Synthesis Report: Annex of Case Studies
URBAN CLIMATE RESILIENCE

URBAN-NEXUS

1. General approaches to adaptation and resilience

1.1 Generic tools and guidelines

1.1.1 Stadtklimalotse (Urban climate pilot)[1]

This is an online decision support tool for urban climate change adaptation, aimed at planners and policy makers from small and medium sized towns and cities, who have a need for quick and easy access to information. It is mainly focused on German and German speaking audiences; however, most of the measures are applicable for any city or town, and international best practice examples are included. The database of urban climate change adaptation measures (Version 4.0 beta; as at January 2012) contains 138 measures in 10 fields of action (energy, health, tourism, water, infrastructure, transportation, green spaces, air quality, agriculture, forestry), 330 links to legislative texts and 61 examples for planning and implementation of measures; further background information on climate change research and an integrated tool for a quick urban vulnerability assessment. These are used to guide the reader through the process of adaptation, raise key questions in a structured manner, and suggest methods and examples – it does not attempt to make direct recommendations for action.

This has been applied in Stuttgart (see section 1.11.2.3) as an integrated regional approach to adaptation, encompassing the city and surrounding towns.

1.1.2 Wiki on adaptation to climate change, Germany[2]

To prepare municipalities for adaptation to the consequences of climate change, Climate Alliance is developing guidelines in the form of a web-based guide for municipalities and an emergency support kit to deal with extreme occurrences. The aim of the guidelines is to help cities and municipalities in the development of an adaptation strategy and in the initiation and implementation of local adaptation activities. The information contained in the guidelines will be made available as a Wiki within an internet-based tool. The aim is for volunteer authors to develop the guidelines. Particularly specialists from the over 450 German Climate Alliance municipalities are invited to actively participate.

[1] www.stadtklimalotse.net/english/ Mark Fleischhauer, Senior Research Fellow at TU Dortmund University, Institute of Spatial Planning (IRPUD)

[2] Dr. Andreas Kress, Senior project manager at Climate Alliance, a.kress@climatealliance.org

1.1.3 REGKLAM – development and testing of an integrated regional climate change adaptation programme for the model region of Dresden[3]

The overall aim of the project is to ensure quality of life, and at the same time make use of economic opportunities in order to increase the competitiveness of the region in future.

The objectives are:

- To develop an Integrated Regional Climate Change Adaptation Programme (IRKAP) based on regionalised climate and economic scenarios, specific adaptation options and cooperation with implementing stakeholders;
- To initiate and accompany the implementation of key projects and further adaptation measures; and
- To consolidate a regional network of stakeholders.

The project is organised in four modules, which integrate several thematically discrete subprojects. All work is oriented towards the IRKAP, and the establishment of a regional adaptation network as the central output of REGKLAM.

The main product of the REGKLAM project is the IRKAP. The programme considers possible climatic and societal changes and their future consequences, and provides tangible adaptation options which address various stakeholders in the Dresden Model Region. It is developed by a continuous communication process between the scientific partners from different disciplines and the stakeholders of the region. Scenarios and adaptation measures are summarised in a manner, which is accessible to decision makers and other stakeholders. The programme is an informal instrument, which aims at fostering the implementation of adaptation measures at various decision-making levels, including industry, regional and local administration, and the state government. It is based on six strategic issues (buildings, open space and urban structures; water systems; agriculture and forestry; regional economy; nature conservation; public health), which are identified and developed in close cooperation with stakeholders from the major fields of activity in the region.

The main challenges are:

- Urban regional climate change adaptation – connection between practice and research;
- Complex issues – urban region as a laboratory for inter- and transdisciplinary research;
- Researcher – a player in the local development arena;
- Urban region as a living research laboratory – governance, participation, cooperation, transfer; and
- Application oriented basic research – redefining evaluation criteria, new forms of scientific excellence.

[3] http://www.klimzug.de/en/98.php ; http://www.regklam.de/1/home/ Tobias Geyer, Regional Office for Coordination City of Dresden; Alfred Olfert, Scientific Project Management, Leibniz Institute of Ecological Urban and Regional Development, Dresden

1.1.4 SUPER - Sustainable Urban Planning for Ecosystem services and Resilience, in Europe and South Africa[4]

SUPER is exploring how to integrate ecosystem services into urban spatial planning to improve promote urban resilience. The project strives to lay a foundation for innovation in urban planning and governance that enable cities to navigate change, build local capacity to respond to disturbance and prepare for uncertainty and foster a transition to more sustainable urban trajectories. Through in-depth case studies in three cities (Stockholm, Istanbul, and Arnhem-Nijmegen) with a reference city of Cape Town (South Africa) and in combination with comparative cross-city studies.

The partners are committed to developing theoretical frameworks that are of strategic use in professional practice. This calls for pan-European collaborative research that can lead by example, and that can deliver first class interdisciplinary-based scientific research with new knowledge exchange between science and practice.

Partners and ongoing work

Ecologists and spatial planners from the three city-regions collaborate together with academic and professional partners are developing knowledge, planning practices and policies that can address two key dimensions of urban resilience:

- the inclusion of diverse ecological processes and functions in planning for metropolitan landscapes, and
- the integration of the many human relationships, physical spaces, urban form and design, and the institutions that are integrally connected to the urban fabric and which support social-ecological links in urban development.

The concepts of resilience and ecosystem services have proven to be very useful theoretical constructs to bridge the disciplinary divide between urban planners and ecologists. Partners are involved in outreach activities, including workshops and public performances. Researchers are working with urban planners in completing a manual for municipal- and regional spatial planning for implementing ecosystem services in strategic planning. A television documentary, “Green Urban Commons” on urban gardening and food production is coming soon.

1.1.5 Gothenburg Free Port, Sweden[5]

This transdisciplinary project emphasises the need for holistic planning strategies to avoid unintended consequences of urban adaptation measures.The overall aim is to develop knowledge and methods that enable an integrated assessment of the impact of climate induced risks on society.

Specific objectives are to:

[4] http://www.beijer.kva.se/research_under.php?id=30 Johan Colding of the Beijer Institute of Ecological Economics, Royal Swedish Academy of Sciences

[5] http://www.gvc.gu.se/Forskning/klimat/stadsklimat/gucg/current-projects/adapting-cities-to-climate-induced-risks/ Sofia Thorsson, Associate Professor, Department of Earth Sciences, University of Gothenburg, Sweden

i) Analyse the role of land use, vegetation and urban morphology for reducing the risks of extreme weather (heat waves, flooding, landslides, changes in pollution situation);

ii) Evaluate socio-economic impacts of climate change and different adaptation measures;

iii) Develop and propose innovative adaptation strategies to manage climate induced risks .

The free-port area in Gothenburg, Sweden, provides a case study to refine the individual scientific methods and interdisciplinary and intersectoral cooperation and integration. Methods will include statistical downscaling of meteorological data, thermal comfort and air quality modelling, stratified vulnerability analysis and natural risk and multicriteria analysis. The project brings together experts in urban climate, atmospheric science, natural risk assessment, stratified vulnerability and multi-criteria analyses, with local city planners in an integrated research effort. Plans for climate adaptation will be developed and proposed. Stakeholder involvement will promote transfer of knowledge and applicability of results.

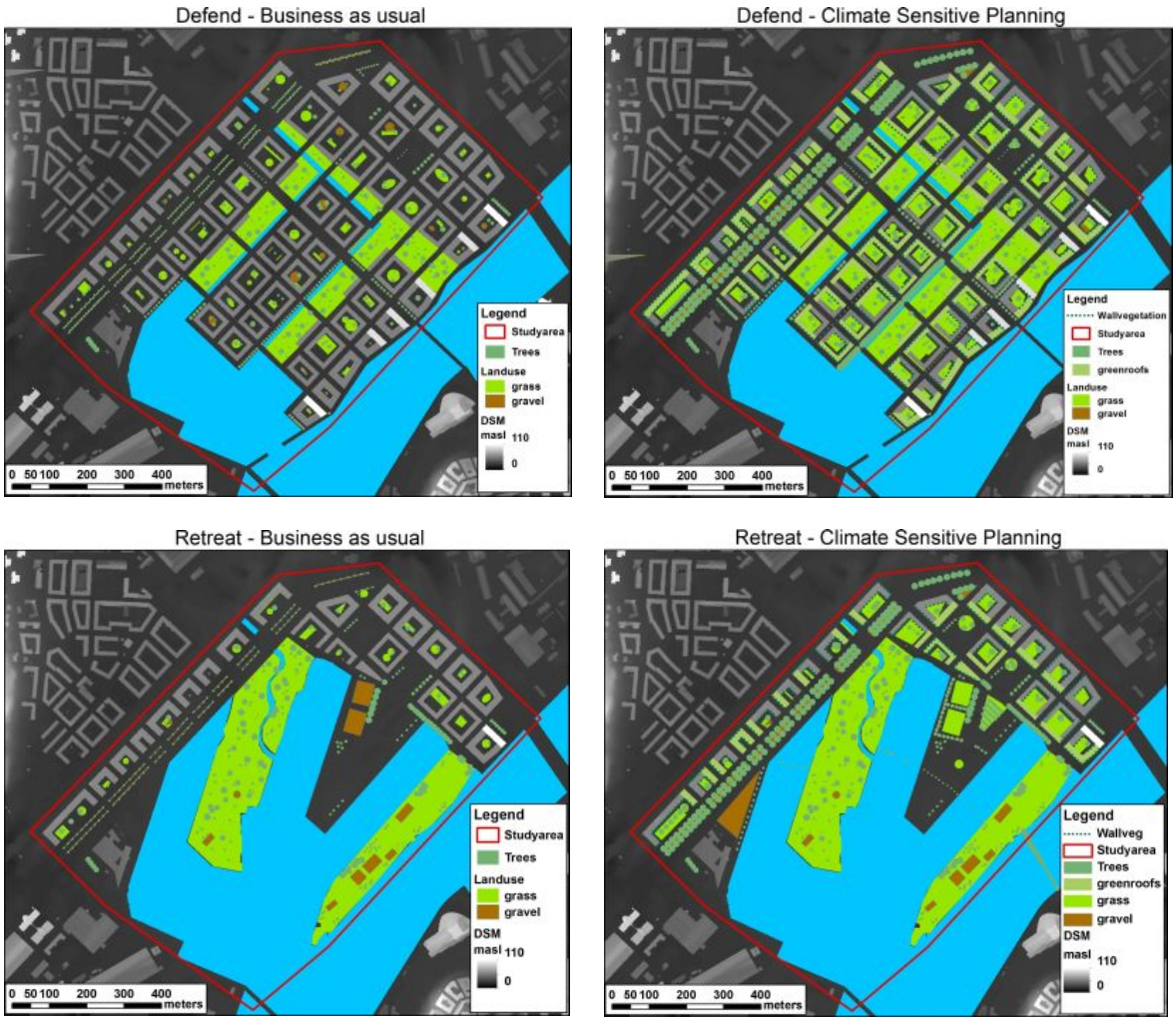


Figure 1: Four scenarios for the Free Port

1.1.6 emBRACE - Building Resilience Amongst Communities in Europe[6]

The emBRACE project aims to improve the pan-European framing of the resilience concept. Using interdisciplinary, socially inclusive and collaborative methods, it will develop a conceptual and methodological approach, to clarify how the resilience capacity of a society confronted with natural hazards and disasters can be characterised, defined and measured. Based on a systematic evaluation of a broad literature base, the project will first develop an initial conceptual framework. Existing datasets will be interrogated to identify variables that provide indications of resilience, and which are consistent with the framework. The framework and data will then be 'tested' and ground truthed by means of several carefully-chosen European case studies (in England, Germany, Poland, the Czech Republic, Switzerland, Italy and Turkey) which will be differentiated by hazard, governance setting, socio-demographic-economic context, and scale.

Indicators to measure resilience will be recommended, based on practical experience and grounded theories. A wide range of stakeholders and experts will be incorporated into different knowledge-sharing groups. A key differentiator of the emBRACE project approach is its seeking out of those people and groups not normally included; not as subjects of research but as partners in the research and experts in their own right (e.g. through Peer-To-Peer Learning Exchanges with grassroots groups).

1.1.7 Enhancing cities' capacity to manage their vulnerability to climate change in Sweden[7]

Vulnerability to climate change is a critical factor for both adaptive capacity, and for the possibility of achieving sustainable development. Even though the climate system is global, most impacts of climate change will be experienced locally. A changing climate will also affect city planning, in that areas may become unsuitable for development due to increased risk of flooding and landslides. Cities and regions, thus, will increasingly get a key role in assessing the requirements for adaptation.

This project aims at enhancing the institutional capacity to assess society's vulnerability to climate change in cities and regions. The project of will apply three methods: double exposure, climate vulnerability index and downscaled socioeconomic scenarios, as well as a number of tools that are used to project biogeophysical impacts of climate change. The methods and tools, developed by international research, emphasise different aspects of vulnerability. The project also uses participatory methodologies to study how the vulnerability methods and impact tools are used within municipal and regional administration, i.e. in the decision processes that they are meant to support.

A group of key stakeholders will be involved throughout the project duration. The outputs will be an integrated vulnerability tool, and criteria for robust decision making designed for planners within municipal and regional administration.

[6] http://embrace-eu.org/ Sylvia Kruse, Research associate, Swiss Federal Institute for Forest, Snow and Landscape Research (WSL)

[7] FORMAS project 2006-2234, Anna Jonsson, Linköping University

1.1.8 Climate adaptation as a new challenge for urban development in Switzerland[8]

Cities are appropriate areas for climate protection as well as for adaptation to climate change. On one hand this is where many of the emissions harmful to the climate are produced, whilst on the other hand urban regions are especially vulnerable to the effects of climate change. There is a lack of information on the need for action and potential for adaptation in Swiss cities, as adaptation to climate change is presently discussed mainly in terms of natural hazards (e.g. floods, avalanche, mudflows). For other potential effects of climate change - for instance heat islands and fresh air corridors, availability of fresh water as drinking water, cooling and processing of water, or provision of electricity - there exist only a few analyses and strategic concepts for urban development.

In this project led by the Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Economics and Social Science, representatives of twelve big Swiss cities were interviewed by telephone, concerning their strategies and measures for adaptation to climate change. The respondents were representatives of urban planning and environmental departments. The aim of these interviews was to identify, from the viewpoint of the cities, the major challenges of climate change and to systematically record the existing activities of the cities. Best practices and pilot projects were highlighted.

1.1.9 A coordinated approach to adapting cities to climate-induced risks in Sweden[9]

There is a strong need for the establishment of resilient cities, which can absorb changes, manage climate induced risks and recognise environmental, social and economic development in an integrated manner. The aim of this transdisciplinary project is to:

1) Analyse the role of land use, vegetation and urban morphology for reducing climate change induced effects and risks (floods, landslides, heat waves, extreme air pollution events),

2) Evaluate socio-economical impacts, and

3) Develop and propose innovative adaptation strategies.

Three urban districts in Göteborg urban area will be selected for case studies: Masthuggskajen (existing environment), Frihamnen (developing area) and Papyrus (large developing area). Methods will include thermal comfort and air quality modelling; natural hazards risk assessment; stratified vulnerability and multi-criteria analysis in an iterative participative stakeholder approach. The consortium includes experts in outdoor thermal comfort, atmospheric science, geo technique and socio-economy as well as local actors working with urban development in Göteborg. By introducing knowledge and research normally not integrated at an early stage in

[8] http://www.wsl.ch/fe/wisoz/projekte/klimawandel_staedte/index_DE ; http://www.are.admin.ch/dokumentation/00880/index.html?lang=de&download=NHzLpZeg7t,lnp6I0NTU042l2Z6ln1acy4Zn4Z2qZpnO2Yuq2Z6gpJCEdH94fGym162epYbg2c_JjKbNoKSn6A-- Sylvia Kruse, Research associate, Swiss Federal Institute for Forest, Snow and Landscape Research (WSL)

[9] FORMAS projects 2010-358 and 2010-1706, Sofia Thorsson, Associate professor, Department of Earth Sciences, University of Gothenburg, Sweden

the planning process, goal conflicts and synergies between different aspects can be identified and implemented.

1.1.10 Climate change adaptation indicators in the UK

This is a partnership between Sniffer[10] and ClimateXChange[11], testing out a new collaborative approach between a commercial consultancy and an academic consultancy. The overall aim of the project is to help inform the future development and use of adaptation-related indicators by building on previous indicator work, including the June 2011 AEA report commissioned by the Adaptation Sub-Committee (ASC) and related recent reports on climate change 'preparedness'.

For the purpose of this project, adaption-related indicators will be defined as: "Indicators that focus on both a) planned adaptation to climate change impacts and b) the actual state of adaptation achieved." Adaptation-related indicators will measure progress and performance in both:

a) Building adaptive capacity, where indicators are needed to monitor the progress in implementing adaptation measures (referred to as process-based indicators).

b) Delivering adaptation actions and outcomes, where indicators are needed to measure the effectiveness of adaptation policies and of society's activities in general (outcome-based indicators).

A combination of process-based and outcome-based indicators are needed in order to monitor and improve progress in adaptation. These definitions are in line with the definition of adaptation indicators outlined in the 2011 ASC report.

1.2 Case studies

1.2.1 Climate adaptation in Fredrikstad, Norway[12]

When Fredrikstad municipality unveiled its climate plan in 2007, the city council decided to map Fredrikstad's vulnerability to future climate change – in addition to efforts to reduce greenhouse gas emissions. The municipality wanted to draw up a

[10] http://www.sniffer.org.uk/our-work.aspx

[11] http://www.climatexchange.org.uk/index.php/cxc-work Ragne Low, Knowledge Officer, ClimateXChange, Scotland

[12] http://www.regjeringen.no/en/dep/md/kampanjer/engelsk-forside-for-klimatilpasning/library/cases/climate-adaptation-in-fredrikstad.html?id=633495

strategy to counteract vulnerability where necessary or desirable. By cooperating with the NORADAPT research project, Fredrikstad municipality has received extensive technical input for its work on climate adaptation.

The project report is the first total documentation in the NORADAPT project of a municipal strategy for climate adaptation. It presents a local climate vulnerability assessment based on the methodical approach developed in the project. The twofold approach looks at natural and the societal vulnerability. The vulnerability analysis is extensive and can serve as a model for other municipalities. It is divided into five main topics: plan for the city areas and municipal plan; roads, water and drainage; health and pollution; agriculture and forestry; and biodiversity. Vulnerability under current climate conditions, societal characteristics of vulnerability, future challenges and possible measures are all reviewed.

1.2.2 Climate change adaptation in Basel, Switzerland[13]

This report was produced by Basel City's Office for Environment and Energy, in the Department of Economy, Social Affairs and Environment. It describes the likely impacts of climate change on Basel, and presents a scenario for 2050. The need for action, and suggested adaptation measures, are given for a range of sectors including shipping, buildings and infrastructure, urban drainage, air quality and urban climate and Health

2. Assessing risk and uncertainty

2.1 Generic tools and guidelines

2.1.1 Extreme weather events and the handling of storm-water in Sweden[14]

This project focuses on the identification and analysis of extreme precipitation events in a changing climate in different environmental conditions, together with methods to reduce the associated peak flows and flooding consequences in different environments. It encompasses the following topics:

a) Changed rain intensities,

b) Altered precipitation pattern such as clustering or longer rain duration and consequent implications for design,

c) Runoff following snowmelt in combination with rain, and

d) Impact of combined high receiving water levels and heavy rainfall.

[13] The full-text report is available in German on http://www.aue.bs.ch/klimafolgenbericht.pdf . Sylvia Kruse, Research associate, Swiss Federal Institute for Forest, Snow and Landscape Research (WSL)
[14] FORMAS project 2010-121, Lars Bengtsson, Swedish Agricultural University

The different methodologies employed are largely based on the analysis of existing data. Different climate scenarios will also be used to assess the impacts of future climate change. The extreme situations identified will be applied to combinations of different sustainable urban drainage systems. Direct practical applications in Trelleborg and Malmö, on the Swedish coast, are for high sea levels in combination with rain.

2.1.2 ClimateXChange, Scotland - significance, risk and uncertainty[15]

ClimateXChange is Scotland's centre of expertise on climate change. Activities in this particular area are understanding, synthesising and communicating the risk and significance of climate change. These activities, and other work by the centre, will be underpinned by: computational expertise, to estimate statistical and geographical distributions of impacts; and by expertise in the perception and communication of risk to improve understanding of stakeholder responses to the potential consequences of climate change.

2.1.3 Comparative risk assessment in Davos and Zurich, Switzerland[16]

This pilot project developed a methodology for evaluating climatic risks and opportunities, and their interdependencies. The consistency of the evaluation will allow for cross-sectoral comparisons across Switzerland to identify the highest priorities for adaptation measures.

2.1.4 Risk assessment in Bulgaria[17]

In response to Bulgarian and European legislation, the UNDP and Bulgarian government funded the publication of a manual on the risk assessment and prevention of disasters. These include flooding, geological or seismic risks, and biological or chemical hazards.

2.2 Case studies

2.2.1 Cities preparing for climate change: a study of six urban regions[18]

Barriers to adaptation strategies are identified in the six cities of London, New York, Boston, Halifax, Vancouver and Seattle. They include:

- Limited public understanding of the urban impacts of climate change – for which it recommends education;

[15] http://www.climatexchange.org.uk/index.php/cxc-work/cxc-coreactivites/cxc-sru Ragne Low, Knowledge Officer, ClimateXchange, Scotland

[16] This report is not yet publicly available. An abstract in German is available on http://www.wsl.ch/fe/wisoz/projekte/klimarisiken/index_DE. Sylvia Kruse, Research associate, Swiss Federal Institute for Forest, Snow and Landscape Research (WSL)

[17] Ina Gencheva, Project assistant, ASDE 'Ecoregions'

[18] http://www.cleanairpartnership.org/pdf/cities_climate_change.pdf May 2007, Clean Air Partnership, in Canada

- Uncertainty about the extent of climate change impacts, as data are insufficient to drive a detailed specification of adequate adaptation measures;
- Known costs of adaptation raise more objections than the unquantifiable costs of inaction.

2.2.2 EIONET 2010 cities project scoping study[19]

This study gives summary examples of cities engaged in projects on climate change vulnerability assessment, 'early adapters', and outlines adaptation appropriate for different types of vulnerability.

3. New governance approaches

3.1 Generic tools and guidelines

3.1.1 Solidarity City, Germany[20]

This project is developing recommendations for climate-related activities of local cooperatives. The objective is to raise the profile of the cooperative movement as an alternative mode of local climate governance, in order to maximise civic involvement in local decision-making.

3.1.2 Distributed urban risk governance, increasing society's adaptive capacity for climate change in Sweden[21]

Climate change is reducing the capacity of urban institutions and associated security and governance systems to deal with climatic extremes and variability. There is an absence of research on the adaptation capacities of citizens - individuals and households. This project is generating knowledge on the role and potential for a more distributed risk of governance, where institutions' and people´s local capacities and strategies for climate change adaptation can support and complement each other.

The research will be carried out in close cooperation with Helsingborg and Malmö municipalities and involve citizens living in areas vulnerable to climate change. Adaptation strategies from other countries will be analysed to identify lessons for Sweden.

[19] 'Urban Regions: Vulnerabilities, Vulnerability Assessments by Indicators and Adaptation Options for Climate Change Impacts - Scoping Study', ETC/ACC Technical Paper 2010/12, December 2010. (European Topic Centre on Air and Climate Change)

[20] http://www.solidarischestadt.de/ (in German), Dr. Heike Walk, Head of section, Centre for Technology and Society, TU Berlin

[21] FORMAS project 2011-901, Christine Wamsler, Department of Fire Engineering and Systems Safety & Lund University Centre for Risk Assessment and Managment

3.1.3 Resilis, a project for cities' organisational resilience, France[22]

This is a collaborative research project, about the management of human and technical urban systems for cities' organisational resilience. It aims to develop innovative organisational and methodological solutions to improve urban resilience, using three types of measures:

- improving multi-scale and multi-actor governance,
- developing the populations' self-reliance, and
- optimising the management of technical networks.

The main objective is to design methods and tools dedicated to local authorities, network managers and citizens, in order to adapt and design social and technical urban systems able to cope with and absorb disturbances.

3.2 Case studies

3.2.1 Cities preparing for climate change: a study of six urban regions[23]

Using the example of early adapters - London, New York, Boston, Halifax, Vancouver and Seattle – this report emphasises the importance of governance in supporting the implementation of adaptation strategies:

"Knowledgeable and committed political or executive champions", with individuals named from London and Washington; "Creation of a specific interagency or interdepartmental organization to lead the adaptation process to ensure the collaboration of relevant stakeholders" (from the same two examples). All cases had "the collaboration of a local community of strong researchers prepared to work with local governments on climate impacts and adaptation" – including academic, government and private sector researchers. There were dedicated staff and budgets in London and New York.

Communications and "outreach approaches included dedicated websites, brochures and factsheets, maps of vulnerable areas, newsletters, public presentations, workshops, conferences and other communication tools", in London, Halifax (Canada), Seattle. Stakeholder engagement successfully achieved buy-in in London and New York, but not in Boston.

3.2.2 The A9 Project[24]

This project was completed by Adaptation Scotland in 2011. It demonstrated the value of a collaborative, area based approach. It helped familiarise local residents with adaptation tools and processes and laid useful foundations for further assessments and decision-making. Benefits

[22] http://www.resilis.fr/en Vincent Cousin, Industrial Advisor, Advancity

[23] http://www.cleanairpartnership.org/pdf/cities_climate_change.pdf May 2007, Clean Air Partnership, in Canada

[24] http://www.adaptationscotland.org.uk/4/88/0/The-A9-Project--Climate-Change-in-the-Central-Highlands.aspx

included building networks and learning the skills and techniques of adaptation planning. As understanding, confidence and skill levels of practitioners improve, and as more organisations make progress in their own plans, this approach will have increasing value.

3.2.3 Climate-ready Clyde[25]

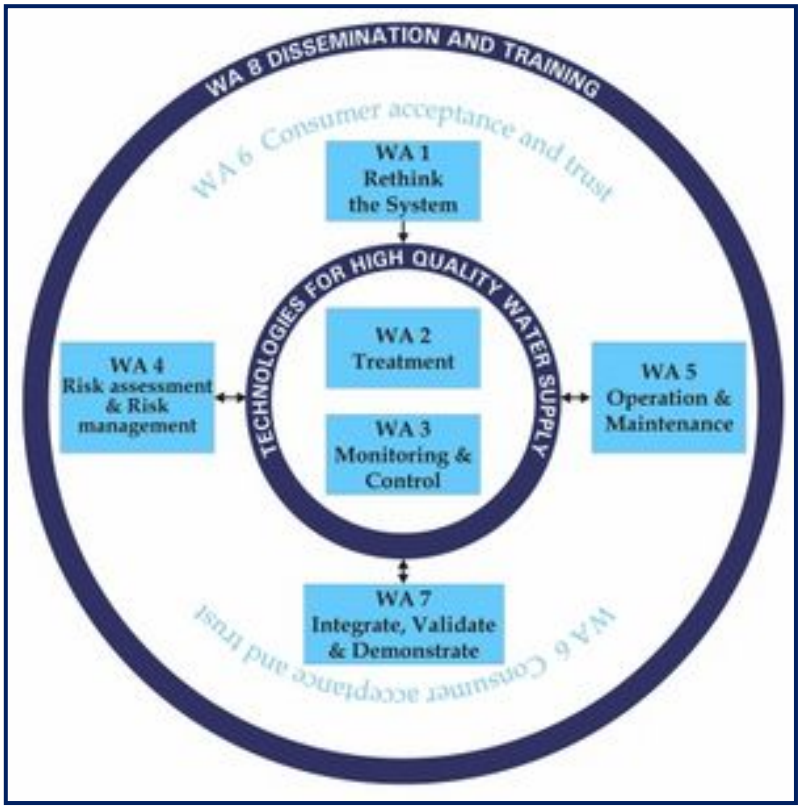
This is an area-based project being run by Adaptation Scotland. A series of workshops for public and private sector organisations is helping to build a common view of strategic priorities and possible responses to adaptation challenges in the area.

4. Adapting to health impacts

4.1 Generic tools and guidelines

4.1.1 Risk assessment and risk management of drinking water supply[26]

DRICKS (the Framework programme for drinking water research at Chalmers) has partnered with Techneau[27], the Swedish Water and Wastewater Association[28], and the City of Gothenburg for an EU FP7 project in seven countries.



The vital importance of a reliable and safe drinking water supply makes efficient risk management necessary for water utilities. Factors such as human health as well as economic development rely on a safe supply of drinking water. Current risks but also emerging risks due to, for example, climate changes pose a wide range of challenges. Useful tools are thus needed in order to enable proper risk assessments considering the entire supply system, from source to tap.

Figure 2: Techneau's project approach and constituent work areas (WA).

[25] http://www.adaptationscotland.org.uk/4/110/0/Area-based-project-Glasgow-and-Clyde-Valley.aspx
[26] http://www.dricks.chalmers.se/publikationer.asp.html - with a list of English-language publications. Lars Rosén, Professor at Chalmers University
[27] http://www.techneau.org/
[28] http://www.svensktvatten.se/Om-Svenskt-Vatten/Om-oss/In-English/

A series of risk assessment and decision support tools have been developed, applied, evaluated and communicated to facilitate proper risk assessments of drinking water supplies and an efficient use of available resources for risk reduction. The tools have been developed in research projects in close collaboration with end-users and applied in case studies. Guidance on the tools has been ed to end-users via several training seminars in different countries.

The case study applications are good examples of how to meet the recommendation by the World Health Organisation on managing drinking water risk by preparing Water Safety Plans. The training seminars and case study applications as well as the underlying work of developing the tools have generated an extensive amount of knowledge on risks to drinking water supplies, how to assess these risks and how to reduce them in a cost-effective manner.

Close collaboration with end-users and case study applications are important in developing and evaluating risk assessment and decision support tools. Training seminars have taught end-users how to apply the developed tools and use the results. Case studies and training seminars make it possible to identify and discuss critical issues that may be easily overseen. Such activities are key to adjusting methods to improve their applicability.

4.2 Case studies

4.2.1 Municipality of Budapest, package of measures for summer heat[29]

The Municipality of Budapest and district Local Governments have formed a partnership with the Metropolitan Public Place Cleaning Company, Metropolitan Gardening Company, public administration offices, libraries, doctors' surgeries, shopping malls and hypermarkets. In order to reduce city temperatures, street surfaces are watered every day. Public health information about heat and hydration is disseminated via public sector organisations' websites. Practical steps to reduce impacts on health include the distribution of drinking water, the provision of taps and sprinklers in the parks, and allowing residents to visit air-conditioned public buildings to cool down during the day.

When these measures were implemented in the summer of 2011, there was a significant decrease in the number of ambulance call-outs on extremely hot days.

4.2.2 Targeted responses to hot weather in Toronto[30]

Toronto's Heat Alert and Response System is considered to be a prime example of climate change adaptation. A Heat Alert is called, and broadcast on local media, when hot weather is forecast that has a greater than 65% chance of contributing to excess deaths.

The Hot Weather Response Plan coordinates the efforts of several municipal and community agencies to provide heat-related services to vulnerable populations. These include children, the

[29] Miklos Marton, Project Manager, Regional Environment Centre (REC)

[30] Rosenzweig C., Solecki, W. D., Hammer, S. A. And Mehrotra, S. (Eds) (2011). 'Climate change and cities: first assessment report of the Urban Climate Change Research Network (ARC3)', Cambridge University Press, Cambridge and New York. P205

elderly, those with pre-existing illnesses, and the homeless. Response measures include opening cooling centres and extending the hours of swimming pools. Local targeting is achieved by an integration of health data with social and geographic data using GIS. This can combine, for example, physical factors that are likely to increase exposure to heat (such as surface temperature) and factors that may affect people's resilience to heat (including age).

4.2.3 Health effects of flooding in the UK[31]

In June and July 2007, the wettest weather since British records began swept across the country, flooding dozens of cities. The reported health effects included deaths by drowning; acute stress, depression and other mental health problems; asthma attacks resulting from exposure to mould in flood-damaged buildings; and diarrhoea. This all happened despite the well-developed infrastructure and emergency services, demonstrating that their current configuration – in the UK and potentially in other countries – does not offer sufficient protection in the face of extreme weather.

5. Reconsidering land use and water for adaptation strategies

5.1 Generic tools and guidelines

5.1.1 Research into urban nature and green space structures in the context of climate change, in Germany[32]

This project addressed the development of transferable, practice-oriented climate adaptation strategies, for spatial planning and the management of green and open space systems in urban areas. The focus was on the following questions:

(1) What do urban green spaces contribute to cities and urban districts adapting to climate change?

(2) How can nature conservation and green space planning objectives be better implemented in urban development in the light of climate change?

Recommendations have been developed for the design of urban greenspaces and greenspace systems under climate change, and the implementation of greenspace planning measures.

[31] Rosenzweig C., Solecki, W. D., Hammer, S. A. And Mehrotra, S. (Eds) (2011). 'Climate change and cities: first assessment report of the Urban Climate Change Research Network (ARC3)', Cambridge University Press, Cambridge and New York. P191.

[32] http://www.ioer.de/1/projekte/abgeschlossene-projekte/p282/ Dr Juliane Mathey, Project Leader and Dr Stefanie Rößler, Research Associate, Leibniz Institute of Ecological Urban and Regional Development (IOER)

5.1.2 Outdoor thermal comfort in European cities[33]

The overall objective of this European project (Gothenburg, Frankfurt and Porto) is to explore the mitigation of global/regional climate changes by urban features such as land use, urban geometry and vegetation, in order to develop a set of design guidelines and policies on how to maintain health and thermal comfort under changing climate conditions and extreme weather events in different European cities.

The influence of urban geometry, land use and vegetation on outdoor thermal comfort will be analyzed. Areas of high risk will be identified and the effectiveness of different adaption measures, such as built density, amount, type and location of vegetation etc. to reduce heat stress at a neighbourhood and city block scale will be investigated.

Once the significance of land use, urban morphology and street trees on outdoor thermal comfort and effects of regional climate change on outdoor thermal comfort at an urban, neighbourhood and street canyon scale is understood, it will be possible to evaluate and translate this knowledge to provide guidance on how to maintain health and outdoor thermal comfort under changed climate conditions and extreme weather events. The guidelines will help to communicate and implement existing knowledge, optimise design of land use, streets and buildings, and the use of street vegetation for different climate zones.

5.1.3 'Vertical green' as a building material in Sweden[34]

The amount of vegetation in urban areas can effectively be increased by green walls, without reducing the available surface for construction. Apart from being a beautiful attraction, green walls moisturise the air, reducing the local temperature. Green walls also affect the energy balance of the building.

Outdoor green walls have rarely been used in Sweden and there is a lack of data regarding their installation. Knowledge is also a lacking about their influence on building energy balance and moisture content of facades. Recent advances in simulation software for thermal balances of buildings show the need for adequate input data from green wall systems for calculating the effect on local urban climate. At present the simulations are not accurately treating green walls.

This project will take a bio-technology approach studying both climbing vegetation and green wall modules. Solar powered irrigation and storm-water recirculation will be tested. Guidelines for selecting substrate, plant species and vegetation system and best practices for installation and maintenance will be produced. The research will identify critical steps during the construction and green wall/building integration. Reliable data will contribute to improved simulations of urban micro-climate and building energy balance also in a future changed climate.

[33] Sofia Thorsson, Associate professor, Department of Earth Sciences, University of Gothenburg,
[34] FORMAS project 2011-230, Tobias Emilsson, Swedish Agricultural University

5.1.4 R&D on sustainable construction for the London Olympics[35]

The London Olympic Stadium is said to be the most sustainable ever built. It has been made from materials 75 percent lighter than steel, the most common material used to build other stadiums. Low-carbon concrete was used in its construction, which contains 40 percent less carbon than usual. Steel and concrete use was reduced further by designing the lower part of the stadium in a bowl in the ground. Hardware used to hang the panels will be recycled after the games, and the fabric is to be reused and recycled.

The Aquatics Centre features a number of key low carbon features including a striking ceiling above the pool made up of 30,000 sections of sustainably-sourced Red Lauro timber. The venue's wave-shaped roof has an aluminium covering, half of which is recycled. The temporary seating stands on either side of the roof are made of steel and phthalate-free uPVC wrap. The 866,000 ceramic tiles installed in the pools, poolside and changing rooms, were delivered by train to the Olympic Park, helping to reduce transport emissions.

5.1.5 The influence of city trees on microclimate in Sweden[36]

This FORMAS project aims to answer the question of whether the size of a single tree, or the relative position of a group of trees, can influence the microclimatic factors in and around a tree to such an extent that atmospheric demand decreases.

The condition of the tree will be monitored in nursery conditions and in streets by measuring photosynthetic capacity, water balances, stress symptoms, street microclimate temperature effects, evaporative demand and water availability. Results will provide guidelines for the selection of street trees and further understanding of a city tree's demand for water and space. This will be of value to planners and managers of city trees.

5.1.6 Green infrastructure for ecological sustainability and human wellbeing in Sweden[37]

How does society take care of forest, rural and urban landscapes so that biodiversity conservation, ecosystem services and human health benefits are delivered? New guidelines use the term "green

[35] http://inhabitat.com/will-london-2012-be-the-green-olympics/ ; http://www.olympicgames2012london.org/london2012olympicsgoinggreen.html Miklos Marton, Project Manager, Regional Environment Centre (REC)

[36] FORMAS project 2006-1537, Dirk Dujesiefken, Swedish Agricultural University

[37] FORMAS project 2011-1737, Per Angelstam, Swedish Agricultural University

infrastructure". To secure functional green infrastructure, ecological and social systems must be included in governance and management.

This project focuses on the diagnosis and treatment of green infrastructures, to contribute to functionality in forest, rural and urban landscapes. We see a strong research environment as integrative research with stakeholders, ability to facilitate and contribute to social learning processes, and knowledge production in place- and area-based research and education. The project team comprises:

- Human and natural scientists at three Swedish universities,
- Actors and stakeholders in forestry, municipal and infrastructure planning, and
- Researchers from countries with traditions of planning from below in the West and from the top in the East.

This project views landscapes as patients who need diagnosis and treatment. With a suite of forest, rural and urban landscapes as laboratories, we will:

i. Diagnose green infrastructure functionality, and examine the ecological and social knowledge needed for green infrastructure; and

ii. develop knowledge, social learning, analysis and visualization tools for integrated planning by different sectors and levels of society.

5.1.7 Modelling climate change impact on coastal flooding and erosion in Sweden[38]

The main objectives of this project are:

(1) To develop methodologies for quantitatively predicting how coastal areas will be affected by flooding and erosion resulting from climate change;

(2) To integrate the outcome from such predictions into the planning and management of the coastal areas.

A risk-based approach will be taken where the probability of certain type of events are combined with the consequences of the events. It will be crucial to consider the simultaneous action of waves, water levels, and runoff from land when assessing the impact of different types of event, also taking into account relevant time and space scales. Scenarios will be developed based on existing prognoses of future climate change (SWECLIM).

The project will focus on two types of coastal impacts with different characteristic scale, namely the response of coastal areas to severe storms over hours to days, and to long-term changes in climatic forcing (e.g., waves, water levels, rainfall) over decades to centuries. In both cases models will be developed to describe physical processes.

[38] FORMAS project 2009-802, Hans Hanson, Lund University

Ystad municipality will be a pilot site for developing general tools which may be used in other for coastal areas of Sweden and other countries.

5.2 Case studies

5.2.1 Reducing the urban heat island (UHI) effect in Tokyo[39]

Tokyo's Metropolitan Government has addressed UHI in its environmental master planning since 2002. Measures include improving the flow of wind through the city, installing pavements that block heat and absorb moisture, roadside tree plantings, and increased greening of roofs and walls.

5.2.2 ZFarm: urban farming with zero acreage in Berlin[40]

Inter3 is analysing opportunities for the inner-city cultivation of fruits and vegetables in existing buildings. Potential obstacles and necessary conditions for realising and disseminating house-integrated agriculture will be studied in Berlin. The objective is to develop solutions that are technically, economically, socially and ecologically sound and to devise a policy framework that supports building-integrated agriculture in Berlin. A variety of stakeholders - including potential operators, urban planners, agricultural experts, politicians and policy makers, interested residents and active urban farmers - will be invited to participate.

Figure 3: Brooklyn Grange, a 4000m^2 'rooftop farm' in New York

[39] Rosenzweig C., Solecki, W. D., Hammer, S. A. And Mehrotra, S. (Eds) (2011). 'Climate change and cities: first assessment report of the Urban Climate Change Research Network (ARC3)', Cambridge University Press, Cambridge and New York. P240

[40] http://www.zfarm.de/ - English pages available. Dr. Heike Walk, Science and Research Programme Manager, Inter 3. Institute for Resource Management

5.2.3 Architectural solutions to extreme weather[41]

Cities across Europe provide examples of ancient and contemporary architectural measures to protect pedestrians from extreme weather.

The ancient city of Bologna is lined by many kilometres of arcades. They offer shade from the summer heat, from rain and from snow. These city features are highly valued by pedestrians and retailers; building regulations protect existing arcades and require them in new developments.

Seville runs shades over streets and squares to shade people from the sun. The new Metropol Parasol - a 30 meter-high concrete and steel structure – has been incorporated into redevelopment of the Plaza de la Encarnación. Difficulties encountered include reaching agreement on sharing costs amongst the connecting buildings or sites under private ownership.

Toronto faces long, hot and humid summers and long, cold winters, so malls such as the Eaton Centre are very popular among residents. Negative impacts (environmental, diverting trade from urban streets) can be mitigated by close integration into the existing urban fabric and into public transport systems.

5.2.4 Green and Blue Space adaptation for urban areas and eco-towns (GRaBS) [42]

GRaBS aims to fill a gap in planning: "Green infrastructure including gardens, parks, productive landscapes, green corridors, green roofs and walls and blue infrastructure such as water bodies, rivers, streams, floodplains and sustainable drainage systems, play a vital role in creating climate resilient development – a role, which is currently not sufficiently recognised and utilised and lacks integration in mainstream planning." There is a series of case studies[43]. The main themes addressed are:

Development incentives for greenspace

The Municipality of Faenza has implemented a bio-neighbourhood incentive programme for developers, which is included in their Town Planning Regulations. This programme allows developers to extend the size of buildings in bio-neighbourhoods in excess of approved standards, if the buildings meet certain environmental criteria. These include green roofs, green walls and water retention systems, and the creation of continuous public green spaces by developers.

In Berlin, new developments are required to incorporate a proportion greenspace. This is the Biotope Area Factor (BAF or BFF for Biotop Flächenfaktor). This requirement is part of a larger suite of regulations relating to landscape planning, landscape design and species protection. It responds to the need to encourage more greenspace in dense urban locations.

[41] http://www.10things.it/guide/bologna/top-10/the-arcades-of-bologna/ , http://en.wikipedia.org/wiki/Metropol_Parasol , http://en.wikipedia.org/wiki/Toronto_Eaton_Centre, Miklos Marton, Project Manager, Regional Environment Centre (REC)

[42] http://www.grabs-eu.org/

[43] http://www.grabs-eu.org/membersArea/files/Executive_summary.pdf

Incentives for green roofs

The city of Basel in Switzerland has the highest area of green roofs per capita in the world. Their profusion is stimulated by a combination of financial incentives and building regulations. Regulations have required vegetation on roofs since 2002. Initiatives aiming to increase the provision of green roofs in Basel were initially driven by energy-saving programmes, and subsequently by biodiversity conservation.

Chicago's Department of Buildings Green Permit Programme offers a rapid permit process to encourage developers to incorporate environmentally conscious design elements, including green roofs on new buildings. Additional benefits include cost savings through reduced need for heating and cooling of the buildings, enhancing the city's and the emergence of businesses specialising in green roof installation.

Adaptation to flooding

In 2008, the City of Toronto became one of the first cities in Canada to develop a comprehensive climate change adaptation strategy. The document details a number of short and long-term actions to adapt to more frequent and severe flooding. The strategy highlights the importance of investment in storm water management, and in parks and urban forests.

The neighbourhood of Augustenborg (Malmö, Sweden) has experienced periods of socio-economic decline in recent decades, and frequently suffered from floods caused by overflowing drainage systems. Augustenborg underwent significant regeneration between 1998 and 2002, in part to improve flood risk management. Significant physical changes in infrastructure took place, focusing on the creation of sustainable urban drainage systems, including ditches, retention ponds, green roofs and greenspace. Rrainwater runoff rates have decreased by half, and increased greenspace has improved the image of the area.

Climate change projections for the Netherlands highlight an increased risk of coastal and river flooding. In 2000 the existing water management system, based on technological solutions, was deemed inadequate. In 2003 "The Netherlands Live with Water" public awareness campaign was launched. The campaign emphasises the need to store water within national and regional water management systems during times of excessive rainfall or high river levels. It also promotes actions that individuals can take to help reduce the threat of flooding.

Following the disastrous failure of structural flood defences during Hurricane Katrina in 2005, the State of Louisiana and the City of New Orleans have taken steps to increase the resilience of the city to sea level rise. One of the key protection measures is the conservation and restoration of wetlands as a buffer zone between the sea and the city. Inclusion of wetland conservation and restoration activities in the New Orleans masterplan signals a significant change to flood-defence tactics in the region, from an emphasis on levees and floodgates to the incorporation of more natural solutions.

Landuse planning

In Slovakia, national standards for land use planning (2009) include guidance on planning of open spaces and green areas. The standards describe not only the aspects relating to the quantity of open space in towns or in a given development, but also include aspects relating to the quality and

character of open spaces, such as percentage of sealed surfaces, percentage of tree cover and accessibility. This exhaustive set of standards builds on examples from other European cities, including Berlin, Graz, and Malmö.

5.2.5 Solanova Project, Dunaújváros, Hungary[44]

This was the first "eco-reconstruction" to improve the thermal performance of a block of flats, of a type that is very common in Hungary. It involved adding a 16cm thick layer of insulation to the walls and roof, double- and triple-glazing, heat-exchange ventilation, and a green roof. As a result, the building's energy consumption for heating has fallen to 16% of its previous figure.

The project was initiated by Kassel University in partnership with Budapest Technical University. It was c-financed by the EU, the Hungarian Ministry of the Environment, the local government of Dunaújváros City, the local heating company, and the block's tenants. Since the completion of this pilot project, many similar conversions have followed.

Figure 4: After the reconstruction

5.2.6 GreenKeys: knowledge exchange across 12 European cities[45]

GreenKeys promotes urban greenspaces to improve the quality of life and increase the sustainability of cities. It is a partnership of the 12 municipalities with eight research partners; a subcontractor maintains the communication channels consisting of internal and external websites.

Pilot projects in each city involve local stakeholders to identify ways of increasing accessibility, social/ recreational value and ecological benefit. Examples of best practice from these pilots will be exchanged throughout the network.

[44] http://www.e-epites.hu/580 - in Hungarian, but with many graphics. Miklos Marton, Project Manager, Regional Environment Centre (REC)

[45] http://www.greenkeys-project.net/en/home.html Ina Gencheva, Project assistant, ASDE 'Ecoregions'

5.2.7 The North American urban agriculture experience[46]

This describes local growing to combat the difficulty of accessing healthy, local and reasonably-priced food, to combat the urban heat island effect, and to serve as stormwater abatement. An example is given of an Urban Agriculture Plan for Oakland (California), which includes an inventory of vacant land, and a tax credit for such land put into agricultural use.

6. Projects for later dialogue cafés

6.1 Mitigation and adaptation

6.1.1 Generic tools and guidelines

6.1.1.1 Resilience: VivaCity2010 in the UK[47]

This project developed understanding of human behaviour in urban environments, and a toolkit of resources for planners and developers to navigate urban sustainability issues. The toolkit encourages decision-makers to think about sustainability in a user-centred, holistic way, identifying overlaps and trade-offs as the drivers of decision-making. The 3D visualisation tool has been used in work with the Black Country Consortium (BCC) urban regeneration project, and in the Life Chances pilot in Salford to aid the Local Authority and key service providers in enabling holistic visualisation of localised service provision needs.

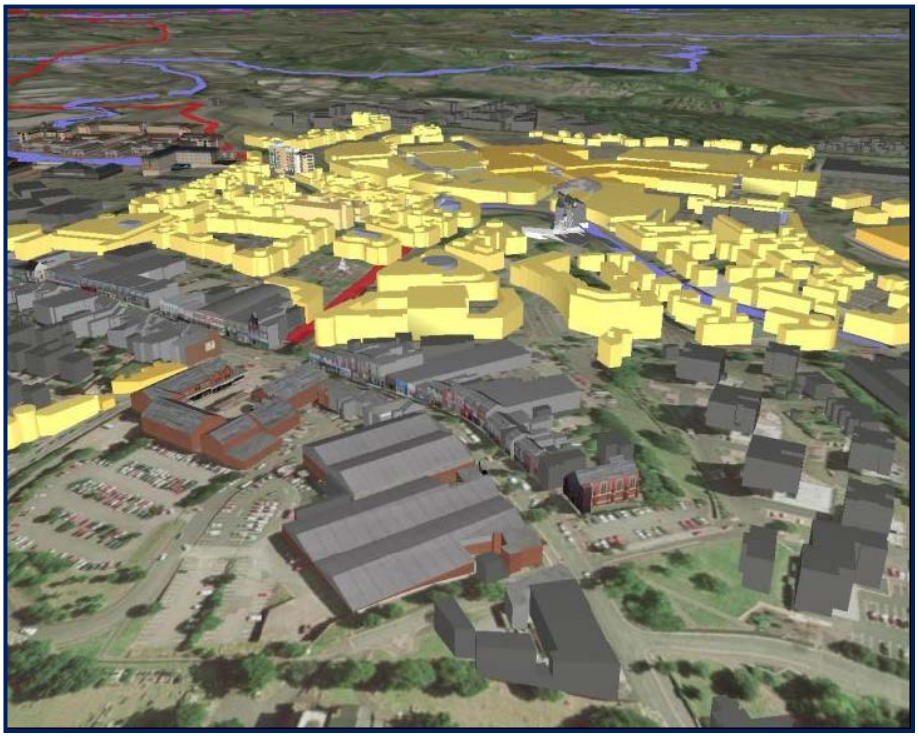


Figure 5: Visualisation of multiple agendas for the Black Country Consortium

[46] http://blogs.worldbank.org/sustainablecities/the-north-american-urban-agriculture-experience?cid=ISG_E_WBWeeklyUpdate_NL

[47] http://www.urbansustainabilityexchange.org.uk/media/ISSUES%20Outputs/ISSUES%20VivaCity2020_Final.pdf

6.1.1.2 Partnership: DISTILLATE – decision support and knowledge exchange in the UK[48]

A decision-making tool developed by project partners is intended for use by local authorities and for consultancies acting on their behalf to signpost policy makers and planners to appropriate guidance on sustainable transport planning including other DISTILLATE tools. The tool was developed in consultation with stakeholders including end-users from public authorities.

6.1.1.3 CHAMP[49]

The CHAMP website presents a capacity development package for local climate change responses. The online tool, 'Integrated management for local climate change response', consists of guidance papers, training materials, tools and case studies for enhancing local capacity in climate change adaptation and mitigation.

6.1.1.4 OECD Green Cities programme[50]

The OECD Green Cities programme seeks to assess how urban green growth and sustainability policies can contribute to improve the economic performance and environmental quality of metropolitan areas and enhance the contribution of urban areas to national growth, **quality of life** and competitiveness. "While a growing number of studies seek to characterise sustainable and "green" cities, they do not provide an assessment across multiple cities of the impact of urban green growth and sustainability policies on job creation, economic attractiveness and demand for green goods and services".

The concept paper includes a literature review as well as a preliminary set of policy interventions and measures that are applied to each case study to compare existing initiatives and monitor their impact in terms of job creation, urban attractiveness and supply and demand of green goods and services. The first round of case studies included the Paris-IDF region and the Chicago/Tri-State Area. A national-level study was completed for Korea, focusing on the implementation of the National Green Growth Strategy in urban areas. A second round of case studies is currently underway, with assessments of Stockholm and Kitakyushu and, at the national level, China.

6.1.1.5 Royal Town Planning Institute (RTPI)[51]

The UK RTPI's "Seven commitments on climate change" is a vision and strategy for the way the RTPI and members should tackle the challenge of climate change, as part of an overall approach to sustainable development. The seven commitments are:

1. Promote behavioural change
2. Adapt existing places
3. Work towards responsive legislation and policies

[48] http://www.urbansustainabilityexchange.org.uk/media/ISSUES%20Outputs/distillate%20formatted%20final.pdf
[49] http://www.localmanagement.eu/index.php/cdp:home
[50] http://www.oecd.org/dataoecd/44/37/49318965.pdf

4. Improve current practice
5. Celebrate best practice
6. Compile a compendium of best practice
7. Develop climate change education and skills.

The commitments are seen as a thread running through RTPI's work to help mainstream climate change within all planning policy and practice. For example, climate change is a consideration in consultation responses to proposed policy changes by national government. Judging criteria for RTPI Planning Awards have been changed so that climate change impacts are considered by all entries. Recent key work has been involvement in the Planning for Climate Change Coalition, and lobbying of Government on changes to the English Localism Act 2011 and the National Planning Policy Framework to improve their legislation and policy in relation to climate change.

6.1.1.6 URBENENEGY Network[52]

This is an integrated model for energy efficiency conscious communities and includes city partners from ten European countries.

The aim was to develop an integrated framework for improving energy efficiency and optimal utilisation of renewable energy sources, by offering an innovative model for creating sustainable energy efficiency in the urban environment. The long-term goal of the project was to turn residential areas from energy consumers into energy producers.

The model is based on four thematic pillars: policy-making, local business, financial, social. Sub-objectives have been pursued under each thematic pillar.

1. Policy-making pillar: Enhancing an integrated policy approach through fostering cooperation among stakeholders and policy-makers, based on lessons drawn from experience in partner cities. The objective was to align various stakeholder interests and develop a jointly agreed energy master plan by bundling the existing studies, strategies, policy approaches, etc. into one coherent package of measures including timeline and cost plan.

2. Local business pillar: Introducing new and innovative technological tools and product packages, capitalising on existing knowledge and know-how, tailored to local needs. The objectives was to survey investment opportunities for the implementation of renewable energy strategy (RES) and energy efficiency (EE) technologies and to support local businesses to enter the renewable energy market and therefore create and support local employment.

3. Financial pillar: Developing financial schemes to support alternative energy solutions for urban environment, based on existing knowledge and exchange of experience between partner cities. The objective was to offer financial solutions for EE technological product packages.

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[51] http://www.rtpi.org.uk/item/2624/23/5/3 Vincent Goodstadt, Trustee of the RTPI; Sarah Lewis, RTPI Policy Officer

[52] http://urbact.eu/en/projects/low-carbon-urban-environments/urbenenergy/homepage/ Liliana Florina Cergan, Legal Counsellor to Avrig, Romania

4. Social pillar: Increasing social acceptance of RES and EE solutions through disseminating and awareness-raising activities. The objectives were to stimulate the use of RES and EE solutions by changing citizens' attitude; to increase awareness and uptake of RES for existing housing stock and businesses; and to promote local community involvement in the planning process of EE retrofitting.

Partner Level Outputs:

1. One integrated policy framework document per partner based on the integrated EE model, to serve as a baseline for Local Action Plans.

2. One local Action Plan per partner, serving as a road map of activities for the Local Authority.

3. One joint statement by LSG/ MAs supporting the Local Action Plan, in order to express local commitment to implementing Local Action Plan.

4. One project idea from each partner will be elaborated on to seek funding and serve as the first step in the practical implementation of Local Action Plans.

Project Level Outputs:

1. a consistent set of strong case studies based on peer review exercises.

2. collection of best practice based upon the case studies.

3. Policy recommendations developed on how RES and improved EE contribute to sustainable urban development.

***Results*:**

1. Local Action Plans adopted by city councils.

2. Municipality staff with increased capacity and increased cooperation among stakeholders.

II. At the Project level:

Recommendations included in: URBACT II PDF generated at 2009-09-25 10:11 Page 7 / 52, and URBENENERGY (Ref : 3235 | Version : 1 | Submitted project).

6.1.1.7 Resilience: TURaS – transitioning towards urban resilience and sustainability[53], across Europe

TURaS is a five year project that will develop visions, feasible strategies, spatial scenarios and guidance tools to help cities address the urgent challenges of:

- climate change adaptation and mitigation,
- natural resources shortages, and

[53] www.turas-cities.eu Dr. Marcus J. Collier, Research Fellow at University College Dublin / TURaS Scientific Co-ordinator

- unsustainable urban growth.

TURaS will enable adaptive governance, collaborative decision-making and behavioural change in order to facilitate local authorities and communities in the transition process. The project will research, demonstrate and disseminate transition strategies and scenarios to enable European cities and their rural interfaces to build vitally-needed resilience. TURaS will demonstrate to city communities, businesses, planners, policy-makers and managers, mechanisms for transition that may be created and implemented as we strive to move to more sustainable urban living.

The project brings together decision makers in local authorities with SMEs and academics, to respond to the efforts of city communities. Eleven local authorities or local development agencies are involved as project partners, and they will orient research and development from the outset towards the most significant sustainability and resilience challenges facing their cities. Nine academic research institutions and eight SMEs will work with these public sector bodies helping them to reduce their urban ecological footprint through proposing new visions, strategies, spatial scenarios and guidance tools to help cities address these challenges. The feasibility of these new approaches will be examined and results compared between participating cities.

6.1.2 Case studies

6.1.2.1 Eco-Parc in Cergy-Pontoise, Paris region[54]

The Eco-Parc has a total of 17 business parks, including 4000 companies. The scheme aims for sustainable mobility and waste management, from planning and design to participative implementation

Within a framework of environmental indicators, the main activities are:

1 - Planning public spaces and transport pooling, including noise reduction and minimising energy consumption; and

2 - Waste management of the industrial city, including development of a waste database, waste pooling, waste treatment and transport, and recycling.

The scheme is undertaken in partnership between the city authorities and a professional association of young entrepreneurs.

6.1.2.2 Governance: climate change policy integration in Sweden[55]

This project focuses on municipal planning as a key arena for achieving more effective climate policy. The barriers and success factors are identified and analysed using case studies in Swedish municipalities that have taken a leading position on climate policy.

The objective is to identify the key measures that could increase the effectiveness of local climate change policy in practice. Formal and informal institutional conditions that affect planning at all

[54] Amel LESLOUS, Managing Partner, AMLING ENGINEERING
[55] FORMAS project 2011-1599, Sofie Storbjörk, Linköping University

stages from a strategic level through to project implementation will be analysed. Agenda-setting, synergies and conflicts between different policy areas and practical learning and opportunities for change will be studied. The research covers several social sciences and is carried out in close collaboration between researchers at the CSPR (Linköping University) and National Road and Transport Research Institute, VTI.

6.1.2.3 Spatial adaptation strategies to climate change: model region Stuttgart[56]

Stuttgart anticipates an increase in the average annual temperature of up to 5 °C, a doubling of heatwaves in summer, increased water shortages, dry periods and extreme weather events.

For many years the region of Stuttgart has had a strategy for climate mitigation and adaptation. The aim is for a regional climate strategy to provide an integrated approach involving multiple departments and administrative levels. This is supported by the Stadtklimalotse decision-support tool (see section 1.1.1).

The main areas of action include:

Planning and traffic:

- landscape planning as “green infrastructure”;
- regional atlas for climate, as a basic planning tool for the communities;
- promotion of public transport by rail;
- housing development through streets suitable for short distance traffic;
- flood protection measures;
- international networking and projects.

Economic development:

- supporting clustering initiatives and demonstration projects;
- establishing a centre of competence for (regenerative) fuel cells;
- advising communities on measures for climate protection;
- holding events, fairs and international projects;
- promoting electro-mobility and new technologies.

[56] http://www.region-stuttgart.org/vrs/main.jsp?navid=68
http://www.region-stuttgart.org/vrs/main.jsp?navid=438 Ines Jerchen, Project Coordinator, Verband Region Stuttgart; Prof. Dr.-Ing. Stefan Siedentop, Institute of Regional Development Planning, University of Stuttgart

6.1.2.4 Local energy independence in Avrig, Romania[57]

This partnership brings together the Municipality of Avrig with the national Environment Agency, the local power company, the business development authority and civil society organisations.

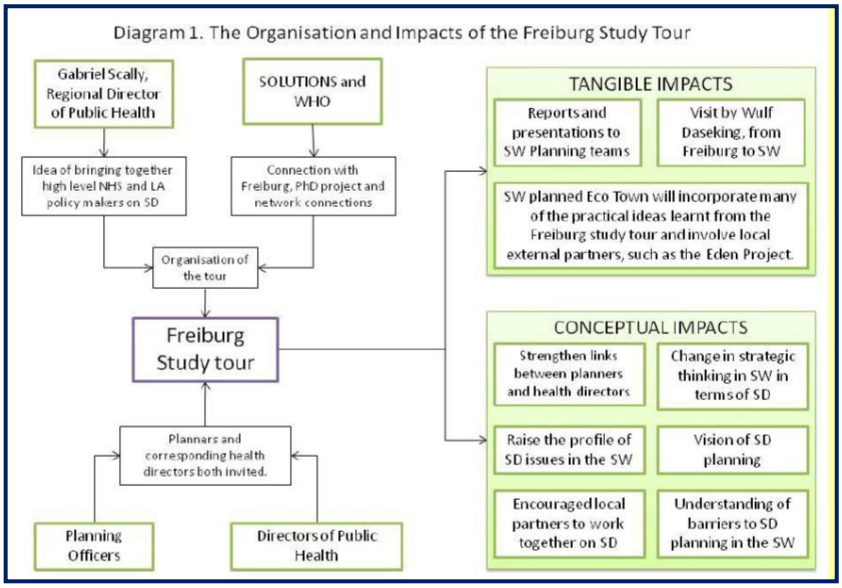
The project has four pillars:

- Renewable energy resources and technologies to produce renewable energy;
- Network systems;
- Energy storage;
- Communication of the outputs throughout the partnership network.

6.1.2.5 CO2 Today[58]

This booklet presents a number of urban energy and climate initiatives, mainly in the Netherlands. It was co-produced by the Dutch Environment and Infrastructure Ministry and Agentschap NL which is an agency of Ministry of Economic Affairs.

6.1.2.6 Resilience: SOLUTIONS, or the value of influence[59]*; UK and Germany*



The Sustainability of Land Use and Transport in Outer Neighbourhoods (SOLUTIONS) consortium investigated how towns and cities can be planned so that they are socially inclusive, environmentally sustainable and economically efficient.

Strategic and management level health officials, planners and local authority staff from southwest England participated in two study tours to the town of Freiburg, to learn first-hand about the city's world-renowned sustainability. The main impact of the tours was to create a shared vision and network of senior leadership connected with sustainable living in the southwest of England. Ideas have been fed into projects such as the Eco-town being created in Cornwall. Having senior decision-makers participate in the study tours has ensured uptake of ideas and created a network that can collaborate on a shared, sustainable vision for the future.

[57] Mirela Petrar, Program Coordinator, Municipality of Avrig
[58] Electronic copy received from Koen Hollander, European Metropolitan Network Institute
[59] http://www.urbansustainabilityexchange.org.uk/media/ISSUES%20Outputs/Impact%20Case%20Study%20-%20SOLTUIONS%20(v4).pdf

6.2 Innovative approaches to governance

6.2.1 Governing the transformation of local infrastructure systems in Sweden[60]

Ecological, social and economic sustainability demand sustainable systems and legitimate policy instruments. In Sweden socio-technical systems, such as water and energy, are traditionally municipal responsibilities. Socio-technical systems are located at specific places and the municipality thus has to take on different roles, which we identify as “a people” (demos), “a place”, and “an institution”.

The project aims:

- to analyse the radical historical changes related to the establishment of municipal infrastructural systems, and then
- to use these experiences to analyse why, whether and how municipalities relate differently to consumers and citizens in socio-technical systems, illustrated by the cases of water and energy systems.

Analysis of current municipal policies for sustainable development from system and user approaches will inform development of a conceptual model of local governance and socio-technical systems. Practical and policy implications will focus on the opportunities and constraints for formulating policy instruments for households, and system design to increase sustainable development.

6.2.2 Gendered structures of climate change response in Sweden[61]

Are there changes in the gendered structures of sustainable development, which affect the concrete climate change responses of Swedish municipalities? Why have some Swedish municipalities responded actively to the issue of climate change, when the vast majority of municipalities in Sweden have not? A current theme in spatial planning literature, local environment and regional studies points out that in OECD countries, despite increasing awareness, the gap between rhetoric and action at the municipal level is a concern. Knowing more about the processes and motivations involved in action is a key aim of this interdisciplinary proposal.

What explains the shift of climate change to the centre of sustainable development? Is it a turning point? If so, it is important to verify and understand how and why this is occurring and who is involved, so that implications can inform professional planning, policy and decision-making.

A high proportion of women are employed in sustainability work in Sweden. This project is exploring all relevant interactions, using actor-network and gender studies and theories to find out whether changes in the gender characteristics of responses to climate change are part of the answers.

[60] FORMAS project 2008-1338, Elin Wihlborg, Linköping University
[61] FORMAS project 2008-203, Richard Langlais, Nordregio-Nordic Centre for Spatial Development Research

6.2.3 Winning hearts and minds, UK[62]

'Winning Hearts and Minds' describes the impact of Birmingham's Eastside Sustainability Advisory Group (ESAG) on individuals, institutions and the city of Birmingham and its inhabitants. Its impact is largely attributed to:

- the work of the two sustainability officers appointed to work alongside the Eastside team at Birmingham City Council, in making sustainability a key part of the decision making process in the regeneration of Birmingham Eastside; and
- the University of Birmingham, which was a member of ESAG from 2002. These ties contributed to knowledge created as part of the Sustainable Eastside project. "Links with the academics from the University of Birmingham not only gave us access to their knowledge and expertise, but gave ESAG's arguments an extra dimension and weight in the eyes of the council and developers", p6.
- The combination of all the above: "It was a combination of the University of Birmingham, the sustainability officers and ESAG that ensured sustainability issues were considered so important by developers", p8.

The report findings are based on background research and interviews with key players in the Eastside regeneration project. It considers both the tangible and conceptual impacts on individuals, institutions and the city of Birmingham and its inhabitants.

6.3 Collaborative approaches

6.3.1 ClimateXChange[63]

ClimateXChange is Scotland's centre of expertise on climate change. This is a collaboration between 16 of Scotland's leading research and higher education institutions to deliver research targeted at policy development.

6.3.2 Advancity's competitiveness cluster on sustainable cities, Paris region[64]

This is a partnership of 190 companies, 30 higher education and research organisations, and 34 local governments which aims to develop the private sector's competitiveness through innovation.

Members meet to discuss issues linked to sustainable cities. Topics cover building, networks, transport, accessibility, mobility services, urban monitoring, planning and governance, and eco-technologies. Members aggregate into project consortia for developing urban innovation in areas where they are ready to engage specific resources.

[62] http://www.urbansustainabilityexchange.org.uk/media/ISSUES%20Outputs/Birmingham%20Eastside%20Winning%20Hearts%20and%20Minds_Template_Final.pdf
[63] www.climatexchange.org.uk Ragne Low, Knowledge Officer, ClimateXChange, Scotland
[64] http://www.advancity.eu/ Vincent Cousin, Industrial advisor, Advancity

Results since 2006:

- 120 innovation projects,
- total investment : 310 M€,
- New products and services, innovation platforms, and experiments.

In summary, collaborative approaches between private and public sectors are gaining momentum, however transfer to market requires more extensive experimentation.

6.3.3 Innovative projects for sustainable cities in France

This was a partnership approach between the French Ministry of Ecology, local governments, land developers, regulatory authorities, ministerial agencies, public financing agencies, and enterprises (consulting, engineering companies, utilities, energy suppliers, construction companies, IT companies). They produced a synthesis report addressing:

- Defining innovation and sustainable cities
- Identifying the conditions for implementing innovative projects
- Identifying are the barriers
- Questions which remain unanswered
- Recommendations for French policy to support urban innovation.

6.3.4 SME projects in Bulgaria

Alliance for Environment has instigated a three partnership projects in Bulgaria, focused on the development of local SMEs:

- EcoStep – Integrated Management System for SMEs is a handbook on Quality management (ISO 9001), Environmental management system (ISO 14001) and Occupational health (OHSAS 18001) with relation to the EMAS – Environmental Management and Auditing System. The handbook helps Bulgarian stakeholders to prepare for the international standards as the last step before certification.
- H_2S Recovery is a research partnership between government, academia and SMEs on the feasibility of extracting hydrogen as a fuel from the Black Sea;
- Integrated Plans for Urban Regeneration and Development (IPURD) is the revitalisation of selected zones in 36 major towns through revised urban land use using defined programmes and tools.

6.3.5 REC Conference Centre, Szentendre, Hungary[65]

This partnership, between five national governments and five technology companies (solar, heating etc.), will redesign a conference centre building with the aim of reducing carbon emissions to zero. The main function of the centre is as a training and demonstration facility for sustainability solutions. It is hoped that this will contribute to the dissemination of knowledge, helping to find effective ways to tackle the global problem of climate change.

6.3.6 USE Efficiency[66]

Universities and Students for Energy Efficiency is a partnership between nine universities and four firms, in ten EU countries. It aims to improve the energy efficiency of university buildings, and to educate students as the next generation of decision-makers.

6.3.7 The Energy Academy, Manchester[67]

The Energy Academy involved "Manchester is My Planet" (a city-region climate pledge campaign), the Greater Manchester office of the national Energy Savings Trust Advice Centre (ESTAC) network, and the sustainable development charity Action for Sustainable Living (AfSL). It focused on the two Greater Manchester boroughs of Trafford and Stockport. The priorities of the Energy Academy were fourfold:

1. The Energy Academy would employ part time co-ordinators to recruit, train and support 30 volunteers to work in communities for the benefit of local people.

2. These volunteers would assist householders to access the energy advice and financial support available locally and nationally, save energy and reduce their wider environmental impacts.

3. As well as direct support, the Academy would help increase understanding of the benefits of energy efficiency, over and above personal financial savings, and build and embed local capacity for ongoing improvements.

4. Delivered over one year (although developing the funding meant the project lasted significantly longer), The Academy would form one of 6 pilot projects taking place throughout the EU as part of the CHANGING BEHAVIOUR project, and help shape new European guidance for behavioural change interventions.

It was planned that monitoring took place through multiple sets of measures that can be characterised in terms of: effectiveness, efficiency and social learning.

There were institutional adjustments and an enlargement of the project network as a result of the pilot. The EST assisted in measuring the pilot project's impact. Also a third Local Authority (Manchester) saw the value of using a supported volunteer network and secured resources to run a very similar programme.

[65] http://archive.rec.org/conferencecenter/index.php
[66] http://www.useefficiency.eu/en
[67] http://manchesterismyplanet.com/behavioural-change/the-energy-academy

6.4 Technological leverage

6.4.1 Local Energy Management Agency, Gran Canaria[68]

Las Palmas de Gran Canaria Local Energy Management Agency is the new autonomous body of the City Council of Las Palmas de Gran Canaria, created within the framework of the Intelligent Energy Europe programme. The agency promotes good practice in energy management and sustainability, including energy efficiency and the introduction of renewable energy.

The Agency proposed the installation of low power wind turbines in Las Palmas de Gran Canaria, thermo solar installations in twenty sport centres of the municipality and six thermo solar installations in six municipal nurseries. All halogen traffic lights in the city have been replaced with LED technology. In addition, the City Council Department for Urban, Environmental and Water Supply Planning has replanted a total surface area of 1,000,000 m^2 with drought tolerant plants.

6.4.2 'Innovation in Design, Construction and Operation of buildings for People' (IDCOP), UK[69]

How to achieve a more sustainable urban environment that would benefit people, the inhabitants and users of these environments, creating a higher quality of life? This research focused on UK building stock and developed new technologies and processes for the maintenance and refurbishment of existing buildings. The Sustainable Built Environment Tool (SuBET) tool has gone from theory to practice. The partners observed a need for master planning to address sustainability and carbon mitigation issues. SuBET is a sustainable master planning tool which will be used to design exemplar planning and development schemes.

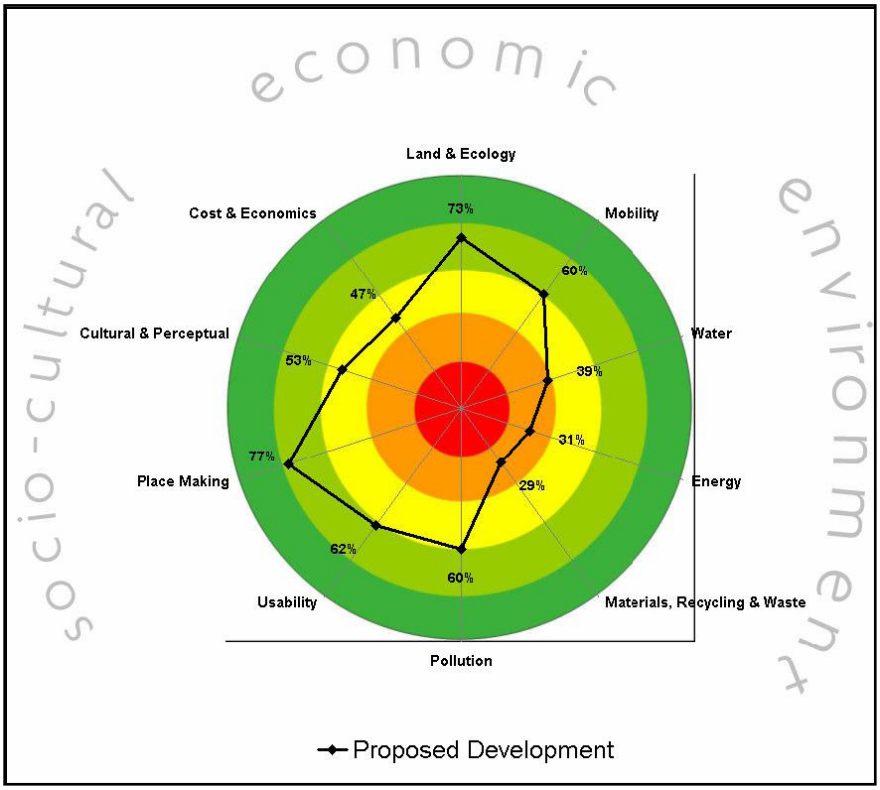


Image: Example spider map of SuBET assessment of a development.

[68] http://www.eukn.org/Dossiers/EU_presidencies/Hungarian_Presidency/Climate/Climate_friendly_urban_governance/Las_Palmas_de_Canaria_a_local_management_energy_agency

[69] http://www.urbansustainabilityexchange.org.uk/media/ISSUES%20Outputs/ISSUES%20IDCOP_Final.pdf

6.4.3 GREENOV renovation cluster

GREENOV is a European cooperation project comprising ten partners from north west Europe. It is led by the new town of Marne-la-Vallée Val Maubuée, France. GREENOV aims at developing the sector of sustainable renovation by stimulating the innovation capacity of SMEs. The project should contribute to the transition to low-carbon cities and sustainable economy and improve the knowledge and expertise on sustainable renovation of existing buildings.

The GREENOV project is structured into 3 groups of activities:

"From exchange of expertise to knowledge transfer"

The GREENOV partners intend to stimulate the innovation cycle by exchanging their expertise and practice and by pooling different stakeholders of the sustainable renovation sector. Transnational experts' panels and thematic conferences are organised. Common and operational indicators and standards are identified. A guide for carrying out and monitoring sustainable renovation is being developed. A joint study on energy efficient refurbishment on a large scale will be also carried out.

"Capitalisation in a cluster approach"

Partners will capitalise on this innovation cycle through an approach leading to: cordination of the SMEs' supply chain through a cluster management structure and collaborative platform; identifying innovative SMEs; carrying out market analysis; and providing training and services for SMEs.

"Demonstration through exemplary investments"

Four GREENOV partners have launched the sustainable renovation of one of their existing buildings (private or public buildings welcoming citizens). The four buildings represent complementary and exemplar case studies. These pilot renovations should impact local market development by stimulating SMEs and by raising awareness among the building sector's stakeholders, from political decision-makers to citizens. (See http://www.greenov.net/Project_presentation for a slideshow).

In summary, GREENOV is a collaborative project gathering different actors of sustainable renovation (users, experts, decision-makers…, public and private) who all bring their knowledge, ideas, experiences to improve practices in sustainable renovation of buildings. The GREENOV approach highlights the importance of the global process to eco-renovation, in gathering the different actors, experts, techniques, and of understanding needs and demands of building owners and inhabitants.

6.4.4 Luas light rail system in Dublin[70]

In May 1998 Dublin Municipality decided to build two light rail lines in Dublin. The project aimed to decrease air pollution by providing an environment-friendly alternative to automobiles. By December 2009, the system had two lines, 40 stations and 26.5 kilometres of track. There are currently plans for some new lines, as well as extensions to the two existing lines. In 2008 Luas carried 27 million passengers.

[70] http://www.eukn.org/Dossiers/EU_presidencies/Hungarian_Presidency/Climate/Climate_friendly_urban_transport/Light_rail_Dublin

6.4.5 Assessing the benefits of urban forest, Canada[71]

Oakville, 40km west of Toronto, is acclaimed for its progressive approach to urban forestry. It conducted an Urban Forests Effect Model study to assess the economic value of its urban forests – including the replacement value, benefits of carbon sequestration, energy savings and pollution filtering. These findings have fed into Oakville's Urban Forest Strategic Management Plan regarding stewardship and extension of forest cover.

6.5 Integrated information tools

6.5.1 Bulgarian Spatial Data Infrastructure (BSDI)[72]

This prototype geoportal provides data for sustainable land management. It incorporates flood simulation models, risk management systems, and monitoring of changes to landcover. Riskwatch[73] is an online news aggregator within BSDI that aims to give early warning of natural disasters.

6.5.2 Data needs: an urban social-ecological atlas

The Urban Atlas Portal[74] is a collaboration between twelve cities around the world: Bangalore, Canberra, Cape Town, Chicago, Helsinki, Istanbul, New Delhi, New Orleans, New York City, Phoenix, Shanghai and Stockholm. The aim is to develop new tools for understanding the social-ecological capacities to provide access to and sustain ecosystem services. The Urban Atlas maps the spatial distribution of selected ecosystem services and biodiversity and to what extent different socio-economic groups have access to these services.

For the first time, this enables users to compare cities of different size and wealth to see how varying social contexts, customs and norms affect urban ecosystems and vice-versa[75]. This offers a starting-point in addressing the reported lack of comparable data for cities.

[71] 'Climate change and cities: first assessment report of the Urban Climate Change Research Network (ARC3) (2011), Cambridge University Press, Cambridge and New York. Eds Rosenzweig C., Solecki, W. D., Hammer, S. A. And Mehrotra, S. P238
[72] http://bsdi.asde-bg.org/lccs_en.php
[73] http://bsdi.asde-bg.org/riskwatch_en.php
[74] http://www.urbanatlasportal.org/UAP/
[75] http://seedmagazine.com/content/article/urban_resilience/P4/