MUNICIPAL ENGINEERING FOUNDATION VICTORIA

AMERICA and EUROPE STUDY TOUR 2008

MINIMISE THE IMPACT ON CLIMATE CHANGE OF NEW DEVELOPMENTS

Michael Ellis
General Manager Assets and Services
Cardinia Shire Council

Municipal Engineering Foundation Victoria

CARDINIA

Table of contents:

Table of contents (cont):

1. ACKNOWLEDGEMENTS

I wish to express my appreciation to the Municipal Engineering Foundation Victoria (MEF Vic) for providing the study tour award and the opportunity to learn from international best practice experiences.

In addition I wish to recognise the assistance provided in the planning and organising of the tour by Mr Keith Wood AM, Chairman of the MEF (Vic) and Mr Robert Ward, foundation trustee and tour leader.

The support for the study tour by Cardinia Shire Council and its CEO Mr Garry McQuillan is appreciated and I wish to especially thank Nicole Bosgard for her considerable contribution in organising the tour.

The following organisations that hosted the study tour require recognition for their hospitality, provision of information and assistance:

- City of Santa Monica, USA
- City of Malmo, Sweden
- Scandinavia Green Roof Institute, Sweden
- City of Vaxjo, Sweden
- City of Stockholm, Sweden
- London Borough of Greenwich, United Kingdom
- London Borough of Sutton, United Kingdom
- Bio Regional Development, United Kingdom
- Milton Keynes Council, United Kingdom
- Oxley Wood Development, United Kingdom

2. EXECUTIVE SUMMARY

Introduction:

The Municipal Engineering Foundation Victoria Study Tour Group of 2008 comprised four local government engineers and a foundation trustee travelling to America and Europe.

The tour group had the common study tour theme relating to sustainability and climate change. My study tour topic was "Minimise the Impact of Climate Change on New Developments" with a focus on:

- Learning from model developments overseas that focus on ecological sustainability as a means of minimising the impact of city development on climate change.
- Studying integrated environmental solutions for developing areas that minimise energy consumption, greenhouse emissions, water consumption and waste production.
- Considering the impact of performance measures and mitigation strategies to achieve healthy cities. Understanding the roles and responsibilities of key stakeholders and methods of community engagement.

Over the period of 14 August to 4 September 2008 the tour party visited local authorities and relevant organisations in the United States of America, Scandinavia and the United Kingdom. In addition, the group attended the American Public Works Association International Public Works Congress in New Orleans.

Study Tour Visitations:

The study tour program was carefully planned around visiting cities that have demonstrated world best practice in delivering integrated sustainable developments that minimise their impact on climate change.

The first city visited was Santa Monica in the USA which is recognised as a green city due to its Urban Watershed Management Program and use of solar power.

The three Swedish cities visited, Malmo, Vaxjo and Stockholm, all use locally renewable energy to achieve integrated sustainable developments.

In the United Kingdom the cities of Greenwich, Sutton and Milton Keynes used innovative designs to create environmentally sustainable housing developments.

APWA International Congress:

The 2008 APWA Congress and Exposition was held in New Orleans, Louisiana over four days with a number of sessions devoted to emergency management and restoration of damaged infrastructure following experiences from Hurricane Katrina.

The APWA Congress was to be held in New Orleans in 2006 but it was deferred until 2008 due to the devastation caused by Katrina.

The congress was well attended with many international delegates benefiting from an extensive range of educational sessions (130 in total) covering all facets of public works. There were many sessions directly related to my study tour focus on sustainability and development impacts on climate change. The opportunity to network with international colleagues was very rewarding.

Key Findings:

1. The development of sustainable urban communities requires long term planning and strategies that recognise global and regional factors require attention at a local level. This strategic framework is particularly important when considering global factors such as climate change and what measures new developments can implement to minimise their impact on the environment.

   All successful sustainable cities visited on the study tour had key stakeholder commitments to agreed sustainability goals. Partnerships between the private and public sector provided substantial up front funding to ensure the long term sustainability of new developments. This was particularly evident where millions of dollars were spent on remediation works of brownfield sites or the extension of light rail to a development precinct.

2. The achievement of self sustaining cities requires a fully integrated approach incorporating the energy systems, built form and bio diversity treatments. This approach is not only a prerequisite for a new development to be sustainable but it is also critical that the integration of services extends beyond the development to a regional or even state level.

   It is important that public transport systems, in particular rail, are integrated into the national network. Sustainable cities use renewable energy sources which have fluctuating production depending on natural factors such as wind and sun. No electricity is produced from wind turbines if there is insufficient wind or from solar cells on overcast days.

   The connection of the energy systems onto the grid provides for both storage capacity during periods of peak production and reserve supplies during low production or high demand periods.

Long term master planning involving all key stakeholders is required to achieve a fully integrated sustainable development. The most progressive developments integrated the structure planning process with agreed environmental goals from the outset.

3. Performance measurement enables the successful achievement of sustainability goals to be measured and opportunities for improvement to be identified. In America, the performance of Council's Sustainable City Plan is measured by Annual Sustainable Report Cards. Innovation targets are often established as a means of achieving environmental improvements to a development.

   The successful operation of a fully integrated sustainable development model (such as Hammarby eco-cycle) is that each phase functions as a key component of the whole system. This is particularly important with integrated energy systems where performance monitoring is essential to keep the system in balance. Reporting on the model's performance is required to encourage continuous improvement and maximise research and development opportunities.

Within the framework of the three key findings identified, a number of recommendations are made in this report for application in the Australian local government environment.

3. INTRODUCTION

The Municipal Engineering Foundation Victoria 2008 Study tour award enabled me to travel to the USA and Europe and learn from local authorities and related organisations on my study tour topic.

The study tour group also attended the American Public Works Association (APWA) International Public Works Congress in New Orleans. The group was joined at the Congress by the Institute of Public Works Engineering Australia National tour party.

The study tour group comprising of Nick Mazzarella, Darebin City, Vicki Shelton, City of Greater Geelong, Justin Hinch, Horsham Rural City Council, Robert Ward, trustees of MEF (Vic) and myself travelled for a period of 21 days from 14 August to 4 September 2008. The experience of travelling with other scholarship recipients was very rewarding and their contribution to the success of the study tour was greatly appreciated.

All members of the tour group had the common study tour theme of sustainability and climate change, so the tour was truly a shared learning experience. My study tour topic was Minimise the Impact on Climate Change of New Developments with a focus on:

- Learning from model developments overseas that focus on ecological sustainability as a means of minimising the impact of city development on climate change.

- Studying integrated environmental solutions for developing areas that minimise energy consumption, greenhouse emissions, water consumption and waste production.

- Considering the impact of performance measures and mitigation strategies to achieve healthy cities. Understanding the roles and responsibilities of key stakeholders and methods of community engagement.

4. BACKGROUND

Melbourne 2030 is the State Government strategy for the sustainable development of Melbourne over 30 years. The strategy provides for a number of growth corridors bounded by green wedge zones to contain development.

The Casey Cardinia Growth Corridor is the only development corridor to the south east of Melbourne and provides for over 82,000 additional houses over the next 17 years.

Cardinia is the fourth fastest growing community in Victoria with approximately 4 per cent growth per annum.

Melbourne 2030 specifies a number of objectives relating to the protection of the environment and promoting long term sustainability and climate change measures.

Direction 7 of the strategy “A greener city” provides nine key objectives for sustainable growth. The objectives relate to:

- water conservation
- waste minimisation and recycling
- energy and greenhouse gas emission reduction
- stormwater and ground water management
- transport planning to reduce CO_2 emissions
- promote biodiversity and protect native habitat
- develop sustainability benchmarks to measure performance.

Cardinia Shire Council has shown leadership in addressing climate change and has introduced measures in the planning controls and growth corridor structure plans to minimise the impact of climate change on new developments. New “sustainability design guidelines” have been prepared for development within residential and employment precincts in the growth corridor to:

- minimise life cycle energy consumption and greenhouse emissions to buildings
- achieve sustainable water cycle management and water conservation
- enhance the health and wellbeing of building occupants by optimising indoor environmental quality in all buildings
- reduce the environmental impact of building construction methods
- avoid waste to landfill during construction, occupation and demolition
- facilitate reduction of car usage and promote use of other modes of transport.

4. BACKGROUND (cont).

Cardinia Shire Council is one of five councils working with the state and federal governments and CSIRO to predict the likely impacts of climate change in the Westernport region over the medium (2030) and long term (2070).

Together the group has produced a comprehensive report titled Impacts of Climate Change on Human Settlements in the Western port region. This report has identified a number of key risks:

- average temperatures will rise by up to 1.3 degrees by 2030 and 3.5 degrees by 2070
- sea levels could rise by up to 170mm by 2030 and by up to 490mm by 2070
- average rainfall is likely to fall by 8 per cent by 2030 and by 23 per cent by 2070 and droughts will be longer and more severe
- storms and floods will be more frequent and of a greater severity.
- hotter, drier weather will lead to an increased wildfire risk.

In addition, the report recognises that 19 per cent of Council's annual expenditure can be classified as being directly 'climate exposed' consisting of capital and maintenance expenditure on roads, drains, open space and buildings.

Cardinia Shire Council has also been assessing its climate change vulnerability using Professor John Martin's framework, namely risk assessments, adaptation and mitigation (RAM). Professor Martin is also working with the Institute of Public Works Engineering Australia (IPWEA) to further develop his model for local government and the experience and knowledge gained from the study tour could assist in developing relevant case studies.

The study tour and report highlights the necessity of early and thorough planning of sustainable developments as the decisions we make today about community infrastructure, water, energy, waste and greenhouse emissions will determine how well-placed we are to meet the climate change challenges that lie ahead.

5. STUDY TOUR VISITATIONS

5.1 CITY OF SANTA MONICA

5.1.1 City of Santa Monica profile

The City of Santa Monica is located on the California coastline in the Los Angeles County. The city has a population of 88,050, a growth rate of 4 per cent and residents working in the transportation, medical and tourism industries and the public sector. The city is considered a “green city” with 75 per cent of public works vehicles run on alternative fuels, and every public building uses some form of renewable energy.

5.1.2 Sustainability Initiatives:

The City of Santa Monica developed an Urban Watershed Management Program, specifying design regulations and construction practices to reduce urban runoff water pollution.

Developers are required to submit an Urban Runoff Mitigation Plan that must comply with ordinance requirements reducing runoff from all impermeable surface areas by a factor of 1.91cm. In addition to controlling catchment runoff, the city constructed a unique runoff recycling facility at the ocean outfall discharge.

The Santa Monica Urban Runoff Recycling Facility (SMURRF) is a unique facility due to its colourful architectural design and high profile location on the Santa Monica Bay foreshore (refer to picture on page 12).

The primary purpose of the facility is to eliminate pollution of Santa Monica Bay caused by urban runoff but also to:

- provide cost effective treatment and produce high quality water for reuse in landscape irrigation
- raise public awareness of Santa Monica Bay pollution by providing appropriate education exhibits at the facility
- construct an aesthetically pleasing and functional facility with significant art elements that attracts people’s attention.

The stormwater recycling facility is the first of its kind in the USA and can process up to 2.2 megalitres per day of runoff. The treatment process involves a series of screens to remove large debris and a rotating drum and grit chamber to remove fine particles.

Dissolved air flotation (DAF) removes grease and oil before entering the micro filtration treatment units to filter out turbidity. Final ultraviolet (UV) radiation disinfects the water, killing bacteria and viruses creating healthy water for reuse.

Surprisingly, legislation in the USA prevents water harvesting practices commonly used in Australia such as the use of roof runoff for domestic purposes. Residential properties generally direct roof storm water runoff into large underground tanks where the water is injected into the aquifer.

The city launched “Solar Santa Monica” resulting in 140 grid connected solar projects producing over 1,000 kilowatts of solar power. Whilst the economic viability of using solar photovoltaic cells is questionable, the city is committed to promoting this form of renewable energy source particularly given the climatic conditions.

At high profile locations, solar photovoltaic cells are bonded to conventional steel roof decks on public car parks to promote the advantages of renewable electricity. Adjacent to the Santa Monica Civic Auditorium is one such car park that is promoted as a ‘Solar Port’ producing 45,000 kilowatt of hours of clean renewable electricity each year that services the auditorium as well as Council’s electric vehicle fleet.

The City of Santa Monica continually demonstrates leadership in environmental sustainability. As an example, its new library received the prestigious gold level certificate for Leadership in Energy and Environmental Designs (LEED). The 10,000 square metre library collects all stormwater runoff in a 1 mega litre cistern and pumps it to the sub surface irrigation system. Water use at the library is reduced by 55 per cent and energy use is minimised due to efficient lighting and the thermal qualities of the roof and walls.

5.1.3 Santa Monica observations

- The City of Santa Monica places a significant emphasis on communicating and advocating its sustainability initiatives. In addition to providing valuable alternative sources of water and power for residents, the projects showcase how public facilities can be used to educate the public and enhance community pride.

- Thirteen years ago Santa Monica developed a Sustainable City Plan (SCP) and each year prepares a sustainable City Report Card detailing performance in meeting the aggressive SLP goals. The report card rates performance in eight sustainable goal areas and benchmarks performance against the previous three years.

- There are limited domestic opportunities to reuse or recycle stormwater in the USA due to legislative health constraints.

The Santa Monica Urban Runoff Recycling Facility (SMURRF)

5.2 AMERICAN PUBLIC WORKS ASSOCIATION (APWA) INTERNATIONAL PUBLIC WORKS CONGRESS

5.2.1 APWA Congress overview

The 2008 APWA Congress and Exposition was held in New Orleans, Louisiana on August 17-20, 2008. In 2006 the APWA Congress was to be held in New Orleans but due to the devastation caused by Hurricane Katrina the congress was deferred in New Orleans until 2008.

A number of the technical education sessions over the four days related to emergency management, restoration of damaged infrastructure and recovery systems stemming from Hurricane Katrina's experiences.

The congress was very well attended with many international delegates benefiting from an extensive range of presentations (130 in total) covering all facets of public works. The Ernest. N. Memorial Convention Centre was the venue for the congress and exposition with over 500 trade displays.

5.2.2 Sessions of Interest

The congress program comprised of a series of educational forums with excellent key note presentations focussing on leadership.

There were many sessions directly relevant to my study tour focus on sustainability and impacts on climate change from developments, including:

- Current issues in adapting Civil Infrastructure to Climate Change.
- Total Stormwater Management—the solution to sustainability.
- Why go Green? Sustainable building strategies.
- Great streets: opportunities for sustainable change.
- Global Warming and transportation: travelling greener.
- ICLEI - Local Government for Sustainability.
- Leading sustainability: Will Public Works rise to the occasion?
- Sustainability by design workshop.

A key learning from the presentations is the need for public works leaders to understand the long term implications of their decisions on the sustainability of future communities.

Local Government engineers must seek to identify opportunities for incorporating sustainability principles into all infrastructure planning and development.

Adaptive sustainability strategies are required to meet the challenges presented by the uncertainty of climate, economic and social change.

5.2.3 Congress networking

A significant benefit in attending the APWA International Congress was the opportunity to network with public works engineers throughout the world. Sharing experiences with international colleagues was something I found invaluable and personally rewarding.

As an example the sharing of information with engineers from the City of Olympic about their innovative green fleet program, the City of Los Angeles about their community engagement and partnership models and the Region of Peel Ontario with their cultural change and leadership program was very beneficial.

5.3 CITY OF MALMO

5.3.1 City of Malmo profile

Malmo is Sweden's third largest city (270,000 inhabitants), and is located in the centre of the Oresund Region Southern Sweden. Traditionally a heavy industrial city, Malmo has evolved into a knowledge city with a large student population. The Western Harbour formally housed the large Kockums shipyards and has now been redeveloped as a model sustainable city.

5.3.2 Sustainability initiatives

Western Harbour Malmo is a city quarter that uses 100 per cent locally renewable energy. A basic concept is that the volume of energy for the Western Harbour is derived from commercially accessible technology.

The sources of renewable energy are:

- Wind power from the Boel wind turbine in the adjacent harbour, supplies approximately 6 GWh of electricity with an output rating of 2MW. This turbine alone produces enough power to supply over 2,500 homes.

- Solar cells and solar collectors. 6,000 kilowatt hours of electricity is produced from 120m² of solar cells which is only enough for about 6 dwellings. 2,600m² of solar collectors are connected into the district heating network providing 700,000 kilowatts for the whole of Western Harbour. The solar collectors provide surplus heating during very cold days.

- Underground aquifer where 10 bores 90 metres deep take water at 15°c during freezing winter temperatures and use it as a heat source in a heat pump. In summer the process is reversed and the cold water is used for the district cooling network. The system produces about, three million kilowatt of cooling.

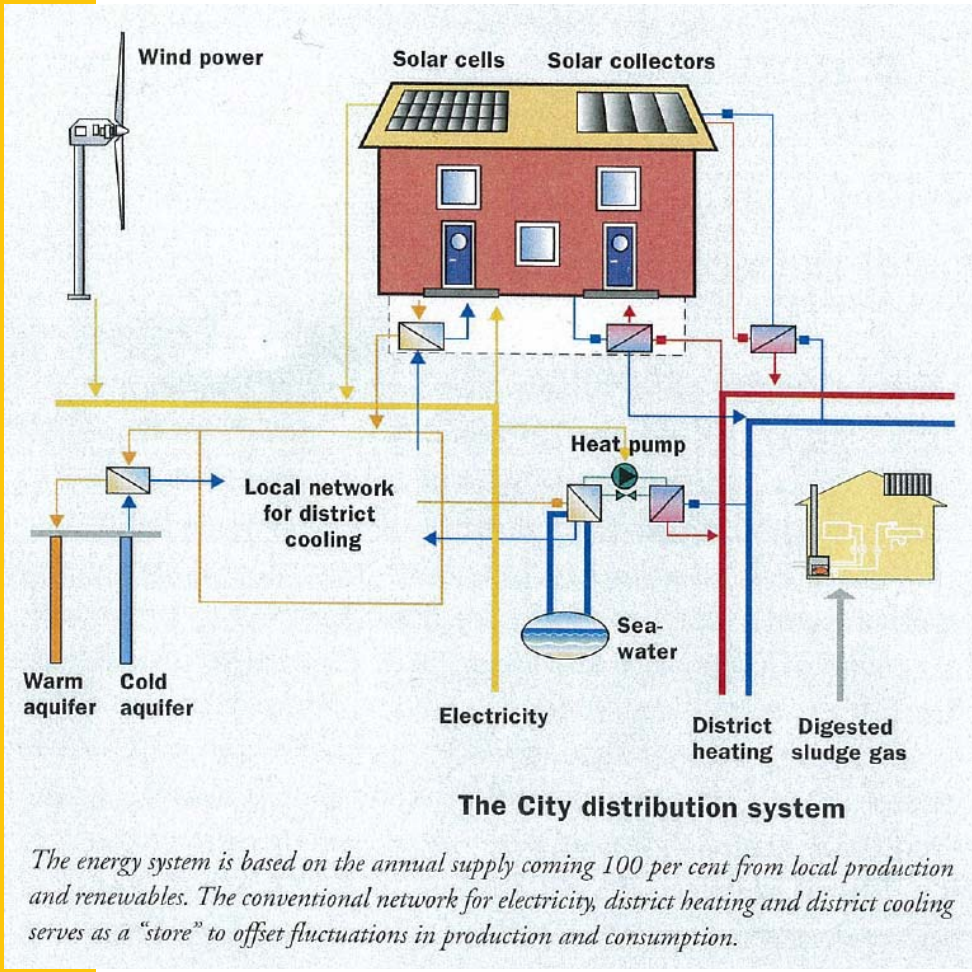
- Domestic waste is vacuum collected at Western Harbour and converted into biogas through anaerobic digestion which is fed into Malmo's natural gas network. The gas produced is used to fuel Malmo City's buses and cars.

- Energy use targets for buildings at Western Harbour were set at 105 kilowatt hour per square metre without compromising resident's comfort. Excellent planning, building orientation and ESD building designs helped achieved these goals in many incidents, however resident's behaviour reduced some of the energy savings, e.g. by turning their radiators on full and airing rooms at the same time.

- Water quality is addressed through Sustainable Urban Drainage (SUD) using greenroofs and wetland systems prior to discharging down open channel systems. The expensive channel systems prevent stormwater permeating into potentially contaminated sub grades.

5.3.3 Observations

- Western Harbour's ambition of 100 per cent locally produced renewable energy has been achieved without the use of fossil fuels such as coal, natural gas or oil.
- The energy goals set for building developments of 150 kilowatt per square metre have been exceeded in many instances due to the lack of commitment by residents towards saving energy and also limited knowledge on how best to utilise the energy saving equipment.
- Malmo's ecological sustainable development at Western Harbour was only achieved due to significant local investments grants and incentives from the European Union and Swedish Government.
- The achievement of the ecological sustainable targets at Malmo required a fully integrated approach for the energy system, built form and biodiversity treatments, as detailed in the city distribution system below.



The City distribution system

Turning Turso, Malmo

5.4 GREENROOF INSTITUTE, SCANDINAVIA

5.4.1 Greenroof profile

The creation of the world's first botanical roof garden started in 1999 in Augustenburg in Malmo. The roof garden covering one hectare was opened to the public in April 2000. The Greenroof Institute and Greenroof Society disseminates knowledge and new technology on greenroofs from this research centre.

5.4.2 Sustainability Initiatives

A greenroof is sown, planted or laid as prefabricated mats. There are three main types of greenroofs: "extensive, semi-intensive and intensive". Extensive greenroofs are light weight with a very thin layer of soil (4cm) using primarily drought resistant plant species such as sedums and mosses. Semi intensive soil depth is 150-200mm and grow flowers herbs and bushes. Extensive green roofs survive on natural rainfall and require limited maintenance. On the other hand intensive roof gardens have deep layers of soil (1metre+) and larger plants and require high levels of maintenance and watering.

Living roofs contribute to a more sustainable development in our cities in many ways by:

- replacing lost green space and improving the ecology with native flora and fauna
- improving the living environment for urban dwellers with attractive outdoor areas and improved micro-climates
- providing excellent insulation, reducing heat loss through wind chill, improved solar reflecting (albedo effect) and solar absorption resulting in energy reduction with less need for heating and cooling
- developments require a green space factor. For dense developments green roofs are used to help achieve the required ratio of green areas to built areas
- retention of 39-53 per cent of precipitation over a year depending on different substrate thicknesses and porosity of growing media
- providing a larger life span of roof membrane and associated structure
- improving Sustainable Urban Drainage (SUD) with the greenroofs absorbing stormwater thus reducing the co-efficient of runoff and time of concentration resulting in the downsizing of the discharging pipe network. The runoff water quality is very high due to the filtering process outfall
- noise level reductions between 5-25dB depending on frequency level with an average reduction of 10dB.

5.4.3 Observations

- Living greenroofs are a practical way to achieve healthier cities by replacing lost green spaces and meeting green space requirements for dense developments
- The initial capital costs of the green roofs can be high particularly for intensive green roof gardens The Augustenborg project received $2.5m from EU-LIFE and Swedish Government to develop the green roofs.
- The installation costs of green roofs have a significant effect where extreme climate conditions occur and energy reduction for heating and cooling are significant.
- The stormwater retention capacities of up to 53 per cent of precipitation per annum has the potential to significantly reduce drainage costs in a inner city environment.

Living greenroofs, the Augustenborg project

Extensive green roof showing mat and membrane

5.5 CITY OF VAXJO

5.5.1 City of Vaxjo profile

The City of Vaxjo in Sweden has a population of 80,000, area of 1,674 kilometres squared containing 200 lakes. The City has a budget of 290m€ and 6,000 employees. The city is promoted as the Greenest City in Europe and has won international awards for its Fossil Fuel Free Program.

5.5.2 Sustainability initiatives

Vaxjo's vision is to have a "fossil fuel free Vaxjo where the energy consumption does not lead to any climate change. The City if Vaxjo strives to use energy from renewable sources of energy, to use energy efficiently and to go over to a fossil fuel free transport system".

Vaxjo's achievement to date in realising their vision:

- The municipality owned energy company VEAB was converted from oil to biomass to produce district heating and electricity. Forest residue, the source of bio energy is found in abundance locally.
- In 1996 a unanimous decision by Council for the city to become fossil fuel free. A climate commission in Vaxjo was established with representation from Council, Vaxjo University, major industry developments and the business sector to drive the sustainability initiatives.
- In 2003 the introduction of an environmental management system, eco BUDGET, to ensure that the goals of the city's Environmental Program are achieved and brought to account as part of the formal budget process. The annual accounts and reports measure environmental performance against environmental asset indicators and efficiency indicators for every business unit (refer Appendix 1).
- In 2005 construction of energy efficient multi storey buildings and houses constructed from wood. The ability of wood to draw up and disperse damp creates an even indoor climate and minimises heating and cooling requirements (refer to picture on page 20).
- In 2006 reduction of Co^2 per capita by 30 per cent compared to 1993. Aim to achieve 50 per cent reduction in Co^2 emissions by 2010 and 70 per cent reduction by 2025. In 2006, 52 per cent of all energy came from renewable energy and the City's aim is now to achieve 100 per cent energy usage from renewable energy.
- Vaxjo municipality provides subsidies for the installation of small scale biomass boilers or solar panels in households.
- Biogas is used for electricity production at the sewerage treatment plant, 2nd generation bio fuels from gasification of biomass waste DMT, FT-diesel. Fleet testing is underway with Volvo DME trucks.
- The municipality requires low energy use in new housing areas and installs more efficient street lighting.
- Free car parking is provided in Vaxjo for environmentally adapted cars.

5.5.3 Observations

- The trigger for Vaxjo to become the “Greenest City in Europe” was the severely polluted lakes close to the city centre which caused community outcry.

- The success of the environmental programs is due to the politicians deciding unanimously that Vaxjo shall become a fossil fuel free City - a decision that made a great stir throughout Europe.

- The creation of “the climate commission of Vaxjo” with representation from Council, the business sector, Vaxjo University, energy experts and the energy agencies themselves gave climate issues a high profile. This public private partnership attracted substantial funding through the Swedish Environmental Protection Agency and the European Commission for the development of sustainable energy systems.

- Vaxjo’s main success to date has been the conversion of its energy company to use biofuels for district heating and power however more is required to make the climate work a long-term success. Vaxjo is now focussed on changing residents behaviour to make it easier to live a life without fossil fuels, for example with cheap and convenient district heating, well designed ESD buildings, energy efficient public transport and good walking and cycling paths.

- The environmental management system eco BUDGET, ensures the sustainable goals that have been developed lead to an improvement using their finance system asset and efficiency indicators. This is an excellent process as the old adage goes “what gets measured gets done”.

- Vaxjo city work hard to promote its sustainability and climate change initiatives to its community, various levels of government and private sector stakeholders. This has resulted in sustainability, environmental initiatives and climate change being an integral part of everyone's way of life. It has also resulted in substantial funding being provided for their programs and enabled the Council and University to run profitable educational programs on these topics.

Wooden City, Vaxjo.

5.6 CITY OF STOCKHOLM

5.6.1 Hammarby Sjostad profile

Hammarby Sjostad, 'Hammarby Sea City', is a new part of inner Stockholm, the capital of Sweden. This former port and industrial area of 200 hectares is being transformed into a modern, ecologically sustainable city with 11,000 apartments housing a population of 25,000. Total development in 2015 will see 35,000 people living and working in the area.

5.6.2 Sustainability initiatives

The City of Stockholm's environmental vision for Hammarby Sjostad is to lower the total environmental impact by half in comparison to a conventional development. The City of Stockholm has specific environmental goals for land usage, transportation, building materials, energy, water and sewerage and waste that Hammarby Sjostad must achieve.

The real key to the district's success is the integrated planning work that involved all stakeholders and was undertaken prior to any development works. The integrated environmental solutions can be followed through an eco-cycle that has become known as the Hammarby model (see model following page 22).

The eco-cycle handles energy, waste, waste water and sewage for housing, offices and other commercial activities in Hammarby Sjostad. The eco-cycle is also designed to act as a role model for the development of equivalent technological systems in large cities.

Significant sustainability commitments at Hammarby Sjostad include:

- minimum of 30 square metres of park area within 300 metres of every apartment
- 80 per cent of resident's and worker's journeys shall be by public transport, on foot or by bicycle by 2010
- 15 per cent of residents shall be signed up to the Hammarby carpool by 2010
- strict adherence to use of sustainable building materials that do not contain chemical products or hazardous substances
- at the completion of the development, residents will produce half of all their energy requirements by utilising the energy present in wastewater and combustible waste
- alternate energy supplies are provided from fuel cells, solar cells and solar panels
- water consumption has been reduced from 200 to 150 litres per person per day
- biogas is extracted from sewage sludge and used as vehicle fuel in city buses and in 1,000 gas stoves. Biosolids are used as a fertiliser on agricultural land
- combustible waste collected by an integrated vacuum system is incinerated to produce district heating and electricity (energy extraction from 99 per cent of combustible waste by 2010 is the target with reuse and recycling of waste is the highest priority)
- heat from treated wastewater is converted into district heating and district cooling.

5.6.3 Observations

- Hammarby Sjostad is recognised as one of the world's highest profile examples of sustainable city development.

- Hammarby Sjostad's success has been due to long term planning when it was originally planned as part of Stockholm's sustainable bid for the 2004 Olympics. The strong focus on ecology and environmental sustainability for the Olympic bid has been retained and enhanced.

- The City of Stockholm owned all the developable land and could therefore ensure its partnership with over 20 different developers delivered the highest environmentally sustainable development outcomes.

- The achievement of world best practice sustainability and climate change outcomes is due to the adoption and implementation of the fully integrated 'Hammarby eco-cycle model'.

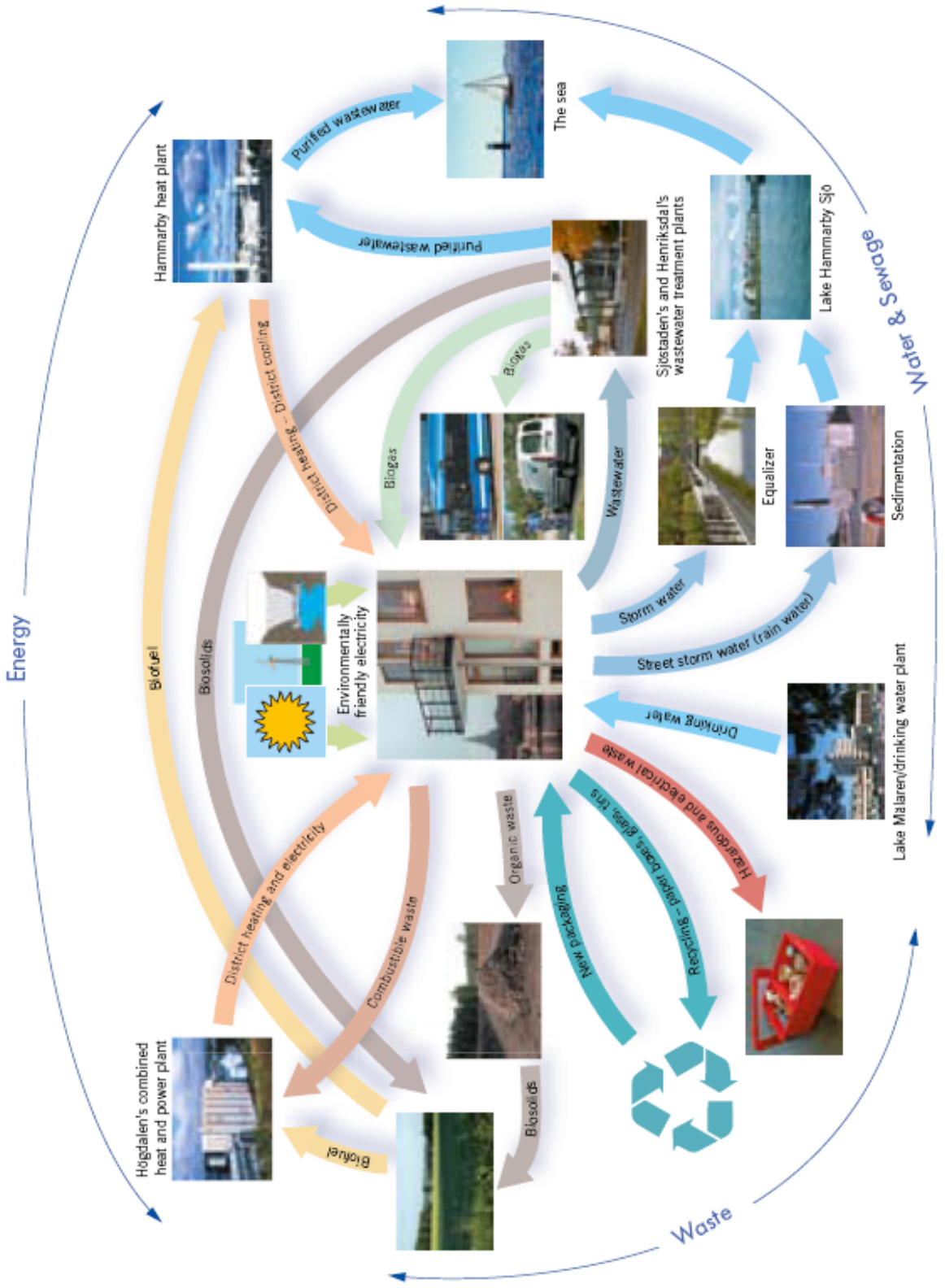
- Reductions in private care usage (and greenhouse emissions) are achieved at Hammarby Sjostad by residents using light rail, ferries, buses, carpools and bicycles. The government made huge investments in public transport, in particular the light rail link 'Tvarbanan'. The City of Stockholm provides a free daily ferry service between Hammarby Sjostad and the Stockholm city centre.

- Stringent requirements are placed on building materials to ensure the use of organically sustainable materials. Eco-certified products are promoted and the use of copper pipes and PVC tubes banned. Stainless steel is used on bridges and external structures. To ensure compliance, eco-inspections occur on all building sites. Developers state that using environmentally sustainable materials adds on extra 2-4 per cent to the total cost of construction.

- The goal of lowering the total environmental impact of the Hammarby Sjostad development by half has not yet been achieved with reductions to date in the order of 35-40 percent.

Hammarby Sjostad

The Hammarby model



5.7 GREENWICH MILLENNIUM VILLAGE LONDON

5.7.1 Greenwich Millennium Village profile

Greenwich Millennium Village (GMV) is located on a 131 hectare site on the Thames Gateway south east London. The development started in 1999 on the former gas works site and will comprise over 3,000 homes when complete. To date 1,400 units are complete and occupied. English Partnerships invested 225 million pounds in remediating, servicing and landscaping the area.

The government's intent with the GMV is to create a new model for urban living based on social cohesion, transport, communication, environment, technology and innovation.

5.7.2 Sustainability initiatives

English Partnerships is England's national regeneration agency helping the government to support high quality sustainable growth in England. English Partnerships specialises in brownfield land redevelopment, low cost sustainable housing initiatives and zero carbon community developments.

English Partnerships set the GMV development team's innovation targets aiming to achieve high quality innovative sustainable development. For each innovation target a performance benchmark was established by which actual differences in performance are measured as the development progresses through five stages. The technical innovation targets for GMV were:

- primary energy – reduce by 80 per cent
- embodied energy used for building construction – reduce by 50 per cent
- Co^2 emissions are not to exceed 20kg Co^2/m^2
- water consumption – reduce by 30 per cent
- construction costs – reduce by 30 per cent
- construction period – reduce by 25 per cent
- construction waste – reduce by 50 per cent (maximum $20m^3$ per dwelling)
- Improve noise insulation standards by 10 per cent above building regulations
- Use 'A' rated materials for buildings from the BRE Green Guide to Housing.

5.7.3 Observations

- Primary energy reduction level achieved to date is 70 per cent through improved insulation standards and use of a highly efficient Combined Heat and Power Facility (CHP) coupled to advanced control systems. The CHP system however can only be wired to 1,000 properties. As is the case in Australia there are difficulties in selling surplus power from the CHP facility back into the grid.

- Embodied energy is already reduced by 30 per cent for stages one and two by selecting materials using the BRE Green Guide that require low amounts of energy for their production and make use of recycled product.

- Water consumption reduction has met the 30 per cent target by using water efficient taps, showers, toilets and whitegoods. Extensive water recycling is not yet considered viable on large urban projects and water harvesting is not utilised.

- As part of the 131 hectare redevelopment of Greenwich Peninsula, an ecology park has been developed as a fresh water habitat to reintroduce biodiversity values into the area. A privately operated environmental education centre is at the ecology park.

- GMV has 20 per cent affordable housing (subsidised by Council) with an ultimate target of 35 per cent on completion. The affordable housing is blended throughout the whole village.

Greenwich Peninsula

Greenwich Millennium Village

5.8 LONDON BOROUGH OF SUTTON

5.8.1 Borough of Sutton Profile

The Borough of Sutton South of London has 185,000 residents, over 3,000 staff and is considered an affluent area. The Sutton Council is a four star authority having gained this rating for its sustainability and environmental policies and projects.

5.8.2 Sustainability Initiatives

The Borough of Sutton developed Agenda 21 'Vision for a sustainable Sutton' which was drawn up by the whole community. In conjunction with Bio Regional the Council is promoting 'One Planet Living' based on reducing their ecological footprint by two thirds (refer appendix 2). BedZED has been developed on this basis and is the UK's leading model of urban sustainability.

The Beddington Zero Energy Development (or BedZed for short) has south-facing living spaces that maximise light and solar gain, 300mm insulated walls that utilise thermal mass and an innovative system of wind cowls that scoop natural air for ventilation (refer to photo on next page).

Significant sustainability initiatives at Sutton include:

- Smart Travel Sutton which reduced congestion by 10 per cent and developed a travel plan showing 80 per cent cut in Co^2 emmisions for regional transport. BedZED eco-village achieved a 50-65 per cent reduction in private car fossil fuel miles travelled compared to the local average.

- BedZED has a car club (ZED Car) and provision of electric charging points powered by 780 square metres PV solar panels with capacity to charge 40 electric vehicles.

- BedZED energy efficient design has resulted in a 25 per cent reduction in electrical consumption, portable water use reduced by 47 per cent and space heating reduced by 88 per cent.

- Sustainability action plans were offered to households in Hackbridge (2,500 homes surveyed) with trained auditors preparing individual eco footprints. Sixty six percent of residents made physical and behavioural change to improve sustainability.

- BedZED adopts a total water strategy using collected rainwater and treated wastewater for toilet flushing. Greenroofs provide residents with private gardens and reduces the runoff co-efficient and drainage network size. Water saving fittings to all plumbing further conserves water usage.

5.8.3 Observations

- The preparation of eco footprints for old 1930 buildings was an excellent initiative however its effectiveness was primarily due to face to face communication with individual residents therefore it consumed considerable resources and time.
- No heating was required in the BedZED houses due to the high insulation qualities of the 300mm thermal mass walls and triple glazed windows.
- The BedZED water purification plant has been shut down due to high levels of maintenance and specialist skills required to operate the plant. The CHP bio fuel generator was also shut down as planning permits did not allow it to operate at night and also there is a shortage of woodchip fuel.

BedZed — wind cowls and green roofs

BedZed—maximises solar gain

5.9 MILTON KEYNES CITY

5.9.1 Milton Keynes City profile

Milton Keynes is located 72 kilometres north of London and is England's largest residential growth corridor. With an area of 90 square kilometres and population of 230,000, Milton Keynes is expected to grow to 400,000 plus by 2031.

Established in 1967 as a master planned community Milton Keynes has one of the top 5 economies in the United Kingdom and a low unemployment rate of 1.72 per cent.

5.9.2 Sustainability Initiatives

A development corporation was established for Milton Keynes that was able to borrow from government and raise funds. Since 1999 Milton Keynes has been in-profit with returns being reinvested. An innovative tariff system was devised to ensure:

- the early delivery of infrastructure
- high level of design and superior construction standards
- carbon emissions are minimised.

The tariff has generated $553m from 15,000 dwellings and $67m from 500,000 square metres of employment/commercial area.

- Milton Keynes' masterplan uses a unique one kilometre grid for arterial roads with over 2,100 roundabouts to create free flow conditions bypassing townships to ease conjestion.

- Large green wedges are provided to manage stormwater with dense planting to enhance biodiversity.

Oxley Woods on the Western fringe of Milton Keynes is a new 145-home environmentally sustainable housing development. English Partnership's 'Design for manufacture' competition challenged developers to create innovative and environmentally sustainable homes with an affordable price tag of $120,000. George Whimpey, England's largest home builder, won the competition and developed eco homes with the following attributes;

- Homes are designed to achieve a 50 per cent reduction in carbon emissions by using high insulated timber panel construction with a eco hut which is an advanced energy saving system.
- The 'eco hut' is a new generation chimney stack that sits on top of the services spine, filters fresh air coming in and re-uses hot air circulating through the stack - complemented by solar energy to optimise energy consumption.
- House design is separated into two components, the living zone and the working zone. The working zone includes bathrooms, utility space and boilers and staircases which are standadised and pre-fabricated. The living zone is treated as a highly flexible shell. Components are delivered to site and assembled in 31 days.

- Modular design with alternate building materials enables the eco homes to achieve a code for sustainable homes level rating ranging from 2-5. Their aspiration is to be carbon neutral (level 6) in the near future.

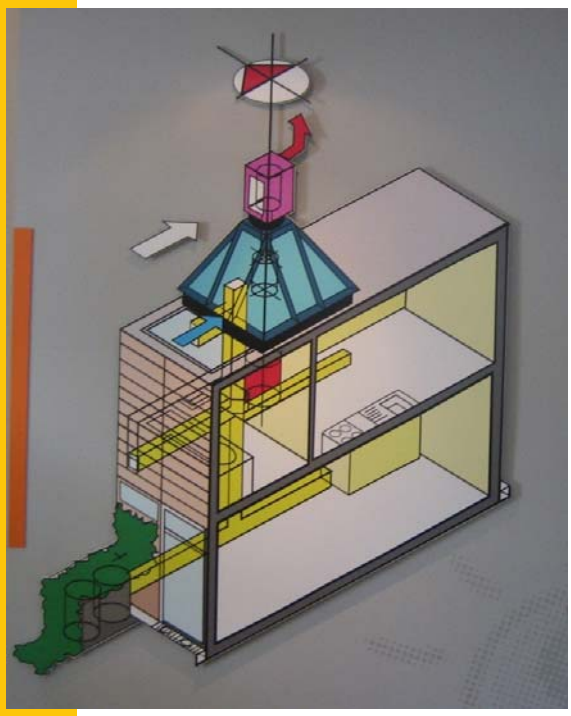
5.9.3 Observations

- To develop the new city of Milton Keynes the government took planning controls from elected local authorities and delegated authority to the Milton Keynes Development Coporation. The corporation's strongly modernist designs are a significant departure from traditional English towns.

- The radical 1 kilometre road network grid enables people to bypass city centres. It is not conducive to efficient public transport but designed around large car volumes. This may not be a sustainable transport system for the future given the dispersed population.

- The Oxley Wood eco homes with bright coloured Trespa cladding and boldly expressed eco huts give the homes business park aesthetics far removed from the warm brick of traditional English homes. Their appeal to the market is being monitored through sales figures.

Eco hut housing design



Eco homes

6. CONCLUSION & RECOMMENDATIONS

The study of model developments overseas that have sucessfully minimised their impact on climate change revealed the adoption of a wide range of innovative strategies and practices.

The different approaches to ecological sustainable development vary significantly from one country to another due to legislative requirements, different physical characteristics and community cultures.

There have been significant achievements in mitigating the impact on climate change of new develpments and implementing successful adaptation strategies. There is however still a long way to go and it is hoped the key findings and recommendations from the study tour may assit those in Australian local government to achieve more sustainable urban developments.

From the study tour I have summarised the key findings under three main headings, namely, Shared Sustainability Vision, Integrated Sustainable Development and Performance Measurement, all of which align with my study topic focus.

1. Shared Sustainablility Vision

1.1 Vision

All of the leading sustainable urban developments visited on the study tour had a clear long term vision and specific sustainability goals. The transformation from ‘vision to reality’ required the support of all key stakeholders including the various levels of government.

The Swedish Government’s strategy for sustainable development recognises the need to develop a framework of global, regional and local cooperation where all policy fields are integrated and national initiatives safegaurd long-term sustainable investments.

World leaders met at the Earth Summit in Rio and developed a global plan for sustainable development called Agenda 21. They decided that global problems such as climate change would be best solved at a local level so local governments were asked to produce Local Agenda 21 (LA21) plans for their local areas.

Many municipalities visited on the study tour in the UK and Europe have prepared sustainable development policies and strategies in accordance with the LA21 vision. A summary of the “Milton Keynes Agenda 21 Strategy” is included in the appendix 3.

Following the adoption of Agenda 21 Strategy in Vaxjo, the Swedish Society for Nature Conservation in conjunction with Vaxjo has developed partnerships and networks with 22 Climate Municipalities in Sweden. This is an excellent example of a global vision being adopted regionally and applied at a local level.

It is important for a municipality's sustainability vision to be clear, specific and have impact so the community can easily understand and embrace its goals. Detailed below are examples of effective vision statements relating to sustainability and climate change at Councils we visited:

- City of Malmo (Western Harbour) — A city quarter that uses 100 per cent locally renewable energy.
- City of Vaxjo — Fossil fuel free Vaxjo, where our energy consumption does not lead to climate change.
- City of Stockholm (Hammarby Sjosted) — The total environmental impact of Hammarby Sjosted is half that of a conventional urban development.
- Borough of Sutton — Committed to 'One Planet Living' by reducing our ecological footprint by two thirds.

1.2 Stakeholder commitments

To realise the agreed sustainability goals for the visited developments, long term commitments were made by all key stakeholders in both the public and private sector. For instance, in Malmo, $50 million in national government support was provided for a local investment program for environmental measures in the Western Harbour, as well as European Union funding to support the development of an "ecologically sustainable city of tomorrow".

The development of the model Augustenborg green roof project in Malmo attracted over $2.5 million for the European Union (EU) life fund and the Swedish government. This expenditure by the government and EU was justified on the basis of educating and promoting the use of green roofs.

A number of new sustainable cities visited in Europe were built on reclaimed brownfield sites (formerly heavy industrial). In these situations, the respective governments committed millions of dollars towards remediation works and servicing costs to enable developments to proceed.

The development of Hammarby Sjostad on a former port and industrial area occurred due to Stockholm City undertaking a massive decontamination project which rendered the site safe for urban development. The city made huge investments in public transport, in particular the extension of light rail (Tvarbanan) to Hammarby, along with the provision of a free daily ferry service. The site reclamation and provision of public transport cost Stockholm City in excess of $1 billion over the 20-year project life.

RECOMMENDATIONS:

1. To achieve sustainable urban developments municipalities must develop visions and strategies on sustainability that are shared with the community, governments and developers.

   The sustainability strategies must align with government policy particularly in relation to climate change where the Australian government has set targets to reduce greenhouse emissions by 60 per cent by 2050 and is establishing the Carbon Pollution Reduction Scheme.

2. Ecological sustainable developments must be in locations where it is easy for residents to adopt sustainable lifestyles. Sustainable developments should include energy efficient buildings, renewable energy, resource efficient infrastructure and proximity to employment and services. Residents must be encouraged to live and behave 'sustainably'.

3. Councils must establish close partnerships with government agencies and the private sector to achieve integrated development solutions, fast track approval processes and obtain necessary financial investment.

   To promote sustainable development and eco-cities, overseas governments committed millions of dollars to on site remediation works, infrastructure provision and public transport to attract private developers.

   The Victorian Government's new Growth Area Infrastructure Contribution (GAIC) of $95,000 per hectare should be provided for state infrastructure and services that support sustainable development that reduces our ecological footprint.

2. Integrated Sustainable Developments

The developments that most successfully minimised their overall impact on climate change were those that implemented integrated sustainable solutions.

Long-term master planning involving all key stakeholders is required to achieve a fully integrated sustainable development. The best example of early master planning was at Hammarby Sjostad where planning works were integrated with environmental goals from the very start of the planning process.

Staff from all key stakeholders/authorities worked from the same premises from day one with information sharing on an interdisciplinary basis. This ensured that all parties had a shared understanding of the outcomes and accelerated the decision-making process.

The Hammarby Integrated Sustainable Development model is based on a unique eco-cycle that handles energy, waste, water and sewage for housing and commercial development (refer to the Hammarby model page 23). The sustainability achievements at Hammarby would not be possible if the eco-cycle model was not fully integrated.

To drive integrated sustainable development in Vaxjo, the Climate Commission of Vaxjo was created with representation from Council, the business sector, Vaxjo University and the energy agencies. This public private partnership had a focus on developing sustainable energy systems and was also able to attract substantial funding from the Swedish (EPA) and European Commission.

Milton Keynes was a master planned community established in 1967 and was deliberately located equidistant from London, Birmingham, Leicester, Oxford and Cambridge with the intention that it would be self-sustaining and eventually become a major regional centre in its own right. Unfortunately, the planning controls were taken from Council and delegated to the Milton Keynes Development Corporation (MKDC). The MKDC was able to fast track the development of a modern city, however without the City as the planning authority, the level of community engagement and support for the radical master planned city is questionable.

The Western Harbour Development in Malmo had acknowledged that the achievement of its ecological sustainable targets required a fully integrated approach of the energy systems, built form and biodiversity treatments (refer to City Distribution System page 16).

In addition, to achieve a fully self sustaining city quarter, it was imperative the Western Harbour Development was integrated with the services and facilities in the remainder of Malmo.

When energy production from the wind turbine and solar panels exceeds consumption the surplus is sent to other parts of Malmo. Conversely, Western Harbour receives heat and electricity from the Malmo network when local production is inadequate.

Another good example of a masterplanned precinct that has created an environmentally and socially sustainable community is the Greenwich Millennium Village (GMV). The GMV resulted from the government's adoption of an overall vision for the Thames Gateway as a key entrance to London which necessitated the redevelopment of the Greenwich peninsula.

The GMV has been created as a 'showcase for sustainable development' demonstrating the successful integration of mixed-tenure developments along the peninsula as well as sustainable transport system to achieve the twenty year vision.

RECOMMENDATION:

1. To achieve the greatest sustainability results Councils need to integrate sustainability into their core business and decision-making process. This begins at the Council Plan level with appropriate sustainability strategies reflected through planning schemes and structure plans that are supported by Sustainable Design Guidelines.

2. Long-term masterplanning involving all key stakeholders at the start of the planning phase is required to obtain shared ownership and commitment to the outcomes. Environmental goals must be recognised early in the planning process to enable delivery of integrated sustainable developments. Strong public private partnership's need to be developed to ensure best practice sustainability initiatives are implemented in a cost-effective manner.

3. The Victorian Government needs to recognise the significant environmental and commercial advantages of decentralised energy systems. The conventional system using dirty fuel (brown coal), looses two thirds of the energy generated as heat and wastes up to 20 per cent of Melbourne's water. The transmission line distribution system has a 75 per cent energy loss and is unable to respond to peak demands as well as a decentralised energy system.

4. All sustainable cities visited used local or regional co-generation or tri-generation plants to provide power and heating. The government must review its policies, regulations and tariffs associated with integrating local energy systems into the national grid to encourage their introduction. In addition the incentives to use photovoltaic systems for commercial and residential applications must continue. The federal government's Solar Home's and Communities Plan is an excellent initiative however the $8,000 rebate on a 1 kilowatt system costing $11,000 is means tested. The state government should also commence photovoltaic rebate programs.

3. PERFORMANCE MEASUREMENT

The City of Santa Monica places significant emphasis on sustainability and in 2003 launched the Sustainable City Plan (SCP). An annual Sustainable City Report Card is prepared which measures the council and community's performance in meeting the aggressive sustainable city goals detailed in the SCP.

The report card highlights areas of success and challenges that face the council and community in eight goal areas. The primary grade given for each goal area reflects the progress in achieving the goal. There is also an effort grade which reflects the level of effort and commitment in the community that is focussed on achieving the goals.

The Sustainable City Plan and report card are well publicised in the Santa Monica community with current data on their achievements and performance detailed on the city's website.

As previously stated, the achievement of the ecological sustainability targets at Western Harbour Malmo requires a fully integrated approach for the energy system. It is critical to maintain an energy balance, therefore the ongoing measurement of the system performance is essential. This is achieved by 300 monitoring points on both the production and user sides measuring temperature, output ratings and flows. This information supplemented by individual property heat and electricity consumption enables the management of the energy system and identifies areas for improvement.

At the City of Vaxjo, the performance in achieving the vision of a fossil fuel-free city is managed through the eco BUDGET program.

Three sets of indicators relating to the budget, environmental assets and efficiency are used to measure performance within the environmental program to ensure improvement goals are achieved. The Eco BUDGET assessment criteria area is included in Appendix 1.

At the Greenwich Millennium Village, English Partnerships established development team innovation targets to ensure innovative sustainable development is promoted. For each sustainable innovation target a performance benchmark was established, through which actual differences in performance are measured as the development progresses. Hold points at the various phases of development ensure the sustainable innovation targets are realised.

Environmental standards are closely monitored and controlled in Hammarby Sjosted with a requirement that all builders/developers declare their chemical products and construction materials before work on their project begins. All buildings are constructed from eco-certified sustainable materials, avoiding the use of chemical products or treated construction materials. Regular eco-inspections are conducted throughout the development to ensure compliance with the stringent environmental building controls.

RECOMMENDATIONS:

1. Performance measurement must apply to all major developments to rate their success in achieving required sustainability targets and seeking opportunities for improvement.

2. The measurement of sustainability achievements at the strategic Council Plan level should assess both councils and the community's performance in meeting the 'sustainable city' goals. The success of the strategies will depend on community support which can be measured through a community report card process.

3. Performance standards for new developments should be measured in terms of the ecological footprints and Co^2 emissions from the development. (Refer to emission models in Appendix 2.)

   In addition, urban developments should establish energy consumption targets for properties that are continuously monitored and set at a maximum of 105 kilowatt hour per square metre annually.

4. Structure plans for new urban developments should include sustainable design standards with specific performance measures to:-

   - minimise lifecycle energy consumption and greenhouse emissions
   - achieve sustainable water cycle management and water conservation
   - reduce the environmental impact of building construction materials
   - avoid waste to landfill during construction
   - facilitate a reduction in car travel and promote the use of public transport
   - improve bio diversity values in the development.

7. APPENDICES

Appendix 1:

Fossil Fuel Free Växjö

We have the vision of a fossil fuel free Växjö, where our energy consumption does not lead to any climate change.

Climate change is one of our time's most urgent environmental problems. Man's emissions of greenhouse gases, particularly carbon dioxide, that is produced when fossil fuels are burned, are a contributory factor to climate change. With our efforts to create a fossil fuel free Växjö we are taking our global responsibility in terms of reducing the effects on climate.

The City of Växjö strives:

- To use energy from renewable sources (T11, E6)
- To use energy efficiently (E7, E8)
- To go over to a fossil fuel free transport system (T12, T13, T14, E9, E10, E11)

Goals to be achieved for the City of Växjö

- To reduce fossil carbon dioxide emissions, per inhabitant, by at least 50 % by the year 2010 and by at least 70 % by the year 2025, compared to 1993. (B10)
  The emissions of carbon dioxide decreased by 24 % per inhabitant up to 2005.

- To reduce the consumption of electrical energy by at least 20 % per inhabitant by the year 2015 compared to 1993. (B11)
  The consumption of electrical energy increased by 5 % per inhabitant up to 2005.

- To increase cycle traffic in the City of Växjö by at least 20 % by the year 2015 compared to 2004. (B12)
  Cycle traffic increased by 7 % up to 2005.

- To increase the use of public city transport by at least 20 % and regional public transport by 12 % compared to 2002. (B13, B14)
  Travel with public city transport decreased by 11 % and with regional public transport by 2 % up to 2005.

Goals to be achieved for Växjö municipal organisation

- To stop the use of oil for heating, other than for complementary use by the year 2010. (B15)
  226 m^3 of oil was used in 2005.

- To reduce fossil carbon dioxide emissions from the municipal transport and services by at least 30 % by the year 2015 compared to 1999, and in the long-term cease to emit fossil carbon dioxide. (B16)
  Emissions of carbon dioxide increased by 2 % up to 2005.

Växjö municipal organisation undertake to:

- To work to form public opinion, both nationally and internationally for a political direction that reduces the effect on the climate.
- To actively work to phase out the use of direct electrical heating.
- When purchasing, leasing or hiring, to choose environment friendly vehicles.
- Until further notice, to provide free parking for environment friendly vehicles in municipal car parks and in other ways to encourage the use of environment friendly vehicles within the municipality.
- To make demands for energy economy when procuring energy consuming goods and systems.
- To provide energy advice for inhabitants of the municipality.
- Within traffic planning and road operations to prioritise measures that make it simple and attractive to walk, cycle or use public transport all year round.

Steering, control and follow-up

The environmental management system *eco*BUDGET is used to ensure that the goals that have been determined within the Environmental Programme lead to an improvement. It follows the structure of the financial system.

Budget indicators (B1, B2 etc.) are used to steer the goals to be achieved within the ecological budget. The result is reported in the accounts for parts of the year and in the annual accounts.

Environmental asset indicators (T1, T2 etc.) are coupled to the Environmental Programme's aspired goals and describes the conditions and trends within the Environmental Programme's profile areas. The environmental asset indicators are not steered by the budget, but are followed up in the annual accounts in order to check that developments are moving in the desired direction.

Efficiency indicators (E1, E2 etc.) describe environmental effects related to human needs and are coupled to the Environmental Programme's aspired goals. The efficiency indicators are not steered within the budget, but are followed up in the annual accounts in order to check that developments are moving in the desired direction.

	Budget indicators	**Unit**
B1	Area of ecologic agriculture in relation to total agricultural area	%
B2	Biologic treatment of organic waste	tons
B3	Number of purchased sheets of (A4) printing/copying paper	sheets
B4	Purchase of ecologic foodstuffs in relation to total foodstuffs purchase	% (or SEK)
B5	Protected land area in relation to total land area	%
B6	Area of productive forest maintained according to FSC or corresponding in relation to the total productive forest	%
B7	Nitrogen emissions to the Mörrum river drainage area calculated as an average over three years	tons/year
B8	Phosphorous emissions to the Mörrum river drainage area calculated as an average over three years	tons/year
B9	Proportion of municipally owned grazed pasture-land, close to urban areas	%
B10	Emissions of fossil carbon dioxide per inhabitant	kg/inh
B11	Use of electricity per inhabitant	kWh/inh
B12	Number of cyclists per day at measuring points	number
B13	Number of journeys per year by public city transports	number
B14	Number of journeys per year by regional public transports	number
B15	Use of heating oil in the municipal organisation	m^3
B16	Emissions of fossil carbon dioxide from transport and service within municipal organisation	tons

	Environmental asset indicators	**Unit**
T1	Index of environmental awareness	index
T2	Total amount of waste that is recycled, incinerated or dumped	tons
T3	Proportion of waste that is recycled, incinerated or dumped	%
T4	Protected areas owned by the municipality	hectares

T5	Walking/cycling roads situated close to the lakes	km
T6	Forest area's proportion of the total area	%
T7	Agricultural area's share of the total area	%
T8	Measurement points showing any signs of acidification	number
T9	Measurement points with low or moderate levels of nitrogen	number
T10	Measurement points with low or moderate levels of phosphorous	number
T11	Total amount of supplied renewable energy	GWh
T12	Total amount of supplied renewable energy in the transport sector	GWh
T13	Length of cycle tracks, roads and paths	km

	Efficiency indicators	**Unit**
E1	Amount of printing/copying paper per employee	sheets/employee
E2	Total amount of waste that is recycled, incinerated or dumped per inhabitant	kg/inh
E3	Area of park and nature in relation to built-up areas in the city	%
E4	Nitrogen emissions into the Mörrum river drainage area per inhabitant	kg/inh
E5	Phosphorous emissions into the Mörrum river drainage area per inhabitant	g/inh
E6	Proportion of renewable energy of the total supply of energy	%
E7	Energy supply per inhabitant	kWh/inh
E8	Energy use per m^2 within municipal organisation	kWh/m^2
E9	Proportion of renewable energy in the transport sector	%
E10	Number of journeys per year by public city transports by inhabitant	trips/inh
E11	Number of journeys per year by regional public transports per inhabitant	trips/inh

Appendix 2:

Figure 2: Average ecological footprint, CO_2 emissions & GHG emissions of a UK resident[3]

	Ecological footprint		Carbon dioxide emissions		Greenhouse gas emissions (in CO_2 equivalents)	
	Gha/cap	Per cent	Tonnes/cap	Per cent	Tonnes/cap	Per cent
Housing	0.46	8%	0.97	8%	1.04	8%
Home energy	1.01	18%	2.78	23%	2.94	22%
Transport	0.83	15%	2.73	23%	2.86	21%
Food	1.23	23%	0.99	8%	1.64	12%
Consumer goods	0.75	14%	1.48	13%	1.70	13%
Private services	0.48	9%	1.18	10%	1.34	10%
Government	0.37	7%	0.93	8%	1.07	8%
Capital assets	0.31	6%	0.80	7%	0.84	6%
Total	**5.45**	**100%**	**11.87**	**100%**	**13.43**	**100%**

3 Ecological footprinting and carbon emissions data modelled by BioRegional using REAP, provided by Stockholm Environment Institute. Definitions of these categories are shown in the appendix.

Three planet living: if everyone in the world consumed as much as we do in the UK, we would need three planets to support us

Figure 3: Ecological footprint of average UK resident

Figure 4: CO_2 emissions of average UK resident

Appendix 3:

The Milton Keynes Local Agenda 21 Strategy
Priority objectives

Social Progress

- Encouraging participation of local people in community life and in community decision-making;
- Improving education and awareness about global and local sustainable living issues;
- Establishing a global centre in Milton Keynes as a resource centre for ideas, information and community initiatives;
- Encouraging healthy living:
    - Good diet
    - Exercise
    - Tackling gender issues
    - Stress reduction
    - Good role models

Environmental Protection

- Tackling climate change by:
    - Increasing energy efficiency & use of renewable energy;
    - Promoting more sustainable forms of travel
    - Reducing amount of waste to landfill
- Reducing pollution of air, water & land;
- Promoting wildlife conservation and habitat enhancement
- Improving countryside access & recreation

Prudent use of natural resources

- Promoting water efficiency
- Reducing waste generation & encouraging recycling, re-use and repair
- Promoting energy efficiency
- Promoting greater use of renewable energy

Cont'd…..

Sustainable Economic Growth

- Ensuring a wide range of local employment opportunities for all, including those disadvantaged
- Promoting responsible business practice:
    - Health & well-being of staff
    - Environmental protection
    - Efficient resource use
    - Local sustainable business charter
- Promote new technology/innovation to assist more sustainable

Milton Keynes Council's role in promoting sustainable development

- Managing and improving the Council's sustainability performance:
    - Mainstreaming sustainability into Council decision-making and service delivery
    - Sustainable purchasing
    - Green Travel Plan
    - Energy Strategy
- Improving education and awareness of sustainable development:
    - Publications, media, displays, events
    - Promoting use of indicators to highlight progress
    - Support local projects/organisations that promote sustainable development
    - Sustainable Development Grant programme
- Developing broad, inclusive and creative approaches to community consultation and involvement:
    - Use existing expertise of MK21 group to facilitate stronger community participation in LA21 issues
    - Use community planning process
- Improving the process and outcome of partnership working towards sustainable development objectives:
    - Encourage all community partners to promote sustainable development within their organisations
- Increasing the number of businesses understanding, and contributing to sustainable development
- Monitoring the effectiveness of the LA21 Strategy

8. BIBLIOGRAPHY

1. State of Victoria, Melbourne 2030 - Planning for sustainable growth, Melbourne, October 2002

2. Marsden Jacob Association, Impacts of Climate Change on Human Settlements in the Western Port Region, Melbourne, June 2008

3. Persson, Bengt, Sustainable City of Tomorrow Bo01 - Experiences of a Swedish Housing Exposition, Sweden, 2005

4. Stockholm City Planning Office, Hammarby Sjostad - a unique environmental project in Stockholm, Stockholm, June 2007

5. Milton Keynes Development Corporation (MKDC), Milton Keynes Planning Manual, Milton Keynes, March 1992