Regional planning for climate proofing cities

I don't think things go in cycles. I think things just change from one situation to the next, there's really no return
(Robert Smithson, entropy made visible, 1973)

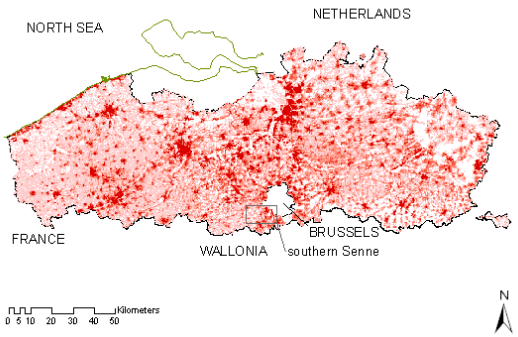
In his 1973 interview with Alison Sky, Robert Smithson, a Land Art artist argues that both architects and economists tend to construct isolated and self-contained systems. *"They never seem to allow for any kind of relationships outside of their grand plan"* he said. Cyclic systems are an abstraction of reality which is easy to understand, but no matter how hard we try, we never can put Humpty-Dumpty back together. In politics and policy we can find many examples of the reduction of reality into cyclic, static systems. Town and country planning often tries to convince society and politicians of a '*grand plan',* and is presented as an *"abstraction that rules in a void, pretending to be free of time".* In Flanders, the 1997 Spatial Structure Plan, has some characteristics of a grand plan.
Ever since the beginning of industrialisation, the environment was treated as if it was stable and cyclic. Man therefore can do as he pleases. Society and economy can grow and prosper, without influencing the environment in an irreversible way. This belief in the paradox of constant (economic) growth within a closed system has led to an active contribution of humankind to climate change.
Climate change makes it undeniably clear that a stable environment is unthinkable in the long run. This change will probably lead the world to a new temporary equilibrium, incomparable to any previous state. Consequently it is pointless to try to keep everything the way it is – or has "always" been.
All research on climate change, including more popular books such as Mark Lynas' "six degrees", points out that we do not know what will exactly happen. What we do know is that it is changing, and man is making it change faster.

From the IPCC's fourth assessment report on, this knowledge is widely spread and accepted as agreed language. Governments, cities, EU, UN, NGO's... are taking huge efforts to raise awareness. Everyone now knows the climate is changing and shares a sense of urgency to act or react upon this knowledge. We are all called to:

1. preserve our own species
2. reduce our impact
3. adapt to events we cannot avoid.

These three challenges force us to rethink how to deal with problems and situations. A clear blueprint plan that shows us how to construct an ideal city and a perfect society, is no longer available. The focus is now on **how** to react to probable and improbable future events. The long term (80+ years) consequences of problems and reactions should be identified and monitored. Scenario's for possible futures are a necessary tool to prepare the right and flexible policies to handle climate change.
By exploring possible futures it will become clear why town and country planning is a key discipline in the climate debate and what spatial elements on national, regional and local level are essential for our future.

In this paper the case of Flanders will be used to map the consequences of these **three** challenges for town and country planning on a regional level and to show how regional planning is able to contribute to the establishment of low carbon, climate proof cities. In a **fourth part**, the lessons learned from the three challenges will be applied in the further elaboration of the Southern Senne case into a possible, integrated spatial plan.
As in figures 1 and 2 below, most figures will show both a map of Flanders and a larger scale map of the area south of Brussels. In this area the Southern Senne case is situated.



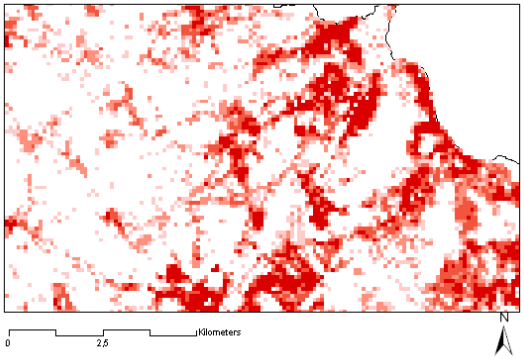


Figure 1-2: Flanders: Density of addresses per hectare
white: 0 addresses/ha; pink-dark red: 1-360 addresses/ha (source: AGIV and own adaptation)

The loss of biodiversity and ecosystems is a threat to the functioning of our planet, our economy and human society. (EC, 2008)

1. to preserve our own species

The best way to monitor the chances of survival of the human species, is probably in looking at other species that live in the same environment. In the first phase of the EC joint initiative 'the economics of ecosystems and biodiversity' (EC, 2008), a direct link between biodiversity and human well-being was already established.
Flanders has a lot of endangered and deteriorating species, and only a limited area is designated as a natura2000 site (fig.3). This was confirmed by the latest nature report. These sites are isolated, and not robustly connected, and species will get caught within small habitats when the climate gets warmer. Moreover, Flanders is a region on the verge of different ecological zones (VMM, 2008). With climate change, some current species will move out to the north, and other 'new' species move in from the south. The complete absence of interconnections that could enable these migrations, are a major threat to biodiversity.

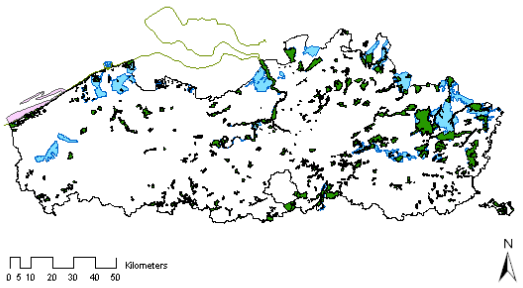


Figure 3: Natura2000 areas in Flanders
pink: ramsar area, blue: EU bird directive, green: EU fauna-flora-habitat directive (source: AGIV)

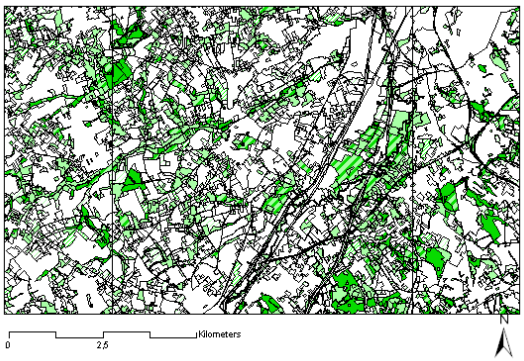


Figure 4: biological value in southern Senne
white: little value; light-dark green: medium to high biological value (source: AGIV)

To have a complete view on the state of biodiversity in Flanders, the following map (Fig. 4) shows the evaluation of biological value in the area south of Brussels. Areas shown green on the map have an important biological value. All areas are dispersed and scattered on the map. In the past, most areas were part of a larger system, e.g. river valleys or woods. Nowadays they are all divided by infrastructure, build environment or intensive agriculture.

If the goal is to preserve and promote biodiversity, it is necessary and very urgent to reinforce the potential habitats both by making individual areas larger and by creating robust interconnections between them. Along rivers and water surfaces, special efforts can be taken to make sure that migration of fauna and flora is stimulated.

Town and country planning should provide the necessary framework to link the designated areas for protected species. Protection of current species and providing shelter for new ones should be the main targets. Spatial policy has the duty to enlarge and connect protected areas in order to maintain and develop biodiversity. At the same time, other efforts have to increase the ecological value and potential of the blank areas on figure 4. In 'low density, low rise' Flanders, there is a huge potential for increasing biodiversity by a slightly different use and maintenance of private gardens, parking spaces, roofs and vacant areas along roads.

'Voluntary action generally tends to be ineffective in climate policy' (ADAM, 2009)

2. to reduce our impact

To reduce our impact on climate change generally means to reduce the emission of antropogenic greenhouse gasses. The role of town and country planning in the reduction of greenhousegas emissions can be limited to the reduction of CO2 emissions related to energy consumption. The main challenge is to use less energy, to use energy efficiently and to use only renewable sources.

Allthough emission reduction targets are set at international and national level, the applications are mainly made in project-solutions (thermal insulation, passive housing,..) and new technology (PV- and thermal solar panels, wind- and hydroenergy, biomass,...). The implications and potential for regional planning therefore are often overlooked. To explore the consequences of low carbon society for spatial planning, Tweewaters, an ambitious large scale inner city development in Leuven, will be taken as an example.

In the Tweewaters case, the aim is to redevelop an old industrial inner city area into a new neighbourhood where 5000 people will have their home or working place. In his focus on long term comfort and wellbeing of all users of the neighbourhood, the developer (Erzberg) proposes to incorporate the energyproduction for the entire development. A bio-fuel combined heat-power installation (CHP) will be dimensioned on the heat-demand of the project. A CHP installation produces mainly electricity, and a rather limited amount of heat. As a consequence the project will produce more renewable electricity than it can ever consume.
This shows that, when enlisting the energy chain efficiently, huge reductions of carbon emissions are possible even in inner city development. Even if combined heat-power installations are already common in Flanders (eg horticulture under glass, waste incineration), the application of CHP in neighbourhood heating systems, however, is rather new and has great potential in new developments. In existing neighbourhoods it is almost impossible to implement CHP projects without a decent regulatory framework, because of

private ownership of individual houses.

Tweewaters also provides an urban environment which promotes sustainable urban mobility. Different aspects of the project are related to the reduction of energyconsuming mobility, such as: the inclusion of many small shops and services within the project; an electronic butler service that can do all your shopping and deliver it while you are not at home, thus avoiding travel to and from the supermarket; a rent-a-bike and a carsharing service will be provided for,... In addition, the public areas (more than 70% of the project area) are designed to invite you to walk, or bike. Cars are kept 'invisible' and can only access the underground parking spaces.
While it's rather easy to manage intra-urban transport by providing complete, mixed neighbourhoods, the large amount of carbon will continue to be emitted by interurban transport, as shown in the ESPON 2006 3.2 scenario research. In Flanders the CO2-emissions of road transport keep rising (VMM, 2008). The challenge for town and country planning is to plan an environment that on the one hand encourages walking, cycling and the use of public transport and on the other hand enables multimodal freight transport. With a widespread network of railroads and waterways (fig 19), Flanders has ample possibilities if the persisting trend of urban sprawl and low density-low rise neighbourhoods can be bend.

Regional planning should rethink the relationship between transport policy and spatial patterns. To minimize energy consumption, a multimodal approach is necessary. In this approach, as many long distance trips as possible should be grouped together using public transport or rail/ship-freight transport. Local trips with individual vehicles should be limited. In a long term perspective, the remaining trips should be fuelled by green hydrogen or electricity (or another green technology that is yet to be invented).
In order to achieve this clean transport future, unadapted spatial patterns should be changed. The low density characteristic of Flanders makes the exploitation of a high performing interurban public transport system difficult. Locally an increase of the density of housing, work, leisure and other activities will be necessary to create a viable green transport system. While increasing density in some places, other areas which cannot be fit into the transport network, can obtain a lower density or even be redeveloped for other activities.

The means of implementation, financial and public income aspects should be a specific concern when trying to remodel unadapted spatial patterns. Local Flemish authorities, just as land owners, often favour development of dwellings and industrial estates to enhance their (tax) revenue, regardless of possible long term spatial impacts.

3. to adapt to evolutions we cannot avoid

For a small region such as Flanders, climate models provide only a limited view on the way climate change might affect our lives. Other adaptation research conducted in Germany, Belgium, The Netherlands and Sweden, shows that a vulnerability approach will probably lead to quick and relative reliable results. For this paper, a rough and simple vulnerability-mapping method is developed, partially based on the model used by Kropp, (Kropp, 2006) for North-Rhine Westfalia (NRW). The current state of Flanders, with its low rise, low density characteristics and the overall dispersion of urban activities and urban sprawl, complicates the direct application of Kropps parameters. It is known that the aggregation of data for each Flemish municipality usually does not provide results that are coherent with spatial reality. Application of aggregated parameters by each Flemish municipality will not lead to distinct characteristics such as in the NRW-case.
Table 1 gives an overview of the basic vulnerability indicators and their relationship with primary and secondary climate effects. The choice and construction of these indicators is based on expert-guesses and the availability of geographical data.

A detailed mapping of eight indicators provides the basis for the calculation of an overall assessment of vulnerability to climate change. The result can be calculated for each square kilometer cell give a highly detailed variation of susceptability of areas to climate change in Flanders.
This vulnerability approach can be used as a quick scan of an adaptation issue in any area. The analysis of the data shows both the number of indicators present in an area and the intensity of each indicator. The number of indicators present in an area demonstrate the complexity and a sense of urgency to make a detailed survey of the area. Individual indicator scores give a first indication of necessary adaptation measures.

Indicator	Description	Indicator for	Affected sectors	Primary climate effect	Possible spatial actions
Areas with high density of adresses	Cells of one hectare with a number of adresses in it medium: 20-50/ha high: >50/ha	Heat stress	Human health Cities/buildings Business	More hot and sultry days	Enhance cooling capacity in build environment (eg with water surfaces, trees, shadow,...)
Areas sensitive to flooding	Flood risk map areas divided in: no risk low risk high risk of flooding	Flood risk	Cities and buildings Business Agriculture	More intense precipitation, flooding, sea level rise, more intense and frequent storms	Create more space for watersystem management; create areas for controlled flooding in agricultural areas
Adresses located within areas sensitive to flooding	Selection of adresses located in areas with low and high risk of flooding	Financial (insurance) aspect of Flood risk	Cities and buildings Business	More intense precipitation, flooding, sea level rise, more intense and frequent storms	Remove buildings intensive activities from these areas, protect vulnerable functions from flooding
Areas sensitive to erosion	Vulnerability to soil erosion, based on different datasets	Soil erosion	Agriculture	More intense precipitation, more intense and frequent storms	Divide large erosion sensitive arable land with strips of permanent vegetation (shrubs, trees and hedges)
Tourist and water recreation areas	Seaside (recreaction) development and larger inland recreational areas	Weather sensitivity of economic sectors Production gain or loss	Tourism Communication	More warm days, more precipitation	Diversify and enlarge seaside and inland parks and water recreation areas Develop complementary economic activities in monofunctional tourist areas
Areas specialised in horticulture (under glass) and fruit cultures	Agricultural area occupated by horticulture of fruit cultures	Weather sensitivity of economic sectors Production and revenue loss	Agriculture	More intense precipitation, more intense and frequent hail, more and longer dry periods,	Spread specialised agricultural activities over larger areas promote the development of complementary activities in monofunctional farms
Industrial estates	Map showing industrial areas larger than 5 ha	Weather sensitivity of economic sectors Production and revenue loss	Business	Flooding, more intense and frequent storms	Renovate or redevelop industrial estates to reduce vulnerability to extreme weather events
Main infrastructure	Railroad infrastructure, motorways, and waterways for vessels larger than 300 tons	Weather sensitivity Just-in-time production Commuting	Technical support systems Communications	More intense precipitation, flooding, more intense and frequent hail and or fog, more and longer hot and dry periods	Relocate, optimize or renovate main infrastructure to make it more resilient to climate change;

Table 1: overview of 8 indicators, sectors involved and possible spatial interventions

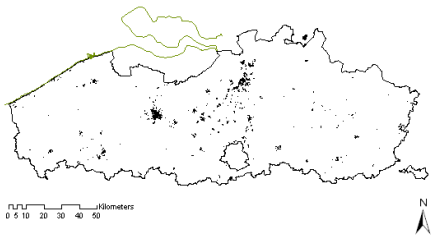
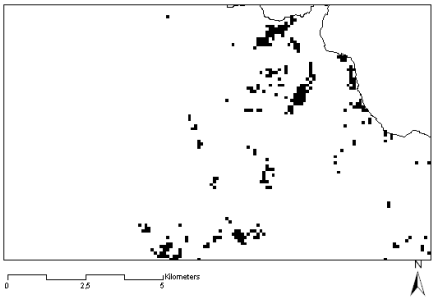
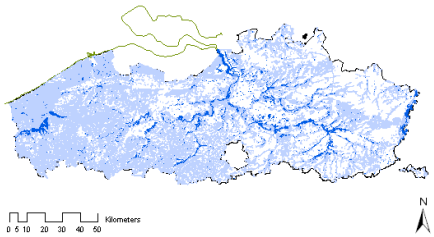
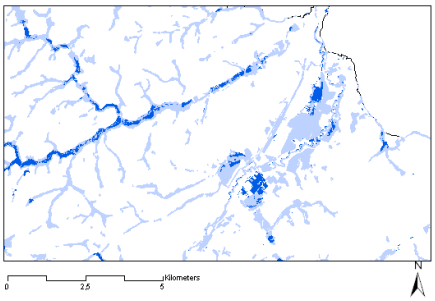
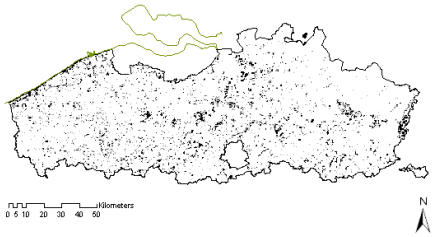
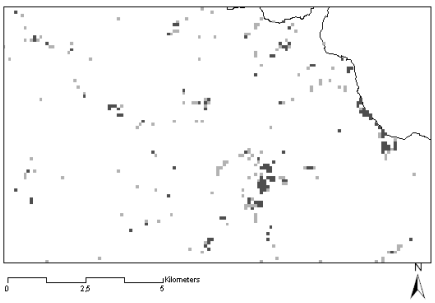
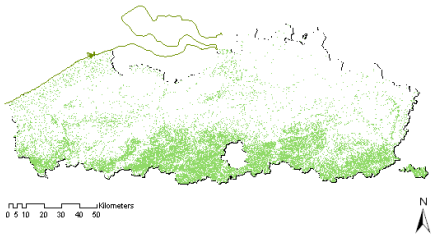
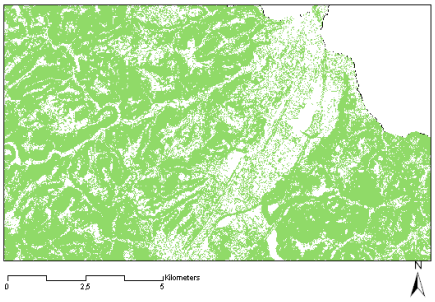
Figures 5-6: Areas with high density of addresses *black*: more than 20 addresses/ha		
Figures 7-8: Areas sensitive to flooding *white*: not sensitive *light blue*: minor risk of flooding *dark blue*: high risk of flooding		
Figures 9-10: Adresses located within areas sensitive to flooding *white*: no addresses *light-dark grey*: 1-360 addresses		
Figures 11-12: Areas sensitive to erosion *green*: areas sensitive to erosion		

Table 2: examples of indicator maps 1-4 (source: AGIV and own adaptation)

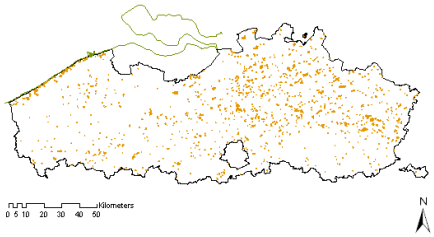
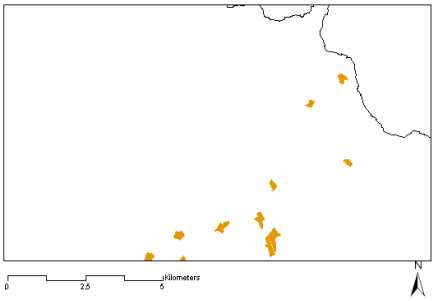
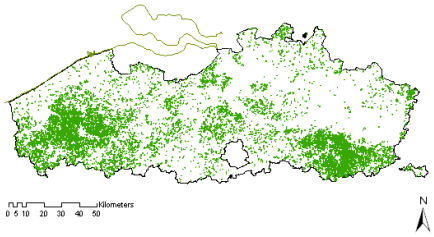
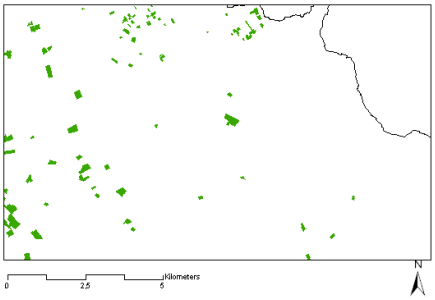
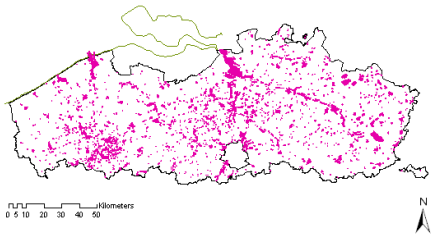
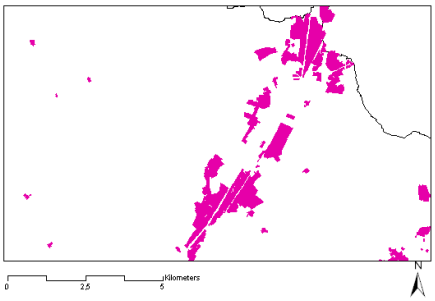
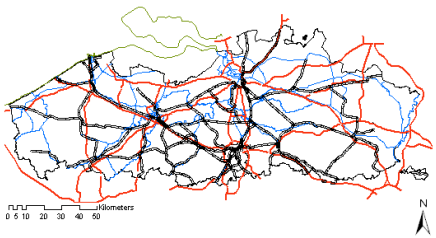
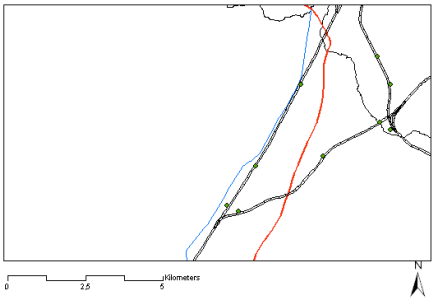
Figures 13-14: Tourist and water recreation areas		
Figures 15-16: Areas specialised in horticulture (under glass) and fruit cultures		
Figures 17-18: Industrial estates		
Figures 19-20: Main infrastructure *blue*: waterways *red*: major motorways *black*: railroad		

Table 3: examples of indicator maps 5-8 (source: AGIV and own adaptation)

4. Southern Senne case

The Southern Senne case is situated in an urban environment, on the verge between urban and peri-urban areas around Brussels. In this case one scenario for a possible future is explored. Table 4 shows an overview of climate proofing initiatives to be implemented in Southern Senne.

Actions for redevelopment of southern Senne		
preserve our own species	**reduce our impact**	**adapt to evolutions we cannot avoid.**
enlarge protected areas	use renewable energy for heat and power	Enhance cooling capacity in build environment
connect protected areas	reduce intra-urban motorized traffic	*Create more space for watersystem management;*
increase the ecological value and potential of the 'blank' areas	optimize interurban multimodal transport	*Remove buildings intensive activities from these areas, protect vulnerable functions from flooding*
	adapt spatial patterns to avoid unnecessary energy consumption	Divide large erosion sensitive arable land with strips of permanent vegetation
		Renovate or redevelop industrial estates to reduce vulnerability to extreme weather events
		Relocate, optimize or renovate main infrastructure to make it more resilient to climate change;

Table 4: suggested climate proofing initiatives

This 'shopping list' contains many items that can only be realised when authorities start a long term coordinated action, with a step-by-step consistent approach. For a designer, the challenge consists in finding elements that amplify each other, and make the long term concept cristal-clear.

The fields indicated in grey in table 4 are the basis of the main concepts for dealing with the problems in Southern Senne. The white fields have a more generic, or project-oriented meaning in this case, and could be worded as follows:

- the redevelopment provides renewable energy (heat and electricity) for a large area around southern Senne. When electricity-production reaches 400MW, the existing gas-powerplant in the Senne can be closed
- actions to fight erosion will at the same time increase the ecological value of areas in between Natura2000 network
- all activities are easily accessible by high performance public transport, pedestrians and cyclists; private cars have no or very limited access to the ground level
- buildings are designed in such a way that they can easily be converted or redeveloped without demolition; this to lengthen the life cycle of buildings;
- technical installations (insulation, ventilation, elevators, ...) are state-of-the-art, and easily allow modifications to the intensity and frequency of the use of the buildings
- walking through the neighbourhood, there is an omnipresence of parks, playgrounds, water surfaces and green areas

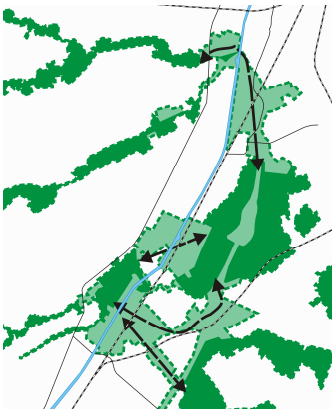
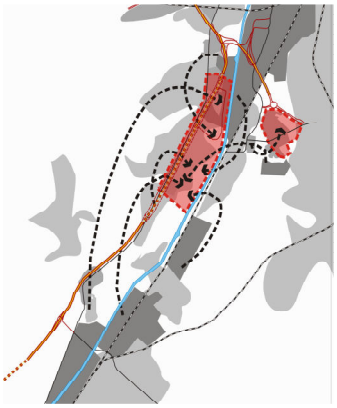
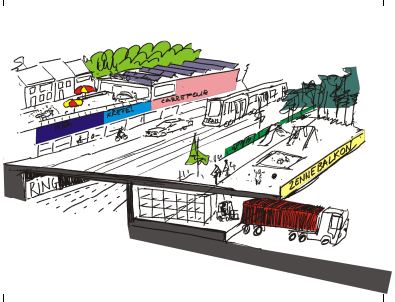
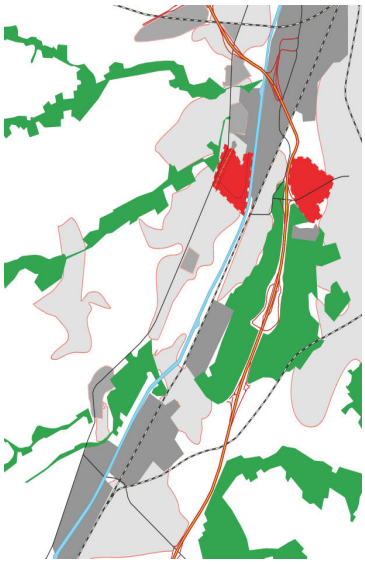
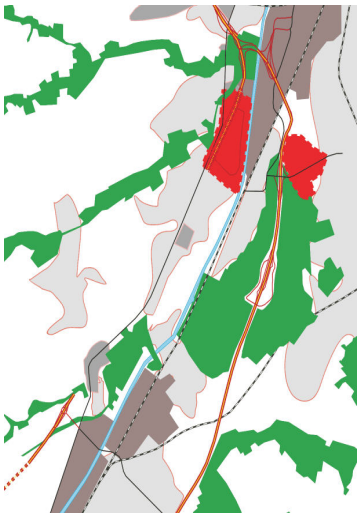
Green southern Senne	*Relocation of activities*	*New urban environment*
		
Existing small protected areas and areas with distinct ecological value are enlarged and connected. A large and continuous natural area is created. The area is alse used for recreation, controlled floods, and is experienced as an pleasant environment.	To implement this green Southern Senne, existing build environment (indicated in grey) will be relocated to the red areas. The Brussels Ringroad which cuts through an important potential area in the Senne Valley also has to be relocated, and will be incorporated in the redevelopment.	Along the ancient A-road, a new urban environment appears. The existing slope hides several underground storeys. Activities that don't need natural light such as motorway, logistics center, shopping, parking,... are situated in these dark spaces. Freight transport can access these underground floors along the Canal Brussels-Charleroi.

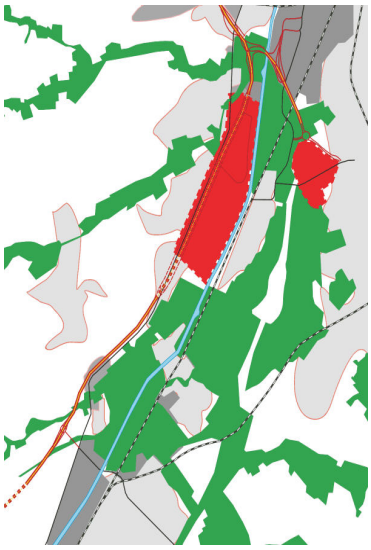
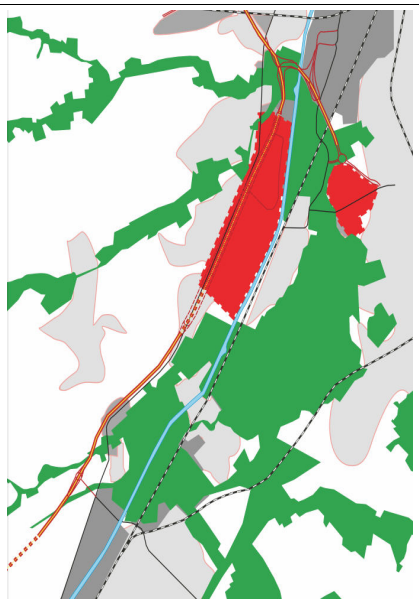
Table 5: main concepts for redevelopment of Southern Senne

Transformation process

Planung hat keinen Anfang, Planung hat kein Ende (L. Burckhardt, 1973)

The ambitious proposal for restructuring southern Senne is only acceptable when respecting historic and cultural patterns and private ownership. Key to success is the establishment of a comprehensive project-process, with all relevant stakeholders, and the necessary flexiblity. A restructuring-process of this size, will take time. The aim is to realise this strategy in such a way that everyone involved has some advantage out of the transformation.
Table 6 gives an insight in steps to be taken throughout the entire process. Relocation of activities and infrastructure necessitates the acceptance of a certain period when a double impact will occur, as new structures are built, and old ones still have to function. All investments are conceived to be easily adapted or transformed in a later stage. If, for instance, road traffic diminishes and a tunnel becomes overdimensioned, parts of it could be used for water storage or room for new technical equipment.
The crux is to create a long term vision, with elements of contemporary knowledge, to give us an idea of what a possible future for Southern Senne might look like. As time goes by, new ideas and applications will change and challenge this visions and its basic concepts. This restructuring process can only succeed by starting now, and persevering in the efforts. If nothing is done, the mapping exercise already gives an insight in what is to be expected.

Year	Actions completed	Map
2014	- planning process finalised - preparatory constructions on two sites (indicated in red) - eastern site: development of shopping, dwellings and workplaces connected to high capacity urban transportnetwork of Brussels Region; on this site a total of 5 ha roof surface is covered with photovoltaïc panels; - western site: vacant part where relocation and redevelopment starts, near 'Ruisbroek' train station; preparatory works and underground constructions (motorway segment, warehouses for logistics) finished; IKEA prepares relocation of existing store situated north of site; - further south of project area, construction for relocation of ringroad has started; first segment is nearly completed	
2019	- further development of western site - first phase of new green areas - eastern site: consolidation of development, public transport system is optimized - western site: first phase is in use, activities originally situated to the north have relocated; northern part is redeveloped; PV-panels and CHP- installations are provided for; new underground logistics park is developed along waterway - natura2000 areas are enlarged, north of western site and south of eastern site; - northern motorway junction is transformed - southern part of new motorway is constructed and open	

2029	- main construction works terminated - new ringroad open - southern expansion of western site; high performance public transport is in service in western part; new green energy technologies are use in redevelopment; PV-installation on roofs are replaced by new high performance PV-panels - between eastern and western site, a huge new nature and water park is realised; south of the two sites, a large connected nature network is constructed on former industrial estates; - between ecological important areas, a network of anti-erosion measures is completed; this network focusses also on migration of species	
2049	- completion of 2009 project - eastern and western sites are consolidated; the 2014 parts are now completely renovated and new activities are located within the development; - green areas and complementary network is completed and fully grown; - road traffic vehicles use only electricity or hydrogen;	
Table 6: four main phases of project		

Epilogue

"None of us really knew each other because we were not a family yet. We were simply a group of survivors in a nameless world. But the past was being erased and a new beginning was replacing it. There was another world waiting for us to inhabit." (B.E.Ellis, 2005)

Jan Zaman, town and country planner (currently working for Flemish spatial planning administration), Belgium

References

Brouwers J., De Nocker L., Schoeters K., Moorkens I., Jespers K., Aernouts K., Beheydt D., Vanneuville W. Vlaamse Milieumaatschappij (VMM) (2008) *Milieurapport Vlaanderen, Achtergronddocument Klimaatverandering 2007.* Brussel: Vlaamse Milieumaatschappij

Baguis, Pierre, Boukhris, Omar, Ntegeka, Victor, Roulin, Emmanuel, Willems, Patrick (2008) *Climate change impact on hydrological extremes along rivers and urban drainage systems in Belgium (CCI-HYDR),* Brussel: Federaal Wetenschapsbeleid

Burckhardt, Lucius (1973) *Die Zeichen der Zeit* In: Fezer, Jesko, Schmitz, Martin (2004) *Lucius Burckhardt: Wer plant die Planung? - Architectur, Politik und Mensch,* Kassel: Martin Schmitz Verlag

Ellis, Brett Easton (2005) *Lunar Park,* London: Picador

ESPON (2006) *Espon project 3.2 Spatial Scenarios and orientations in relation to the ESDP and Cohesion policy. Final Report,* Luxembourg: Espon monitoring committee

European Communities (EC) (2008) *The economics of ecosystems and biodiversity,* Wesseling: Wetzel+Hardt

European Environmental Agency (EEA) (2008) *Impacts of Europe's changing climate – 2008 indicator-based assessment,* Luxemburg: Office for Official Publications of the European Communties

Gobin, Anne, et al (2008) *Adaptatiemogelijkheden van de Vlaamse landbouw aan klimaatverandering,* Leuven: Klimaatpark Arenberg

Hume, Mike, Neufeldt, Henry, Colyer, Helen (eds.) (2009) *Adaptation and mitigation strategies: European Climate Policy. The final report from the ADAM project,* Norwich UK: Tyndall Centre for Climate Change Research, University of East Anglia

Kropp, J.P., Block, A., Reusswig, F., Zickfeld, K., Schellnhuber, H.J. (2006) "*Semiquantitative assessment of regional climate vulnerability: the North-Rhine Westphalia study" Climatic Change* Vol. 2006 No 76

Smithson, Robert (1973) *Entropy made visible,* in: Flam, Jack (ed) (1996) *Robert Smithson: the collected writings,* Berkeley: University of California Press

Swedish Government Official Reports (2007) *Sweden facing climate change – threats and opportunities. Final report from the Swedish Commission on Climate and Vulnerability,* Stockholm: Edita Sverige AB

van Drunen, Michiel (ed) (2006) *Naar een klimaatbestendig Nederland, samenvatting Routeplanner,* Den Haag: Klimaat voor Ruimte, Leven met Water, Habiforum en CURNET

Veraart, J.A., Opdam, P., Nijburg, C, Makaske, B. (eds) (2006) *Quickscan kennisaanbod en -leemten in Klimaatbestendigheid. Effecten, adaptatiestrategieën en maatschappelijke inbedding. Deelrapport uit het routeplanner traject 2010-2050 in kader van de BSIK programma's Klimaat voor Ruimte, Leven met Water, Habiforum/vernieuwend ruimtegebruik en Ruimte voor Geo-informatie* Den Haag: Klimaat voor Ruimte, Leven met Water, Habiforum en CURNET

Zaman, Jan (2009) *Zennevallei 2049,* in: Bouma, G., Filius, F., Leinfelder, H., Waterhout, B. (eds.) (2009) *Tussen droom en werkelijkheid – bijdragen aan de plandag 2009,* Delft: Stichting planologische discussiedagen

Websites

http://rsv.vlaanderen.be

http://tweewaters.be/

http://www.marklynas.org/

http://www.electrabel.be/sustainable_development_corp/act_today_whatwedo_act_nl.aspx

http://www.agiv.be