

Integrative Spatial Concept Climate Protection & Adaption

Kristin Barbey^{*1}

^{*1} Department of Architecture, Institute for Urban and Landscape Design,
KIT Karlsruhe Institute of Technology

Corresponding author: Kristin Barbey, kristin.barbey@berlin.de

ABSTRACT

Climate change and climate impacts require in consequence of their anthropogenic causes a changed handling of space and nature. The objective of this research project is to develop a consistent *INTEGRATIVE SPATIAL CONCEPT* towards a *NATURE-ORIENTATED, CLIMATE-FRIENDLY METROPOLITAN REGION 2050*, looking for the best place to implement most efficiently the different measures of *CLIMATE PROTECTION & ADAPTION* in the urban and regional spatial context. *THE CONCEPT OF INTERACTING STRATEGIES: NATURE DEVELOPMENT – URBAN RESTRUCTURING – ENERGY TRANSFORMATION* presents the strategies of *CLIMATE PROTECTION & ADAPTION* as qualification processes, which can lead to an improvement of existing qualities. In connection and interaction of these strategies a path of spatial sustainability will be developed in an ecological, aesthetical and sociopolitical regard. The *PROJECT NATURE* is the theoretical background and content base of the *INTEGRATED SPATIAL CONCEPT* and signifies within the conceptual process the objective for the strategic spatial decision.

Key Words : The PROJECT NATURE

1. Spatial Significance Climate Change

The global budget of anthropogenic operating causes by handling with space and nature, especially with the open space of the earth atmosphere, an impact on the global climate. Anthropogenic greenhouse emissions in summation reinforce the natural greenhouse effect and support, beside natural impetus, global climate warming, whose climate impacts basically affect all local, regional, national and continental spaces, as well as every human society, biologic life-form and large scale, as well as small scale ecosystems.

The representation of climate warming by the climate research clarifies the existential global spatial and climatic interdependencies and allows a contemporary perspective on the correlations of human and nature existence. The knowledge of the anthropogenic responsibility, referring to global warming and the involved climatic consequences by the IPCC 2007, questions the previous forms of anthropogenic use of space (e.g. CO₂-emissions → atmosphere) and previously used spatial strategies for urban development, energy and agriculture, industry and mobility, because they exceedingly contribute to anthropogenic climate warming.

The society of the 21st century is in a state of flux, regarding the climate change and its impact, the depletion of fossil energy sources and the nuclear disaster in the Japanese city Fukushima in March 2011, which revealed the obvious risks of nuclear energy again. In April 2011 the German Advisory Council on Global Change (WBGU) described this structural change as “The Great Transformation” from fossil to post-fossil [post-nuclear] society. Recognizing the anthropogenic causes, climate change and climate impacts require a different handling of space and nature – climate protection, climate adaption and energy transformation have to be located on every spatial level. In this context the space itself obtains fundamental relevance for a sustainable and climate-friendly development, as location for the realisation of climate protection and adaption and as basis for upcoming transformation processes. While the causes of anthropogenic climate change result from the previously dominant way to deal with space, it is possible to reduce climate change, depending on the spatial strategy (climate protection), and to adapt to the impacts on climate change (climate adaption). Spatial strategies have to be developed to locate the change of energy systems from fossil to renewable and thereby counteract climate change (climate protection) and to adapt spatial

structures to the expected climate impact (climate adaption) to secure ecosystems and human living conditions.

SPATIAL STRATEGIES, CLIMATE PROTECTION and *CLIMATE ADAPTION* increase additional demands on space – existing potentials have to be used in terms of resource protection and energy efficiency, renewable energy systems have to be located and free space has to be protected in a special way. The challenge of the space, city and landscape planning is to develop and direct these demands in a reasonable way towards a sustainable, nature-orientated and climate-friendly spatial development, which is closely connected to the aims of climate protection and adaption, also in a spatial-aesthetic appropriate way. An integrative spatial concept is needed, which locates the strategies of climate protection and adaption and communicates a spatial understanding of the future development and transformation processes.

This research project is an exemplary attempt to develop a consistent spatial concept relating to the Metropolitan Region Rhine-Neckar (5.640 km², 2,4 Mio. inhabitants, the warmest Region in the South-West of Germany with projections of increasing heat, rain and flood events, dense polycentric urban structure of cities as Heidelberg, Mannheim and Ludwigshafen and villages in a diverse open space and landscape structure, important universities and highly industrialized urban poles situated in a beautiful Rhine-valley landscape framed by hilly Palatine and Odenwald forests, confluence of the rivers Rhine and Neckar) looking for the best place to implement most efficiently the different measures, which could be the basis for discussions and civic participation with the intention to support the spatial realisation of the climate protective and adaptive transformation.

2. Integrative Spatial Concept

Out of the overview of the strategic focus of already established concepts in European metropolitan regions and due to the analysis of recent research results in the sectors climate research and spatial development, forestry and energy science, space and water management, planning theory and nature philosophy, *THE CONCEPT OF INTERACTING STRATEGIES: NATURE DEVELOPMENT – URBAN RESTRUCTURING – ENERGY TRANSFORMATION* is developed, which contains essential theoretic basics for the spatial conception.

2.1 The Project Nature

The content basis of the spatial concept, developed in this research project, is the *PROJECT NATURE*. The recognition of the anthropogenic responsibility for global warming and the thereby related climate impact by the IPCC demand the change of the previous form of anthropogenic spatial use (e.g. CO₂

emissions → Atmosphere) in expression (e.g. CO₂ emissions) and development (e.g. land use). Climate change and climate impacts require in consequence of knowledge of their anthropogenic causes a changed handling of space and nature.

The *PROJECT NATURE* is the theoretical background and content base of the spatial concept and represents within the consideration of spatial strategies, climate protection and adaption, the collective objective for the strategic decision.

All represented spatial strategies (*NATURE DEVELOPMENT – URBAN RESTRUCTURING – ENERGY TRANSFORMATION*) are orientated on the *PROJECT NATURE*. In the process of the overall spatial concept development, the orientation on the strategic aims of the *PROJECT NATURE* is of primary importance for the development of future decisions in dealing with space.

The *PROJECT NATURE* contains the qualification of ecological potentials, the stabilisation of ecosystems and the renewal of existential space substance. We must turn the principle of the ruthless use of natural resources (e.g. CO₂ emissions → atmosphere), as the actual cause of the expected damaging effects of anthropogenic climate change, into the principle of saving, protecting and developing nature.

It is the fundamental project to secure the human existence and maintain decent living conditions as well as to sustain actively climate protection and adaption. Climate protection, climate adaption and energy transformation have to be placed on every spatial level.

For the development of the *NATURE-ORIENTATED, CLIMATE-FRIENDLY METROPOLITAN REGION 2050* following strategies are essential: *NATURE DEVELOPMENT – URBAN RESTRUCTURING – ENERGY TRANSFORMATION. THE CONCEPT OF INTERACTING STRATEGIES: NATURE DEVELOPMENT – URBAN RESTRUCTURING – ENERGY TRANSFORMATION* has to be developed in the local and regional context at all spatial levels in the *METROPOLITAN REGION – CITY – DISTRICT – QUARTER – HOUSE*.

2.2 Aesthetical Principles

With the intention of combining ecological and aesthetical aspects in the spatial qualification of the metropolitan area, aesthetical principles are defined in addition to the mentioned ecological principles of the *PROJECT NATURE*, which are in the consideration of the integrative spatial concept of adequate relevant importance. These aesthetical principles orientate the design and the decision making process of the spatial settings to a substantial aesthetic level and represent basically the spatial principles *CONCENTRATION & PROTECTION* as well as the paradigm of the 21st century towards a sustainable development related to a changed handling of space and nature: *RESSOURCE SAVING & ENERGY EFFICIENCY*.

3. Nature-Orientated, Climate-Friendly Metropolitan Region 2050

Applying this content base and reflecting the particular site-specific geophysical, natural and urban spatial as well as climatic and energetic parameters, the integrative spatial concept for the metropolitan region Rhine-Neckar was developed looking forward the perspective *NATURE-ORIENTATED, CLIMATE-FRIENDLY METROPOLITAN REGION RHINE-NECKAR 2050* (Fig. 1).

The spatial concept shows in the regional context, which appropriate strategies for climate protection and adaption should be placed where, i.e. at which place measures could be concentrated to advance climate protection and climate adaption and to realise the processes *NATURE DEVELOPMENT – URBAN RESTRUCTURING – ENERGY TRANSFORMATION* actually on a grand scale. Inside the catalogue of strategies, which could be considered as a kind of *ROADMAP 2050 CLIMATE PROTECTION AND ADAPTATION* for the Metropolitan Region Rhine-Neckar, the following strategies are considered to be forward-looking:

Spatial strategies and Principles Climate Protection and Adaption

NATURE DEVELOPMENT 1.) forest transformation and forest development 2.) protection and development of open space 3.) development of inner-city green space 4.) room for the river 5.) groundwater protection 6.) organic farming
URBAN RESTRUCTURING 1.) development of the inner-city 2.) development of the existing building stock 3.) energetic urban renewal 4.) climate-friendly and water-sensitive urban development
ENERGY TRANSFORMATION 1.) spatial concentration of wind turbines 2.) urban concentrated use of photovoltaic 3.) use of regional potentials → geothermal energy 4.) use of regional and local potentials → bioenergy 5.) use of regional potentials → hydraulic energy 6.) expansion of public transport & climate neutral mobility 7.) expansion of the electricity network and energy storage

3.1 Spatial Ambition: Nature-Orientated, Climate-Friendly Metropolitan Region 2050

Roadmap 2050: Recommendations for Action in Metropolitan Regions

In the sum of the interactive strategies *NATURE DEVELOPMENT – URBAN RESTRUCTURING – ENERGY TRANSFORMATION*, for which the effects can be approximately valued on the results of scientific reports, 50% energy can be saved (organic agriculture, energetic urban renewal, development of the public transport and the climate

neutral mobility) and 70% CO₂ emissions can be reduced (organic agriculture, energetic urban renewal, development of the existing building stock, application of renewable energies, development of the public transport and the climate neutral mobility).

The integrative spatial concept shows the potentials of climate protection and climate adaption, the focus of strategies and the combination of measures and their interacting effects and synergies. It represents concentrated activity of priority action areas as well as challenges of local and regional interaction. It locates the goals climate protection and adaption and formulates the idea of a *NATURE-ORIENTATED, CLIMATE-FRIENDLY METROPOLITAN REGION 2050* as a common task for local stakeholders with a concrete time frame.

In the general view of the integrative spatial concept a self-evident picture is developed in the implementation of the different measures. The conception of spatial positioning of the strategies in the plan seem partly self-evident, which is caused by the exact consideration of the site-specific geographical reference and about the *WHERE* and *HOW* of the integration of measures in the spatial context. The spatial effects of the strategies serve besides climate protection and adaption to substantial improvement of ecologic and spatial aesthetic qualities.

The strategies are located within the conceptual designing and decision-making process in the maps (Fig. 1+2) according to the analyzed specific characteristics and abilities of the particular spaces and describe the spatial potentials for climate protection and adaption in metropolises and metropolitan regions. The overall view of the integrative concept shows the synergetic principle of the interaction of *NATURE DEVELOPMENT – URBAN RESTRUCTURING – ENERGY TRANSFORMATION* for *CLIMATE PROTECTION & ADAPTATION*. This approach is explicitly oriented to the spatial possibilities and geographical and natural conditions on the sites and to the existing urban building stock. In the setting of the measures the spatial aesthetic principles, mentioned above, have been applied under the title: *CONCENTRATION & PROTECTION* or rather keeping free, which will be explained here with a few examples:

The principle of emphasizing the natural characteristics: The Rhine valley is emphasized as landscape-park with new forests and retention areas. The Palatine and Odenwald forests are kept free of energy-related interventions. They are protected and presented as specific natural treasure of the metropolitan region.

The principle of integration in the environmental context: New forests are integrated in the sparsely wooded Rhine valley, in the Kraichgau, in the landscape along the Rhine and as urban forest in the cities and additional forest in the Odenwald forest.

The principle of spatial concentration of structural, natural and energy-technical interventions as well as the continuance

of existing potentials: Five wind parks are concentrated and connected to existing wind parks and existing networks. According to the priority positioning of the strategy *NATURE DEVELOPMENT*, the construction of wind energy plants in the Palatine forest and Odenwald forest is a taboo – environmental and landscape protection play the mayor role in decision-making.

The spatial characterized choice of location (choice of the adequate location, by weighing up climate protection, climate adaption and spatial aesthetics): Industrial and commercial areas have the greatest potentials for generating solar power compared to other urban space typologies, because of their large roof structures, as well as façade surfaces. In these areas the energy yield is the highest. For this as well as for aesthetic and practicable reasons (simplified realisation of civic power plants), an urban concentrated use of photovoltaics is recommended (protection of cropland for organic farming and forest development).

4. Spatial Ambition: Nature-Orientated, Climate-Friendly Metropolis 2050

Roadmap 2050: Recommendations for Action in Metropolises

The strategies are transferred from the regional (Fig. 1) to the local level (Fig. 2) and the concept *NATURE-ORIENTATED, CLIMATE-FRIENDLY METROPOLIS MANNHEIM 2050* (Fig. 2) is developed to show in addition to the regional (Fig. 1), the urban spatial potentials (Fig. 2) of climate protection and climate adaption. Only in the interaction of integrated regional and local urban strategies the spatial ambition: *NATURE-ORIENTATED, CLIMATE-FRIENDLY METROPOLITAN REGION 2050* could be realized. The following recommended aspects of action are derived from the conception:

- For a climate responsible urban development it is reasonable,
1. to define a superior green space system as basis for future urban development and
 2. to develop the individual urban districts according to the concept of the interactive strategies *NATURE DEVELOPMENT – URBAN RESTRUCTURING – ENERGY TRANSFORMATION*.
 3. On the citywide level the concept of the *NATURE-ORIENTATED, CLIMATE-FRIENDLY METROPOLIS 2050* then results from the principle of interaction between super-ordinated green space structure and climate-friendly developed urban districts and quarters.
- The open green space of the city is the super-ordinated green space system, which connects the city with the landscape and the urban quarters with each other. The strategies *NATURE DEVELOPMENT – URBAN RESTRUCTURING – ENERGY TRANSFORMATION*, which are formulated on a regional level,

are transferred on the local level of the city and of every urban district.

→ The urban districts, which appear partly fragmented, will be supplemented structurally (inner-city development), the existing building stock will be renovated energetically, energy clusters and district heating networks will be established, the energetic potentials will be developed and used by public participation in common power stations (in industrial and commercial areas). Every urban quarter gets a resilient, spatial high qualitative green system with green space for shadow and fresh air in the direct surrounding.

→ The concepts *GREEN METROPOLIS, INNER CITY DEVELOPMENT* as well as *ENERGY EFFICIENCY & ENERGY GAIN* describe in their summation the process of urban restructuring for the city of Mannheim.

→ Climate protection and climate adaption have to be developed in the city and in the quarter according to the potentials of the particular place.

→ The concepts *GREEN METROPOLIS, INNER CITY DEVELOPMENT* as well as *ENERGY EFFICIENCY & ENERGY GAIN* have to interact on a spatial level in the quarters and in the sum of the quarters in the city.

→ The urban quarter seems to be the adequate and effective cell of climate conscious and water-sensitive urban development in the overall urban context towards a *NATURE-ORIENTATED, CLIMATE-FRIENDLY METROPOLIS 2050*, also because of its manageable dimension. The development of district-related concepts of interactive strategies provides the opportunity to develop district-specific and qualifying solutions and beyond that the activation of local stakeholders.

5. Summary of the recommended action for the spatial development of the metropolis

The open green space as starting point of planning

→Establishment of an continuous green space system

(resilient spatial structure and spatial connecting of the different quarters of the city)

→*The individual urban districts are the objects on the ground of the natural green space* (Figure – Ground)

→Developing the districts as functional clusters climate protection + climate adaption,

Interaction of the concepts *GREEN METROPOLIS, INNER CITY DEVELOPMENT, ENERGY EFFICIENCY & ENERGY GAIN*, which in total represents a *NATURE-ORIENTATED, CLIMATE-FRIENDLY & WATER-SENSITIVE METROPOLIS 2050*.

The nature-orientated, climate-friendly and water-sensitive urban development contains in every quarter the concepts:

CONCEPT GREEN METROPOLIS

CONCEPT INNER URBAN DEVELOPMENT

CONCEPT ENERGY EFFICIENCY & ENERGY GAIN

with the aims of the development of spatial qualities and spatial sustainability in the city.

The special challenge in the realisation of spatial strategies for climate protection and adaption and in the success of the transformation, caused by climate change and energy turnaround, is about the principles of *CONNECTING, COOPERATING & INTERACTING* as the upcoming tasks will only be accomplished through a *COMMON SOCIETAL ACT OF SOLIDARITY*. The *CONCEPT OF INTERACTING STRATEGIES* points to the potential to realise appropriate tasks and strategies as well as to achieve an appropriate impact in the network of stakeholders. First experiences in the implementation of the represented national and international examples point to the essential role of political commitments for the spatial implementation of the formulated political aims. Political

commitments have to be represented in spatial concepts with a concrete time horizon of realisation. They have to correspond to the space and its specific conditions.

6. Chances

NATURE DEVELOPMENT – URBAN RESTRUCTURING – ENERGY TRANSFORMATION are qualification processes, which can lead to an improvement of existing qualities.

NATURE DEVELOPMENT

→ Chance of ecological (+ aesthetic) Qualification

URBAN RESTRUCTURING

→ Chance of aesthetic (+ ecological) Qualification

ENERGY TRANSFORMATION

→ Chance of sociopolitical (+ ecological) Renewal

In connection and interaction of these strategies a development path of sustainable spatial development will be developed in an ecological, aesthetic and sociopolitical regard.

(Received Nov. 30, 2014, Accepted Dec. 27, 2014)

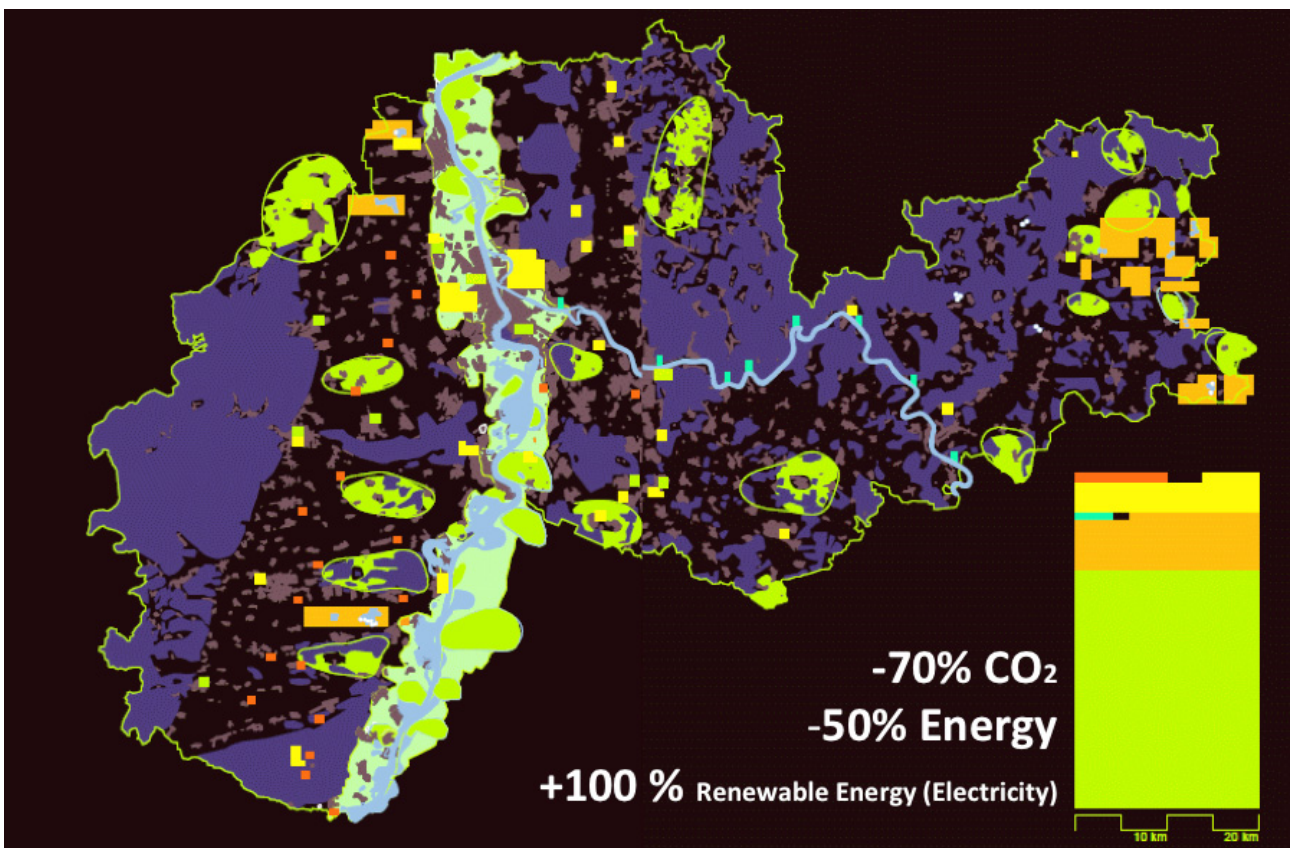


Fig. 1 *NATURE-ORIENTATED, CLIMATE-FRIENDLY METROPOLITAN REGION 2050*

Legend: green: new forests, orange: wind energy, yellow: photovoltaics, turquoise: hydroenergy red: geothermal energy

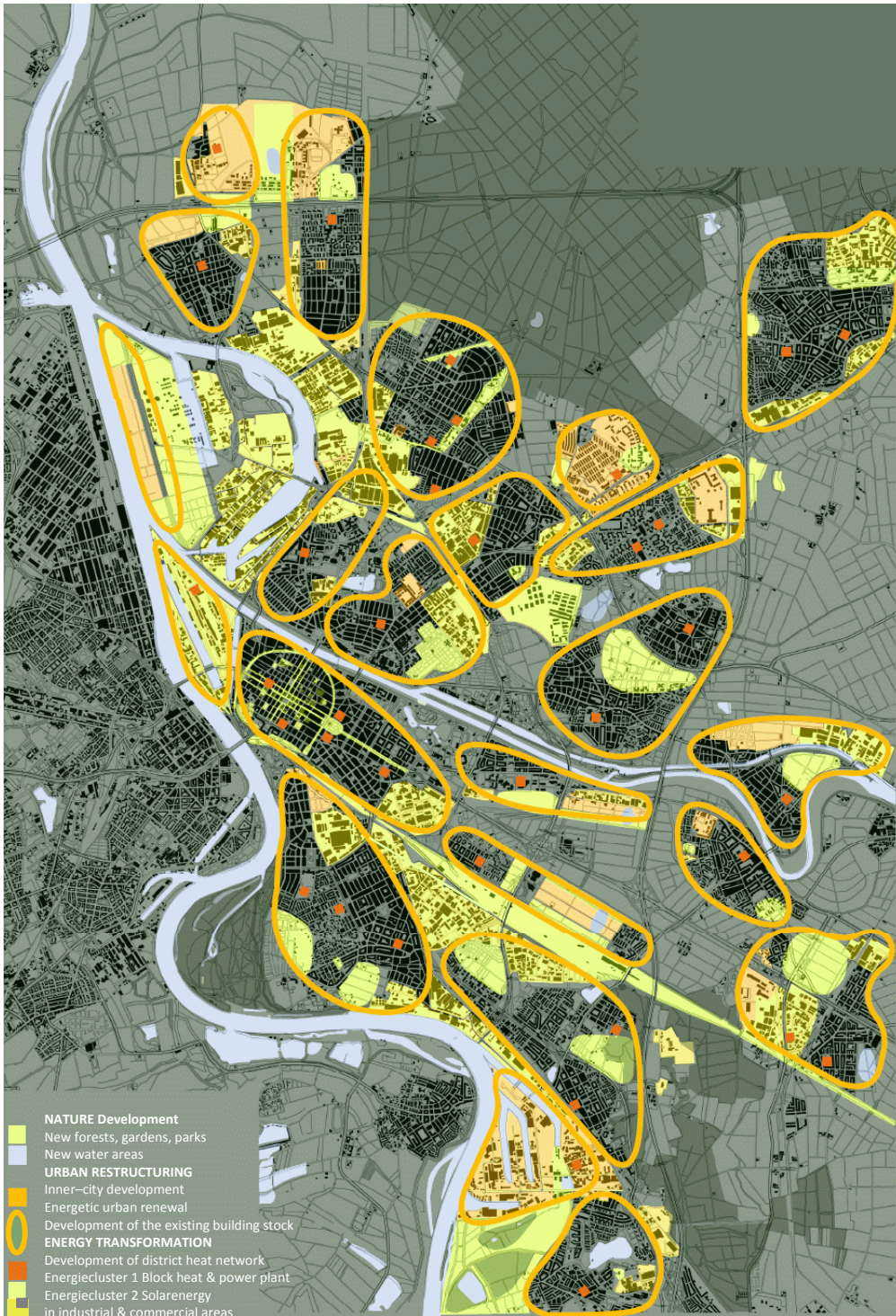


Fig. 2 NATURE-ORIENTATED, CLIMATE-FRIENDLY METROPOLIS 2050

Legend: NATURE DEVELOPMENT: green: New Forests, Gardens & Parks, blue: New Water Areas

URBAN RESTRUCTURING: orange: Inner-City Development, Energetic Urban Renewal

orange line: Development of the Existing Building Stock +

ENERGY TRANSFORMATION: Development of District Heat Network

red: Energiecluster 1 Block Heat & Power Plant

yellow: Energiecluster 2 Solarenergy in Industrial & Commercial Areas

(Metropolregion im Klimawandel – Räumliche Strategien Klimaschutz und Klimaanpassung,

Kristin Barbey, KIT Scientific publishing 2012: <http://digbib.ubka.uni-karlsruhe.de/volltexte/1000029071>)