Green open spaces and urban perforation – opportunities, concepts and challenges for shrinking cities

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Introduction

Historically, urban growth and contraction are normal phenomena. Changes in population and settlement structure can be brought about by geological processes such as the silting of harbours in classical and mediaeval periods, triggered by changing political, economic and trade conditions like the reorientation of renaissance cities in the Eastern Mediterranean and enforced by diseases or destruction during periods of war, for example during the wars of the seventeenth to the twentieth century in Europe. Apart from different ways of temporarily using redundant land for food production there is a history of taking advantage of the availability of vacant areas – housing, commercial or military – and creating new infrastructure, sustainable building developments and urban green spaces with ecological functions and for recreation.

The expansion of cities – even during periods of massive growth in times of industrialisation or when driven by collective and individual transport progress in the twentieth century – has rarely happened in a concentric way. Naturally inaccessible sites, valuable horticultural land, parks and private estates have always been part of the urban fabric. Some areas remained undeveloped by their owners for decades. Growth has never happened in an indiscriminate way but is always influenced by natural, social and technical conditions, more or less guided by planning instruments. Shrinkage, too, is a result of complex conditions and its patterns can be described as a process of 'perforation' of the built environment, which creates open spaces.

Shrinkage and perforation mean that landscape fragments, natural features, agricultural land or parks can be recovered, complemented and interconnected by land which has been used for housing, industry and infrastructure. Emerging spaces of perforation allow the creation of new open space qualities, contributing to climate mitigation and biodiversity, recreation and water management, easy circulation for pedestrians and cyclists. They provide options for the appropriation of open space by children, youth, neighbourhood groups involved in horticulture, conservation, culture or sports. In many cities that are subject to shrinkage and perforation, the question is whether open spaces can be provided and managed within a restrictive budget and are adaptable in a highly dynamic situation of urban transformation.

In the following contribution, consideration is given to the implications of shrinkage and spatial perforation in cities in the contexts of planning theory and practice, experimental schemes, programmes and instruments – mainly looking at the situation in Germany. As an example of an urban situation in which all of these aspects are combined in the context of severe loss of population, the city of Dessau-Rosslau 'Landscape Belt' is portrayed, including

practitioners' positions. Opportunities to develop open spaces with different functions in the context of shrinkage and retrofit are introduced in an international context. Finally implications for policy and practice are suggested.

Landscape and urban open space as strategic issues in urban development

Dealing with urban structures in metropolitan areas has been an issue as long as there has been the idea of rationally harnessing the forces of urban growth. Predominant reasons were the need to protect agricultural land, coordinate mining or large industry, provide traffic infrastructure, recreation and services like water and waste management. Inspired by exhibitions of planning concepts, research and recent developments, green belts and networks were designated and secured by land acquisition in river valleys, regions of mining and heavy and chemical industry and the metropolitan areas of large cities like London, Vienna and Berlin. Strategic ideas on urban open space are an important reference for the development of planning culture (Freestone and Amati, 2014) in situations of decline, shrinkage and destruction and it can be said that examples of dealing with additionally available open space have repeatedly played an important role in academic debate and professional practice, e.g. in international building exhibitions in Germany, since the Second World War.

Pioneering work, discussions and publications on outer and inner urban peripheries since the 1990s broadened the professional, academic and public discourse significantly (e.g. Sieverts, 1997, 2003). Close collaboration of politics, economics, institutional innovation and the dissemination of new practices facilitated new approaches in relation to development programmes, planning systems and the participation of stakeholders in the design, implementation and management of open spaces. This rationale of improvement is also reflected in the European Landscape Convention (Council of Europe, 2000).

Challenges for theory and professional practice: the central role of open spaces in the management of shrinkage and perforation

For politicians and planners managing reduction proves much more difficult than planning for expansion. The fairly vague notion of shrinkage received further definition through the concept of 'perforation', which has become a keyword in urban decision-making. In the late 1990s, the city of Leipzig – with its population of 500,000 inhabitants rapidly decreasing, a stock of 800,000 square metres of empty commercial space and 60,000 redundant flats – became a focus of debate (Lüdtke-Daldrup, 2001). Experts had started to point out the necessity to create programmes to take large numbers of redundant flats off the market and compensate owners. Leipzig and other cities in East Germany became laboratories not only for financially managing depreciation and value adjustment of housing stock after demolition, but also for new philosophies of planning. The traditional function of urban planning disciplines to designate and control was critically reappraised. It had become important to observe processes of dereliction and redundancy, listen to housing companies and providers of infrastructure regarding costs and utilisation ratios, include stakeholders by offering them

opportunities. New tasks associated with assessing urban cores and infrastructural backbones to be stabilised, intermediate zones to be transformed – or areas of stagnation to be monitored with patience – required different attitudes from those traditionally cherished in urban planning.

In Leipzig-East, an inner city district with almost half of its flats empty in 2000, young urban planners joined forces and campaigned for the retention of historically valuable and image-relevant 'nuclei' surrounded by 'plasma' with options to rebuild, retain and develop small parks – and they developed an open green corridor. Afterwards landscape architects took the lead in programming the open space structure as a sequence of open spaces along a small stream which had been culverted long ago but served as a natural orientation (Stadt Leipzig, 2004). Characteristic landscape elements became the backbone of the concept for urban renewal accepted by the councillors in 2004, where the issue was consolidating the remaining fabric in 'urban core areas' and qualifying the surrounding space. Massive urban shrinkage in small and middle-sized towns and cities was first systematically addressed in the International Building Exhibition (IBA) 'Urban Redevelopment' 2010, in the Federal State of Saxony-Anhalt. Under the heading 'Less Is Future. 19 Cities – 19 Themes' open space became a fundamental element and resource and an exhibition brochure was published, together with a catalogue and a range of topical and local studies (Saxony-Anhalt Ministry, 2010a, 2010b). The concept of stabilising urban cores and qualifying open space as 'Landscape Belt' in the city of Dessau-Rosslau is taken as an example in this contribution.

Challenges of financial models: going beyond funding physical improvements to include social issues

In Germany, the national government programme 'Urban Transformation East' ('Stadtumbau Ost') started in 2002 to assist municipalities with developing new city-wide concepts, setting priorities, supporting the housing sector in demolishing an estimated 1,000,000 redundant flats and improving neighbourhood quality (BMVBS, 2012).

At the beginning, cities were invited to enter their conceptual ideas in a national competition which generated an impressive range of ideas – often bringing together public, voluntary and private stakeholders in interesting constellations (BMVBS, 2003). The funding available through this programme was predominantly directed towards reducing surplus housing stock through demolition – mainly on multistorey housing estates. Emerging open spaces and some remaining buildings were transformed and provided opportunities for social, ecological and aesthetic improvements as well as niches for voluntary, public and private initiatives.

After a pilot period the federal programme 'Urban Transformation West' ('Stadtumbau West') started in 2004, targeting towns and cities which had to cope with severe problems of adaptation to changing economic, social and environmental conditions. Main fields of action include the conservation of valuable historic buildings, high quality urban design, landscape design and architecture, adaptation of services and infrastructure and measures for climatic adaptation. Restructuring and revitalisation of industrial, transport related or military

brownfield land and derelict or problematic buildings often provides the impetus for new cultural, educational or leisure uses. ‘Urban Transformation West’ concepts are successful in supporting cities’ attempts to fundamentally restructure areas and realise the potential of sites formerly occupied by transport or industry – in many cases as open space (BMUB, 2014).

Monitoring revealed that federal and state programmes did not generally achieve a marked increase in open space quality. Investment in open space was mostly low and local authorities as well as housing companies found it difficult to maintain an adequate standard, managed by qualified staff (Berndt, 2010; Rößler, 2010). Experiences gathered from ‘Urban Transformation East’ suggest that social and economic aspects were, apart from the issue of managing demolition and refurbishment of housing, of prime concern for residents, owners and municipalities. But generally the development of green open space after demolition seems to contribute to residents’ identification with the area and their appreciation of the quality of life it offers. The programmes initially directed towards urban economic and demographic change are increasingly applied in a proactive function, encompassing social, economic and ecological aims relevant for open spaces (Rößler, 2010). They are increasingly combined with public programmes for urban renewal, recreation, public transport, water supply, rainwater and sewage, mitigation of climate change and increasing biodiversity.

Informal and integrative approaches: complementing the formal planning system

Municipal planning instruments such as urban structure plans, which address all relevant topics of urban development and designate land and infrastructure decades in advance, have increasing difficulties in estimating necessary levels of provision. Discrepancies between forecasts and actual development influenced by external factors are shown by Wiechmann and Pallagst (2012), using Dresden as an example. Regarding issues of landscape and open space, the role of landscape planning is to survey and assess landscape qualities, define targets, point out requirements and develop measures (BfN, 2002). Strategic environmental assessment of projects according to EU regulations helps to prevent, mitigate and compensate for negative environmental impacts. Landscape planning provides guidance on which areas to protect, where to concentrate efforts to acquire land for compensation measures or to balance deficits and improve recreation, ecosystem services and urban identity. It is important that concepts of landscape and open space design use the full spectrum of open space functions, demonstrate solutions for spatial organisation of green infrastructure and are incorporated in land use plans. Time frames for development have to combine long-, medium- and short-term as well as temporary processes and interactions (GreenKeys Project Team, 2008; Rößler, 2010: 384f.).

Traditional and legally required instruments of urban planning on the level of structure plans and local plans have been developed regarding their aims and they are increasingly complemented by additional conceptual studies. An elaborate planning system with clear-cut zoning regulations may be able to manage increase and decrease within a normal spectrum. With rapidly and severely changing economic or demographic factors, traditional zoning plans may become an obstacle to experimental, temporary or future-oriented land use.

Informal instruments and concepts of spatial development with a high degree of stakeholder involvement can be used as a sensitive source of information about potential directions of future development. The importance of integrated urban planning and public participation is also underlined in the *Leipzig Charter on Sustainable European Cities* (European Union, 2007). The city of Leipzig itself tries to apply these principles to its management of perforated areas (City of Leipzig, 2011).

When looking at programming and implementing the siting, development, usage and maintenance of open space, the suitability of certain types of open space in the context of history, social and economic structure, ecology and environment has to be taken into account. However, rigorous analysis and a transparent methodology of assessment are not sufficient to supply concepts which provide an adequate framework for future development. There must be minimum standards for a basic structure and quality of open space. In addition, development corridors can be shown within which there is a variability of use, providing responsive structures to accommodate the changing interests of inhabitants, and alterations in the preferences of owners, administrations and politics. Thus, contributions from different scientific and professional fields, new ideas for change and development and the integration of open space as a key topic in all aspects of urban development are essential. The continuous involvement of stakeholders, in particular local residents, neighbourhood groups and local institutions and enterprises is of prime importance.

Redefining the urban area through open space: the case of the landscape belt in Dessau-Rosslau, Germany

Massive loss of population and unplanned redundancy of land and buildings stretch the steering capacities of municipal institutions and planning instruments to create adaptive responses. The city of Dessau declined from 100,000 to 80,000 inhabitants between 1990 and 2000, forecasts expecting a mere 52,000 in 2015. The speed of population loss then reduced its rate, so more recent consolidation scenarios assume around 56,000 inhabitants in 2020. In the year 2000, there were large disused industrial plots and about 6,000 empty flats, mostly in housing blocks of the 1920s, 1970s and 1980s. The situation and prospects motivated the city to develop a new spatial model: 'Urban Cores – Landscape Zones' was the city's contribution to the International Building Exhibition IBA Urban Redevelopment 2010 in the Federal State of Saxony-Anhalt (Steglich 2010: 588 and http://www.iba-stadtumbau.de/index.php?iba-cities). Statements of local practitioners who have been involved in the concept and its management for many years are included in this chapter.

Understanding urban renewal as a continuing process needing strategic land use decisions as well as the small scale involvement of stakeholders, a strategic framework for the development of a 'Landscape Belt' ('Landschaftszug') in the least stable urban fabric south of the city centre was commissioned (Brückner and Stein, 2007). The green corridor is conceived as mainly open extensive meadowland and components of green infrastructure serving the inner urban neighbourhoods and improving connectivity for pedestrians and cyclists. The Landscape Belt also links up with a historic designed landscape of the period of

the Enlightenment, the ‘Dessau-Woerlitz Garden Realm’, a UNESCO world heritage site since the year 2000 (http://www.unesco.de/316.html?&L=1).

The Landscape Belt includes existing historic buildings as landmarks and focal points, and is accompanied by strong new spatial elements like treelines and group plantings of oak. Recreation facilities, spaces for private and voluntary activities and interfaces with urban infrastructure are carefully developed (Langner, 2014). Former industrial buildings provide a public viewing platform 30 metres above ground, and an indoor BMX track was established by local youth. Information on the general concept of the landscape corridor and its future character, the history of the site, its current management and the involvement of stakeholders is given on poles with red flags – providing orientation in space as well.

In terms of ideas, institutions and instruments, the Dessau Landscape Belt project is based on

- a concept of strengthening urban cores referring to housing areas to be stabilised by improvement
- continuous public information on site and through media as well as cooperation with stakeholders
- a programme of estate management developed by the city jointly with landowners
- acquisition of land for permanent parts of the landscape corridor on the free market or in auction
- licensing agreements with landowners, allowing temporary use of building sites as open space
- an interdisciplinary concept for ecological and aesthetic management as guideline and reference
- adaptation of roads and technical infrastructure related to current and future requirements.

The concept of a coherent Landscape Belt with specific references to history and sites was qualified further by the idea of including the diversity of uses and functions and its gradual evolvement by means of an adequate model of ‘pixelation’ (Brückner and Stein, 2007). To invite and stimulate appropriation by the neighbourhood, patches of 20 metres by 20 metres, so-called ‘claims’, were offered to stakeholders for interim use. Underlying this concept are ideas of integrating urban and rural forms of settlement and landscape, for example Ebenezer Howard’s Garden City, Frank Lloyd Wright’s Broadacre City, current forms of urban gardening in America and European countries (Brückner, 2010: 502). The character of the Dessau Landscape Belt is no longer that of a representative park, but a townscape growing out of concrete action taken by participants. It obtains value from its design by many individuals (Brückner, 2010: 509).

In some stretches of the Landscape Belt, a number of 400-square metre sites were marked visually by orange-coloured frames and graphics on buildings. In addition, guided walks helped trigger the participation process. Since 2004 several community uses on 400-square metre claims have consolidated, including the privately initiated Garden of the Senses and Apothecary’s and Beekeeper’s Garden. Voluntary initiatives interested in the claims are developing slowly but continually and while more and more redundant sites are added to the

landscape corridor, the demand for sites for community use varies in acceptance and stability over time. A pasture with goats as an experiment for low cost maintenance proved controversial among neighbours, and the area is still too fragmented by streets and leftover houses for sheep. The planting of fruit trees and soft fruit shrubs and vegetable beds prepared, seeded and harvested have seen wide acceptance. An 'Urban Farm' community association supports urban gardeners and is developing pastures, orchards and environmental learning opportunities with educational institutions. Searching for management solutions for the whole Landscape Belt, plant material is currently collected for a central compost works and central biogas production. 'Urban Farm's' future projects are a neighbourhood kitchen for local produce and a small biogas plant to ostensively show decentralised forms of post-fossil urban living.

The idea of a future continuous green corridor through a large part of the fragmented town has been readily taken up by children and youth but is difficult to imagine for many residents and political decision-makers, despite all the information and participation offered. Acceptance of extensive green space management by local people seems to be limited. Many inhabitants expect a different type of green – more traditional in the sense of an urban park with well-tended lawns, herbaceous borders and ornamental trees. However, children and youth greatly enjoy the Landscape Belt, which provides a multitude of opportunities for nature experience and appropriation, activities and play. The residents of a nearby old people's home are among the regular users of the extensive meadows, mowing their own footpath for walking and admiring flowering herbs in spring, slender grasses in the autumn dew and snow covered boughs in winter.

From an ecological point of view, the development of plant communities and biodiversity was an integral part of the concept. Special seeds were collected and combined, a diverse mosaic of soil conditions created. The high aesthetic variety and dynamics in vegetation development on an experimental area integrated in the Landscape Belt was conceived, implemented and monitored in partnership with the regional Hochschule Anhalt (Felinks *et al.*, 2011). Further research is intended to evaluate the degree of awareness and acceptance of the landscape corridor by people and stakeholders in the neighbourhood.

It must be assumed that the improvement of environmental quality next to the landscape corridor has stabilising effects on housing in the neighbourhood. In some areas environmental improvements such as developing green open space after demolition contribute to residents' identification with the area and their appreciation of the quality of life it provides. This leads in turn to the reluctance of housing companies to give up buildings which were designated for demolition years ago when they had a high rate of redundancy.

Open spaces as opportunities: green infrastructure creates benefits for local communities

Green infrastructure can be complemented, strengthened and qualified using the opportunities arising in the context of shrinkage and perforation processes. 'Green infrastructure is the use of green spaces, wetlands, parks, forest areas, and native vegetation to manage storm water

naturally, reduce flooding risk, and improve water quality' (Hoornbeek and Schwarz, 2009: 26). In the context of safeguarding valuable productive soils for urban agriculture the explicit inclusion of productive land use in urban planning decision-making is requested (Hagan, 2005). In its Green Infrastructure Action Plan, Liverpool City Council points out options of strategic intervention regarding reduced industrial and infrastructural land use. Some inner urban areas, where provision of public open space is low, and the proportion of derelict and undefined amenity land comparatively high, have a considerable potential for conversion to permanent or temporary use for recreation or production (Liverpool City Council, 2010). The EU GreenKeys Project Team (2008) has explored the interdependence of spatial situation, qualitative aims and institutional constellation using examples from seven European countries. In developing city-wide green infrastructure, potentials of disused former industrial and military land in private and public ownership have to be reflected in urban green strategies. Regarding the planning and development process, the participation of local stakeholders and community based voluntary agencies is a fundamental prerequisite of sustainable orientation and management.

Gardens as personal and collective realms

Food centred responses to shrinking processes in cities are explored in this book, giving consideration to economic, social and political dimensions. Here, both recreational and productive aspects are looked at, asking questions of spatial and organisational constellation. Depending upon the specific situation there is a spectrum ranging from temporary use by individuals and/or voluntary agencies up to the permanent creation of gardens for the neighbourhood or as part of adjoining housing plots. Spontaneous and often non-legal appropriation of sites for gardening is practised in many cities, developing into networks of volunteer activities. Often projects without contract are quite long-lived as expulsion from occupied plots is not immediately pursued by owners. There are also many examples of agreements between owners and users which are limited in time and are made or arranged by authorities.

An example of permanent conversion to private garden use can be found in the densely built-up nineteenth century industrial suburb of Magdeburg-Buckau. The urban renewal process based on EU programme URBAN 21, national programme Urban Transformation East and state funding for urban renewal led to a neighbourhood master plan (Landeshauptstadt Magdeburg, 2004). Since then, redundant plots have been bought by the city and converted to public open spaces to improve pedestrian connections, offer playgrounds and establish meeting places for youth. Other derelict plots have been acquired by private owners of adjacent houses. The sites are now used as private garden extensions providing better access and recreational quality, particularly for tenant families.

The spatial (and ownership) structure in late nineteenth century Magdeburg-Buckau is small scale and diverse, allowing more punctuated private, collective and public interventions embedded in the historic settlement pattern to enhance the local quality of life. The Dessau 'Landscape Belt' described earlier lends itself to becoming a larger continuous green corridor. The 400-square metre plots in green zones between multistorey buildings

offer the opportunity of variety and activity to local private and voluntary stakeholders and indirectly stand for positive social control in a continually extending public green space.

Public open spaces on derelict land as community platforms

There are numerous projects for creating new city parks or public play and recreation areas on derelict land. Under conditions of urban growth, concise planning arguments as well as political will and support by neighbourhood organisations are required to retain control of a share of existing open space, maintain historically valuable buildings and elements and develop affordable space for living and working. In principle the same factors apply under conditions of shrinkage and decline as decisions about land acquisition need to be made, the allocation of funds has to be negotiated and future development needs to be properly sited.

On derelict plots in the nineteenth century district of Dresden-Löbtau, public playgrounds and small pocket parks are introduced through the combined efforts of the city's urban renewal and open space departments. Decisions to establish playgrounds are based on a city-wide strategic play action plan which is regularly updated. Plots are either acquired and permanently developed, or sites are temporarily equipped for an estimated life span of eight to ten years on the basis of licence agreements with owners whose right to build is maintained. This has had a sizeable effect on improving the attractivity of the neighbourhood for young families with children and has led to an obvious increase in young families in the neighbourhood.

A former regional railway terminus in Leipzig was first identified as a potential part of a green corridor by neighbourhood groups. Interest in securing and developing the site grew even more through bottom-up information activities, neighbourhood forums and a youth camp and resulted in negotiations with owners and land acquisition by the city. A workshop of landscape architects for the design of the Lene-Voigt-Park resulted in a concept with promenade, play areas for different age groups, a railway building transformed to cultural use, conservation of vegetation and a strong backbone of garden-chambers for neighbourhood gardening and activities (Stadt Leipzig, 2005 and http://www.werkstatt-stadt.de/en/projects/48/). A notable example for the inclusion of youth as a specific target group in Leipzig is Rabet-Park: incorporating buildings with social infrastructure and a circular path system and playgrounds it serves to extend opportunities of open space activities to the social institutions and the surrounding housing area. Local youth were involved at the beginning of the planning process in 2001/2 and consulted until the opening in 2005 (Stadt Leipzig, 2005 and http://www.werkstatt-stadt.de/en/projects/129/).

Urban woodlands – experience of dynamic growth

Woodlands and forests owned and managed by cities have a long tradition in European urban culture. They have always had multiple functions in respect to ecology, fuel and food production as well as recreation. Development and plantings of urban woodland on disused

land within the fabric of shrinking conurbations have an important function for human recreation and environmental experience (Konijnendijk *et al.*, 2005: 35f). The aims are not only to augment forests in a highly urbanised region, but also to protect the authenticity of sites and their specific dynamics of natural development as opposed to redesigning them as ubiquitous parks. Woodlands can be legally developed with a lower level of liability and investment for infrastructure than parkland. But if the social and ecological welfare effects of urban woodlands are to be utilised to their full extent, there is a permanent need for rangers to supervise and for qualified workers to manage these valuable resources (Dettmar, 2005: 266ff.).

In the city of Leipzig, woodland is developed in two different spatial contexts: larger sites as part of a metropolitan green network for biodiversity, recreation and subdividing the settlement structure; small sites as elements of urban design that are a structuring element of heterogeneous areas or a framework surrounding roads and buffering traffic emissions. Ten model sites on derelict land in Leipzig were defined and the proposals that were developed were monitored by the German Federal Agency for Nature Conservation BfN (Bundesamt für Naturschutz). Part of the plan was to include existing valuable and aesthetically diverse vegetation in new plantings. Woodland can offer a large variety of edible species mixed with broadleaf trees in sectors with diverse spatial structures and atmospheres. Neighbourhood education and recreation facilities are included, offering opportunities to increase children's environmental and social awareness.

Climatic and biological as well as aesthetic, psychological and social benefits can be substantial while the aspect of economic return on urban forests has to be put into perspective to avoid inadequate expectations (Kowarik and Körner, 2005). In particular, urban woodland or forest projects offer opportunities for citizens' participation and partnerships with institutions. Various authors in Konijnendijk *et al.* (2005) conclude that more emphasis should be placed on the communication and planning process and the responsibilities and skills required for social inclusion and interaction. Legal regulations for woodland or forests are geared up to long-term use and larger surfaces and may require them to be some distance away from buildings. This renders adaptation to inner urban structures and short- or medium-term changes difficult. Short rotation forestry can be considered as an alternative: however, the ecological value is lower and for economical exploitation larger, somewhat featureless plots are desirable. But if sufficient space is available, plantations can be embedded into green infrastructure while respecting natural and historic landscape features and integrating recreation and play elements.

Spaces for sustainable resource management and energy production

In urbanism, future uses of redundant land as open space are discussed with increasing intensity. Since the 1990s, landscape recovery has been focused on in theoretical thought (e.g. Corner, 1999) and is present in academic debate (ECLAS, 2012). Examples of the potential to derive environmental benefits from comprehensive (re)design of large infrastructural elements are shown by Prominski (2004, 2012).

The question of adapting technical infrastructure to greater extremes of natural impact has to be tackled urgently and is becoming a central topic in research and programmes of the civil engineering and management sectors. Providing utilities requires expensive construction works and considerable maintenance costs. Even in almost depopulated urban neighbourhoods, options to completely cut off or eliminate technical infrastructure are rarely used as they imply that those areas will have to be excluded from settlement for a foreseeable time. Numerous local politicians and most professionals who are educated to expand and develop infrastructure provision are only reluctantly accepting the need for reduction, and are implementing radical measures. Related to the rain and wastewater management of the Northern Ruhr region in Germany, the Emscher redevelopment project results in impressive projects of water retention, river revitalisation, culture and recreation along a system of green corridors (Emschergenossenschaft, 2012 and http://www.eglv.de/en/waterportal).

Transferable experiences are also made by using sites unsuitable for building for the collection of solar energy. Examples along transport corridors or on contaminated land previously used for industrial production, as a dump or for military purposes demonstrate that energy can be harvested on technically sealed or unstable ground. Solar collectors can easily be mounted on buildings, but larger installations require inclusion and designation in municipal structure plans and local plans.

The design of urban landscapes combining recreation and culture, nature conservation and the sustainable production of energy from wind and sun has become a major interdisciplinary challenge for engineers, ecologists and landscape architects. A prominent example is Freshkills Park, Staten Island, a large landfill site which, after closure in 2001, is being transformed into a new type of park (City of New York, 2006). With similar interdisciplinary approaches, redundant land in inner urban locations can also contribute to rainwater management. Advice for local authorities on so-called Low Impact Development and on Green Infrastructure is available from national agencies in the US (EPA, 2010, 2014). Impressive transformations of derelict industrial and circulation sites into green infrastructure are achieved in areas of dereliction and multidisciplinary concepts for elaborate open space systems are becoming standard masterplanning features in shrinking as well as expanding cities (Infrastructure Research Initiative at SWA, 2011).

From research on providers of municipal infrastructure it can be concluded that there is a need to develop smarter technologies of decentralised provision and disposal and guide growth and degrowth closely to avoid increasing costs. Vacant land in shrinking cities can be harnessed as infrastructure for future challenges (Hoornbeek and Schwarz, 2009). Farming and horticulture, community woodlands and biofuel production in short rotation forestry have already been touched upon. Suggestions to include phytoremediation of contaminated soils, wastewater treatment by vegetation, the recycling of construction material and the recovery of redundant buildings and open spaces for cultural and environmental purposes are advanced in the comprehensive, interdisciplinary and long-term Detroit Works Project (Griffin *et al.*, 2014), which also involves landscape architects in a multidisciplinary group of consultants (http://www.stoss.net/projects/29/detroit-future-city). This large-scale and ambitious

programme combines social diversity, community expertise with professional approaches. It will be worthwhile to observe how the massive problems of a shrinking metropolis can be turned into opportunities to master future challenges and there will be a lot to learn from the progress that is about to be made in Detroit. Green infrastructure can be seen as a strategic reference for the decision on future land use in shrinking cities in Europe as well. It is already recognised as a vehicle to achieve environmental, economic and social improvement by European institutions (European Commission, 2012, 2013). Redesignation and retrofitting of redundant sites according to strategic open space concepts creates a unique opportunity to make cities more resilient and can eventually turn shrinking cities into becoming the forerunners of changes which will be a necessary component of our urban future.

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