GREEN BUILDINGS AND SUSTAINABLE NEIGHBOURHOODS

PROJECT LEADER

Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

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Exhibition

Build4People Project

Sustainable Buildings for People - Enhancing Urban Quality of Life in Cambodia

Exhibition Aims and Rationale

Aims:

- The exhibition is a tangible product raising awareness on the topic of green buildings and sustainable neighbourhoods.
- The exhibition provides information in an accessible format with easy-to-understand language, many graphic visualisations and photos to reach out to a wide public.
- The main target group for this exhibition are end-consumers in Cambodia, architects, construction and engineering companies, developer enterprises and institutions of higher education.
- Presentation of first ideas how to apply those to Cambodia.
- Manufacturing of the exhibits in a portable form because the aim is to do a touring exhibition which shall be shown at as many locations as possible in Cambodia.

Rationale:

Highly dynamic urbanisation is giving rise to more resource-intensive lifestyles, going along with new values and life concepts being formed, with new aspirations and new possibilities are set into place.

Therefore, the development towards a modern consumer society in urban Cambodia strongly affects the way buildings are designed, built and operated.

All in all, the potential to promote climate-adapted architecture, energy efficient and healthy buildings and sustainable neighbourhoods is far from exhausted.

Implementing green buildings and sustainable neighbourhoods will reduce energy costs - which are the among the highest in the region - but it will also contribute to an overall higher urban quality of life through increased thermal comfort, better access to urban green as well as improved indoor and outdoor air quality.

(fig. 1)

The Sustainable Development Goals (SDGs) of the United Nations are the blueprint to achieve a better and more sustainable future for all. They address the global challenges we face, including those related to poverty, inequality, climate change, environmental degradation, peace and justice. The 17 goals are all interconnected, and in order to leave no one behind, it is important that we achieve them all by 2030.

The project Build4People addresses mainly SDG Goal 11 and 12, but it also contributes to other goals and related objectives.

Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Goal 12: Ensure sustainable consumption and production patterns

Acknowledgement

The development of the Build4People exhibition was supported by funds from the German Ministry of Education and Research (BMBF) in the context of the research project “Build4People: Sustainable Buildings for People – Enhancing Urban Quality of Life in Cambodia”. This is part of the BMBF funding programme “Sustainable Development of Urban Regions”.

Curator of the Build4People Exhibition “Green Buildings and Sustainable Neighbourhoods”

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Three Exhibition Parts

Part 1
Science Posters

They introduce general principles of sustainability from a multi-disciplinary team which are based on different policy fields such as urban green, urban climate, buildings, neighbourhood development or urban transformation.

Part 2
Case Study Posters

The 1st edition of the Build4People exhibition introduces best-practice case studies from Germany and Europe.

Part 3
Introducing DGNB

Europe's biggest network for sustainable building

DGNB
Deutsche Gesellschaft für Nachhaltiges Bauen
German Sustainable Building Council

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Comprehensive sustainable neighbourhood development and green building design (fig. 2)

Better City – Better Life

The EXPO 2010 in Shanghai was the first World Exhibition that focused on innovative models for a higher urban quality of life in our increasingly urbanized world: Better City - Better Life.

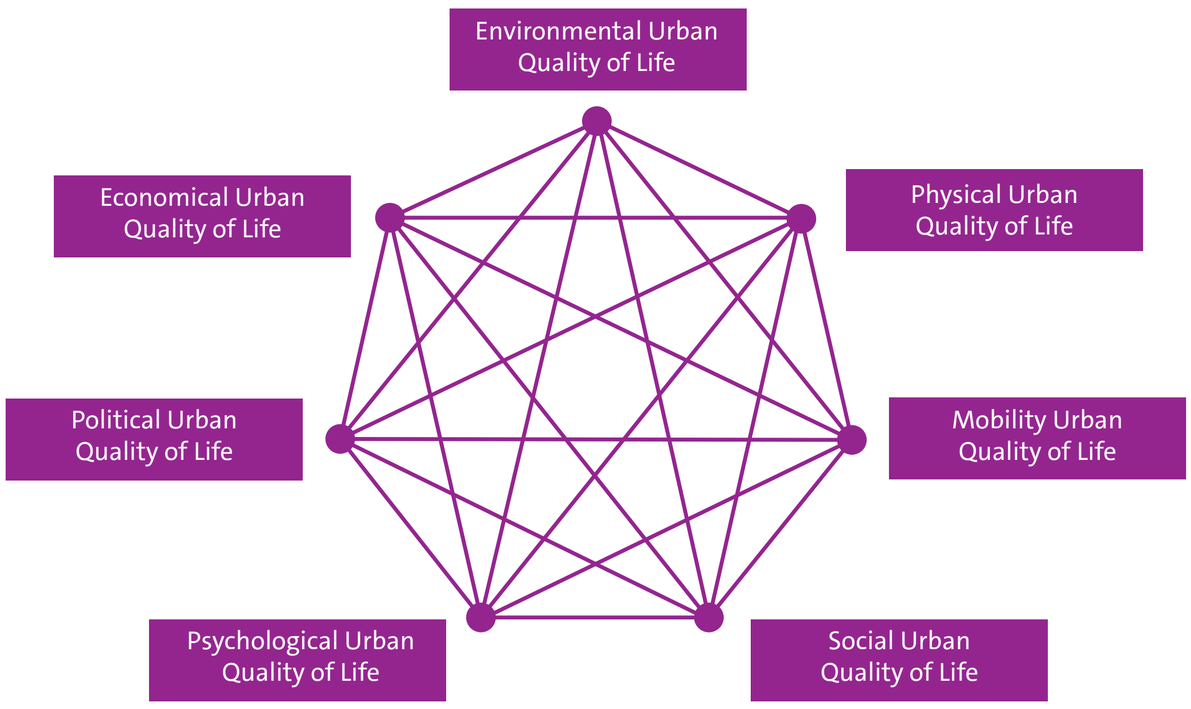
Though various definitions of "quality of life" exist, it is generally understood as a multi-dimensional notion that brings together physical, psychological, social and ecological aspects. Most quality of life concepts take into account both subjectively perceived well-being such as individual health satisfaction levels and "objectively" measurable conditions including crime rates or average income levels.

Research on quality of urban life focuses on urban residents as a specific group and the urban space with its socio-cultural, built and natural characteristics as key determinants. As such, quality of urban life is the outcome of dynamic "human environment interactions" and can thus be considered modifiable by urban planning and other forms of interventions.

The research on quality of urban life is interdisciplinary in orientation and includes fields such as urban planning, geography, urban sociology, psychology, economics, medicine and other disciplines of spatial and urban research.

Objective indicators	Subjective indicators
Employment rates	Housing and neighbourhood satisfaction
Educational attainment	Desire to move
Per capita income	Perceptions of crime
Crime statistics	Perceptions of school quality
Domestic violence	Perceptions of health care services
Death rates	Feelings about neighbours
Incidence of chronic diseases	Feelings about rubbish collection
Air quality	Feelings about congestion and crowding
Residential density	Feelings about governance
Housing vacancy rates	Satisfaction with health
Amount of green spaces	Satisfaction with family, friends, job, etc.
Distance to transit stop	Life satisfaction, overall happiness (overall well-being)

Select indicators of urban quality of life (fig. 3)



Urban quality of life dimensions (fig. 4)

Application to Cambodia

The quality of urban life has not yet been sufficiently researched in Cambodia. Based on a solid understanding of aspects and processes that influence the quality of life in Cambodia, civil society, the business community and policy makers can align their actions with the research findings in order to make Cambodian cities better and more liveable.

Our multi-disciplinary research team includes Cambodian and German partners from several disciplines who cooperate on a trans-disciplinary basis. Led by the University of Hamburg, the consortium brings together four universities and two SMEs from Germany, and three Cambodian universities. This includes the Royal University of Phnom Penh, the Royal University of Agriculture and the Paññāsāstra University of Cambodia.

Image credits:

Poster A01, fig. 1 www.sustainabledevelopment.un.org/sdgs
fig. 2 Eble Messerschmidt Partner / moka-studio GbR Hamburg
Poster 2 Text Source: German Advisory Council on Global Change (WBGU) 2016
fig. 3 Marans and Stimson (2011)
fig. 4 Heptagon Shape, The Researcher 2012

Work Package 7
Coordination, Communication and Dissemination

Universität Hamburg
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Local Research Partner

CIUS
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Dr. Susanne Bodach

Build4People Project
Sustainable Buildings for People - Enhancing Urban Quality of Life in Cambodia

www.build4people.org

B 01

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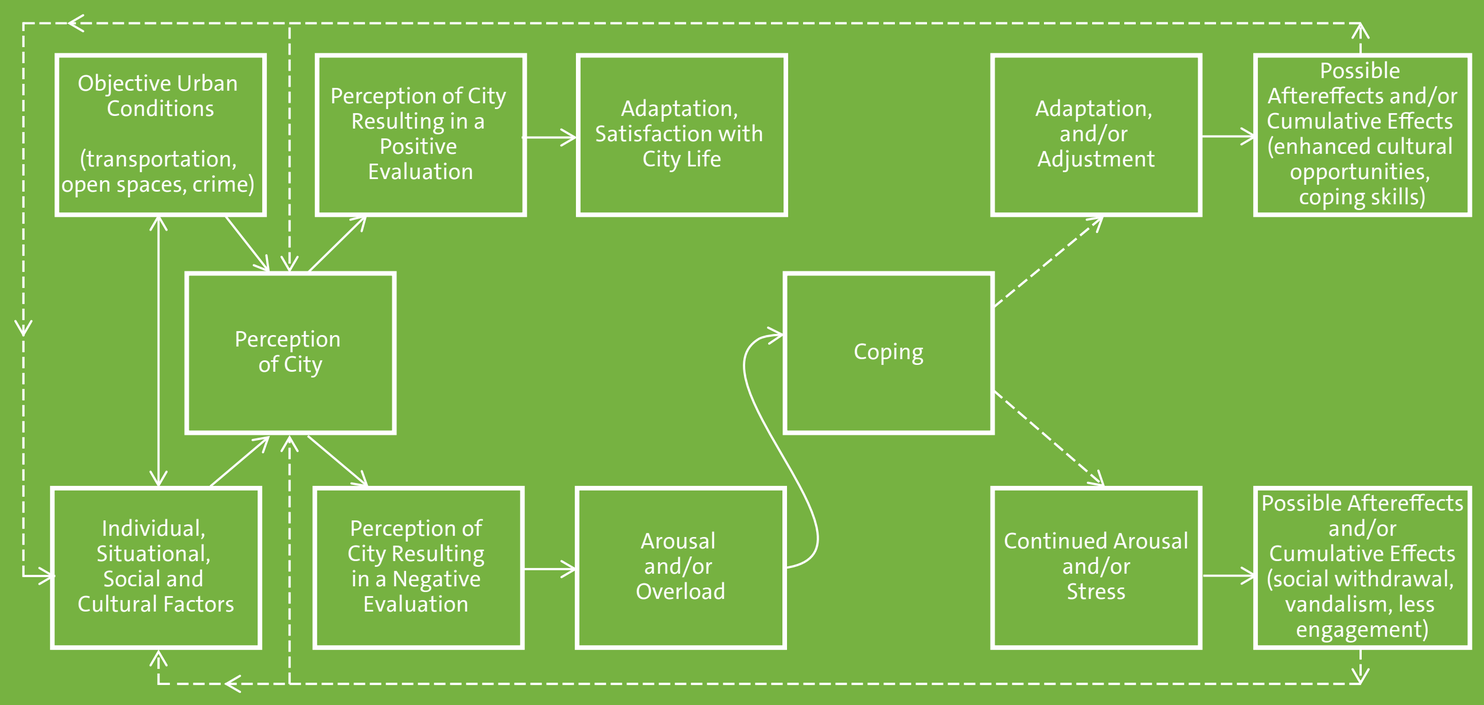
A city for people – What factors determine urban quality of life and pro-environmental behaviour in cities?



Coping with Environmental Stress (fig. 1)

Behaviour Change

SDG 12: Worldwide material consumption has expanded rapidly, as has material footprint per capita. Actions should include policies that improve resource efficiency, reduce waste and mainstream sustainability practices across all sectors of the economy.

Goals and Background

With the perspective of environmental psychology, we focus on motives and factors that influence pro-environmental behaviour. Moreover, we want to understand human-environment interactions in the city and urban quality of life.

Quality of life includes psychological basic needs, psychological stress, and mechanisms how people cope with stress (→ coping).

Pro-Environmental Behaviour

- Different behaviours are considered to have a relevant impact on the local and the global climate.
- We want to learn more about relevant behaviours and how they are influenced by the social context.
- With a better understanding of the circumstances of people's life, we try to support a sustainable lifestyle with the help of interventions.

Environmental Stress Coping

- Urban quality of life is connected to coping with environmental stress.
- Different factors lead to one's perception of the city, associated with activation.
- This activation can lead into successful or unsuccessful coping, which may affect people's well-being in different ways.

Various Facets of Environmentally Friendly Behaviours

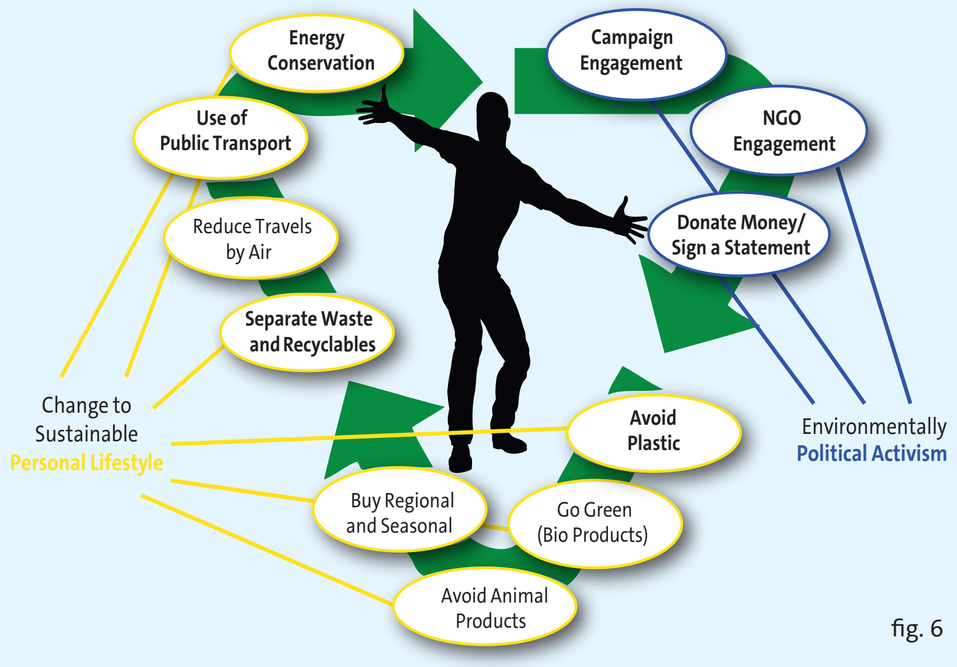
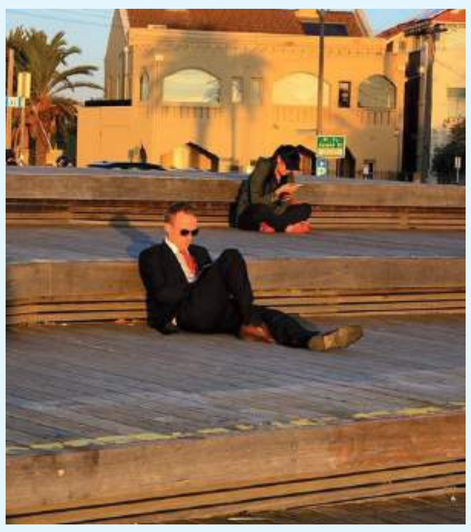


fig. 6



Public open spaces in urban areas can contribute to people's quality of life by giving the possibility to rest and stay in an area with less stimuli. Melbourne (fig. 2)

The infrastructure of a city can contribute to pro-environmental behaviours like sustainable forms of mobility. Amsterdam (fig. 3)

Cities offer many possibilities for different requirements. At the same time, several environmental stressors can lead to an overload of information and affect people's well-being. (fig. 4)

Open green spaces in cities can enhance people's well-being as they offer different kinds of recreation and social activities. Munich (fig. 5)

Application to Cambodia

Due to the increasing availability of goods and purchasing power, the lifestyle of the Cambodian society also changes in regard to environmental issues. Our aim is to find factors which determine pro-environmental behaviour and the evaluation of urban quality of life. We especially focus on the group of the so-called „new consumers", since they can be characterised by a higher autonomy in choosing housing and lifestyle options.

Image credits:
fig. 1-6 Own design Build4People WP#1

Work Package 1
Behaviour Change

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WP Research Associate: Annalena Becker

Local Research Partner

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Buildings with good indoor environmental quality, energy efficiency and resource-efficient design that are well-integrated in the urban environment and make use of natural energy sources.

The Heliotrop was the first home in the world to produce more energy than it consumes: emission-free, CO2 neutral and 100% regenerative.

The Heliotrop, Freiburg, Germany (fig. 1)

SDG Target 11.c: Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials.

Sustainable Buildings

Goals and Background

Buildings in Germany are responsible for 35% of end energy use and 60% of resource consumption for construction and operation.

Improvements towards energy-efficient and sustainable buildings, will therefore make significant contributions towards the achievements of the national and international climate protection goals and the protection of natural resources.

Buildings provide protected spaces for people with private spaces and controlled indoor conditions. Indoor environmental quality contributes to peoples' well-being and quality of life.

Sustainable buildings will satisfy these objectives based on assessment of socio-functional, economic and environmental criteria through thoughtful design of technical and functional systems and material selection.

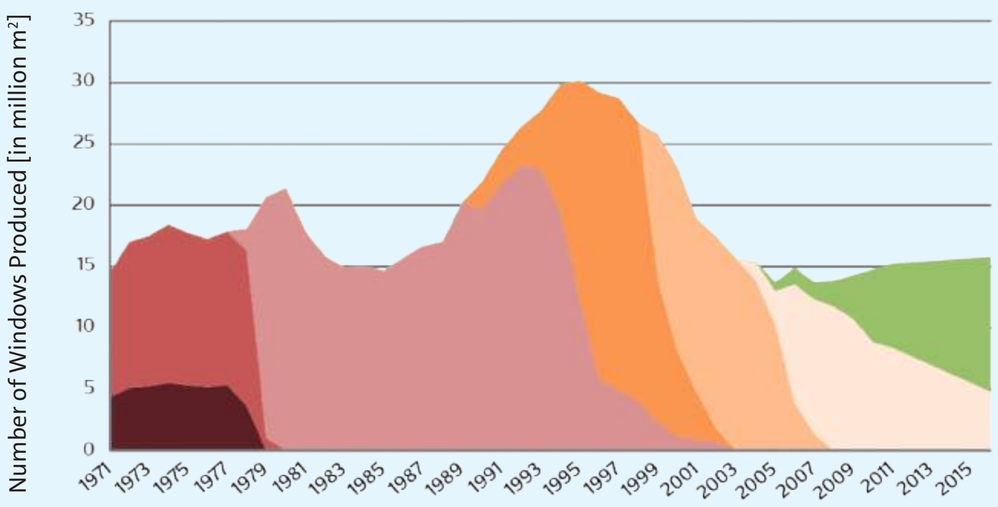
Building Envelope

- To protect the inside of the buildings from the cold in the German climate the building envelope is equipped with insulation layers made of materials with low heat conductivity.
- Glazing systems and window frames are developed to reduce heat transmission from the inside to the outside. All joints and elements are executed to ensure airtightness, reduce unwanted air exchange and energy loss.

Controlled Ventilation

- As in new energy-efficient buildings uncontrolled ventilation is reduced through the airtight building envelope, provisions need to be made to supply "fresh" outside air to the interiors. This is necessary to remove CO2 and moisture from the building to avoid high CO2 concentrations and moisture-related damages to the building envelope.
- Controlled ventilation will also allow installing heat exchanger to warm the supplied outside air against the warm removed inside air. Thereby heating energy is saved.

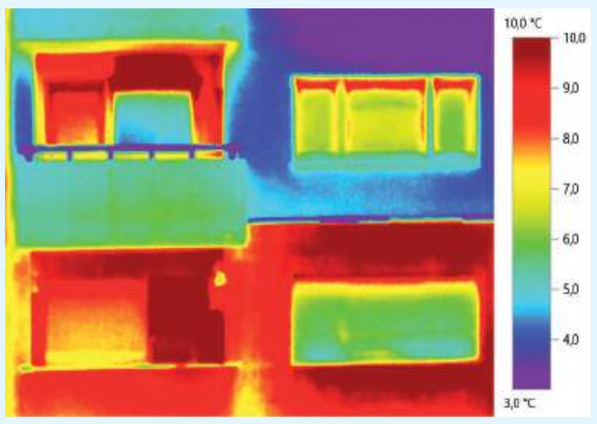
Produced Glazing-Types in Germany in the Course of Time



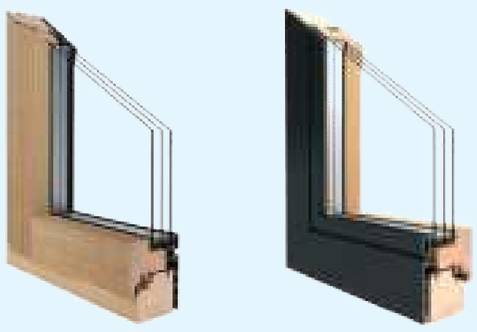
Single glass Ug = 5.8 W/(qm-K)
Insulating glass (uncoated)Ug = 2.8 W/(qm-K)
2-fold thermal insulation glass Ug = 1.2 W(qm-K)
3-fold thermal insulation glass Ug = 0.7 W(qm-K)

Box type/composite window Ug = 2.8 W/(qm-K)
2-fold thermal insulation glass Ug = 1.4 W(qm-K)
2-fold thermal insulation glass Ug = 1.1 W(qm-K)

fig. 2

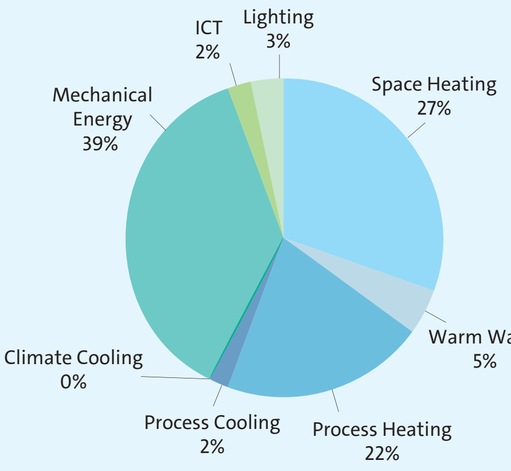


Example of Energy Loss through Windows and Roof (fig. 3)

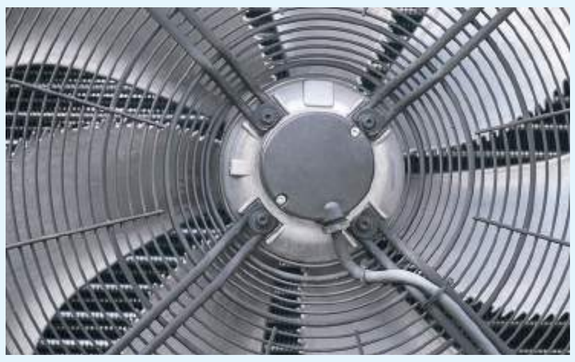


Example of Window Glazing Systems (fig. 4)

In Germany 30-35% of the End Energy Demand is used in Buildings



End Energy by Use in Germany's Building Sector (fig. 5)



Example of Mechanical Ventilation Systems (fig. 6)

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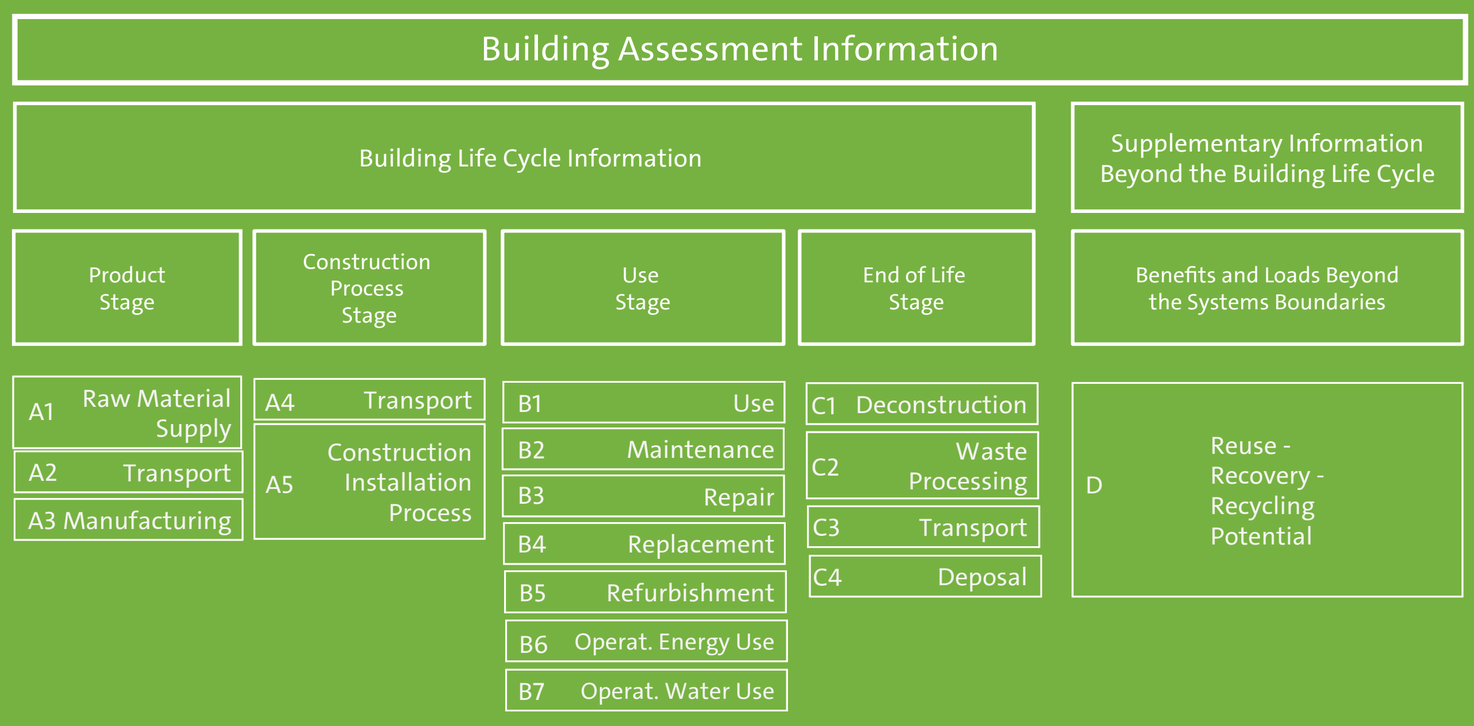


Life Cycle Phases for Building Assessment (fig. 8)

Sustainable Buildings

Sun Shading

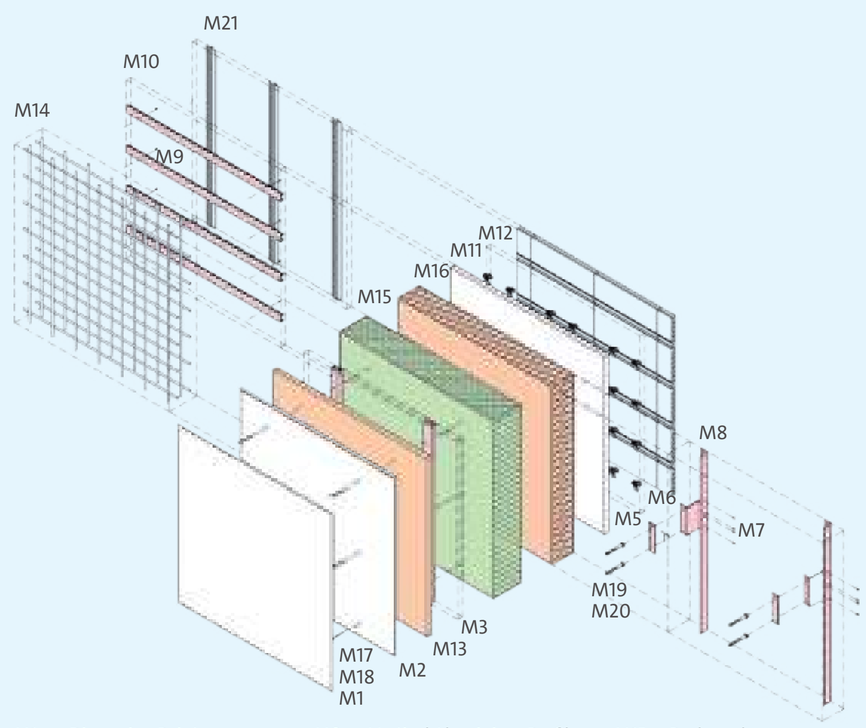
- In summer the building's interior needs to be protected from the sun to avoid overheating and discomfort glare in the occupied spaces. Mechanical cooling is to be avoided through passive design.

Renewable Energy Applications

- In recent years it has become common practice to make use of renewable energy for domestic hot water generation and for solar supported heating systems with solar thermal systems as well as for building integrated electricity generation with PV-systems.
- Today all new buildings in Germany need to prove that they make use of renewable energy sources in order to receive a construction permit.

Resource-Efficient Design

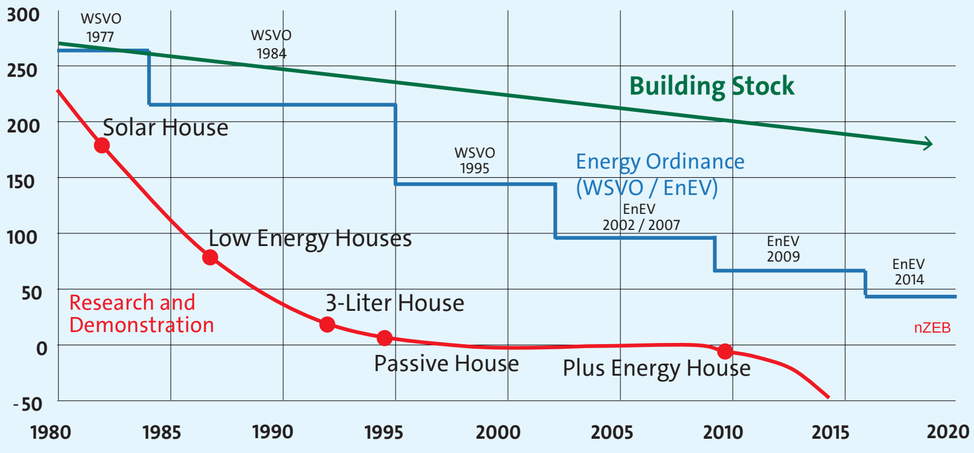
- In order to reduce the demand for resources in construction projects various principles are applied. During the design of sustainable buildings the resource consumption and the environmental impact is assessed in life-cycle-assessment studies (LCA).
- Also, buildings are being built with recycled content and very innovative buildings are designed for deconstruction. Wood structures are increasingly constructed, to replace energy- and resource-intensive concrete and other heavy materials.



M1	Dispersion Paint	M8	Vertical Aluminium Profile	M15	Rockwool
M2	Aluminium Gypsum Plates	M9	Steel Rivets	M16	Air Layer
M3	Aluminium Profile	M10	Steel Rivets	M17	Screws
M4	Ready-Mix Concrete	M11	Aluminum Fasteners	M18	Dowels
M5	Therm. Separator Elements	M12	Brick Plates	M19	Screws
M6	Aluminium Wall Bracket	M13	Aluminium Profile	M20	Dowels
M7	Steel Rivets	M14	Reinforcement Mats	M21	Aluminium Joint Profile

Design for Deconstruction (fig. 13)

Primary Energy Demand – Heating [kWh/m²a]



Development of the Energy Demand in the Residential Building Sector in Germany (fig. 7)

SMA Solar Academy (fig. 11)

Example of Sun Shading (fig. 9)

Example of an Integrated PV System (fig. 10)

Example of Efficient Insulation System (fig. 12)

Application to Cambodia

While the climate and the context is different in Cambodia, the key objectives for sustainable building are the same for building design around the world.

Buildings shall provide functional and healthy environments for people, energy-efficient operation and be constructed saving the essential resources. Sustainable buildings are connected to the urban environment and make use of natural energy sources for ventilation, conditioning and energy supply.

Image credits:

fig. 1 Rolf Disch, SolarArchitektur
fig. 2 VFF/BF 2017, Mehr Energie sparen mit neuen Fenstern
fig. 3 D. Schwede, 2020
fig. 4 https://www.hood.de/i/holz-alu-fenster
fig. 5 Bott, Grassl & Anders (2019)
fig. 6 Adobe Stock Calek
fig. 7 Own graphic Build4People WP#2, after H. Erhorn-Kluttig et. al. 2015, FH IBP
fig. 8 DIN EN 15804:2012-04
fig. 9 Adobe Stock mrivserg
fig. 10 Adobe Stock galam
fig. 11 SMA Solar Academy_Constantin Meyer
fig. 12 Adobe Stock Arpad Nagy-Bagoly
fig. 13 D. Schwede, E.Störl, 2016, Methode zur Analyse der Rezyklierbarkeit von Baukonstruktionen

Work Package 2
Sustainable Building

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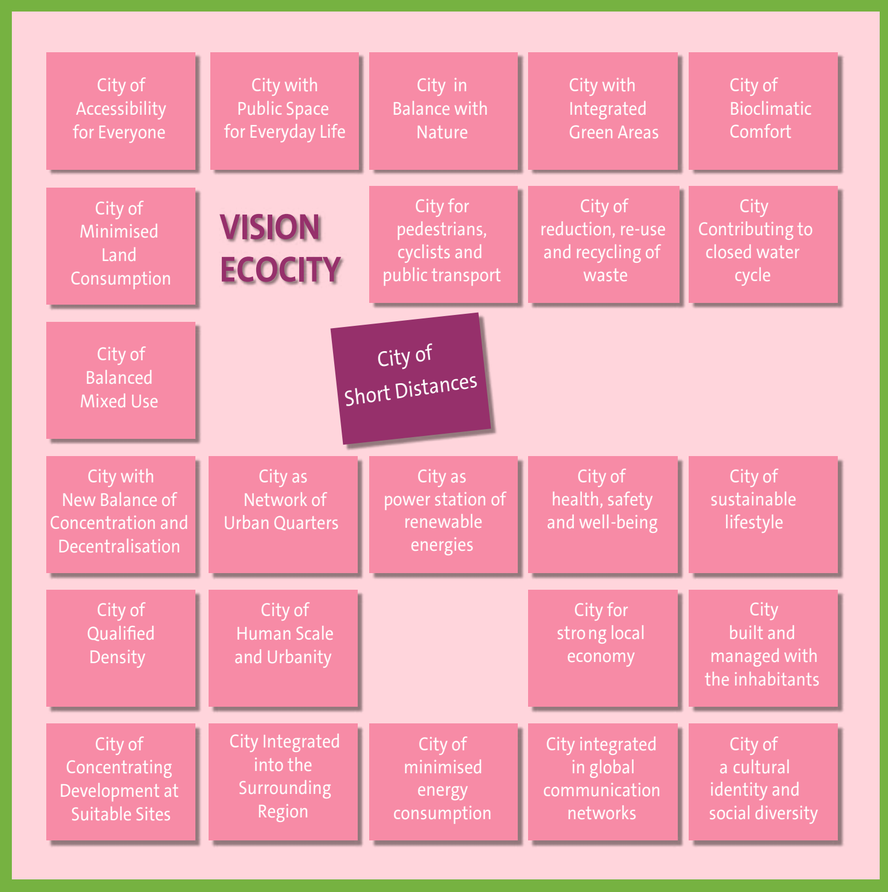
Sustainable Neighbourhoods provide urban-structural, socio-economic and cultural preconditions for sustainable lifestyles – based on community involvement and urban management.



Vision of an Ecocity (fig. 1)

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Sustainable Neighbourhoods

Goals and Background

Neighbourhoods are key activity areas for sustainable urban development and a high urban quality of life. The focus of sustainable neighbourhood development should be based on people's aspirations and needs: By offering many homes and workspaces, public and private amities, as well as by providing a mix of uses and social diversity. At the same time, the open spaces, building patterns and technical infrastructure have to address climate protection and climate change.

Liveable mixed-use neighbourhoods can attract businesses, particularly small and medium sized enterprises, and boost the local economy.

The design and management of neighbourhoods should be based on citizens' and user's participation. Multi-disciplinary design processes should involve all relevant experts from early project stages on for developing sectoral concepts (such as landscape, mobility, energy, water and urban climate).

This will support synergetic effects between the different concepts. Furthermore, advanced quality assurance and assessment tools for sustainable neighbourhoods can foster the sustainability profile of developments.

The ultimate goal is to achieve vibrant, resilient and future proof neighbourhoods with a long-term economic infrastructure that are well integrated into the built and natural environment.

Sustainable Urban Planning

The goal is to strive for a polycentric, compact and transit-oriented city structure and to develop holistic neighbourhoods that integrate all mentioned concepts in the highest possible sustainability quality. The objectives are:

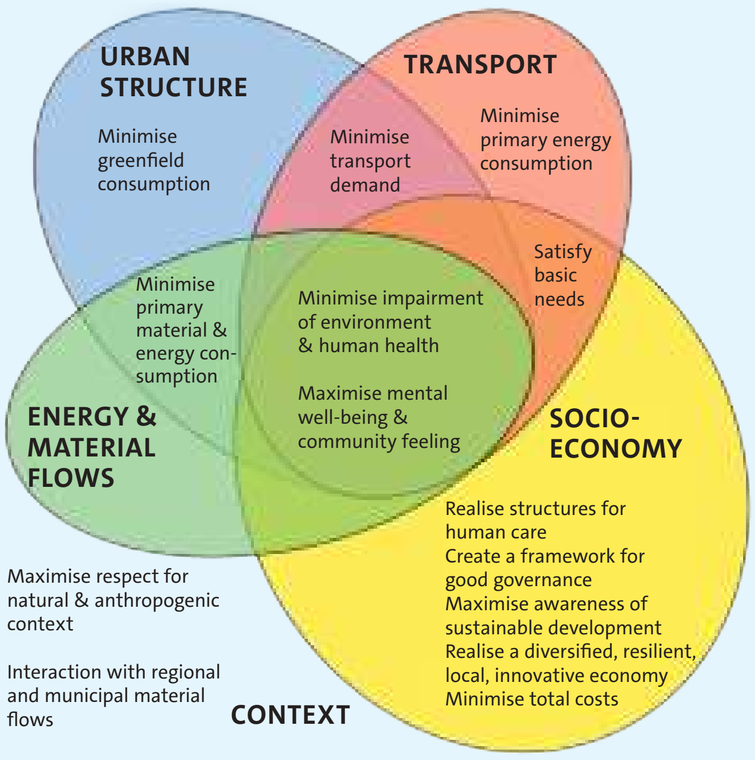
- Increase re-use of land and built structures to reduce demand for land and new buildings.
- Develop structures of ecologically and socially qualified high density.
- Promote use, re-use and revitalisation of the cultural heritage.

Balanced Mix of Uses

Mixed use neighbourhoods contribute strongly to the quality of urban life, addressing the following objectives:

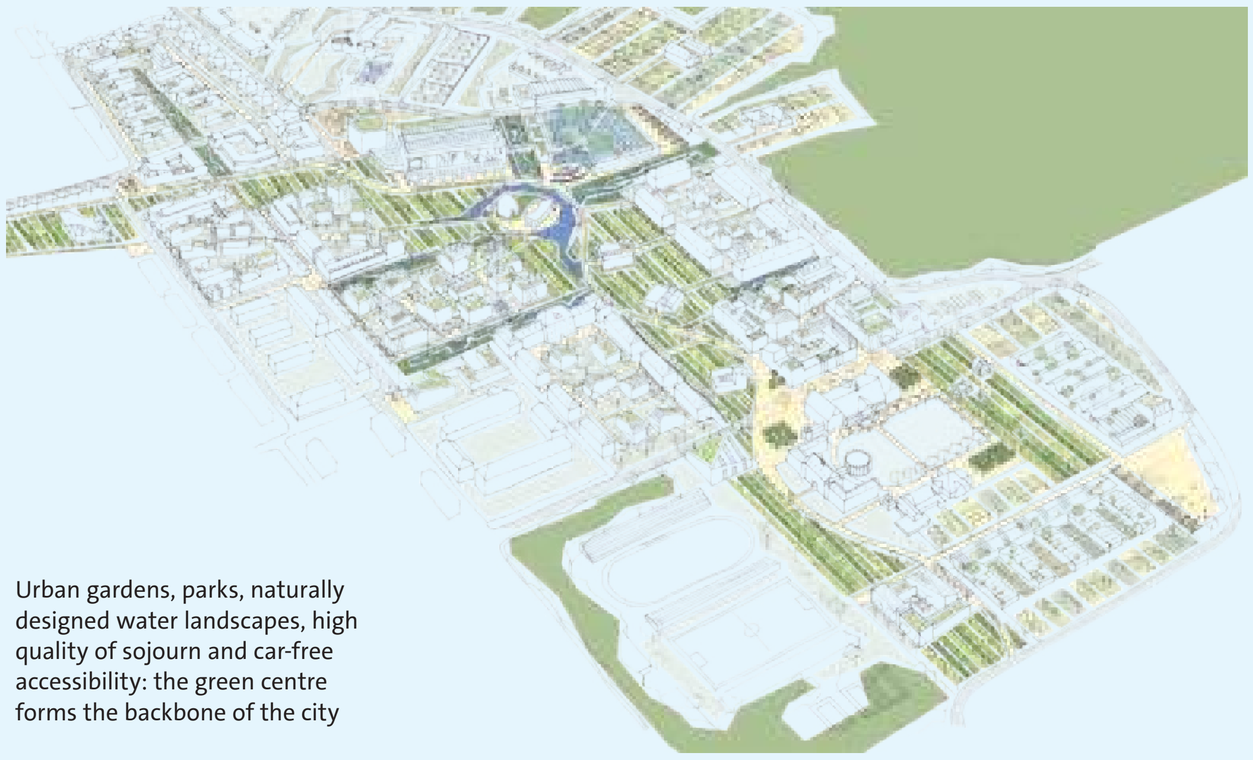
- Organise a balance of residential, employment and educational uses, as well as supply and recreational facilities.
- Strive for fine-meshed mixed-use structures at building, block or neighbourhood level, also considering the variability and flexibility of urban and building structures.
- Provide social infrastructure with good accessibility.

Comprehensive Neighbourhood Design



Overall Ecocity Goals (fig. 2)

Blue-Green Infrastructure



Urban gardens, parks, naturally designed water landscapes, high quality of sojourn and car-free accessibility: the green centre forms the backbone of the city

Example of an integrated neighbourhood design, International Campus Ecocity Wünsdorf (near to Berlin) (fig. 3)

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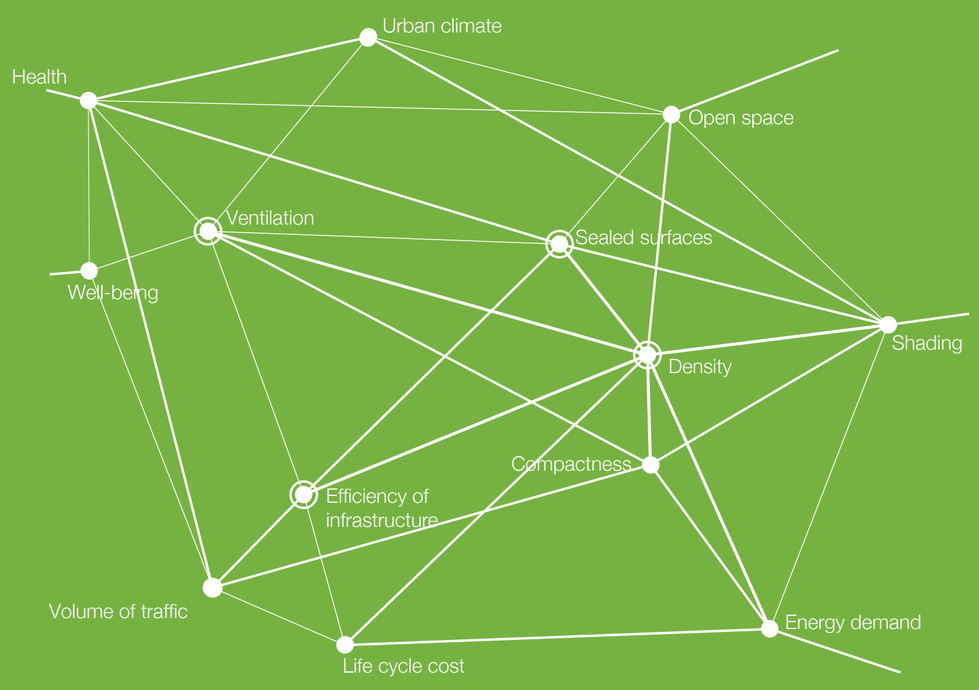


Interrelated Urban Design Parameters (fig. 4)

Lake for stormwater management, biodiversity and outdoor comfort in residential area, example Winnenden (near to Stuttgart) (fig. 5)

Sustainable Neighbourhoods

Social Diversity

Developments should promote social diversity and integration as a precondition for long term stable neighbourhoods. The objectives are:

- Strive for a mixed population (in terms of income, age, cultural background and lifestyle concepts).
- Provide a variety of dwelling types for different population groups (e.g. singles, families, senior citizens).
- Plan for different ownership models (owner-occupied houses or flats and rented apartments, including social and low-cost housing).

Attractive and Green Open Spaces

Open space design is essential for communication and encounter, for slow movement within the neighbourhoods and for creating or restoring biodiversity. The objectives are:

- Provide attractive and liveable public spaces for everyday life.
- Consider liveability, legibility and connectivity of public space patterns.
- Create landscape patterns for a high social usability.
- Integrate natural elements and cycles into the urban tissue.

Climate Responsive Urban Design

For addressing climate change and climate adaptation, the following objectives should be considered:

- Plan in accordance with the climatic, topographical and geological setting.
- Strive for high daily, seasonal and annual outdoor comfort: in open spaces.
- Minimise air pollution by reducing gaseous and particulate emissions at source and integrating air cleaning elements.
- Minimise noise pollution.

Water Sensitive Urban Design

Water in the city is an important activity area for mitigating climate adaption. Saving the scarce resource water, stormwater management for flood protection and the integration of a blue-green infrastructure should be addressed with these objectives:

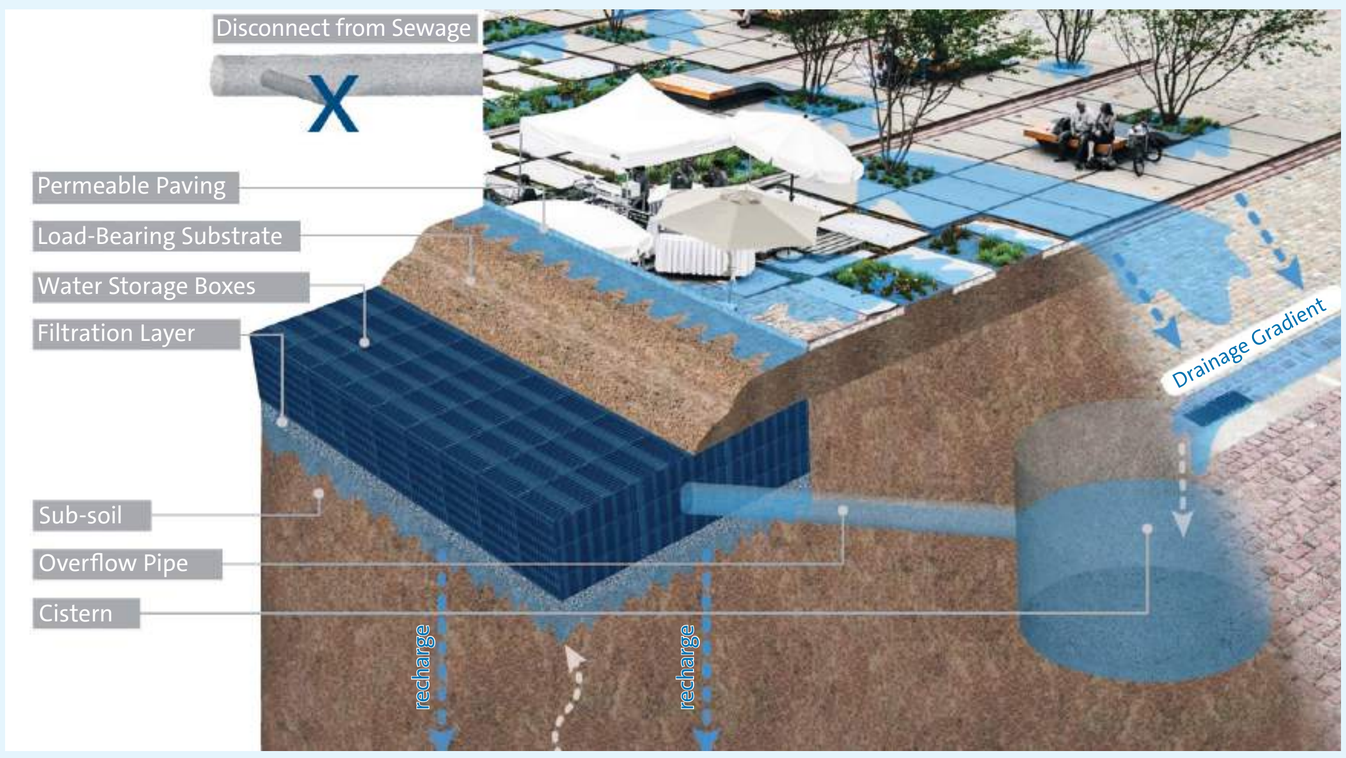
- Minimise primary water consumption (e.g. water-saving devices, using of rainwater, recycling of greywater, efficient irrigation).
- Minimise impairment of the natural water cycle (e.g. permeability of soil, sustainable drainage systems).

Carbon-Zero Energy Neighbourhoods

For achieving the national German and European climate protection goals, all neighbourhoods should strive for a yearly balance of carbon emissions, which is zero or even positive. The objectives are:

- Optimise the energy efficiency of the urban structure (e.g. compactness of buildings, solarisation and shading, day-lighting conditions).
- Minimise energy demand of buildings and infrastructure.
- Maximise efficiency of energy supply and share of renewable energies.

Sponge City for Climate Responsive Urban Design



Stormwater management in dense inner-city areas, example Zollhallen Square in Freiburg (fig. 6)

Mixed-use and liveable streetscapes, example Tuebingen Suedstadt (fig. 7)

Water playground, example Arkadien Asperg near to Stuttgart (fig. 8)

Green community courtyard, example Alte Weberei Tübingen (fig. 9)

Urban Gardening in cities, example Princess Gardens in Berlin (fig. 10)

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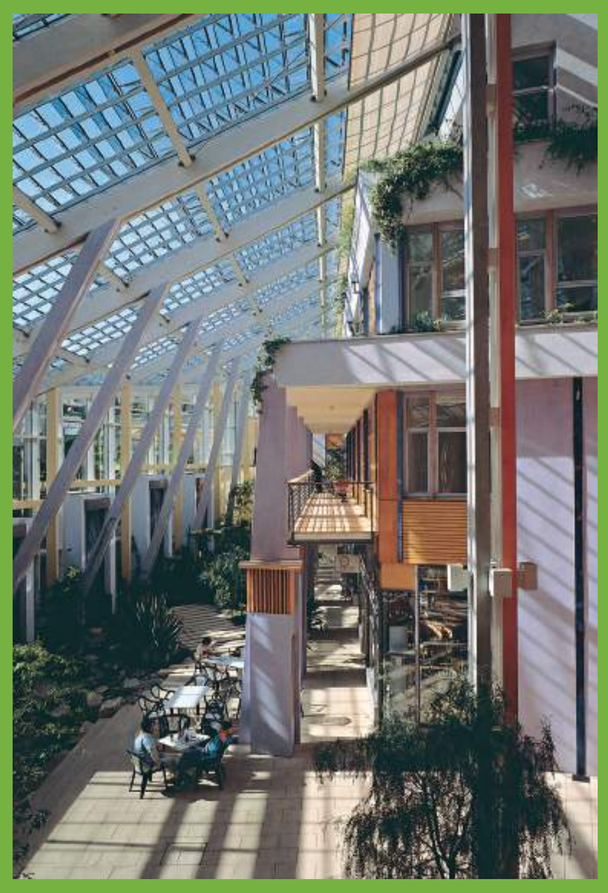
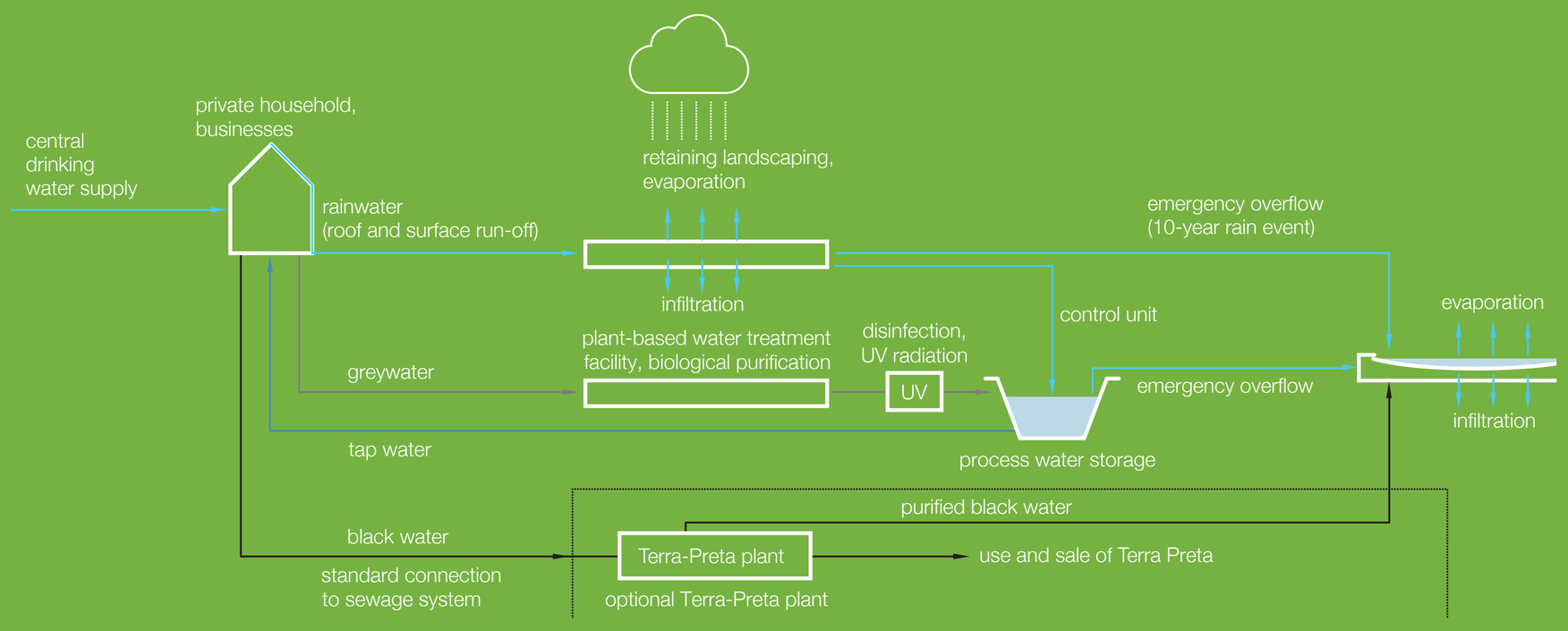


Greenhouse as a sheltered urban indoor area, with an integrated energy, water and landscape strategy (fig. 11)



Sustainable water management incl. production of fertile black soil “Terra Preta” (fig. 12)

Sustainable Neighbourhoods

Post-Fossil Mobility

In order to provide mobility for all, to increase safely and to reduce carbon, other gaseous and noise emissions at the same time, a sustainable transport system is of major importance.
The objectives are:

- Minimise distances (in time and space) between activities to reduce travel demand.
- Give priority to public transport as the most important element of a sustainable personal transport.
- Give priority to pedestrian and cycle paths as the main network for internal neighbourhood traffic.
- Provide mobility management measures to support modal shift to environmentally compatible modes.
- Reduce the volume and speed of individual motorised travel and support the reduction of motorised traffic through parking management.
- Use of alternatively fuelled vehicles.
- Facilitate a neighbourhood logistics and delivery concept.
- Plan for efficient construction logistics.

Circular Economy Neighbourhoods

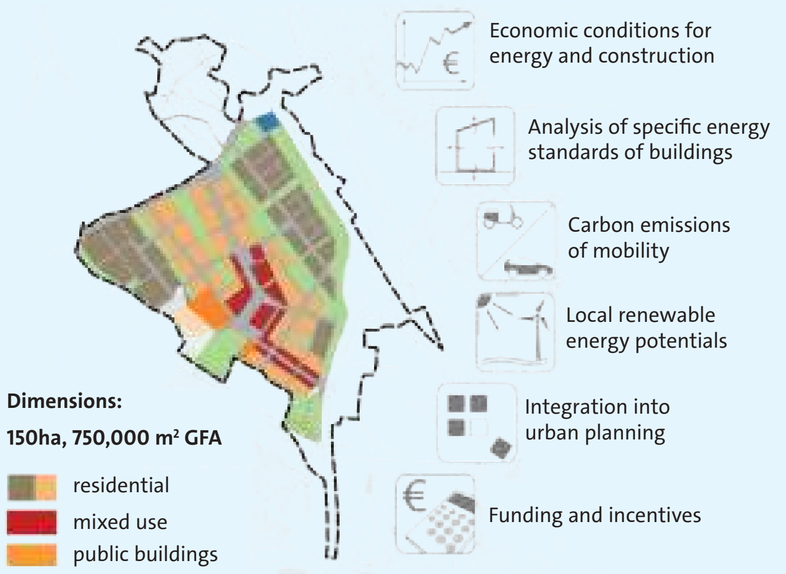
The goal is to consider the entire life-cycle of materials: From cradle-to-cradle. The first step is to avoid waste, and then to re-cycle and re-use materials or entire building components. The objectives are:

- Minimise the volume of waste and of waste going to disposal.
- Minimise building material consumption, maximise recyclability.
- Maximise the use of environmentally friendly building materials.
- Consider circular material flows for supply and disposal systems.

Urban timber architecture as a German approach to sustainable construction systems, example Lagarde Barracks Bamberg (fig. 16)

Carbon Zero Energy Strategy

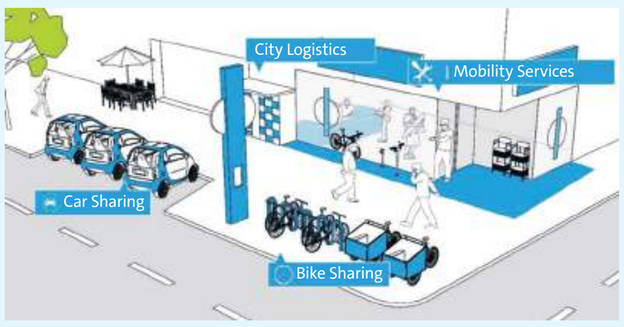
Energy Strategy Dietenbach Neighbourhood



Smart grid, large PV areas and batteries, community heating network and CHP operated with local renewables, seasonal thermal storage with central heat pump.

Example Freiburg-Dietenbach (fig. 13)

Autonomous driving e-vehicle service (fig. 14)



Example of a multimodal mobility hub (fig. 15)

Application to Cambodia

The knowledge transfer of German and European approaches shall lead to innovative ways of neighbourhood development in Cambodia. It is intended that the results of the Build4People project contribute to:

- Sustainable planning concepts adapted to the Cambodian cultural heritage and climate conditions.
- Developing new multi-disciplinary and collaborative planning strategies for implementing sustainable neighbourhood development.
- Application of audits for the certification of sustainable neighbourhoods and making sustainability measurable.
- Raising considerably value to design and fostering the sustainability performance.

The strategies and design guidelines will be applied to a pilot eco-town development in Phnom Penh and should to be applicable to other cities in Cambodia.

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fig. 15 Argus Stadt und Verkehr
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Work Package 3
Sustainable Neighbourhoods

EBLE MESSERSCHMIDT PARTNER
Architekten und Stadtplaner PartGmbB

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Local Research Partner

Phnom Penh Capital Administration

GREEN BUILDINGS AND SUSTAINABLE NEIGHBOURHOODS

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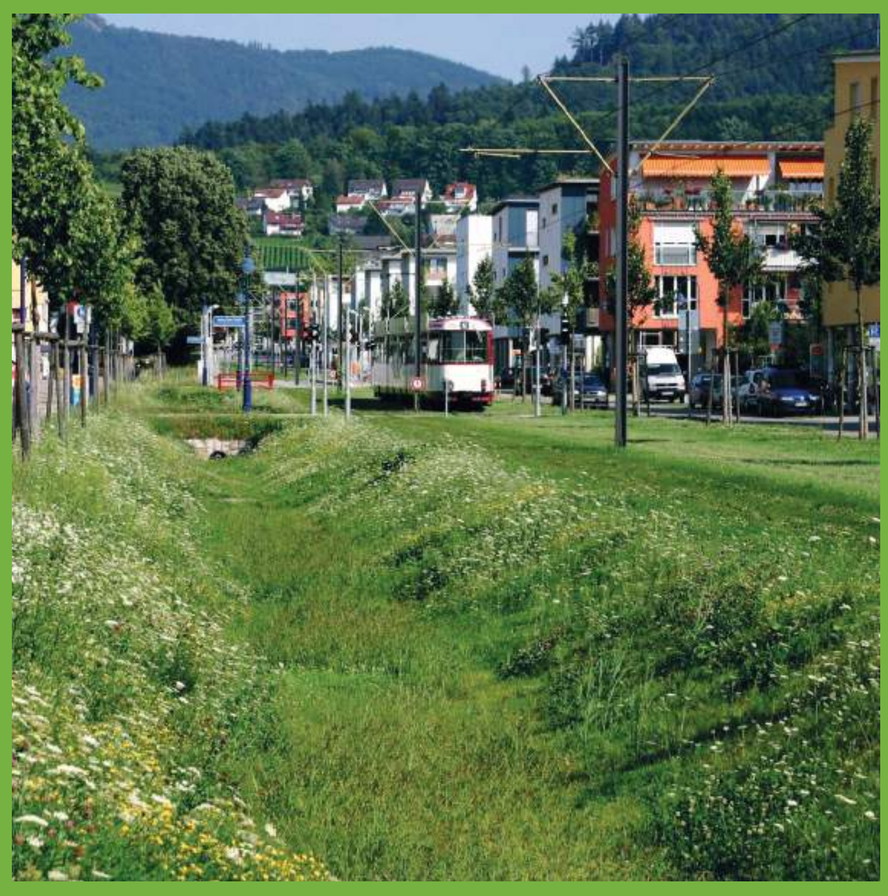
Urban green spaces (UGS) are subsistent components of urban environment systems.

They offer multifaceted benefits for people and help therefore to improve and maintain quality of life within cities.



The main axis road of Vauban District, Freiburg, Germany, is an urban green space fulfilling several functions. Among others, it is the most important drainage space of the neighbourhood. (Fig. 1)

Urban Green

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable. Within this goal, target 11.7 is to be considered: By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.

Goals and Background

At present, global urbanization is developing rapidly, construction booms change characters of cities and promote urban encroachment.

Ecosystem service are the benefits that humans receive from nature. They include provisioning services like well-being, food, strong economy and public health. In general, natural resources secure our air, soil, land and water. In contrast, drivers of change have a negative impact on above described ecosystem services.

In Europe, mostly local authorities are responsible for UGS management and using digital spatial data stored in geo-databases to form the urban green space cadaster system.

The geographic information system (GIS) and remote sensing (RE) tools are mainly used to extract, collect, map and manage spatial data of UGS of a certain city or region. For this purpose, UGS are defined as comprehensive concept referring to areas covered by vegetation.

Environmental data analysis allows us to extract and produce quantifiable information about green spatial structures, distribution and the amount of UGS in any city.

Different products, such as analysis of land cover and land use at various spatial and temporal scales, are some examples of products which are essential for today's sustainable urban planning.

Comprehensive knowledge about UGS facilitates the management and the decision-making process in cities.

Along with general maintenance of urban green and the wastewater management, such spatial information are one substantial data layer in early warning systems concerning natural hazard mitigation (flood control) and climate impact research.

Urban Ecosystem Services (UES)

Urban Green Spaces (UGS) belong to our ecosystems and provide benefits that humans receive from nature, known as ecosystem services and for cities urban ecosystems services (UES)

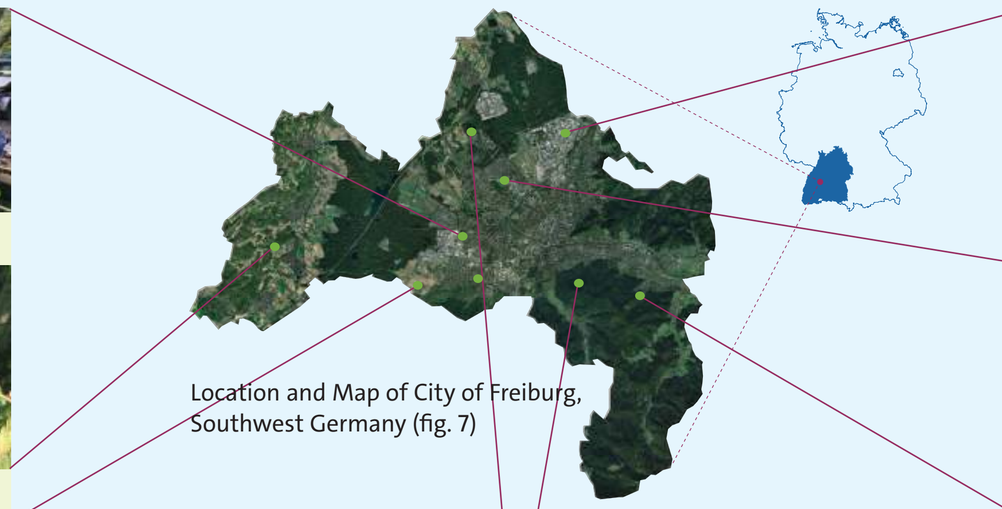
Well-Being (fig. 2)

Strong Economy (fig. 4)

Recreation (fig. 3)

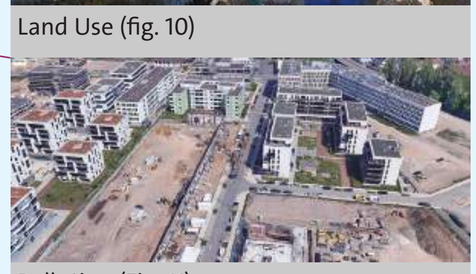
Food, Water, and Materials (fig. 5)

Examples of Benefits (fig. 2-5)



Location and Map of City of Freiburg, Southwest Germany (fig. 7)

Land Use (fig. 10)



Pollution (Fig. 11)

Land and Soil (fig. 6)

Water (fig. 8)

Air (fig. 9)

Examples of Natural Resources (fig. 6-9)

Climate & Weather (fig. 12)

Examples of Drivers of Change (Fig. 10-12)

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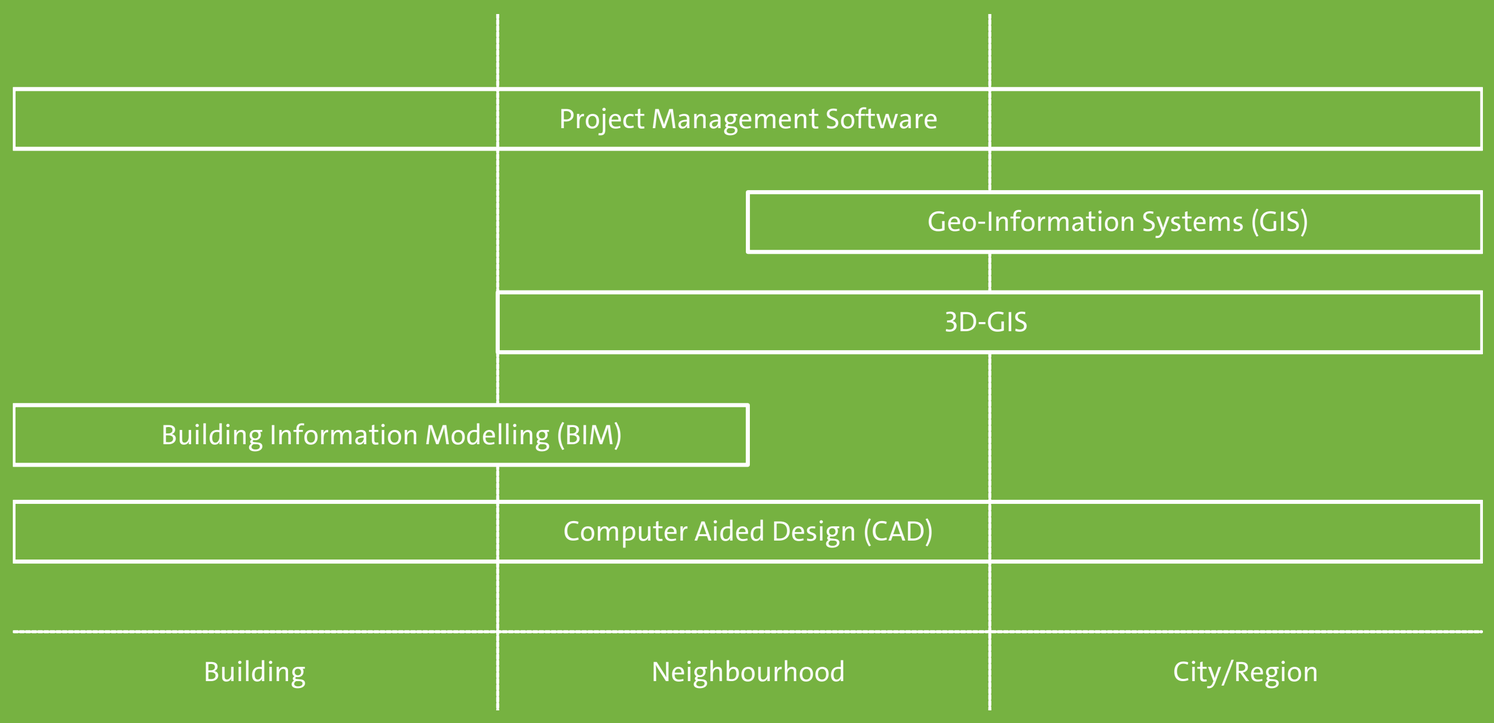


Computer Aided Tools and their Uses (fig. 13)

Urban Green

Remote Sensing Classification

What we do in regions where spatial information is not available?

Remote sensing tools allow for the gathering of information about an object without coming into physical contact with it by using Satellite or Radar images.

- Create a land cover classification using Satellite images.
- Use a set of satellite images of different times and seasons and compare past and present with human impact change applying a time series of remote sensing data.
- Remote Sensing of UAV: Take image via UAV and use such for groundthruthing data in remote sensing classification.

Urban Green Space Typology

Create geospatial data about UGS and combine such information into an urban green space typology. Such categorization of different green and blue spaces help to produce easy to use tools for their management and maintenance.

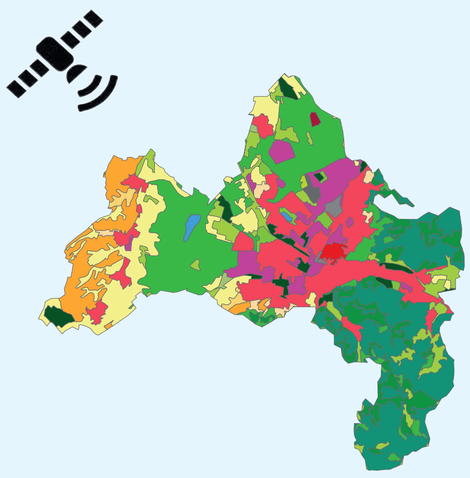
Spatial Index Calculation

The calculation of different remote sensing indices allows the establishment of estimation models regarding natural phenomena like flood events, distribution of city climate and greenness of cities. The data can derive from land cover classification and/or from meteorological stations.

Implementation Strategies

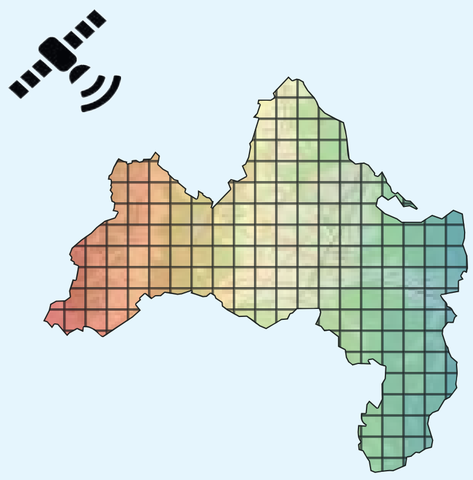
Urban green spaces are valuable features for any city. The outcomes can be used on different levels as below:

- Project Level: Improve scientific knowledge and academic understanding on #WP4 urban green research topics and research questions.
- Municipality and Developer Level: Measures for ecological sustainable and environmentally friendly urban planning and serve as addition information for specific spatial regulation and management measures.
- Citizens Level: Results will help to highlight the spatial interaction between the human and physical environment of cities.



Example of Remote Sensing Classification, in Freiburg (Fig. 14)

Example of Urban Green Space Typology, in a Neighbourhood, Freiburg (Fig. 15)



Example of Spatial Index Calculation, in Freiburg (Fig. 16)

Use of an UAV for Remote Sensing Application: DJI Mavic 2 Enterprise with Thermal Camera (Fig. 17)

Application to Cambodia

Climate: Urban Green Spaces (UGS) help to mitigate hot temperatures in cities. The canopy of trees yields human thermal comfort as they deliver shade. It is of crucial importance to improve the maintenance and develop UGS and the plantation of trees as those determine the temperatures of cities in the future.

Recreation, Culture, and Aesthetics: UGS are places for cultural events for relaxation and exercise. Overall, UGS foster human well-being and people's health - physically, socially and mentally.

Natural Hazard Mitigation: UGS and natural water bodies serving as natural flood control and wastewater management systems. In general, non-permanently sealed surfaces let rainwater percolate. This is especially important in tropical cities with rainy seasons like Phnom Penh. A decline in non-sealed surfaces leads to serious flooding problems.

Image credits:

fig. 1 City of Freiburg
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fig. 5 https://www.uvinum.de/blog/deutschlands-weinbaugebiete-baden-2401593
fig. 6 Extracted from Google Earth Pro
fig. 7 Germany and Freiburg provided by HNEE-Geodaten Hochschule für nachhaltige Entwicklung Eberswalde (FH); VG250 Ebenen und kompakt - Verwaltungsgebiete der Bundesrepublik Deutschland
fig. 8 Extracted from Google Earth Pro
fig. 9 https://freiburg.stadtbesten.de/besten-liste/die-schoensten-freiburger-parks/
fig. 10 Kreditanstalt für Wiederaufbau (German Development Bank)
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fig. 13 Bott, Grassl & Anders (2019)
fig. 14 CORINE Landcover Classification
fig. 15 Edited by Author with image from https://www.geoventis.de and base map from OSM
fig. 16 Own design Build4People WP#4
fig. 17 Sebastian Kupski (INKEK)

Work Package 4
Urban Green

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Royal University of Agriculture

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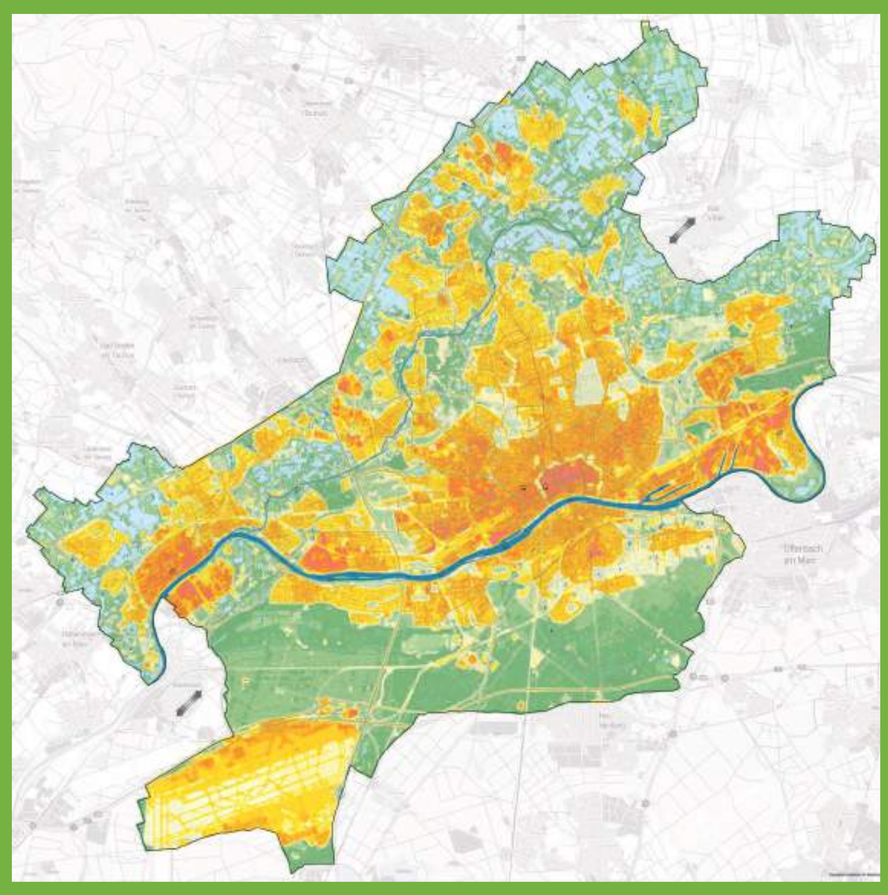
Urban climate is important for risk reduction, health and flooding solutions. Capacity building in urban climate management is a relevant issue to sustainable urban development.

For city development, the urban climate, particularly the urban heat island, must be considered.

The main urban climate tools are urban climatic maps in different scales.



Urban Climate Map, Frankfurt (fig. 1)

SDG Target 11.B: By 2020, substantially increase the number of cities implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement holistic disaster risk management at all levels.

Urban Climate

Goals and Background

Climatic systems describe areas with the same urban climatological characteristics. They are generated and influenced by morphological and urban fabric factors, including thermal load, ventilation and can also air pollution aspects.

Urban climate recommendations lead to more sustainable development and sustainable buildings. Dealing with the thermal and air pollution aspects it is crucial not only to deal with the presentation of large-scale mean climatic conditions, but also to assess differing observations of individual inner-city local climates, including their reciprocal interactions. The main urban climate tools are urban climatic maps in different scales, which provide relevant information for planning and make qualitative as well as quantitative statements on thermal and air quality issues.

The maps demonstrate the thermal efficiency complex which refers to the effects of the total meteorological relevant aspects of the urban canopy layer (radiant heat, sensible and latent heat, anthropogenically generated heat, thermal circulation, wind).

Regional Climate

Climatic influence and relations between cities and their environs for sustainable urban development.

- Regional climate analysis study addressing aspects of ventilation, thermal situation and the impact of climate change.
- Relations between cities and their environs to derive planning approaches.
- Statistical and numerical computer modelling.

Urban Climate

City wide mesoclimate analysis to verify the urban heat island and the climatic interactions.

- Creation of an urban climate map according to VDI guidelines with planning information.
- Target content:
  - Heat load analysis and development of measures in existing and planned areas.
  - Development of future scenarios
  - Vulnerability analysis for age groups and sensitive uses.

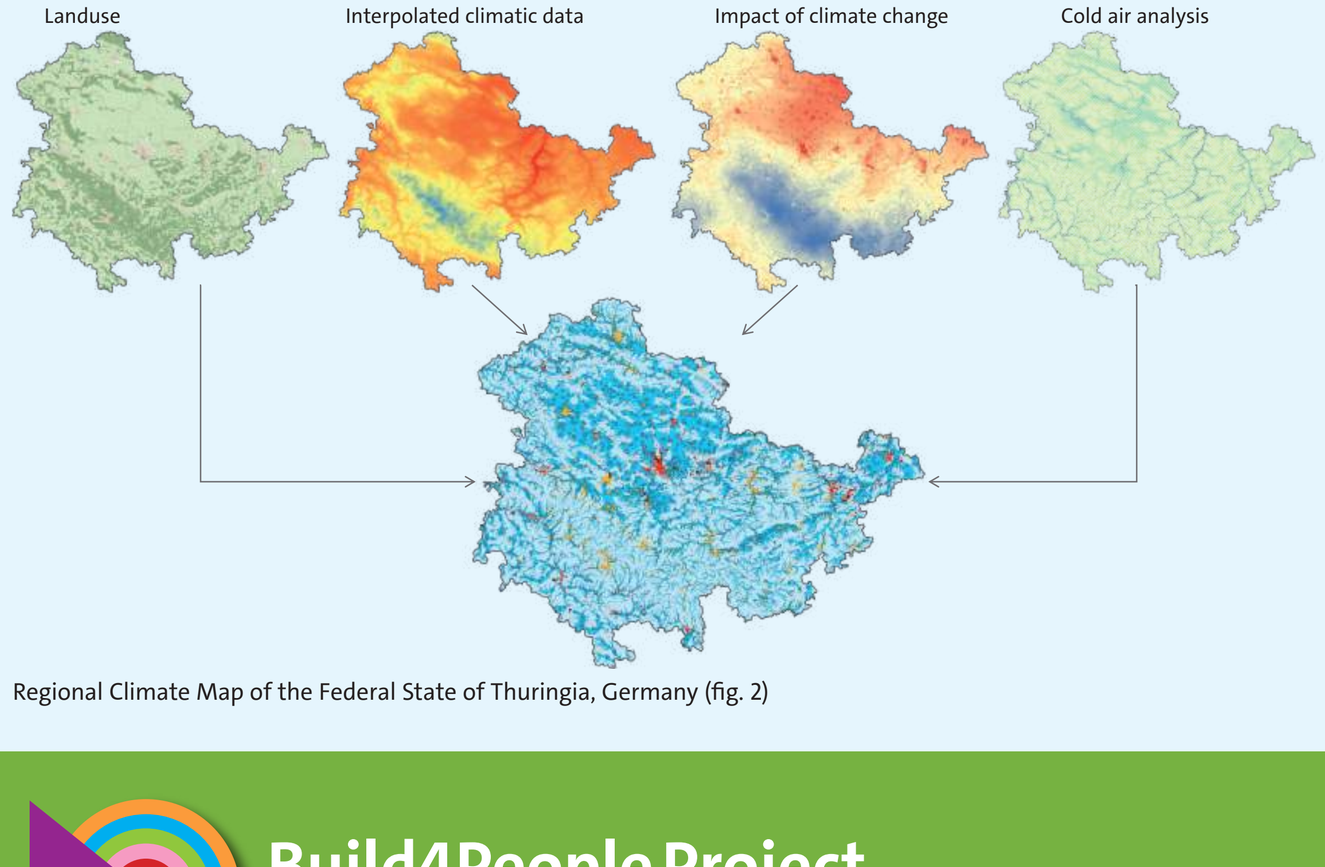
Microclimate

Consideration of the climatic situation of selected city squares.

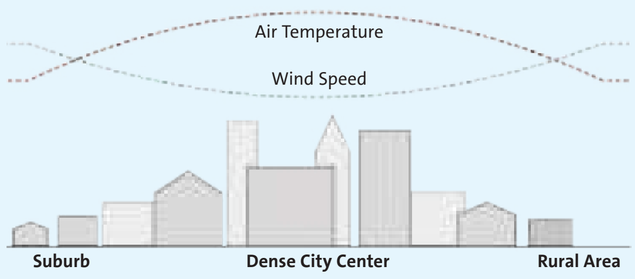
- Visualisation of the thermal conditions in time and space.
- Microclimatic simulation of the current state and the planned state.
- Calculation of different parameters, times and timeslots.
- Calculation of the positive influence of vegetation.
- Visualisation work and animations.

Schematic Representation of the Processing

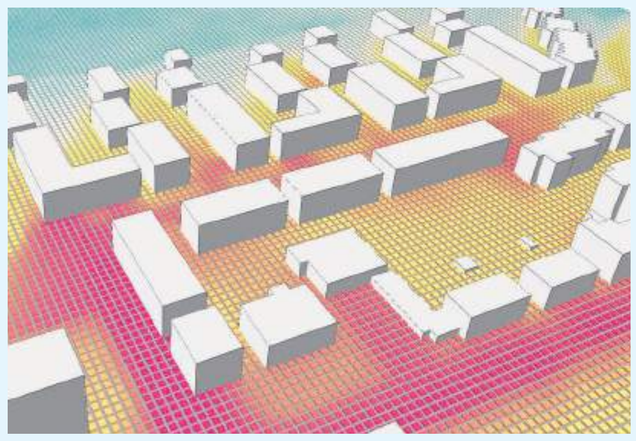
Expert opinion on climate assessment as a technical contribution "Climate-ecological compensation" for regional planning in Thuringia



Regional Climate Map of the Federal State of Thuringia, Germany (fig. 2)



Urban Heat Island Effect (fig. 3)



Example of Microclimate Simulation (fig. 4)

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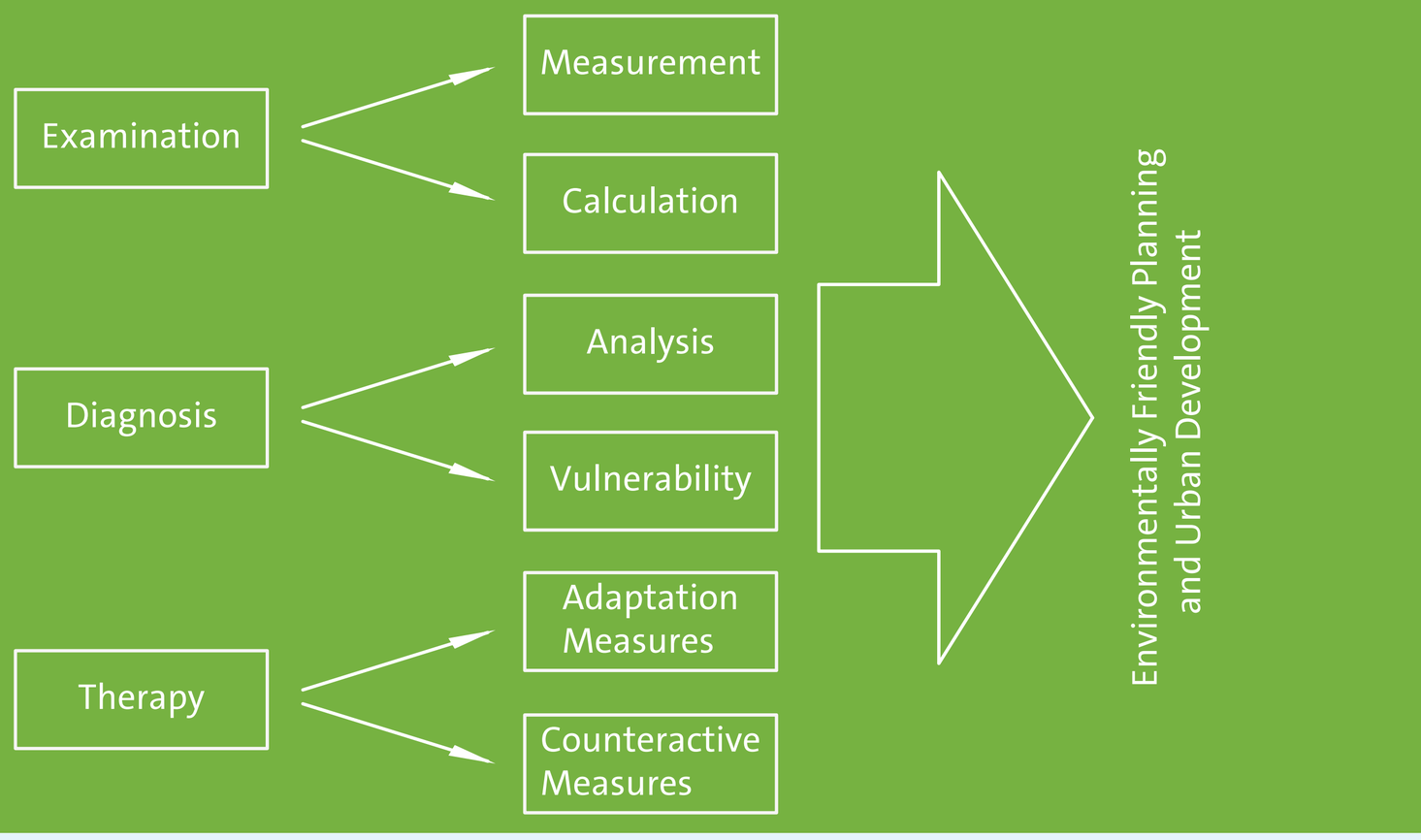


Schematic Process for Necessary Research into the Urban Climate (fig. 5)

Urban Climate

Theory, discussions and consultation

Theoretical background, clarification of needs and planning recommendation.

- Lectures on Urban Climate.
- Discussion with local planners and architects.
- Urban climate conscious recommendations for zoning plans.

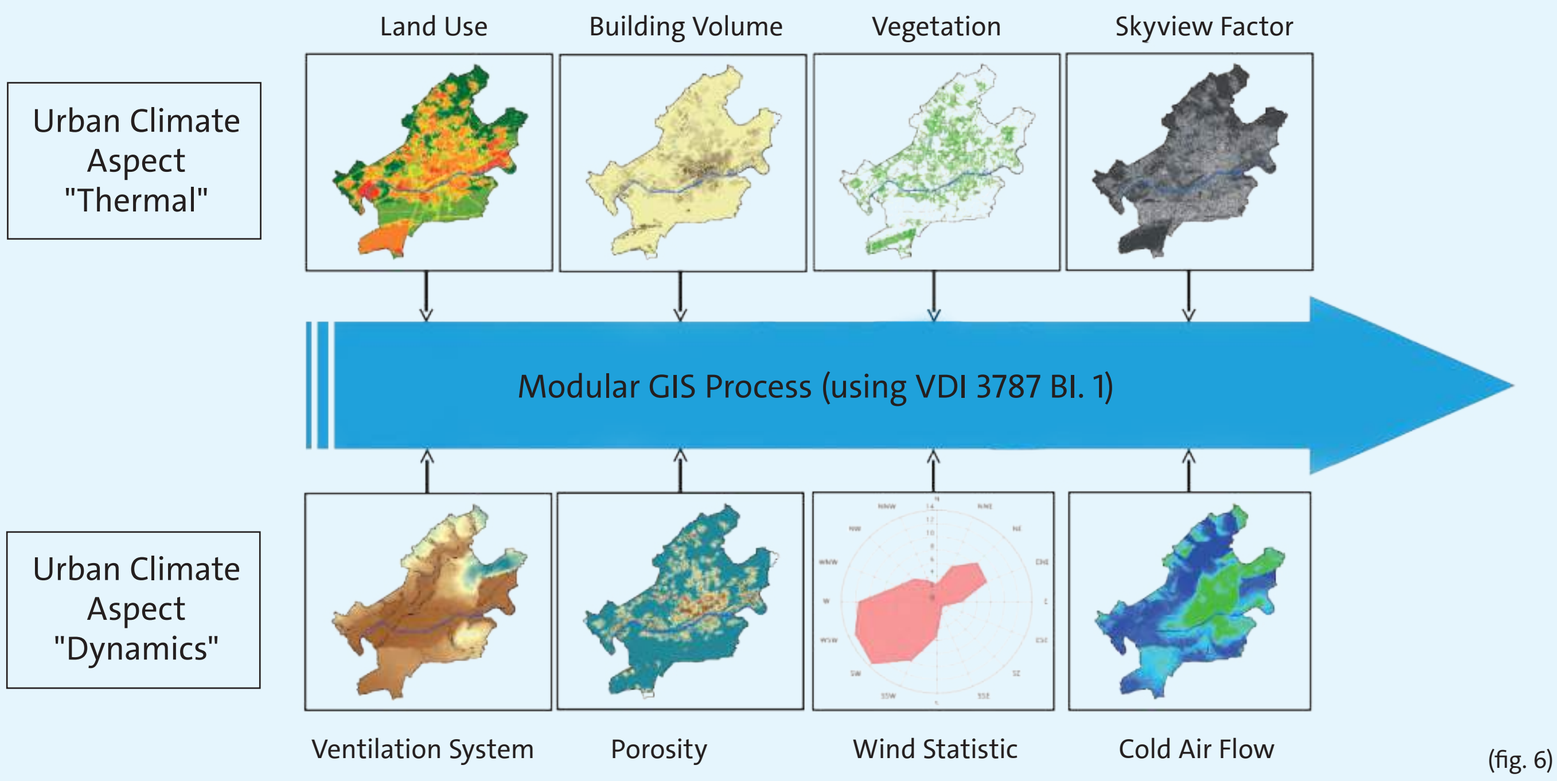
Measurements

As a supplement to the computer modelling - measurement campaigns in an urban environment.

- Use of long-term measurement data.
- Short and intensive case studies to characterize different urban structure types.
- Special measurements to determine the positive influence of vegetation.

Example of Measurement Tools (fig.7)

Modular Geographic Information System Process



(fig. 6)

Application to Cambodia

Based on the previous analyses of urban climate conditions the following perspectives and plans can be derived:

- Climate recommendations for urban master plans to characterize areas for city for development perspectives.
- Recommendations for zoning plans or neighbourhood plans or blocks with detailed specifications.
- Recommendation for building design, building sites and building density.
- Future perspectives will take the climate change into account, especially for open spaces and input of vegetation types.

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fig. 1 City of Frankfurt, Umweltplanatlas Frankfurt (2016)
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fig. 5 Bott, Grassl & Anders (2019)
fig. 6 City of Frankfurt, Umweltplanatlas Frankfurt (2016)
fig. 7 Own Photos INKEK

Work Package 5
Urban Climate

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Researching and supporting change towards urban sustainability.

Sustainable development can only be achieved if we significantly transform the way we build and manage our urban spaces.

Icon of UN Sustainable Development Goal, SDG 11 (Fig. 1)

SDG Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.

Sustainable Urban Transformation

Goals and Background

Research on sustainable urban transformation explores innovative pathways of fundamental change towards urban sustainability.

It highlights not only the technical but particularly the political and social barriers and drivers. The governance of the transformation process is therefore considered to be crucial.

The first step includes the analysis of existing practices, powers, interests, and regulations that create lock-ins and path dependencies in the building and urban development sectors.

In a second step, suitable approaches to strengthen or initiate change towards urban sustainability are identified, modified and applied.

Therefore, sustainable urban transformation concepts have both an analytical and a normative implementation dimension.

The following approaches have been developed to support a sustainable urban transformation with a focus on the building and urban development sector.

Possible Pathways of Urban Development

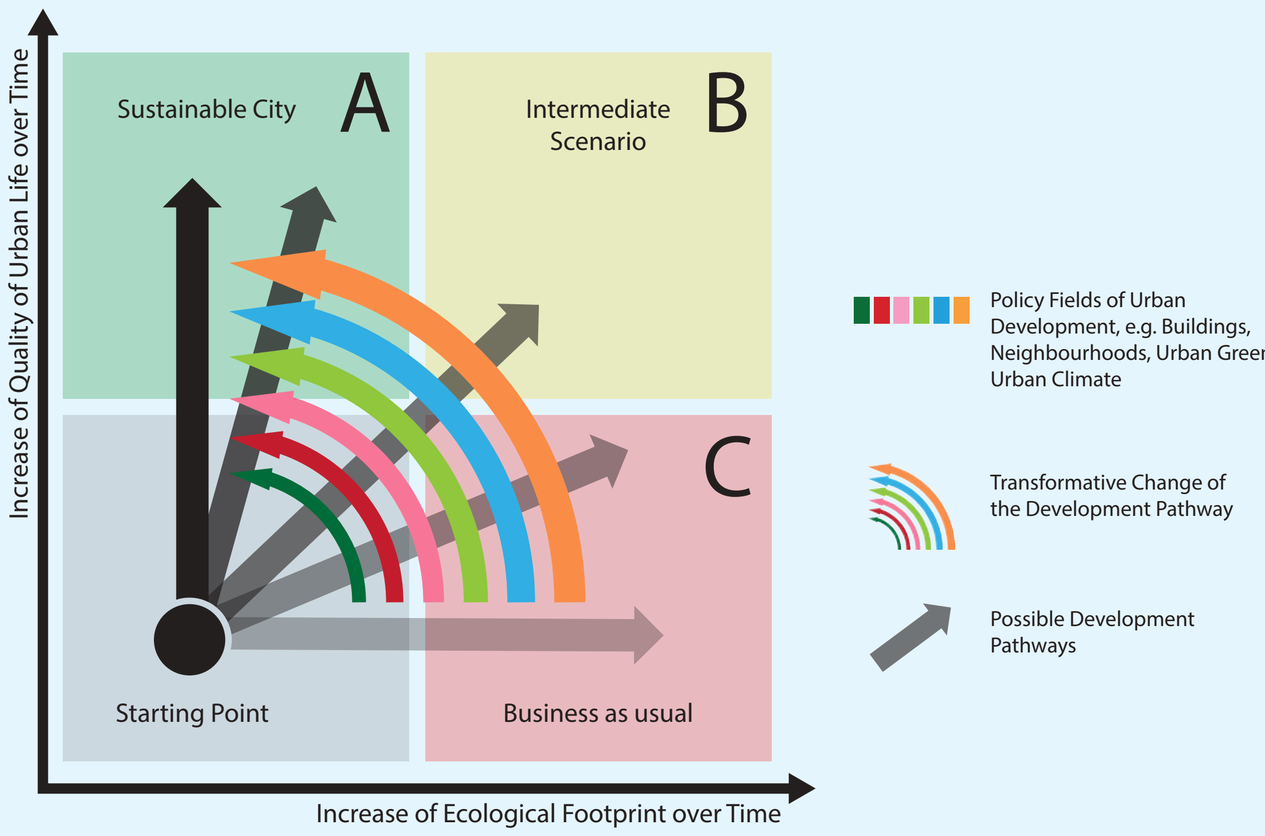

fig. 2

Setting of Transition Agenda, Riegel, Germany (Fig. 3)

Hands-On-Planning Sessions - Build4People Ecocity Transition Lab at Phnom Penh City Hall, Cambodia in March 2020 (fig. 4)

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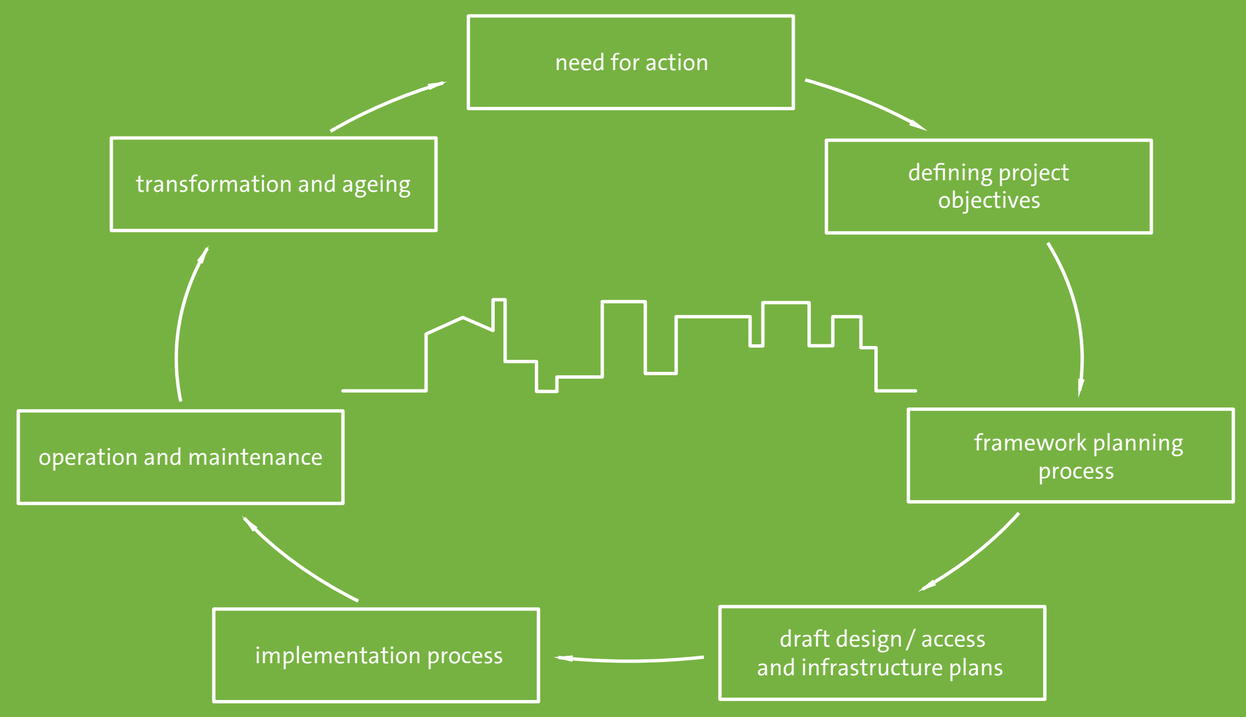

Example for an Integrated Planning Process (Fig. 5)

Sustainable Urban Transformation

Alternative Cooperative Planning Praxis

To realize a sustainable urban transformation the state can opt for an alternative planning praxis and assume a more collaborative role. Such a governance framework can involve:

- Forms of Transition Labs & Transition Management
  - Cooperative methods of research and policy development that include various stakeholders to trigger & direct change towards sustainability (see Fig. 2).
- Participatory Planning
  - with a focus on the needs and the input of local stakeholders.
- Strategic Niche Management
  - A method that supports transformational change through the protection and support of innovative pioneers.

These alternative approaches open up space for innovation and allow actors to develop ideas, visions and concrete plans for a transition.

Alternative Social or Tenure Systems

Community-driven or non-profit tenure systems have a stronger emphasis on quality of life and sustainability as they are not driven by profit but by the inhabitants and their needs. Various promising tenure systems exist:

- Building Groups & Innovative Housing Associations
  - Often have an ecological and co-living focus.
  - Efficiency and community-building through shared facilities and spaces.
- Non-Profit Housing Foundations & Community Land Trusts
  - Long-term orientation, democratic institutions, responsive to local sustainability demands and needs.
- Best Practices include:
  - The “Cenni di Cambiamento” in Milan (Italy), a Non-Profit Housing Foundation.
  - The Municipal non-profit housing foundation “PWG” in Zurich (Switzerland).
  - St. Clement’s Community Land Trust in London, United Kingdom (CLT).
- Successful outcomes:
  - Two-thirds of Vienna's population live in municipal or publicly subsidised housing.
  - 20% of rental housing in Hamburg (Germany) is provided by (non-profit oriented) cooperative housing associations.

Transition Management Process Framework:

Initiating and Directing Transformational Change towards Urban Sustainability

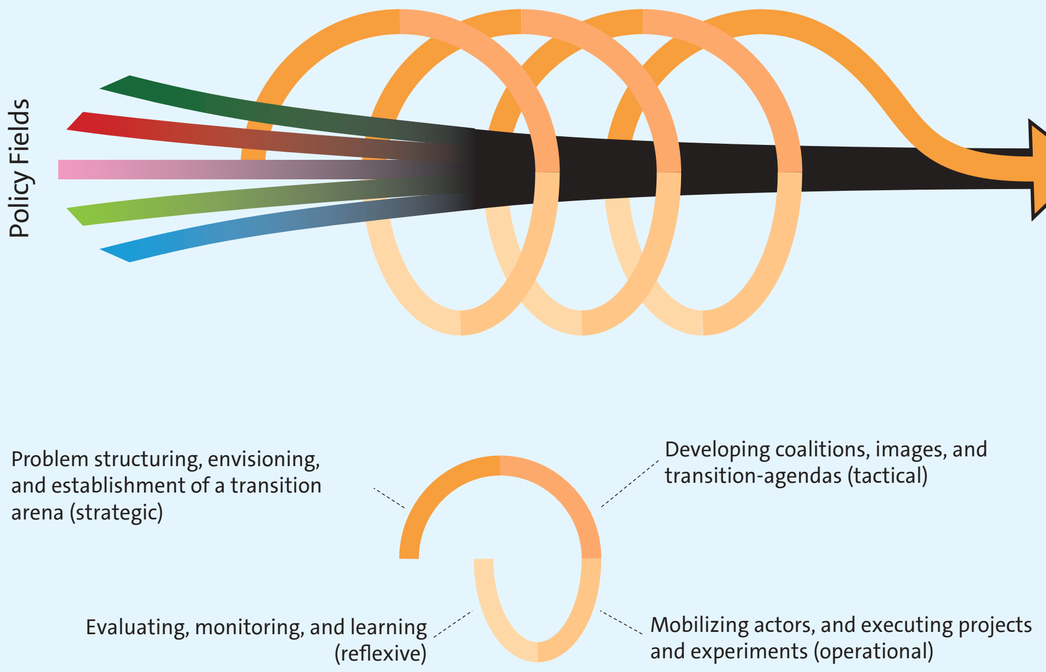

fig. 6

Building Cooperative, Tuebingen, Germany (fig. 7)

Community Event at Neighbourhood Alter Weberei, Tuebingen, Germany (fig. 8)

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Certification Systems for Sustainable Neighbourhoods Worldwide (fig. 9)

Sustainable Urban Transformation

Innovative Regulatory Framework

- Building permits can be linked to mandatory sustainability requirements or innovative concepts.
- All housing and most other building projects in Germany have to comply with the national energy efficiency regulation (EnEV). The requirements of EnEV are regularly tightened according to technological progress.
- Voluntary industry self-regulation initiatives such as Green Building certification schemes can increase a building's visibility and value.
- Obligatory energy passes for buildings indicate about the individual energy performance of a residential unit influencing decisions to invest into energy efficiency.

Financial Incentives

Market mechanisms can be used to incentivize sustainable building practices. This can include:

- Higher charges or taxes on unsustainable practices and products.
- Subsidization of sustainable practices and products.
- Subsidised interest rates for sustainable building projects.
- Best Practices include:
  - The German Development Bank KfW offers financial incentives in the form of subsidised loans and grants that reward low-carbon building designs that exceed the national energy efficiency requirements. Around 40% of new buildings currently being constructed in Germany receive such financial support.

DEUTSCHLAND MACHT'S EFFIZIENT.

German Energy Efficiency Campaign ("Germany does it efficiently") (fig. 13)

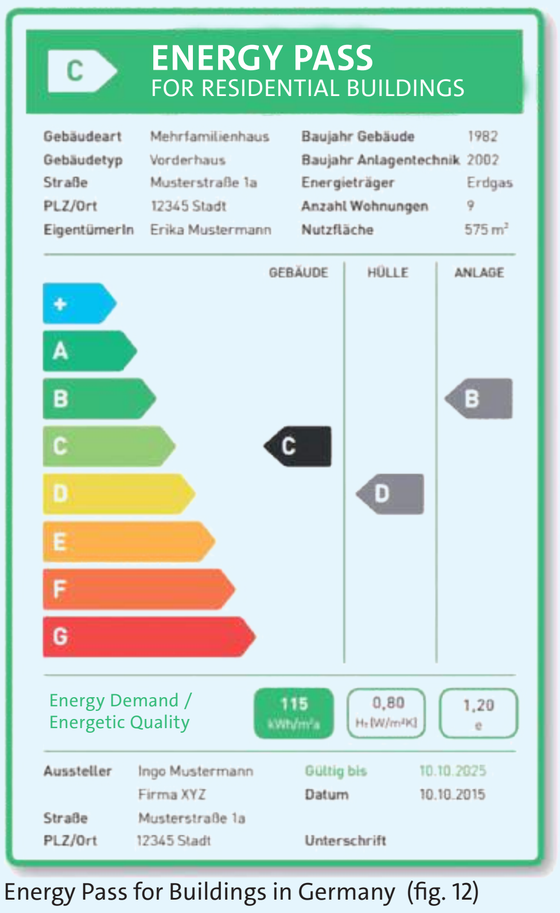
KFW

Kreditanstalt für Wiederaufbau (German Development Bank) (fig. 14)

DGNB
Deutsche Gesellschaft für Nachhaltiges Bauen
German Sustainable Building Council

DGNB German Sustainable Building Council (fig. 10)

Other Sustainable Building Labels (fig. 11)



Energy Pass for Buildings in Germany (fig. 12)

Application to Cambodia

Spaces for innovation and the development of ideas, visions and concrete plans for a transition towards urban sustainability can be generated through experiments with different governance and tenure systems.

Both mandatory and voluntary sustainability requirements for new construction projects can accelerate the transformation of Cambodia's building sector, while financial incentives can effectively address the business-minded attitude of many Cambodian households.

The overall outcome of the interplay of the approaches outlined above (and others) has resulted in a 44% reduction of carbon emissions in the German building sector since 1990. It is currently the most successful policy field of the Germany's national agenda to promote sustainability.

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fig. 8 Eble Messerschmidt Partner
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fig. 10 Kreditanstalt für Wiederaufbau (German Development Bank)
fig. 11 Issuing Institutions
fig. 12 https://www.energie-experten.org
fig. 13 Federal Ministry for Economic Affairs and Energy
fig. 14 https://www.kfw.de

Work Package 6
Sustainable Urban Transformation

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The neighbourhood presents an outstanding model for sustainable development to generate variety and urban density, as well as small-parcelled and mixed-used inner-city development.

Aerial view Loretto (fig. 1)

Südstadt Tübingen, Germany

Background and Overview

The city of Tuebingen has bought the military area of Loretto and the French Quarter and undertook the necessary planning and provision of infrastructure. The plots were sold to private building-cooperatives. The objectives were to foster inner city development on a brownfield site and to create a variety of uses, residential structures, building-types and social groups. Furthermore, a low energy building standard in combination with a district heating network rounds out the comprehensive approach.

Small-Parcelled Mixed Use

The desegregation of living and working renders the organisation of daily life easier, facilitates contacts and minimizes distances. Mixed quarters are highly attractive and lively compared to segregated, single-use residential and industrial quarters.

Therefore the objective was to create a small-parcelled, vertical mixture. So far around 340 businesses have decided to settle here, particularly on ground floor level and in old buildings.

Social and Cultural Infrastructure

Within the Südstadt development, a large variety of public social and cultural facilities have been created, serving not only the neighbourhood, but the entire town.

The emphasis is on decentralised and community-oriented services, which often rely on community involvement. Proceeds from the sale of plots have been invested by the city into kindergardens, day-care facilities, schools and other community facilities.

Mobility concept French Quarter with centralised parking, bus routes and car-sharing, as well traffic-calmed streets (fig. 2)

Green corridor with water course (fig. 3)

Central square with water playground (fig. 4)

Hybrid-timber construction (fig. 5)

Community courtyards with playgrounds and for encounter (fig. 6)

House with workshops for residents (fig. 7)

Community space in former tanks garage (fig. 8)

Parking garage with mechanical system (fig. 9)

Passive-House with PVs (fig. 10)

Café in ground floor (fig. 11)

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Active frontages by retail, offices and other non-residential use on all ground floors (fig. 12)

Masterplan Area (fig. 13)

Südstadt Tübingen, Germany

Density and Re-Using Old Buildings

Compared to other parts of the city, the building density in the Suedstadt development is exceptionally high. In addition to ecological reasons – short distances and the avoidance of further scattering of the urban settlement - and aspects of urban design, social factors are taken into consideration: High-density building is much more affordable.

Nearly all of the older military buildings were given to other uses as an attractive offer particularly to small industrial workshops.

Building Co-operatives

The majority of the home-owners are private builders who have joined together in so-called “private building co-operatives”. Because of this, a multitude of very different, highly individual projects have been created, most of them with costs ranging much lower than those generated by conventional builders. This is made possible by consistently selling the parcels to private builders, by determining size and shape of each parcel in accordance with the buyer‘s needs and by a supportive city administration.

Integration and Social Mixture

Due to the building co-operatives, the Südstadt area has been settled by a varied cross-section of the population: Not only “standard families”, but also senior citizens, non-German citizens, mentally and physically han-dicapped citizens, students and many other groups.
The aim of the Suedstadt development is to focus on the idea of integration: The city’s structure is serving as a platform for com-munication and discourse. This leads to a long-term, attractive, stable and resilient neighbourhood.

Public Space, Mobility, Participation

The public spaces, roads and squares mainly serve as communicative spaces for the inhabitants and those who work here. Their function as a traffic network is secondary. Cars are not prohibited in these quarters, but the vehicles of employees, inhabitants and visitors are parked in public neighbourhood-garages.
The use of the multitude of spaces generated by this policy is determined and facilitated in a co-operative process supported by an intensive participation and transparent governance process.

Aerial view French Quarter (fig. 14)

French Quarter (fig. 15)

Site:	**Former barracks site of French Army**
Dimension:	**60 ha**
Inhabitants:	**ca. 3,400 (French Quarter, Loretto)**
Enterprises:	**ca. 350**
Implementation:	**1996 to 2008**
Urban Planning:	**Lehendrei, Stuttgart, and City of Tuebingen**
Awards:	**German Urban Planning Award, European Urban Planning Award, National Award for Integrated Urban Development and Building Culture, DIFA Award etc.**

Image credits:

fig. 1+14 Manfred Grohe
fig. 2-5, 8, 11, 15 City of Tuebingen
fig. 9+10 Eble Messerschmidt Partner
fig. 6 Freiraumconcept
fig. 12 Daniel Fuhrhop
fig. 13 City of Tuebingen, Lehendrei Planungsgemeinschaft

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The model neighbourhood is a shining example of the Green City Freiburg – thanks to an ambitious environmental policy, its citizens' commitment to renewable energy and sustainable transport, as well as excellent neighbourly relations.

Aerial photo (fig. 1)

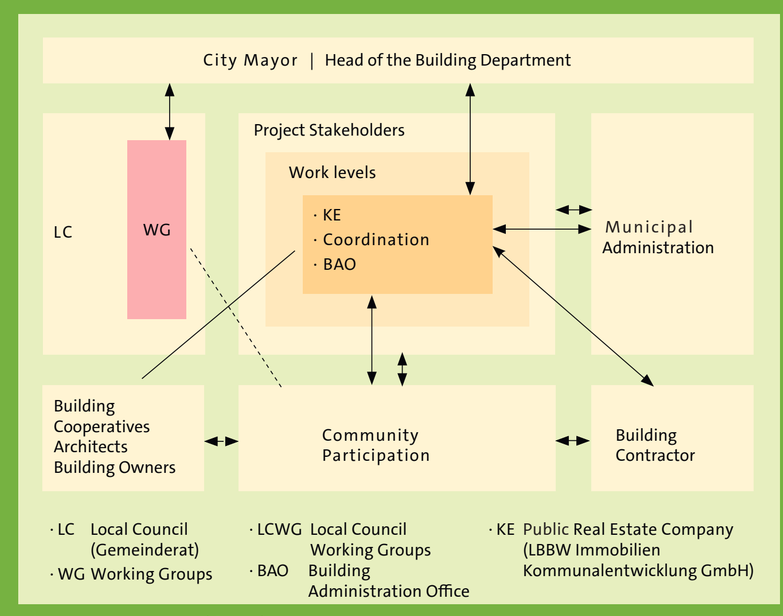
Vauban Freiburg, Germany

Background and Overview

Two influential associations, founded by committed residents, played a significant role in the process. As a result, important ecological and social topics were considered. The detailed plan provided a wide range of different plot sizes, creating a mix of individual building projects that promote social integration. Existing buildings were converted into affordable housing by the "self-organised, independent neighbourhood initiative".

Architecture and Housing Typologies

Architects were allowed a flexibility and variability for their building designs in the first phase accompanied by design counselling. In combination with the commitment of the building-owners, very good architectural results could be achieved. The outcome is a lively neighbourhood with a diverse appearance.
Most building plots were predominantly distributed to private building-owners both for single building projects and building projects of groups of building-owners who cooperated in the development of the building from the start (building cooperatives). Normally these are four-storey multiple family houses, which consist of two accommodation units built on top of each other. Other residences from property developers include apartment buildings, condominiums, and buildings with a mix of both condos and rented apartments.



Planning Process (fig. 2)

Green courtyards and elevations (fig. 9)

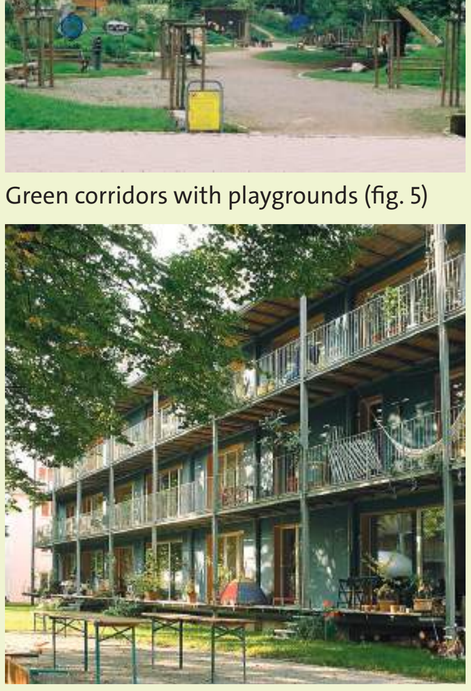
Green City Hotel (fig. 3)

Home zone as shared space (fig. 4)

Green corridors with playgrounds (fig. 5)

Tram line (fig. 6)

Mixed use project "Amöbe" (fig. 7)



Passive-house "Living and Working" (fig. 8)

Solar neighbourhood garage (fig. 10)

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Solar Settlement with maximised PV roofs and passive-house energy standard (fig. 11)

Site plan (fig. 12)

Vauban
Freiburg, Germany

Public Spaces

The Vauban has two important squares – Paula-Modersohn Platz, which also marks the starting point and public transport hub as entry to the neighbourhood, and Alfred-Döblin-Platz, which is regarded as the quartés central market place. The design for the Alfred-Döblin-Platz is based on the basic considerations of a workshop of the residents. Accordingly, the already established use of the space as a multifunctional area was to be maintained as well as expanded further.

Green Spaces and Water

Five new public green corridors were created, which separate residential areas and include recreational spaces and playgrounds. Building-owners were involved in the design through participatory workshops. The tree population was maintained and protected biotopes supplement the green area concept. The rainwater is directed through gullies into two central draining ditches. Some of the projects also collect rainwater in cisterns for further use and one recycles greywater.

Commercial a. Social Infrastructure

A local supermarket, the neighbourhood's weekly market and an organic market provide the basic food supply. Cafés, restaurants, and shops cover other day-to-day needs. Two innovative commercial projects integrate service providers, arts and crafts. Two nursery schools and an elementary school are available for childcare. One central building was converted to Freiburg's first self-managed community centre, which has become a central contact point.

Mobility

A special focus was led on a clear and easy foot and bicycle path-system, as well as on pedestrianised areas. However, there is a hierarchical traffic concept for cars including motorised traffic-reduced residential roads. Residents owning a vehicle must acquire a parking space in one of the neighbourhood's multi-storey car parks. Registered "car-free" households, can use car-sharing projects. The already good public transport was improved by a new tramline.

Energy

In addition to fulfilling Freiburg's low energy standard for all buildings, some passive-houses with a maximum energy consumption of 15 kWh/m² have been realised. The "Zero Energy-Houses" as well as the "Plus Energy Solar Settlement" including the "Sun Ship" are unique, as they produce more energy than they use. The district's heat is supplied by a combined heat and power plant, which also joins forces with numerous photovoltaic installations to supply electricity.

Mixed use block development "City Oasis", expressive architecture (fig. 13)

Building co-operative with passive-house, hybrid timber construction (fig. 14)

"Sun Ship" with retail, services and offices, as well rooftop housing with PVs (fig. 15)

Site: Former Barracks of French Army
Dimension: ca. 38 ha
Inhabitants: ca. 5,300
Implementation: 1997-2018
Urban Planning: Kohlhoff & Kohlhoff, Stuttgart, and City of Freiburg
Awards: World UN Habitat Award Presentation, Award for Sustainable Urban Renewal by the State in Baden-Württemberg, World Expo Shanghai, Eco Traffic

Image credits:

fig. 1+2, 4, 7-9, 12 City of Freiburg
fig. 3 Green City Hotel
fig. 6 Carsten Sperling
fig. 10 triolog Freiburg
fig. 13 Brillux
fig. 5+14 Eble Messerschmidt Partner
fig. 11+15 Rolf Disch SolarArchitektur

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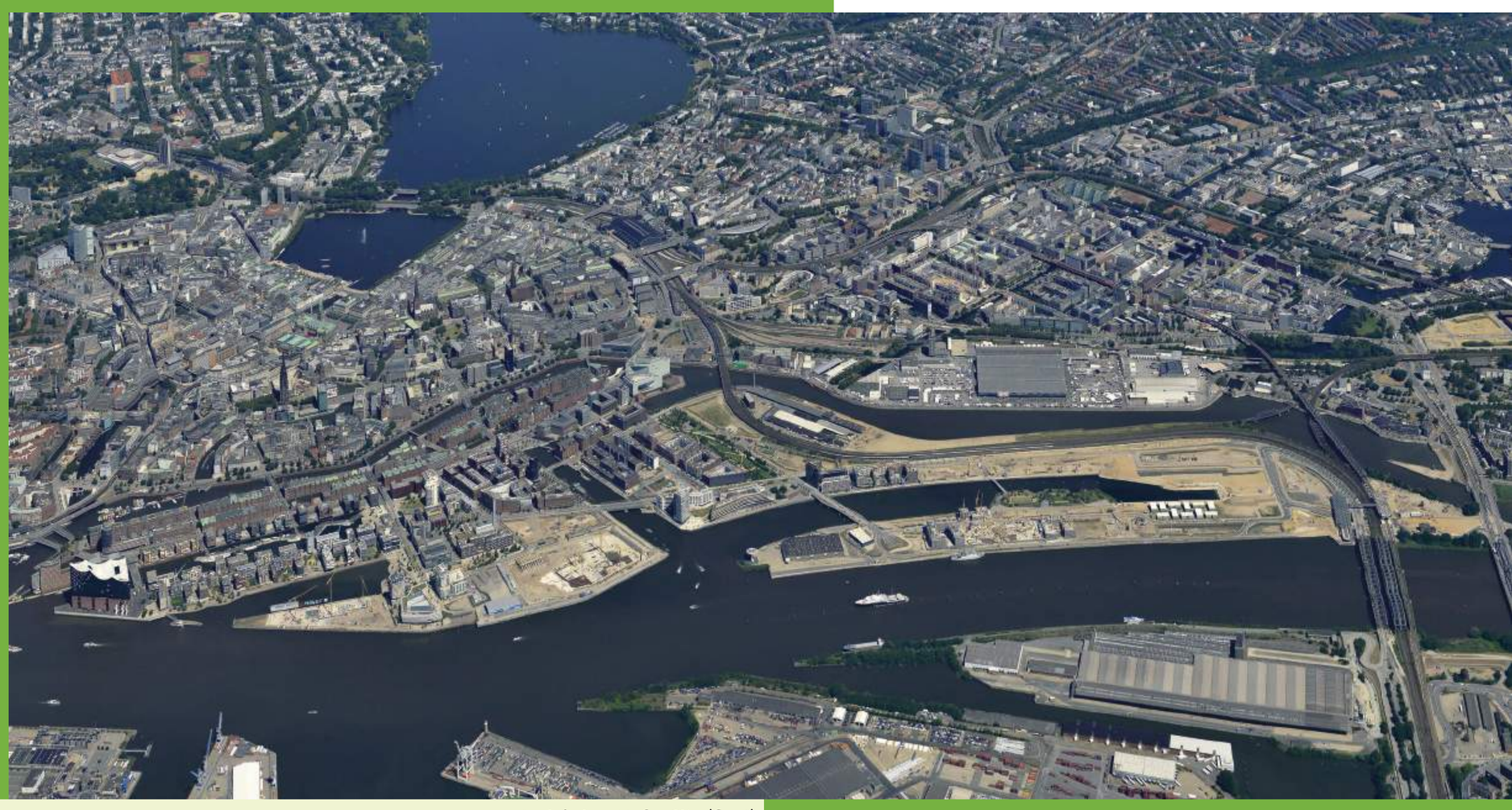
Europe's largest inner-city urban development project features a fine-grained, mixed and densely built urban structure, uses renewable energies, has eco-friendly buildings and resource-efficient mobility, as well as large and attractive open spaces.



Aerial view HafenCity (fig. 1)

Hafencity Hamburg, Germany

Background and Overview

With the development of a huge new urban space along the Elbe River, Hamburg is setting new standards throughout Europe: A vibrant city with a maritime atmosphere is taking shape and which uniquely blends work and living, culture and leisure, tourism and retail. It will encompass at least 7,000 homes and create a space for up to 45,000 jobs, cultural and recreational facilities, retail and green parks and promenades.

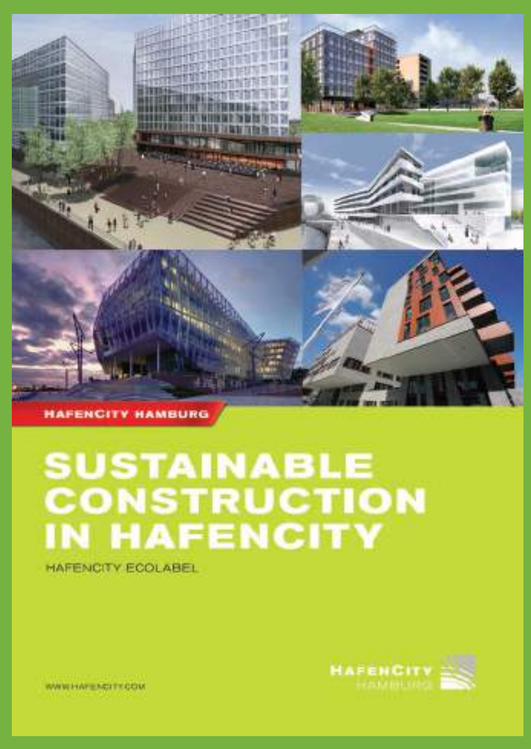
Within a few minutes' walk of the city hall and the main station, HafenCity is directly adjacent to today's downtown and will extend its area by around 40 percent by 2025/2030.

A special focus was led on flood protection for buildings, parking garages and opens spaces, as well as safety and emergency accessibility in case of a flood event.

Sustainable Urban Structure

An old port area is transformed into a densely built, mixed-use place for working, living, leisure, culture and education. This includes the integration of the dock structure and old buildings, which promotes a very strong identity.

Within the overall concept "Differenciated Unity", a variety of distinct character areas and very specific buildings have been realised.



Ecolabel of the HafenCity, based on a mandatory certification process for sustainable design and construction (fig. 2)

Elbe Arcades (fig. 3)

Überseeboulevard (fig. 4)

Grasbrook Park (fig. 5)

Lohse Park (fig. 6)

Marco-Polo-Tower (fig. 7)

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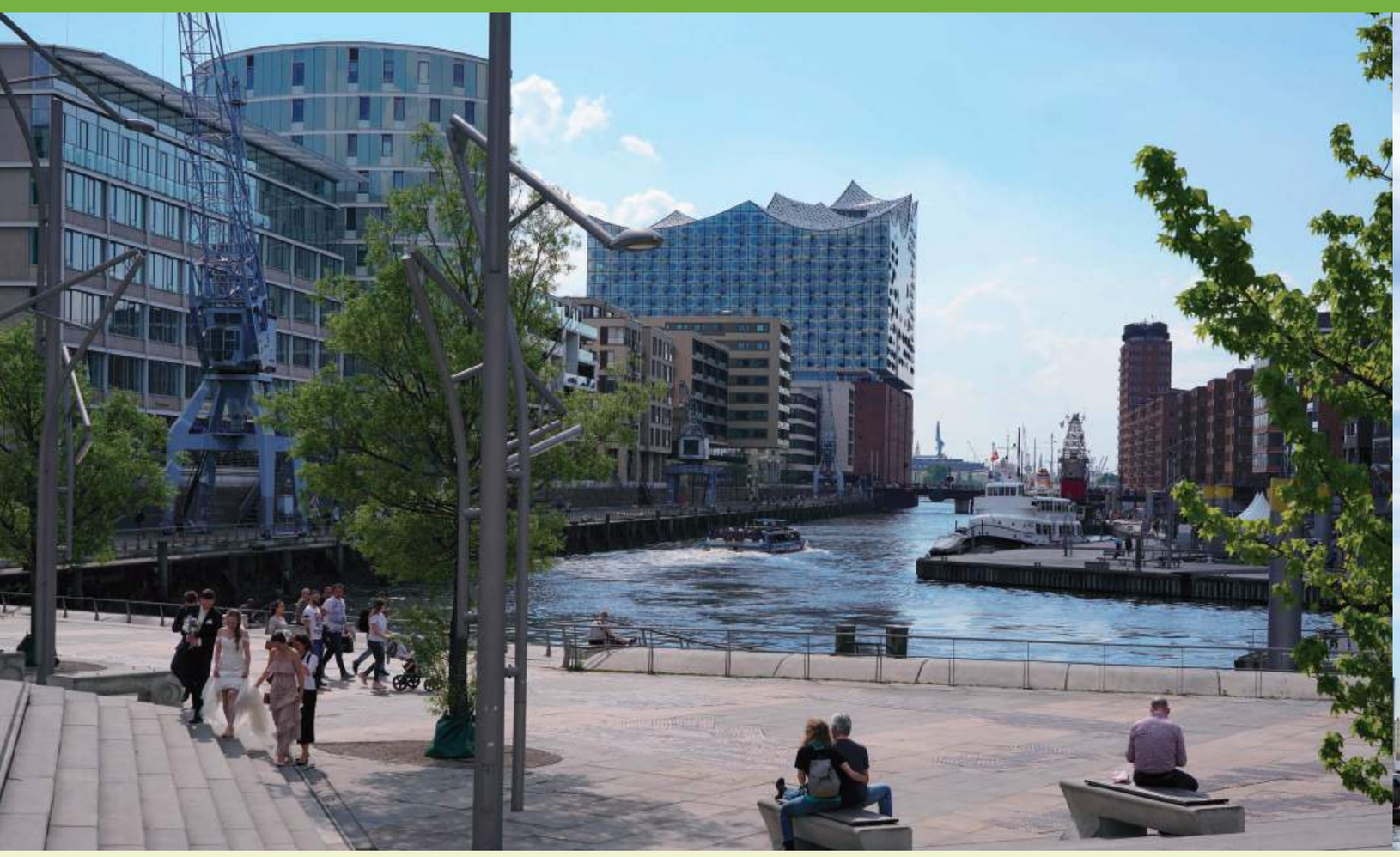

Magellan-Terraces at an old dock with a view to the river Elbe and the Elbphilharmonie (fig. 8)

The Elbphilharmonie (fig. 9)

Hafencity Hamburg, Germany

Energy

More than 90 percent of the heating for the eastern HafenCity comes from renewables, a cogeneration-based CHP (Combined-Heat-and-Power) plant that is supported by solar thermals. CO2-reducing generating plants (such as a steam turbine heating plant) supplement the energy supply.
Furthermore, high ecological standards for the buildings are mandatory. The sustainability performance of the building projects has to be proven by the HafenCity authority in a certification process.

Mobility

The mobility concept gives priority to non-motorised transport modes and public transport. The focus is on walkability and bikeability in combination with a dense mix of uses, contributing to a city of short distances. Excellent public transport is provided with the Hamburg underground railway system and attractive new stations. Next to and a small number of parking spaces for cars and an advanced e-mobility infrastructure, Europe's largest neighbourhood-based e-carsharing project is located in the HafenCity.

Public Spaces

The significance of urban open space for HafenCity is clear from just a few key figures: 25 percent of its land area – as much as 28 ha – will be made up of public open spaces. Open space accounts for 25 percent of its area, in comparison to just five percent in the existing city center. Visitors and residents alike appreciate its many green areas and attractive waterside plazas. This includes the public plaza at the Elbphilharmonie building, which is in an elevated position 37 m above the street level and provides amazing views.

The new Elbbrücken public transit terminal station (fig.10+11)

Bike street at Lohsepark (fig. 12)

HafenCity Masterplan designed by Kees Christiaanse Architects & Planners (KCAP) / ASTOC Architects and Planners (fig. 13)

Site:	**Former Harbour and Industry Area**
Dimension:	**ca. 157 ha**
Inhabitants:	**ca. 14,000**
Jobs:	**ca. 45,000**
Implementation:	**1999-2030**
Urban Planning:	**Kees Christiaanse / ASTOC and others, City of Hamburg**
Awards:	**Several awards for development agency, building projects, open spaces and infrastructure**

Image credits:

fig. 1 -9, 11, 12 HafenCity Hamburg GmbH fig. 13 Masterplan KCAP / ASTOC
fig. 10 www. baakenhafen.net

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Combining generous landscaping, ease of mobility and great social involvement, as well as cutting-edge water management and an energy strategy with a high share of renewables lead to a unique Dutch model project for sustainable urban development, which is attracting international interest.

Aerial photo (fig.1)

EVA Lanxmeer Culemborg, Netherlands

Background and Overview

EVA Lanxmeer is an ecological and innovative residential area situated in Culemborg (near to Utrecht). It consists of around 300 houses, sustainable office buildings, an elementary school, a secondary school, a swimming pool and an organic farm. There is a broad variety of resale and rental property situated around community gardens. In 1997 the city council and the initiators (the EVA Foundation), in close cooperation with aspiring residents, realized the first phase of the project.

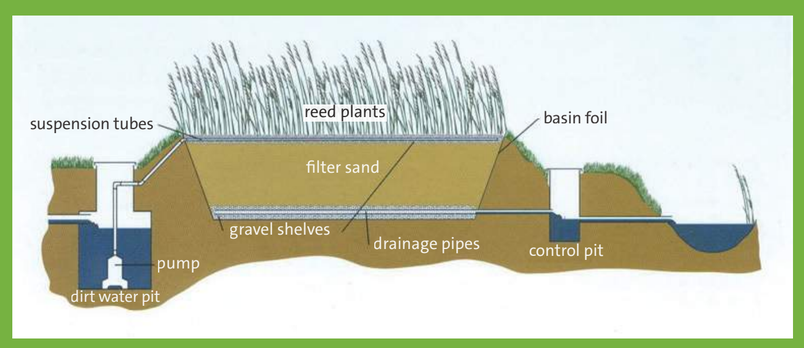
Sustainable Urban Design

The neighbourhood is a lively area with a lot of public green space and an edible landscape. Energy-saving buildings and district heating with Lanxmeer's own energy company contribute to climate protection. Eco-materials such as timber-frame structures and multifunctional housing supplement the sustainability approach. People living here have a highly sustainable lifestyle, and there is a continuous flow of new initiatives, new businesses and activities.

Open Spaces

The neighbourhood is situated in a water-collection area, around an old orchard. An old meander of the River Lek has been deepened for collecting rainwater and making a recreational pond. There is gradual transition from private gardens into community gardens, park like areas and water-collection areas. The design and management is based on the principles of permaculture. Altogether, there is lots of public green space, which gives the area the character of a Garden City.

fig. 2 + fig. 3



Constructed wetland for greywater treatment (fig. 2+3)

Solar architecture with PV roof (fig. 4)

Contemporary reet covered building (fig. 5)

Houses on central pond with natural landscaping (fig. 6)

Organic city farm with farm shop (fig. 7)

"Kwartelhof" for elderly people and rainwater pond (fig. 8)

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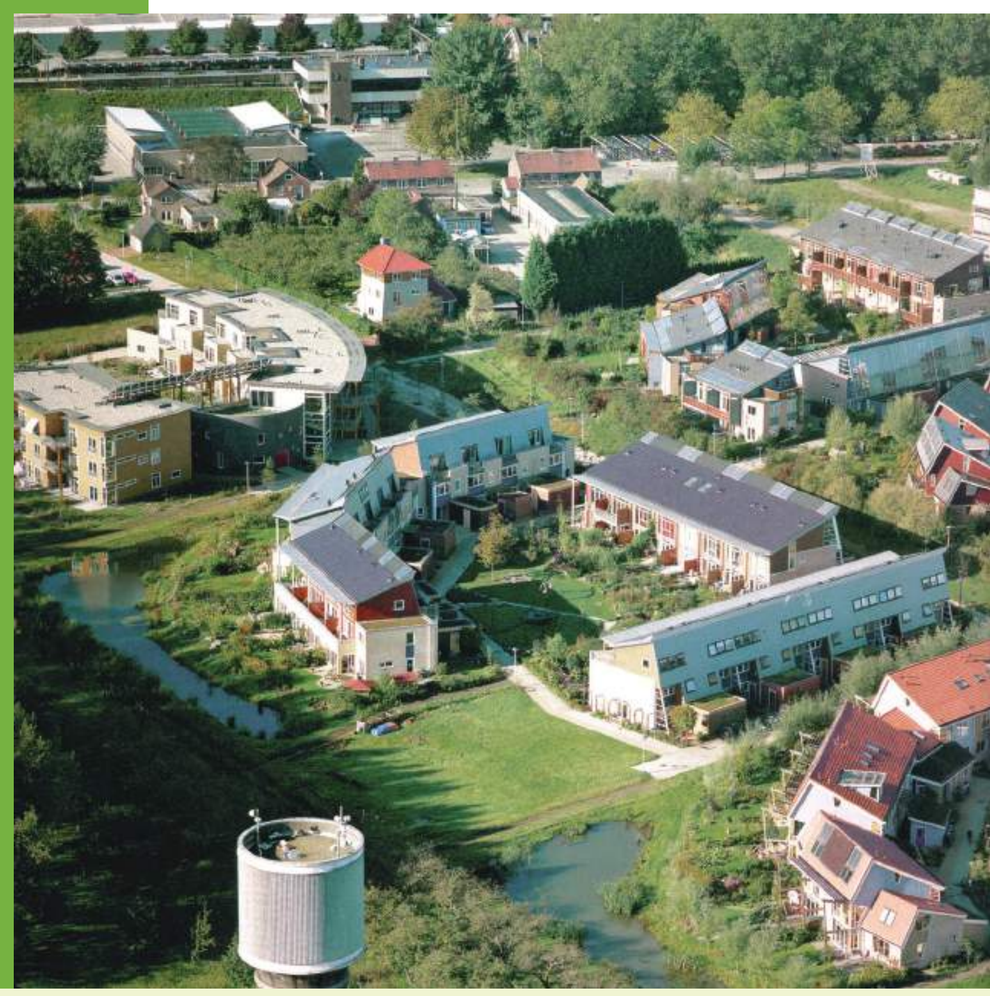
Solar city (fig. 9)



Solar city (fig. 10)

EVA Lanxmeer Culemborg, Netherlands

Water

The comprehensive water management strategy includes water-saving measures. The sewage water is split into blackwater (coming from toilets) and greywater (other sources). The greywater is and treated in well-integrated constructed wetlands within the neighbourhood. Collected rainwater is conducted via “wadis” or ditches to retention ponds. The pavement is reduced and carried out in water permeable way.

Mobility

The Lanxmeer neighbourhood is situated near a railway station and close to town center. The transport concept promotes walking and cycling, and low traffic with parking lots near the edges of the development.
Furthermore, a car-sharing concept has been implemented. The courtyards are connected by small alleyways.
Living, working and relaxing with area park, recreational pond and local farm are all at a short distances.

Social Involvement

Information within the neighbourhood is shared via newsletters, a website and meetings. The residents maintain their courtyard and contribute to festivities, e.g. at apple harvest.
The public green space is organized and managed by the owner’s foundation. The organic farm includes educational activities, a shop, terrace and kitchen. Other initiatives are a private “Waldorf School”, a community for elderly and on car-sharing.

Community initiatives: Foundation, energy company, city farm etc. (fig. 11)

Courtyard community (fig. 12)

Experiment attached houses in greenhouses (fig. 13)

Terraced houses at rainwater pond (fig. 14)

“Kwartelhof” for elderly people with community courtyard (fig. 15)

Solar roofs on terraced houses: PVs and solar thermal collectors (fig. 16)

Site:	**Former water-collection area inside city boundary**
Dimension:	**33 ha (incl. 14 ha public open space)**
Homes:	**ca. 250**
Busin. Premises:	**40,000 m²**
Implementation:	**1999 to 2008**
Urban Planning:	**Eble Messerschmidt Partner in cooperation with Copijn, Utrecht, and City of Culemborg**
Awards:	**Model project for “Duurzaam Bouwen” of the Dutch Ministry for Building VROM**

Image credits:

fig. 1+10 Pandion Aerial Photography
fig. 2-9, 11, 13-16 Eble Messerschmidt Partner
fig. 12 Hyco Verhaagen

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The project presents a unique urban plan and highly attractive open spaces, while the building exhibition is derived from guidelines for architectural quality, materials and energy standards as well as the technical infrastructure.

Aerial photo of the site Bo01 in Malmö, Sweden (fig. 1)

Bo01 Western Harbour Malmö, Sweden

Background and Overview

Malmö's economy, which used to be dominated by industry, has changed considerably in the recent decades. Now it is based on smaller companies in the service, trade and IT sectors. In 2001, the city hosted the International Building Exhibition (IBA) Bo01, in a former dockland and industrial area. This neighbourhood is the first development phase of the overall urban development project called Västra Hamnen (Western Harbour).

Quality Programme

The project was initiated by the City of Malmö, which has attached particular importance to environmental policy for decades. The Bo01 project office worked with the construction companies involved to develop a quality assurance programme to specify requirements and ecological objectives. These guidelines define architectural quality, materials and energy standards for buildings, as well as the characteristics of the technical infrastructure.

Urban Design

Landowners were obliged to commission different architects to design individual buildings to create a mixed and colourful neighbourhood. Head architect Klas Tham envisioned a network of streets with a broken-up character, much like that of medieval towns. On the west, a spacious beach promenade invites cyclists and passers-by to linger, whilst tall buildings around the neighbourhood's perimeter shield inner areas from the wind.

Site Plan Bo01 of waterfront regeneration in Malmö (fig. 2)

Lively roofscape and differentiated building typologies (fig. 3)

Solar thermal vacuum pipe collectors (fig. 4)

Protecting PV structure (fig. 5)

Apartment blocks with cafés and a restaurant on ground floor level (fig. 6)

Neo-futurist residential high-rise building Turning Torso (fig. 7)

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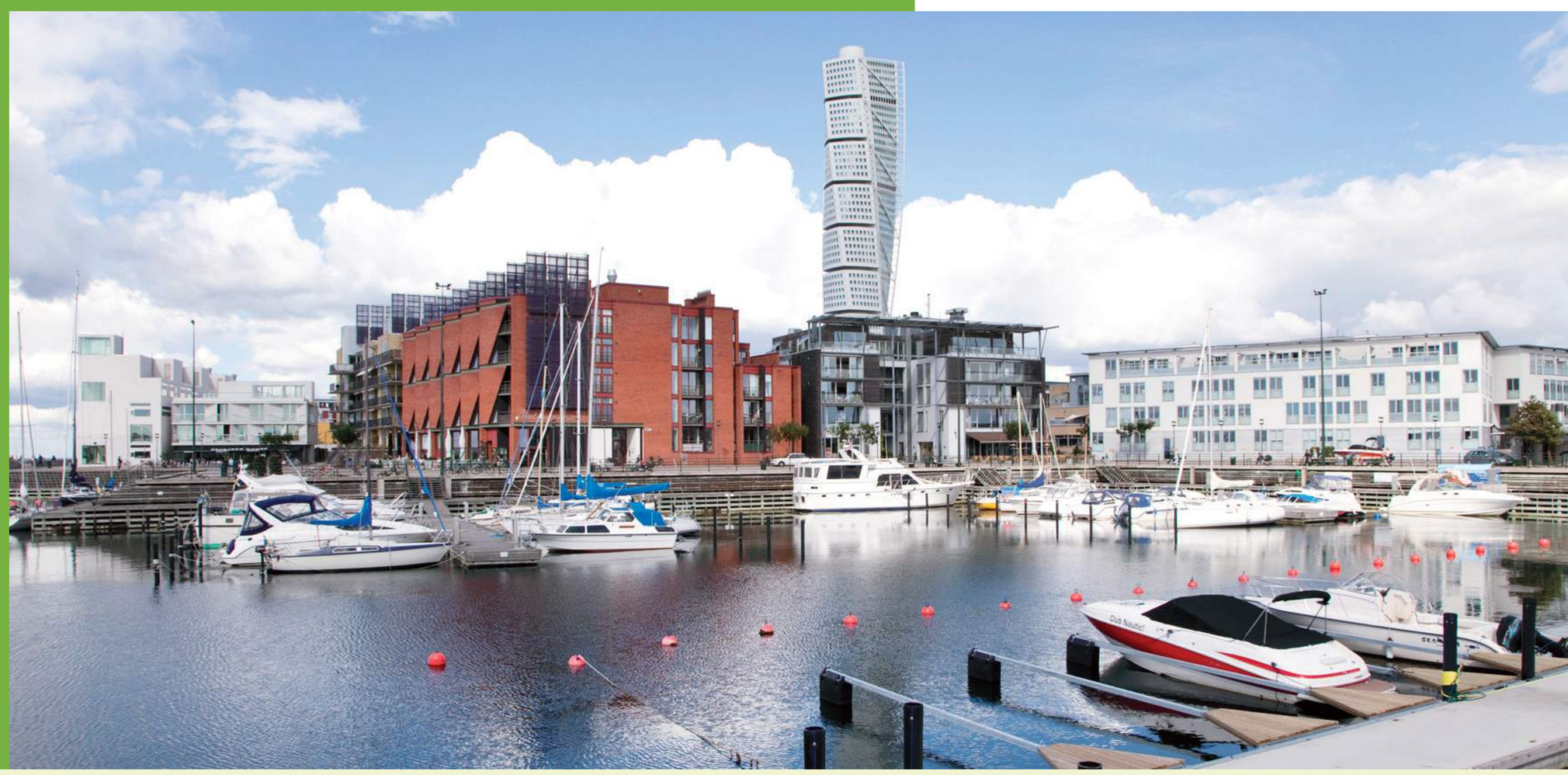

Harbour with boats at the southern edge of the neighbourhood (fig. 8)

Bo01 Western Harbour Malmö, Sweden

Open Spaces

To increase long-term biodiversity, green spaces resemble nature with many different habitats for different animal and plant species. In addition, colonies of rare species and bird hatcheries have been introduced. Rainwater runs through the neighbourhood in open channels before seeping into the ground. Commissioning different landscape planners for all the major open spaces made an essential contribution to ensuring a varied, high quality design.

Energy

To achieve the project goal of 100 % local and renewable energy supply, a major share of heating demand is covered by heat pumps using groundwater, supported by solar collectors. The electricity for heat pumps and for apartments is generated by rooftop photovoltaic panels and a wind power plant in the nearby. Organic waste is converted into biogas, which is used to heat apartments and drive vehicles. A vacuum pipe system transports waste directly to the biogas plant.

Mobility

In order to promote environmentally friendly means of transport, neighbourhood parking facilities were deliberately kept low, whilst providing excellent public transport links and attractive footpaths and cycle paths. One of the consequences of this is that the electric vehicles provided at specially designated parking spaces are very popular. There is a bus stop no more than 300 m from every apartment, served by biofuel buses.

Waterfront with spacious beach promenade (fig. 9)

Steps down to Oeresund sea (fig. 10)

Waterfront park (fig. 11)

Water square (fig. 12)

Open rainwater channel (fig. 13)

Terraced houses along canal (fig. 14)

Site: Former dockland and industrial area
Dimension: 25 ha
Inhabitants: ca. 2,350
Implementation: 2001 to 2030 (Western Harbour)
Urban Planning: Klas Tham and City of Malmö
Awards: Lee Kuan Yew World City Prize

Image credits:

fig. 1 Aerial photo: Bojana Lukac, City of Malmo
fig. 12+13 Ramboll Studio Dreiseitl

fig. 2, 8-10 Jan-Erik Andersson, City of Malmo
fig. 3-6, 11, 14 Eble Messerschmidt Partner

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The mixed use redevelopment project employs environmentally friendly technologies and an extraordinary material flow strategy with the aim of reducing the ecological footprint largely.

Aerial photo (fig. 1)

Hammarby Sjöstad Stockholm, Sweden

Background and Overview

The dockland and industrial brownfield was designated as a mixed-use development in 1993 in response to major population and urban growth. Hammarby became Stockholm's largest urban development project, reaching completion in 2016. The neighbourhood environmental information centre, GlashusEtt, hosts events to explain the concept of the neighbourhood to residents and raise their awareness of a sustainable lifestyle.

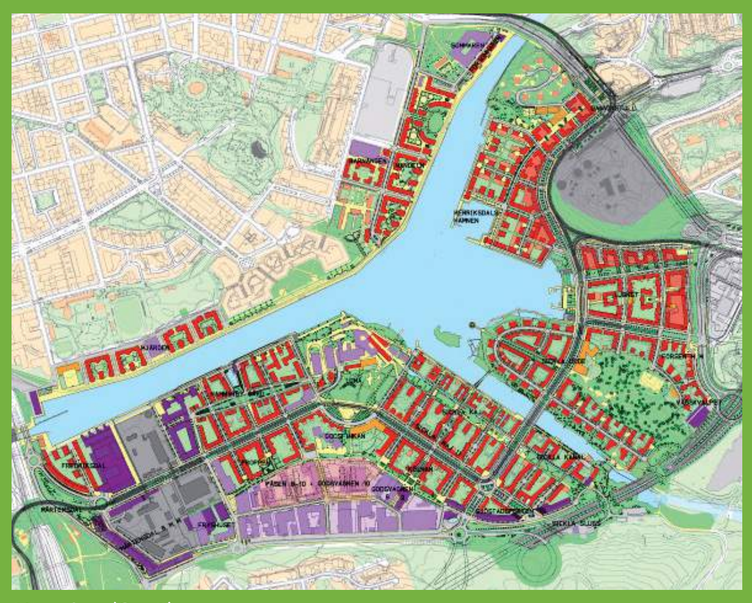
Sustainable Urban Design

The masterplan sets out the quality of urban space and integrates environmentally friendly technologies with the aim of reducing the ecological footprint by 50 percent in comparison to other districts in Stockholm. Individual building plots were given to the developer who demonstrated the most innovative design approach. The real key to the district's success is the integrated planning work that was carried out from the beginning in a unique way.

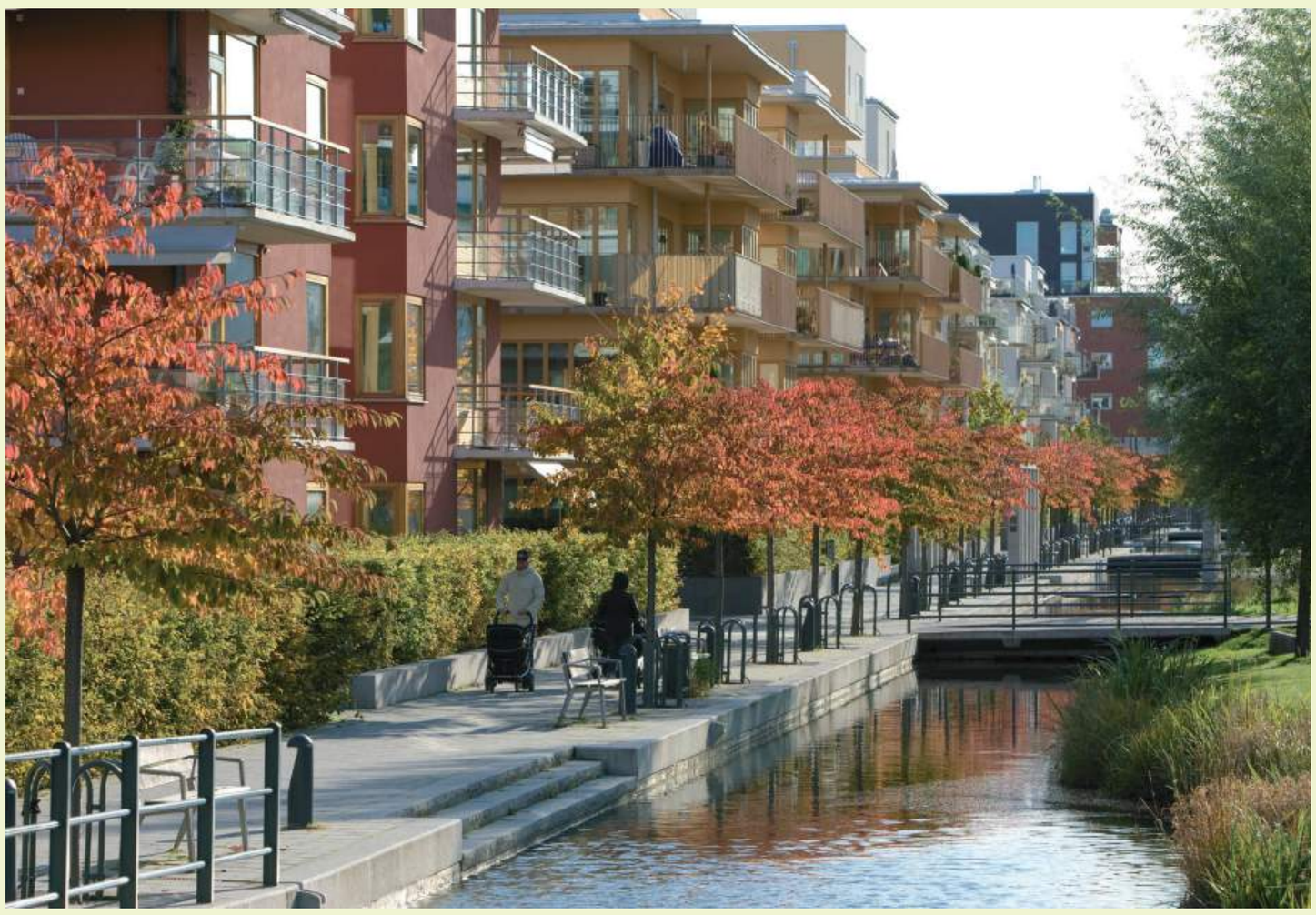
Mobility

The mobility plan focuses on a dense network of footpaths and cycle routes connecting to surrounding areas. A new tram line and two new bus routes connect Hammarby Sjöstad with other parts of the city.

Municipal ferry provide water-bound public transport and 46 electric cars are for rent available. These measures contribute to reduce private car ownership to just 20 percent of residents.



Site plan (fig. 2)



Attractive open spaces and channel for stormwater from buildings and gardens (fig. 3)

Waterfront park (fig. 4)

Pleasure boat moorings at old dock (fig. 5)

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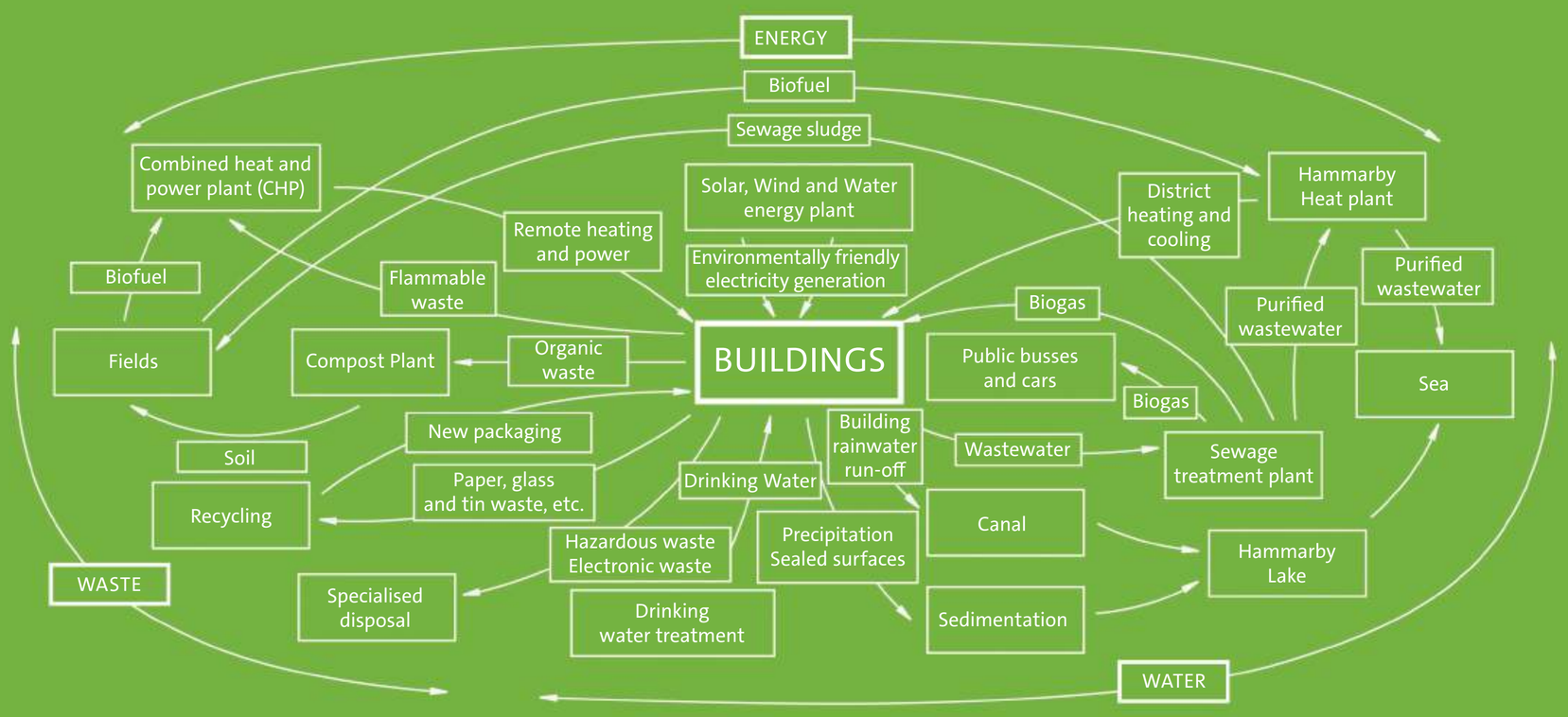
Hammarby Sjöstad



Model showing the flows of food, water, fuel, energy and waste (fig. 6)

Hammarby Sjöstad Stockholm, Sweden

Energy, Material Flows

Hammarby Sjöstad features a purpose-built integral energy and material flow system, which is now being copied by other cities. The core idea is to recreate a zero-waste natural cycle within the neighbourhood. A system of vacuum pipes collects combustible waste in different fractions which is used to generate heat and electricity in a CHP plant. Biogas produced as a by-product from waste water treatment is used to operate buses and cars in the neighbourhood, and to generate heat, cooling and electricity.

Water and Open Spaces

As a by-product from biogas production, sewage sludge is dried and used as fertiliser. Water for domestic cooking, drinking and washing is drawn from the water treatment plant fed by the nearby Lake Mälaren. Heat energy stored in grey and black water is extracted and used to support the local heating system before sewage is cleaned in an experimental sewage treatment plant and naturally infiltrated. The design of the open space includes open conduits for rainfall.

Many roof areas are greened, which contributes to mitigating flood peaks and improving the neighbourhood's microclimate and biodiversity. Water draining from roofs during heavy rainfall is stored in cisterns and used to irrigate gardens and flush toilets.

Individual buildings include various grey and black water recycling systems to reduce drinking water demand. The water consumption is 100 l/person/day, which means 50% lower than Stockholm's average.

Waste collection with underground vacuum system (fig. 7)

Waste collection station: Above ground, collection points for paper, metal, glass and plastic waste are located on each building block. Non-flammable components are collected and fed into the recycling cycle. Hazardous waste such as paints or batteries are collected centrally for appropriate disposal. (fig. 8)

Waterfront development on the lake Hammarby Sjö (fig. 9)

Site:	**Former dockland and industrial area**
Dimension:	**150 ha + 50 ha water area**
Inhabitants:	**ca. 25,000**
Jobs:	**10,000**
Implementation:	**1999 to 2016**
Urban Planning:	**Stockholm urban planning office in cooperation with White Architects, Nyréns Architects and Erséus Architects**
Awards:	**World Clean Energy Award Construction (new, urban development, rehabilitation), Transport and Mobility**

GREEN BUILDINGS AND SUSTAINABLE NEIGHBOURHOODS

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The Aktiv-Stadthaus in Frankfurt am Main is an eight-storey apartment building with PlusEnergy performance.
While being a demonstration and research project, it is also a project developed by a business-oriented developer in Frankfurt.

fig. 1

Aktiv-Stadthaus Frankfurt a. M., Germany

Background and Overview

This project demonstrated that technology developed in the area of single-family homes can also be applied to large-scale multi-storey residential buildings in the inner-city of a metropolis.

The Aktiv-Stadthaus has won several design and innovation awards and thereby presents its owner at the forefront of the development towards sustainable low-energy urban development.

Design Principles

Sun Shading

The facade openings are protected with external moveable shading systems to prevent the building from overheating.

Controlled Ventilation and IAQ

The apartments are equipped with decentral ventilation units to ensure that sufficient air is supplied and to enable energy saving with heat recovery units.

Improved Building Envelope

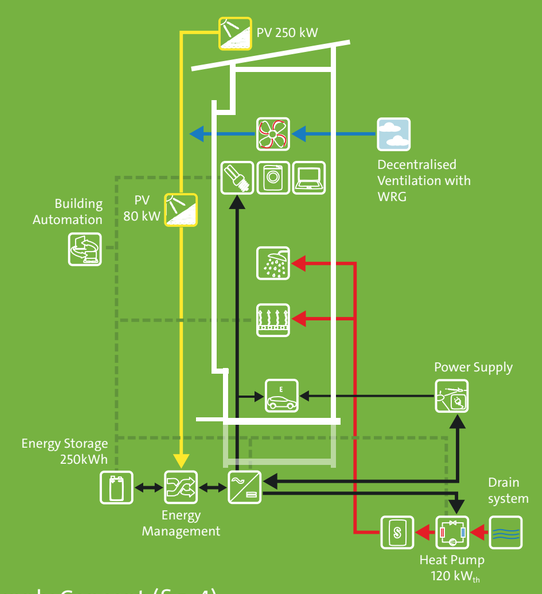
The building envelope is well-insulated and air-tight to reduce the heating demand.

Energy-Efficient and Low Carbon Heating

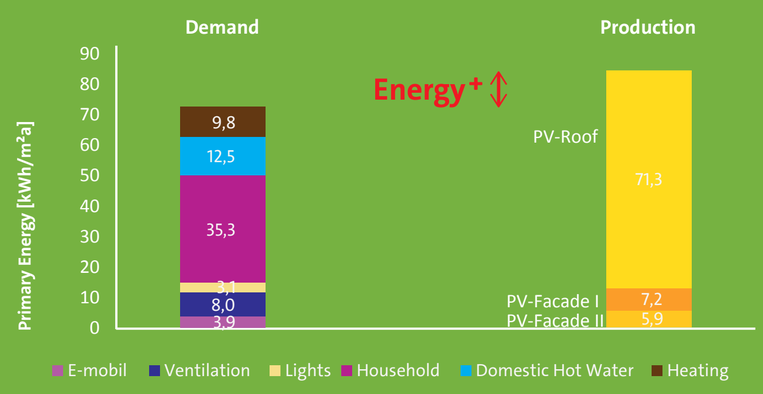
The heating and domestic hot water system is supplied with heat from a heat pump, which uses waste heat from the public sewage system.

Renewable Energy Generation

The building is equipped with PV panels on the roof and in the facade. It does not only fully generate its own power to meet the annual demand, but also produces a surplus of energy.



Energy Supply Concept (fig. 4)



Primary Energy Demand and Energy Production (fig. 5)

fig. 2

fig. 3

Client: ABG FRANKFURT HOLDING
Architects: HHS PLANER + ARCHITEKTEN BDA, Kassel
Energy concept: EGS-plan, Stuttgart

Image credits:

fig. 1+3 ABG Frankfurt Holding, Herbert Kratzel
fig. 2 ABG Frankfurt Holding, Ralf Pelkmann
fig. 4+5 EGS-plan

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The Eichendorff-School in Esslingen am Neckar, close to Stuttgart, was originally built in the 1950s and retro-fitted in 2001 to be one of the first Zero-Carbon-School-Buildings in Germany.

(fig. 1)

Eichendorff-School Esslingen a. N., Germany

Background and overview

Besides the energy updated, the refurbishment improved the indoor environmental quality and the learning environment.

Sun Shading

Shading systems have been installed to prevent the classrooms from over-heating. These systems also reduce glare when the sun is at its strongest.

Energy-Efficient and Low Carbon Heating

As fuel for the heating system biomass is used with low CO2-emissions compared to conventional energy carriers.

Design Principles

Improved Building Envelope

The building envelope was equipped with an insulation layer and improved windows were installed to reduce energy consumption in winter.

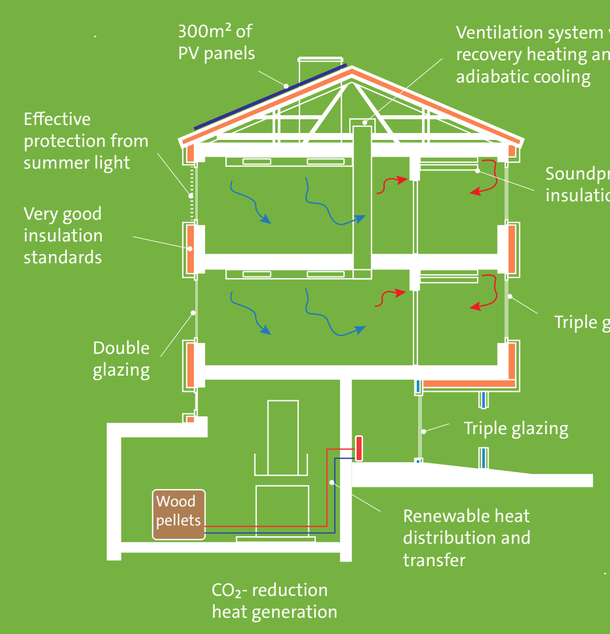
Controlled Ventilation and IAQ

The high occupancy in classrooms often leads to high CO2-concentration. A newly installed mechanical ventilation system ensures the delivery of “fresh” air and allow heat recovery.

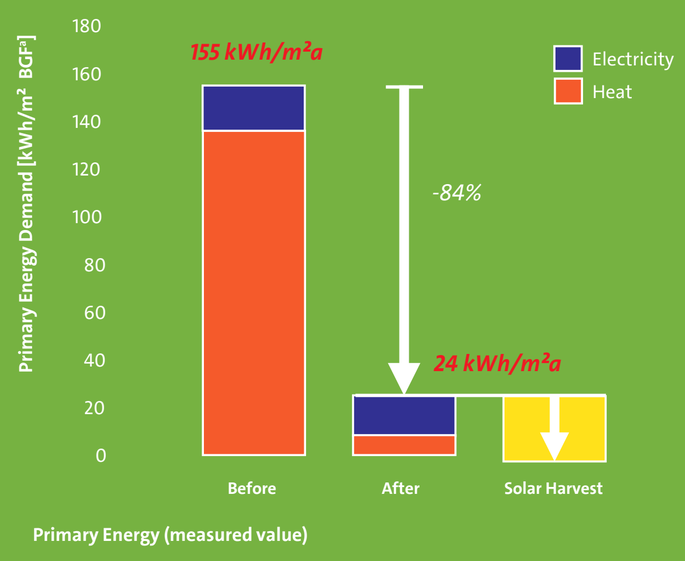
Renewable Energy-Generation

The southerly roof of the school was equipped with a large PV-system, so energy is produced. The solar harvest is displayed in front of the building for the students and the public to see.

Public display of solar harvest in front of school building (fig. 2)



Energy Supply Concept (fig. 3)



Primary Energy Demand (fig. 4)

Client: City of Esslingen am Neckar
Energy concept: EGS-plan, Stuttgart

Image credits:

fig. 1-4 EGS-plan

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The German Sustainable Building Council: Europe‘s biggest network for sustainable building

DGNB

DGNB Main Criteria Groups (fig. 1)

The German Sustainable Building Council DGNB

Members from 30 countries	DGNB System Partner in Denmark, Austria and Switzerland	Collaboration with over 60 universities and colleges of higher education	Network with partners in more than 40 countries

A global network - strong partners on a common journey (fig. 2)

DGNB Academy (fig. 3)

DGNB Head Office in Stuttgart (fig. 4)

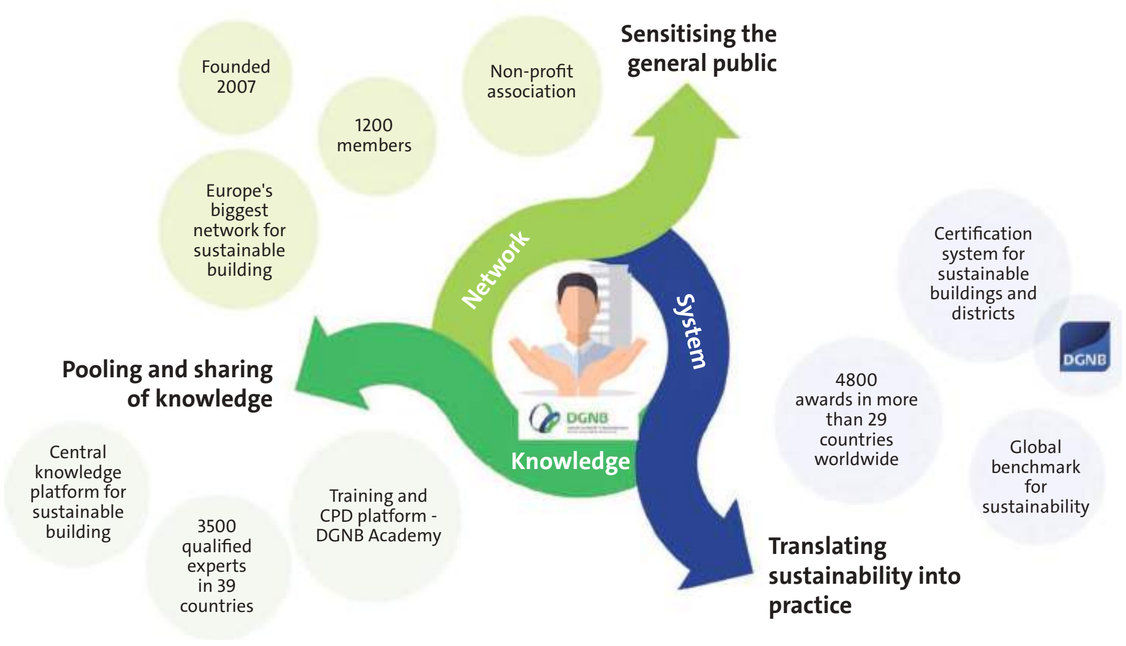
Elobau E+ production hall, certified as Climate Positive (fig. 5)

Townhall Freiburg certified as Climate Positive (fig. 6)

Sustainable Building | **Climate Positive** | **Circular Economy**

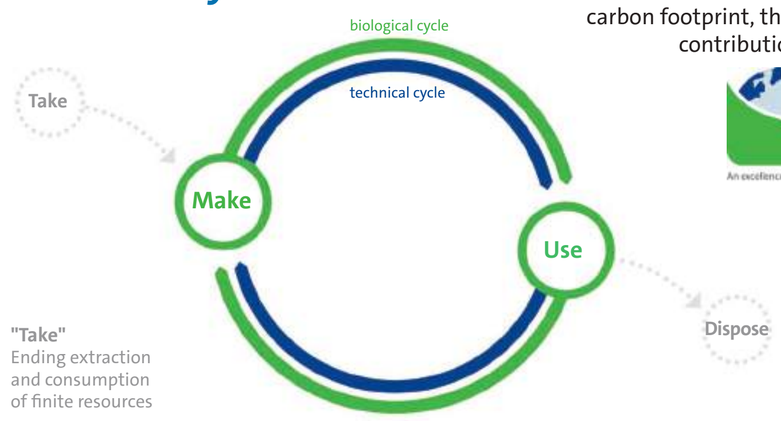
DGNB-Topics

The DGNB Organisation Chart



(fig. 7)

Circular Economy Model



"Take"
Ending extraction and consumption of finite resources

"Make"
- Maintain the quality and value of the raw materials used at the highest level
- Reduce the number of processing steps and complexity
- Retain comprehensive use / reuse options
- Only manufacture products with can be returned into the cycle

"Use"
- Maximise service life through high repair friendliness (while at the same time ensuring the greatest possible efficiency)
- Increase intensity of use through diverse use options
- Ensure adaptability and flexibility
- Planning and stating usage times

"Dispose"
Stop producing waste and recycle raw materials if equivalent use is no longer possible

(fig. 8)

The DGNB considers a building to be ‚Climate-Positive‘ if using or running the building results in a balanced – or ideally negative – annual carbon footprint, thus making an important contribution to climate protection.

Climate Positive
An excellence award of the DGNB German Sustainable Building Council

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The DGNB goals are:

Buildings that are known to be good and districts that are pleasant to live in for architectural environments with a future.

Transformation of the construction and property market, promoting a sensible understanding of quality as a foundation for responsible and sustainable action.

Architecture: Haas Cook Zemmrich; Photo: Roland Halbe

Alnatura Headquarter Darmstadt, Germany: DGNB Platinum Award and German Sustainable Architecture Award 2020 (fig. 9)

The DGNB Certification System

The DGNB System: Global Benchmark for Sustainability

There are a number of certification systems for sustainable building. The DGNB System is unique. It provides an objective description and assessment of the sustainability of buildings and urban districts. Quality is assessed comprehensively over the entire life cycle of the building. The DGNB Certification System can be applied internationally.
Due to its flexibility it can be tailored precisely to various uses of a building and even to meet country-specific requirements. The outstanding fulfilment of up to 50 sustainability criteria from the quality sections ecology, economy, socio-cultural aspects, technology, process work flows and site are certified. The system is based on voluntarily outperforming the concepts that are common or usual today.
If a performance requirement is met, the DGNB awards the DGNB certificate in bronze, silver, gold and platinum. In addition, there is the option of simple pre-certification in the planning phase both condos and rented apartments.
Protecting resources, using energy efficiently and planning future-oriented districts – sustainable building objectives offer solutions for challenges which are truly global. Therefore the DGNB certification system is internationally applicable. Its flexible structure allows precise tailoring precisely for various building types.
The international implementation of the DGNB System is based on its adaptation to country specific conditions. The International DGNB System version 2014 provides the basis for two international certification routes which vary in scope.

DGNB International

More than a System: DGNB Quality applicable to all Types of Building Use

Interiors	Buildings	Urban Districts
		
Sparkassen House Leer Architecture: Ellwanger Chabert Architects Photo: Sparkasse LeerWittmund	House B1 Proj. VIER Pelikan Quarter Hannover Architecture: Architekten BKSP Photo: Clemens Born	Spinnereipark Kolbermoor Living on the green Architecture and Visualisation: Behnisch Architects

Examples of certified projects (fig. 10-12)

Architecture: Kaden+Lager, Photo: Eble Messerschmidt Partner

(fig. 13)

Architecture und Photo: Kaden+Lager

(fig. 14)

Architecture: Kaden+Lager, Photo: Eble Messerschmidt Partner

(fig. 15)

DGNB Gold Certified Building Skaio, District „Neckarbogen“, a part of the National Garden Exhibition 2019 in Heilbronn, Germany (fig. 13-15)

Certification as a Proof of Quality: DGNB Awards

	DGNB Platinum	DGNB Gold	DGNB Silver	DGNB Bronze
Total performance index	80% and higher	65% and higher	50% and higher	35% and higher
Minimum performance index	65%	50 %	35 %	-- %

(fig. 16)

The DNA of the DGNB System

Life cycle assessment
All audits take the entire life cycle of a building project into account

Holistic
Equal emphasis on three core sustainability factors: environmental, economical and sociocultural

Emphasis on performance
The DGNB System assesses the overall performance of a development and not just individual measures

(fig. 17)

Key Figures on DGNB Awards

Market leader in Germany (fig. 18)

National and international awards 2009-2018 (fig. 19)

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Cities of the future require districts, which provide more than just individual, sustainable buildings.

Therefore the DGNB in cooperation with international experts has developed a certificate for districts as a planning and optimisation tool.

National Garden Exhibition 2019 in Heilbronn, Germany: DGNB Platinum Award (fig. 20)

The DGNB Certificate for Districts

Five Equally Weighted Qualities and Related Criteria for Urban Districts

The DGNB System encompasses five qualities, which are weighted equally. Thereby the DGNB is the only system, which gives equal importance to the economic quality as to environmental quality. These qualities are divided into 31 criteria, however not every criterion is applicable for different system applications. For version 2020, the system was fundamentally overhauled and key future topics are now included. The DGNB promotes innovative concepts and solutions. The system therefore additionally awards bonus points and innovation areas, which have a positive effect on the certification result.
Buildings, open spaces and infrastructure – the system for districts combines resource-efficient construction, energy-efficient operation with a high quality of indoor and outdoor spaces, thereby laying the foundation for sustainable districts. The DGNB certificate for districts is market leader in Europe.

Environmental quality
- Life cycle impact assessment
- Building pollutants
- Urban climate
- Environmental risks
- Water cycle
- Land use
- Biodiversity

Economic quality
- Life cycle costs
- Resilience and adaptability
- Land use efficiency
- Value stability

Sociocultural and functional quality
- Thermal comfort in open spaces
- Open space
- Workplace comfort
- Noise, exhaust and light emissions
- Barrier-free design
- Urban design
- Social and functional mix
- Social and commercial infrastructure

Technical quality
- Energy infrastructure
- Resource management
- Smart infrastructure
- Mobility infrastructure – motorised transportation
- Mobility infrastructure – pedestrians and cyclists

Process quality
- Integrated design
- Consultation
- Project management
- Governance
- Safety
- Construction site and construction process
- Monitoring

Site quality

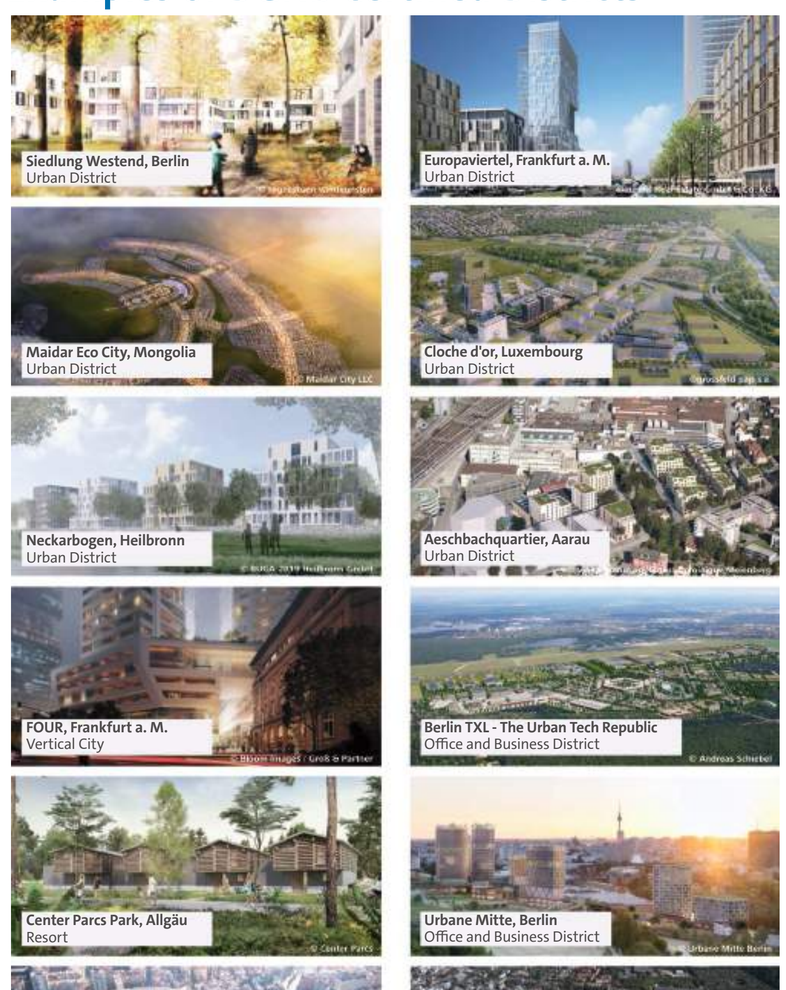
Key Topics of the DGNB District System

- Climate protection and climate adaption
- Circular economy
- Social mix and participation
- Promotion of health
- Digitalisation

Advantages of Certifying

- Holistic approach in all relevant sustainability criteria
- Quality assurance in the long-term
- Building image and value stability for the district
- Advantages in marketing and in financing
- Minimising risk
- Contributing to UN Sustainable Development Goals

Examples of DGNB Certified Districts



Examples of DGNB Certified Districts (fig. 22)

Application to Cambodia

With the Build4People project the adaption of the DGNB assessment system for "Sustainable Neighbourhoods" to Cambodia will be explored. This shall be based on the consideration of the climate, socio-cultural and institutional context of Cambodia. The goal is to foster the sustainability performance of projects in design and implementation by making sustainability measurable.

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fig. 10 Sparkasse LeerWittmund
fig. 11 Gundlach Bau und Immobilie Clemens Born
fig. 12 Visualisation Behnisch Architects
fig. 14 Kaden und Lager
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