 2008; Pallagst *et al*., 2009; Hollander *et al.*, 2009; Less is Future, 2010; Wiechmann & Pallagst, 2012; Martinez-Fernandez *et al*., 2012). In this Training School we explored the opportunities regarding climate change adaptation.

2.1.2. Research on Climate Change Adaptation

With the publication of the 4th IPCC-Report and the Stern-Review in 2007, there is a broad consensus on the existence of climate change as well as on the man-made character of this "natural" phenomenon and hence on the necessity to react to it (Grothmann et al. 2011: 84). First, mitigation measures must be taken to reduce greenhouse gas emissions (e.g. EC 2009: 3). Second, due to the already existing accumulation of greenhouse gases in the atmosphere, there are unavoidable impacts of climate change, which societies have to deal with by means of adaptation (EC 2009: 3; Grothmann et al. 2011: 84; Keskitalo 2010: 1). There are documented adaptations to climate change in some markets, e.g. insurance, re-insurance, health interventions, or coastal planning (Adger et al. 2005). However, the field of adaption research is young and still scattered. There are disciplines that already reacted to the challenge to adapt, such as those related to the water sector (see e.g. Pahl-Wostl 2007). The concepts of vulnerability and resilience are also focussed in social science research on climate change adaptation issues and extreme events (Nelson et al. 2007: 395).

Adaptation appears in different forms at different governance levels (Keskitalo 2010: 2). On the national level, some countries have elaborated national adaptation strategies to climate change and defined relevant fields of action for this adaptation. There are some research projects on the comparison of such national adaptation strategies. An important example is the first PEER-Report (Partnership for European Environmental Research) (Swart et al. 2009). Adaptation actions are more prevalent on the local level. These actions are measures aiming at reducing "unavoidable impacts of climate change in the short and medium terms" (Davoudi et al. 2009: 12). For the local scale, for example, the German Association of Cities has elaborated a position paper including measures and recommendations for adaptation to climate change. These recommendations apply to nine fields of action as health, civil protection, water or urbanism (Deutscher Städtetag 2012).

Adapting planning to a changing climate

Climate change will not only modify temperatures, but also the spatial patterns of precipitation, floods and droughts. Hence land use is severely influenced by climate change and its impacts (Pütz et al. 2011: 1). Vice versa, land use and the spatial shape of urban areas also affect the possibilities for climate change mitigation and adaptation measures (Davoudi *et al*. 2009: 13). Consequently, spatial planning is a field particularly challenged by climate change. Therefore planning from the existing situations' point of view would be misguiding considering future needs (Keskitalo 2010: 2). Studies on the issue of spatial planning for a changing

climate were for example carried out for the Alpine space in the project CLISP (Climate Change Adaptation by Spatial Planning in the Alpine Space) (see Pütz *et al*. 2011). In this project, a guideline for planners was elaborated to help "*to assess the climate change fitness of their spatial planning policies and instruments*"(Pütz *et al*. 2011: 89).

Only a small part of the "*growing body of work on climate change adaptation*" refers to urban areas (Bicknell *et al*. 2009: xxi). Nevertheless there are several examples of climate change adaptation in particular cities (see e.g. *Bicknell et al*. 2009; New York City Panel on Climate Change 2010). Primarily for German municipalities, the research programme *ExWoSt* (Experimental Housing and Urban Development) developed an online decision support system "*Stadtklimalotse*". This decision support system aims at supporting "*the identification and implementation of appropriate measures for mitigation and adaptation in urban development*" (Stadtklimalotse 2012). A critical question in this regard is how the actual economic recession will influence the weighting of priorities in spatial planning decisions, as a long-lasting period of economic growth came to an end or at least to a halt (Davoudi *et al*. 2009: 16). This question is particularly important for shrinking cities, as they are places characterised by decline in different fields, such as business activities, revenues or population numbers. However, these characteristics can also be a chance for shrinking cities: Due to nascent resources, they have a big scope of action for implementing climate change adaptation measures. Insofar, the prospects to be well prepared for future needs are not bad in shrinking cities if the abundance of space is well used in an early stage of shrinkage.

The fact that the loss of population and urban functions are reducing the pressure on urban areas could be an opportunity for the creation of new urban landscapes in those areas where urban pollution reduces environmental quality. This work is, therefore, aimed at exploring the context of shrinking cities and climate change and at the identification of possible relationships between the two phenomena in order to detect feasible urban scenarios.

The changing in the urban structure, particularly in the urban landscapes, can promote a strong tendency of citizens actively participating in the processes of urban development, paving the way for adaptation to climate change. Furthermore, discussions and activities in the sustainable urban development field sensitize people to new environmental challenges. With these objectives in mind, some initial studies have been conducted in Dessau, Germany directed to the identification of connections between the two phenomena (Scurrell, 2012) claiming that at the time the two issues of climate change and demographic decline concur together and the cities will face a special challenge.

There is a chance that shrinking cities could be an important actor in the implementation of measures of climate change adaptation. For this, it is necessary to develop strategies to deal with "managing the decline" of the population of the city, by introducing a change into the current development model, with a particular attention the problems of climate change. Is it also possible to find a connection between adaptation to climate change and demographic change? Between the Cities and climate change is a two-way relationship, based on some fundamental factors such as Cities' contribution to CO2 emissions; their vulnerability to water-related calamities when located in coastal areas; urban density and spatial organization are key factors that influence energy consumption, especially in the transportation and building sectors. It will be necessary for future planning and management of cities to take climate change adaptation into account.

2.2. EXAMPLE: DESSAU IBA URBAN REDEVELOPMENT 2010

The International Building Exhibition – IBA (German: **I**nternationale **B**au**a**usstellung) is a German concept of showing new trends and innovative solutions for contemporary problems in architecture, urban planning and urban engineering. The exhibition includes long term investments leading to practical changes as well as innovative approaches in architecture, planning and urban design. The first IBA was held in Darmstadt in 1901 and the following took place in Leipzig (1913 – fair trade area), Berlin (1957 – rebuilding of the district Hansaviertel and 1977-87 – careful urban renewal and critical reconstruction), Ruhr Area – Emscher Park (1989-1999 – restructuring the old industrial areas) and Lusatia (2000-2010 – revitalizing the old brown coal mine region). The currently on-going/planned exhibitions are located in:

- Hamburg (2007-2013) – European metropolis in 21st century,
- Basel (2010-2020) – cross-border cooperation,
- Berlin (2020) – spatial inclusion of the former Tempelhof Airport area,
- Heidelberg (2012-2022) – knowledge based city,
- Thüringen (2023) – changes in the cultural landscape
- Parkstad Limburg (starting 2013) – re-use empty spaces, recycle used material.

The main issue of the IBA Urban Redevelopment 2010 was dealing with the shrinkage process and declining population. The eastern part of Germany was one of the first regions being so heavily affected with this problem. The main reason was an economic crisis after reunification of Germany in 1990, which forced many inhabitants of Saxony-Anhalt (and other former GDR-regions) to move to the western part of Germany. As a result, the population of

the region dropped by 17% in the years 1989-2010 - with further decline being expected. The number of vacant flats, in the city centres as well as in outer districts with prefabricated buildings, increased also due to the process of suburbanization – in the year 2000, there were already one million vacant flats. The issue of shrinking regions - not only shrinking cities like it used to be in the past - is becoming more present in Europe. The main reasons are:

- decline in birth rate,
- loss of industrial jobs,
- suburbanization,
- trans-regional and trans-national migration.

According to the EU-Study "*Shrinking Regions: a Paradigm Shift in Demography and Territorial Development*" the countries most affected by population decline in the years 2003-2030 will be: the eastern part of Germany, Estonia, Latvia, Romania, Bulgaria, southern Italy (especially Basilicata region) and Liguria, central and northern Spain (Castile and Leon, Asturia) and Upper Silesia in Poland.

The most innovative approach of IBA Urban Redevelopment 2010 was not trying to change the whole process (according to the growth paradigm) but using it as an opportunity for innovation and renewal. The area of work consisted of 19 towns and cities, where local politicians, representatives of the municipal administration and of institutions located there as well as inhabitants and their organizations entered in dialogue with experts and each other to share experiences and search for new, unusual solutions. For every city, a separate project was designed. All of them may be divided in 5 categories:

- urban models,
- landscape,
- education,
- built heritage,
- identity.

All together over 100 projects were realized, including: education centres, art galleries, green areas and public spaces. The participation of the local communities and enabling a communication between them and the authorities is very worth stressing. Moreover, for the first time, a whole federal state was the area of the exhibition. Also for the first time, it was focused on small and medium sized cities rather than metropolitan regions. Interestingly, in contrary to previous editions of the International Building Exhibition, not many new constructions were built – the idea was to re-use the old, vacant buildings and strengthen the city core, sometimes by tearing down the building in the outer zones. The budget included Euro 206,9 mil-

lion, which was only a fraction of the funds spent on the previous national building exhibitions in Berlin and Ruhr area. It consisted of funds from *Urban Redevelopment East*-Program (Euro 121,9 million), *European Regional Development Fund* (Euro 19,4 million), budgets of participating cities (Euro 40,6 million) and money from private investors (Euro 35 million).

3. ELEMENTARY WORK STEPS / METHODOLOGY

3.1. Definition Urban Area and City Region

Displaying the various aspects of shrinkage and chances for climate change is not just a question of finding proper indicators but also to define their spatial reference. Thereby, the first objective of measuring links between shrinkage and climate change is to define "urban areas" and "city region" implemented in urban and environmental research.

There are some criteria to define "urban": a threshold (e.g. population) is used to separate cities from rural areas, densities and land cover characteristics, links and interaction within some region etc. Moreover, different definitions of a city are used among the countries, whereas they can be grouped into three different types (ESPON 1.4.1., 2006: 41, Guérois, 2003: 68f):

- ***Administrative definition***: the urban zone is defined by the administrative or legal status of municipalities (usually based on a population threshold). This definition is not accurate since it does not take into account the extensions of the city outside its administrative limits (underbounded). By contrast, the administrative city limits can also be larger than the city's developed area (overbounded).
- ***Morphological definition*** (urban area or urban agglomeration, built-up area): the urban zone is defined by density and building continuity, often combined with a population threshold. Since most of the population and employment are still concentrated in the densest parts of the urban region, this definition reflects the characteristics of a city very well. However, the criteria used to define building continuity can vary among countries depending on national contexts as well as criteria for using land cover data.
- ***Functional definition*** (urban region or metropolitan area): this definition takes into account the sphere of influence and attraction of a city on its surroundings. It is based on the existence of a common labor market measured through daily commuting

flows. This definition is very useful to seize the processes of de-concentration, suburbanization and sprawl.

These criteria are mainly combined with population threshold and it is to note that countries use different indicators and thresholds to define building continuity or limits of travel-to-work areas.

Since the main chances for adaptation to climate change are regarded to changes of built-up area, the morphological view is of obvious relevance. In exact delimitation of the "morphological city" indicators of built-up area and continuity – density, distances between buildings, characteristics of land cover and land use – need to be applied. For the application of these indicators the spatial framework needs to be determined. There are two approaches which vary regarding the used data: elementary statistical units (municipality) and classes of land cover.

In most countries urban area as "morphological city" is defined by national statistical institutes, but while the use of the parameters (density, distance between buildings) is commonly accepted there are some differences in thresholds applied in each country (Le Gléau *et al*., 2006). The advantage of this approach, since it is based on elementary statistical units, is the availability of other parameters, such as indicators of shrinkage, but there are some limitations to compare it between different countries.

Alternatively, satellite images or aerial photographies, which are "independent" from statistical units, can be used to delimitate urban areas. CORINE Land Cover is an original source, which allows comparison by providing extent and density of European cities.[1] It uses the definition of "urban morphological zone" as "a set of urban areas laying less than 200 m apart" with distinction of some core land cover classes (continuous and discontinuous urban fabric, industrial or commercial units, green urban areas) and enlarged classes like airports, sport and leisure facilities, road and rail networks if they are neighbors to core classifications. Obvious advantage of this approach is the comparability of cities across Europe, but selected classes may be too generalized to study how the shrinking cities can adapt to climate change.

Main attention should be laid on definition and classification of different spaces within the urban area, especially on difference between "built-up" and "covered" areas as the chances of shrinking cities for adaption to climate change are related to decreasing density and footprint. The discussion of bridging the debate of shrinking cities and climate change adaptation

[1] CORINE Land Cover data covers the whole area of Europe is therefore discussed here. For an even more precise picture of land use in selected cities the GMES Urban Atlas can be used. (http://www.eea.europa.eu/data-and-maps/data/urban-atlas)

is also strongly related to the question of indicators and spatial reference (how to define a city?). Whereas built-up areas mirror climate change processes and structures within a city, demographic and socio-economic data is usually collected on administrative level for describing the shrinking phenomenon even combined with functional approaches for catching functional interrelations and trends. The special challenge and potential lays in the combination of both approaches in order to enrich the scientific debate of both topics.

3.2. Differentiation between different spaces of Urban Area

The complexity which characterizes the city allows multiple interpretations and classifications of the components of the urban fabric. An accurate analysis must include all the fields within an urban area, by an integrated approach which focuses both on the single component and on the mutual interaction between all the components. During the last decades, the scale and articulation of knowledge and its modes of structuring has also been associated with a new connotation of complexity of the cognitive frameworks. This complexity has often been used to highlight a new range of problems and sometimes to hide them (Rotondo, 2012). The term complexity has been used to refer to very different situations; sometimes it has been used "*to refer to properties of things instead of the models used, thus the complexity has also become an obstructive feature, that somehow invited to surrender*" (Secchi, 1989) to describe, to learn, and then to understand the reality of a region, as well as its potential. On the contrary, through the structuring of knowledge and in particular through the study of complexity, it is possible, in fact, to build an interpretive model to really understand how a territory became what it is now, how it works and what it tends to be (McHarg, 1969).

Therefore, in all these complex studies and analyses, the ontology represents a basic element to a real comprehension and explanation of what is being done. According to Gruber (1993), ontology is an explicit, formal and shared conceptualization of a particular domain. The conceptualization process represents the attribution of unambiguous meanings to the terms which define the knowledge in that precise domain (ontology domain). Guarino (1998) defines ontology as a set of logical axioms designed to account for the intended meaning of a vocabulary. Obviously, it is impossible to define a universal ontology, but it is important to identify from time to time the specific ontology used in a specific case-study, in order to clarify many aspects of the study and at the same time to make the study more easily understandable.

The urban fabric is an integrated habitat mixing multiple dimensions: economic, social, cultural, spatial and environmental. For each one, it's necessary to choose a way of analysis,

which can also contain links with all other dimensions: the analysis must represent - as much as possible - the complexity of the urban fabric. A significant difference does exist, for example, between a two-dimensional physical analysis and a three-dimensional one: the choice depends on the objective of the analysis and on the subject studied - there is no absolute right analysis.

In order to achieve the goal of identifying indicators which explain the link between urban shrinkage and climate change adaptation and mitigation, it's necessary to analyze the complexity of the urban fabric and every element which composes it. It is possible to identify and classify these elements considering several points of view, depending on the objective and the description of the urban area. Consequently, the analyses have to focus on the aspects of the city which could interact with both the phenomena of urban shrinkage and the climate change.

The elements considered to classify the different spaces of the urban area are numerous and linked with those aspects of urban life which influence the urban micro-climate and which could therefore represent adaptation and mitigation tools to climate change: the type of the surfaces - porous or not, green or paved, natural or artificial, etc.- , the presence or absence of ecological corridors and trees along the streets, the presence of infrastructures and traffics - with the resulting pollution -, the quantity of volumes built - they have a key role in pro-

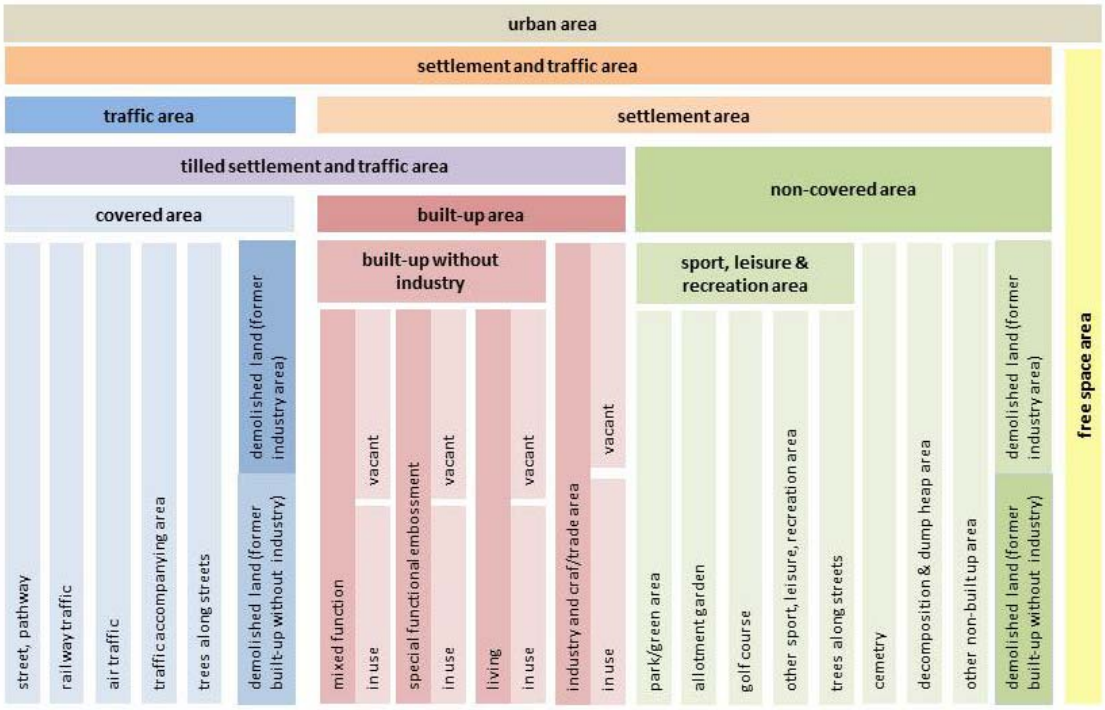


Figure 1: Typology of Urban Spaces (Source: own sketch)

ducing shadows and in deviating the air flows -, the current uses of the areas - which influence the energy consumption, the pollution, especially in case of the industrial areas, the traffic, the consumption of the resources and more the like.

The whole urban area can be divided in two parts (see **Figure 1**): the *settlement and traffic area*, which is the part actually used by citizens, and the *free space area*, which coincides especially with suburban areas, straddle the countryside. The settlement and traffic area is analyzed from two points of view: the use and the type of surface. Thus, on one hand we can consider the traffic area and the settlement area, on the other hand the tilled settlement and traffic area and the non-covered area. The first includes the covered area, which is the two-dimensional area characterized by an artificial - and mostly impermeable - cover (street, pathway, railway traffic, air traffic, traffic accompanying area, tree along the streets, demolished land) and the built-up area, which is the three-dimensional area, again divided in several parts depending on the use: on one hand, mixed function, special functional embossment, living, concerning the built-up area without industry; on the other hand, industry and craft/trade area. The non-covered area, characterized by a porous surface, includes the sport, leisure sport, leisure and recreation areas (i.e. parks and green areas, allotment gardens, golf courses, other sports, leisure and recreation areas and tree paths), cemeteries, decomposition and dump heap areas, other non-covered areas and demolished land (former built-up without industry area and former industry area.

The use of these categories and classification is useful to fix a starting point in order to search for indicators and connections between the components of the urban area and climate change adaptation and mitigation, in order to use the knowledge arising from different fields and backgrounds (engineering, architecture, geography, sociology, etc.), trying to consider as much as possible the real complexity of the city.

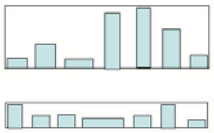
3.3. Indicators to Measure Chances of Shrinking Cities to adapt to Climate Change

During the training school we had as main goal the development of indicators that would respond to the question: "What chances do Shrinking Cities have for Climate Change Adaptation?"

Based on this problem, we developed a set of indicators on both sides: the city decline and climate change. These indicators are used to experiment on the city in decline and to design improvement scenarios to the phenomenon of climate change.

We identified themes of analysis based on the population, the permeable areas and green corridors, the building density, renewable technologies and in particular biomass, and the presence of empty buildings. Based on these themes we have identified the main areas of analysis.

Table 1: Indicators for measuring chances of shrinking cities to adapt to climate change

Indicator	Category	Formula	Characteristics of SC	Relevance for CC	Chances for CCA	Scale
Population/ km2 (urban area)	D, (Lu)	=total population/ urban area in km²	decreasing population	emission land use	- reduction of emission - optimizing land use	C
Ratio of non-covered area %	Lu, F	=non-covered area/ urban areas in km²	growing potential for non-covered area	water absorption heat / albedo soil quality air quality	- Health issue - Flood risk reduction - Ground water improvement - Increasing of green spaces/ biomass	C
Biomass m³, m², …?	D, Lu, F, T	=volume Area Interconnectedness	growing potential for biomass	CO^2 reduction > renewable energy production -"-	- Absorption of CO_2 - Production of sustainable energy	C / MC
Ratio built-up volume/ total potential volume	D, M		t.b.c.	heat island energy consumption & emission	- reduction of the heat island effect - reduction of energy consumption	C
Corridors **(urban area)**	M, Lu	general: traffic natural: water, green area interconnected linear areas/ patterns in km	potential of prolonging corridors	air flow biodiversity	- reduction of heat island effects - improvement of air quality (e.g. greenhouse gases)	C
Vacant buildings	D, F	total number of units &buildings (residential/ commercial/ industry)	increasing vacancy	see other indicators	- reduction of energy consumption - reduction of emission reduction - biodiversity	C
Technical Infrastructure	D, T	- technology (qual. (status)) - utilization/ potential use	need for adjustment of technical infrastructure	emission/ consumption related to technology	- reducing energy consumption + emission by using new technology	C

The macro-categories that include the two research areas are (see **Table 1**): the density (D), morphology (M), land use (Lu), function (F) and technology (T).

The seven indicators that we have identified have been classified by category, and a formula to calculate them has been formulated: the links of the indicator with the city in decline, the relevance of the indicator to climate change, the chances that cities in contraction have on adaptation to climate change in relation to the indicator and the scale of analysis.

These are the used indicators (also see **Table 1**):

- ***Population /urban area*** (total population/urban area in km^2): the categories are density and land use and the scale analysis is the city. This indicator characterizes the shrinking city by decreasing population, and it is important for the climate change for emissions and land use. The chances for climate change adaptation are the reduction of emission and optimizing land use.
- ***Ratio of non-covered area*** (non-covered area in km^2/urban area in km^2): the categories are land use and function and the scale analysis is the city. This indicator characterizes the shrinking city by growing potential for non-covered area, and it is important for the climate change for water absorption, heat/albedo, soil quality and air quality. The chances for climate change adaptation are the heath issue, flood risk reduction, ground water improvement and increasing of green spaces.
- ***Biomass*** (volume): the categories are density, land use, functions and technology and scales of analysis are the city and the micro city. This indicator characterizes the shrinking city by growing potential for biomass, and it is important for the climate change for CO_2 reduction, and for renewable energy production. The chances for climate change adaptation are the absorption of $CO_2$and the production of sustainable energy.
- ***Ratio built-up volume/total potential volume***: the categories are density and morphology. The scale for analysis is the city. This indicator is important for the climate change for CO_2 reduction, for the heat island and the energy consumption. The chances for climate change adaptation are, in fact, the reduction of the heat island effect, and the reduction of energy consumption.
- ***Corridors*** (interconnected linear areas/ patterns in km^2): the categories are morphology and land use and the scale analysis is the city. This indicator characterizes the shrinking city by the potential of prolonging corridors, and it is important for the climate change for air flow and biodiversity. The chances for climate change

adaptation are the reduction of heat island effects and improvement of air quality.

- ***Vacant buildings of residential, commercial or industry*** (vacant buildings/total number of units): the categories are density and function and the scale analysis is the city. This indicator characterizes the shrinking city by the increasing vacancy. The chances for climate change adaptation are the reduction of energy consumption and the reduction of emission.
- ***Technical Infrastructure*** (technology, utilization or potential use): the categories are density and Technology and the scale analysis is the city. This indicator characterizes the shrinking city by need for adjustment of technical infrastructure, and it is important for the climate change for emissions and the consumption related to technology. The chances for climate change adaptation are the reducing energy consumption and emission by using new technologies.

It is necessary to reconsider the entire urban strategy promoting the recovery of existing buildings and public spaces, avoiding any soil and energy consume due to city expansion, specific territorial heritages, economic potential and new technologies for the energy production (renewable energy). With these indicators we have the possibility to calculate the potential of shrinking cities toundertake sustainable strategies to improve the local and global urban climate.

4. ACHIEVEMENTS OF THE TRAINING SCHOOL

4.1. DEFINING A METHOD AND BRIDGING THE TWO DEBATES REGARDING SPECIAL CHANCES FOR CLIMATE CHANGE ADAPTATION IN SHRINKING CITIES

So far both discourses – on shrinking cities as well as on adaptation to climate change – run parallel to each other. Both phenomena are still "new" when it comes to reflection, acceptance or even measures undertaken to keep up or improve quality of life. Since the negative aspects of urban climate – heat islands, air pollution, and the risk of flooding – are often related to a high density build-up area with a lack of green spaces, air corridors and floodplains, it is nearby to ask for an interrelationship between both developments: Is there an easier or more effective way to answer the challenges combining the instruments of problem solving?

At this point one has to differ between the local and the global effects of climate change. Shrinkage implies a loss of functions, actors and activities as well as inhabitants. In this way it mostly contributes to mitigating climate change - at least at the place concerned. But to use the abundance of buildings, urban space and/or materials for climate adaptation is no obvious developmental strategy. Planners usually advised to build dense, compact cities to reduce the city's ecological footprint. Only recently a debate on the ecosystem services of green spaces in cities arose.

Against this background the training school participants searched for a method to provide information if and how the spatial conditions in shrinking cities can be used for climate change adaptation. The easiest way to approach the topic seemed to be via land use and building structure in the cities. What types of land use have to be differentiated in urban areas? Which data are available in the various national contexts? Can shrinking cities establish green spaces for cooling and water retention? What are the socio-economic, cultural and aesthetic qualities of such areas?

The participants were able to develop a first set of indicators showing the potential of climate change adaption in shrinking cities. In this attempt it became obvious, that a decreasing population and a higher rate of vacancies creates potential for a reduction of build-up area and therefore increase the resilience towards natural extremes caused by climate change.

The goal was not to develop new tools for climate change adaption in shrinking cities but to assess the potential for already existing methods in a shrinking city. The situation in a shrinking city with low prices for real estate and a reduced pressure for new developments, espe-

cially in ecological sensitive areas, creates the potential for a healthier and environmentally friendly city.

Of course the potential for climate change adaption in a shrinking city is not easy to realize because of the financial situation linked with shrinkage. Obvious a balance has to be found between de-densification of the city and adapting to climate change and to create a compact city to reduce the costs of utilities and transport.

After an initial discussion on the spatial scale of different indicators the participants of the Training School were able to define a set of indicators applying to both fields shrinking cities and climate change adaption and, even more, show the relations between both topics. The search for indicators was guided by the data availability of different European countries or, if not available, they should at least be easily aggregated from existing data to avoid cost intensive investigations.

A typology of urban spaces was a first result and precondition for further discussion.

As one can see in **figure 1** the city's urban area was defined as settlement and traffic area and furthermore divided into tilled settlement and traffic area and non-built-up area. The distinction between covered area and built-up area was necessary because of the different characteristics of these areas and different national viewpoints/definitions on the subject. The non-built-up areas have a rather positive effect on urban micro-climate and therefore have their own category as well.

The participants then gathered ideas to formulate indicators concerning/reflecting shrinkage and climate change adaptation and for which it is likely to find data.

By the end of the Training School some questions remained partially unanswered for example the implications of CCA measures in a SC on the local labour market, the role of public transportation and the balance between capacity and demand for technical infrastructure. Additionally the question came up, if the defined indicators are specific enough for the situation in a SC? Most of the indicators can also be applied in a non-shrinking or even growing city, especially if one keeps in mind that growth and shrinkage often occur in parallel in the same city or region (Pallagst 2008).

The discussion led to an understanding for all participants on how challenging the future discussion will be in bridging two complex and multi-causal problems like SC and CCA.

4.2. Overlapping Goals and Synergies with other Dimensions and Aspects

The phenomena of urban shrinkage and climate change (and the possible measures to adapt to shrinkage and climate change) are highly relevant and urgent but also extremely complex topics. Urban shrinkage as well as climate change (mitigation and adaptation) – being socially relevant issues - are both connected to economic, ecological and social dimensions.

The focus of the working process training school naturally laid on various questions uniting simple socio-demographic and basic ecological (-land use and development) indicators, being just a first step in combining these two threads of discussion. What advantages/ disadvantages could shrinking cities have when it comes to climate change adaptation/ mitigation? Does a shrinking city need special "attention" or does it have possibilities to adapt more easily? What goals should a shrinking city follow when facing climate change? And what are the uttermost priorities and necessities?

What made it even more difficult is the fact that being up to date topics each thread of discussion has an individual set of goals, which are not negotiated. Nevertheless - linking the two discussions at this very point seems promising in order to obtain a realistic vision of a sustainable future, using existing (limited) budgets and social resources in a smart way.

The scientific community states that we need to enforce our knowledge on "how to balance trade-offs and juggle conflicting agendas, how to make the economic justification for a social or environmental need when faced with other pressing priorities?" Yet, the crisis-laden present situation (economic and financial crisis, ecological crisis, climate crisis, crisis of the welfare state, labour market crisis) might call for re-consideration of this statement. A possible re-formulation would then put social and ecological issues as priorities on the agenda, asking for economic structures and measures to be adapted to serve these goals.

While contradictory goals have to be managed in on-going negotiation, synergies and overlapping goals are a good way to achieve the overarching goal of a sustainable and liveable environment.

As a result of the experimental, trans-disciplinary work of the Bauhaus Dessau Foundation Brückner and Scurrell put forward the following theses:

- Social inclusion occurs by the appropriation of urban landscapes, encouraging participation and leading to capacity building in communities and to self-fulfilment for residents.
- Built density is replaced by a social density of interaction and cultural functions. This stabilizes an important form of urban density, while keeping green areas for resilience functions.

- The enabling state is exercised at city level by creating an integrative atmosphere and offering advocacy and support to communities and neighbourhoods.
- Renaturation of the city supports ecosystem services and climate adaptation processes. Ecological activity is supported by green networks in city quarters.
- Open (brownfield) areas are reinstated for local food or biomass production which reduces carbon emissions from transport and energy production.

During the training school discussions also risks could be identified. These can be stated as key-topics in need of further investigation and consideration:

- Labour market
- Transportation (infrastructure for private and public transport)
- Capacity vs. demand of technical infrastructure (e.g. water and sewage)

Especially the social consequences of climate related developments have to be investigated more thoroughly.

It seems especially important that measures reinforce themselves instead of levelling each other out in order to spiral in a positive process. Therefore more collaboration of all actors and long-term but nevertheless flexible plans for regions are necessary to achieve common and social desirable goals – sustaining liveable living conditions for us and generations to come.

4.3. Addressees for future Work with findings of the Trainings School

The topic of the training school is - as already outlined - very up to date as it combines two urban development discourses of utmost importance. The findings of the training school are therefore of high importance and offer new ways and views of dealing with shrinking cities and the chances for adaptation to climate change at the same time. In order to bridge the theoretical discussions and findings of the training school with practical reality, possible addressees where considered as well. Besides the already stated future need of scientific work on bridging the debates with other aspects of urban development and the necessity to further define and develop indicators for measurements, scenario building and hypotheses, it is as important to actually use these findings within the practical world of urban planning. Therefore the following (by no means complete) addressees have to be considered:

a) Actors and debates within the ***sustainable urban development discourse*** have to start to consider shrinking cities. The discourse and debates so far show only little attention to the potential shrinking cities bear in regard to a sustainable urban development. The findings of the training school so far show very clearly, aspects

of climate change – being a part of the sustainability debate - can and should be linked to the phenomenon of shrinking cities. Therefore more awareness of the potential shrinking cities bear for a sustainable urban development has to be achieved. Within the sustainability discourse a shift away from a paradigm of ever growing and enlarging cities can be seen. Exactly this paradigm shift is the optimal mixing point with shrinking cities, sustainability and especially preservation. With regard to scientific research as well as practical work, the findings of the training school offer good potentials for future work and opportunities within the sustainable urban development discourse.

b) Beside the sustainable urban development discourse, where ***urban actors*** have already been mentioned, they are a group of very important addressees for the findings of the training school, which provide numerous arguments for integrative urban development approaches. They offer the potential to emphasise and underline not only the necessity but also the opportunity of approaches with regard to climate change adaptation in shrinking cities.

c) As already mentioned and as it becomes clear in this report, the two debates are current research topics not only within spatial planning but also in terms of landscape architecture, architecture, geography etc. Therefore the findings of the training school can be applied by a wide range of ***junior and senior researchers*** throughout the different sciences. The multidisciplinary composition of the training school attendees has clearly shown the wide range of topics and scopes of action. Future research should be emphasised, not only in order to continue the started work and findings by the young researchers of the training school. But also in order to develop tools to work within these debates in future and to bridge theory to practice as well.

The list of addressees does definitely not end at this point. This is only a small list of opportunities; the findings of the training school can assist. The idea to interlink two recent debates and to find ways of interactive research and practical work already hints to a number of possible addressees within research but also practical work. This is underlined by the considerable multidisciplinarity of the debates, their fields of action, the way of transduction and their enthusiasts.

4.4. BRIDGING THE FINDINGS OF THE TWO TRAINING SCHOOLS

The first Training School of the COST-Action "*Mapping Urban Shrinkage in Europe*" took place in Dortmund in November 2011 and dealt with finding and synchronizing indicators for measuring urban shrink-age throughout Europe. The aim was to find a common database for Europe and to illustrate the process of urban shrinkage Europe-wide. Also methodological questions like time references, spatial boundaries and methods of data collection were discussed. As a first result a shared data set with a comparable type in every country was achieved. Those data included total population on the municipal level for all municipalities larger than 5.000 inhabitants for the years 1990/1991, 1995, 1999/2000/2001, 2005 and 2010 (or the most recent data available).

The second Training School on "Urban Shrinkage and Chances for Adaptation to Climate Change" took place in September 2012. The discussion was also methodological, while trying to link the phenomena of shrinking cities with the topic of climate change. The focus of the discussion was to combine simple social-demographic indicators with basic ecological and land-use indicators while joining the phenomena of urban shrinkage with climate change adaptation.

The purpose of both events was to come up with an operationalization of two academic debates which had been discussed theoretically in various countries. On the one hand, the inter-linkage of related research interest represented by the training school participants was essential to mirror the various aspects which had to be considered when trying to model multidimensional processes. On the other hand, discussing and combining different country-specific views has enriched the debate by coming up with an approach suitable for Europe. One of the common points of both training schools was the question of the adequate spatial reference. Moreover, the training school's discussions finalized an approach of suitable data, mirroring the process of shrinkage and climate change adaptation together with explanations of the indicator's characteristics bridging shrinkage and climate change adaptation.

The work of the first training school can be seen as one necessary requirement for linking the phenomena of shrinkage and climate change on a Europe-wide level. Furthermore methodological toolsets and a better understanding for other disciplines, as well as an insight into national differences in data processing and evaluation could be appropriated during both events.

5. APPENDIX: LIST OF PARTICIPANTS

Name	Surname	Country
Dietersdorfer	Lisa	Austria
Efremova	Vera	Russia
Fernandez Agueda	Beatriz	Spain
Fleschurz	René	Germany
Mangialardi	Giovanna	Italy
Piscitelli	Claudia	Italy
Schmitz	Sandra	Germany
Scurrell	Babette	Germany
Sosinski	Piotr	Poland
Willi	Corina	Switzerland
Wolff	Manuel	Germany

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