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## Challenges and Answers of Urban Development Focusing Green Infrastructure in European Metropolises

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# Challenges and Answers of Urban Development Focusing Green Infrastructure in European Metropolises

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## Abstract

Urban sprawl is a general problem of developed countries and several European strategies highlight the importance of controlled development, compact settlements structure, and protection of ecologic values. We analyzed European metropolis regions focusing on challenges of preservation of green infrastructure and controlling urban sprawl. Vienna has protected the green spaces in and around the city for a century already. In case of Munich, the “compact-urban-green” leitmotif was implemented. Rennes created a green belt around the city, protecting agricultural land and privileges high densification and the agglomeration is planned in a polycentric model. In our comparison analysis, we would like to draw the consequences for metropolitan region of Budapest for which the state adopted an act for shaping the frames of spatial development. The Urban Atlas elaborated by the European Environmental Agency helps us to compare the land development between 2006 and 2012 in the surveyed metropolis regions.

## Introduction

For decades, the strong phenomenon of suburbanization has been consuming the natural values around cities. Urban sprawl is a general problem of developed countries. Several spatial planning, land use regulation and landscape planning tools are applied in the practice (Jaeger et al. 2010, Baing, 2010). In our research we have chosen four metropolitan regions across Europe with different, but special strategies controlling urban sprawl.

## Background and Literature Review

Urban sprawl is a general phenomenon in the developed world. In the scientific literature there are several definitions (e.g. Galster et al., Ewing et al., 2003, Jaeger et al. 2010). In most cases this term describes the phenomenon, and the process as well. According to Jaeger the common characteristics of different definitions for urban sprawl:

- the expansion of urban areas;
- the area-intensive growth which results in patches of built up areas are within the landscape;
- high land development per person.

There are different tools for controlled development and urban growth. On regional level it is inevitable to create a common platform, or cooperation for harmonized spatial development. The **European Spatial Development Perspective** already in 1999 and later, **Leipzig Charter on Sustainable European Cities** (EC, 2007) highlighted the need for guided development by pursuing the concept of compact settlement structure and building partnership (EC, 1999). For statistical reasons, to define the functional regional

units where the surrounding area (commuting zone) is highly integrated with the core city, the European Union and the OECD using population density and travel-to-work flows (OECD, 2013).

Experts argue that compact city structure has a lower spatial footprint (EEA report 2016; Ludlow 2009) but still there are some uncertainties related to social, economic and ecologic impacts (Williams, K. et al., 2000). A recent initiative is BIMBY a soft densification tool in urban planning without owning the land (Vigneron et. al. 2019).

In our research, we would like to focus on landscape planning related tools such as greenbelt, green infrastructure, and landscape protection. The Council of Europe, in 2000, adopted the **European Landscape Convention** with the aim to identify and evaluate landscapes, analyze their characteristics, and the forces transforming them, and integrating landscape into spatial policies, importance of public consultation.

Green infrastructure planning, development and maintenance of green networks, are important tools for preserving ecologic functions of peri-urban landscapes. The GI as a strategically planned network of natural and semi-natural spaces, represent a crucial approach in maintenance and development of ecosystems and ecosystem services (Benedict and McMahon, 2001; Williamson, 2003). The most important aspect in peri-urban landscapes is the multi-functional open spaces offering the integration and interaction of different services and benefits (Davies et al., 2006). The city-region level is an especially important planning scale because it represents strategic significance and is also relevant to local communities at the same time (Laforteza et.al. 2013). In the broader terms of GI, we have to highlight the greenbelts and greenways which are extremely important in peri-urban areas. Greenbelt is a very strong spatial planning tool in the UK but in Germany metropolitan regions have also defined their “Grüngürtel” (Köln, München, Frankfurt am Main etc.) more as spatial distinguishing open spaces than strict land use regulations. Vienna has a greenbelt which is among the first ones in the world. Baing argues that the more centralized planning policy and the strong instrument of green belts were more effective in controlling urban sprawl than German planning instruments (Baing, 2010). The French ‘trame verte et bleue’ (Green and Blue Network) is a spatial planning tool to conserve and restore ecological continuities (Mazza et. al., 2011, Sala 2014).

Budapest has just elaborated its Green Infrastructure Plan and the Land Use Framework Plan of Budapest Agglomeration Zone was adopted at the end of last year (2017). It is worth to analyzing and comparing the “green governance system” of other metropolis regions.

#### **Our research questions are:**

- What are the main tools and institutions of spatial management and control of urban sprawl?
- Is there any specific green belt/green infrastructure strategy in the analyzed metropolis regions?
- What is the ratio and direction of land use changes in the Functional Urban Areas?

## Methods

In our research, we analyzed and compared the answers and reactions to how Vienna, Rennes, Munich and Budapest (Table 1.) try to control urban sprawl.

**Budapest** agglomeration zone contains 81 settlements. Budapest's urban agglomeration represents 2.7% of Hungary's entire land mass and its 2.5 million inhabitants make up one quarter of the country's total population.

The case of **Rennes** (France) is unique, in order to reduce the disadvantages of the fragmented system of French local governments, inter-communal co-operations have a long tradition. Rennes has the status of *pays*, a region with common geographical, economic, cultural, or social interests. It covers four smaller intercommunal cooperation and the inter-communal cooperation zone of Rennes (*Rennes Métropole*) (<http://www.paysderennes.fr>).

**Munich** is Germany's most productive urban center. Metropolitan region Greater Munich is one of the eleven metropolitan regions in Germany covering 40% of the state of Bavaria. The Functional Urban Area (FUA) of Munich covers 185 cities, markets and municipalities.

The city of **Vienna** has the dual status of being a city and a State, but the functional area of the city goes beyond the administrative borders and covers parts of Lower Austria. Vienna is part of a cross-border integration zone: CENTROPE integrating the agglomeration zones of Vienna, Bratislava (Slovakia) and Győr (Hungary).

We analyzed the administrative and governance structure of each of the metropolitan areas. We carried out a comparative analysis of spatial strategies of the core cities and agglomeration zones or regions around the city looking for answers for the challenge of urban sprawl and protection of ecologic values. We used European datasets. The Urban Atlas elaborated by the European Environmental Agency helped us to compare the land development between 2006 and 2012 in the surveyed metropolis regions. We analyzed the ratio of changes in the case of our FUA regions and direction of changes, from natural, semi-natural to artificial or reversed.

## Results

All study areas suffer continuous loss of unbuilt areas and planners are forecasting more development. The need and prognosis for population growth is different. In spite of the fact that Rennes is the smallest agglomeration zone, it expects to double the population in the next 30 years (from 485,000 to 800,000 inhabitants) and, just for comparison, Viennese region also forecasts approximately a growth of 400,000 in population number, but has a much larger overall population. It is highly relevant what kind of tools these regions use to control urban sprawl and to guide urban development in a sustainable way.

	<b>Budapest</b>	<b>Munich</b>	<b>Vienna</b>	<b>Rennes</b>
<b>City population</b>	1.73 Million	1.54 Million	1.55 Million	216 268
<b>City area</b>	525 km <sup>2</sup>	310 km <sup>2</sup>	414 km <sup>2</sup>	50.39 km <sup>2</sup>
<b>Area of FUA</b>	6393 km <sup>2</sup>	5500 km <sup>2</sup>	9180 km <sup>2</sup>	3820 km <sup>2</sup>
<b>Regional administrative unit for agglomeration zone</b>	No	Regional Planning Association	No, just association of municipalities	Metropole region and Pays
<b>Regional plan</b>	Yes, adopted by an act	Yes, adopted by Regional Planning Association	No, but special plans by the SUM, Land	Yes, adopted by Metropole region and Pays
<b>Larger integration zone</b>	No	METROPOLITAN REGION Greater Munich with more than 5,203,738 (42% of the Bavarian population)	CENTROPE cross-border integration zone	No
<b>Planning for the agglomeration zone</b>	Land use regulation plan adopted by the state	Regional Planning Association draws up plans	Co-operation platform, plans adopted by the Land and dif. planning associations	Pays and Rennes Metropole Region draws up plans
<b>Spatial objectives City level/ regional level</b>	Compact city Control of urban sprawl	Compact, urban and green Green belt around the city	Green belt around the city	Polycentric-"Archipelago City"
<b>Special tools for controlling urban sprawl</b>	Land use restrictions by the agglomeration spatial plan, limits to growth, "land switch"	Green belt, Ökokonto	Ökokonto	Green belt Greenway BIMBY

**Table 1. General data about the study areas**

## Main tools and institutions of spatial management and control of urban sprawl

### *Functional urban area – administration – planning authority*

A very important question is whether a metropolitan governance system exists with planning responsibilities in the agglomeration zone. In many cases there is no planning authority for the functional agglomeration zone. Just in the case of Munich is the planning association equal to the area of FUA and in case of Rennes there are two planning associations. The FUA is equal to the Regional Planning Association Munich (RPV), which is the legally planned association of municipalities. The main task of the RPV is to coordinate the spatial development of the Munich region across disciplines. It draws up a regional plan for this purpose and coordinates the regional interests.

The case of **Rennes** is unique, all the *pays* and the metropolitan region has planning authority adopting strategic plans and local planning regulations. The plans and actions for the agglomeration zone were conducted by a private agency *Audiar*, which for nearly 45 years, has been a place of exchange and intermediation between the actors of planning of the agglomeration.

**Vienna** and the municipalities of Lower Austria do not have a common inter-municipal planning body due to political reasons, but they have a co-operation platform: the Vienna *Stadt Umland Management* (SUM), which was founded in 2006 and coordinates between Vienna and 60 settlements and the States (*Länder*) of which Vienna is one and Lower Austria. As Austria is a federal state, all the *Länder* have different Urban Planning Law. The SUM has no decision power as such, furthermore funding is coming equally from Vienna and Lower Austria, and covers maintenance expenses, harmonizing transport and environmental issues. Regional planning and planning between the city of Vienna and the municipalities of Lower Austria is mainly based on single projects. On greater regional level, further co-operation platforms exist as Planning Association East integrating Burgenland, Lower Austria and Vienna. The Planning Association defined a smaller functional zone the Cityregion+ (*Stadtregion+*), which contain 23 districts of Vienna, 205 municipalities from Lower Austria and 63 from Burgenland.

**Budapest** agglomeration zone does not have any regional authority, but the state defined the agglomeration zone and an act forms the framework for spatial development (Act LXIV on Spatial Planning in the Agglomeration of Budapest in July, 2005).

So, common planning activities can be found mostly in the regions of Munich, Rennes. In Vienna, there is a strong cooperation mechanism. In the Budapest region, there is more of a top-down development control.

### Special tools for controlling urban sprawl

In Metropole of **Rennes**, through land use regulations (ZAC, introduced in 1970) and cooperation between stakeholders and planners, the region controls urban sprawl. As a model initiative the BIMBY program is launched, “Build In My Back Yard”. There is a changing attitude about single-family house neighborhoods and densifying these areas by building backyard cottages is hoped to ease the pressure of greenfield investments (Vigneron et. al. 2019).

A special tool in Germany is the so called “eco-accounts” or land banking system (Ökokonto). Based on the landscape program, local communities define pre-compensation areas where ecologic compensation



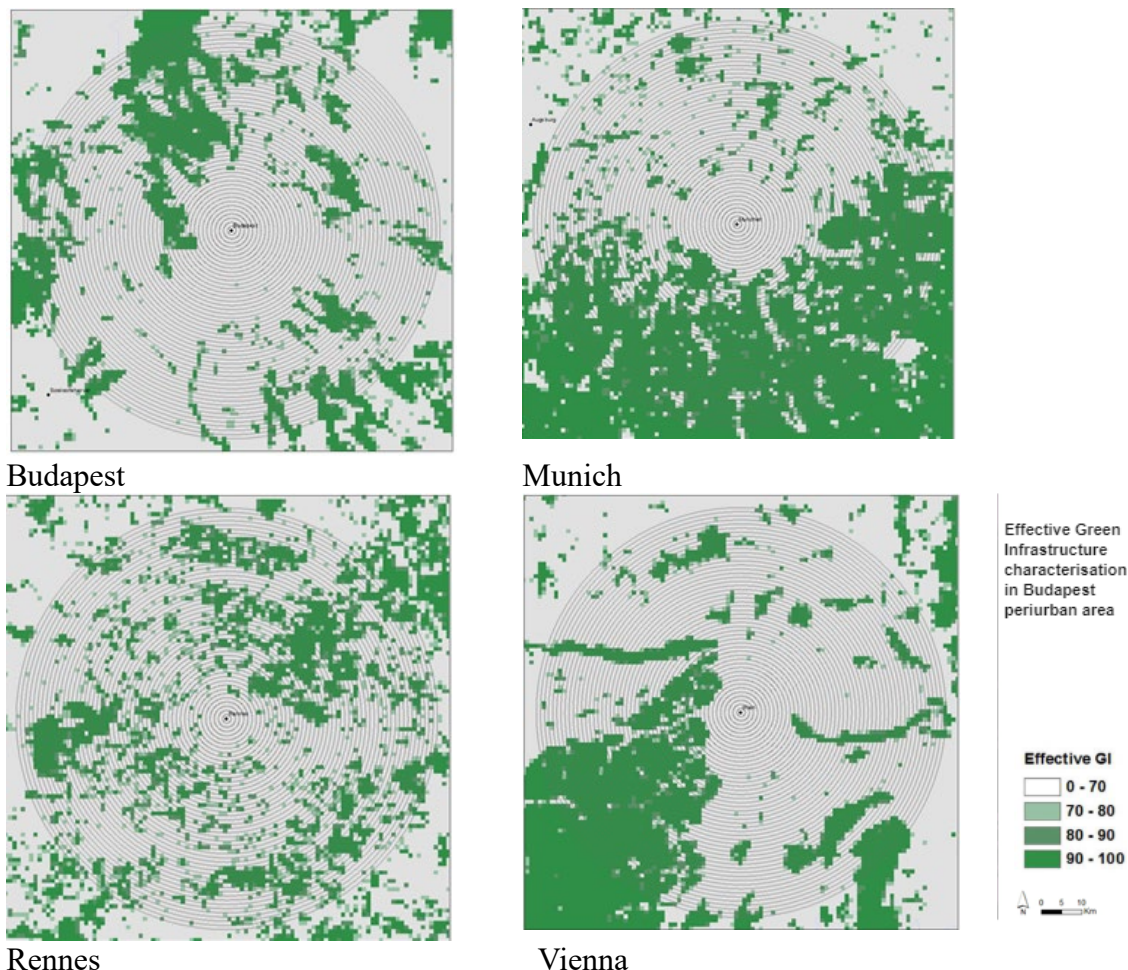
and mitigation measures can be taken; an example of such areas in **Munich** are a fenland area in the northwest to restore wetlands and small streams (Pauleit and Oppermann, 2002).

Initiated by SUM, **Vienna** and Region Lower Austria has introduced a new tool the Landschaftskonto for environmental compensation, based on the German instrument.

The spatial structure of the **Budapest** agglomeration is regulated by the Spatial Plan of the Budapest Agglomeration (BATrT). In 2011, the goal of the amendment of the BATrT was to control urban sprawl using regulatory instruments (controlling the location of new investments, limiting urban growth in 2%). As a new tool, land exchange, makes structural corrections possible.

### Specific green belt/ green infrastructure strategies

In all the analyzed metropolitan regions, the improvement of green infrastructure is a priority, although the availability of green network elements is different (Fig. 1.). In all regions, a green belt strategy exists except for Budapest, but there is a strong intention for controlling urban sprawl.



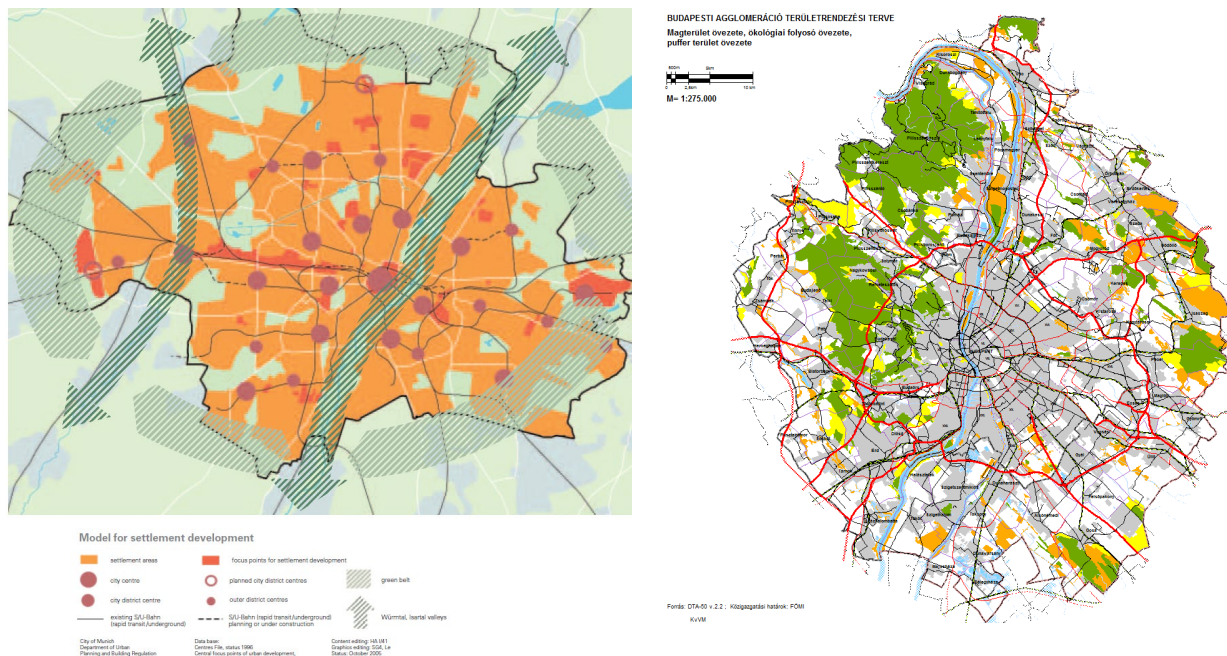
**Figure 1, Effective Green Infrastructure characterization in peri-urban areas (Effective Green Infrastructure - the potential distribution of green infrastructure in the peri-urban area, that is, the probability of finding a green infrastructure element in the territory or in the neighboring area. Source: EEA)**

**Rennes** Metropole has created a green belt to protect the agricultural lands. The city is growing with a polycentric model pursuing the goal of "Archipelago City". The Pays of Rennes has created a Green and Blue Network to protect natural heritage, the landscape and the traditional landscapes of Bocage a terrain mixed of pasture and woodlands. The city created a greenway enhancing nature and recreational possibilities in the city, and ecological corridors between waterways and river.

In **Munich** city region, the regional plan includes a landscape program. Most of the open spaces around the city are designated as green belt areas (Figure 2.a.). However, green belts are mostly an instrument to control development whereas modern farming and a variety of other economic activities are not restricted in these green belts.

The act about the spatial plan of **Budapest** agglomeration does not have special green belt concept but there are strict regulations to protect agricultural areas, forests and other natural or semi-natural areas (Figure 2.b.). During the beginning of the planning process for the spatial plan of Budapest agglomeration there was a strong intention to create a green belt strategy but it failed in the negotiation process.

The city of **Vienna** has a strict green belt regulation which is one of the oldest green belts in the world. Already in 1905, the Viennese forest and meadows belt was initiated with the protection of Wienerwald. Afterwards, step by step, smaller green areas were protected and connected into the Viennese green belt which makes up half of the territory of the city. On regional level several strategies, plans were elaborated for improvement of ecological network and habitat development but because of financial reasons, or low political weight of green development projects, these plans and problematic integration of these plans into the spatial plans are not very effective.



**Figure 2. a Green belt concept of Munich (Munich 2005), b, Ecologic Network in Budapest Agglomeration Spatial plan (green- core area, orange- ecologic corridor, yellow- buffer zone)**

Scale/ratio and direction of land use changes in the Functional Urban Areas

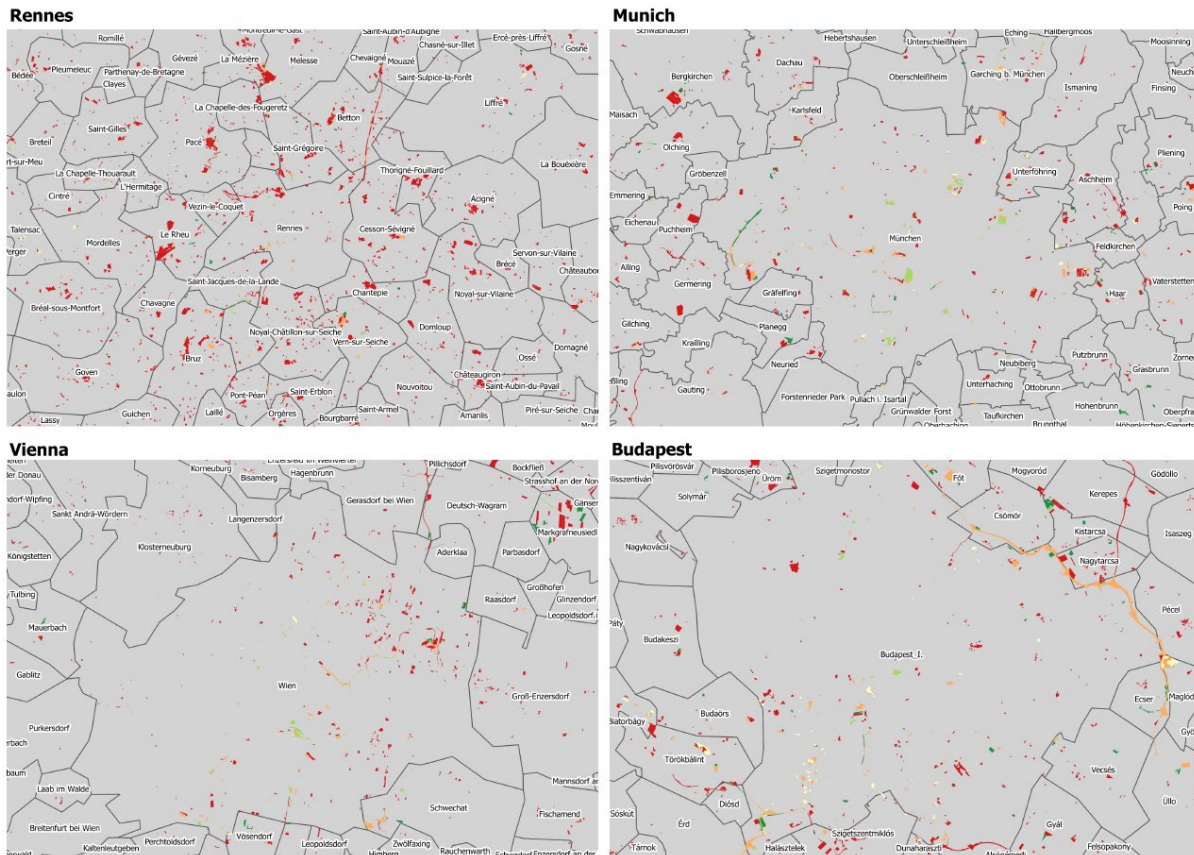
According to the Urban Atlas, the metropolitan regions are developing at different rates, but all have shown growth of urban areas. Although Rennes is the smallest functional urban area, it showed the fastest ratio of changes. In all cases, the biggest new land use type were industrial, commercial, and government types of land use, accounting for units 7-10 % of all changes (Table 2.).

FUA	SUM FUA Area km <sup>2</sup>	Total Area of change in FUA (km <sup>2</sup> )	Percentage of change in FUA (%)	1 <sup>st</sup> largest new area (km <sup>2</sup> ) Industrial, commercial, public, military and private units	2 <sup>nd</sup> largest new type by 2012	Ratio of 2 <sup>nd</sup> largest type within changes (%)	Direction of changes
<b>Rennes</b>	3820	61.759166	1.6	10.4	Discontinuous low density urban fabric	15.0	-37 846 360
<b>Munich</b>	5499	47.754149	0.9	8.4	Construction sites	10.0	-18 126 570
<b>Vienna</b>	9180	48.192647	0.5	8.5	Mineral extraction and dump sites	11.4	-26 907 350
<b>Budapest</b>	6393	53.607508	0.8	7.2	Fast transit roads and associated land	8.9	-13 794 580

**Table 2. Data based on the Urban Atlas, summarizing the changed land uses and indicator about the direction of changes (as a calculated index, the negative value shows change from natural to artificial state)**

In majority, we see changes into the developed direction (Figure 3.). Mostly the main idea is to direct the changes and new investments along the built-up areas. For example, in Rennes region the polycentric location of new investments is due to aligning them to the built up area of neighboring settlements. As rehabilitation projects or park reconstruction we can see also land use changes into natural direction especially in city areas. Around Budapest, the new track of M0 ring road is remarkable, here development is focused in Southern, Western and North-Eastern agglomeration zone.





**Figure 3. Land use changes- red- changes into developed direction, green-changes into more natural condition Source: Urban Atlas, Changes 2006-2012. EEA**

## Discussion and Conclusion

The growth of urban areas is a highly complex phenomenon depending on demographic developments, economic growth, and regulation tools. Population growth is stronger in Western-European countries; furthermore, Budapest greatly suffered during the economic recession, which slowed down the construction sector.

The analyzed city regions have different landscape conditions, different spatial planning traditions, and landscape protection has a different role in the spatial policy. The cities are in different levels of the settlement hierarchy. Rennes is much smaller than the others, but it is growing fastest. So, it is highly difficult to reveal the effectiveness of the controlling tools, although in all of the metropolitan regions controlling urban sprawl is a high priority. Mostly we can highlight the problems, but for a clearer view of the differences of the efficiency, more detailed research on a wider scale of cities and analysis of spatial planning tools of the countries, would be needed.

The implementation of effective common planning strategies is hindered by the fact that mostly the administrative regional borders do not follow the FUA or metropolitan area. Regional governance could be an important tool, in several cases we see a bottom up approach, fostering co-operation of stakeholders,

while in case of Budapest there is a strong top-down regulation. Regional co-operation platforms are glaringly missing in the Budapest agglomeration.

Unfortunately, the development controlling tools and measures have deficiencies in all countries. In spite of the fact that Germany has a very mature, hierarchical green infrastructure planning tool, that is integrated into spatial planning, experts argue that green issues seem to have a relatively low priority as compared to economic and infrastructure issues (Pauleit and Oppermann, 2002) and this is a similar problem in all countries. While a set of standards exist to provide greenspace for recreation, ecological targets are only adopted in a general way.

Green infrastructure protection and development is a crucial tool in the control of urban sprawl, especially by connecting the peri-urban and urban ecologic networks, elaborating the green belt around urban areas. It would be important to give green strategies higher priority. For the Budapest region, the implementation of a regional green-belt based on co-operation of neighboring municipalities would be important to stop the loss of peri-urban green infrastructure.

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