

Low carbon districts: Mitigating the urban heat island with green roof infrastructure



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ABSTRACT

New urban design concepts should guide the inclusion and re-introduction of greenery and biodiversity in the urban built environment. Preserving biodiversity in the face of urbanization, habitat fragmentation, environmental degradation and climate change is probably one of the greatest challenges of our time. The integration of trees, shrubs and flora into green spaces and gardens in the city is particularly important in helping to keep the urban built environment cool, because buildings and pavements increase heat absorption and reflection (what is called the urban heat island effect). Tomorrow's urban precincts will have to offer new forms of green spaces, both for recreation and also to mitigate the warmer urban climate. In addition, future urban precincts will have to generate at least half of their power themselves. Integrated urban development with a focus on energy, water, greenery and the urban microclimate will have to assume a lead role and urban designers will engage with policy makers in order to drastically reduce our cities' consumption of energy and resources. This paper introduces the holistic concept of green urbanism as a framework for environmentally conscious urban development. Then one of Australia's largest urban renewal projects: the Barangaroo waterfront development at East Darling Harbour in Sydney. At Barangaroo, all roofscapes will be green roofs, contributing to the mitigation of the urban heat island effect and collecting rainwater; this inner-city precinct is setting new standards for Australian urban renewal, including solutions for environmental, energy and roofscape issues.

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Introduction

All cities are inherently evolutionary, always transforming and never 'completed'. Planners have now started to think about cities as complex biological and natural systems that are analogous to self-sufficient living organisms. Tomorrow's urban precincts will have to generate at least half of their power themselves, locally and on-site. This will not be possible without zero-energy and plus-energy buildings. These are already state-of-the-art, and the next stage, with the city district itself acting as a 'power plant', is now coming. Precincts that generate all the power they need on their own through decentralized systems for renewable energy (using solar PV, biomass, micro wind turbines or geothermal technology) will make city planners' age-old dreams of inexhaustible clean energy come true. The secure provision of renewable energy and green urban transfor-

mation is fast becoming a reality for our society and a major planning focus around the globe. However, realizing this dream requires the input of policy makers, power suppliers, researchers, architects and planners, and citizens alike.

The world continues to urbanize. Today we find shrinking, undynamic and insufficiently developed urban precincts with limited investment and obsolete infrastructure alongside fast-growing, dynamically changing precincts. We need innovative and comprehensive strategies that enable us to more effectively manage the coming demographic and structural changes (Lehmann and Crocker, 2012).

But is the city as we know it today sustainable? Integrated urban development with a focus on energy, water and the urban microclimate will have to assume a lead role and policy makers will have to engage with it in order to drastically reduce our cities' consumption of energy, water and resources (ICLEI, 2007). The 'low-carbon precinct' concept must be developed further into that of a plus-energy city district that is compact, mixed-use and well-connected

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to public transport. A large portion of each district (minimum 30–40 per cent of the area) should be dedicated to public green space to maximize open space while allowing for higher densities. This approach will give cities new functions and fields of action that will be instrumental in creating the so-called low-carbon city. The challenges resulting from this are part of what I call the post-industrial condition of waterfront spaces, where dock and working harbour functions have moved away to allow for a new type of inner-city public waterfront. Barangaroo in Sydney is such a new precinct; it will be introduced later in this chapter.

The climate-friendly, energy-optimized and resource-efficient city

All around the world cities face challenges and need to take action – even if the contexts may differ from Australia to the Asia-Pacific region, from the Americas to Europe. What a climate-friendly and energy-optimized city should look like is one of today's central questions (Brown, 2009). In the Asian region the main issues are rapid growth and urbanization processes and the related migration of people. The US, Canada and Australia are exploring strategies to reduce their unsustainable urban sprawl and enormous dependency on automobiles. In Germany and other European countries, the focus is mainly on the energy-efficient conversion of existing buildings and on optimizing material and energy flows, as the new construction rate is only around 2 per cent (Lehmann, 2012). Almost 40 per cent of European cities are now shrinking and many others are stagnating, while a few popular cities enjoy growth and investment. The growing cities are the ones with high liveability indicators, popular with a skilled workforce in a globalized and increasingly knowledge-based society.

Design concepts for new urban precincts will need to guide the inclusion and re-introduction of biodiversity into the urban built environment. Preserving biodiversity in the face of urbanization, habitat fragmentation, environmental degradation and climate change is probably one of the greatest challenges of our time. Tomorrow's urban precincts will have to offer new forms of green space for recreation, but also to mitigate the warmer urban climate and risk of heatwave impacts and the urban heat island effect.

How, then, can the transition to the post-industrial plus-energy city be achieved? *Green urbanism* is a holistic concept for tomorrow's plus-energy urban precincts that is based on the consistent, sound use of energy, land, water, green spaces, materials and mobility. Its long-term goals are zero emissions, zero waste and the avoidance of energy/water/material wastage. These goals will be achieved through the intermediate stage of the low-carbon city. This will always include promoting socially and ecologically sustainable urban districts and precincts (see Fig. 1 and Table 1). Similar principles have already been successfully implemented in Vauban, a green precinct of Freiburg im Breisgau (Germany), in Hammarby-Sjöstad in Stockholm and Malmö (Sweden), and in Copenhagen (Denmark). These are sustainable and walkable precincts with short distances between living and working. The 'city of short distances' is a sustainable model that is now being emulated all over the world.

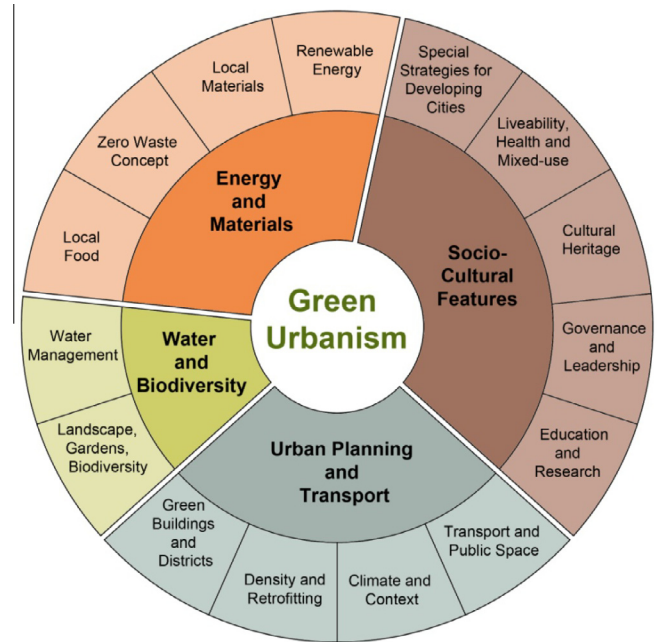


Fig. 1. The 15 principles of green urbanism and their interconnections. (Lehmann, 2010)

Sustainable urban growth: the holistic framework of green urbanism

Green urbanism is a holistic concept of sustainable urban systems and interconnected features, enabling existence and change (growth or shrinkage) without negatively impacting planetary life support systems and ecosystems. It is a particular form of urbanism that is concerned with a healthy balance between the city, the peri-urban area and its surrounding (and supporting) hinterland. Green urbanism also underpins practical action in order to shape the urban environment in a sustainable way (see Table 1).

The principle-based concept of green urbanism was developed in the late 1990s, promoting more compact energy-efficient urban development, seeking to transform and re-engineer existing city districts and to regenerate the post-industrial city centre, promoted at the same time by Beatley in the USA (2004), and by Lehmann in Europe and Australia (2005). Since then, the concept of green urbanism has been adopted in many parts of the world. Several Australian cities have recently formulated metropolitan plans that espouse strategies such as alternative energy generation, using combined-heat-and-power co-generation within urban districts, offsetting construction impact with green roofs and green facades, and integrating more green space to mitigate the urban heat island effect. These public green spaces can come in all sizes, from intimate small gardens, to urban farming and community gardens, to more formal parks, to meadows and urban forests – all reintroducing biodiversity into the built environment. Other factors such as reducing the risk of urban flooding, stormwater harvesting, new concepts of efficient public transport and eco-mobility, resource recovery through local waste recycling, biodiversity protection, and the establishment and re-establishment of ecological connections have also been considered in these plans.

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