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KRITERIJI ZA VREDNOTENJE IN USMERITVE ZA NAČRTOVANJE NAMENSKE RABE Z VIDIKA TRAJNOSTNEGA RAZVOJA URBANIH OBMOČIJ

CRITERIA FOR EVALUATION AND GUIDELINES FOR LAND USE PLANNING IN TERMS OF SUSTAINABLE URBAN DEVELOPMENT

DOI: 10.15292/IU-CG.2014.02.024-032 ▮ UDK: 504.06 : 71 ▮ 1.02 Pregledni znanstveni članek / Scientific Article ▮ SUBMITTED: May 2014 / REVISED: June 2014 / PUBLISHED: October 2014

IZVLEČEK

Trajnostni prostorski razvoj je splošno sprejet vrednostni cilj in načelo urejanja prostora. Operacionaliziran je predvsem z ukrepi za izvedbo v predpisih posameznih sektorjev upravljanja z naravnimi viri, ne pa tudi celovito v izvedbenih predpisih za upravljanje z urbanim prostorom. Med najpomembnejše inštrumente politike urejanja prostora na lokalni ravni sodi namenska raba tal, za katero ni opredeljene celovite sistematizacije ukrepov za uresničevanje trajnostnih ciljev prostorskega razvoja v urbanih območjih. Skladno s pregledom in kritično analizo literature so v prispevku predstavljeni štirje ukrepi: zaščita naravnih virov in zmanjševanje okoljsko-podnebnih tveganj, strnjena urbana struktura, mešane rabe in dostopnost urbanih funkcij. Izkazalo se je, da našteti ukrepi omogočajo trajnostni razvoj urbanih območij, vendar le pod pogojem, če se načrtujejo in izvajajo skladno s podpornimi prostorskimi, socialnimi in ekonomskimi elementi urbanega prostora. V sklepu je predstavljen nabor kriterijev, s katerimi lahko ovrednotimo stopnjo trajnosti zasnove namenske rabe v urbanih območjih ter usmeritve za prestrukturiranje namenske rabe obstoječih poselitvenih območij.

KLJUČNE BESEDE

trajnostni prostorski razvoj, urbani prostor, raba tal, naravni viri

ABSTRACT

Sustainable spatial development is a generally accepted objective and principle in spatial planning. It is implemented mainly by regulations in the sectors for management of natural resources, but not comprehensively in implementing regulations for urban space management. One of the most important instruments of spatial planning at local level is land use, for which there is no comprehensive framework of implementing measures for achieving sustainable spatial objectives in urban areas. In accordance with the review and critical analysis of literature, there are four measures presented in the paper: protection of natural resources and reduction of environmental-climate risks, compact urban structure, mixed-use and accessibility of urban functions. The review and analysis have shown that the listed measures enable sustainable development of urban areas, but only if they are planned and implemented in accordance with supporting physical, social and economic elements of urban space. In the conclusion, indicators which can assess the level of sustainability in land use design are presented and guidelines for restructuring land use in existing settlement areas are described.

KEY-WORDS

sustainable spatial development, urban space, land use, natural resources

1. INTRODUCTION

Sustainable spatial development has become a generally adopted value system and compulsory format of all planning interventions, yet it hasn't been neither defined nor standardised. Fons et al. (2010) emphasise that the concept of sustainable urban development in most cases does not have clearly defined empirical and conceptual baseline. Therefore it is difficult to determine objectively measurable and comparable data, which could evaluate status and trends in terms of sustainable development. Sustainable spatial development is defined as strategic objective in a number of international, European and national documents, such as: Agenda 21, the Habitat Agenda, Rio +20, the Lisbon Strategy, the European Sustainable Development Strategy, the Europe 2020 Strategy, Spatial Development Strategy of Slovenia (Zavodnik Lamovšek, 2003; Rebernik, 2008; Perez--Soba et al., 2012). Sustainable spatial development objectives are operationalized through measures to be realised mainly in the sectors of natural resources management (biodiversity, soil protection, water protection, agriculture, etc.), but not comprehensively and adapted to management of urban space. The problem of sustainable urban development can therefore be defined as deficiency of links between global strategic objectives and a comprehensive system of implementing measures and control criteria for regulating urban space at local level.

Among the most important instruments of spatial planning at local level, according to Pogačnik (1999), is land use. This instrument coordinates protective and developmental aspects of spatial-environmental, social and economic development of urban areas. Land use defines areas for (Perez--Soba et al., 2012):

- agriculture, forestry and exploitation of natural raw materials, which are traditionally economic categories of land use;
- nature conservation, natural resources and rural tourism as predominantly protective categories of land use;
- areas for settlements, transport and municipal energy infrastructure as predominantly urban land use.

According to Rydin (2011) land use is defined in a multi-disciplinary process and participation of lay and professional publics, whereby the interests of various stakeholders are made instrumental in planning documents. The starting point of the process should be stimulation of local well-being and economic prosperity, while the result is the definition of areas of different land uses, which accelerate their mutual positive effects, diminish negative effects and increase the economic value of land.

However, the characteristics of land uses in today's cities are different. According to a number of authors (Rebernik et al., 2008; Fons et al., 2010; Rydin, 2011) they are dominated by dispersed urbanization, extensive monoprogramic areas and fragmented areas of natural habitats which cause a number of environmental, social and economic problems, such as: high consumption of resources, environmental pollution, suburbanization, inefficient mobility, high cost of public infrastructure, social stratification, etc.. Many spatial models and best practices in sustainable spatial development are described in professional and scientific literature, but they are not systemised or methodologically introduced into a day-to-day urbanistic practice (see also: Williams et al., 2001; Mostafavi and Doherty, 2010; Meijer et al., 2011). The purpose of the article is therefore to systematically review and critically analyse expert and scientific literature in order to identify comprehensive measures for achieving objectives of sustainable spatial development by instrument of land use.

Spatial measures in the instrument of land use which enhance sustainability are (see e.g. Williams at al., 2001; Marušič and Mlakar, 2004; Park and Andrews, 2004; Plut, 2006; Pogačnik et al., 2006; Rebernik et al., 2008; Zavodnik Lamovšek et al., 2008; Garcia et al., 2012):

- safeguarding of natural resources and diminishing environmental-climate risks;
- compact urban structure;
- mixed use;
- accessibility of urban functions.

The article argues that the listed measures are efficient only when planned and implemented into urban areas together with supporting spatial, social and economic measures (see e.g. Gehl et al., 2006; Goličnik et al., 2008; Rydin, 2011; Leduc and Van Kann, 2013).

Based on the reviewed literature, the article first presents the concept of sustainable spatial development and its effect on land use planning, and then outlines particular underlying measures. Each measure is described and critically analysed from the perspective of achieving sustainable impacts on natural environment and urban space. A set of criteria which can be applied to assess the level of sustainability of land use in urban areas and guidelines for restructuring land use in extant settlement areas conclude the article.

2. DEFINITION OF SUSTAINABLE SPATIAL DEVELOPMENT AND ITS EFFECTS ON LAND USE PLANNING

In their concept of sustainability and equilibrium, Pogačnik et al. (2006) distinguish four aspects:

- environmental aspect, focusing on the functionality and capacity of natural equilibrium, orientation to environmental carrying capacity, safeguarding of natural resources, sustainable exploitation of natural resources and preservation of landscape variety;
- social aspect, manifested by changes in societal values, inter- and intra--generational justice, ensuring levels of sufficiency, increasing qualitative aspects of social welfare (e.g. health, quality of life, social justice, landscape variety);
- economic aspect, which is conditioned by safeguarding of natural resources and manifested by balanced economic growth and level of exploitation of natural resources, increasing efficiency of economic development, ensuring specific levels of self-sufficiency, stimulating circular economic development which reduces the use of natural resources and replaces them with continuous recycling of waste products;

- cultural aspect, which is seen as respect for cultural particularities, safeguarding regional identity and cultural variety.

As it is evident from the objectives listed the sustainable spatial development is possible through intertwining actions at all levels of urban space. It is a complex and interdependent network of elements and corresponding measures. Čerpes (2010, p. 108) states: "The sustainable city/.../ is not a physical phenomenon or spatial form. It is a social process of constant, gradual realisation of sustainability goals, nature- and humanity-friendly development in all aspects of social life".

Becker et al. (1997 in: Kos, 2004) defined the relations between environmental-spatial, socio-cultural and economic factors with the concept of three levels of sustainable development that have to be observed simultaneously: analytical, normative and strategic. The analytical level brings empirical measuring of consequences of societal actions on the use of natural resources and carrying capacity of the natural environment, the normative level checks the level and mode of societal responses to these findings, while the strategic level defines goals and measures for achieving sustainable development. Kos (2004) points out that interpretation of sustainable development must (ibid., p. 335): "/.../ also consider the 'motivation capacity' of humanity, which encompasses both cognitive and value-related dimensions. Therefore for the enforcing of 'sustainable development' it is of utmost importance to 1) structure very complex ideas and 2) achieve concordance on the dynamics of introducing new, inevitable measures." These findings give a clear answer to the question why sustainable development cannot be globally standardised. It can be standardized on the analytical level, where the level of burdening of natural environment can be measured empirically, but when it comes to societal responses (normative level) or the definition of achieving goals and strategies (strategic level), these are conditioned by their pertaining socio-cultural-economic environments.

Picture 1: Scheme for sustainability principles of urban areas by the method of urban metabolism (adapted from Meijer et al., 2011)

Despite the complexity and mutual interdependence of components in sustainable cities the article focuses on its spatial-environmental level and impacts on natural resources. Sustainability performance of urban area in terms of burdening natural resources can be evaluated by the method of urban metabolism. Spatial-structural parts of the city are defined as flows of energy and material, which demand inputs of energy and material and produce a defined quantity of products – material and energy emissions. Sustainable development demands reduction of burdening of natural resources, therefore cities pursuing the sustainable course have to diminish quantities of energy-material inputs and efficiently use energy from renewable sources. Thus the quantity of energy-material products is diminished and also returned to the system as recycled – secondary inputs (Plut, 2006). According to Meijer et al. (2011), energy-material inputs which are necessary for the functioning of urban systems are water, soil, energy, resources or raw materials, while the products are hard waste and emissions into the air, water and soil, which directly pollute natural resources (picture 1). Inefficient use and pollution of natural resources decrease the suitability of the environment for settlement and carrying capacity for the functioning of the urban system. They also have negative economic consequences because of the necessary investment in remediation of environmental damages and negative effects on the health of population.

The variable which can evaluate the amount of inputs into the urban system, the processes within and the quantity of products is the use of energy (Liu et al., 2009; Pincetl et al., 2012). The indicator of energy use in urban areas is objective when calculated with the LCA method (Life Cycle Assessment), which provides control over environmental impacts of cities on the local and global levels (Liu et al., 2009).

The article proposes principles of land use planning, which we have, following Becker, grouped at the analytical level of sustainable development. They diminish the burdening of natural environments, i.e. they preserve the environment's natural potential, enable rational use of land, decrease the use of energy, water and materials and cause less pollution.

3. PRINCIPLES OF SUSTAINABLE LAND USE PLANNING IN URBAN AREAS

3.1 Safeguarding natural resources and diminishing environmental-climate risks

Safeguarding and efficient management of natural resources and potential environmental risks were amongst the first measures when environmental-sustainability aspects were introduced to spatial planning. In member states of the European Union they are officially adopted within national legislative frameworks. In Slovenia safeguarding conditions are stipulated for drinking water aquifers, aquatic areas, agricultural land and forests, areas with natural values, flood plains, landslides and for the exploitation of natural resources. Many authors criticise the departmental and regulatory approach, since the quality and dynamics of ecosystems are not sufficiently observed, nor is placing activities optimised (e.g.: Williams et al., 2001;

Marušič and Mlakar, 2004; Carter et al., 2005). Marušič and Mlakar (2004) estimate that effective and comprehensive spatial planning is possible only through the assessment of space for safeguarding and development of particular spatial elements, which can be provided by analytical spatial planning tools, such as e.g. the vulnerability analysis.

In the evaluation analysis of protection and development of spatial features the following should be considered (Williams et al., 2001; Marušič and Mlakar, 2004; Carter et al., 2005; Pogačnik et al., 2006; Vrščaj and Vernik, 2010; Garcia et al., 2012):

- elements of nature protection: legally protected natural areas, landscape and ecosystem functions of the environment, connectivity and integrity of natural habitats;
- elements of nature protection as natural resource: forest areas, areas of surface and underground waters, areas for food and biomass production, safeguarding soil for its environmental role in matter-energy cycles, areas for exploitation of the renewable energy sources and the natural resources;
- elements of quality of living: mitigation of environmental risks (floods, storms, landslides, droughts, explosions, fires) and climate change mitigation.

The issue of climate change and connected risks isn't dealt with adequately in spatial planning. Urban planning can be instrumental in alleviating the causes and consequences of climate change. The cause demands a global measure: decrease in use of fossil fuels. Land use planning can affect changes in use of energy for transport, construction, use and maintenance of buildings and utilities-energy infrastructure. The consequences of climate change demand local measures, adapted to local climatic conditions and scenarios of climate changes. According to Kajfež Bogataj (2012) urban planning in Slovenia has to predict measures to:

- decrease temperatures of urban heat islands in the summer,
- retain precipitation and flood water,
- prevent consequences of higher sea levels in coastal areas,
- manage water supply for the population and for agriculture,
- adapt to decreased quantity of snowfall in the winter.

In the research project Adapting to climate change with spatial planning tools, Golobič et al. (2012) developed a method of analysing vulnerability of space to climate change and standing spatial measures for adaptation to climate change.

3.2 Compact urban structure

Compact or dispersed urban areas are determined by physical (morphological) and functional characteristics. Galster et al. (2001 in: Fons et al., 2010) have identified a dispersion of urban areas with low levels of some of the eight parameters: density, connectivity, concentration, clustering, centrality, nuclearity, mixed-use and proximity. Physical compactness depends on spatial distribution of land uses, while the functional depends on density and mixing functions. Zavodnik Lamovšek et al. (2008) define also population density as a criterion for compactness of urban areas. The authors have developed a methodology for defining borders of compact urban areas, which is an operational planning tool for preventing dispersed urbanization.

The effects of compactness of urban areas on the use of natural resources, particularly energy use, are subject to numerous studies. Park and Andrews (2004) proved that the use of energy for transport decreases when urbanised areas are more compact, when higher variety and density of urban functions, housing and work places is ensured (mixed use) and positioned at shorter distances (accessibility to urban functions). The authors establish that negative effects of increased car-mobility cannot be dispatched only by technical innovations (hybrid vehicles, cleaner technologies, intelligent information systems on the transport network, etc.). However, Fons et al. (2010) point out that the difference between energy use in transport is essential only in extreme urban patterns of compactness and dispersion. They note that the impact of land use on energy use in transport and consequently on air pollution is strongly conditioned by the effectiveness of public transport, the corresponding density of population, local geographic and climatic conditions.

Prevalent strategies for preventing urban sprawl are reuse of degraded urban areas, quality densification of housing estates and compact development of already urbanised areas (Koželj, 1998; Rebernik et al., 2008; Garcia et al., 2012). Strategies of contemporary sustainable cities are directing development into corridors with high-capacity, competitive public transport, with the nodes of programmatically self-sufficient compact urban areas (Šašek Divjak, 2004).

Inner city development can also have negative effects. In the research on effects of density on sustainable urban development Dempsey et al. (2012) conclude that in the compact city model it is necessary to establish optimal population densities with short distances to sufficiently large open green areas. They advocate that the compact city model is not universal and has to be adapted to local contexts. Urban regeneration of inner city areas is also much more demanding and complex than building on greenfield areas. It has to be promoted by land tax policy and public co-investment. According to Rebernik et al. (2008), land policy determines taxation levels, which stimulate development of degraded areas and hinder development on greenfield sites on the urban fringe.

Rydin (2011) defines two models of urban regeneration: the free market and the social model. In the free market model the city or state initiates development of urban degraded areas with public investments into remediation of pollution, providing high quality public spaces and constructing public facilities. The goal is to attract private investors, who would invest and exceed the share of public funding, thus trigger a process of increasing land and property values. Within this approach it is important to initiate private ventures by public investments, while insuring the needs of local community are met within the spatial plan and partly financed by profits of private investors. The social model is based on a 'bottom-up' approach and active participation of local community. This approach also requires an

active public sector, especially for direction and coordination. It differs from the first model mainly in the regeneration rationale, which grows from local community needs and not private investment agenda. Public finance mechanisms of urban regeneration should stimulate the development of local economy, for example the establishment of time banks for non-monetary exchange of services, urban farming which stimulates healthy food and sale of low-priced food products, micro-crediting schemes for the development of small entrepreneurial initiatives for the financially less-capable groups, initiatives for renewable energy sources, improving the energy performance of buildings, waste recycling, etc. The goal of such projects is economic regeneration of the local population with their own activities and local resources, often underestimated and overlooked in classical market systems. Besides their economic role, non-profit activities have a significant social role and contribute to co-creation of communities and alleviation of social tensions.

3.3 Mixed use

Functionally compact urban areas imply adequate density, variety, disposition and distances between urban functions. Higher levels of functional compactness are ensured by mixed use, which includes housing, offices, retail, services, cultural, sports, administration and production programmes in functional entities and with respect to the needs of local age and social groups and cultural characteristics of the area (Dempsey et al., 2012). Contrary to mono-programmatic positioning of retail and employment capacities on the urban fringe, mixed use physically and socially enriches the urban structure and has synergetic social, economic and environmental effects. Mono-programmatic areas increase car mobility (Uršič, 2006) and also induce the closing of shops and services in urban centres. Plut (2006) states that research conducted in Great Britain in the 1990s proved that the market share of city centres decreased by up to 70 percent after out of town shopping centres were developed.

The execution of planned mixed use areas in cities has been put in the domain of market mechanisms, and is therefore largely dependant on the regulation of mono-programmatic areas and the scope of possibilities enabled by planning documents for realising market interests of investors. Rebernik et al. (2008) state that the effects of defined mixed use in plans can be optimal only if a main activity is proscribed, coupled with complementary or additional and/or dedicated uses. Mixing and variety inevitably cause conflicts (Goličnik et al., 2008), therefore it is necessary to check the mutual effects of activities beforehand. However, the vicinity of compatible functions increases economic activity and has positive effects, but only if optimal settlement density is maintained, which ensures adequate demand and economic viability of programmes (Mladenovič, 2011). Gehl et al. (2006) claim that public programmes should be positioned on the city ground floor and connected to the network of public open areas intended for pedestrians and cyclists, previously relieved of parked and moving cars. Such areas are conditioned by good accessibility and sustainable mobility modes, i.e. cycling, walking and public transport.

From the technical point of view, mixed use is the primary condition for achieving cost efficiency of systems for distant heating or cooling, which require 24-hour operation. The present technical approach to mixed use is their material-energy balance, whereby waste and surplus energy are used as resources. In the study EU-LUPA European Land Use Patterns (Garcia et al., 2012) the measure is proposed as a policy instrument to increase sustainable land use in regional and urban scale, especially for areas with a high degree of urbanization and large environmental footprint. The described approach requires a new multidisciplinary and comprehensive approach to energy and urban planning as well as management of urban space.

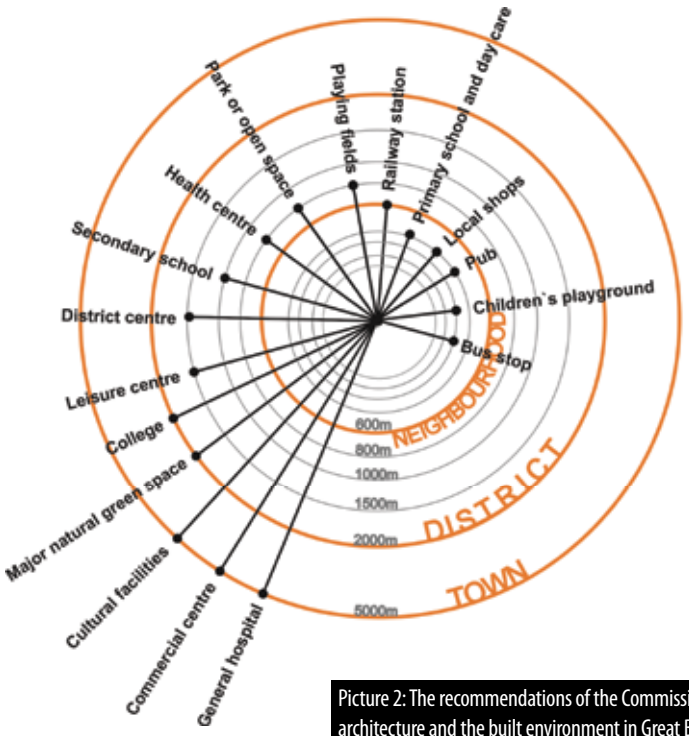
3.4 Accessibility of urban functions

Sustainability as the concept for planning transport systems has changed the rationale from enabling mobility for motor cars to ensuring accessibility to programmes by sustainable transport modes, i.e. walking, cycling and public transport (Bertolini et al., 2005). Sustainable mobility is not only a change in travel patterns in the city. It is the result of integrated planning of programmes and transport systems, with emphasis on non-car forms of transport (Aftabuzzaman and Mazloumi, 2011). Vale (2013) states that such spatial development in itself is not sufficient and has to be supported by complementary measures, which will stimulate users to change their travel habits. An important measure for increasing sustainable mobility is the limiting of car mobility, but as Uršič (2006) points out, such measures, e.g. extending pedestrian areas, higher parking rates, reducing the quantity of parking spaces, etc. have the opposite effect and limit city development if not balanced with alternative modes of public transport, which enable access of people, goods, information and capital to an urban area.

According to Curtis (2008), activities vary in frequency of use and size of gravitational areas of users, from neighbourhoods, urban quarters, to the city and region. Gehl at al. (1987 in: Curtis, 2008) emphasises that planning of land use, programmes and transport systems have to take onboard the notion that all activities have to be accessible by sustainable transport systems, according to Bertolini et al. (2005), within half an hour travelling time. In the recommendations of the Commission for architecture and the built environment in Great Britain, accessibility to functions (picture 2) is determined according to distance, quantity of potential users and frequency of the programme's use (Internet 1):

- on the neighbourhood level: public transport stops (300 m), children's playgrounds (400 m), primary school with day care (400 m), local shop (400 m);
- on the city quarter level: railway station (600 m), sports fields for ball games and recreation (800 m), parks (800 m), health care centres (800 m), secondary schools (1 km), district centres (1,5 km), leisure centres (1,5 km);
- on the city level: faculties (2 km), larger natural open areas (2 km), cultural institutions (5 km), large retail - commercial centre (5 km), general hospital (5 km).

In Copenhagen, the so called pocket parks, covering up to 5000 m^2, are distributed throughout the city perimeter, thus allowing the inhabitants access to green surfaces at a walking distance of five minutes, i.e. at a



Picture 2: The recommendations of the Commission for architecture and the built environment in Great Britain for accessibility of urban functions (adopted by Internet 1)

distance of less than 300 m (Internet 2). Different norms concerning accessibility in Copenhagen (300 m) and Great Britain (800 m) follow socially acceptable norms and point out the differences in normative or strategic levels of sustainability, as was also mentioned by Becker et al. (1997 in: Kos, 2004). Different norms are a consequence of varying cultural, social and economic environments, as well as prevalent values and life patterns. Thus they cannot be transferred from one environment to another and have to be adapted to local contexts.

4. CONCLUSION

In accordance with the reviewed literature, we find that land use planning for sustainable urban development has to take into account the following principles:

1. Sustainable spatial development in terms of protecting natural resources requires minimising energy use in all life situations of inhabitants and life-cycle stages of products or services.

2. Energy consumption in urban areas is indirectly conditioned by the land use structure, which affects energy use in transport, construction and use of buildings as well as in construction and maintenance of communal-energy infrastructure.

3. Parameters of land use structure which reduce energy consumption in urban areas are: compact urban structure, mixed uses on the level of building blocks and city districts, accessibility of urban functions by sustainable mobility systems, protection of natural resources and mitigation of environmental-climate risks.

Established categorization of land uses and mixed use principles based on functionality, compatibility and exclusion of negative factors needs to be upgraded by energy efficiency criteria. This is important both in terms of shorter travel paths for transport of goods and people, as well as shorter distances between energy production and end-users. An important aspect is also local and efficient re-use of waste products, i.e. materials, energy, and water.

This type of land use regulation and deployment of urban functions is established, for example, in:

- Denmark, where for the past 20 years legislative regulations have prevented the development of hypermarkets on the outskirts of the city; commercial areas are channeled into shopping complexes in the city and local centers (Internet 3);
- the UK, where legislative regulations stipulate that at least 70% of public investment (public facilities, housing, etc.) has to be situated in degraded urban areas (Williams, 2010);
- Copenhagen and Zürich, where incinerators are designed as the central city facility for heat - electricity production and are placed at the edge of the city center due to efficient energy transport. In Copenhagen the roof of the incinerator is designed as a ski slope which will provide the inhabitants of the city with unique opportunities for winter recreation and enrich the urban social infrastructure (Internet 4);
- the Netherlands, where in the town of Kerkrade leisure and mixed use programmess are planned to be inserted into the existing industrial area in order to increase density of built structures, provide the missing programmes within walking distance to the adjacent residential neighborhood and to effectively recycle waste energy, water and materials (Leduc and Van Kann, 2013).

Sustainable urban development requires properly managed programme contents (picture 3) and structural characteristics of land use patterns (picture 4). Considering the programme content, it is necessary to ensure diversity and density of programmes that allow residence, employment and spending leisure time for different social and age groups as well as combine programmes that efficiently recycle waste materials, water and energy. Daily functions (kindergarten, school, shop with basic supplies, public transport stops, playground) need to be located within a walking distance of 400 - 800m, access to other programmes should be provided within a half-hour distance by bike or public transport. Structurally it is necessary to manage land use patterns from: dispersed to compact, from monofunctional to functionally mixed, from large-grained[1] to fine-grained, from sparsely connected into densely connected. An important aspect of

1 Grain structure is by Koželj (1990) defined as the ratio between the number of parts and the area of the structural field.

Picture 3: The programme content of land uses that increase the level of sustainability in urban areas (source: authors)

sustainable urban development is also protecting natural resources and mitigating environmental-climate risks by natural environments, which are reflected in the interweaving and connectivity of natural areas in the settlement area.

Based on the analysed research and studies we can define the guidelines for sustainable planning or restructured land use in urban areas:

compact urban areas with mixed use and sustainable accessible urban functions can be effectively developed on spatially limited territories, where a 30-minute access by bicycle or public transport can be ensured;

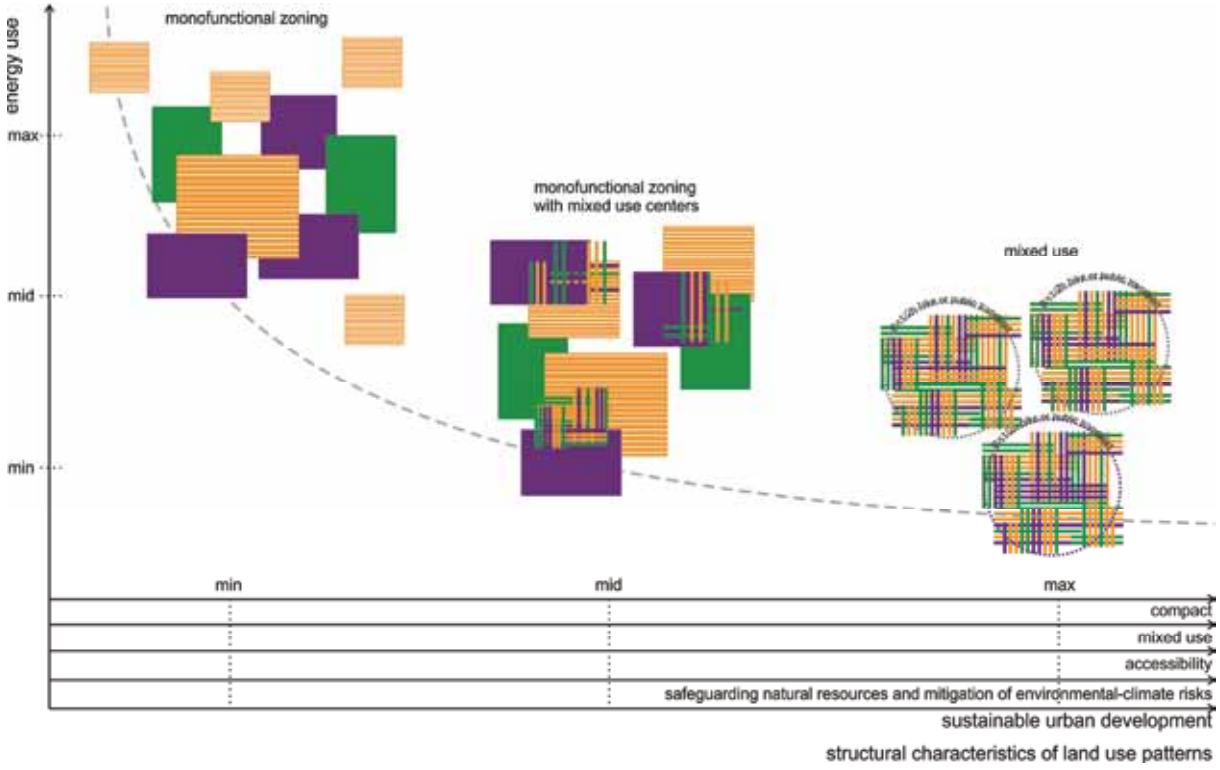
larger urban areas should be restructured into a network of programmatically autonomous "medium-sized" cities, defined by the half-hour isochronous accessibility with sustainable mobility systems and interconnected with efficient public transport systems;

smaller and less densely populated urban areas should be oriented towards integrating into the before mentioned spatial-programmatic-transport structure or a new model of efficient public transport should be developed, which would be adapted to a lower quantity of spatially dispersed users in a functional region.

Achieving sustainability goals by land use restructuring as described above is conditioned by planning and implementation of supporting spatial, social and economic measures. Supporting spatial measures are:

- providing optimum population density, which enables viability of commercial programmes and public social, transport and utility infrastructure, i.e. at least 50 dwellings / ha (Power, 2004), and at the same time provides access to sufficiently large open green spaces at short distances;
- allocating settlement areas, urban functions and mixed-use onto the network of cycling routes and stops of effective public transport;
- regulating high quality public open space in mixed-use areas.

At the same time it is necessary to carry out social support measures which affect travel and consumer habits of the inhabitants, to promote public



Picture 4: Structural characteristics of land use patterns as a function of energy use and the level of sustainability of urban areas (source: authors)

participation in the development of local environment and provide a proactive approach of public administration in revitalizing degraded urban areas. Two models of proactive approach are possible. In the market model of urban renewal, a city or a country initiates the development of degraded areas through public investments into public infrastructure, public space and public institutions. Its aim is to attract private capital to generate the process of enhancing property values and good quality of urban space. In the social model, public investments stimulate development of local entrepreneurship in order to economically regenerate local population, alleviate social problems and reintegrate the community. Other economic support measures include land, tax and investment policies that foster internal development of brownfield sites and inhibit the development of dispersed settlement and monoprogrammatic commercial and business areas on the outskirts of the city.

The discussion in the article proves that sustainable land use planning in urban environments can have positive environmental, spatial, social and economic effects, the condition being that it is introduced to the planning and implementation process harmonised with support measures and adapted to the local context. It also proved that there is a lack of measurable planning and defined target values for compactness of urban areas, mixed uses and accessibility of urban functions as well as interdependent supportive measures, such as densities, which would support planning decisions concerning sustainable land use design in urban areas.

English lector: dr. Lara Burazer, prof.ang.

ACKNOWLEDGEMENTS:

The article presents part of a research, which started in 2012 within the doctoral study at the Faculty of architecture, University of Ljubljana and the framework of the research programme P4.0085 Applicative botanics, genetics and ecology at the Biotechnological faculty, University of Ljubljana. The research is supported by the European social fund of the European Union. Co-financing is conducted within the Operational programme Human resources development for the period 2007-2013, 1st development priority: Supporting entrepreneurship and adaptability, priority axis 1.3 scholarship schemes. Herewith we express our gratitude to prof. Lars Bylund for his help and advice.

LITERATURE AND SOURCES:

Aftabuzzaman M., Mazloumi, E. (2011). Achieving sustainable urban transport mobility in post peak oil era. Transport Policy, vol. 18, 5, pp. 695–702. DOI: 10.1016/j.tranpol.2011.01.004

Bertolini, L., le Clerq, F., Kapoen, L. (2005). Sustainable accessibility: a conceptual framework to integrate transport and land use plan – making. Transport policy, vol. 12, 2, pp. 207–220. DOI: 10.1016/j.tranpol.2005.01.006

Carter, N., Kreutzwiser, R.D., de Loe, R.C. (2005). Closing the circle: linking land use planning and water management at the local level. Land Use Policy, vol. 22, 2, pp. 115–127. DOI: 10.1016/j.landusepol.2004.01.004

Curtis, C. (2008). Planning for sustainable accessibility: the implementation challenge. Transport policy, vol. 15, 2, pp. 104–112. DOI: 10.1016/j.tranpol.2007.10.003

Čerpes, I. (2010). Preizkus za trajnostno mesto. Dialogi (Maribor), vol. 46, 7/8, pp. 99–114.

Dempsey, N., Brown, C., Bramley, G. (2012). The key to sustainable urban development in UK cities? The influence of density on social sustainability. Progress in Planning, vol. 77, 3, pp. 89–141.

Fons, J., Simon, A., Kleeschulte, S., Gregor, M. (2010). Environment in European cities -"sustainability" (Chapter 1). In : FOCI: Future orientations for Cities, pp.16 - 49. Reasearch report, version 15/12/2010. Accessed on March 3rd 2014, webpage: http://www.espon.eu/main/Menu_Projects/Menu_AppliedResearch/foci.html

Garcia, G., Feliu, E., Tapia, C. (2012). Policy Options and Recommendations. In: EU-LUPA European Land Use Patterns (Chapter 3). Reasearch report, version 01/06/2012. Accessed on February 28th 2014, webpage: http://www.espon.eu/main/Menu_Projects/Menu_AppliedResearch/EU-Lupa.html

Gehl, J., Gemzoe, L., Kirkneas, S., Sternhagen, B. (2006). New city life. Copenhagen: The Danish Architectural Press.

Goličnik, B., Nikšič, M., Repič Vogelnik, K., Mujkić, S., Tominc, B., Uršič, M. (2008). Povezovanje kriterijev in ukrepov za doseganje trajnostnega prostorskega razvoja mest in drugih naselij v širšem mestnem prostorsu (no. V5 - 0302): Urbanistični kriteriji. Reaserch report, vol. 2. Ljubljana: Urbanistični inštitut RS.

Golobič, M., Praper Gulič, S., Gulič, A., Cof, A. (2012). Prilagajanje podnebnim spremembam z orodji prostorskega načrtovanja: Ocenjevanje ranljivosti sektorjev in prostora za podnebne spremembe. Ljubljana: Ministrstvo za okolje in prostor, Direktorat za prostor.

Internet 1: Commission for architecture and built environment. Accessed on November 25th 2012, webpage: http://webarchive.nationalarchives.gov.uk/20110118095356/http://www.cabe.org.uk/case-studies/hammarby-sjostad?photos=true&viewing=776

Internet 2: European green capital. Accessed on November 24th 2012, webpage: http://ec.europa.eu/environment/europeangreencapital/wp-content/uploads/2012/07/Section-3-green-urban-areas_Copenhagen.pdf

Internet 3: Cities for people, a blog by Gehl Architects. Accessed on May 15th 2014, webpage: http://gehlcitiesforpeople.dk/2014/04/22/hypermarkets-belong-to-the-past/

Internet 4: webpage Bjarke Ingels Group. Accessed on May 18th 2014, webpage: http://www.big.dk/#projects-arc

Kajfež Bogataj, L. (2012). Vroči novi svet. Ljubljana: Cankarjeva založba.

Kos, D. (2004). Tri ravni trajnostnega razvoja. Teorija in praksa (Ljubljana), vol. 41, 1/2, pp. 332–339.

Koželj, J., Capuder T. (1990). Metodologija priprave prvin urbanističnega oblikovanja velikih prostorskih meril kot sestavnega dela urbanističnih oziroma krajinskih zasnov. Ljubljana: Univerza v Ljubljani, FAGG.

Koželj, J. (1998). Degradirana urbana območja. Ljubljana: Ministrstvo za okolje in prostor, Urad RS za prostorsko planiranje.

Leduc, W.R.W.A, Van Kann, F.M.G. (2013). Spatial planning based on urban energy harvesting toward productive urban regions. Journal of Cleaner Production, vol. 2013, 39, pp. 180–190. DOI: 10.1016/j.jclepro.2012.09.014

Liu, J., Matsumoto, T., Xue, Y. (2009). Applicability of Emergy analysis method to indicators for sustainable development by comparison with Exergy, LCA and footprint methods. In: M. Havranek (ed.), Urban metabolism - measuring the ecological city (pp. 29-39). Prague: Charles University Environment Center.

Marušič, J., Mlakar, A. (2004). Vključevanje analiz ranljivosti prostora v različne ravni urejanja prostora. Research report. Ljubljana: RS Ministrstvo za okolje in prostor, RS Ministrstvo za šolstvo, znanost in šport.

Mladenovič, L. (2011). Kriteriji za trajnostno načrtovanje in gradnjo območij z visoko gostoto poselitve. Doctoral dissertation. Ljubljana: Univerza v Ljubljani, Fakulteta za arhitekturo.

Meijer, M., Adriaens, F., van der Linden, O., Schik, W. (2011). A next step for sustainable urban design in the Netherlands. Cities, vol. 28, 6, pp. 536–544. DOI: 10.1016/j.cities.2011.07.001

Mostafavi, M., Doherty, G. (2010). Ecological urbanism. Cambridge: Harvard University Graduate School of design, Lars Muller Publishers.

Park, H., Andrews, C. (2004). City Planning and energy use. In: Cleveland C.J. (ed.), Encyclopedia of Energy, Volume 1 (pp. 317-330). Elsevier.

Perez-Soba, M., Danes, M., Mucher, S., Van Eupen, M., Hazeu, G. (2012). Land Use Functions and their linked land use performance and efficiency, Chapter 2. V: EU-LUPA European Land Use Patterns. Reaserch report, version 00/06/2012. Accessed on February 28th 2014, webpage: http://www.espon.eu/main/Menu_Projects/Menu_AppliedResearch/EU-Lupa.html

Pincetl, S., Bunje, P., Holmes, T. (2012). An expanded urban metabolism method. Landscape and Urban Planning, vol. 107, 3, pp. 193-202. Accessed on November 16th 2012. DOI: 10.1016/j.landurbplan.2012.06.006

Plut, D. (2006). Mesta in sonaravni razvoj. Ljubljana: Znanstvenoraziskovalni inštitut Filozofske fakultete.

Pogačnik, A. (1999). Urbanistično planiranje. Ljubljana: Fakulteta za gradbeništvo in geodezijo.

Pogačnik A., Lavrač, I., Marušič, J., Ravbar, M (2006). Metodologija integracije razvojnega in prostorskega načrtovanja ter varstva okolja. Raziskovalno poročilo. Ljubljana: Fakulteta za gradbeništvo in geodezijo, Katedra za prostorsko planiranje.

Power, A. (2004). Sustainable communities and sustainable development, A review of the sustainable communities plan. London: Sustainable Development Commission. Accessed on May 23rd 2014, webpage: http://sticerd.lse.ac.uk/dps/case/CR/CASEreport23.pdf

Rebernik, D., Pichler-Milanović, N., Lampič, B., Cigale, D., Mrak, I., Kušar, S. et al. (2008). Povezovanje kriterijev in ukrepov za doseganje trajnostnega prostorskega razvoja mest in drugih naselij v širšem mestnem prostoru (no. V5 - 0302). Reaserch report, vol. 1. Ljubljana: Univerza v Ljubljani, Filozofska fakulteta, Oddelek za geografijo.

Rydin, Y. (2011). The purpose of planning: creating sustainable towns and cities. Bristol: The Policy Press, University of Bristol.

Šašek Divjak., M. (2004). Prometni koridorji in poselitev v regiji: navezovanje poselitve na javni promet. Urbani izziv (Ljubljana), vol. 15, 1, pp. 19–27. DOI: 10.5379/urbani-izziv-en-2004-15-01-003

Uršič, M. (2006). Modernizacija prometa v obdobju industrijske urbanizacije – bogata zapuščina ali breme teženj k povečanju mobilnosti v slovenskih mestih? Urbani izziv (Ljubljana), vol. 17, 1/2, pp. 18–29. DOI: 10.5379/urbani-izziv-en-2006-17-01-02-003

Vale, D.S. (2013). Does commuting time tolerance impede sustainable urban mobility? Journal of Transport Geography, vol.32, 10, pp. 38–48. DOI: 10.1016/j.jtrangeo.2013.08.003

Vrščaj, B., Vernik, T. (2010). Sistemi in orodja za potrebe varovanja tal in trajnostne rabe zemljišč. V: Zavodnik Lamovšek, A., Fikfak, A., Babič, A. (ed.), Podeželje na preizkušnji (pp. 218–226). Ljubljana: Univerza v Ljubljani, Fakulteta za gradbeništvo in geodezijo.

Zavodnik Lamovšek, A. (2003). Vzdržen prostorski razvoj v Sloveniji. Ljubljana: Ministrstvo za okolje, prostor in energijo, Urad RS za prostorsko planiranje.

Zavodnik Lamovšek, A., Drobne, S., Žaucer, T. (2008). Opredelitev metodološkega pristopa za razmejitev mest in odprtega prostora (Chapter 2.3). In: Prosen, A., Zavodnik Lamovšek, A., Žaucer, T., Drobne S. in Soss, K., Pomen majhnih in srednje velikih mest za razvoj urbanih območij (pp. 16-28). Final report. Ljubljana, Maribor: Univerza v Ljubljani, Fakulteta za gradbeništvo in geodezijo, Filozofska fakulteta, Univerza v Mariboru, Fakulteta za gradbeništvo.

Williams, K., Burton, E., Jenks, M. (ed.) (2001). Achieving sustainable urban form. London: Spon Press.

Williams, K. (2010). Brownfield policy in England. In: Vancutsem, D. (ed.), LUMASEC Thematic Report 3, Governance of sustainable land use management (pp. 35-43). Accessed on February 21st 2014, webpage: http://urbact.eu/fileadmin/Projects/LUMASEC/outputs_media/LUMASEC_Thematic_Report_3_01.pdf