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Impact Assessment

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D4.3.2

Results of impact assessment for selected case studies

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SIXTH FRAMEWORK PROGRAMME

Contents

Abstract

Objectives/aims
D4.3.2 summarises the regional impact assessment of land use changes at regional level that has been conducted in work package (WP) 4.3 within Module 4 (Sustainability Impact Assessment). Sample regions were 3 case studies: Leipzig-Halle (Germany), Koper (Slovenia) and Haaglanden (Netherlands).

Methodology
The methodology includes an indicator selection procedure for environmental, economic and social indicators according to the three dimensions of sustainability. The final indicator assessment was realised using models (ecological impacts models, indices, look-up tables, regression functions, conjoint analysis) for each indicator to quantify its performance for three land use scenarios 2025 (cf. D1.3.2) compared to the year 2000. To get an integrative picture of all indicators for the whole case study area, the urban, peri-urban and rural areas, spidergrams were produced.

Results / findings / conclusion
The results of the impact assessment show considerable differences in both provisioning of ecosystem services and quality of life in the three case study regions depending on the land use scenario. Compared to the Fragmentation, Peak oil and Eco-environmental land use scenarios with limited urban growth assumptions of further GDP and population growth as well as accelerated transport and technological development assumed in the Hypertech scenario lead to an increase of land consumption and of artificial surfaces. The provision of ecosystem services such as local climate regulation or cooling green and recreational spaces declines and the human quality of life accordingly. Land use gradients show the heterogeneity of land use patterns along the rural-to-urban gradient.

Popular science description of main results
The deliverable describes indicators, methods and results of the integrated impact assessment of land use changes for a range of different scenarios. The results comprise verbal descriptions, spidergrams, gradients and scenario maps.

Classification of results / outputs:
For the purpose of integrating the results of this deliverable into the PLUREL Explorer dissemination platform as fact sheets and associated documentation please classify the results in relation to spatial scale; DPSIR framework; land use issues; output indicators and knowledge type.

Spatial scale for results: Regional, national, European	Regional The results are depicted for the three PLUREL case studies Haaglanden, Koper, Leipzig-Halle.
DPSIR framework: Driver, Pressure, State, Impact, Response	Impact The results of the impact assessment on ecosystem services and quality of life are described.
Land use issues covered: Housing, Traffic, Agriculture, Natural area, Water, Tourism/recreation	All This summary of the impact assessment covers the different land use issues relevant in the case study regions.
Scenario sensitivity: Are the products/outputs sensitive to Module 1 scenarios?	Yes The impact assessment has been done with the M1 scenarios that were downscaled for the case study regions.
Output indicators: Socio-economic & environmental external constraints; Land Use structure; RUR Metabolism; ECO-system integrity; Ecosystem Services; Socio-economic assessment Criteria; Decisions	Ecosystem services and quality of life.
Knowledge type: Narrative storylines; Response functions; GIS-based maps; Tables or charts; Handbooks	Tables and charts.

How many fact sheets will be derived from this deliverable:	**1**

1 Introduction

1.1 PLUREL'S WP 4.3

This deliverable summarises the regional impact assessment that has been conducted in work package (WP) 4.3 within Module 4 (Sustainability Impact Assessment).

The impact assessment is the endpoint of an analysis chain within PLUREL that

- Uses pan-European scenarios (Module 1)
- That have been downscaled for the case study regions (Module 3)
- To model land use changes at the regional scale (Module 2)
- And then assesses the impact of these changes onto ecosystem services and quality of life (Module 4).

Thus, the impact assessment is directly and indirectly related to a number of other deliverables and tools that have been produced within the PLUREL project. The main products and deliverables are:

- **iIAT** (interactive Impact Assessment Tool): It has two components: EU and Region. In the regional component, all results of the impact assessment are included. Thus, comparisons of scenarios for case study regions as well as comparisons between case studies can be analysed visually. The iIAT will be accessible via the PLUREL XPLORER at the beginning of 2010 and is described in detail in D5.2.2.
- **QoLSim** (Quality of Life-Simulator): The QoLSim is a tool that encompasses all quality of life questionnaires that have been conducted in the PLUREL case study regions. The QoLSim will also be available in the PLUREL XPLORER and is summarised in D4.3.3.
- **MOLAND scenarios**: The impact assessment uses the MOLAND modelling results as input for land use changes in the future. The MOLAND modelling has been conducted for the three PLUREL case study regions Koper, Haaglanden, and Leipzig-Halle. Thus, these cities are included in the impact assessment. The modelling exercises for the regions are summarised in D2.4.3.
- **Indicator framework**: The impact assessment builds upon a selection of indicators and their quantification for future land use scenarios. The procedure of selecting indicators is described in D4.3.1.

1.2 Objectives of the deliverable

The objective of this deliverable is to summarise the findings of the impact assessment for the case study regions. It shows the main results of the impact assessment for three case study regions (namely Koper in Slovenia, Haaglanden in the Netherlands and Leipzig-Halle in Germany) and compares indicator assessments for each of the regions separated for their urban, peri-urban and rural parts.

Thus, the deliverable does not elaborate on the methodology and data for the assessment itself but rather focuses on the results. However, it provides a brief summary of the methods. The detailed description of the methodologies and methods behind the impact assessment can be found in the corresponding fact sheets in the PLUREL XPLORER.

1.3 Structure of the deliverable

The deliverable is structured as follows. In chapter 2, data and methods for the impact assessment are briefly described. This refers to indicator selection (2.1), the indicators on ecosystem services (2.2) and quality of life (2.3). In chapters 3 to 5, the impact assessment for each of the three case study regions is summarised. For each of the case study regions, the chapters are organised similarly: First, an overview of land use change scenarios is given (3.1, 4.1 and 5.1 respectively). Then, the impact assessment related to ecosystem services (3.2, 4.2 and 5.2) and quality of life (3.3, 4.3 and 5.3) is summarised. Each chapter concludes with a summary for the case study region (3.4, 4.4 and 5.4). Finally, conclusions are drawn in chapter 6.

2 Data and methods

2.1 Indicator selection

The selection of indicators for case study-specific assessment was a continuous process with a steady demand for trade-offs between the theoretical requirements of a complete indicator set, the preferences of practitioners, the suitability of available data and methods as well as the overall aims of the PLUREL project. Thus, several feed backs, discussions, workshops and evaluations were necessary to reach the final version of the indicator set. Several sessions on indicators have been carried throughout the PLUREL conferences (e.g. indicator workshops in Leipzig, Warsaw, The Hague, Koper, plenum discussions in Leipzig and the Hague), and the internal indicator task force provided a basic framework for assessment as well as a basic variable set. During these processes the number of indicators has decreased dramatically in a stepwise manner, reflecting the multiple demands and constraints of the project groups. A more detailed description of the selection processes can be found in D4.3.1 at www.plurel.net.

The main concepts were selected: ecosystem services for environmental aspects, quality of life to cover social aspects, and economic valuation. The first two concepts led to the impact assessment as summarised here. The economic assessment can be found in D4.4.3.

2.2 Ecosystem services

At the regional scale, no new indicators have been developed, but a defined set taken from already existing sustainability indicator sets was being refined for the purpose and especially for the purpose of assessing the impact of land use change across the gradient of a rural-urban region (RUR). None of the existing local or regional sustainability indicator sets focuses on the integration and relationship of both rural and urban areas. In addition, the hereinafter presented indicator set reflects the stakeholder-oriented participatory research that is carried out and is therefore a tool to integrate the results. The methodological steps executed in order to develop the indicator set for sustainability impact assessment on the regional scale incorporated the development of an a priori theoretical model, the derivation of a preliminary indicator list based on the theoretical model and discussions in workshops, the analysis of indicator relations in an integrated indicator matrix and finally, the selection of key indicators based on matrix results and stakeholder feedback (Kroll et al., 2010; Figure 2.1).

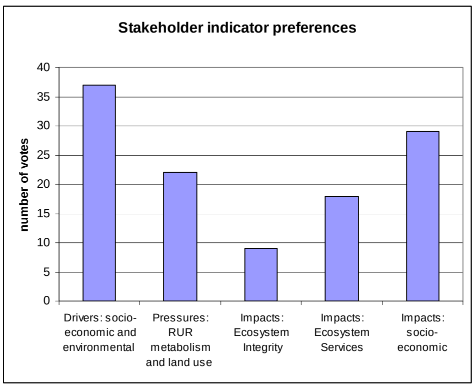

Figure 2.1: Stakeholder indicator preferences (right) and results of the participative workshop in The Hague (left).

For the detailed land use change impact assessment, a small sub-set of key indicators was chosen to cover the three pillars of sustainability. For the ecological aspects, the ecosystem services concept was chosen as a framework. Recently the concept of ecosystem goods and services (which are jointly called ecosystem services) has demonstrated a rapid conceptual development at the interface of society and nature. Basing on the “functions of nature” (De Groot, 1992), ecosystem ser-vices are “the benefits people obtain from ecosystems and the processes that sup-port the production of ecosystem goods” (MA, 2005). They result in “the benefits of nature to households, communities, and economies” (Daily, 1997) as “components of nature, directly enjoyed, consumed, or used to yield human well-being” (Boyd and Banzhaf, 2006).
Generally, three classes of ecosystem services are distinguished: Provisioning services (goods produced or provided by ecosystems such as food and clean water), regulating services (benefits obtained from regulation processes in ecosystems such as climate regulation), and cultural services (non-material benefits obtained from ecosystems such as recreation). Since the controversial paper of Costanza et al. (1997), the basic ideas of the ecosystem service approach have been assumed by various international endeavors, such as the Millennium Ecosystem Assessment (MA, 2005), the Ecosystem Approach of the UN Commission on Biodiversity (CBD, http://www.cbd.int/ecosystem), the International Union for Conservation of Nature (e.g. Smith and Maltby, 2008), the European Environ-mental Agency that seeks for an environmental-economic accounting system “beyond GDP” (see http://www.eea.europa.eu/highlights/beyond-gdp) with ecosystem services in its focus, the TEEB report (2010), or CICES (e.g. Haines-Young and Potschin, 2010) that aims at providing a common international classification of ecosystem goods and services. Recently, the COP 10 conference of the CBD (Nagoya, October 2010) has stressed the high demand for substantiated statements about the economic costs of biodiversity loss (cf. also Sukhdev, 2008). Table 2.1 provides an overview over the indicators and the respective impact models.

Table 2.1: List of all impact models and indicators used

Concept	Indicator	Impact model
ESS[1]	Local climate regulation	Land surface emissivity is computed as a proxy, with case-study specific satellite images (Schwarz et al., 2010).
ESS	Recreation potential	Recreation of natural and semi-natural areas is computed using the proxy of the per-capita green space.
ESS	Carbon mitigation	Estimated by a quantification of carbon storage in trees, based upon extrapolation of field data.
ESS	Water quantity regulation	Quantified with evapotranspiration (ETP) using the empirical model of the TUB-BGR approach by Wessolek et al. (2004).
ESS	Biodiversity potential	Potential of land use types for serving as habitat for urban, agricultural and forest bird species (regression model; Strohbach, 2009).
ESS	Food production	Empirical additive model of the produced food in comparison to yields in tons per hectare out of statistical data.
ESS	Energy provision	Summary of all types of energy, computed out of statistical values per land cover type.
ESS	Fresh water provision	Calculated using the proxy of groundwater recharge (TUB-BGR approach by Wessolek et al. 2004).
QoL[2]	Quality of life aggregate	Weighted sum value of all quality of life indicators measured for a case study using the Quality-of-Life Simulator
QoL	Air quality	
QoL	Access to green space	
QoL	Public transport	Single variable to determine the quality of life for a case study using the Quality-of-Life Simulator
QoL	Shops in the neighborhood	
QoL	Noise pollution	

[1]Ecosystem Services; [2]Quality of Life.

To summarize, the conceptual implementation of the approach into environmental and sustainability policy is steadily increasing. Thus, the ecosystem service concept is highly suitable to represent impacts of land use and land cover changes, also because the land cover pattern is one of the most important aspects that affect a landscape’s capacity to provide ecosystem services (Burkhard et al., 2009). The social aspects were framed by the concept of quality of life. The economic aspects were calculated using GDP and external costs of land uses.

2.3 Quality of life

How do people react to changes in the quality of their living environment? One answer is that if it deteriorates, they will move (if they can afford to do so). The quality of life in rural urban regions can be subject to improvement or deterioration as a result of many factors. In this study a series of indicators were developed, derived from selection of pre-existing sets and which were sensitive to land use change. The way these indicators operate can vary, being affected by the attitudes of different people with varying backgrounds and residential locations. The Quality-of-Life Simulator (QoLSim; Figure 2.2) uses the concept of affordances to explore these differences using a sample of people of different demographic back-grounds living in different sections of a rural urban region using several European cities and urban regions.

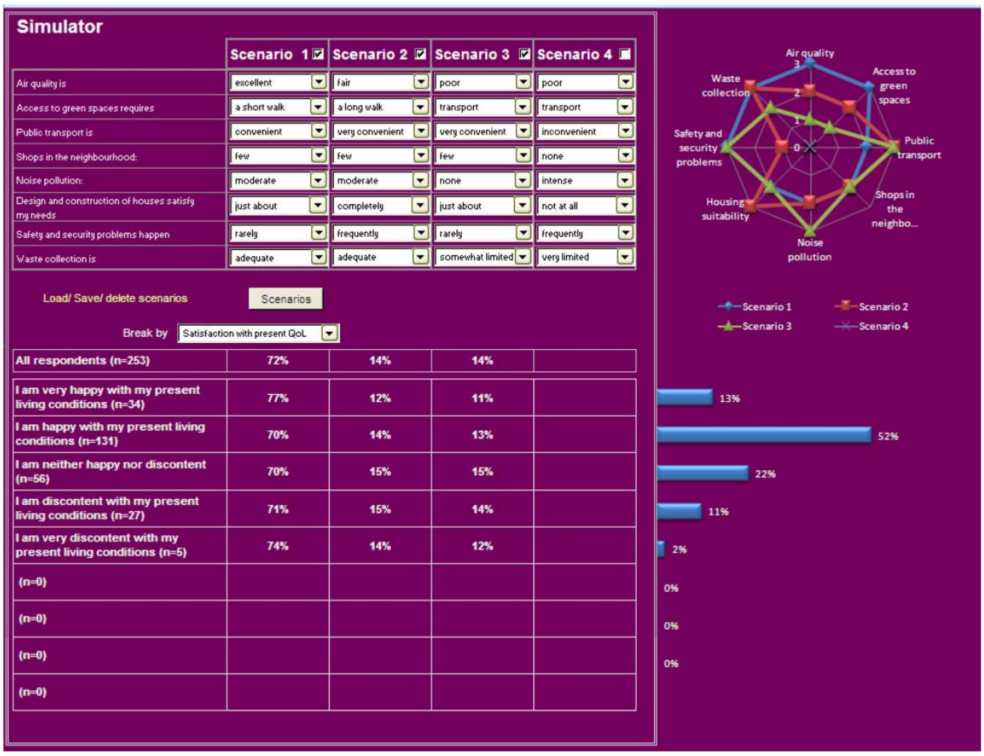

Figure 2.2. Graphical User Interface (GUI) of the Quality-of-life simulator QoLSim displaying resident responses of an arbitrary RUR in Europe

The methodology used is adaptive conjoint which uses tradeoffs in residential choice depending on different scenarios as a means of assessing the thresholds of effect of the indicators chosen for the project. The data was analysed and fed into a the modelling system of the Quality of Life Simulator which enables the effects of land use change derived from the land use modelling scenarios to be converted into predictions of behaviour by residents, using residential choice as the vehicle for measuring the threshold. Taking a number of variables which affect the living environment, such as safety and security, air quality, commuting distances and ac-cess to green space, it is possible to test how different people react to possible changes in these by predicting when they are likely to consider that the environment has become too unsatisfactory for them to live there any more, or where an-other environment has become more attractive. These choices depend on the type of person or their life stage and they change over time.
By developing a tool for modelling behaviour it is possible to predict what changes to land use may affect people for the better or worse. The results show that of all the quality of life

factors studied, safety and security are the most important while accessibility to green space is least important. This can provide valuable information for planners and policy makers. However, the linkage of the measured quality of life perception values with the land use change values of the regionalized land use change scenarios remains challenging. Here, still more emphasis is needed to prove the rule-set developed so far of how land use change quantitatively affects quality of life in a specific region.

2.4 Explanation of graphs

The results for ecosystem services for each region are differentiated for the whole case study region as well as for its urban, peri-urban and rural parts. The assignment of the case study area into urban/peri-urban/rural was done by the local scientists in the case studies. They took into account population density and settlement structures amongst others.

The impact assessment is visualised using spidergrams. The axes show the indicators for ecosystem services or quality of life, respectively. The scaling of axes is different for ecosystem services and quality of life, as changes in quality of life in general are much smaller. However, the scaling is comparable throughout the case studies. The lines represent all the scenarios that have been run in the PLUREL project (see also the legend). The change for each indicator between 2000 and 2025 is shown: “1” indicators no changes for this indicator, and higher values hint at an increase, lower values at a decrease. A value of “0” means that the indicator is not present in the specified region.

3 Impact assessment Koper

3.1 Overview of land use change scenarios (cited from D2.4.2)

Four scenarios are outlined within the PLUREL Module 1 (taken from PLUREL D1.3.2):

- A1-techno, rapid development in ICT leading to reduced commuting and transport needs, with no constraints on the location of new build (WP1.4),
- A2-climate - climate change reaches a tipping point leading to impacts including rapid sea level rise, flooding and water resource constraints (WP1.3).
- B1-econ, an energy price shock leading to rapidly increasing energy and transport costs and consequent changes in mobility and trade flows (WP1.1),
- B2-demog, a pandemic disease leading to major population declines and behavioural shifts within society (WP1.2).

These scenarios were adapted to suit the mandate of the PLUREL project (D1.3.2). A full description of the adapted scenarios can be found in the PLUREL D1.3.2. The scenarios were presented and discussed with the Koper Stakeholder committee and two scenarios were retained for the Koper case study: Hyper Tech (A1) and Peak oil (B1). The business as usual scenario was also run in addition to these two scenarios. The results of the three scenarios are shown in Table 3.1 and Figure 3.1.

Table 3.1 Land use classes for 2000, BAU, Hypertech and Peak oil for 2015/2025

MOLAND class	Land use 2000	Hyper-tech 2015	Hyper-tech 2025	BAU 2015	BAU 2025	PeakOil 2015	PeakOil 2025
				km²			
arable land	21,22	23,38	23,59	23,08	22,93	17,59	17,46
permanent crop	45,84	32,01	31,57	32,97	33,70	44,92	52,49
pastures	63,74	46,22	46,12	45,94	45,17	40,16	32,76
heterogeneous agricultural areas	5,60	4,48	3,22	4,66	3,54	4,93	4,00
forests	148,44	176,29	175,92	176,31	176,05	175,51	174,73
shrub/herbaceous vegetation	0,39	0,55	0,54	0,58	0,56	0,46	0,43
open spaces	1,42	0,21	0,21	0,21	0,21	0,21	0,21
wetlands	1,53	1,30	1,13	1,25	1,11	1,31	1,15
continuous urban fabric	0,30	0,29	0,34	0,27	0,33	0,28	0,33
discontinuous urban fabric	9,49	9,67	10,62	9,75	10,70	9,66	10,72
industrial and commercial	2,73	3,22	4,14	2,65	2,92	2,93	3,45
construction sites	0,00	0,00	0,00	0,00	0,00	0,00	0,00
port areas	2,17	2,57	2,87	2,75	3,29	2,58	2,86
airports	0,00	0,00	0,00	0,00	0,00	0,00	0,00
mineral extraction	0,57	0,67	0,67	0,67	0,67	0,67	0,67
dump sites	0,00	0,00	0,00	0,00	0,00	0,00	0,00
road and rail networks	5,57	8,26	8,20	8,10	8,01	7,99	7,95
artificial non-agriculture	0,32	0,57	0,56	0,49	0,49	0,49	0,49
water bodies	1,10	0,76	0,73	0,75	0,76	0,74	0,73

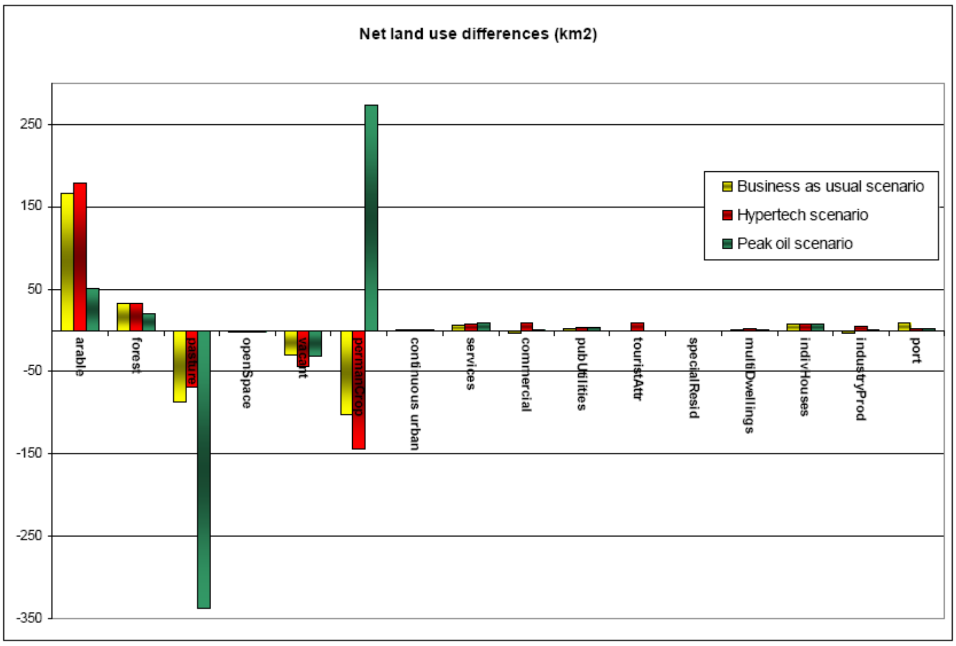

Figure 3.1 Net changes for land use classes between scenarios projections for 2025

3.2 Ecosystem services

The summary of the ecosystem services assessment for the case study region of Koper is depicted in Figure 3.1. Note: Out of the eight ecosystem services indicators, changes in biodiversity were not assessed for the case study region of Koper because of a lack of breeding bird data. Thus, the graphs show a 0 for this indicator.

The Koper case study region shows a sharp increase in energy provision for all scenarios, which is mainly located in the rural part and in the peri-urban areas (for some of the scenarios). This is due to the extension of agricultural land and improvements in agricultural practices in these scenarios. Most of the other ecosystem services indicators show decreasing trends for the scenarios, e.g. recreation potential, water quantity regulation or fresh water provision. On the other hand, local climate regulation remains stable or even increases.

3.3 Quality of Life

The summary of the quality of life assessment for the case study region Koper is depicted in Figure 3.2. For the whole case study region, a slight increase in quality of life has been detected for the different scenarios. However, the spatial differentiation reveals that the changes show different patterns throughout the region: The spidergram for Kopers rural part is very irregular, hinting at diverging patterns. The increase of quality of life in the rural parts mostly takes place with respect to shops in the neighbourhood and public transport, while quality of life related to noise and air quality decreases in the rural areas. The spidergrams for peri-urban and urban areas are more evenly shaped.

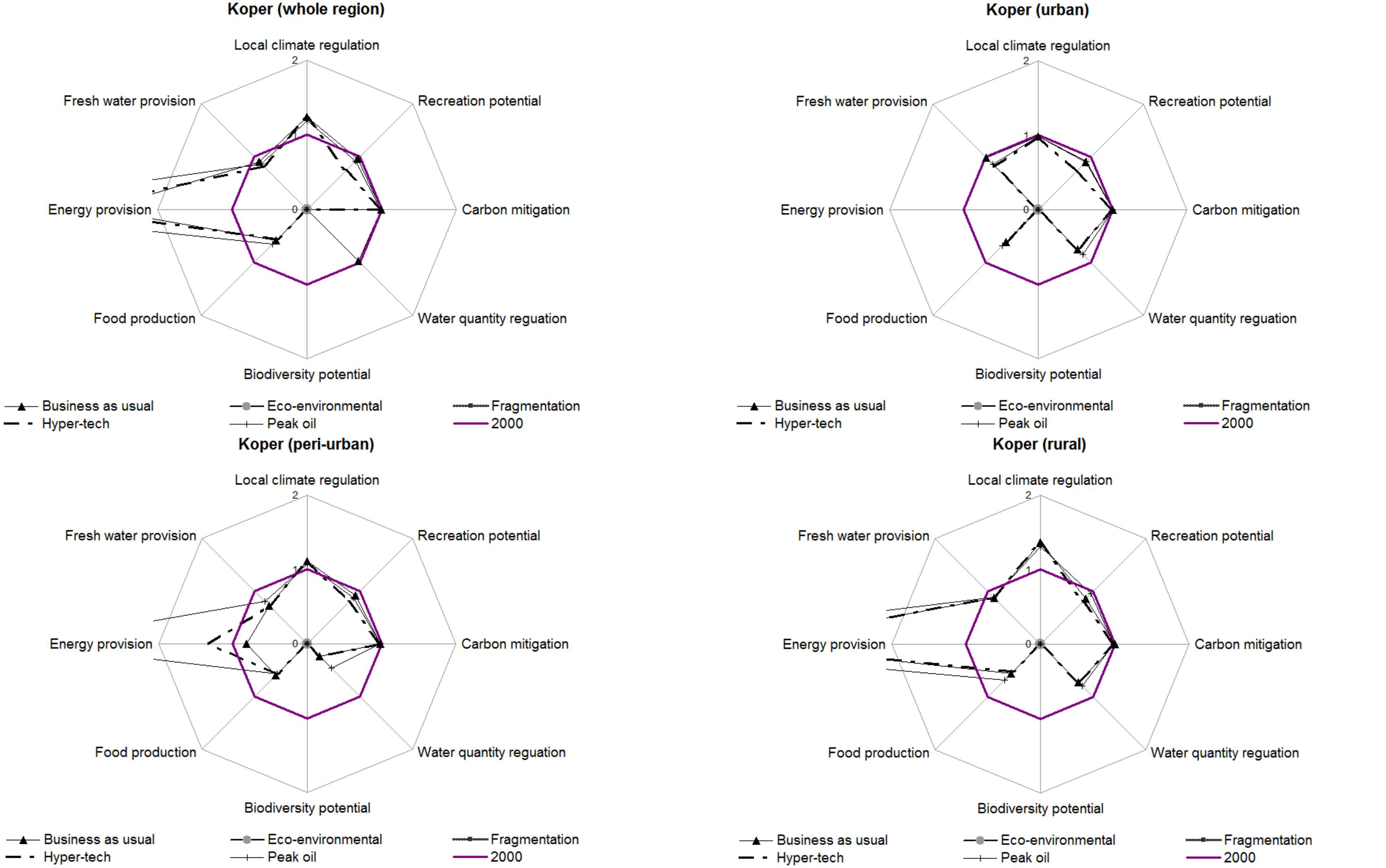

Figure 3.1: Ecosystem services assessment for case study region Koper.

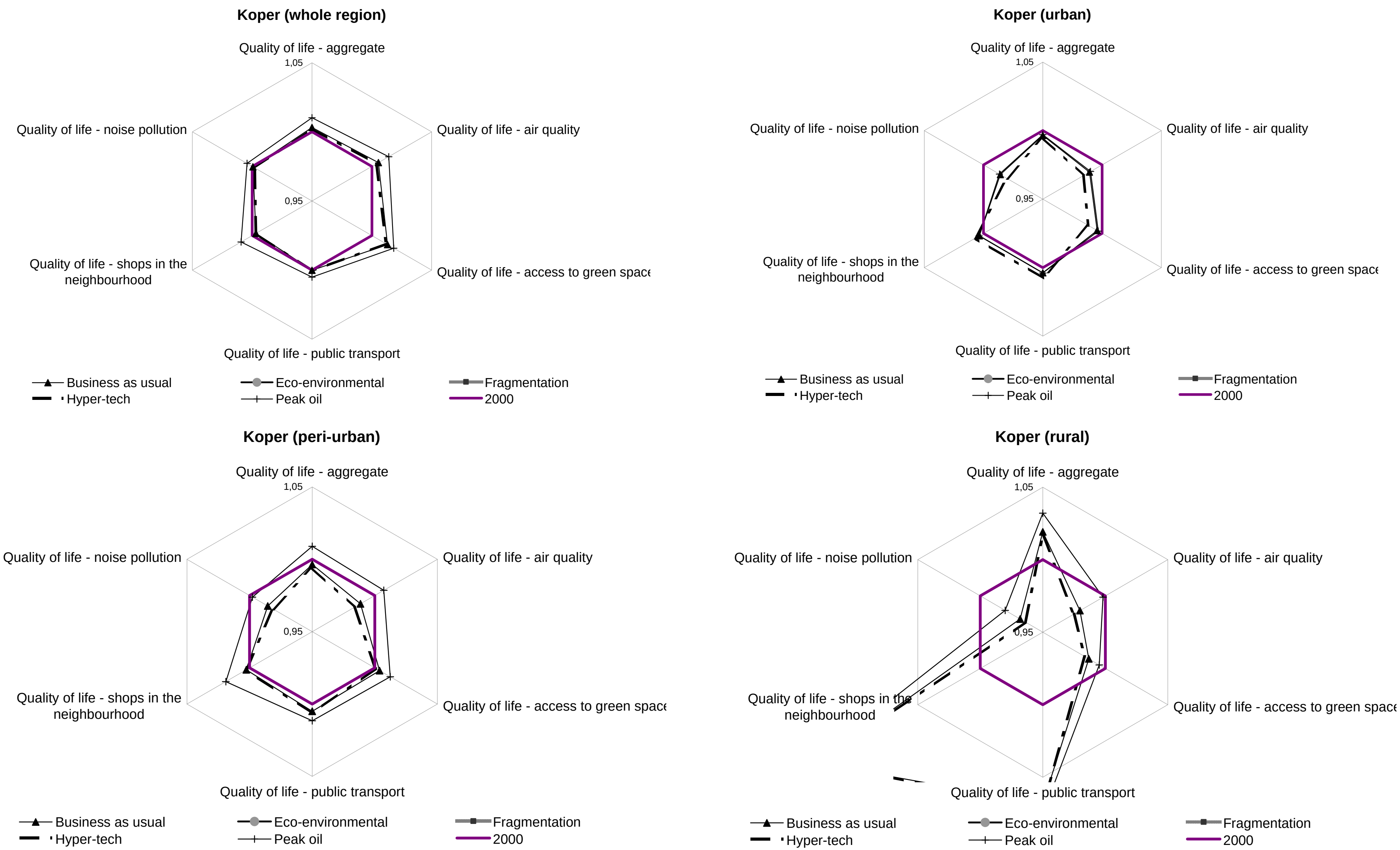

Figure 3.3: Quality of Life assessment for case study region Koper.

3.4 Summary for Koper

The scenarios show that a likely increase of artificial surfaces in most of the scenarios will worsen the provision of ecosystem services and quality of life in the entire case study region.

4 Impact assessment Haaglanden

4.1 Overview of land use change scenarios (cited from D2.4.2)

According to the July 2009 version of the working paper WP 3.4 "PLUREL scenario workshop The Hague Region 11 and 12, May 2009", two scenarios were retained for The Hague test case: Peak oil (B1) and Fragmentation (B2). The business as usual scenario was also run in addition to these two scenarios. The results of the three scenarios are shown in Table 4.1 and Figure 4.1.

Table 4.1 Land use classes for 2000, BAU, Fragmentation and Peak oil scenario for 2015/2025 each

MOLAND class	Land use 2000	Frag. 2015	Frag. 2025	BAU 2015	BAU 2025	PeakOil 2015	PeakOil 2025
				km²			
arable land	604,68	579,77	574,13	562,22	556,19	645,98	686,38
permanent crop	130,68	110,6	111,44	146,54	146,59	112,01	109,17
pastures	1049,3	1036,36	1020,5	1021,8	1003,86	900,63	863,72
heterogeneous agricultural areas	0	0	0	0	0	0	0
forests	73,73	28,51	66,01	85,7	81,89	152,69	147,24
shrub/herbaceous vegetation	0	0	0	0	0	0	0
open spaces	0,92	54,91	51,45	1,27	1,17	34,74	37,96
wetlands	139,04	139,23	139,1	139	138,94	139	139,01
continuous urban fabric	512,68	559,22	580,99	559,32	588,03	538,58	543,28
discontinuous urban fabric	23,61	24,42	24,75	21,35	21,74	24,32	24,92
industrial and commercial	82,78	63,88	56,77	79,82	77,15	80,69	81,63
construction sites	0	0	0	0	0	0	0
port areas	58,55	55,16	51,33	62,14	63,33	51,17	47,62
airports	5,62	4,97	4,64	3,55	3,27	5,14	4,74
mineral extraction	0	0	0	0	0	0	0
dump sites	0	0	0	0	0	0	0
road and rail networks	100,24	99,6	99,57	99,47	99,26	98,9	98,74
artificial non-agriculture	195,88	196,64	197,26	196,61	197,47	194,15	193,63
water bodies	468,19	467,97	467,99	467,12	467,01	467,91	467,89

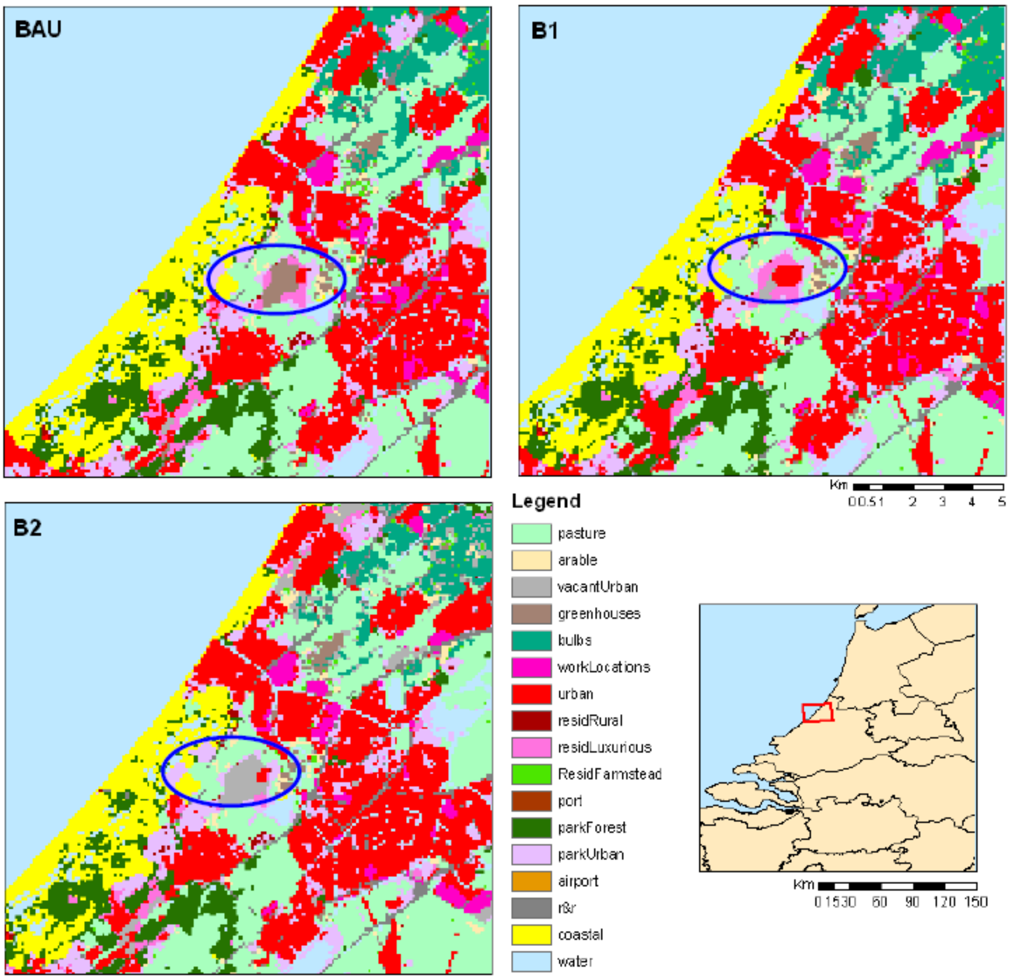

Figure 4.1 Land use change for 2000 and scenarios BAU, Peak oil (B1) and Fragmentation (B2)

4.2 Ecosystem services

The summary of the ecosystem services assessment for the case study region Haaglanden is depicted in Figure 4.1. Note: Out of the eight ecosystem services indicators, changes in biodiversity were not assessed for the case study region Haaglanden because of a lack of breeding bird data. Thus, the graphs show a 0 for this indicator.

The rural parts of Haaglanden show decreasing trends for almost all indicators apart from energy provision and fresh water provision, while the peri-urban area shows more increasing indicators (e.g. for fresh water provision and recreation potential). The urban areas are characterised by stable or decreasing ecosystem services indicators for the scenarios.

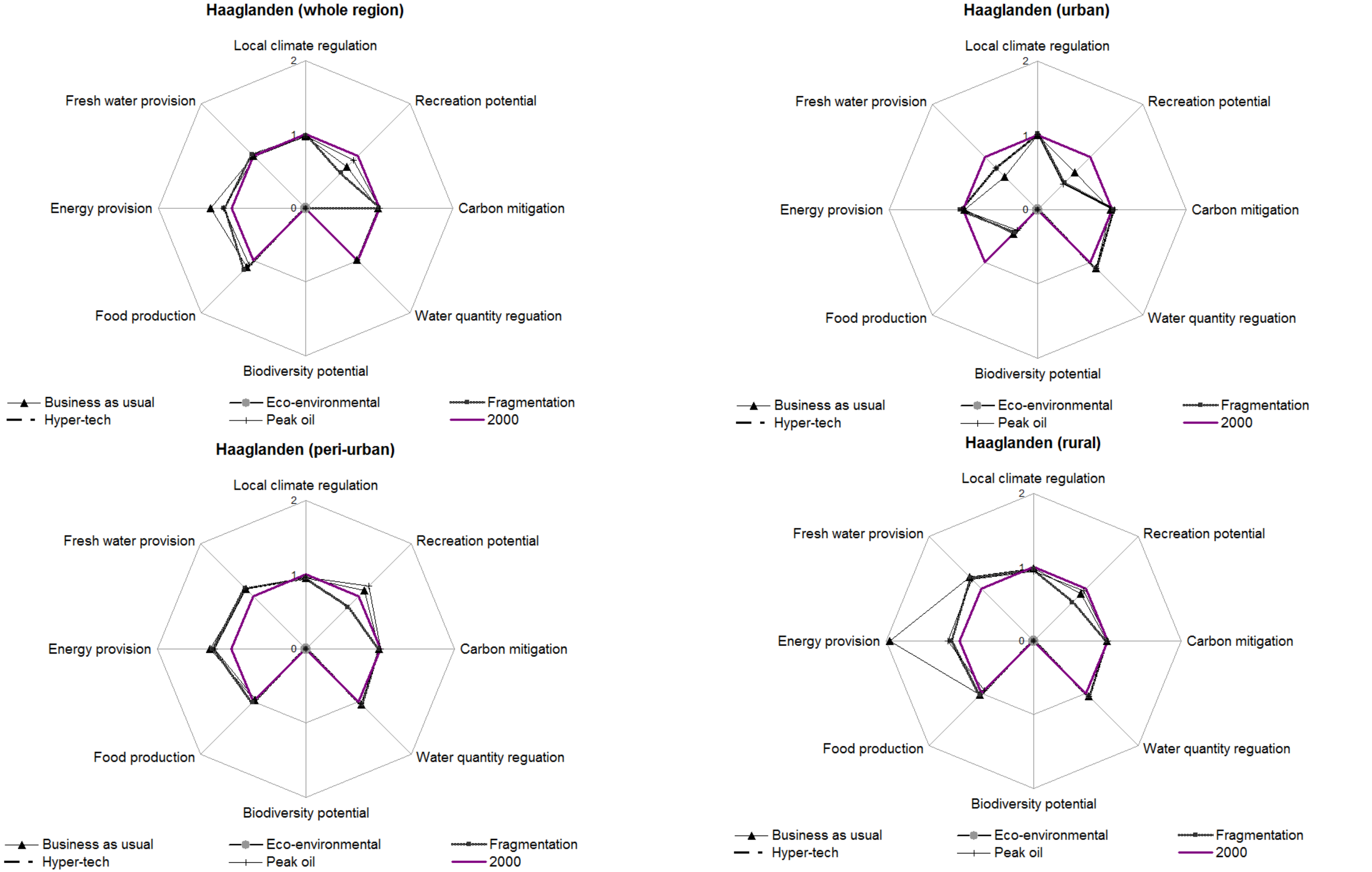

Figure 4.1: Ecosystem services assessment for case study region Haaglanden.

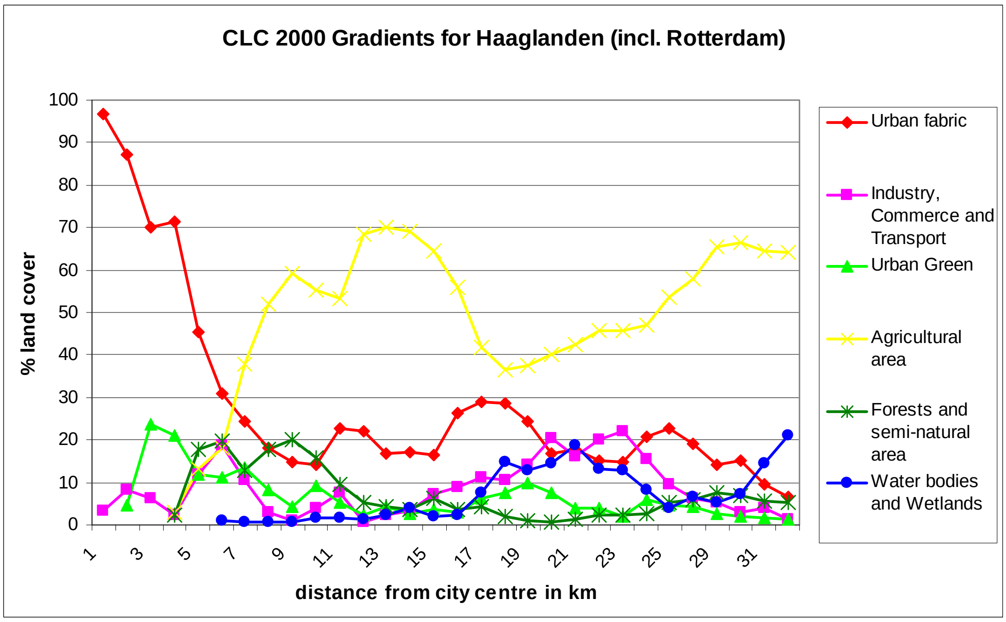

Figure 4.3: Rural-urban land use gradients for case study region Haaglanden (CLC 2000).

Figure 4.3 provides an example of a rural-to-urban land use gradient for the Haaglanden case study showing the steep increase of sealed surfaces towards the city centre and an increase of open land use classes with increasing distance from the city centre. The decline of arable land at a distance of about 20km from the city centre and the parallel increase of residential land show the results of ongoing suburbanisation.

4.3 Quality of Life

The summary of the quality of life assessment for the case study region Haaglanden is depicted in Figure 4.2. Overall, quality of life for the whole region does not change a lot according to the scenarios. However, the urban and peri-urban parts show differences regarding the different scenarios, while the rural parts remain stable. Quality of life regarding both air quality and access to green space increases in the urban parts, whereas diverging trends are visible for the peri-urban parts. Quality of life regarding noise in the urban parts shows an increase, whereas the peri-urban parts are likely to show a slight decrease.

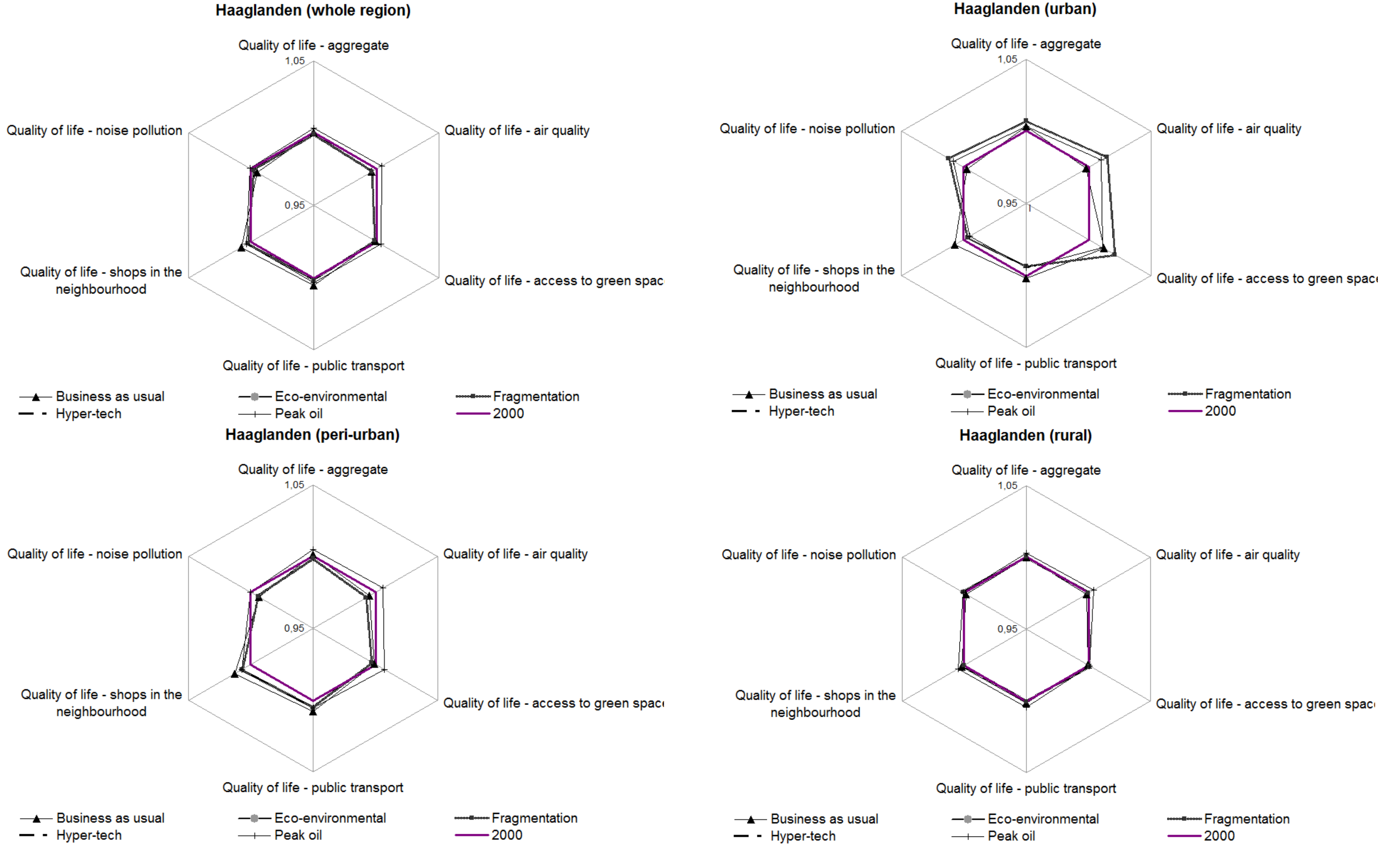

Figure 4.3: Quality of Life assessment for case study region Haaglanden.

4.4 Summary for Haaglanden

Whereas the ecological conditions and the provisioning of ecosystems services in the urban parts of the case region decrease the quality of life slightly increases. For the Peak oil and Fragmentation scenarios the ecosystem services provision increases for the whole area.

5 Impact assessment Leipzig-Halle

5.1 Overview of land use change scenarios

A scenario framework was developed including a business-as-usual, a Hypertech and an Eco-environmental scenario. These scenarios are consistent stories of how futures could look like. In a stakeholder workshop in the Leipzig-Halle region the basic framework scenarios were locally adapted and specified to better capture the regional development. In particular, population decline was added to population growth and a shrinkage scenario was explored (Haase et al., 2009; Petrov et al., 2009). To make scenarios comprehensible and not over-complex, for all locally adapted scenarios, different assumptions on general driving factors of land use change were made in accordance between scientists and stakeholders: population, economy and spatial planning. Using these factors, a matrix was developed that combines assumptions on demographic and economic development (growth and shrinkage) with the strength of spatial planning (strong and laissez-faire).

Table 5.1 Land use classes for 2000, BAU, Hypertech and Eco-Environmental for 2015/2025

MOLAND class	Land use 2000	Hyper-tech 2015	Hyper-tech 2025	BAU 2015	BAU 2025	EcoEnv 2015	EcoEnv 2025
				km²			
arable land	67,89	2970	2946,66	2928,35	2947	2927,37	2966,85
permanent crop	0,21	9	8,48	8,46	8	8,35	8,49
pastures	2,42	106	88,85	80,31	94	86,45	99,87
heterogeneous agricultural areas	2,61	114	97,14	88,29	104	99,38	106,49
forests	8,94	391	376,18	366,30	385	382,99	383,76
shrub/herbaceous vegetation	1,19	52	36,46	27,39	44	38,21	47,13
open spaces	0,75	33	27,79	23,72	30	26,61	31,32
wetlands	0,05	2	1,56	0,71	2	1,26	1,75
continuous urban fabric	0,21	9	9,36	9,77	9	8,80	11,22
discontinuous urban fabric	8,73	382	411,20	431,73	405	421,30	391,44
industrial and commercial	2,19	96	151,77	189,04	134	159,39	110,11
construction sites	0,05	2	4,95	6,75	5	6,76	2,40
port areas	0,00	0	0,01	0,01	0	0,01	0,01
airports	0,41	18	23,89	23,84	18	17,80	23,88
mineral extraction	2,38	104	103,89	103,88	104	103,89	103,86
dump sites	0,16	7	7,03	7,04	7	7,04	7,04
road and rail networks	0,11	5	4,80	4,80	5	4,82	4,83
artificial non-agriculture	0,55	24	24,66	24,28	24	24,27	24,28
water bodies	1,17	51	50,77	50,76	51	50,77	50,73

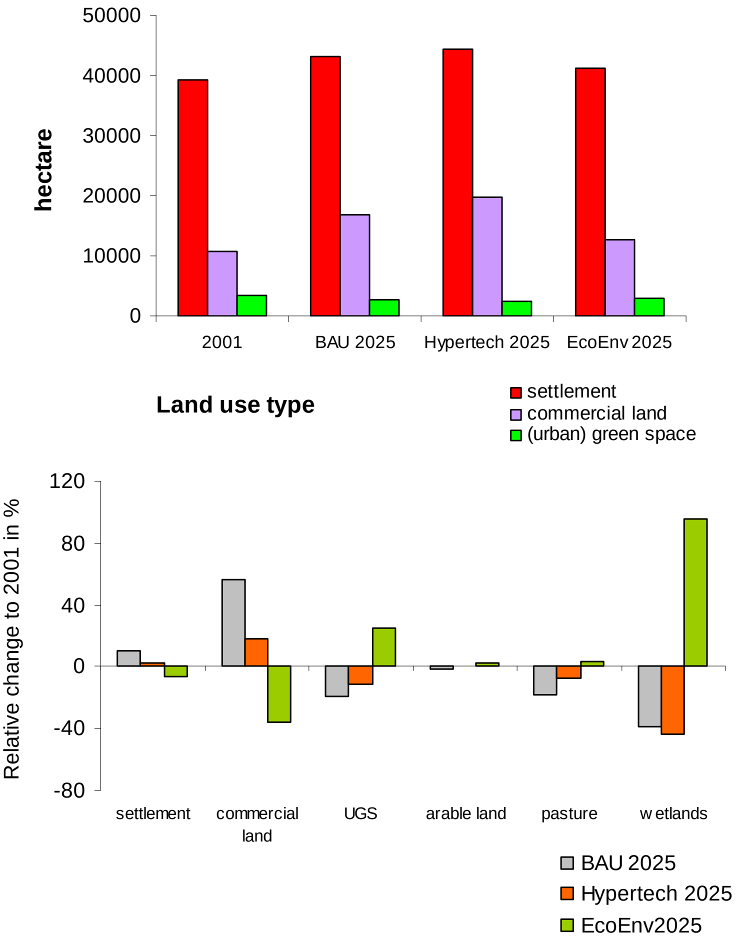

Figure 5.1 Land use changes displayed for major land use classes for 2000 and scenarios BAU, Hypertech and Eco-Environmental for 2025

5.2 Ecosystem services

The summary of the ecosystem services assessment for the case study region Leipzig-Halle is depicted in Figure 5.1. The assessment shows stable results for most of the environmental indicators. Recreation potential shows slight changes due to the different scenarios, mainly in the urban parts of the case study region. Energy and food provision increase, mostly in rural and peri-urban areas.

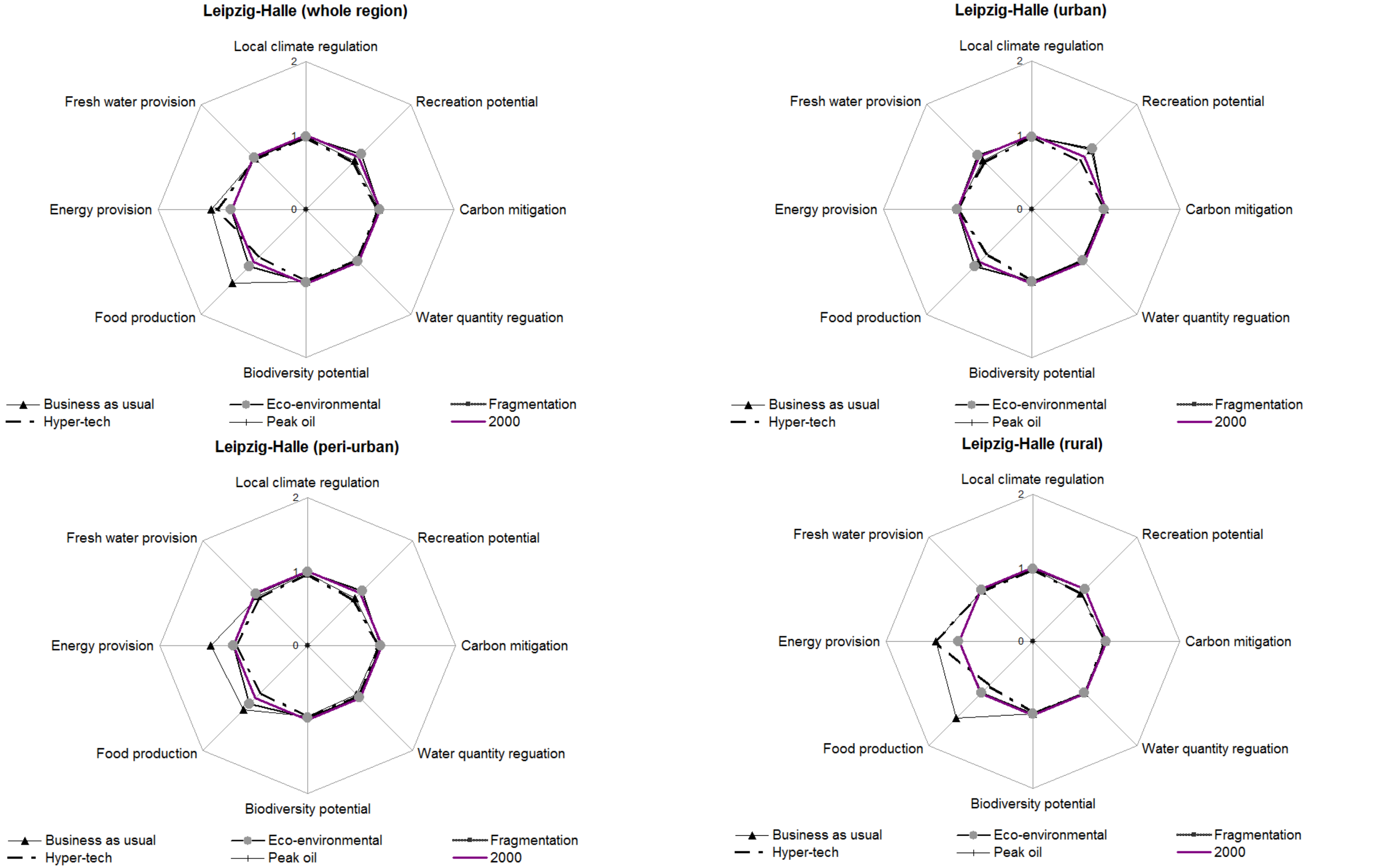

Figure 5.1: Ecosystem services assessment for case study region Leipzig-Halle.

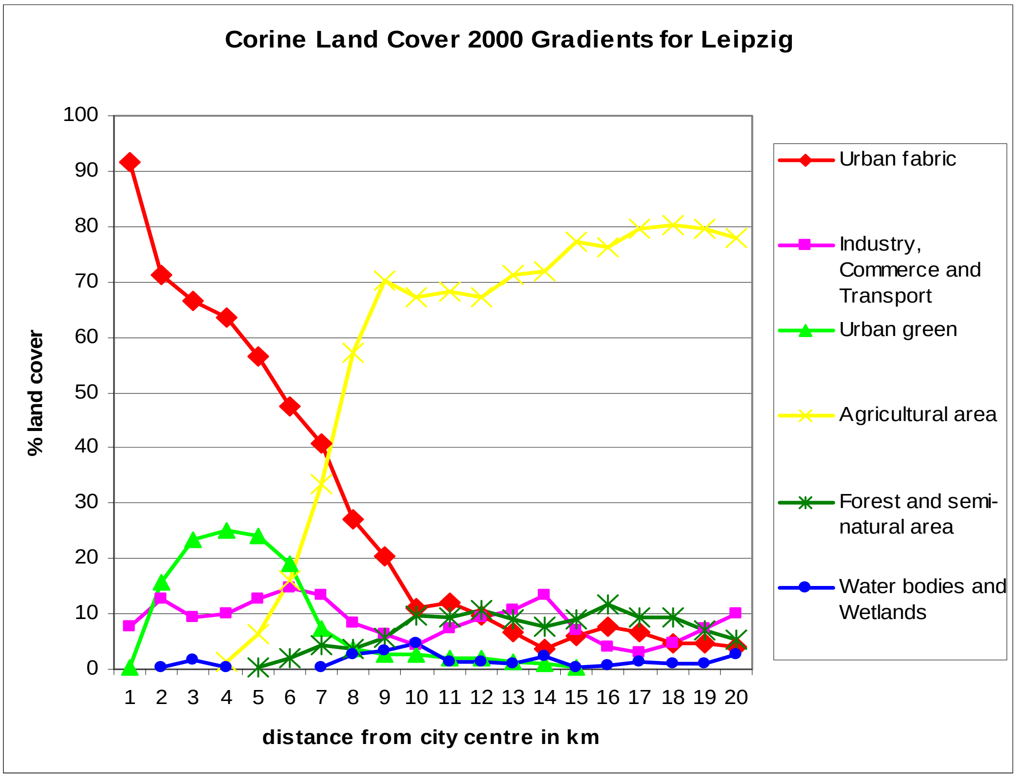

Figure 5.3: Rural-urban land use gradients for case study region Leipzig-Halle (CLC 2000).

Figure 5.3 provides an example of a rural-to-urban land use gradient for the Leipzig-Halle case study (Leipzig site) showing the steep increase of sealed surfaces towards the city centre and an increase of open land use classes with increasing distance from the city centre. Compared to the Haaglanden gradient suburbanisation is less visible. The central floodplains of Leipzig make up the major part of inner-urban green spaces at a distance of less than 5km from the city centre.

5.3 Quality of Life

The summary of the quality of life assessment for the case study region Leipzig-Halle is depicted in Figure 5.2. The overall assessment for quality of life in the whole region shows stable results for the scenarios. However, the differentiated view shows trade-offs between the quality of life related to traffic noise versus shops in the neighbourhood. This is especially visible in the peri-urban parts of Leipzig-Halle. In these parts, quality of life with respect to air quality also decreases, while the availability of public transportation increases.

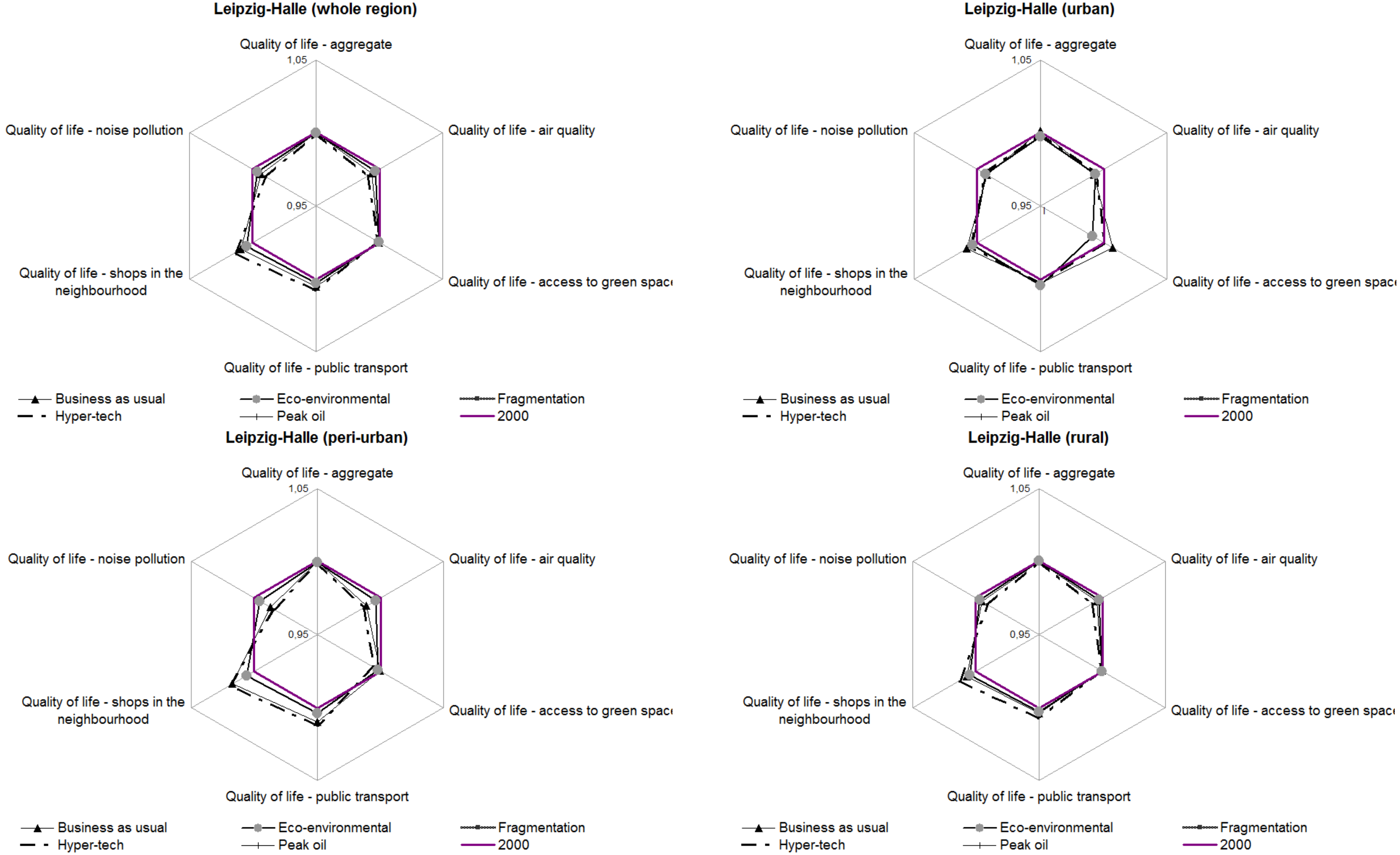

Figure 5.3: Quality of Life assessment for case study region Leipzig-Halle.

5.4 Summary for Leipzig-Halle

The results for the Leipzig-Halle case study show that a more local development with limited economic growth would improve both the provision of ecosystem services and, simultaneously, the human quality of life in different regards. A trend development seems to bring a further increase of artificial surfaces in the regions as displayed in the business-as-usual scenario. This would worse the socio-environmental conditions, particularly in the urban and inner peri-urban parts.

6 Conclusions

The results of the impact assessment show considerable differences in both provisioning of ecosystem services and quality of life in the three case study regions depending on the land use scenario. Compared to the Fragmentation, Peak oil and Eco-environmental land use scenarios with limited urban growth assumptions of further GDP and population growth as well as accelerated transport and technological development assumed in the Hypertech scenario lead to an increase of land consumption and of artificial surfaces. The provision of ecosystem services such as local climate regulation or cooling green and recreational spaces declines and the human quality of life accordingly. Land use gradients show the heterogeneity of land use patterns along the rural-to-urban gradient.

From a more methodological point of view, the spidergrams show comparisons of scenarios per case study, for whole region as well as urban, peri-urban and rural parts. The respective iIAT-Region provides an interactive design of own spidergrams by e.g. comparing same scenario for different case studies, or integrating quality of life and ecosystem services in the same diagram (see D 5.2.2).

The approach discussed in this deliverable bears great potential: a comparison and a quick visualisation of impact analysis results, even the analysis of trade-offs (one ecosystem service increases while the other decreases) and synergies. The spidergrams as well as the ecosystem services maps also show potentials of improving ecosystem services in different parts of a region. At the same time, the approach still has a range of limitation: uncertainties are not depicted, only mean values for each indicator and scenario is shown. The quantification of scenarios has been done locally, so that scenarios in themselves are only comparable in terms of storylines. The indicator selection was driven by stakeholders' needs, data availability and the like: thus, indicators only show a part of the whole picture.

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