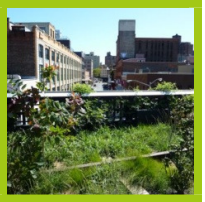
Sustainable Development

Municipal Engineering Foundation Victoria

International Study Tour 2009
David Fricke

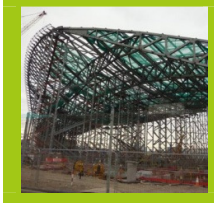












Municipal Engineering Foundation Victoria

Institute of Public Works Engineering Australia

City of Moonee Valley

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Acknowledgements

I would like to acknowledge the grant received from the Municipal Engineering Foundation Victoria (MEF). As a recipient of the study tour grant, I was one of five public works engineers from around Australia to participate in the Institute of Public Works Engineers Australia (IPWEA) National Overseas Study Tour 2009.

I also appreciate the support of Moonee Valley City Council in recognising the value of the tour and allowing me the time to attend.

Executive Summary

The 2009 International Study Tour provided the opportunity to take a first hand look at a wide range of potential measures that could improve the sustainability of our cities. A recurring theme throughout the tour was the Bioregional 'one planet living' concept, which was outlined by Bob Berkebile at the APWA National Congress. This concept is focussed on identifying the necessary changes to enable society to live within the planet's resources.

It was noted during meetings with the Olympic Delivery Authority in London, that the Games' theme 'Towards a one-planet Olympics' was derived from the Bioregional concept. One of the objectives of the Games is to raise awareness of sustainability and to showcase demonstration projects on a large scale.

Another recurring theme was the New Urbanism movement, which was discussed during the visit to New York University Polytechnic (NYU Poly). The principles of New Urbanism could be observed in all of the case study developments that were visited and were noted as ways to improve the sustainability of these developments. For example, the importance of appropriate density was emphasised in Copenhagen

and Malmö. A density of five to six storeys was considered to be a 'human scale', which provided sufficient population density to support local services and efficient public transport. This scale also allows all residents to have reasonable access to sunlight and does not feel excessively overcrowded.

Related to this, a phrase that was heard repeatedly from many of the engineers and planners that we met in Denmark and Sweden, was that development should allow people 'to be part of city life'. This meant that development should seek to create mixed-use neighbourhoods where people can walk to most of their daily needs, thus creating opportunities for social interaction. This also minimises the need for unnecessary car travel.

One of the key ways that cities can become more sustainable is to reduce car dependency. Each of the developments that were observed sought to discourage car use by making it unnecessary and even cumbersome for day-to-day use.

Through the study tour, a range of recommendations have been identified that could aid sustainability. These are focussed on the areas where municipal engineers are most likely to be of influence. Therefore, while public transport is an obvious area of interest in reducing car dependency, it is not a key part of the report as it is generally a state government function in Australia. Instead, the report focuses on what can be done to make walking and cycling more attractive, as these are more within the normal realm of local government. Public transport is considered only in terms of its availability and accessibility.

Another issue that was investigated in a range of contexts was the urban heat island effect, which is caused by the concentration of dark coloured, heat absorbing surface materials of roads and buildings. It is estimated that it can lead to an increase in air temperatures of more than four degrees Celsius. Due to its impact on the liveability of cities, it is also related to the ideas of New Urbanism. Reversing the concentration of dark, heat-absorbing materials can reduce the impact of the urban heat island effect. Innovative examples of addressing this concern were observed, such as the development of the Highline Park in New York, changes to the type of paving products used, various water sensitive urban design treatments and the use of green roofs in Malmö.

The report also considers ways of reducing the greenhouse gas emissions produced by energy. Although energy production is not generally a local government responsibility, Woking Council outside London is an example of a municipality taking a lead role in developing and promoting the use of decentralised energy production and district heating networks. It is estimated that up to two thirds of energy in electricity generation is lost through heat and transmission. Therefore, local electricity generation and the harnessing of the heat produced can play a significant role in reducing greenhouse emissions.

Introduction

Overview of Study Tour

The 2009 IPWEA National Overseas Study 2009 took place from 11 to 30 September 2009.

Chris Champion, Chief Executive Officer of IPWEA, led the tour. Dave Harris, National President of IPWEA also attended the American leg of the tour. The other study tour participants were:

Wayne Prangnell	Director Infrastructure Services	Augusta Margaret River Shire Council, WA
Gary Baker	Manager Infrastructure, Assets and Maintenance	City of Port Adelaide Enfield, SA
Gerhard Joubert	Manager Infrastructure Planning North	Moreton Bay Regional Council, Queensland
Peter Miller	Team Leader, Civil and Structural Engineer	Barnson Pty Ltd, NSW

The tour commenced in the USA where we attended the American Public Works Association (APWA) National Congress in Columbus, Ohio. In addition to some worthwhile presentations, the Congress was a valuable opportunity to meet with public works practitioners from a range of communities. It was interesting to note the many common issues we face and to consider different approaches. For example, I met a number of participants in an Emerging Leaders Program that APWA was running. The program itself was similar in format to the Victorian LGPro Emerging Leaders Program (except that the APWA program was specifically for public works leaders) and I attended a presentation by the group on potential uses for social media in public works.

Following the Congress, the group visited a range of other agencies, with various aspects of sustainability being a common theme to the visits.

We first travelled to New York, where we met with staff from the Civil Engineering Department of New York University Polytechnic (NYU Poly). Our time in New York also provided the opportunity to look at some innovative treatments for the reallocation of road space and also to see an interesting new park, The High Line.

From New York, we travelled to Copenhagen, Denmark, where we spend our first day with the City of Copenhagen. For a different perspective on urban planning and traffic issues, we then spent a day with staff from the City of Odense, Denmark's third largest city with a population of 187,000. We also spent a day in Malmö, Sweden, which is connected to Copenhagen by the Öresund Bridge.

Figure 1 - the study tour group in a meeting with staff from the City of Odense

While in Odense, the group was fortunate to be hosted in an historic building that had just been renovated. It now houses the City's main civic meeting rooms.

The group then travelled from Copenhagen to London, where we met with the Olympic Delivery Authority and were given a tour of the London Olympic Park. We also spent a day investigating alternative energy options, with visits to the London Development Agency and Thameswey Energy.

Scope

The focus of the report is on how cities affect the way that we live. Therefore, with a view to making cities more sustainable, the question posed by the investigation is:

> What can be done differently in our cities to influence the way that citizens live, in order to reduce their consumption of the earth's finite resources? In particular, what impact can those involved in the public works sector do encourage a more sustainable lifestyle in the communities that we serve?

The report also considers some related issues such as how cities can be made healthier, more pleasant and enjoyable places to live for their inhabitants.

Objective

The way that we live our lives in cities is very energy and resource intensive. As outlined below in the definition of sustainable development, it is estimated that if the whole world lived like the average Australian or North American, we would need five planets to support us.

The study tour provided an opportunity to learn about some of the measures that are being taken in other parts of the world to reduce the impact that cities have on the environment. Initiatives to reduce the need for private car use were observed in a number of locations outside the formal study tour schedule.

The objective of this report is to identify measures that could be implemented in Australian cities to enhance the sustainability of urban living.

Background

What is Sustainable Development?

A keynote speaker at the APWA Congress, Bob Berkebile, Principal of BNIM Architects, spoke on the topic of Infrastructure for the 21st Century. Bob outlined the concept of One Planet Living, which is promoted by the organisation BioRegional, for which he is on the North American Board of Directors.

One Planet Living is concerned with how we can live within our fair share of the earth's resources[1]. The BioRegional website contains tools for calculating ecological footprint. Based on the method that the organisation has developed, it is estimated that if everyone in the world consumed as much natural resources as the average person in the UK, we would need three planets to support the total population. If everyone consumed as much as the average North American (or Australian[2]) then we would need five planets.

With this in mind, sustainable development could be considered in terms of developing cities in ways that help their citizens to live within the limits of the planet's natural resources. It is probably unrealistic to think that any individual development in Australia could have such an impact on its inhabitants as to reduce their resource consumption to sustainable levels (ie. A 'one planet' ecological footprint). However,

[1] www.bioregional.com - One Planet Living

[2] (Australia assumed to be similar to North America, on the basis Australia's per capita consumption of fossil fuels is similar)

any new development that enables its inhabitants to reduce their consumption of the world's resources below their previous levels is contributing to a more sustainable future.

Engineering Education and Sustainability

Professor Bugliarello of NYU Poly spoke about the phenomenon of rapid urbanisation in the developing world[3]. He also observes that urban sustainability needs to be considered with respect to two contexts:

- Local context – conditions in cities that make them liveable indefinitely.
- Global context – impact of urban phenomenon on global sustainability.

When planning for the future of our cities, consideration of historical reasons for the downfall of cities may help us to avoid some of the pitfalls that have beset many once great cities. For example, in some cases there will be a need to consider how to manage and plan for "shrinking cities". Detroit and Venice are well known examples of this phenomenon. In other cases, major industries moving out of a city may be an opportunity for reinvention. Good examples of this were observed in Copenhagen and Malmö, as outlined further in this report.

City as a System

Dr Kate Garnet of NYU Poly observes that cities need to be considered as systems – they are complex and interdependent. She also emphasises that we need to move towards an integrated urban future. This means that we need to aim for cities that are better, smarter, greener and more secure.

Professor Bugliarello outlined a paradigm for thinking about cities – the Biosoma:

Bio	Biological – humans and other species;
So	Social – organisations, government, business, family, religion, customs, trust;
Ma	Machine – infrastructure, housing, transportation

These all need to be considered in the context of the wider environment – geography, climate and resources. The city is a system of systems, made up of a myriad of interacting components.

In the discussions that took place at NYU Poly, it was noted that the educational needs of engineers are entering a new phase. To best serve our communities, engineers of the future will need to be educated in technical, techno-environmental and biosocial disciplines. For example, Massachusetts Institute of Technology (MIT) now requires engineering students to study biology and Yale is undertaking urban ecology research.

In a local example of the need for public works engineers to become involved in non-traditional fields, Stormwater Victoria and the Australian Institute of Landscape Architects have held a joint seminar, 'Blurring the lines – where does landscape architecture stop and engineering begin?'

Sustainable Cities

NYU Poly has been developing courses over the past three years around the idea of sustainable cities. One of the issues being considered is the convergence of urbanisation and sustainability. It was noted that cities in the developing world have greater "plasticity" than those in the developed world. That is, the rate and scale of

[3] Urban Sustainability – A Global Perspective, Prof George Bugliarello, NYU Poly

change in developing cities means that there is still some ability to shape cities as they grow. However, in the developed world, there is generally very little opportunity to shape the way a city works on a large scale. Therefore, any change towards making established cities more sustainable needs to be considered on a more incremental basis.

It was also noted that engineering courses at NYU Poly consider the concept of "New Urbanism". New Urbanism[4] promotes the creation and restoration of diverse, walkable, compact, vibrant, mixed-use communities. These contain housing, work places, shops, entertainment, schools, parks, and civic facilities essential to the daily lives of the residents, all within easy walking distance of each other. New Urbanism also promotes the increased use of trains and light rail, instead of more highways and roads.

New Urbanism is an international movement that aims to reform the design of the built environment and is about raising our quality of life and standard of living by creating better places to live. It involves fixing and infilling cities, as well as the creation of compact new towns and villages.

The principles of New Urbanism include:

1. Walkability – most things within a ten-minute walk; pedestrian friendly street design.
2. Connectivity – an interconnected street network disperses traffic and eases walking; a hierarchy of narrow streets, boulevards, and alleys; high quality pedestrian network and public realm makes walking pleasurable.
3. Mixed-use and diversity – a mix of shops, offices, apartments and homes; mixed-use within neighbourhoods, within blocks and within buildings; diversity of people – ages, income levels and cultures.
4. Mixed housing – a range of types, sizes and prices in closer proximity.
5. Quality architecture and urban design – emphasis on aesthetics, human comfort and creating a sense of place.
6. Traditional neighbourhood structure – discernable city centre and edge; public space at centre; contains a range of densities and uses within a 10-minute walk; highest densities at town centre and progressively less dense toward the edge.
7. Increased density – more residences, shops and services closer together for ease of walking, to enable a more efficient use of services and resources and to create a more convenient, enjoyable place to live.
8. Smart transportation – a network of high-quality public transport that connects cities, towns and neighbourhoods; a pedestrian friendly design that encourages cycling and walking as daily transportation.
9. Sustainability – minimal environmental impact of development and its ongoing operation. This means greater energy efficiency, less use of non-renewable energy, more local production and more walking/less driving.
10. Quality of life – taken together, these principles add up to a high quality of life and create desirable environments in which to live and visit.

While these principles may seem far removed from typical suburban Australian development patterns, they should not be dismissed as being irrelevant or unachievable in the Australian context. Many of the principles can be seen in older inner-city areas, which were developed before the era of the motorcar. Throughout the world, many of these areas have undergone regeneration to become some of the most desirable places to live.

[4] www.newurbanism.org

Examples of this can be seen in the gentrification and redevelopment of older areas in most Australian cities. Similarly, many European city centres exemplify these principles and are widely regarded as great places to live and to visit. During meetings in Copenhagen and Malmö, it was noted that the old centres of both cities had seen a resurgence in popularity as places to live over the last 20 years.

In the USA, New York City encompasses many of the principles of New Urbanism, with high densities, mixed use and good access to public transport. Residents clearly appreciate the ability to access a wide range of local attractions. Most residents of Manhattan would live within an easy walk of all of their day-to-day needs, as well as a wide range of recreational options.

Figure 2 - Union Square farmer's market

Recommendations for engineering education

1. **The public works profession and tertiary institutions could both benefit through a closer relationship, such as that observed between NYU Poly and the City of New York.**
    a. **In New York the scale of the City with 8.5 million residents aids this relationship. This puts it in a good position to work with key local engineering institutions such as NYU Poly.**
    b. **In the Australian context, where most individual municipalities are too small to effectively deal with tertiary institutions on an individual basis, the relationship would be better focussed on peak bodies such as IPWEA. A recent example is the collaboration between the Municipal Association of Victoria (MAV) and Swinburne University, to study the suitability of recycled materials as a base for footpaths.**
2. **Closer links between the public works sector and engineering institutions could also be used as a means of promoting careers in public works to tertiary students. This is already happening to some extent, with initiatives such as MEF sponsored places at public works conferences for tertiary students, but the issues needs ongoing attention to ensure that local government is taken seriously as a career option by engineering students.**
3. **Engineering courses need to encompass a broad range of subjects and have a view to what engineers of the future may be likely to need. For example:**
    a. **Environmental engineering courses are already popular, but shouldn't be viewed solely as a specialist area. For example, all engineers involved in drainage will need to understand water sensitive urban design principles.**
    b. **As preparation for careers in the field of public works, engineers should be aware of the various other professions involved such as planning and landscape architecture, as well as any emerging issues such as New Urbanism.**

Development Case Studies

For the purposes of this report, the developments that were investigated during the study tour form the basis of the consideration of aspects of sustainable development. These were Nordhavnen in Copenhagen, Western Harbour and Augustenborg in Malmö and the development of the London Olympic Park for future residential use.

Nordhavnen, Copenhagen

Background on Copenhagen

Copenhagen City has a population of approximately 500,000. The wider metropolitan area has around 1.8 million and when Malmö, over the Oresund Bridge in Sweden and surrounding commuter areas are included, there is a total urban population of approximately 2.7 million.

The Old City is the main centre and tourist area and is home to approximately 7,000 residents. Many buildings were converted to offices in past decades when the old buildings were not a desirable place to live. The City is now trying to encourage more residents back. The "human scale" of this area is now appreciated – therefore, no high-rise development will be allowed in this area.

The City reported that 57 percent of Copenhageners currently use bikes for commuting. It was also noted that the City as a whole aims to be carbon neutral by 2020.

Nordhavnen (North Harbour)

Nordhavnen was constructed on reclaimed land, mostly between the 1880s and 1930s and catered for a range of harbour and port-related activities. The economy has changed since that time, with a move away from manufacturing. This has resulted in the obsolescence and closure of port related facilities. Therefore, land at Nordhavnen is now available for redevelopment.

The site has an area of approximately 200 hectares and is very close to the centre of Copenhagen. The City intends that urban development of Nordhavnen will counter the trend towards increased commuting in the region, through the creation of new local housing and workplaces.

Figure 3 - Nordhavnen, before closure of shipping

The City's plan is to ultimately accommodate approximately 40,000 residents and 40,000 jobs in the area. These figures were determined in light of what the City considers to be the ideal population density of approximately 200 people per hectare. It is also preferable to have a balance of residents and jobs, to increase the opportunities for people to work locally and reduce the need for travel.

By&Havn was formed approximately two years ago, through a merger of the Port Authority, which was approximately 100 years old and Orestad Development Corporation, which was founded in 1992 to develop Orestad. The company owns the Nordhavnen land and is developing it for the City.

The City has decided that the objective for Nordhavnen is to be a sustainable city of the future. This includes consideration of environmental and social sustainability and encompasses six aims/visions for the city:

- Eco friendly city
- City at the water
- City for everyone
- Dynamic city
- City of sustainable mobility
- Vibrant city

The Government will use profits from development of the land to help fund a new metro line, which will cost an estimated 15 billion Danish Krones ($3.2 billion AUD).

The project was opened up to an international design competition. As part of this process, ideas were defined in a brief that was jointly prepared by the municipality and the development corporation. The brief was prepared as a glossy, magazine-style document[5].

There were 180 entries received from 36 countries, mostly in Europe. The information that was required related to planning, not building detail. Three winners were selected, who were each paid to do further development of their proposals.

Significant citizen involvement was sought at all stages, which included:

- Opportunity for the input of ideas to be included in the brief.
- An exhibition was staged to display all of the 180 submissions. This was done to enable input on the judging, with comments submitted to the jury for consideration.
- The public were taken on boat trips around the site to gain a better appreciation of it.

The winner was COBE, Sleth og Rambøll, a Danish firm of architects and engineers. The winning scheme uses canals to separate different quarters (or islands) that make up the total development. The benefits of this are that:

- Each island can have its own identity.
- The development can be staged, without residents feeling like they are part of a development site when further stages are being developed.
- Excavated material from the proposed metro tunnel will be re-used to build the reclaimed areas.
- Incorporation of a "green loop", which will include an elevated metro line and bike lanes. It also aims to secure biological diversity.

[5] Brief Open International Ideas Competition Copenhagen 2008, www.byoghavn.dk

- Aims to be the 'five minute city' – a reference to the maximum length of any walk that will be required. For example, from your home or office to transport, shops or other attractions.
- Maximum distance to walk to public transport will be 600 metres.

It is estimated that approximately a third of residents will walk (to work or transport), a third will travel by bike and a third by car.

Experience has shown that the market for this type of development, being relatively affluent, cannot be persuaded to go without cars entirely. However, they can be persuaded to use them less and to have one rather than two cars per household, provided that other transport options are attractive.

Car parking will be available for residents, but not necessarily right at their house – it will be in designated areas. Parking will not be available for workers.

Figure 4 - Winning design for Nordhavnen

Energy for electricity, heating and cooling has been considered from the outset of planning for the project:

- Heating – a distributed heating system is used by almost all homes in Copenhagen. Nordhavnen will be zoned as a low-energy area in which low-energy district heating will be available[6].
- Electricity – currently all from power plants. Initially, some wind turbines will be used and it is planned that solar will also be introduced later. There is an aim to maximise local generation.
- Cooling – not really needed/expected in the past, but is becoming more needed/common. Typical air-conditioning is a heavy user of electricity. Therefore, a distributed cooling system is proposed – using ground and/or seawater to circulate chilled water for cooling.

[6] Brief Open International Ideas Competition Copenhagen 2008, www.byoghavn.dk

With these initiatives, the City is planning for Nordhavnen to have a zero carbon footprint in terms of energy. This will be controlled by placing a limit on the total energy that each home is allowed to use, which will require residents to use energy efficient appliances and appropriate building standards.

The City is concerned that many companies attempt to use "green" as a marketing tool. Therefore, there is a desire to ensure that companies and/or residents don't move into the area just to prove their green credentials (or appear "green"). Controls are still being investigated in this regard.

Denmark uses pure groundwater for drinking water, with virtually no treatment required. Therefore, it is important to protect the quality of groundwater, which is why the rest of Copenhagen currently uses a combined sewer system. In Nordhavnen, there will be a requirement for all storm water to be re-used on site.

Land will be raised to approximately three metres above current sea level to allow for the impacts of climate change. The old city is only one to two metres above sea level. It was noted that the intention of the City is to plan for affected areas to cope with occasional flooding (similar to Venice) rather than trying to prevent it.

One of the reasons that many people move to outer suburbs is to have green spaces and gardens. Therefore, an aim for Nordhavnen is to provide for these needs in a more central and higher density location.

Around two years ago, apartment prices in central areas of Copenhagen were approximately 30,000 to 35,000 Danish Krones per square metre ($6,300 to $7,400 AUD). However, prices are currently falling and there is very little residential development, which will affect the staging of development.

Western Harbour, Malmö

Background and History

Malmö is Sweden's third largest city, with a population of 280,000, while the greater Malmö metropolitan area has a total population of 630,000. The city has evolved from having an economy based around heavy industry and its focus is now on knowledge. Industry such as wind farms and railway components are still important to the city. Malmö has a young population compared with the rest of Sweden, with around 50 percent of the population being under 30 years of age.

The population is growing by approximately 5000 to 6000 annually. Therefore, while development has slowed due to the economic downturn, there is still demand for housing.

Malmö removed its tram system in the 1970's in favour of cars. This is now recognised as a mistake and the City is looking to reintroduce trams within the next 10 years.

The connection to Denmark is very important strategically for Malmö. It has cheaper rents than Denmark, which make it attractive for living and as a base for businesses, while having ready access to Copenhagen. Approximately 16,000 people travel between Malmö and Copenhagen each day.

Figure 5 - Map showing Copenhagen and Malmö connected by the Öresund Bridge. Bo01 is the first stage of development in the Western Harbour area.

The Western Harbour area is all landfill and was created in stages from the 1870s through to the 1980s. It was created for shipping and related industry and when this closed in the early 1990s, a large part of the population was left unemployed.

The development of the Western Harbour area evolved from a crisis – the closure of shipping and loss of thousands of jobs. However, the City has been able to turn this into an opportunity. At the height of the area's industrial past, a single company, Kockums Mechanical Works, employed 6,000 people. Today, aside from the residential development, the area is home to 200 companies, employing 8,000 people. This diversification, along with enhanced regional connectivity, should ensure a more stable future for Malmö.

Figure 6 – Western Harbour Malmö, prior to closure of shipping

Sustainable Development for the Western Harbour

The vision for the Western Harbour is to create a national example of sustainable urban development[7]. Economic, social and environmental sustainability were all considered of equal importance. For example, to enhance economic sustainability, the City has collaborated with developers to ensure a high proportion of rental flats in the area, while not compromising on the standards of sustainability, style and durability. In terms of social sustainability, developers have been encouraged to ensure that housing is suitable for all stages of life and is accessible for all. Safety has also been considered, through designing a layout that encourages outdoor movement and ensures that homes overlook walkways to provide passive surveillance.

The City wants the area to be comprised of a mix of work and study facilities, services and housing for a broad cross section of the population. To ensure a mix of residents, the Western Harbour will contain a range of housing types, including rental apartments, cooperatives and freehold properties.

Landfill for the redevelopment of Western Harbour was completed around 2002. In 2008, the population was approximately 3,200 in 175 hectares.

The first stage of development was the demonstration project Bo01, which was developed in connection with the Bo01 European Housing Exhibition in 2001 and received government support of €25 million ($39 million AUD). The demonstration project covers 22 hectares and has 1,420 apartments and around 2,000 residents.

Apartments are currently priced at approximately 1,850 Swedish Krona per square metre per year to rent ($284 AUD). This makes the area relatively expensive compared with the rest of Malmö.

In subsequent stages, development needs to be economically viable in its own right. Therefore, the challenge is for developers to be able to deliver affordable rents, while still meeting required sustainability objectives. In the second stage, the City aimed to provide 70 percent affordable housing. To achieve this, increased density was required and it has been possible to bring rental prices down to around 1,300 Swedish Krona per square meter per year ($199 AUD).

In the planning process, the aim was to seek a 'creative dialogue' with developers, rather than the adversarial approach that can often characterise negotiations regarding development.

Variety was rated as important, in terms of vegetation, built form, colour and materials. Therefore, the City sought to have as many developers and architects as possible involved in the area's development. There were incentives for investors and developers to perform well.

The aim is for the Western Harbour to be a city for humans, not cars. Therefore, pedestrians and cyclists have priority in the way that roads have been designed.

The area is within walking distance of the city centre and is planned as a place that can be enjoyed by all residents and visitors to Malmö, particularly given its location on the coastline. Therefore, it was determined that no 'gated communities' would be allowed.

[7] Plans and Strategies for Western Harbour, City of Malmö, 2008

The scale and density of the Western Harbour has been modelled on that of Malmö's city centre. Apartment buildings are generally five or six storey, except for the Turning Torso, which is the second highest apartment building in Europe (the highest is in Moscow). Prior to the closure of shipping, Malmö's main landmark on the horizon was the Kockums crane (which can be seen in Figure 6 – Western Harbour Malmö, prior to closure of shipping). The City wanted a landmark tall building for the site to take the place of the crane on the horizon. The Turning Torso was designed by Spanish architect Santiago Calatrava and is the only high-rise building that will be allowed in the area.

Figure 7 - Turning Torso, towering over 5 and 6 storey waterfront apartment buildings

There will be more apartments with future development at the northern part of the site, which is currently dominated by business uses. This will achieve more balance between residents and workers.

Figure 8 - Western Harbour in 2009, with the Bo01 area in the foreground

Larger buildings are positioned on the outside, to protect smaller ones on the inside from wind. This is also the reason that there are no straight streets, as these would become wind tunnels.

The area has been designed around the idea of an environmental transport system, which is based on mobility management, information and persuasion. This includes:

- The City sells bikes cheaply to companies so that they can make them available to employees when they need to travel short distances, rather than taking the car.
- Cars are restricted in terms of where they can drive and park.
- Parking for bikes is much more convenient than for cars.
- Apartments in Malmö are generally provided with 0.9 car parking spaces per apartment as planning requirement. In the Western Harbour, this has been reduced to 0.7, with parking provided in central locations, rather than at each residence.
- Two bus routes with high frequency services were provided from the beginning.

It was noted that it was difficult to get people to change initially, as being an affluent area, people tended to have two cars per apartment. However, they are now realising that this is not necessary.

Figure 9 - Company bicycles outside an office building in the Western Harbour

Figure 10 – Parking for bikes is convenient to apartments, but not for cars

Waste

In Bo01, food waste disposers have been included. A vacuum system is used to take waste from collection points in each building to an underground tank. A convenient collection system for recycling of paper, glass and plastics has also been considered from the outset of design.

Biodiversity and storm water management

Traditionally in Malmö, storm water would be directed underground into a combined sewer. However, in the Western Harbour, open channels and ponds have been used for storm water, as a means of cleansing and infiltration. This also helps residents to see a connection to the natural environment. For example, when it rains, water can be seen being directed from roofs into open channels and then into ponds. After

cleansing, storm water is then discharged to the sea, which is a saving in terms of the sewer capacity required for the area.

Planning requires developers to calculate a 'biotope area factor' (green space factor), whereby developments must achieve a certain score, with points allocated for the use of permeable areas, trees, green roofs etc. This requires landscape architects to calculate compliance and design, which has improved the overall quality of design. Vegetation helps to improve the microclimate and atmospheric hygiene, leading to a better residential environment.

Figure 11 - downpipes feed directly into open drains

Figure 12 - open drains feed landscaped areas and ponds

Augustenborg, Malmö

How can we make cities more sustainable through the use of plants on roofs?

Augustenborg is a 1950s development with 1,800 apartments and around 3,000 residents. It was considered the height of modernity when first built, but it became less desirable from the 1960s onwards, as people moved further out from the city to larger and more modern apartments. More recently, the rejuvenated city centre with its historic buildings has also become a desirable residential area. Augustenborg, meanwhile, became neglected and social problems had developed.

In addition to the area's social problems, flooding became a problem due to the combined sewer and rainwater system that was under capacity for modern conditions. Since original development of the area, more green space had been replaced with hard surfaces and natural streams had been diverted into drains[8].

The area has now been transformed through a program of ecological improvement that has been widely recognised. The program was developed through an initial partnership between MKB Housing Company and the City of Malmö, which owns the adjacent (City owned) Augustenborg industrial area[9]. The program was developed

[8] T Graham, Echoes of Tomorrow, Ecostaden Augustenborg, Malmö, 2002, www.ecostaden.com

[9] T Graham, 2002

through funding from the European Union, the Swedish Government and the City of Malmö.

The starting point in Augustenborg was different to other developments such as Western Harbour, in that it involved 50 year old buildings, existing infrastructure and existing residents who were relatively poor people. The aim was to demonstrate the ability to make existing areas more sustainable, rather than to only focus on new developments.Dialogue with existing residents and businesses was a key factor in the success of the program.

One of the measures taken to reduce storm water runoff into the combined sewer has been to convert the rooftops of the industrial area into green roofs. There is approximately 10,000 square metres of green roof area, which is able to retain up to 70 percent of the rain water that falls on it. This keeps a large amount of rainwater from going directly into the drainage system, thereby reducing the risk of flooding.

The green roofs have other benefits including:

- Cooling the city as a whole – reducing 'heat island effect'.
- Help cleanse the air
- Looks good
- Good for human health – wellbeing is assisted just by seeing more greenery.

Figure 13 - Demonstration green roof on municipal building in Augustenborg

Figure 14 - Detail of typical section of green roof

The storm water system in the rest of Augustenborg has been redesigned so that water is directed into an open rainwater system. Downpipes discharge into a system open channels, which lead to a number of ponds throughout the area. The channels and ponds have become a landscape feature, improving the area's appearance and helping to develop a sense of pride in the area amongst residents. Similar to the open drainage channels in the Western Harbour, the rainwater system in Augustenborg helps to create a green oasis in an urban environment and helps to promote an ecological message to the community.

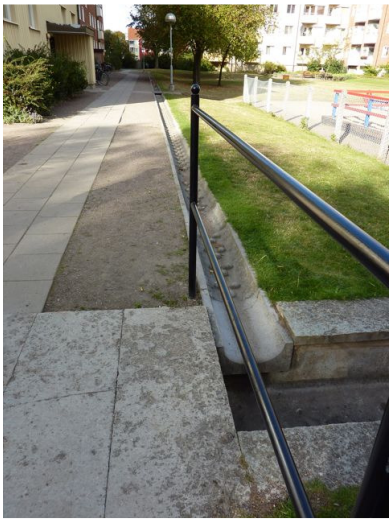

Figure 15 - Open drainage channels in Augustenborg

Figure 16 - Open drains feed ponds that help to cleanse storm water and also act as a landscape feature

The MKB Housing Company has undertaken building improvements aimed at saving energy. This has included restoring facades to their original appearance, the provision of new ventilation systems, low energy electrical fittings and additional insulation.

London Olympic Park

The Olympic Bid

Sustainability was at the heart of London's bid for the 2012 Olympics, framed by the concept of 'Towards a One Planet Olympics'[10]. This was derived from the Bioregional concept of 'One Planet Living', which was outlined earlier in this report.

The full carbon footprint of the Games has been calculated, including the embedded energy of materials, but is not yet available.

From the perspective of sustainable development, the development of the Olympic Park site is significant in terms of the ambition to reduce the environmental impact of the Games, as well as for the planning that is taking place for the legacy use of the site. It is hoped that the site will play a major part in the regeneration of this part of East London. The importance of planning for legacy benefit was a major part of the bid. The legacy that the area will receive from the Games is seen as making up for generations of under-investment in the area.

One of the sustainability targets is to improve on standard performance by 50 percent. For example, buildings should perform 50 percent better than current building regulations would require.

The Olympic Delivery Authority (ODA) is responsible for building the new venues and infrastructure for the Games, as well as ensuring that they have a viable legacy use. The ODA is also the planning authority for the Olympic Park site in East London. It is a

[10] London 2012 Sustainability Plan, London Organising Committee of the Olympic Games and Paralympic Games Ltd, 2007

public body funded through council tax, lottery and regeneration funding. The ODA has approximately 300 staff internally, plus a further 500 with its delivery partner.

The three key organisations involved in staging the Games are:

- ODA – set up as a planning authority – critical to the success of the project, in order to streamline decisions.
- LOCOG – London Organising Committee of the Olympic Games
- LDA – London Development Agency – Olympic Park Legacy Agency will take over from ODA for long-term management of residential development etc.

The total budget for the Games is £9.3 billion ($16.6 billion AUD) from government. Included in this, the budget for ODA is approximately £7 billion ($12.5 billion AUD).

The Olympic bid is based around three zones:

- Central London – road races etc.
- River Zone – Greenwich, Millennium Dome etc – fight sports (Judo etc).
- Olympic Zone – main stadiums and village.

Soccer will be played around the country.

The Olympic Park Site

This will be the first time that the Olympics have been held in a park setting since Munich 1972.

The compulsory purchase of land for the Olympic site was initiated before the bid was won, as this is a two to three year process. The London Development Agency (LDA) has as an objective of keeping jobs in London. Therefore, it was keen to relocate people and businesses locally wherever possible.

The ODA ultimately got possession of the land in 2007, with the Games having been announced in July 2005. The site is 500 acres including the village and is being planned in conjunction with an adjoining Westfield site.

The site covers four local authority areas. However, in contrast to major Australian cities, the Mayor of London has jurisdiction over the whole London area. Planning approval was obtained in mid 2007.

The Olympic Park site included the old Westham Tip, which included rubble from all over London following the Blitz. Therefore, it was anticipated that unexploded ordinance may be found – several hand grenades and one large bomb were found.

The master plan for the whole site includes transport planning. Road access to the site was already adequate and there is also good rail capacity. All public access to the Games will be by rail or bus. Part of the Eurostar will be used during the Games, which will be able to deliver 25,000 people per hour from central London in seven minutes. The site also has access to nine other rail lines.

Flood modelling has been done for the site and significant landscaping including wetlands has been incorporated into the design.

Construction

There are currently around 7,000 workers on the Olympic Park site. Workers are encouraged to travel by public transport. Parking for workers is very limited and is only available for those with a genuine need such as to bring in equipment.

There is a high level of security for all workers, including biometric security. As an example of the security planning that is taking place for the Games, an adjacent highway was identified as providing the only potential access for a large-scale bomb such as a truck bomb. Therefore, a multi-level car park has been strategically sited to protect the rest of the site from any blast from the highway. The car park will be removed after the Games.

There is a requirement that 50 percent of all construction materials must enter the site by rail or river.

To provide a benefit to the surrounding area, opportunities for local employment were desirable. This couldn't be mandated in contracts, but the values of the ODA were stated. Statements from tenderers regarding how they would address these values could then be considered as part of the tender assessment.

Construction of all major building works is on schedule to be completed by summer 2011, which will allow a year for commissioning and testing.

Legacy

A key aspect of the Games bid was the legacy that would be left for this area of London. Any venues or facilities without a legacy use after the Games will be temporary. For example:

- The basketball venue will be temporary.
- The upper part of the main stand will be removed after the Games. For the duration of the Games, the stadium will have a capacity of 80,000, however, there is no forecast demand in London for another stadium of this size after the Games. Attempts to get a soccer club to take over the stadium after 2012 were not successful and it is forecast that a capacity of only 25,000 will be required for the life of the stadium after the Games. Therefore, the upper part of the stadium with a capacity of 55,000 will be a temporary structure and will be removed after the Games.
- Consideration of legacy needs also includes the width of bridges throughout the site. Wider bridges will be required to cater to the large pedestrian numbers during the Games, but would exceed requirements afterwards. If left, over-sized infrastructure would detract from the appearance of parkland and be an unnecessary long-term maintenance cost. Therefore, under the contract to provide bridges, the contractor(s) will be required to remove the extra width after the Games (e.g. 12 metres down to 4 metres). The hope is that the contractors will be able to re-use the components (benefitting the environment through less waste) and that a good price will be obtained.
- There will be 45 hectares of concourse provided for use during the Games. This will be substantially reduced in legacy to better suit future use.
- The Aquatic Centre, designed by renowned architect Zaha Hadid with a 160 metre sweeping roof frame weighing more than 3,000 tonnes and resting on just three concrete supports, will be the gateway to the Olympic Park[11].
    - For the Games, the Aquatic Centre will have 17,000 seats, but this will be reduced to 3,000 in legacy.
    - In legacy the venue will provide two 50 metre swimming pools, a diving pool and dry diving area for community and elite use.
    - Additional seating for the Games will be provided utilising temporary stands on the outside of the legacy building. Therefore, the building really only comes into its own in legacy when the temporary stands are removed.

[11] www. london2012.com/news/media-releases/2009-11

Figure 17 - Construction of the Aquatic Centre's steel frame

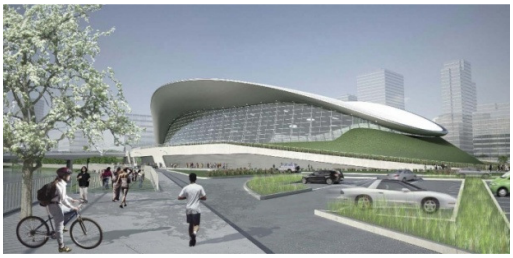

Figure 18 – Image of Aquatic Centre post Games

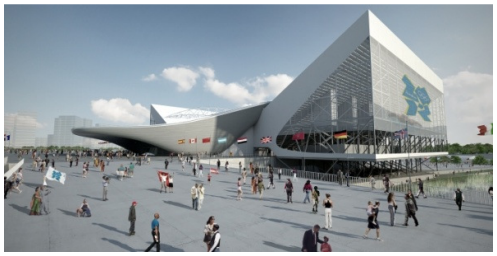

Figure 19 - Image of Aquatic Centre showing temporary stands that will be removed after the Games

Planning has included a focus on high quality design, but directed at the legacy buildings. Those to be removed are done much more cheaply. It is intended that their appearance will be enhanced with treatments such as lighting effects and screening. It is thought that the quality of design of the legacy buildings will be a key influence of the ODA's reputation after the Games.

Housing and Community Planning

Housing for Olympic teams will be in six large apartment blocks, each with four buildings facing a courtyard. There will be 17,000 beds required for the Games, in approximately 6,000 apartments.

It is considered that the apartments are being built to a high enough standard and will be managed well enough after the Games to ensure that they are socially sustainable. That is, that the area doesn't develop social problems that can be an issue in high-rise social/public housing.

Residential developments in London must provide a percentage of affordable and social housing. The London Housing Strategy has an objective for around 50 percent of new housing to be affordable, with around 70 percent of these being socially rented. The aim is to create mixed and balanced communities and avoid the creation of mono-tenure, mono-class neighbourhoods[12].

[12] London Housing Strategy, from www.london.gov.uk

It is planned that another 10,000 homes will be built after the Games on other parts of the site, as well as business development. Areas will be opened up in stages for mixed-use development. This will need to be managed with respect to surrounding developments, priorities and market conditions.

The overall Olympic Site is being planned in conjunction with an adjacent Westfield development. The direct benefits to the surrounding area are largely in the form of rail and road upgrades. However, some improvements are also planned for open spaces and public spaces in the surrounding area. This is primarily to improve perceptions of the area for visitors, but will also benefit the local area following the Games.

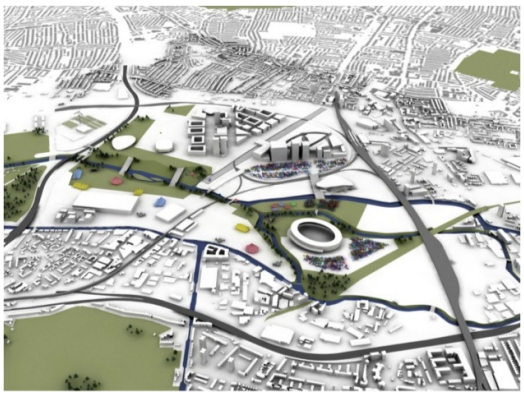

Figure 20 - Master plan for the Olympic site, immediately after Games

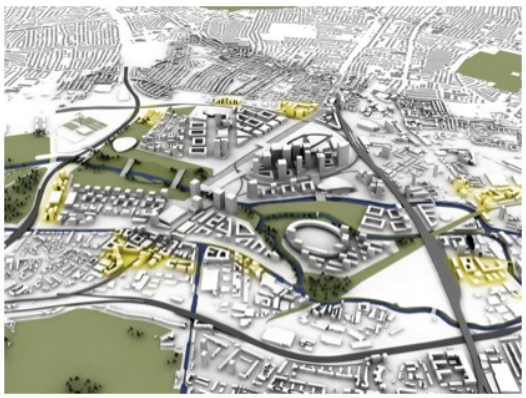

Figure 21 - Master plan for the Olympic site highlighting final stages of development

There are also employment benefits resulting from the works, such as training opportunities for local unemployed people.

The bid involved a £250 million ($447 million AUD) project to underground power transmission lines that went right through the site. The project involves the undergrounding of 2.5 kilometres of major transmission lines, which wouldn't have happened if the games bid had not been won. However, some other components would have proceeded, because regeneration was badly needed in this area.

The impetus of a major project such as the Olympics can be used to assist the regeneration of an area. The Olympics deadline creates a real sense of urgency that is not present in other regeneration projects.

Key Themes

Transport and Mobility – Reducing Car Dependency

Many good examples of initiatives aimed at reducing the use of the private vehicle in built up areas were observed throughout the tour. Each of the development case studies included this as a key objective.

Planning for Nordhavnen and the Western Harbour was focussed on ensuring that people would not need cars for their day-to-day lives. This led to design principles such as the `five minute city' concept for Nordhavnen, where there should never be a need to walk for more than five minutes between a person's home or workplace and transport and/or shops and other attractions. Both of these developments also

aimed to deter car use for short trips by making it less convenient than other forms of transport. They both used the approach that car parking would not be provided right at your home or apartment, but rather in centralised parking areas.

The London Olympic Park site was chosen in part for its very high level of public transport access. Therefore, the future housing component of the development will be well connected to other parts of London, reducing the need for car use. The site also benefits from its position next to a major Westfield shopping centre development. Given that approximately 37 percent of London households do not have access to a car[13] and that for inner boroughs more than 50 percent of households do not have a car[14], these connections are likely to be important for future residents.

Woking Council, which is considered later in the report for its alternative energy initiatives, has been working with business in the aim of removing or at least reducing the need for business people to bring cars into the town centre. Rental cars are available by the hour instead and these are high efficiency vehicles.

Woking Council operates a large car park in the town centre and uses this as an opportunity to promote and encourage the use of more efficient vehicles. The CO2 output of all vehicles is monitored and high emitting vehicles are charged more for parking.

Odense Traffic and Mobility Plan

Odense is Denmark's third largest city, with a population of 187,000. It is approximately an hour and a half by train from Copenhagen.

One of the City's visions for Odense is "To play is to live". This can be interpreted as creating a city where people are able to enjoy their daily lives.

According to the City's traffic planners, traffic planning in most of Denmark has tended to consider solely vehicles until recently. It is considered that Denmark has been behind Holland and Belgium with respect to involving cyclists, pedestrians and city life as part of traffic planning. The speed limit in residential areas is 30 kilometres per hour, which enhances the safety of pedestrians and cyclists compared with Australian cities.

The City has developed a Transport and Mobility Plan. The goals of the Plan are:

- To provide the physical frames to create a coherent city centre with a focus on city life.
- It must be easy to get by in Odense – in a healthy, safe and sustainable way.

The focus of these goals is on improving city life and the development of a compact city where the need for car use is minimised.

Pedestrian planning is a key component of the Transport and Mobility Plan. The Plan aims to create continuous pedestrian routes along desired paths of travel. It aims for pedestrians to be able to undertake a range of activities along a continuous route, without the need to retrace their path (back to where their bike is parked).

The Plan notes that studies show pedestrian activity increases where there are interesting things to see or do along a route. Therefore, the traffic planners have used

[13] Office of National Statistics, Households with Regular Use of a Car, 2000 www.statistics.gov.uk

[14] Office of National Statistics, Households without a Car or Van – Social Trends 2004, www.statistics.gov.uk

this knowledge to identify routes of interest to pedestrians, as well as to inform planning for the creation of new sites of interest. These may relate to planning controls to encourage suitable private development such as shops or cafes along key routes, as well as development of future City projects such as parks, streetscape works or public art.

Car ownership in Denmark has increased during 10 years of economic growth, but there is still at least one bike per person. The Plan intends that cars will still be allowed in the City, but will be more difficult to use.

Parking is currently in many small lots, each with around six to ten spaces. This results in a significant volume of 'parking seeking traffic' in the city centre. A ring road is being planned, which will effectively be a 'parking seeking route'. The city area within the ring road will be divided into quarters and it won't be possible to drive between them.

The existing parking lots will be replaced with a small number of large underground lots, positioned within 400 metres of the pedestrian area. This will reduce 'parking seeking traffic', as motorists will no longer need to drive from one small car park to another seeking a vacant space. The old parking lots will be turned into parks or public space.

These changes will be funded by private construction of the proposed underground car parks and the sale of land from closed sections of road. These will be sold with approval for development, which will enhance their value, as well as giving the City control of the form of the ensuing development.

It is estimated that 80 percent of all traffic currently using major roads is through traffic. The Plan aims to get these away from the city centre and also to ensure that no trucks will use the city centre as a short cut. Extensive traffic modelling has been done to support the Plan.

The Plan considers measures that can be taken to encourage behavioural change in the way that people travel. One of these is the Safe Routes to School (RTS) program, which aims to get school students accustomed to walking as a means of transport. Denmark was one of the first countries to pioneer SRTS programs[15] and early efforts were successful in reducing traffic speeds in the vicinity of schools. Odense first initiated such a program in 1979, while it was not until the 1990s that SRTS programs were being implemented in Victoria.

The Plan seeks to encourage a change in Odense's modal split, in part to support the City's environmental objectives. It is planned that:

- The number of trips taken by car must decrease by 16 percent by 2020.
- The share of trips made by bike should increase 25 percent by 2012 and 35 percent by 2020.
- The share of trips via public transport should increase 33 percent by 2020.

In relation to public transport, the Plan notes the importance of competitive travel times, high frequency and high comfort.

An example of enhancing convenience for public transport users is an SMS system for purchasing tickets that was introduced in the region around 2 years ago. The system can also be used to make purchases on trains.

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[15] P Cairney, The Impact of Safe Routes to Schools Program on Road Safety Knowledge and Behaviour in Victorian Primary Schools, ARRB Transport Research

Light rail is being considered as a future public transport option for Odense. It was noted that a city of 187,000 was traditionally considered too small to for light rail to be feasible. However, it is now thought a dramatic change such as the introduction of light rail may be required to achieve the modal shift targets that are identified in the Plan.

Significant public consultation was undertaken in the development of the Transport and Mobility Plan. It was noted that good design and well-written text for invitations and documents was very important to the success of the consultative process. Another key to the success of the consultation was to keep meetings relatively informal and to make people feel important. Interest in the Plan for the wider community was created with City advertisements with captions such as 'New life for your city'.

The City advised that typical housing prices in Odense would be approximately $700,000 AUD in the city centre, while prices five kilometres out from the centre would be approximately $450,000. This was an indication of the value that citizens place on living in a convenient location where they can easily walk or cycle to all of the services that they need.

Walking

One of the principles of New Urbanism is walkability[16]. Walkability can be enhanced through pedestrian friendly street design, which encompasses consideration of:

- Buildings close to street;
- Treatment of windows, doors and balconies – engagement with the street;
- Wide, high quality footpaths;
- Street lighting;
- Street furniture;
- Street connectivity – the directness of travel routes;
- Tree-lined streets;
- Treatment of on street parking;
- Hidden parking lots;
- Garages accessed via rear lane;
- Narrow, slow speed streets;
- Pedestrian streets free of cars in special cases

The Heart Foundation of Australia has released a position statement, The Built Environment and Walking[17]. The position paper recognises the importance of physical activity in reducing risk factors for cardiovascular and other chronic diseases. The promotion of walking is noted as a promising means of increasing physical activity across a broad range of the population. The built environment, encompassing land use, transport systems and urban design, can either facilitate or discourage walking. It is also noted that there are two key conduits for increasing walking:

- Encouraging more walking for transport, and/or
- Encouraging more walking for recreation.

Walking for transport is influenced by:

- Mixed-use planning – variety and proximity of destinations to walk to.

[16] www.newurbanism.org

[17] National Heart Foundation of Australia, www.heartfoundation.org.au The Heart Foundation's National Physical Advisory Committee: Position Statement – The Built Environment and Walking, 2009

- Density – areas with higher residential densities are more likely to support the presence of shops and services. Therefore, the density of an area is indirectly related to walking.
- Street connectivity – the directness of travel routes between homes, shops, workplaces and other destinations. Walking for transport is more likely when the street network is more connected and obstacles are kept to a minimum.

There is an obvious overlap between these influences on walking and the objective of New Urbanism to promote the creation and restoration of diverse, walkable, compact, vibrant, mixed-use communities.

Different aspects of the built environment tend to influence walking for recreation. Elements such as the attractiveness of the neighbourhood environment, as well as the quality and convenience of paths and other facilities have a positive influence on walking of recreation. Access to beaches or large areas of public open space also tends to encourage walking for recreation.

Elements of the built environment and their impact on walking can be considered at both the macro and micro levels:

- Macro environment – urban development and land use, transport options, car use, density, connectivity, access to destinations etc.
- Micro environment – small scale neighbourhood features such as street lighting, signage, safety, surface treatments, traffic calming measures etc.

There are considerable barriers to implementing macro-level changes to existing neighbourhoods. These include the high costs of remodelling or retrofitting neighbourhoods, the slow pace of change in the urban landscape, zoning regulations and conflict between various stakeholders, such as opposition from existing residents to higher densities. Although retrofitting the macro-level environment to encourage walking is challenging, opportunities to do so should not be overlooked.

Improvements to the micro-level environment are easier to implement and also have the potential to encourage walking. However, the impact of micro-level changes in isolation of a supportive macro environment (e.g. destinations to walk to) is unknown.

In the design of both the Nordhavnen and Western Harbour developments, there was a clear focus on encouraging residents and visitors to walk as a means of transport.

In Nordhavnen, the design criteria that five minutes would be the maximum walk required between a person's home or office and transport and/or shops will ensure that walking is a viable means of transport. The layout of the development ensures good connections for pedestrians, while motorists will be required to take a more circuitous route.

The approach at the Western Harbour development was similar. Pedestrians are given priority over other road users and this was apparent when visiting the area. Pedestrian spaces were pleasant and well designed and as a pedestrian, there was never the feeling that you were competing with cars. Vehicle numbers were very low, partly due to very long term parking not being available except in centralised car parks. The 30 kilometre per hour speed limit in local streets was supported by a road layout that discouraged speed. Distances between housing and any attractions such as workplaces, shops, cafes and the waterfront were not great, so it was easy to see how residents could manage without using a car for their day-to-day lives. The centre of Malmö and its major train station was only a short, pleasant walk and despite development only being in its early stages, a high frequency bus service

was already in operation.

Accessibility

The City of Copenhagen has a vision that everyone has the right to participate in city life and that urban accessibility should be an automatic consideration.

The City has developed an Action Plan for walkability, involving all relevant departments. The focus has been on improving accessibility on the most highly used pedestrian routes. It was noted that it is difficult for Copenhagen to apply a standard where historic paths such as patterned cobblestones are encountered. A high value is paced on maintaining the history and character of the city and this is often in conflict with the desire to improve accessibility.

The 'Copenhagen Standard' for footpaths is defined in a pictorial guide. As well as being an urban design guide, this has many similarities with Road Management Plans developed under the Road Management Act 2004 in Victoria, in that it defines maintenance standards. For example, the Inspection Manual, which is part of the Moonee Valley City Council Road Management Plan[18], outlines the types of defects that will be repaired in the City of Moonee Valley.

The Copenhagen guide includes a design for 'ramp stones' to overcome the small step that is common at shop entrances in older areas. The stone can accommodate a rise of up to 125mm. The owner needs to get a permit to install the stone, which the Council encourages them to do. Once installed, they become part of the shop.

In the case of Copenhagen, it was surprising to learn that a trip hazard of 30mm is the widely accepted intervention level and that disability advisory groups have accepted this. Similarly, a 25mm lip is considered acceptable at kerbs and building entrances. In a city renowned for its culture of walking, these standards are lower than typical intervention levels in many Melbourne metropolitan municipalities.

Figure 22 - 'Copenhagen standard' footpath

The 'Copenhagen Standard' for footpaths uses rows of cobblestones between concrete pavers to maintain character. The concrete pavers provide a reasonable standard of accessibility (but not up to typical Australian expectations).

This led to the interesting observation that maybe the focus in Australia (and Victoria in particular with the Road Management Act 2004) on liability with respect to footpath standards has been taken too far, at the expense of other influences on walkability. In all of the areas visited on the study tour, footpath conditions were observed that would generally be considered unacceptable in Australia and a liability to the responsible authority.

[18] Moonee Valley City Council Road Management Plan 2009, www.mvcc.gov.au - Transport Roads and Drains – Roads and Footpaths - Maintenance

In New York, accessibility is hindered by a lack of pram crossings at many major intersections, as well as road surfaces that are often in very poor condition. This does not appear to deter most people from walking – population density and the high cost of parking make it a necessity. However, such issues would cause problems for some footpath users.

Figure 23 - Accessibility issues in New York, intersection of 8th Avenue and West 20th Street

Recommendations to encourage walking
1. Planning for pedestrians is important:
a. Start by mapping out key pedestrian routes – identify the attractions that people are likely to walk to such as transport nodes, shopping precincts and recreational opportunities.
b. Consider how mixed uses can be incorporated in key pedestrian routes, to add interest for pedestrians.
2. Accessibility and quality footpath surface are important aspects of the pedestrian environment, but they are not key determinants of whether people will walk. Aspects such as character and history should not be overlooked in the effort to provide a risk free environment for pedestrians. There needs to be a balance, which should be reflected in Road Management Plans and urban design guidelines.
3. An attractive walking environment is important. Consider improvements such as:
a. Street trees – for shade and visual appeal.
b. Street furniture – many pedestrians need seats on which to rest and they should also add to the visual appeal of the street.
c. Incorporation of public art on major routes.
d. Look for opportunities to include different surface treatments when sections of path need upgrading – break up the monotony of concrete and asphalt. Other surfaces will generally be more expensive, so should be considered at key sites and areas of high pedestrian activity.
e. Town planning – what types of buildings/uses are important to retain; how could new development add to the pedestrian appeal of the area?
4. Encouraging people to walk as a means transport should be given a high priority in any new development or major redevelopment, as this is where there is the greatest potential impact. Consider:
a. Appropriate density to support services being spaced closely enough for walking. In Denmark and Sweden, a density of five or six storeys was considered ideal and was described as a 'human scale'. It is dense enough to create vibrancy, but not to the point of being alienating to people or feeling too overcrowded.
b. Design street networks that make walking easier and more pleasant and driving more difficult – priority to pedestrians in design.
c. Pedestrian safety with respect to street layout and building orientation – people won't walk if they don't feel safe when they leave their

	building. For example, avoid creating spaces where pedestrians would be secluded by ensuring that pedestrian areas are overlooked by habitable rooms and active frontages – not by car parks or blank walls.
d.	**Car parking should not dominate.**

Cycling

The benefits of planning for cyclists were clearly evident in Copenhagen, Odense and Malmö. Cycling in these cities is seen as a viable means of transport for the general population, not just for a committed few.

In the developments at Nordhavnen and Western Harbour, bicycles were given a higher priority than cars, with more direct access routes and more convenient parking facilities.

While cycling is already quite popular in Melbourne, it is a long way behind cities such as Copenhagen in terms of being seen as a viable means of transport for the general population. However, Melbourne is well suited to encouraging greater use of cycling, with a relatively flat topography, many wide streets that can easily be modified to accommodate cyclists safely and a climate that is generally well suited to cycling.

Cycle Planning in Copenhagen

The 'Copenhagen Standard' that was outlined in the section on walking and accessibility, also includes standard treatments for cycle lanes. The cycle lane is adjacent to the footpath and is separated from traffic or parking lanes through being at mid-height between the footpath and road. There is a 50mm kerb between the footpath and cycle path, then another 50mm kerb between the cycle path and the road.

The City of Copenhagen has been progressively implementing projects along Nørrebrogade, which aim to give priority (and road space) to pedestrians and cyclists.

Figure 24 - Cycle lane on Nørrebrogade, Copenhagen

Sections of Nørrebrogade have been closed to traffic (except for buses), removing through traffic. The closed section is highlighted by red dots on road surface.

Cycle lanes are highlighted with sections of coloured surface at intersections. This highlights the cycle lane through areas of potential conflict, while minimising costs by not providing coloured treatments where not really needed.

Buses and cyclists have priority along the route. This includes real-time information at each bus stop. To assist cyclists, signals along the route are timed to suit the average cycling speed. This ensures a good run for cyclists.

One user of road space that was clearly given a low priority along the entire route was car parking, with virtually no space along the through route being taken up by parked cars.

By contrast, recent experience in Melbourne with the extension of clearway times showed that any reduction of roadside parking is likely to meet with strong opposition.

Figure 25 - Priority to public transport and cyclists along Nørrebrogade

Cycling in Malmö

Improving Malmö's Traffic Environment[19] is a strategy produced by the City of Malmö that aims to reduce the negative impact of vehicles on the city such as clogging the streets in the old areas of the city and reducing air quality. As part of the strategy, the city wants cycling to be:

- Faster,
- Safer and
- More enjoyable

Some of the innovations that the city has introduced along key routes identified in the strategy include:

- Rails at traffic lights that cyclists can rest against so that they don't need to put their feet down.
- Different types of lighting have been trialled to make it easier for cyclists to see and be seen.
- To give priority to cyclists, radar sensors have been installed at around 30 crossings in Malmö to detect cyclists and automatically give them a green light.
- Air pumps have been installed at six locations around the city for the convenience of cyclists who need to top up the air in their tyres. Some basic tools are also available at some, turning them into mini-service stations where cyclists can carry out minor repairs.

The city will also install bicycle parking garages at new train stations that are being planned as part of the City Tunnel project, which also involves remodelling of the city's Central Station. This aims to make it convenient for the growing number of people who combine public transport and cycling as their means of commuting.

Odense – Cyclist City

A master plan for cycling in Odense was first developed in 1976 and is still relevant today. The plan is regularly reviewed and small extensions are done each year.

[19] Improving Malmö's Traffic Environment, Malmö Stad, 2009

Odense is keen to be seen as a 'Cycle City'. The City aims to demonstrate this by showing cyclists that they are as important (or more so) than cars. Good design of cycle facilities is one of the ways that it demonstrates this. For example:

- High quality bike parking facilities
- There are 11 air stations around the town
- Intersections include slip lanes for bikes
- Well designed underpasses with natural light
- Cycle paths maintained to a better standard than roads.
- Commuter route – priority treatments for cyclists at intersections (similar to the raised pedestrian crossings that are common in many inner-Melbourne municipalities).
- Use of ITS for cyclists – eg. Speed advisory to meet green lights.

This cycle counter is on a key pedestrian route in the centre of Odense.

It was provided in order to send the message to cyclists that they are "part of the cycling city". For any non-cyclists in the area, it also demonstrates the importance that the city places on providing for cyclists.

Cyclists get much better access to the city centre than motorists, along with higher quality facilities.

Figure 26 - Cycle counter in central Odense

Free air filling stations for bicycles help to make cycling more pleasant. The stations are well designed and are placed in prominent locations.

This also adds to the visibility of cycling, ensuring that passers by will be aware of the convenient facilities available to cyclists.

Figure 27 - Air station for bicycle tyres

Figure 28 - Bicycle parking

The city aims to provide bicycle parking that is attractive, functional, well located and safe.

This is another example of giving priority to cyclists, through providing for their needs in preference to those of motorists. If you arrive in the city centre by car, you will probably have to walk further and your parking space will probably not be in such an attractive, well maintained area.

Interestingly, it was noted that helmets are not compulsory in Denmark and the traffic planners were very keen to discuss Australia's approach to helmets. While agreeing that wearing a helmet was a good idea, they were concerned that making it compulsory may deter people from cycling in some cases. However, it was noted

that it would be frowned upon to allow children (up to around the age of 9 or 10) to ride without one.

Bicycle hire schemes

Various grades of bicycle hire schemes were operating in Copenhagen, Malmö and London. However, by far the most widespread and well-used scheme that was observed was in Paris the week following the study tour.

The Paris scheme, known as Vélib' (a combination of vélo, meaning bike and liberté, meaning freedom[20]) is a self-service bicycle hire scheme. Users can pick up a distinctive grey bicycle from one Vélib' station, cycle to wherever they are going and return the bicycle to another station at their destination. With more than 1,400 Vélib' stations across the city with typical spacing of 300 metres, users can be assured of finding convenient stations at either end of their journey.

Theft is discouraged by the distinctive appearance of the bicycles. They are also geared so as to be uncomfortable for riding long distances, which also reinforces the intention of the bikes to be used for travelling short distances.

Figure 29 - typical Vélib' station in Paris

Users need to obtain a Vélib' account, which involves paying a subscription (€1 per day or €30 per year) and a deposit which gives them a swipe card to which credit can be added. Accounts can be managed and credit on the card topped up using the machines positioned at each station.

The user swipes their card at the bike stand to obtain a bike and again when they return it. The first half hour is free, then €2 for the next half hour and €4 for each half hour thereafter. The pricing structure supports the aim of the scheme for bikes to be used for short trips and returned as soon as possible, rather than for long-term hire.

A similar system has recently been launched in Melbourne, with the Royal Automotive Club of Victoria (RACV) being awarded a contract in October 2009 to implement a system that will initially provide 600 bikes at 50 sites around the city[21]. There have been small-scale trials, but the scheme is scheduled to commence regular operation in mid-2010.

One of the issues still to be resolved with this scheme is whether helmets will be available (preliminary indications are that users will need to provide their own). Difficulty in accessing helmets and the law that helmets must be worn could be a major obstacle to some potential users such as tourists.

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[20] Fallon S and Williams N, Paris City Guide, Lonely Planet Publications

[21] www.heraldsun.com.au Melbourne to get European-style bike hire program, 1 November 2009

Recommendations to encourage cycling
1. Give priority to cycling in transport planning:
a. For cycling to be adopted as a viable means of transport for the general population, it needs to be convenient, safe and comfortable.
b. Identify a network of cycle routes that make cycling direct. In most situations, cyclists shouldn't need to take an indirect to avoid conflict with motor vehicles.
c. Cyclists need priority on continuous routes – a common pitfall is that cycle lanes are provided where it is easy to do so, but where space is constrained, priority is still given to motorists.
d. Accept that giving priory to cyclists on these routes may cause inconvenience and delays for motorists.
e. Providing adequate cycle routes may also mean removing car parking spaces – councils need to accept the inevitable objections and focus on the objective of increasing cyclist numbers. For example, removing a handful of car parking spaces may enable improved cycling conditions along a route, which could lead to a large number of new cyclists being willing to use the route.
2. Make cyclists feel valued. In addition to safe cycle routes, provide other facilities that make cycling more pleasant and aid the visibility of cycling. For example:
a. Provide well-located, high quality parking facilities for bikes.
b. Provide facilities such as the air filling stations observed in Odense.
c. Ensure that public transport interchanges and stations include facilities such as secure bike storage.
3. Invest in cycling infrastructure:
a. If Australian cities wish to progress towards the conditions for cyclists that were observed in Denmark and Sweden in particular, significant investment is required.
b. State road authorities and councils should consider investment in cycling infrastructure based on potential cyclist numbers, rather that current numbers. Using existing numbers as the basis for decisions can lead to projects not achieving the benefit cost ratio required to obtain funding.
4. Ensure that cycling is seen as a form of transport in new developments:
a. Ensure that road layouts are designed to accommodate cyclists.
b. People moving into a new development need to see cycling as a viable means of transport from the time they move in, as this is when travel patterns will be established. Therefore, it is not good enough to provide cycling facilities at some later date.
c. Look for opportunities for developments to fund improvements to cycling infrastructure. For example, encourage a developer to fund cycle projects in the vicinity of the development that will benefit residents and visitors. This could be considered in return for waivers on car parking requirements or allowing higher density than may otherwise be allowable.
d. Ensure that office developments provide facilities such as showers and secure bike storage.
5. To aid the success of Melbourne's proposed bicycle share scheme, consideration should be given to allowing users to not wear a helmet. Assuming that like in Paris, the bikes will have a distinctive appearance and be geared to only travel at relatively low speeds, it would be possible for a waiver to be applied to only these bikes.

Public Transport

While public transport was not a focus of the study tour, there were plenty of opportunities to observe measures that made public transport more attractive as a means of transport than is typical in Australian cities.

Reallocation of Road Space

Sections of Broadway in New York were closed to traffic in May 2009, with the duel purpose of improving traffic flow on adjacent streets and providing better conditions for pedestrians[22].

Broadway cuts diagonally the grid pattern of Avenues (north-south) and streets (east-west) in mid-town Manhattan. In doing so, it creates complex intersections with acute angles. These created delays due to multiple sequences and long red lights required for pedestrians to clear wide intersections. The closure of Broadway from 33rd to 35th Streets and 42nd to 27th Streets has simplified intersections and resulted in improved traffic flows. It has also enabled large areas of road space to be reallocated to pedestrians[23].

More than 350,000 people walk through Times Square each day, which is 4.5 times the number of vehicles prior to the changes. However, only 11 percent of the space was allocated to pedestrians, who had to negotiate overcrowded footpaths. The closures have created vastly improved conditions for pedestrians.

Figure 30 - New pedestrianised area in Times Square

The addition of street furniture provides an opportunity to linger and appreciate the sights of Times Square. Pedestrian conditions were previously very overcrowded.

Delineation between roadway, cycle and pedestrian areas has been achieved through the placement of large pot plants and rocks.

[22] New York Times, 25 May 2009 - www.nytimes.com/2009/05/25/nyregion/25bway

[23] New York City Department of Transport, www.nyc.gov/html/dot - Green Light for Midtown

The initial closures were done relatively cheaply, with a budget of $1.5 million. Existing kerbs have been retained and coloured surface treatments have been used to distinguish the new pedestrian areas from the adjacent roads.

The project has created more than 12,000 square metres of new open space and greenery at 24 locations.

Figure 31 - Closed section of Broadway at 34th Street (Herald Square)

The project was initiated as a traffic experiment and was due to be reassessed at the end of 2009.

The works to improve conditions for cyclists and pedestrians in Nørrebrogade in Copenhagen also involved the reallocation of road space. When considering a hierarchy of road users, cyclists and pedestrians have been given priority over vehicles along this route. As explained previously, through traffic has been removed except for buses. The reduction in vehicle numbers means that more space can be given to pedestrians and cyclists, who previously faced quite crowded conditions.

An observation when visiting the area was that in some parts of the route, conditions for pedestrians in some sections were still relatively poor. Footpaths were often narrow, crowded and in relatively poor condition.

Cyclists were generally well catered for, with exclusive continuous lanes and dedicated space for bicycle parking.

Figure 32 - Section of Nørrebrogade with space allocated to pedestrians, cyclist and bicycle parking

In this section of Nørrebrogade, traffic lanes have been removed and the former 'Copenhagen standard' bike lane has been converted to an area for street furniture, new plantings, bike parking and street trading. This aims to provide better conditions for pedestrians as well as cyclists. A new bike lane has been created where the traffic lane has been removed.

Figure 33 - Modification of 'Copenhagen' cycle lane

Recommendations for reallocating road space

1. **Identify areas where excess space is allocated to vehicles. For example, many older style roads have very wide traffic lanes, to leave space for parking.**
2. **Identify and delineate necessary traffic lanes more clearly, to create space for cycle lanes and/or dedicated parking lanes.**
3. **Look at opportunities to reduce the number and/or width of traffic lanes.**
4. **Consider trialling changes as traffic management experiments to gauge public perception, rather than consulting extensively before acting.**
5. **Develop a hierarchy of road users and allocate space accordingly. For example:**
    a. **If space is limited, consider whether it is appropriate that a high proportion of the available space is allocated to vehicles that carry a relatively small number of people, while much larger numbers of pedestrians face crowded conditions?**
    b. **If there is a desire to encourage cycling, appropriate space needs to be allocated to cyclists to ensure that cycling can be a safe and convenient form of transport.**

The Urban Heat Island Effect

The urban heat island effect is a recognised problem caused by the concentration of dark coloured, heat absorbing surface materials of roads and buildings, as well as changes to landscape and hydrology that reduce evaporative cooling[24]. It is estimated that it can lead to an increase in air temperatures of more than four degrees Celsius.

The urban heat island effect exacerbates air quality problems such the concentration of ground level ozone and can lead to health problems amongst vulnerable parts of the population. It also increases demand for air-conditioning, resulting in higher energy consumption and greenhouse gas emissions.

Increasing population and greater intensity of development tend to increase the contribution that private land makes to the urban heat island effect. For example, in-fill developments that provide medium density housing in existing suburban areas often lead to a loss of private green space. Similarly, the extension or redevelopment of older houses to meet modern expectations generally means a loss of private open space as well as larger paved areas rather than lawns and gardens.

Therefore, there are two primary approaches that a city can take in an effort to minimise the urban heat island effect:

1. Seek to minimise the impact of private development – for example, ensure that private property includes provision of vegetation, permeable areas, reduction in dark coloured materials etc. This could be achieved through a mix of appropriate incentives and/or planning restrictions.
2. Undertake works to reduce the contribution of public land to the effect – for example, reduce hard paved surfaces, prevent the loss of vegetated parkland and look for ways to increase vegetated areas.

[24] High Performance Infrastructure Guidelines, Department of Design and Construction, New York City, 2005

Road Reserve

New York City has more than 111 million square metres of road reserve[25] and invests over $2 billion per year on infrastructure. The City has identified its treatment of roadways as having the potential to significantly minimise the heat island effect and is investigating treatments such as:

- Reducing the paved area
- Using permeable pavements
- Increasing pavement albedo (reflectivity)
- Designing landscapes to maximise shading of pavements

In the City of Moonee Valley, road reserve accounts for approximately ten percent of the total area of the municipality. Therefore, there is potential to gain considerable environmental and social benefits from even modest improvements to roadways.

Ideas for reducing the area of paved roadway were discussed under Reallocation of Road Space. Further to this, to contribute to reducing the heat island effect consideration should also be given to:

- Investigate whether the space allocated to vehicles can be reduced, so that additional vegetated area can be included in the reclaimed space.
- Dark, heat-absorbing materials such as asphalt are the greatest contributor to the effect – therefore, consider alternative materials where possible. For example, lighter coloured materials such as concrete would be better, while permeable surfaces would be even better.
- Plan street tree planting that will provide the maximum shade for roadways and paths.

Open Space

Public open space is an important contribution to the amount of green space in a city and, therefore, to mitigating the urban heat island effect. Therefore, in attempting to contain the effect, cities should focus on minimising any loss of green open space, as well as seeking to develop more open space in areas where there is a deficiency.

It is difficult in an established city to increase public open space, due to the prohibitive cost of acquiring land. An innovative approach to the development of a new park was observed in New York, with a visit to the High Line Park, the first stage of which was opened to the public on 9 June 2009[26].

The High Line is built on a 1930s freight rail structure on Manhattan's West Side. When it was operational, the railway delivered goods and produce directly to upper floor loading docks of factories and warehouses. The area has undergone significant change since the last train ran in 1980, with the remaining warehouses now converted to offices, apartments, shops, restaurants and galleries.

When all sections are complete, the High Line Park will be a continuous 1.5 mile long park, running north/south through three neighbourhoods – the Meatpacking District, West Chelsea and Hell's Kitchen. Having once been industrial areas, these districts suffered from a lack of open space and a lack of vegetation.

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[25] High Performance Infrastructure Guidelines, Department of Design and Construction, New York City, 2005

[26] High Line Map/Info – www.thehighline.org

Figure 34 - The High Line

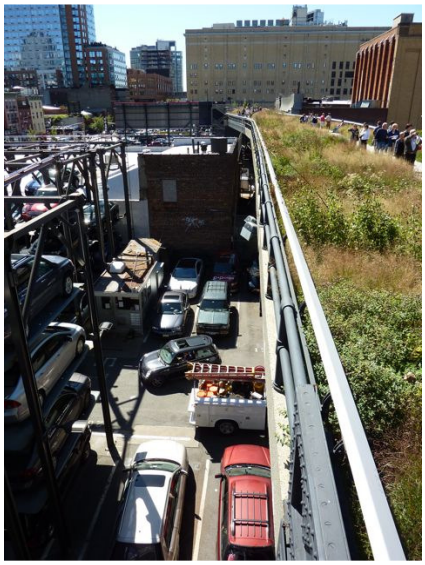


Figure 35 – Car parking stacked 5 high adjacent to the High Line illustrates the premium on space

Friends of the High Line is a non-profit conservancy, responsible for maintaining the public park on the High Line under a license agreement with the New York City Department of Parks and Recreation. This group was instrumental in advocating initially for protection of the High Line structure, then for its development as a public park. A study undertaken by the group in 2002 showed that new tax revenue generated by the public space would be sufficient to cover the cost of construction.

Figure 36 – Section of the High Line Park

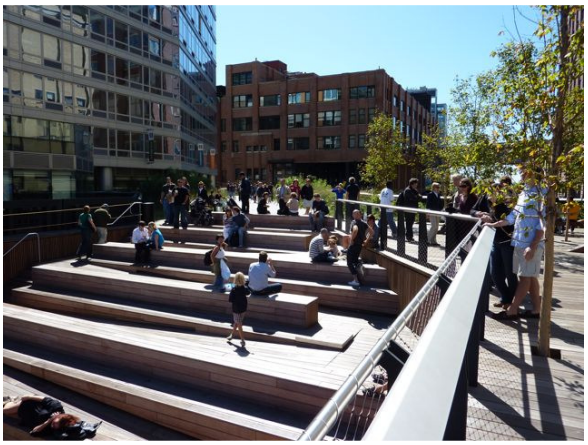
The High Line provides a belt of green through an otherwise highly urban area that has very little open space or vegetation.

The majority of planting along the High Line is intended to appear naturalistic. Sections of railway line have been maintained amongst the planting, to act as a reminder of the structure's heritage.

Sections of the original structure that provided direct access to upper floor loading docks have been preserved as a reminder of the High Line's history.

A section of the Park between 15th and 16th Streets runs through a building, which includes public art and space for cafes and market stalls.

Figure 37 – The High Line Park at Chelsea Market



The High Line incorporates a variety of spaces for gathering or relaxing.

Areas intended for gathering or resting generally have timber decking, while walking paths are generally light coloured concrete pavers. These are preferable to darker coloured or impermeable surfaces in terms of their impact on the urban heat island effect.

Figure 38 - The High Line - terraced deck for gathering where the structure crosses 10th Avenue

Public Buildings

While public buildings may appear to be a relatively small component of the overall built environment, their significance should not be overlooked for two key reasons:

1. Public buildings often encroach on land that would otherwise be parkland.
2. There is an opportunity to use public buildings as demonstration projects for innovations such as green roofs, sustainable building materials or energy efficient design.

Therefore, when developing or extending public buildings, attention should be paid to the net impact on the urban heat island effect. Where a new or expanded public building results in loss of vegetation, consideration could be given to compensating the loss. This may involve a combination of:

- Creating an additional vegetated area to compensate. This could mean acquiring additional open space or converting existing hard surfaced areas.
- Minimising the footprint of the building and any associated paved areas to ensure that it is no larger than absolutely warranted.
- Use of green roofs or incorporation of additional landscaping.
- Use of lighter, reflective building materials on the building itself.
- Incorporating water sensitive urban design (WSUD) type drainage treatments.
- Further offset could be achieved through modifying other municipal facilities. For example, changing roofing and cladding materials on other buildings when they are being renovated and changing existing paved areas to lighter coloured and/or permeable paving materials.

Good examples of these approaches were observed in some of the case studies that were visited. The incorporation of green roofs on the municipal buildings in Malmö was an obvious example, with the green roofs contributing 10,000 square metres of vegetated area to the municipality. They also serve as a demonstration to others of what can be achieved and are a way of trialling different methods and plant species to determine what is most effective. The knowledge gained can then be passed on to others.

Another example was observed in the planning of the London Olympic Park, where care was being taken to ensure that buildings and paved areas that would remain after the Olympics were no larger than required. The ultimate development of the site will see a large net increase in vegetated open space for the area.

Private Development

Private land and the built form, being the largest proportion of land use, is obviously important when considering the urban heat island effect, but difficult to control. The Western Harbour development in Malmö demonstrated a thorough consideration of the issue and planning controls were enforced to achieve the desired result. Calculation of the 'biotope area factor' (green space factor) was required to ensure that each property met its obligations in terms of mitigating the urban heat island effect. Each development must achieve a certain score, with points allocated for the use of permeable areas, trees, green roofs etc.

Recommendations for mitigating the urban heat island effect
1. **Identify areas where excess road space is allocated to vehicles, as per the recommendation under Reallocation of Road Space.**
2. **Seek opportunities to remove areas of paved surface and replace with vegetated areas.**
3. **Look for opportunities in Council projects such as car parks or building projects to increase vegetated areas/reduce the area of hard surfaces. These could be treated as demonstration projects.**
4. **Set up a system for calculating the net impact on the urban heat island effect, particularly for all public land including road reserves. This would include:** a. **Green space lost to expansion of buildings or hard paved areas;** b. **Green space gained through any reduction in the area of roadway;** c. **Green space gained through any development of new public open space;** d. **Area of dark paved surface such as asphalt replaced with lighter, more reflective materials;** e. **Area of impermeable surface replaced with permeable surface; etc**
5. **Look for opportunities to increase public open space in areas where it is lacking, taking inspiration from projects like the High Line. Consider the way that such a project could help to transform a neighbourhood and add value to properties.**
6. **Look for ways to increase permeable and green areas within private developments. Consider education and planning controls to support this.**

Energy

London Development Agency

London's Mayor has set a target that the City's carbon dioxide emissions will be reduced by 60 percent on 1990 levels by 2025. It is estimated that 2.2 million tonnes per year of savings are needed to meet this target. In addition to this emissions target, it is planned that a quarter of the City's energy needs will be met by decentralised energy by 2025.

The London Development Agency (LDA) is the Regional Development Agency for Greater London. The Agency aims to stimulate the decentralised energy market and to achieve this, a team is working on identifying areas where decentralised energy makes the most commercial sense. It has allocated up to £16 million for decentralised energy over the next four years (from 2009-2010)[27], which aims to identify and facilitate potential projects and to attract private sector finance on key schemes.

[27] www.lda.gov.uk - Decentralised energy

The LDA advises that decentralised energy has an important role in terms of carbon savings and therefore in meeting the targets set by the Mayor. The majority of London's energy is currently generated from fossil fuels at large power stations located a long distance from the city. Aside from the use of fossil fuels, this is also wasteful as up to two thirds of energy can be lost in transmission[28]. Therefore, a key benefit of decentralised energy production is the reduction in losses through transmission.

Combined heat and power (CHP) systems and district heating networks are expected to be the main source of carbon reduction through decentralised energy. This involves the production of heat and electricity close to where it is used. Heat is a by-product of electricity production that is normally wasted. However, in a CHP system, the heat that is produced is channelled through underground district heat networks to provide heating and hot water.

In district heating networks, it is estimated that there is heat loss of approximately one degree Celsius per kilometre of pipe. Therefore, local generation reduces loses and enables by-product heating to be used for district heating systems.

An assessment has been done on the benefits of small, medium and large scale distributed energy options and this concluded that large scale is the most cost effective. The economic case for different options will vary between areas based on factors such as population density, current fuel/energy sources, available space and existing distribution networks.

The LDA is developing an Energy Master Plan for London, in conjunction with all 32 London boroughs. The Plan will consider how decentralised energy fits in. It will also include heat mapping, which will help developers and government agencies identify the potential for decentralised energy opportunities in various parts of London. The heat map will include details of major energy consumers, energy supply plants, community heating networks and heat density.

One of the opportunities that can be considered for CHP systems involves taking waste heat from power generation or industrial uses. Heat can then be distributed to areas of redevelopment and/or areas of very high density, noting that sufficient density is needed to support the cost of the distribution network.

The LDA believes its role is to use proven commercially viable technologies for CHP projects. They will allow others to use more experimental technologies, but will not direct public money to it.

Scandinavian examples of CHP projects are now proving that they can become commercially viable over time. Systems that were initially government owned and operated are now being privatised and operated at a profit. It is estimated that the payback period could be around 20 years.

The LDA aims to produce a manual for London on district heating. This will need to consider issues such as the density that is required for district heating to be viable. This would be based on how many KWH can be sold per linear metre of pipe. A tariff system is still being developed. It is anticipate that this will include a charge based on carbon content.

[28] www.london.gov.uk - Press Release – Mayor sets out to deliver low carbon, lower cost energy for London, October 2009

The LDA looks at output targets to report its success. In the case of energy, the amount of public money spent per tonne of CO_2 saved is a key measure. Therefore, projects are prioritised based on the greatest CO_2 savings for available budget.

Woking Borough Council and Thameswey Energy Ltd

The town of Woking is approximately 35 kilometres south west of central London and functions largely as a dormitory area in the London commuter belt. It has a population of approximately 90,000, with 36,000 homes. It has a very low unemployment rate of around 0.2 percent.

Woking Borough Council has been recognised as a 'Beacon Council for Sustainable Energy' by the Improvement and Development Agency, which identifies excellence and innovation in local government[29]. This recognises the Council's achievements in the areas of energy efficiency and sustainable living, including:

- The adoption of a comprehensive Climate Change Strategy.
- A reduction in corporate energy consumption of 49 percent since 1990.
- The development of a town centre CHP station that provides electricity, district heating and cooling directly to local customers.
- The use of a 200kW sustainable energy fuel cell that provides heat and power to the Pool in the Park and lighting for Woking Park.

Thameswey Limited was set up as an energy and environmental services company, which is wholly owned by Woking Borough Council. It was established to:

- Promote energy efficiency, energy conservation and environmental objectives by providing energy and/or environmental services.
- Develop and implement new technologies for the production and supply of energy.
- Produce and supply energy (and any related by-products) in all its forms.

Thameswey Limited acts as a contractor to Woking Borough Council to invest in CHP systems and to sell heat and power in an environmentally friendly way, with a view to improving the environment within the Borough.

Thameswey Energy Limited is a joint venture company, 90 percent owned by Thameswey Limited and 10 percent owned by Danish company Xergi Limited and was established to:

- Own and operate plant for the production and supply of electricity, heat and chilled water to customers.
- Develop and implement technologies for the production of energy.

The company structure of Thameswey Energy Ltd was set up to isolate Council from risk associated with entrepreneurial activities. Council can lend money to these companies and the Council's Climate Change Group decides how to spend the profits that are generated. The Council believes that what is being done benefits the wellbeing of the community and all profits are reinvested in sustainability initiatives.

The Woking Town Centre CHP station was the first project of Thameswey Energy Limited and is believed to be the first commercially operating energy station of its kind in the UK. The system uses natural gas to generate combined heat and power. A private wire network is used for electricity distribution. Private pipe networks distribute heated and chilled water services. Customers include nearby hotels, a conference centre, museum, car park and the civic offices.

[29] Woking Borough Council www.woking.gov.uk

Figure 39 - Woking Town Centre CHP station

The town centre CHP is incorporated in the base of a council owned multi-storey car park. It includes a window to enable the generator to be seen and interpretive signage to explain the system to passers by. However, aside from this, the system is very unobtrusive and would be easily hidden away with other mechanical services if so required.

The Albion Square Canopy was constructed in 2004, to create a gateway to the town centre at the railway station entrance. The structure is equipped with photovoltaic cells that collect solar energy. The total cost of the project was approximately £4 million. Of this, the photovoltaic cells were only £450,000, which was offset by a grant of £350,000. Therefore, incorporation of the photovoltaic cells was very cost effective for Council. The payback period is estimated to be seven years, which is much shorter than typical payback period for renewable energy projects.

The canopy generates between 51,000 and 58,000 kWh per year and is expected to save over 41 tonnes of CO_2 emissions per year.

The energy generated is in excess of what is needed to light the canopy. The surplus energy is fed back into the private town centre wire network. This way, Woking avoids the costs that are imposed on power generators and supplier for accessing the national grid.

By contrast, it was noted that in Germany, utilities effectively rent roof space from homeowners to place photovoltaic cells.

Figure 40 - Albion Square Canopy, Woking

Energy in Australia

When it comes to electricity generation, Australia is a long way behind the examples that were observed in Britain, Denmark and Sweden. An obvious reason for this would appear to be economic, with higher electricity prices in other countries helping to make other forms of power generation more competitive.

The following table gives an indication of Australian electricity prices compared with some of the other countries that were visited:

	Household electricity price per kWh in $US for 2009
Australia+	0.1302
Denmark*	0.3960
United Kingdom*	0.2313
United States*	0.1135

+ - TRU Energy home account, Melbourne June 2009, assuming exchange rate of $1AUD = $0.88US

* - International Energy Agency Key World Energy Statistics 2009[30]

For example, the LDA noted that CHP projects in Scandinavia were proving to be commercially viable, with a payback period of approximately 20 years. It was also noted that Denmark has regulations that favour the use of CHP, such as making it illegal to heat new developments with electric power. However, the commercial viability of this technology appears very doubtful in Australia at present, where the price of electricity is less than a third of that of Denmark.

While a price on carbon could be used to increase the cost of polluting forms of power generation, it is beyond the scope of this report to consider such a complex issue. Rather, the recommendations are restricted to the technologies that were observed. It is assumed that a carbon price or other legislative drivers will eventually make them more attractive.

The City of Sydney has adopted the Sustainable Sydney 2030 Plan[31], which commits Council to reducing greenhouse gas emissions by 70 percent on 2006 levels by 2030. Related to this, the City also aims to produce 70 percent of its electricity by trigeneration by 2030. To help it achieve these targets, the City has appointed Alan Jones, who has previously worked with the cities of Woking and London. Mr Jones notes that the legislative barriers to decentralised energy in New South Wales are similar to the UK. Woking initially overcame these through the creation of private distribution networks. The model used in London was to set up a 'virtual private network' over the existing distribution network, which required license modification.

Under this plan, the City is seeking to develop a range of reports including a Renewable Energy Master Plan.

Discussions about energy in Copenhagen and Malmö emphasised the importance of considering local conditions. In addition to CHP projects, both cities were interested in renewable energy. While solar power generation was in limited trial use, it was noted that solar access was not high. However, it was noted that as these cities were virtually always windy, wind generation was a more reliable and cost effective source of electricity in their situation. There were a number of wind farms off the coast and local wind generation was planned as part of the Nordhavnen development in Copenhagen, as seen in Figure 4 - Winning design for Nordhavnen on page 12.

Recommendations for reducing energy related greenhouse gas emissions

1. **Monitor the City of Sydney's progress in the implementation of trigeneration projects, to keep abreast of key findings.**
2. **With this in mind, consider other situations where decentralised energy may be possible.**
3. **Seek to incorporate small scale renewable energy generation in Council projects a demonstration. Measures such as effectiveness and payback**

[30]Key World Energy Statistics 2009, International Energy Agency, Paris, www.iea.org

[31] City of Sydney, www.cityofsydney.nsw.gov.au

	period should be reported, to enable lessons to be learnt.
4.	**Similarly, use Council projects to demonstrate measures to improve energy efficiency and reduce demand.**
5.	**Consider ways to incorporate efficiency measures into private development.**
6.	**Be aware of local conditions to determine the most effective ways of reducing emissions through energy generation. For example:**
	a. How reliable is solar access?
	b. How reliable is wind in the area?
	c. What are the local users of electricity, heat and cooling?
	d. Consider their number, demand, density, transmission distance etc, to determine how to best meet their needs.
7.	**Advocate for the removal of legislative barriers to decentralised energy production.**

Conclusion

Much of this report has focussed on the lessons that Australia could learn from European cities to improve sustainability. Therefore, it is interesting to note that the report 'Good examples for European Cities'[32] cites Melbourne's central business district as an example that other cities could learn from. The report recognises the success that Melbourne has achieved in revitalising its city centre through moving from a mono-functional area to a multifunctional area over the past 30 years. Melbourne's transition is reported alongside eleven other examples from around the world, including the Western Harbour development in Malmö and the transformation of the Nørrebro area in Copenhagen through the removal of through traffic from Nørrebrogade.

Melbourne is commended in the report for the success of its strategy to turn its centre into a thriving mixed-use area. In keeping with the principles of New Urbanism, this benefits sustainability through enabling a range of activities to take place in the same area, including being a place to live for a growing number of people. This reduces the need for travel and contributes to the city being a more enjoyable place to live and visit. Melbourne is noted for its local character, connectivity, density, mixed use, adaptability, high quality public realm, integrated decision making and user participation. Particular note is made of the impact that incremental improvements to the public realm have had, as well as the success of getting residents to move back to the city centre.

While this recognition of Melbourne's achievements is heartening to see, it is focussed on the central business district and does not reflect the whole of the city. There is still much that can be done in the rest of Melbourne and other parts of Australia to improve the sustainability of urban areas.

It is now up to those involved in both new development and the redevelopment of existing areas to look at what they can do to help new and existing citizens to live more sustainably. Through the study tour, a range of recommendations have been identified that could aid sustainability – these are included at the end of each section and are listed in total in the following section. The recommendations are focussed on the areas where municipal engineers are most likely to be of influence.

[32] Good examples for European Cities, Gehl Architects, for Federal Ministry of Transport, Building and Urban Affairs, Berlin, 2007

Many of the recommendations should be readily applicable in a wide range of metropolitan municipalities, as well as regional centres. While the densities of five to six storeys that were considered ideal in Denmark and Sweden may not be popular or achievable in many parts of Australia, there is a growing acceptance of apartment living in many areas. Increased density in a range of areas is supported by the Victorian Government's Melbourne @ 5 million[33] strategy, which aims for a number of Central Activities Districts around Melbourne. That is, Melbourne will become a multi-centred city, with a number of centres providing a CBD-type function. In line with what has been achieved in the CBD, each of these other districts should also seek to be multi-functioned and a range of the recommendations identified in this report could be applied in their development.

Even where significantly higher densities are not feasible, many of the other recommendations could still be applicable. For example, seeking to make cycling and walking more attractive as a means of transport should still be considered in all areas. Similarly, recommendations around reducing the urban heat island effect and reallocating road space are generally aimed at making urban areas more liveable and could be applied in a wide range of areas.

The other area that was investigated where the sustainability of cities could be improved was through reducing energy related greenhouse gas emissions. The approach to this should be two-pronged – firstly to improve efficiency and reduce consumption; and secondly to consider alternative forms of energy generation. This may include renewable energy generation, as well as decentralised energy. Decentralised energy contributes to an overall reduction in greenhouse emissions by reducing transmission loses and also enables the opportunity to utilise the heat which is a by-product of energy generation for district heating and cooling.

While the objective of the report was to identify measures aimed at improving sustainability, most of the recommendations that have been identified contribute to generally making cities better places to live and visit. The key is to include such measures as part of other strategies and to take a long-term approach to change, as has been successful in the City of Melbourne. It was also noted in Copenhagen that the changes that have lead to such a high acceptance of cycling have been very gradual.

Recommendations

Recommendations for engineering education
1. **The public works profession and tertiary institutions could both benefit through a closer relationship, such as that observed between NYU Poly and the City of New York.**
a. **In New York the scale of the City with 8.5 million residents aids this relationship. This puts it in a good position to work with key local engineering institutions such as NYU Poly.**
b. **In the Australian context, where most individual municipalities are too small to effectively deal with tertiary institutions on an individual basis, the relationship would be better focussed on peak bodies such as IPWEA. A recent example is the collaboration between the Municipal**

[33] Melbourne @ 5 million, Department of Planning and Community Development, www.dse.vic.gov.au - planning, policy and projects

Association of Victoria (MAV) and Swinburne University, to study the suitability of recycled materials as a base for footpaths.

2. Closer links between the public works sector and engineering institutions could also be used as a means of promoting careers in public works to tertiary students. This is already happening to some extent, with initiatives such as MEF sponsored places at public works conferences for tertiary students, but the issues needs ongoing attention to ensure that local government is taken seriously as a career option by engineering students.
3. Engineering courses need to encompass a broad range of subjects and have a view to what engineers of the future may be likely to need. For example:
    a. Environmental engineering courses are already popular, but shouldn't be viewed solely as a specialist area. For example, all engineers involved in drainage will need to understand water sensitive urban design principles.
    b. As preparation for careers in the field of public works, engineers should be aware of the various other professions involved such as planning and landscape architecture, as well as any emerging issues such as New Urbanism.

Recommendations to encourage walking

1. Planning for pedestrians is important:
    a. Start by mapping out key pedestrian routes – identify the attractions that people are likely to walk to such as transport nodes, shopping precincts and recreational opportunities.
    b. Consider how mixed uses can be incorporated in key pedestrian routes, to add interest for pedestrians.
2. Accessibility and quality footpath surface are important aspects of the pedestrian environment, but they are not key determinants of whether people will walk. Aspects such as character and history should not be overlooked in the effort to provide a risk free environment for pedestrians. There needs to be a balance, which should be reflected in Road Management Plans and urban design guidelines.
3. An attractive walking environment is important. Consider improvements such as:
    a. Street trees – for shade and visual appeal.
    b. Street furniture – many pedestrians need seats on which to rest and they should also add to the visual appeal of the street.
    c. Incorporation of public art on major routes.
    d. Look for opportunities to include different surface treatments when sections of path need upgrading – break up the monotony of concrete and asphalt. Other surfaces will generally be more expensive, so should be considered at key sites and areas of high pedestrian activity.
    e. Town planning – what types of buildings/uses are important to retain; how could new development add to the pedestrian appeal of the area?
4. Encouraging people to walk as a means transport should be given a high priority in any new development or major redevelopment, as this is where there is the greatest potential impact. Consider:
    a. Appropriate density to support services being spaced closely enough for walking. In Denmark and Sweden, a density of five or six storeys was considered ideal and was described as a 'human scale'. It is dense enough to create vibrancy, but not to the point of being alienating to people or feeling too overcrowded.
    b. Design street networks that make walking easier and more pleasant

and driving more difficult – priority to pedestrians in design.

c. Pedestrian safety with respect to street layout and building orientation – people won't walk if they don't feel safe when they leave their building. For example, avoid creating spaces where pedestrians would be secluded by ensuring that pedestrian areas are overlooked by habitable rooms and active frontages – not by car parks or blank walls.

d. Car parking should not dominate.

Recommendations to encourage cycling

1. Give priority to cycling in transport planning:
   a. For cycling to be adopted as a viable means of transport for the general population, it needs to be convenient, safe and comfortable.
   b. Identify a network of cycle routes that make cycling direct. In most situations, cyclists shouldn't need to take an indirect to avoid conflict with motor vehicles.
   c. Cyclists need priority on continuous routes – a common pitfall is that cycle lanes are provided where it is easy to do so, but where space is constrained, priority is still given to motorists.
   d. Accept that giving priory to cyclists on these routes may cause inconvenience and delays for motorists.
   e. Providing adequate cycle routes may also mean removing car parking spaces – councils need to accept the inevitable objections and focus on the objective of increasing cyclist numbers. For example, removing a handful of car parking spaces may enable improved cycling conditions along a route, which could lead to a large number of new cyclists being willing to use the route.
2. Make cyclist feel valued. In addition to safe cycle routes, provide other facilities that make cycling more pleasant and aid the visibility of cycling. For example:
   a. Provide well-located, high quality parking facilities for bikes.
   b. Provide facilities such as the air filling stations observed in Odense.
   c. Ensure that public transport interchanges and stations include facilities such as secure bike storage.
3. Invest in cycling infrastructure:
   a. If Australian cities wish to progress towards the conditions for cyclists that were observed in Denmark and Sweden in particular, significant investment is required.
   b. State road authorities and councils should consider investment in cycling infrastructure based on potential cyclist numbers, rather that current numbers. Using existing numbers as the basis for decisions can lead to projects not achieving the benefit cost ratio required to obtain funding.
4. Ensure that cycling is seen as a form of transport in new developments:
   a. Ensure that road layouts are designed to accommodate cyclists.
   b. People moving into a new development need to see cycling as a viable means of transport from the time they move in, as this is when travel patterns will be established. Therefore, it is not good enough to provide cycling facilities at some later date.
   c. Look for opportunities for developments to fund improvements to cycling infrastructure. For example, encourage a developer to fund cycle projects in the vicinity of the development that will benefit residents and visitors. This could be considered in return for waivers on car parking requirements or allowing higher density than may otherwise be allowable.

d. Ensure that office developments provide facilities such as showers and secure bike storage.

5. To aid the success of Melbourne's proposed bicycle share scheme, consideration should be given to allowing users to not wear a helmet. Assuming that like in Paris, the bikes will have a distinctive appearance and be geared to only travel at relatively low speeds, it would be possible for a waiver to be applied to only these bikes.

Recommendations for reallocating road space

1. Identify areas where excess space is allocated to vehicles. For example, many older style roads have very wide traffic lanes, to leave space for parking.
2. Identify and delineate necessary traffic lanes more clearly, to create space for cycle lanes and/or dedicated parking lanes.
3. Look at opportunities to reduce the number and/or width of traffic lanes.
4. Consider trialling changes as traffic management experiments to gauge public perception, rather than consulting extensively before acting.
5. Develop a hierarchy of road users and allocate space accordingly. For example:
    a. If space is limited, consider whether it is appropriate that a high proportion of the available space is allocated to vehicles that carry a relatively small number of people, while much larger numbers of pedestrians face crowded conditions?
    b. If there is a desire to encourage cycling, appropriate space needs to be allocated to cyclists to ensure that cycling can be a safe and convenient form of transport.

Recommendations for mitigating the urban heat island effect

1. Identify areas where excess road space is allocated to vehicles, as per the recommendation under Reallocation of Road Space.
2. Seek opportunities to remove areas of paved surface and replace with vegetated areas.
3. Look for opportunities in Council projects such as car parks or building projects to increase vegetated areas/reduce the area of hard surfaces. These could be treated as demonstration projects.
4. Set up a system for calculating the net impact on the urban heat island effect, particularly for all public land including road reserves. This would include:
    a. Green space lost to expansion of buildings or hard paved areas;
    b. Green space gained through any reduction in the area of roadway;
    c. Green space gained through any development of new public open space;
    d. Area of dark paved surface such as asphalt replaced with lighter, more reflective materials;
    e. Area of impermeable surface replaced with permeable surface; etc
5. Look for opportunities to increase public open space in areas where it is lacking, taking inspiration from projects like the High Line. Consider the way that such a project could help to transform a neighbourhood and add value to properties.
6. Look for ways to increase permeable and green areas within private developments. Consider education and planning controls to support this.

Recommendations for reducing energy related greenhouse gas emissions

1. Monitor the City of Sydney's progress in the implementation of trigeneration projects, to keep abreast of key findings.
2. With this in mind, consider other situations where decentralised energy may

	be possible.
3.	**Seek to incorporate small scale renewable energy generation in Council projects a demonstration. Measures such as effectiveness and payback period should be reported, to enable lessons to be learnt.**
4.	**Similarly, use Council projects to demonstrate measures to improve energy efficiency and reduce demand.**
5.	**Consider ways to incorporate efficiency measures into private development.**
6.	**Be aware of local conditions to determine the most effective ways of reducing emissions through energy generation. For example:**
	a. How reliable is solar access?
	b. How reliable is wind in the area?
	c. What are the local users of electricity, heat and cooling?
	d. Consider their number, demand, density, transmission distance etc, to determine how to best meet their needs.
7.	**Advocate for the removal of legislative barriers to decentralised energy production.**

Study Tour Itinerary and Contacts

Date	Location	Organisation	Contact
11 September 2009	Los Angeles, USA		
13 – 16 September 2009	Columbus, Ohio	American Public Works Association Conference	
18 September 2009	New York City, USA	New York University Polytechnic	
22 September 2009	Copenhagen, Denmark	City of Copenhagen	Kim Brodersen, Senior Consultant – Lawyer Rita Justesen, Head of Planning (By&Havn) Lotte Bech, Urban Planner, Architect Janus Steen Møller, Urban Accessibility, Program Manager
23 September 2009	Odense, Denmark	City of Odense	Charlotte Moosdorf – Head of Department of Industrial Environment, Department of Culture and Urban Planning Birthe Papsø, Manager Transport Connie Juel Clausen, Traffic Planner
24 September 2009	Malmö, Sweden	City of Malmö	Lars Böhme, Landscape Architect
		Augustenborg Botanical Roof Garden	Louise Lundberg, Superintendent of Botanical Roof Garden
28 September 2009	London, UK	Olympic Delivery Authority	Simon Wright, Director of Infrastructure and Utilities, is responsible for the delivery of environmental, geotechnical and civil engineering solutions and infrastructure, including ground remediation, earthworks, roads bridges and retaining walls. He is also responsible for the commissioning and securing of operator licences to provide for a full range of all major utilities – water and sewerage, gas, electricity and other services required to stage the Games and to ensure that legacy

			issues are fully integrated and planned for.[34] Alison Nimmo, Director Design and Regeneration, worked on the Games bid. Alison is a chartered surveyor and town planner, specialising in regeneration and master planning. She has worked in both the public and private sectors and is probably best known for her track record in delivering major regeneration programmes in Manchester and Sheffield city centres[35].
29 September 2009		London Development Agency	Peter North, Head of Project Delivery, Environment
		Thameswey Energy Ltd, Woking Council	John Thorp

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