# 186: Two Models for Sustainable Urban Growth of the Post-industrial City: *Port City* and *City Campus*

**Professor Steffen Lehmann**

*The University of Newcastle, Australia*
*Steffen.Lehmann@newcastle.edu.au*

**Abstract**

This paper presents new research in the area of *Green Urbanism* in form of two models for urban growth and neighbourhoods, as cities transform from a fossil-based model to a model based on renewable energy sources.

Among the most significant environmental challenges of our time are the increasing fossil fuel dependency of cities and buildings and their growing demand for energy – all likely to be major challenges for urbanism in the 21st century. In this context, avoiding mistakes in urban design at early stages could genuinely lead to more sustainable cities and less greenhouse gas emissions. This paper reflects upon practical strategies focused on increasing sustainability on the urban scale, beyond and within the scope of individual buildings.

Several big cities in the developed world have now started projects and initiatives focused on energy transformation in urban areas to reduce their dependency on oil, coal and gas resources. This paper deals with cross-cutting issues in architecture and urban design and addresses the question of how we can best and cohesively integrate all aspects of energy systems, transport systems, waste and water management, passive and active strategies, natural ventilation and so on, into contemporary urban design, improving the environmental performance of our cities. The author provides a context for the discourse about the regeneration of the city centre, its step-by-step transformation to a sustainable model, and discusses how urbanism is affected (and can be expected to be even more affected in future) by the paradigms of ecology.

Research in sustainable urban design recommends increased harnessing of the energies manifested in the existing fabrics – for instance, through the adaptive re-use of former industrial (brownfield) sites and the upgrade and extension of existing building structures. Two recent and relevant examples for the application of such urban design principles are the proposals for the Australian city of Newcastle: the 'City Campus' and 'Port City' projects. These concrete and realistic case studies give the paper a specific focus and illustrate, that it is less environmentally damaging to stimulate growth within the established city centre rather than sprawling into formerly un-built greenfield areas.

Keywords: Urban design principles; cities in transition; climate responsive urbanism; compact communities; carbon-neutral neighbourhoods; brownfield sites; case studies: *Port City* and *City Campus*.

## 1. Introduction

Excessive fossil fuel dependency of cities and buildings, and their growing demand for energy are major challenges of 21st century urbanism. The significance of the presented research is found in the pressing need for an integration of sustainability principles in the urban design and a transformation process of post-industrial cities. This is of particular relevance to the rapid urban growth of cities in Asia and the Pacific region that have, in the past, frequently been poorly managed. A very fast process of urbanization is taking place, especially in Asia, Africa and Latin America (refer to: UN reports, 2005 and 2006). It is in cities where the world's final energy consumption is mainly taking place, and the largest amount of energy is used for cooling, heating, lighting and transport. However, cities could operate with far lower energy consumption rates if we would be adopting appropriate techniques and technologies in urban design. For instance, new concepts of sustainable urban design and *Green Urbanism* recommend increased harnessing of the energies manifested in the existing fabrics – for instance, through the adaptive re-use of former industrial (brownfield) sites and the upgrade and extension of existing building structures. [1] [2] In the second half of the paper, two case studies for the application of such urban design principles are discussed and explained through the *City Campus* and *Port City* projects.

Australia presents a particular pressing case: The country is the 12th-largest emitter of carbon dioxide (CO2). However, on a per capita basis, Australia is the world-leading polluter because of its reliance on coal for power generation; e.g. 93% of electricity in New South Wales is supplied by burning coal. Change is necessary and possible: *The Australian Business Roundtable on Climate Change* (2007) recently showed that it was possible for countries such as Australia to deliver significant reductions in greenhouse gas emissions at an affordable cost, while maintaining strong economic growth.

## 2. Criteria for Sustainable Urban Growth

We need to develop new urban design approaches based on new concepts of urban energy systems.

Recent research published by the *Urban Land Institute* ('Growing Cooler', 2007) [3] gives comprehensive evidence that there is a direct connection between urban development and climate change. Findings point out that applying principles of sustainable urban growth leads to human settlements which enable their residents to live a good quality of life, while using minimal natural resources and supporting maximum biodiversity. These sustainable settlements could be typified by the following criteria:

- Mixed-use urban consolidation to ensure that new homes are close to employment, education, shopping, health services, etc. giving the option to walk and bike (mobility concepts, such as the *City of Short Distances*, providing good pedestrian linkages, cyclist facilities and safe bike paths), and use of efficient public transport;
- Residential and office typologies that are multi-storey, flexible and compact, to maximise the land available for green space and gardens, avoiding sprawl (there is now a 'renaissance' of the 4 to 5 storey urban block model);
- Buildings that make the best use of renewable sources, such as sun, wind, rainfall (collecting rainwater through green roofs; on-site energy production) and natural cross ventilation, through passive design concepts, therefore: minimising the primary energy demand of cities and buildings, while maximising the efficiency of energy supply;
- Urban water management strategies are integrated;
- Urban designs that emphasis development on land which has previously been developed and is of little ecological value (inner-city densification and infill projects; re-use of formerly industrial sites), integrating existing structures, with a strong emphasis on adaptive re-use and retro-fitting;
- Developments where a high proportion of building materials are designed for re-use, disassembly and recycling, to minimise materials consumption;
- Planning that reflect 'best practice' of compactness, orientation, density and internal location of cores, to optimize concepts of passive design and maximum day lighting;
- Materials, food and other goods that are sourced from nearby, in order to cut $CO_2$ emissions through transport and short supply chains;
- Strict waste management to reduce waste going to landfill and waste during construction.

Importantly, most of the mentioned criteria are decided at a very early stage of any development, some for instance already with selection of a site. In the same way do early decisions on shape and compactness have ramifications on the crucial ratio that exists between volume and façade surface (see: Fig. 2).

## 3. An Attitude of making *Place* and *Space*

There are *green principles* that can creatively support the main design concept. When we study the architecture of Louis Kahn or Alvar Aalto, we find that those architects designed buildings based on what they regarded as 'timeless fundamentals', such as the human experience of space. Both masters designed naturally ventilated office buildings and incorporated climate-responsive design principles long before the notion of 'sustainable architecture' was introduced (so was, for instance, Rachel Carson's pivotal book 'Silent Spring' published in 1962). [4]

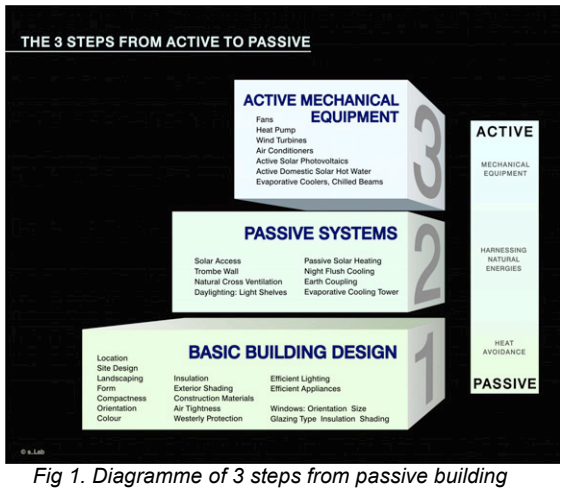


*Fig 1. Diagramme of 3 steps from passive building design to active mechanical equipment. The designer needs to take full advantage of basic, passive building strategies first, before adding mechanical active equipment. Motto: 'More with less'. (© diagramme by the author)*

The concepts and knowledge of night-time cooling, evaporative cooling, solar chimneys, cross-ventilation and thermal mass have existed for centuries, even millennia. This supports the notion that sustainability in architecture is about a

fundamental attitude of making *place* and *space*, and less about the technological solution for 'ventilation' or additive mechanical solutions. It is important to recognise that architecture is predominantly about establishing meaning, about the human experience and substance – and not *per se* about technological sophistication. Therefore, a 'green building' is not always automatically a good work of architecture. [2] [5]

Architecture and urban design have the potential of re-establishing our relationship with nature, the climate and the experience of the sun, rain and wind. As Scott notes, such environmentally responsible design is at its best 'when it achieves an outcome in which the environmentally sensible elements are closely linked to the design process, go beyond being additive and become meaningful parts of an architectural whole.' [5] Integration of sustainability aims within the design process demands that the environmental concept and the urban design concept fully support each other. This requires the identification of environmental strategies that correspond to strong design concepts, support a unique design idea, and reinforce the urban district's or building's relationship with the landscape.

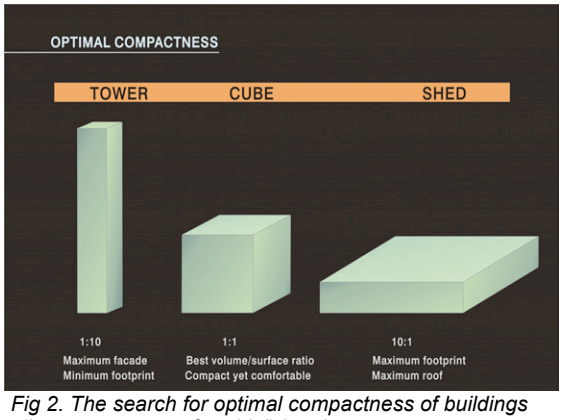


*Fig 2. The search for optimal compactness of buildings ('compact yet comfortable') is relevant, as we want to maximize the passive solar gain, without resulting in overheating in summer. The ideal building shape per se does not exist; the optimization process depends each time on location, climate, orientation, etc. (© diagramme by the author)*

## 4. Is a new Symbiosis between Country-side and City possible?

The local use of solar and wind energy allows a reconnection of energy production with the place of final energy consumption. This means, with the possibility for decentralized, on-site energy production (close to the point of energy consumption), the chance for an entire new type of urbanism has emerged: With the end of the 'old' fossil energy system, urban designers can now rethink the relationship between city and countryside, where the city does not exist and grow anymore at the expense of its rural hinterland. It can be assumed that in 10 years, the concept of decentralized, distributed energy generation will become standard for newly planned models of neighbourhoods. As a consequence, the existing infrastructure of the long-distance grid network will become obsolete and the sustainable city districts themselves will be able to act as 'powerstations'. (see: Fig. 3)

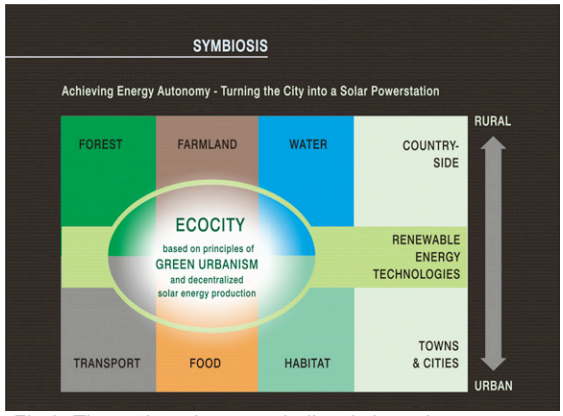


*Fig 3. The entire urban metabolism is based on energy supply. However, a new symbiosis between countryside and city is emerging: The century-old tension between 'rural' and 'urban' might finally get resolved, where the city stops to grow at the expense of its rural hinterland. (© diagramme by the author)*

## 5. Background to the City of Newcastle

Two relevant examples for the application of such urban design principles, offering further insight in their application, are the proposals for the Australian city of Newcastle: the 'City Campus' and 'Port City' projects (2007-08). These concrete case studies illustrate, that it is less environmentally damaging to stimulate growth within the established city centre rather than sprawling into formerly un-built greenfield areas. For almost 100 years, the city of Newcastle used to be the most industrial city of Australia, with heavy industries such as steel manufacturing, aluminium smeltering, coal mining and ship building. Over the last fifteen years, with the painful closure of many of these industries, this has changed and a new identity for Newcastle is emerging. This 'new identity' is connected with a growing service sector, creative industries, education and conference tourism.

- What industries in Newcastle have closed down? Employment in manufacturing and heavy industries in the Hunter region has, historically, always been high. Steel manufacturing plants, smelters and ship building yards went slowly out of business and closed in the years around 1980-98. Today, the formerly industrially used lands are often brownfield sites in prime waterfront location.
- What is Newcastle like today? The major urban regeneration development (the 'Honeysuckle' development) was started in 1992 with the NSW State Government's 'Building Better Cities' program, and is now almost completed. It has redeveloped 50 hectares of derelict land and buildings along Newcastle Harbour, adjacent to the city centre. The development has introduced a denser form of apartment living. However, it is frequently accused of having sucked out the

vitality of the historical city centre, such as from the now derelict Hunter Mall. Over the last twenty years, most of the retail facilities (72%) have gradually moved away to new shopping mall precincts in the suburbs.


*Fig 4. The city of Newcastle is the capital of the Hunter Region, around 140 kilometres north of Sydney, in New South Wales (Australia). The greater population catchment of Newcastle is around 600,000 people. The city centre is located on a narrow peninsula, between the Pacific ocean and the port. Through its close proximity to the city centre, the area around the Inner Harbour and Dyke Point (see 'Growth Area') is ideal for a sustainable city expansion along the waterfront, which currently consists of a series of underutilized and derelict spaces.*

Until today, the 'Honeysuckle' precinct remains an isolated fragment, only weakly connected to the existing city centre. There is now increasing pressure for an overall vision, which would deliver a robust framework for some future large development investments (which otherwise would remain 'dispersed mosaic projects').
- Predicted population growth: Most new jobs are created in the growing service sector or to build houses for new people arriving in Newcastle and the Hunter Region. For Newcastle city centre, the predictions are: 10,000 new jobs and 6,500 new residents in the next 20 years. In fact, since 1996, people have started to move back into the city centre, and, over the last ten years, the city centre has witnessed a population increase of around 6,000 people.

## 6. Two Models of Urban Design: *City Campus* and *Port City*

Large areas of formerly industrially used land – brownfield sites in prime waterfront locations – have become available for new ideas of sustainable urban development or conversion into parkland. The following, is a short description of two projects, *City Campus* and *Port City*. Both projects are based on a balanced approach, including renewable energy technologies and inner-city green space. They offer a great opportunity and vision for Newcastle to grow and regenerate in the near future. These two presented case studies to renew the post-industrial landscape, are:

- Densification model: By 2012 - The *City Campus* will be a major contribution to the densification and revitalization of the City Centre;
- Expansion model: By 2018 - The *Port City* will be a unique opportunity to expand the city centre along the waterfront.

## 7. First Urban Infill, then Growth along the Waterfront

***City Campus – Strategies for Urban Infill*** is a design study recently undertaken at the University of Newcastle, with the aim to accommodate educational facilities for 2,500 students in the area around centrally located Civic Park. The brief asked for university facilities, including a new public library, a flexible performing arts theatre space, buildings to relocate the Faculty of Business, and adjacent research and student services facilities, to be partially accommodated into new structures as well as into existing buildings (50% of the brief was to be accommodated in existing buildings through adaptive re-use). The relocation of significant parts of the University from its 1960s suburban campus back into the city will increase the university's presence and revitalise this neglected centre. A new landscape design for Civic Park is part of the project to get a high quality green space, green roofs and increased biodiversity within a sustainable neighbourhood. The *City Campus* will be based on optimised density and will include eco-buildings with ideal day-lighting conditions, where each city block gains maximum solar exposure for renewable energy generation, combined with good shading devices for western facades.
The urban renewal of the existing city centre can be generated through such programs that carefully develop new densities around transport nodes or along park edges and cultural precincts, hereby improving the quality of urban life for all groups, including disadvantaged residents. 'Sustainable neighbourhood' has been defined as 'a compact community cluster using as little natural resources as possible, with careful consideration for, and improvement of, public space.' [6] The *City Campus* will facilitate the revitalisation of the city centre and be instrumental in halting any further decline. The design proposals were publicly exhibited and discussed, and key recommendations for policy makers have been formulated.

***City expansion along the waterfront: The Port City*** proposal: The world's most intriguing city centres are the ones located on the water edge, and the most successful waterfront cities are those that are based on developments which celebrate the relationship between the city and the harbour. Large port infrastructures juxtaposed with the cityscape is a constant inspiration for any planner and architect. In preparation of this urban

design project, similar port redevelopment projects, such as in Hamburg, Rotterdam, Genoa, Vancouver and Barcelona have been analysed.

'Port City – reclaiming the post-industrial waterfront' is part of the urban design study involving a cohort of final year architecture students and is based on strategies for reclaiming former industrially used waterfront land. It is a mixed-use urban waterfront development of ten hectares, of which about half will be dedicated to public parkland. Once the industrial working harbour has moved up the Hunter River (in around seven to eight years), it is proposed to connect the Dyke Point peninsula with the city centre by a new pedestrian and cycle bridge, so that the now underutilised land can be turned into a carbon-neutral city precinct. This mixed-use extension of the city along the waterfront land would be strongly connected to the Honeysuckle precinct by the footbridge. Forging such a strong link between the city centre and the waterfront development and integrating the existing local community, are both crucial to the success of the *Port City*. The aim for the *Port City* is to be a zero-emission development, to demonstrate that it is affordable and achievable to make such a major new urban development carbon-neutral. All energy is to be provided by distributed power generation from a variety of sources – photovoltaic and wind (utilizing building roofs and facades), as well as biomass and consideration of geothermal. These measurements would turn the new city district into an 'urban powerstation', covering its own energy demands.

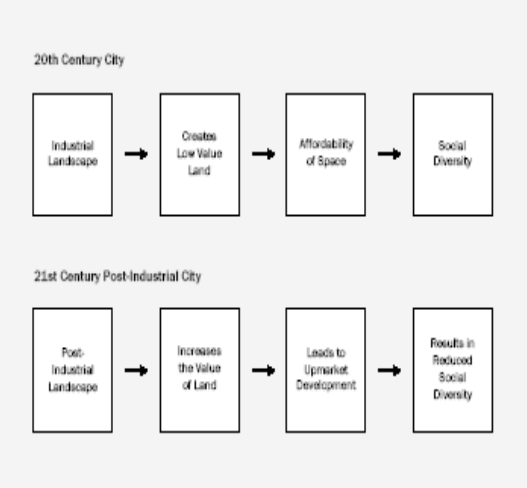


*Fig 5. The city's transformation from the 20th century industrial to the 21st century post-industrial condition is not without problems: The increase of land value leads frequently to a kind of upmarket developments which result in reduced social diversity. (© diagramme by the author)*

There are reliable studies available on the issue of payback of such urban investment and the transformation of the city to such sustainable models based on decentralized renewable energy generation. For instance, American scientist Greg Kats is the internationally known author of the most widely referenced study of the costs and benefits of green buildings and cities. (In regard to payback times, refer to: Kats, G. et al; 2003: '*The Costs and Financial Benefits of Green Buildings'*; a report to California's Sustainable Building Task Force). [9] This study has demonstrated conclusively that sustainable building and the use of renewable energies is a cost-effective investment. According to Sir Nicholas Stern's review (Stern, 2006), delaying the shift to clean energy will cost us more in the long run; he convincingly pointed out that to weaken or delay the clean energy shift would be poor economic management. [10]

Urban design encapsulates a series of critical and complex dependencies. Questions of density, scale, ecological footprint, connection to urban public transport, optimized solar orientation, and the maritime heritage of the working harbour are all critical to the project, as is the social integration of the established local community. Optimized building shapes, appropriate orientation, internal layout and the position of openings and sun shading – all these criteria can enhance natural ventilation and reduce the need for air-conditioning during the hot summer periods. Special care has been given to the urban layout of the Port City, to ensure maximum solar gain in winter (when the sun is low), and – at the same time – to avoid buildings too close to each other (which otherwise would hamper natural lighting).

It is important to note that the implementation of most of the mentioned urban design rules is made easier if the urban layout of the new district has been properly and carefully configured. Our study has taken a cohesive approach to demonstrate this. The study has also illustrated how the staging of the *Port City* development and the site remediation could be used to drive the design approach and enable a step-by-step approach. At the beginning, one could activate the existing Carrington Pump House (built 1877) as a catalyst and starting point of the development. In the final stage, the *Port City* would offer 2,000 units in this very special inner-city waterfront living and working environment.

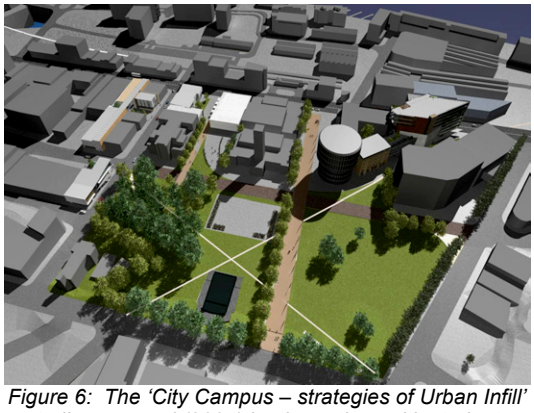

*Figure 6: The 'City Campus – strategies of Urban Infill' studio, proposal (2007) by the author, with students Michael Smith and Tim Hulme. Half of the new educational facilities will be accommodated in existing buildings, through adaptive re-use strategies.*

*Figure 7: The 'Port City – reclaiming the post-industrial waterfront' studio, proposal (2007) by the author, with student Bede Campbell. This new city district will act as its 'urban powerstation', harnessing solar and wind energy to generate decentralized energy; the harbour water can be utilized for cooling the buildings.*

## 8. Conclusion

The *anti-sprawl critique* was raised by Jane Jacobs in the early 1960s leading to a mainly negative image of suburbanisation. However, the implementation of more compact, denser city expansions will need to deal with emerging issues and challenges that come along with higher densities and less distances between buildings, such as social changes and conflicts in inter-neighbourhood relationships, e.g. of multi-apartment housing (for instance, in Sydney some 25 per cent of the population now live in multi-unit housing, which has started to change the social fabric. This proportion is still low in comparison with European cities, but is predicted to grow to 45 per cent by 2030). [7] [8]

It is likely, that in future, new theories of ecosystems will increasingly be applied to urban systems, with the aim to increase the environmental sustainability and dynamic intensity of urban activities (e.g. to ensure the vitality of public space); a clear advantage of applying more of such evolutionary approaches in urban planning will be, that the complexity of urban life and its related processes are better understood.

This paper has illustrated how we are able to address the need for environmental sustainability on the urban scale. The wish to achieve a real difference requires urban designers to rethink the city and urban planning conventions. New compact models for urban growth will be part of long-term strategies for urban renewal and help to achieve a sustainable, revitalized city centre. In terms of integrating and re-using existing structures, the most sustainable building is the one that already exists (due to its embodied energy). This approach has also the advantage that it keeps the city centre authentic, and the public space network vital, while carefully developing higher densities around transport nodes and cultural / educational facilities.

Today, in many cases, large corporations and department stores have abandoned the city centre, while downtowns are increasingly turned into residential districts and centres of entertainment, education and culture. The *City Campus* project proposes a denser, mixed-use and revitalized city centre, where educational facilities and the university play a major role.

On the other hand, the *Port City* project recommends a model for urban expansion - to be applied after having first densified and revitalized the city centre for several years. Our study has revealed the tremendous potential of a harbour in the city in general, and of these formerly port-related waterfront sites in particular.

## 9. Acknowledgements

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## 10. References

[1] Gauzin-Mueller, Dominique, (2002). *Sustainable architecture and urbanism: Concepts, technologies, examples*. Birkhaeuser, Basel

[2] Lehmann, Steffen, (2006). *Towards a Sustainable City Centre: Integrating Ecologically Sustainable Development (ESD) Principles into Urban Renewal*. In*: Journal of Green Building*, College Publishing, Vol. 1, Number 3 (Summer 2006) pp. 85-104

[3] Urban Land Institute, (2007). *Growing Cooler*, study by ULI, USA; www.uli.org

[4] Carson, Rachel (1962). Silent Spring, USA.

[5] Scott, Andrew, (2006). *Design Strategies for Green Practice*. In*: Journal of Green Building*, College Publishing, Vol. 1, Number 4 (Fall 2006) pp. 11-27

[6] Breheny, Michael J. (1992). *Sustainable Development and Urban Form*. Pion.

[7] Newman, P. and Kenworthy, J. (1989). *Cities and automobile dependence: An international source book*. Gower, Aldershot.

[8] Burton, E. (2000). *The compact city: just or just compact? A preliminary analysis*. In: *Urban Studies*, no 37 (11, 2000).

[9] Kats, Greg, et al. (2003). *The Costs and Financial Benefits of Green Buildings*; report to California's Sustainable Building Task Force, Oct. 2003.

[10] Stern, Sir Nicholas (2007). *The Stern Review: The Economics of Climate Change.* Cambridge University Press (2006, published 01/2007).