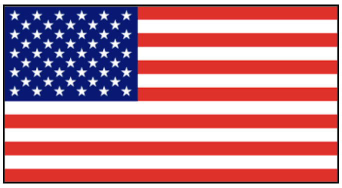
Municipal Engineering Foundation of Victoria

2008 Overseas Study Tour

ENVIRONMENTAL SUSTAINABLE DESIGN (ESD) TO ACHIEVE CARBON NEUTRAL TARGETS



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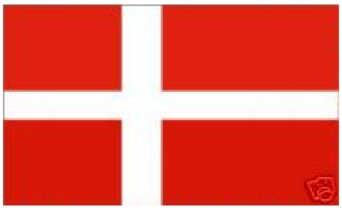

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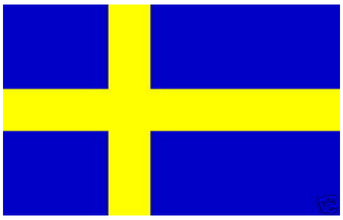

Sweden

United Kingdom

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PRELIMINARIES

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VERSION CONTROL

Version 1.0

A copy of this report can be viewed on the Municipal Engineering Foundation Victoria website, www.mefvic.org.au.

ACKNOWLEDGEMENT

I would like to acknowledge the grant provided by the Municipal Foundation Victoria (MEFV) that has allowed me to participate in the 2008 Study Tour and for its on going support for the local government engineering in Victoria through the professional development of local government engineers.

I would also like to thank the City of Darebin for allowing me the time to participate in the study tour and my family for their support. Lastly, the host organisations who took the time to share their knowledge with us are acknowledged - without them, the tour would not be possible.

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EXECUTIVE SUMMARY

The author took part in an international study tour in 2008 sponsored by the Municipal Engineering Foundation Victoria. The study tour, consisting of four Victorian municipal engineering professionals travelled through United States, Scandinavia and United Kingdom. The tour provided an excellent opportunity to review policies, practices and approached across a number of countries.

The objective of this report is to explore international perspectives and practices on environmental sustainable design (ESD) to achieve carbon neutral targets and make recommendation for consideration by Victorian and State Government.

This report does not seek to provide a comprehensive expose on the various issues but rather to highlight observations of interest, identify differences between Victorian and overseas practices and to target opportunities for improvement for Victorian local and State governments.

SUMMARY OF RECOMMENDATONS

RECOMMENDATION: INTRODUCTION

Address both the energy supply chain as well as demand side efficiency to reach the future energy efficiency targets. Some future trends that could help reverse this are:

- User pays for utilities such as electricity, gas and water.
- More mixed-use, larger and 24 hour building use.
- Better energy performance in buildings (i.e. 50% better in existing buildings, 75% in new)
- New low carbon construction materials to replace high mass material as concrete and masonry.
- Greater density and diversity of housing stock to ensure better availability of appropriate sized houses for household sizes, in a more compact living.
- Improved building performance by better use of design and construction professionals. Only 2% of the world's population use professionals when building their houses and 98% percent build their own houses.[1]

RECOMMENDATION: POLICY

The following measures are recommended to help solve future energy demand in a sustainable way:

- Encourage mixed-use development enabling living and working within short distances to minimise infrastructure and flexible use of buildings.
- Reuse old structures and historic buildings.
- Build energy neutral buildings and energy producing buildings.
- Ensure green areas are integrated with the buildings to create a micro-climate.
- Use local material to reduce transportation and pollution.

Adopt an integrated environmental solution which involves energy, waste, water and sewage for housing, offices and other commercial activities.

Advocate for State Government to legislate for zero-carbon sustainable homes for all new dwellings. Zero-carbon means zero net emission of carbon-dioxide over a year.

RECOMMENDATION: SUSTAINABLE BUILDINGS AND PRECINCTS

All buildings should be tuned after construction to ensure their operation is meeting the sustainable design objectives. This can take up to 12 months and should be made a requirement of the building contract.

Local government should be encouraged to build net ‘zero fossil energy’ buildings in which it will produce at least as much energy from renewable sources as it consumes.

Local government should strongly consider the provision of charge points for electric cars in public car parks and partner with car clubs to encourage electric car share schemes in built up urban area (i.e. usually within 10 km of the CBD).

RECOMMENDATION: MATERIALS AND PRODUCTS

Solar ports (solar array shelters) can be used for a range of uses in the urban landscape while generating renewable power.

Explore the installation of vertical axis wind turbines along major roadways or in suitable urban areas.

Explore the viability of wind assisted passive stack heat exchange ventilation units (Wind Cowl or Eco Hat) being installed on residential or community facility.

Trial the installation of synthetic turf as a substitute for grass for urban verges that are affected by the drought (i.e. little rainfall and water restrictions).

RECOMMENDATION: ENERGY

Local Government should look reducing energy consumption and becoming carbon neutral by 2020. Purchase green energy or generate energy from renewable resources.

Ensure that embodied energy calculations are included in the environmental assessment of infrastructure options.

RECOMMENDATION: COGENERATION

Install cogeneration for high energy community facilities such as aquatic centres and investigate viability of trigeneration for large mixed-use precincts where the demands of heating cooling can be balanced over the day.

RECOMMENDATION: DRAINAGE AND FLOODING

Local Government should look to installing dry weather treatment facilities for urban runoff, and preferably recycle the water for beneficial uses, i.e. irrigation or toilet flushing.

Increase the amount of open stormwater system in growing urban environments to decrease pressure on underground drainage systems and assist in improving water quality.

RECOMMENDATION: ROOF GARDENS

Install green roofs on community facilities in high urban density areas to assist with insulation and also the educational message of its benefits.

RECOMMENDATION: WATER SENSITIVE URBAN DESIGN

The practice of disconnecting down pipes could be considered (cautiously) provided that landscaping, soil infiltration, runoff grades and overland flow paths are all designed, constructed and maintained appropriately.

Utilise pervious pavement for car parks or large hardstand areas to reduce the amount of run-off.

RECOMMENDATION: RECYCLED WATER

For community and sports centre, adopt the principle that no potable use is to be utilised for use other than for potable purposes. This will require the investment of local harvesting, storage, treatment and recycling of water.

RECOMMENDATION: SUSTAINABLE TRANSPORT

Provide higher status to sustainable transport modes such as walking, biking and public transport.

Local Governments should look to an electric fleet.

Encourage developers to implement a car share scheme as a requirement on large developments as a means to control parking and traffic congestion.

Advocate to the State Government for buses to be equipped with bike racks at the front of the vehicles.

Develop Walking Strategies at the local government level to increase the number of walking trips.

Provide shelters over major bicycle parking facilities.

RECOMMENDATION: OPEN SPACE

Consider converting grass playing surfaces to synthetic where appropriate.

RECOMMENDATION: WASTE MANAGEMENT

Provide separate bins in public spaces for the separation of waste.

Local Government to provide organic waste management on site for all community facilities.

BACKGROUND

Study Tour

A Study Tour was sponsored by the Municipal Engineering Foundation Victoria from 14 August to 7 September 2008 and the travel party consisted of:

- Nick Mazzarella, Manager Major Projects – City of Darebin
- Michael Ellis, General Manager Assets & Services – Cardinia Shire Council
- Justin Hinch – Design Engineer Assets & Development – Horsham Rural City Council
- Vicki Shelton – Coordinator Roads & Drainage Infrastructure – City of Greater Geelong
- Robert Ward – Municipal Engineering Foundation Victoria Trustee

The Study Tour was of considerable value to all of the participants. On every occasion, the members of the travel group were openly welcomed and supported by host Councils.

Travel Itinerary

The Study Tour commenced in the USA with all four participants attending the American Public Works Association (APWA) Congress. From there the participants travelled to Denmark and Sweden before proceeding to the United Kingdom each investigating a specific topic of interest. Refer to Appendix A for a detailed itinerary of places and organisations visited.

INTRODUCTION

Greenhouse Effect & Climate Change

The greenhouse effect is created by a layer of greenhouse gases around the Earth letting in the warmth from the sun but preventing it from escaping. However, the layer is getting thicker as we produce greenhouse gases in our everyday lives – and this means that the earth is warming up. Emissions of greenhouse gases, particularly carbon dioxide from the burning of fossil fuels is the primary cause of climate change. If the use of fossil fuels continues at its current pace, we can expect drastic changes in our climate, and these effects will occur at an ever increasing pace. Managing and reducing the emissions of carbon dioxide and other greenhouse gases is our greatest challenge. Long-term sustainable development requires a major reduction in the use of fossil fuels.

A quarter of greenhouse gases are generated from the building industry. The World Resources Institute estimate that buildings are directly responsible for 15.3% percent of global greenhouse gases emissions.[1]

Climate change will most certainly have multiple impacts on the building sector. Higher global temperatures will not only increase the need for energy (for cooling), but also result in dramatic changes in weather patterns and the consequential repairs and reconstruction demands.

Ecological Footprint

The Ecological Footprint measures humanity's demand on the biosphere in terms of the area of biological productive land and sea required to provide the resources we use and to absorb our waste.

The footprint of a country includes all the cropland, grazing land, forest and fishing grounds required to produce the food, fibre and timber it consumes, to absorb the wastes emitted in generating the energy it uses, and to provide space for its infrastructure.

In 2003, the global Ecological Footprint was 14.1 billion global hectares, or 2.2 global hectares per person. The total supply of productive area, or biocapacity, in 2003 was 11.2 global hectares, or 1.8 global hectares per person.[2]

Humanity's footprint first grew larger than global biocapacity in the 1980s; this overshoot has been increasing every year since, with demand exceeding supply by about 25% in 2003.[2] For three decades now we have been in overshoot, drawing down these assets and increasing the amount of CO^2 in the air.

Separating the Ecological Footprint into its individual components demonstrates how each one contributes to humanity's overall demand on the planet. The CO_2 footprint, from the use of fossil fuels, was the fastest growing component, increasing more than ninefold from 1961 to 2003.[2]

Environmentally Sustainable Design (ESD)

Funding ESD initiatives is often seen as discretionary and usually the first items to be sacrificed in meeting budget objectives.

RECOMMENDATION: INTRODUCTION

Address both the energy supply chain as well as demand side efficiency to reach the future energy efficiency targets. Some future trends that could help reverse this are:

- User pays for utilities such as electricity, gas and water.
- More mixed-use, larger and 24 hour building use.
- Better energy performance in buildings (ie 50% better in existing buildings, 75% in new)
- New low carbon construction materials to replace high mass material as concrete and masonry.
- Greater density and diversity of housing stock to ensure better availability of appropriate sized houses for household sizes, in a more compact living.
- Improved building performance by better use of design and construction professionals. Only 2% of the world's population use professionals when building their houses and 98% percent build their own houses.[1]

POLICY

Urban Planning

The following urban planning measures can be used to help solve future energy demand in a sustainable way:

- Mixed use development enabling living and working within short distances to minimise infrastructure and flexible use of buildings.
- Reuse old structures and historic buildings.
- Energy neutral buildings and energy producing buildings.
- Green areas must be integrated with the buildings to create a micro-climate.
- Use local material to reduce transportation and pollution.

Rating Tools

Various rating tools are used across the work to develop sustainable buildings, e.g.:

- EcoEffect – Sweden (developed by University of Gavle and KTH)
- Sustainable Homes - United Kingdom (BRE).
- LEED (Leadership is Energy and Environmental Design), USA, Green Building Council.
- Nordic Swan - Norway.
- UK BREEAM tool - UK Code for Sustainable Homes.

Sweden's Environmental Objectives

Sweden has adopted the following 15 national environmental objectives to guide its environmental performance.[3]

1. Reduced climate impact
2. Clean air
3. Natural acidification only
4. A non-toxic environment
5. A protective ozone layer
6. A safe radiation environment
7. Zero eutrophication
8. Flourishing lakes and streams
9. Good-quality groundwater
10. A balanced marine environment, flourishing coastal areas and achipelagos
11. Thriving wetlands
12. Healthy forests
13. A varied agricultural landscape
14. A magnificent mountain landscape
15. A good built environment

The purpose of the environmental objectives is to improve human health, preserve biodiversity and protect the cultural environment and cultural heritage. The aim of these environmental objectives is for Sweden to solve the major environmental problems by the next generation.

The Hammarby model in Sweden is an integrated environmental solution which involves energy, waste, water and sewage for housing, offices and other commercial activities in Hammarby Sjostad.

The City of Stockholm's environmental goals for water and sewage in Hammarby Sjostad are:

- Water consumption shall be reduced to 100 litres per person per day.
- 95% of the phosphorus in wastewater is to be reusable on agricultural land.
- The quantity of heavy metals and other environmentally harmful substances shall be 50% lower in the wastewater from the area than in the wastewater from the rest of Stockholm.
- Lifecycle analyses shall be carried out to determine the suitability, from an energy and emissions viewpoint, of returning nitrogen to agricultural land and of utilising the chemical energy present in the wastewater.
- Drainage water shall be connected to the storm water network and not to the wastewater network.
- Storm water shall primarily be treated locally.
- The nitrogen content of the purified wastewater shall not exceed 6mg/litre and the phosphorous content shall not exceed 0.15 mg/litre.
- Storm water from streets with more than 8,000 vehicles per day shall be treated.

<u>Hammarby Sjostad's own eco-cycle:</u>

Energy

- Combustible waste is converted into district heating and electricity.
- Biofuel from nature is converted into district heating and electricity.
- Heat from treated wastewater is converted into district heating and district cooling.
- Solar cells convert solar energy into electricity.
- Solar panels utilise solar energy to heat water.
- Electricity must be a "Good Environmental Choice" product, or equivalent.

Water & Sewage:

- Water consumption is reduced through the use of low flush toilets and air mixer taps.
- A pilot wastewater treatment plant has been built specifically for the area in order to evaluate new sewage treatment techniques.
- Digestion is used to extract biogas from the sewage sludge.
- The digested biosolids can be used as fertiliser.
- Rainwater from yards and roofs is drained into Hammarby Sjo, rather than into the wastewater treatment plant.
- Rainwater from streets is treated locally using settling basins and then drained into Hammarby Sjo, rather than being drained into the wastewater treatment plant.

Water:

- Prepared soil for filtration of storm water from streets.
- Storm water basin with wetland for storm water from streets.
- Storm water basin with filtration.
- Channel for storm water from buildings and gardens only.
- Green roofs and yards collect storm water locally.
- Experimental wastewater treatment plant (Sjostadsverket and spearhead-projects for new wastewater treatment techniques.

Energy:

- Solar cells on GlashusEtt.
- Power grid station
- Fortum's Thermal Power Plant supplies Hammarby Sjostad with district heating and district cooling from treated wastewater and biofuels.
- Biogas cookers are installed in approximately 1,000 apartments on Sickla Udde and Sickla Kaj.
- Biogas production facility.
- Solar cells on the roof of JM's block, Fjarden, providing electricity used in the communal areas.
- Solar cells for the Grynnan block.

Waste and recycling material:

- GlashusEtt also houses a collecting point for hazardous waste.
- One of the docking points where the refuse collection truck connects to the automated waste disposal unit.
- Collection centre for the stationary automated waste disposal system.
- New tree-lined avenue that stretches throughout Hammarby Sjostad.

<u>United Kingdom</u>

The policy drivers for renewable energy investments are the EU-Emission Trading Scheme, the United Kingdom renewable energy and energy efficiency obligations for energy suppliers, and the new United Kingdom Government legislated target of Zero carbon homes by 2016.[1]

The Code for Sustainable Homes:

- Code for sustainable homes has target that all new dwellings must be zero-carbon by 2016.
- Zero-carbon means zero net emission of carbon-dioxide over a year.
- 200,000 new homes need to be built by 2016.
- Code Level 6 for CO_2 emissions is awarded only to true Zero Carbon homes.
- A true Zero Carbon home must produce zero emissions, including those produced by the use of appliances, and have a heat loss parameter equal to 0.8 W/m^2K or less.

- A ground source heat pump in a dwelling with a heat loss parameter of 0.8 Wm^2K will require a very small amount of electricity.
- In order for PV panels to generate enough electricity, a 4.7KWp system will be required for a Type C dwelling. This will occupy an area of 3.7 m^2. The whole roof would need to be at 22.5 ^{O}C monopitch.
- Ground source heat pumps provide one of the simplest methods for achieving Code for Sustainable Homes' Level 4 for carbon dioxide emissions.
- Levels 5 and 6 can be achieved by the addition of a suitably sized photovoltaic (PV) array. The size of the PV array required are smaller for a heat pump compared to a gas heater.
- Minimising the heat loss parameter of the dwelling significantly reduces the amount of electricity that needs to be generated by PV panels.

RECOMMENDATION: POLICY

The following measures are recommended to help solve future energy demand in a sustainable way:

- Encourage mixed-use development enabling living and working within short distances to minimise infrastructure and flexible use of buildings.
- Reuse old structures and historic buildings.
- Build energy neutral buildings and energy producing buildings.
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- Use local material to reduce transportation and pollution.

Adopt an integrated environmental solution which involves energy, waste, water and sewage for housing, offices and other commercial activities.

Advocate for State Government to legislate for zero-carbon sustainable homes for all new dwellings. Zero-carbon means zero net emission of carbon-dioxide over a year.

SUSTAINABLE BUILDINGS AND PRECINCTS

General

Buildings affect environmental, financial and social factors, not only during the construction phase, but for many years after the buildings are completed. It is therefore important to design and construct buildings optimally from a long-term perspective. Furthermore, the quality of the continuous management and operation of buildings play an important role in its long-term sustainability.

The energy consumption must be monitored during and after the building is put into operation to make sure that the consumption is not rising above the expected level.

Technical and non-technical measures used to improve sustainability in buildings:

- Extensive use of sensors
- Undertake risk management of costings.
- Monitor energy consumption to detect excessive energy use and to motivate occupants to reduce energy use.
- Training of building operators of the building control systems to manage the high level of complexity.
- Employ experienced operators.
- Good communication between designer and operator.

The physical structure can be used to install energy generating appliances (e.g. PV cells, solar collectors or combined heat and power plants).

Case Study - Beddington (BedZED) case study, United Kingdom

The Beddington Zero Energy Development (ZED) in Beddington, Sutton is the United Kingdom's largest eco-village and a practical solution for sustainable living. BedZED was built by a partnership between Sutton Council and the Peabody Trust as part of the innovative and environmentally friendly BedZED development of housing and workspace completed in 2002.

The Beddington Zero Energy Development (BedZED) is the United Kingdom's largest carbon-neutral eco-community – the first of its kind in this country. BedZED has become an excellent learning centre for sustainable development, attracting considerable local, national and international media coverage and interest.

BedZED is a mixed-use, mixed-tenure development that incorporates innovative approaches to energy conservation and environmental sustainability. It is built on reclaimed land owned by the London Borough of Sutton, sold to Peabody Trust at below market value due to the planned environmental initiatives.

BedZED has developed 99 homes and 1,405 m^2 of work space accommodating around 210 residents and 60 workers. BedZED has been designed to reduce the need to commute. The homes are a mixture of sizes and the project also includes buildings for commercial use, an exhibition centre, a children's nursery and a demonstration home so that visitors may see what it is like to live at BedZED.

The BedZED design concept was driven by the desire to create a net 'zero fossil energy development', one that will produce at least as much energy from renewable sources as it consumes. Only energy from renewable sources is used to meet the energy needs of the development. BedZED is therefore a carbon neutral development – resulting in no net addition of carbon dioxide to the atmosphere.

At BedZED, the homes are very energy efficient and there is on-site renewable energy generation. Various environmental initiatives have been implemented, such as water efficiency measures, on-site recycling, composting and food growing, a green transport plan (including London's first car club), sustainable construction materials, local organic food delivery and a community meeting place.

The ZED system offers a coherent solution to the challenge of sustainable living within the urban environment. The ZED system integrates environmental, social and economic needs and brings together proven strategies to reduce energy, water and car use. The ZED system offers:

- High density housing while maintaining high levels of amenity. All homes enjoy generous access to sunlight, green roof terraces or gardens and conservatories.
- Office accommodation to encourage local economic development and reduce the need for commuting.
- Energy efficient design and renewable energy supply to avoid global warming emissions.
- A 'Green Transport Plan' for residents and businesses to reduced dependence on the car.
- Water efficient design and on-site water recycling to cut mains water demand.
- A mix of social, shared ownership and reasonably priced homes for sale, with savings on fuel and water bills.
- The ZED system makes sustainable living easy, attractive and affordable.

Buildings are constructed from thermally massive materials that store heat during warm conditions and release heat at cooler times. In addition, all buildings are enclosed in a 300 mm insulation jacket.

BedZED houses are arranged in solar facing terraces to maximise heat gain from the sun, known as passive solar gain. Each terrace is backed by offices, where minimal solar gain reduces the tendency to overheat and the need for energy hungry air conditioning.

The mixed-use development makes sense environmentally, socially and financially. The extra revenue from workspace units located below roof gardens is used to finance the environmental upgrades for the development. This innovative funding mechanism allows ZED homes to be sold without a premium.

BedZED has been designed to address environmental, social and economic needs. It brings together a number of proven methods – none of them particularly high tech – of reducing energy, water and car use. Crucially, it produces affordable, attractive and environmentally responsive housing and workspace.

Key features include:

- BedZED is built from natural, recycles or reclaimed materials. All the wood used has been approved by the Forest Stewardship Council or comparable internationally recognised environmental organisations, to ensure that it comes from a sustainable source.
- Through the innovative design and construction, heat from the sun and heat generated by occupants and every day activities such as cooking is sufficient to heat BedZED homes to a comfortable temperature. The need for space heating, which accounts for a significant part of the energy demand in conventional buildings, is therefore reduced or completely eliminated.
- BedZED homes and offices are fitted with low energy lighting and energy efficient appliances to reduce electricity requirements.
- To enable residents and workers to keep track of their heat and electricity use, meters are mounted in each home and office kitchen.

Mixed development, for residential and commercial use, is increasingly recognised as essential to encourage vibrant local communities. The ZED system integrates workspace cost-effectiveness into the system by placing offices in the shade zone of the housing. Offices are lit naturally by indirect northern sunlight, which is ideal for a working environment.

Energy efficient design

The ZED system is based on proven techniques to minimise the energy demands of homes and offices. Solar facing homes are fronted by conservatories to capture natural (and free) heat and light gains from the sun. Construction materials are thermally massive to store heat and release it slowly, maintaining pleasant and constant internal temperatures. Super insulation retains heat from normal domestic activities such as cooking, which would otherwise be wasted. By combing passive solar gain, thermal mass and super insulation, ZED design eliminates the need for a central heating system. Heating requirements of ZED homes are around 10% of that for a typical home of the same size.

Reducing ‘embodied’ energy:

- Embodied energy is a measure of the energy required to manufacture a product. A product that requires large amounts of energy to obtain and process the necessary raw materials, or a product that is transported long distances during processing or to market, will have a high-embodied energy level.
- To reduce the embodied energy of BedZED, construction materials were selected for their low embodied energy and sourced within a 35-mile radius of the site where possible. The energy expended in transporting materials to the site was therefore minimised.

Renewable energy supply

The ZED system uses only energy from renewable sources. This provides a ‘carbon-neutral’ energy supply to ZED developments, avoiding contribution to the greenhouse effect. At BedZED, a 130 kW modern combined heat and power (CHP) unit fuelled by tree surgery waste (diverted from landfill) generates electricity to power homes and offices. Heat produced as a by-product is captured to supply hot water across the development via a small district heating system. A connection to the national grid allows electricity to be sold when demand is low, and bought in at times of peak demand. European and United Kingdom government was secured to install 777 m^2 of PV solar panels which generate enough energy to power 40 electric vehicles.

Combined heat and power plant:

- BedZED receives power from a small-scale combined heat and power plant (CHP). In conventional energy generation, the heat that is produced as a by-product of generating electricity is lost. With CHP technology, this heat can be harnessed and put to use.
- At BedZED, the heat from the CHP provides hot water, which is distributed around the site via a district heating system of super-insulated pipes. Should residents or workers require a heating boost, each home or office has a domestic hot water tank that doubles as a radiator.
- The CHP plant at BedZED is powered by off-cuts fro tree surgery waste that would otherwise go to landfill. Wood is a carbon neutral fuel because the CO_2 released when the wood is burned is equal to that absorbed by the tree as it grew.

Diversity of Housing Choice

BedZED has a mixed tenure policy, incorporating social housing, properties for shared ownership and reasonably priced homes for sale. On site facilities include child care and sports facilities and the BedZED Centre – an exhibition and community space.

Total water strategy

The ZED system reduces dependence on mains water by using rainwater collected from roofs for toilet flushing. The rainwater is stored in large tanks in the base of each house. At BedZED, wastewater is treated on site using a biological sewage treatment plant. The treated water is used to top up the rainwater supply for toilet flushing.

Water efficient appliances at BedZED have reduced mains water use to 91 litres per person / day compared with the United Kingdom average of 150 litres. These appliances can be fitted to any home. BedZED's rain water harvesting system and Green Water Treatment Plant – which treats all waste water for reuse – have saved another 15 litres of mains water per person / day, high operating and maintenance costs make the treatment plant uneconomic, but rain water is successfully being used for toilet flushing.

Porous paving and sedum roofs allow rain water to slowly percolate back to ground water rather than rapidly running off the site and contributing to urban flood risks. Water consumption is reduced to a minimum by fitting water saving appliances such as washing machines and low flush toilets in all homes. Residents are able to monitor their water use via a highly visible meter mounted in the kitchen. Reduced mains water consumption means lower water bills.

Construction materials

Construction materials for BedZED have been carefully selected to minimise environmental impact. Reclaimed structural steel and timber for internal partitions have been used to minimise embodied energy and divert waste from landfill. More than 50% of construction materials have been sourced from within a 56 km radius of the BedZED site, supporting the regional economy and minimising pollution from freight transport. Where possible, new timber is sourced from Forest Stewardship Council (FSC) accredited forests.

Healthy buildings

ZED buildings have been designed to be allergy free, introducing excellent ventilation and minimising the breeding areas for house mites. At BedZED, floors are tiled or lino covered, with rugs that can be washed easily. Low allergy, in particular formaldehyde-free, construction materials have been specified.

Integrated transport

Transport accounts for over 30% of United Kingdom's energy consumption. BedZED includes a Green Transport Plan to reduce the need to travel, promote public transport and offer alternatives to private car travel.

Designed as a Home Zone with low speed limits, pedestrians and cyclists have priority over cars, creating a safer place to live. An annual charge is levied on parking spaces, with rebates for electric and LPG vehicles. Electric vehicle charging facilities are offered free of charge. Half of the residents own one car, 5% own two cars and 45% do not own a car.

Live and work options, on-site facilities and grocery delivery services reduce car-based commuting and shopping trips. Facilities such as the ZEDcars car club, good public transport links and secure bicycle storage for residents and workers help reduce local pollution and congestion.

Building-integrated photovoltaic panels generate enough electricity to charge 40 electric vehicles, providing carbon neutral transport.

Green transport plan:

- Transport energy accounts for a large proportion of the energy consumption of any development.
- A green transport plan promotes walking, cycling and use of public transport. A car pool for residents has been established, and all these initiatives have helped to provide a strategic and integrated approach to transport issues.
- The BedZED project shows that is possible to reduce reliance on cars and introduced the first legally binding Green Transport Plan as a condition of planning permission. BedZED's target is a 50% reduction in fossil-fuel consumption by private car use over the next ten years compared with a conventional development.

- BedZED has been designed to encourage alternatives to car use. BedZED has good public transport links, including two railway stations, two bus routes and a tamlink. An onsite Car Club called 'ZEDcars'. BedZED was the first low car development in the UK to incorporate a car club.
- A 'pedestrian first' policy with good lighting, drop kerbs for prams and wheelchairs and a road layout that keeps vehicles to walking speed.
- On-site charging points for electric cars and a few public electric vehicle charging point is already available in Sutton town centre. BedZED's 10-year target is to produce enough electricity from photovoltaic panels (which convert sunlight into energy) to power 40 electric vehicles. It is hoped that a mixture of private cars and vehicles available through the car club will minimise fossil fuel use as the community settles. For owners of electric vehicles energy and parking will be free of charge.

Each home has one parking space, with potential access to an electric car club under solar electric canopies in the central mews and well overlooked children's play space with potential allotments. Central mews properties encourage living and working on site, with options to convert integral garages into studio space.

Waste

BedZED aims to reduce the quality of waste produced, and for a recycling rate of 60%. There are extensive on site recycling facilities. The average BedZED home produces 11 kg of waste per week – lower than the average for London. The recycling rate of this reduced amount of waste at BedZED is 26% by volume.

Results:

Numerous lessons were learnt during the construction of BedZED and in the years since residents first moved in during March 2002. The scheme has enabled residents to live a sustainable lifestyle without making severe demands on routines. Peabody Trust has produced a resident's handbook and a green lifestyles officer at BioRegional offers advice to residents. A car club has been established that reduces car ownership and improves accessibility for those who are unable to afford a car.

A resident satisfaction survey indicates that the residents favourite features include the design of homes, sense of community, gardens, green features, sunspaces and reduced energy bills.

At the Beddington Zero Energy Development (BedZED) in Hackbridge, energy use in the home is designed to be carbon neutral thanks to a massive 88% reduction in heating requirements, a 25% reduction in electricity usage and a carbon neutral energy source – local waste wood – to provide the remainder.

Designed to produce all energy on-site from renewable sources – photovoltaic panels and a Combined Heat and Power (CHP) plant fuelled by local wood chip. Monitoring shows that renewable energy has supplied between 80% (in 2003) and 11% (in 2006) of the site's energy needs, this is due to problems with the CHP.

Space heating is reduced by around 90% and hot water is reduced by around 60%, compared to 2002 United Kingdom average housing stock.

Measures such as energy efficient appliances and light bulbs have reduced electricity use by 25%.

Energy bills are reduced by up to half compared to resident's previous homes.

BedZED's green transport plan achieved its aims of a 50% reduction in private petrol fuelled car miles compared to the local average.

25% of residents have joined the local organic fruit and vegetable box scheme and more grow their own food in on site mini allotments and gardens.

RuralZED – The Zero Carbon House

RuralZED is a true zero carbon housing system and uses traditional proven natural materials and construction techniques designed for a minimum lifetime of five generations. RuralZED is a solution to the 70% of United Kingdom sites which are built at 50 homes per hectare or less.

RuralZED has a hybrid laminated timber frame, strong enough to support massive walls, floor finishes and ceilings, with flexible masterplan options allowing all orientations with flexible architectural design.

RuralZED catches sunlight, wind, fresh air and rain, and minimises energy and water demand.

By meeting the government definition of a zero carbon home for private sales, stamp duty relief is available and can fund half the cost of the renewable energy package. The remaining capital cost can be paid for by an energy mortgage, which is less than a conventional fossil fuel bill. The home will only require a small amount of wood pellets each year for heating which is significant reduction in CO_2.

Houses can be built to the following levels:

- Code Level 3 – Standard Base Specification
    - Superior insulation
    - Thermal mass
    - Airtight construction
    - AAA rated appliances
    - Low energy lighting
    - Low water fittings
    - Green flat roof

- Code Level 4 – Add:
    - Passive heat recovery ventilation
    - Solar hot water
    - Wood pallet heating
    - Kit cost 900 pounds/m^2, erected 1,150 / m^2

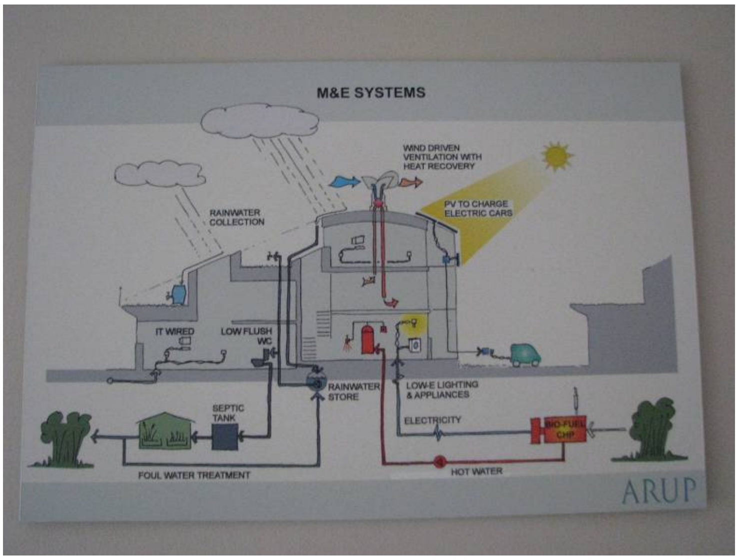
- Code Level 5 – Add:
    - Pitched roof

- o 7 No. 180w PV panels
  - o Rainwater harvesting
  - o Green roof on north slope

- Code Level 6 – Add:
  - o Pitched roof
  - o 7No. 180 w PV panels
  - o Rainwater harvesting
  - o Kit cost 1,250 pounds / m^2, erected 1,500 pounds / m^2

- Code Level 7 – Add:
  - o Wind turbine

All homes have enough solar facing roof surface clad in photovoltaics to meet most households annual electric demand, with solar thermal collectors and shared wood pellet boilers providing renewable heating and hot water. Solar facing homes enjoy double height sunspaces with retractable shades to maximise the benefits of winter sun, whilst east / west facing units complete the streetscape and provide enclosure to the central garden areas.



Beddington, Sutton, London, United Kingdom, September 2008
(Schematic of mechanical and electrical systems)

<u>CASE STUDY - Greenwich Millennium Village (GMV), United Kingdom</u>

The Greenwich Peninsula is part of the Thames Gateway regeneration project and its renovation will include the creation of new homes, a school, roads, services, shops, restaurants, transport links, leisure facilities and community facilities.

By 2012, the O_2 will host the gymnastics and basketball events at the Olympics and the Peninsula will house more than 4,000 residents working in the business district, as well as 2000 in construction. By 2020, it is predicted that there will be over 20,000 residents and 24,000 workers on the transformed Greenwich Peninsula.[59]

English Partnerships in 1999 set the Greenwich Millennium Village development team innovation targets to ensure that the momentum for innovation in the development industry is maintained, and also to ensure that new ideas are focused to achieve tangible differences.

For each innovation target a performance benchmark was established, through which actual differences in performance are measured as the development progresses. The technical innovation targets, to be progressively achieved over the first development phase of the project, were:

Innovation Measure	Performance Benchmark	Result to date
Primary energy	Reduce by 80%	Reduced by 65% through improved insulation standards and use of Combined Heat and Power
Embodied energy used for building construction	Reduce by 50%	Reduced by 25% 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	Reduce by 30%	Reduced by 25% by specifying water efficient taps, showers, toilets and white goods.[59]
Construction cost	Reduce by 30%	Reduced the real cost by 20% while maintaining high specification levels through value engineering, partnering with suppliers and standardization.
Construction period	Reduce by 25%	
Work towards achieving zero defects on practical completions		Significant progress has been made through implementing staged quality reviews during the design and construction. A 50% improvement has been achieved in the initial phases over industry standards.
Construction waste	Reduce by 50%	Reduced by 50% by measuring and reporting the waste produced, segregating and recovering waste that can be recycled through the building process.

Future phases of the development will take the number of homes from 1095 to circa 2750, between 2007 and 2014. English Partnerships have set additional standards for the Greenwich Millennium Village team, being[59]:

- CO_2 emissions not to exceed 20 $kgCO_2/m^2$ (2005 standards)
- Embodied energy used to construct buildings to be less than-
  - For high rise apartments – 500 $kgCO_2/m^2$ total building area
  - For low rise houses and apartments – 260 $kgCO_2/m^2$.
- Reduce average construction waste for apartment block construction to a maximum of 20 m^3 per dwelling.
- The number of snagging defects recorded at Practical Completion to be less than an average of 25 items per dwelling.
- Improve noise insulation standards by 10% above building regulations Part E (2004)
- For structural and finishing timber – 75% is to be certified (FSC, CSA, MTCC, PEFC, SFI) as sustainable timber products.
- 'A' rated materials from the BRE Green Guide to Housing to be used on roof, internal and external walls and elsewhere wherever practical.
- The "Eco Homes" scheme acknowledges improved environmental performance in house design and is used to show potential purchases that well-rated homes will have reduced energy consumption. The scheme considers the home's environmental performance under seven different categories:
  - Energy
  - Water
  - Pollution
  - Materials
  - Transport
  - Ecology and Land Use as well as
  - Health and being.
- The Village scored well across all the categories assessed, with particular success in the energy saving and landscaping areas. Energy savings of around 25% are expected when compared to heating by electricity, with water consumption being reduced by 15%.
- Comparing like with like for a fully managed service (eg. Gas fired central heating), Combined Heat and Power is the most cost effective solution.
- A key factor in the energy reduction is that, for the first time in the United Kingdom at a major private development, the homes are heated and electrically powered by a high efficiency Combined Heat and Power facility coupled to advanced control systems. This with improved insulation gives a massive 65% reduction in CO_2 emissions.
- The Combined Heat and Power facility is a fully managed service which means that residents do not need to individually maintain boilers.
- The Ecology Park at Greenwich Millennium Village is based around a man-made lake with inter-connecting ponds, reed-beds and islets. This creates a habitat for estuarine birds and migrating species. There is controlled access to board walks leading to bird hides.
- Greenwich Millennium Village is an outstanding example of how to build safely on chemically contaminated ground and is a blueprint for the remediation of former industrial sites. The methods used a Greenwich Millennium Village

illustrate advanced environmental engineering at its best and have been accepted by the Environment Agency, the London Borough of Greenwich and the National House Building Council.

Greenwich Millenium Village, London, United Kingdom, September 2009

Greenwich Millenium Village, London, United Kingdom, September 2009
(Model)

Greenwich Millenium Village, London, United Kingdom, September 2008

Greenwich Millenium Village, London, United Kingdom, September 2008

GlashusEtt environmental information centre, Stockholm, Sweden

The GlashusEtt is a focal point for information on environmental issues in Hammarby Sjostad and is a natural hub for demonstrating the links between modern technology and a better environment.

The environmental information centre is tasked with spreading knowledge through study visits, exhibitions and demonstrations of the Hammarby Model and new eco-friendly technology. National and international visitors come to Sjostaden to see not only how the City of Stockholm has planned the new city district, but also how an eco-minded approach has characterized the entire Sjostaden planning process that went into making it the sustainable city.

The aim throughout was to achieve a good indoor climate with low energy consumption. Double-glazed facades linked to an advanced control system cuts energy consumption to 50% of that of an equivalent building with glass facades. The double-glazed facades reduce the need for artificial light and the energy requirement for heating, cooling and ventilation.

Low-energy lighting has been planned for the entire building. The advanced control system adjusts lighting and ventilation in line with current activities, the amount of daylight, etc.

On the roof – sedum plants have been planted to act as a compensation basin during heavy rainfall. A solar power plant, a control system cabinet for the alternative energy system, a weather station and a tank containing hydrogen for a fuel cell are also here.

On the ground floor – which is open to the public, visitors can see how the unique Hammarby Model works, both on computer screens and in the form of exhibitions.

The middle floor – is designed as a conference facility where interested parties can be invited and learn more about the project's interested parties and their environmental work.

The upper floor – houses most of the building's technical installations, such as a fuel cell and its associated equipment, electrolyser, biogas boiler, an accumulator tank for hot water, control systems for the building's ventilation, etc. A small group meeting room, with a kitchenette equipped with a biogas-powered stove, is also on this floor.

The basement – contains a sewage pumping station, a vacuum-based refuse collection installation and a mains power substation.

Stockholm, Sweden, August 2008
(Sustainability Centre)

Stockholm, Sweden, August 2008
(Timber Building)

RECOMMENDATION: SUSTAINABLE BUILDINGS AND PRECINCTS

All buildings should be tuned after construction to ensure their operation is meeting the sustainable design objectives. This can take up to 12 months and should be made a requirement of the building contract.

Local government should be encouraged to build net 'zero fossil energy' buildings in which it will produce at least as much energy from renewable sources as it consumes.

Local government should strongly consider the provision of charge points for electric cars in public car parks and partner with car clubs to encourage electric car share schemes in built up urban area (i.e. usually within 10 km of the CBD).

MATERIALS AND PRODUCTS

Vaxjo, Sweden - Valle Broar - wood constructed city

When the Swedish government announced its strategy “More Wood in Construction”, Vaxjo municipality made a major commitment at Valle Broar, a modern wood constructed city located between the centre of Vaxjo and University campus area.

This region of Sweden is the richest region in forestry and with a university that has an extensive research program, there is an abundance of both knowledge and raw material.

After a series of large fires in the 19th Century it was prohibited to use wood in the support structures of multi-storey buildings. However, the European Union paved the way for new possibilities to be opened up resulting in the laws finally being changed in favour of using wood materials about 10 years ago.

Two wooden houses 8 storeys high containing 67 apartments are now under construction and are the first part of Limnologen. It will be the tallest constructed wooden houses in Sweden and the wood construction will have benefits in acoustics and drawing up and dispersing damp to create an even indoor climate.

However, the wood construction method required some additional measures compared with traditional construction techniques. This includes the requirement to erect a tent over the construction site to prevent damp within the structure. The tent must be continually elevated as the building is increased in height.

Vaxjo, Sweden, August 2008
(Timber construction high-density residential buildings)

Vaxjo, Sweden, August 2008
(Timber construction high-density residential building)


Vaxjo, Sweden, August 2008
(Timber construction high-density residential building)

<u>Sutton, United Kingdom - One Planet Products, BioRegional</u>

BioRegional Development Group is an entrepreneurial, independent environmental organisation that develops award wining, commercially viable products and services to help enable One Planet living – living within our fair share of the Earth's resources.

One Planet Living is a global initiative based on 10 guiding principles of sustainability developed by BioRegional and WWF, being:

1. Zero Carbon
2. Zero Waste
3. Sustainable Transport

4. Local and Sustainable Materials
5. Local and Sustainable Food
6. Sustainable Water
7. Natural Habitats and Wildlife
8. Culture and Heritage
9. Equity and Fair-trade
10. Health and Happiness

One Planet Products Ltd – is a not-for-profit organisation, managed as a member-led club. It enables members to specify and purchase environmental construction products, materials and services more cost effectively and easily, reducing the environmental impact of their developments. This initiative helps its members to purchase and specify green construction products easily and affordably helps them build knowledge in sustainability.

A product review process enables members to select sustainable products quickly, without the need for carrying out expensive and time-consuming research themselves. Suppliers are not charged to be listed. All suppliers and products are assessed against the One Planet Living principles and against the additional following criteria:

- Environmental benefits of each product or material
- Energy, CO_2e and water savings
- EcoHomes and Code for Sustainable Homes point's available
- The 10 One Planet Living Principles
- The suppliers supply chain
- Lifetime savings and payback periods

The member benefits are:

- Access to data on water and energy saved compared to using the mainstream alternative.
- Continuing Professional Development training events.
- Advice in meeting EcoHomes and Code for Sustainable Homes standards.
- Discounts on sustainable products and services.
- Members only part of the website, which lists detailed product information and research.
- Opportunity to give feedback to suppliers on product performance and development.
- Opportunity to meet, learn and share with other Members at exclusive Members only events.
- Access to One Planet Products product specialist's advice and research on environmental products.

Housing currently produces around one third of the United Kingdom's carbon dioxide emissions adding to the effects of climate change. By encouraging the use of low-energy materials, innovative resource-saving devices and high quality construction methods, One Planet Products aims to reduce the environmental impact of the United Kingdom housing stock.

<u>Renewable energy solutions</u>

Photovoltaics:

Photovoltaics (PV) panels generate electricity when exposed to light. They generate a DC voltage and when linked to an inverter, mains voltage is generated that can be fed back into grid through the meter. Panels use state of the art monocrystaline high efficiency cells. The embodied energy payback for solar panels is around 3 years. The panel life should be anything from 20 to 40 years.

The City of Santa Monica has used a solar array as cladding for one side of a medium density affordable housing building it recently built.

Solar Panels, 502 Colorado Road Santa Monica (Affordable Housing), United States of America, August 2008

Photovoltaic SolaPort

The City of Santa Monica has also built a solar array on one of its multi-level car parks. As well as reducing the City of Santa Monica's Civic Auditorium's electric bill and providing covered parking for 39 automobile owners, the SolarPort will also reduce air pollution in Santa Monica. Over the life of the SolaPort, it will:

- Generate over 1.3 million kilowatt-hours of electricity, replacing electricity that would have been generated by the utility by burning 600 tons of coal, 2,200 barrels of crude oil, or 12.8 million cubic feet of natural gas.
- Eliminate 955 tons of carbon dioxide (CO^2), the major cause of global warming. It takes 9 acres of trees to absorb the carbon dioxide that the SolaPort will prevent.
- Eliminate 3,900 pounds of sulphur dioxide (SO^2), a major cause of acid rain.
- Eliminate 5,400 pounds of nitrogen oxides (NOx), a major cause of smog.
- Reduce emissions equal to that of 7 average passenger cars

Solar Port, City of Santa Monica, United States of America, August 2008

Solar panel shade, Malmo, Sweden, August 2008

Wind Turbines:

The problem with the first generation on the market was their inability to generate 3 minutes of smooth power suitable for grid connection. This time period is required by regulation before the inverter could start. They might have been generating 2.5 minutes of suitable power, but it would count for nothing as it would not have allowed to reach the fuse box. To get around this, the turbine will charge a battery which when charged, would be wired through an inverter back to the grid. A battery is less efficient than using an inverter directly, but it is better to be 70% efficient 100% of the time than 100% efficient 5% of the time. For windy areas, a battery may not be needed. Vertical axis wind turbine can take wind from any direction without having to turn around to face the oncoming wind. They are therefore ideal for windy but turbulent locations. Horizontal axis wind turbine (traditional propeller type turbine) is best suited to sites with consistent wind and/or where it can be mounted on a tall mast. Its multi-blade design, large swept area and small generator make it better suited to locations with low average wind speed.

Heat Technologies

These products include solar thermal panels, biomass boilers, heat stores and community bio-fuel fuel cell systems.

Space heating to a home can be reduced by properly insulating, air sealing and using heat exchange ventilation.

Evacuated Tube direct flow solar thermal power is among the most efficient system on the market and is used in more extreme climates. Direct flow is accepted as the most efficient way of transporting the heat collected by the panel to the hot water store as it combines the best features of evacuated tube systems (ie great insulative properties of evacuated tubes which allows them to generate hot water even on frosty sunny days), with the direct single heat exchange process of flat panel collectors. These tubes are able to provide water at 70^{o} C on sunny mid winter days and up to 55^{o} C on partially cloudy mid winter days. Water in the panel has to be mixed with glycol (antifreeze) to prevent it freezing (or boiling).

An intelligent thermal store is more than a simple hot water cylinder. Since excess heat cannot be exported back to the grid as you can with excess electricity, a hot water tank or thermal store is as important as electrical batteries are to an off-grid house or electric car. If the store is too small, there is a chance of running out of power. If it is too big, then they can never be fully charged and so will never really give full power. If incorrectly designed, they will already be full when the sun comes out so all that solar panel will have to be dumped. The art is to have a store that is always cold enough to provide somewhere to store solar heat available, yet be hot enough to provide hot water from the taps and space heating if required.

Wood fuel heating form wood pellet boilers has long been the norm in countries such as Austria. It will produce zero carbon heat when required, day in day out. A biomass boiler will never be comparable in cost to a gas boiler, so it is more appropriate for medium density apartment buildings. The boiler house combines the automatic wood pellet boiler with a fuel hopper that incorporates automatic level monitoring and fuel ordering. It also has a communal thermal store that allows the boiler to only run when it is efficient to do so while making sure there is always a source of heat for the heat main.

Oxley Wood, Milton Kenes, United Kingdom, September 2008
(Hot Water System)

<u>Ventilation and Cooling Technologies</u>

The EcoHat is a new generation of chimney stack which sits on top of the services spine, filters fresh air coming in to the building, and reuses hot air circulating through the stack.

Wind assisted passive stack heat exchange ventilation (The Wind Cowl) was designed because of problems encountered when Zero Carbon homes commenced design, namely:

- Once a building is superinsulated and airtight the biggest source of heat loss is the ventilation required to maintain air quality. To reduce this heat loss, exhaust air is supplied through a heat exchanger so the out going air transfers its heat into the incoming air.
- Electricity is responsible for three and half times the amount of carbon dioxide per kilowatt hour as heat is (if you burn gas) and is up to four times the price, so for a heat exchange ventilation system with a fan to be useful it must save at least three and a half times the amount of heat kWhrs as the electricity kWhrs the fan uses. From a pure physics study, it is unlikely to do so.

- The cost of the PV panels required to generate the kWhrs used by the fan for electric heat exchange units is much greater than the cost difference between an electric heat exchange unit and a wind heat exchange unit.

The solution to this problem is to replace the fan with a cowl that uses wind pressure to force fresh air in and the stale air out.

The following strict design rules need to be adhered to from a very early design stage in intending to install wind cowls to ventilate a building:

- The super low energy cooling and dehumidification version of the wind cowl has such a low energy demand, it can be powered by renewable systems on the roof of the same house / building. It mainly uses solar thermal to dry out the desiccants that provide dehumidification and also provide absorption cooling. The electrical power needed for an additional small heat pump is provided by dedicated PV panels.
- The whole system works on the principal of ‘the more the sun shines – the harder it works).

The EcoHat Carbon Footprint Reduction:

- 27% from house construction
- 40% with the inclusion of the EcoHat
- 50% when the EcoHat is attached to top up energy for a hot water system
- 70% if the EcoHat uses geothermal energy sources through a local bore hole

Eco-hat is a factory finished product to fit all houses. It provides filtered ventilation and passive heating. It can be rotated to be oriented towards the sun. The solar absorbent panel preheats input ventilation. The carcass contains ventilation and solar hot water heating equipment. It is adaptable and upgradable to provide enhanced levels of energy performance. EcoHat enables air tight efficient dwellings and 30% less carbon emissions. It allows for updating and the addition of appropriate technology.

Sutton, London, United Kingdom, September 2008
(Wind Cowl – Beddington)

Oxley Wood, Milton Kenes, United Kingdom, September 2008
(Exhaust flue for Eco Hat)

Sutton, London, United Kingdom, September 2008
(Opening ceiling windows)

Oxley Wood, Milton Kenes, United Kingdom, September 2008
(Carbon Zero House)

Oxley Wood, Milton Kenes, United Kingdom, September 2008
(Eco Hat)

Building Energy Management Technologies

These include simple packaged management systems for community energy management such as:

- Heat metering, billing and management:
    - A web based software system has been developed that automatically receives meter readings from individual properties, generates accounts with monthly direct debits and orders fuel for community energy systems.

- Fuel Cell / Pyrolysis CHP:
    - The advantage of the fuel cell lies in its 40:60 heat to electric power ratio, leading to greater production of high value electricity. This is a far more suitable energy ratio for high density urban communities (traditional biomass CHP produces twice as much heat as electricity leading to heat dumping in the summer in order to meet electrical loads).
    - The Fuel Cells modules are also compatible with either bio-gas or natural gas; meaning that any down time for pyrolysis maintenance doesn't stop production of heat and power.
    - The pyrolysis unit can process a wise range of biomass and is far more tolerant of the moisture content of fuel than conventional CHP technologies. Furthermore, the by-products of producing the bio-gas include a solid "bio-char". The char retains a large proportion of the nutrients of the biomass and can be returned to the soil, enhancing its fertility.
    - Overall the system promises to overcome many of the problems associated with conventional CHP and provide a more compact, efficient, robust and reliable solution. Most important of all, it has been designed to run on cropwaste.
    - This new biogas technology is clean and compact, can be fitted on farms and in urban areas, the gas can be distributed within the existing has mains, and there is no competition between food production and energy production – as both use the same crop.
    - This system would be suitable for high density developments where each home would not see enough sky to make solar energy a complete solution. This product uses far less biomass per unit of electricity than anything else.

<u>Water Heating</u>

Solar Thermal Collectors use sunlight to heat water. Solar Thermal Evacuated tubes have been developed particularly for northern European climates where outdoor air temperatures are low.

The term Evacuated Tube refers to the glass tubes that seal a vacuum around the collector tube. This glass tube transmits the suns rays to warm the collectors and the vacuum virtually stops the heat from escaping from the tubes. The closed-loop solar collector systems use electric pumps, valves, and controllers to circulate a glycol-water antifreeze mixture through the collectors and a hot water storage tank, heating the water indirectly.


Evacuated Tube Solar Thermal Collectors, Malmo, Sweden, August 2008


Evacuated Tube Solar Thermal Collectors, Malmo, Sweden, August 2008


Evacuated Tube Solar Thermal Collectors, Malmo, Sweden, August 2008


Solar hot water, Augustenborgs, Sweden, August 2008

Solar hot water, Augustenborgs, Sweden, August 2008

Wood Pellet Boilers

A range of package boilers have been designed to meet the needs of the European market, being CO_2 neutral, easy to operate, automatic and highly efficient up to 90%+.

Boilers up to 75kW are fitted with integral hoppers. Larger units require an independent fuel bunker to hold a practical amount of fuel. Delivery of the fuel from the bunker to the boiler is automatic utilising a conveyance systems. The small amount of ash produced by burning wood pellets requires emptying approximately once per week.

Multi-Fuel District Heat Banks

The aim of the system is to combine all potential energy (heat) sources within a property for the provision of space heating and hot water, from a zero-carbon approach.

The District model is also based on the use of a remote boiler system, with the facility to meter the energy used for billing purposes. This approach is becoming more attractive as it allows a zero-carbon boiler house using renewable fuels such as bio-mass to generate heat (and possibly electricity) for local domestic consumption, where it may not be possible or advantageous to site such boilers within properties.

The advantages of a District model are:

- Ability to combine a Boiler (local or district), Solar, Solid Fuel, Heat Pump and Electric in a single system.
- Allows any heat source to be used for both hot water and heating.
- Ensures that each type of heat source is utilised to optimum effect and efficiency.
- Ability for user to control volumes heated up by boiler or electric.
- Vented storage overcoming the strict controls and maintenance schedules required by pressurised storage.
- No annual maintenance, and no need for specially qualified installers.

- Can generate mains pressure hot water to tap at 9 bar pressure, and 30 litres per minute (as standard).
- Fully pre-assembled, wired and tested ready for quick installation.

The basic idea of a Heat Bank is that it is a thermal store that stores primary hot water as opposed to domestic hot water that flows out of taps. The water in the store never changes, and is circulated around the central heating system to drive radiators and / or underfloor heating using stored energy. Domestic hot water for taps is not stored, but is generated upon demand by heating mains water flowing through a plate heat exchanger with the heat energy in the store. The store is generally vented and unpressurised, as this overcomes many of the regulations that apply to pressurised storage and makes it possible to connect uncontrolled heat sources such as wood burners.

One of the key design elements in the MultiFuel Heat Bank is the use of the plate heat exchangers. They provide the ability to move heat energy from source to load very efficiently, without the large temperature drops that are generated by using coil heat exchangers. They can also transfer heat at a far higher rate than coils, with exchange rates of 100kW easily possible from a small heat exchanger, and they allow the transferred heat to be directed to where it is needed. The system uses three plate heat exchangers in total.

A point often raised when using plate heat exchangers is the need for additional pumps that are not required if using coils. It is true that additional pumps are another item that need maintenance and may introduce an additional energy drain, and problems during a power cut. Pumps are relatively reliable with 10 years life or more expected. They can be very quickly replaced thanks to isolating valves and unions on all pumps, overcoming the need to drain a system. Pumps are readily available and relatively inexpensive and the energy use on a pump for hot water generation to taps is very small, approximately 5kWh per year (based on a 45W pump running for 15 minutes each day), The energy savings that are made possible far outweigh this, especially if using low energy pumps.

<u>Greenwich Millennium Village – UK March 2007</u>

Greenwich Millennium Village is constructed using environmentally friendly materials. In the design process, materials and systems were selected using an assessment using the BRE Green Guide. Preference was given to 'A' rated materials wherever practicable. These selections included evaluations of cost and performance as well as environmental considerations.

The environmental issues that were considered in the design are:

- Contribution that their manufacture makes to greenhouse gasses.
- Embodied energy required for manufacture.
- Local sourcing.
- Pollution.
- Waste disposal and recycling.
- Depletion of materials through extraction.

Details were obtained from suppliers as to the environmental performance of their manufacturing and sourcing systems. Preference was given to suppliers that were able to demonstrate high environmental performance particularly through reduced pollution and embodied energy. Within the design, consideration was given to the use of recycled materials, including:

- Road making materials.
- Concrete (including the use of cement replacements).
- Hard-landscaping materials.
- Street furniture.
- Top soil.
- Recycled timber.

In addition:

- For the external walls, materials with a low mass were chosen to reduce the embodied energy. Insulation materials were selected which are non-ozone depleting.
- Windows were selected that have certificates of environmental performance.
- Internally, paints were chosen that are non-polluting.
- Timber was sourced from sustainable sources and all timber including recycled timber products were Forest Stewardship Council certified where this has been possible.

Passive Solar Heating & Glazing

Correct glazing forms a vital part in creating internal spaces with a special environment. Daylight is important to maintain activity levels and to save energy from artificial lighting. On sun facing elevations, the sun can be used to heat rooms. Windows also create a feeling of interior space.

Using the sun to provide heat is one of the energy efficiency measures being taken. To maximize these effects, the largest windows need to be non-sun facing, with smaller windows facing the sun.

The weakest part of any home is the windows. Glass panels typically conduct heat five times greater than the solid wall areas. Window systems should be selected that offer high levels of performance for both thermal insulation and air-tightness, as well as being made from environmentally friendly materials.

Shading is required on the sun faces to prevent over-heating which can be engineered or natural such as deciduous trees that provides summer shading and allows solar penetration in the winter.

City of Santa Monica Offices, United States of America, August 2008

Thermal Insulation

Providing high levels of thermal insulation is an important part of creating energy efficient buildings. Not only does saving energy reduce costs but it also maintains a better global environment with reduced greenhouse gas emissions and pollution. Clean air is vital for our future quality-of-life in towns and cities.

Insulation materials that do not pollute the environment during their manufacture use non-ozone depleting methods in place of CFC/HCFCs to give the low material densities required. Materials such as Rockwool and Rigid Urethane boards are used to meet both insulation and environmental concerns.

Natural insulation materials include natural sheep's wool that makes use of waste wool from wool manufacture and certain recycled materials.

Each Oxley Woods home also has high levels of insulation, much of it made from recycled materials. The homes achieve the maximum National Home Energy Rating and a "Very Good" EcoHomes classification.

Oxley Wood, Milton Kenes, United Kingdom, September 2008
(Deep wall construction with compressed timber panels on exterior)

Oxley Wood, Milton Kenes, United Kingdom, September 2008
(Sample wall construction)


Oxley Wood, Milton Kenes, United Kingdom, September 2008
(Sample Roof section)

Bo01 development – Malmo, Sweden

Bo01 is based on the principles of:

- Minimal energy consumption.
- 100% local renewable sources of energy.
- Balance between production and consumption of energy within the district over a course of a year.
- High level of individual comfort.

Sun, wind and water are the basis for energy production. Sweden's largest urban solar energy project is implemented in the area. Energy and sewage systems work together through heat extraction and biogas production.

The theme of Bo01 is the 'City of Tomorrow' in an ecologically sustainable information and welfare community. The district aims to be a driving force in Malmo's development towards environmental sustainability.

The overall aim is to hand over to the next generation a society in which the major environmental problems have been solved. The 14 environmental objectives that have been adopted are:[4]

- Clean air.
- High Quality groundwater.
- Sustainable lakes and watercourse.
- Flourishing wetlands.
- A varied agricultural landscape.
- A magnificent mountain landscape.
- A non-toxic environment.
- A balanced marine environment, sustainable coastal areas and archipelagos.
- No eutrophication.
- Natural acidification only.
- Sustainable forests.
- A good urban environment.
- A safe radiation environment.
- A protective ozone layer.

<u>Synthetic Surfaces</u>

The conversion of natural turf playing areas and open space is becoming more popular as evidenced in the United States of America. The initial capital cost is much greater, however, this is more than offset by lower ongoing maintenance costs with the advantage of all year round high quality.

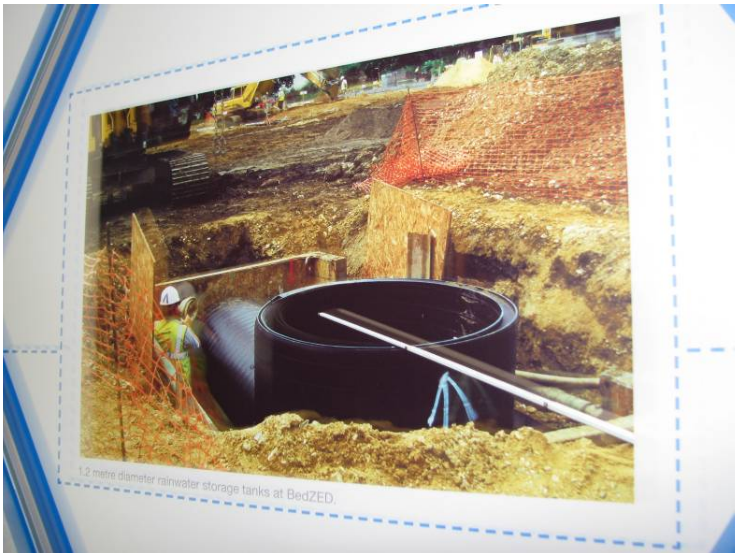
Synthetic verge, Santa Monica, USA, August 2008

Sutton, London, United Kingdom, September 2008
(Smart meters in kitchen - Beddington)

Sutton, London, United Kingdom, September 2008
(Smart meters - Beddington)

Sutton, London, United Kingdom, September 2008
(Recycling bins - Beddington)

Sutton, London, United Kingdom, September 2008
(Thermal mass walls - Beddington)



Beddington, Sutton, London, United Kingdom, September 2008
(Stormwater storage tank)

Sustainability:

- All timber comes from sustainable and managed sources
- Insulation is made from recycled paper and pumped into walls on site
- Cladding is made from 70% softwood from renewable forests
- Cladding is factory cut and recycled at the plant
- Factory fabrication of superstructure enables the 5% waste to be recycled at source
- No site waste of superstructure = no superstructure skips at site = no transportation of waste
- For superstructure water only used for foundations
- No ceramics are used on site
- Larger windows provide high levels of natural light reducing the demand for artificial lighting
- Large corner kitchen windows increase security
- Air leakage is equivalent to one golf ball
- Separated structures enable very high levels of sound proofing between dwellings
- Fabrication systems enable very high levels of sound proofing between dwellings
- Life-cycle analysis of all construction products are mapped to assess their relative environmental impacts

RECOMMENDATION: MATERIALS AND PRODUCTS

Solar ports (solar array shelters) can be used for a range of uses in the urban landscape while generating renewable power.

Explore the installation of vertical axis wind turbines along major roadways or in suitable urban areas.

Explore the viability of wind assisted passive stack heat exchange ventilation units (Wind

Cowl or EcoHat) being installed on residential or community facility.

Trial the installation of synthetic turf as a substitute for grass for urban verges that are affected by the drought (i.e. little rainfall and water restrictions).

ENERGY

Solar

Santa Monica – US:

The City of Santa Monica has invested significant effort in resource conservation. The city government purchases 100% renewable power for municipal operations. The City of Santa Monica's commitment to green building resulted in the Santa Monica Public Library receiving Leadership in Energy and Environmental Design (LEED) certification. The building received the prestigious gold level certification. This library celebrated 1,000,000 visitors in 2006[5].

The City of Santa Monica recently launched Solar Santa Monica, an initiative to install solar panels on Santa Monica's rooftops, a big step towards energy independence towards a net zero energy community. 20 solar projects were installed in 2006[5].

Western Harbour – Sweden:

Hammarby Sjostad has solar cells installed on several facades and roofs which capture the energy of the sun's light and convert into electrical power.

Solar cells capture the sun's luminous energy and convert it into electrical power in solar cells. The energy from a 1 m^2 solar cell module provides approximately 100 kWhr/year, which corresponds to the domestic electricity requirement for 3 m^2 residential floor space.

Solar cells and solar collectors make use of the energy from the sun in two different ways. The solar cells consist of semiconductors, which can be manufactured from various kinds of material, usually silicon. In silicon, the rays of the sun are converted directly into electrical energy. At present, this is rather an expensive way of producing energy, but it is hoped that manufacturing costs will come down dramatically during the next few years. About 6,000 kWh of electricity is produced per year, from 120 square metres of solar cells.

Another way of using solar energy is with solar collectors. A solar collector heats the water up; the water normally circulates in an enclosed system. In the Western Harbour, the 2,600 square metres of solar collectors are connected to the district heating network. This enables the network to function as an accumulator, so that when the solar collectors produce more energy than is required within the Western Harbour, it can be leant to the rest of Malmo – and can be received back when there is an energy deficit. Total heat production is 700,000 kWh per year, equivalent to about 10% of the heating and hot water used in the area.

The solar energy project is a big success, and the results exceed expectations. The solar collectors also provide surplus heat during very cold days, and are an important contribution to the entire solution. Despite this, production is lower than average during years with lower than average during years with lower than average hours of sunshine. One of the most important lessons is that it is possible to integrate solar collectors in modern architecture in a way which involves not attempting to hide them, but instead emphasizing the function.

Natural Gas / Biogas

The City of Malmo's (Sweden) local buses as well as most taxis are fuelled by natural gas.[6]

Through anaerobic digestion, the organic waste from the Western Harbour can be converted to biogas, which is fed into Malmo's natural gas network. As a fuel, natural gas provides considerable environmental advantages, and at present is used for the majority of Malmo's city buses and cars.

A maximum of 105 kWh per square metre per year was set as a goal for energy use in the properties. At the same time, the comfort of the residents was not impaired.

Biomas

As an environmentally renewable fuel and natural product, wood pellets offer the highest level of supply security and are independent of global developments. Furthermore, pellets are one of the most environmentally friendly fuels. When burned, they only produce as much CO_2 as was absorbed by the trees when they grew – CO_2 neutral.

Wind Power

Wind power has delivered energy to the Western Harbour area in Sweden since 2001.

Ocean between Denmark & Sweden, August 2008
(Ocean Wind Farm)

Stockholm, Sweden, August 2008
(Wind Sculpture)

Greenwich, London, United Kingdom, September 2008
(Vertical Wind Turbines)

Geothermal

Western Harbour – Sweden:

An aquifer is a natural underground storage reservoir. Ten bore holes, each 90 metres deep, have been sunk down to the aquifer in the Western Harbour in Sweden. In the winter, water at a temperature of 15 degrees is taken up from one row of wells, being the warm side. The water is used as a heat source in a heat pump, and after cooling, is pumped back into the aquifer through the wells of the other row, down on the cold side. The heat from the heat pump is distributed out into the district heating network. During the course of a year, just over five million kWh of heat is produced, which is 90% of the heat required by the area.

During the summer, the process is reversed, so that cooling is produced for the district cooling network. During the course of the year, this gives about three million kWh of cooling.

Vastra Hamnen, the Bo01 development – Malmo, Sweden - 2001

Sweden has reduced the carbon dioxide emissions significantly in the past 20 years. This was possible because of the Swedish and Nordic way of solving the heating problem in cities using district heating, which has been a major success storey.[1]

The Bo01 development reaches these measures by:[4]

- Minimising energy use to less than 105 kWh/m2a for all buildings.
- Maximum recycling of energy from waste and sewage.
- Using 100% locally renewable energy sources such as clean production of energy by an 80m wind turbine, 2,000 m^2 of Photovoltaic Panels and heat pumps that use heat from soil and water.

Connection to the national grid is necessary for temporary shortages or overproduction.

Combined Heat and Power is the one of the best ways of increased effectiveness in the energy and housing sector. Using new methods of gasification of biofuel, the potential is estimated at about 44 TWh – 7 % of Sweden's supplied energy and more than half of the total fuel used by Swedish road traffic.[1]

E.ON has developed a unique concept based on 100% locally renewable energy for the new city district. The concept is based on local conditions for energy production. In the Bo01 area, 1,000 homes get their energy supply from renewable sources; solar energy, wind power and water – the latter through a heat pump that extracts heat from seawater and an aquifer – a natural water reserve in the bedrock that facilitates seasonal storage of both heat and cold water.

1,400 m^2 of solar collectors, placed on top of ten of the buildings complement the heat produced by the heat pump to supply the area. A large wind power station (2MW) placed in Norra Hamnen (the north harbour) and 120 m^2 of solar cells produce electricity for the apartments, the heat pump, fans and other pumps within the area. A unique part of the energy concept is that the plants are linked to the energy systems in the city for district heating, district cooling and the electricity grid. The 100% renewable energy equation is based on an annual cycle, meaning that at certain periods of the year the city district borrows from the city systems and at other times the Bo01 area supplies the energy systems with its surplus. This connection also provides reserve capacity for the area.

An important part of the concept is low energy use in the buildings. Each unit is only allowed to use 105kWh/m^2/year, including household electricity. Several of the buildings have met the targets, however there are a number of buildings where the energy consumption exceeds the target excessively. Investigations are undertaken on these buildings and the energy consumption is measured continuously.

Boel, the wind power plant is in the northern harbour in Malmo and generates a maximum of 2 MW with a calculated annual electricity production of 6,300 MWh.

In the area,1400 m^2 solar collectors have been installed on ten buildings. Of these there are 200 m^2 vacuum collectors, these are more effective than the other flat-plate collectors. Calculated annual heat production is 500MWh.

Vaxjo, Sweden - Energy Efficiency:

In a fossil fuel free society, the energy consumption has to be based on renewable energy sources. In 2005, 51% of the energy consumption was based on renewable energy sources. Most of the renewable energy consumption originates from the heating sector, where 88% of the consumption was based on renewable energy sources.[7]

Hammarby - Sweden

A thermal power plant supplies Hammarby Sjostad with district heating and district cooling from treated wastewater and biofuels.

A Biogas production facility provides biogas to over 1,000 cookers in apartments.

Sutton, United Kingdom

Households account for over a quarter of the United Kingdom's carbon dioxide emissions. These emissions are contributing to climate, but new technologies and small changes to our lifestyles can dramatically reduce emissions.

Greenwich, United Kingdom

Increasing the proportion of electricity derived from renewable sources is part of a wider national strategy to reduce consumption of conventional fossil fuels and associated production of greenhouse gas emissions. Achieving these reductions will also require transport emissions to be cut and increased energy efficiency and conservation within the domestic, commercial and industrial sectors.

The Council encourages development that is energy efficient by influencing layout and orientation, design and use of materials where these do not conflict with other policies of the Plan. All developments aim to be:

- Be environmentally and resource efficient to build and to operate.
- Use materials from local sustainable sources wherever possible, including the re-use of materials;
- Incorporate a waste segregation system
- Incorporate measures for water conservation; and
- Be subject to an assessment of the impact on the amenity of the local environment, taking into account the existing character of the area.

The Council will expect all new developments with a floorspace greater than 1,000 square metres or residential developments of 10 or more units to incorporate renewable energy production equipment to provide at least 10% of the predicted energy.

The Council will encourage the development of renewable energy projects and developments which include renewable energy facilities and energy saving technologies.

The government policy aims to stimulate the use of renewable energy sources wherever they are economically attractive and environmentally acceptable.

Buildings in use account for a significant proportion of energy use: the planning system can help to reduce energy requirements, by ensuring the provision of renewable energy production equipment in new development or refurbishment / conversion of existing buildings. Encouraging energy efficiency by promoting improved design, form, layout and orientation of development and use of appropriate materials can lead to reduced consumption of energy and environmental cost of running the building. This could include the use of passive solar design principles. Savings of energy for heating, lighting, cooling and ventilation can all be achieved depending on the building type, although passive solar design principles are best suited to newly built buildings. This approach will also contribute to national efforts to reverse the damaging effects of energy consumption on climate change.

65% of the electricity used in the Council's administration buildings, is 'green electricity' from low carbon fuels. The Council will introduce measures to improve thermal insulation in its own properties to the standard set by the building regulations and wherever possible aims to exceed this standard. Developers will be encouraged to do likewise. Water conservation measures may include where appropriate; water efficient toilet and shower facilities, grey water recycling systems, compostable toilets and/or garden water conservation systems. When assessing applications particular regard will be paid to the existing character of the area and the appropriateness of the design.

There are various types of renewable energy and regard also needs to be paid to technologies which may emerge in the future. Within Greenwich, the most promising sources of renewable energy generation are likely to be solar heated hot water, photovoltaic cells and combined heat and power. The various renewable energy technologies will have different environmental impacts, and it has to be recognised that some technologies may not be suitable in Greenwich. Combined Heat and Power (CHP), on its own and in conjunction with Community Heating systems, can provide cost effective, reliable energy and heating at high levels of efficiency and relatively low levels of pollution. CHP engines are already used at a number of Council-sponsored and private sector buildings in the Borough, including the Waterfront Leisure Centre, Woolwich, the Glyndon Road Estate and Amylum UK Ltd, Tunnel Avenue. Community Heating is in use in the Greenwich Millennium Village.

Embodied Energy:

- By 2010 embodied energy within building fabric and construction methods will be included in code
- 1 kilowatt hour = 10 x 100 watt bulbs on for 1 hour
- 1 tonne of timber = 640 kilowatt hours
- 1 tonne of bricks x 4
- 1 tonne of concrete x 5
- 1 tonne of glass x 14
- 1 tonne of steel x 24
- 1 tonne of aluminium x 126

RECOMMENDATION: ENERGY

Local Government should look reducing energy consumption and becoming carbon neutral by 2020. Purchase green energy or generate energy from renewable resources.

Ensure that embodied energy calculations are included in the environmental assessment of infrastructure options.

COGENERATION

Sweden - Eco-friendly energy, district heating and district cooling

The Hogdalen Combined Heat and Power plant uses sorted, combustible waste as an energy source (fuel) to produce electricity and district heating. The Hammarby heat plant extracts waste heat from the treated wastewater from the Henriksdal wastewater treatment plant.

District cooling in Stockholm has developed over a decade into the world's largest system of its kind. From the cooled and treated wastewater that leaves the Hammarby plant's heat pumps, heat is exchanged into cooling in the water that circulates in the district cooling network in Hammarby Sjostad. Cooling is, in other words, purely and simply a waste product from the production of district heating.

Vaxjo - Sweden

A partnership has been formed around district heating from a pulp-mill in Monsteras with E.ON, Varme, Sodra Cell and Monsteras Municipality. Commissioned in June 2003, about 95% of the energy for heating houses in Monsteras comes from Sodra Cell's pulp-mill and the reduction of CO^2 emissions is about 14,000 tons/year compared to previous.[1]

The municipality owned Vaxjo Energy AB, VEAB, pioneered the use of wooden biomass to replace oil for large scale district heating in 1980 and biomass fuelled combined heat and power, CHP.[8] VEAB now operates a 104 MW CHP plant and the city has set aside land for a biomass plant for vehicle fuel, to work in conjunction with the CHP plant. A number of smaller district heating plants have been built in communities surrounding the city.[8]

In 1996, bioenergy companies in Vaxjo and Smaland founded the Bioenergy Group in Vaxjo Ltd, with the aim of supporting bioenergy research activities at Vaxjo University and to promote the use of wooden biomass in the region.[8]

In the same year, the Vaxjo City Council decided to make the city fossil fuel free and the county has since adopted a similar goal. Between the years 1993 and 2003, the per capita carbon dioxide emissions in Vaxjo have decreased by 21% to 3,680 kilos per year.[8]

Biofuel for increased flexibility

The Sandvik plant comprises several units which are combined to meet the demand for energy in as environmentally friendly way as possible. Sandvik 2 can be fired using most types of fuel – including chips, bark, sawdust and peat, even damp fuel.[9]

Beyond these there are reserve peak load oil-fired cogeneration units which are used if there are any problems at the Sandvik plant or connecting district heating pipelines. Production at the cogeneration block splits into one third electricity / two thirds heat, with the heat sent to the district heating customers and the electricity to the electricity market. The electricity that is produced represents 35-40% of Vaxjo's annual consumption.

Since the move into district heating in 1970, Vaxjo has focused on replacing electricity and oil-based heating with district heating. Nowadays most large buildings and a large proportion of houses are supplied with district heating from the Sandvik combined heat and power plant. The plant is fuelled primarily with biofuel and is equipped with an effective flue gas purification system.

Cogeneration plants enables one third of the energy to become electricity and two thirds into heat. In other types of power plant such as coal-fired condense plants this heat is cooled away in the sea and is completely wasted.

The plans operates 98.7% on Biofuel and 1.3% on oil. There are over 348 km of district heating pipelines in Vaxjo.

<u>What happens to the flue gases?</u>

Much of the ash from the flue leaves the boiler with the flue gases. Therefore, the gases are purified before they reach the chimney by charging the ash particles with electricity and separating them. As much as 99.5% of the matter is caught in this way by the electric filter. The ash is collected in a silo before being treated in various ways – and then finally returned to the forest as fertiliser.[9]

The purified flue gases are then led through a flue gas condenser which is cooled by the water returning from our district heating customers. This cooling of the flue gases provides further district heating without the need for extra fuel. Before the heat is used in the flue gas condenser, much of the remaining ash is “cleaned” out from the flue gases. This means that the gases are extremely clean when they leave the chimney.

<u>How does district heating works?</u>

District heating is water circulating round a closed-loop system. The water is heated by the heat source and piped out to buildings where the heat is transferred to the customer’s heating and hot water system. The customer pays for and owns their own district heating unit. The expansion of the district heating system can be carried out in stages.

The hot water is transferred to the customer’s building via district heating pipes. The customer’s district heating unit has two heat exchangers which transfer the heat from the water to the building’s heating system and tap water system. The cooled water (which has given its heat up to the building) is returned to the CHP plant and heated again. The water is pumped round the building in a closed-loop system, providing heating.

Using biofuels for the production of the heat and electricity in the combined heat and power plant reduces the need for fossil fuels such as oil, coal and gas.

The raw material mostly comprises logging residues plus sawdust, bark and milled peat. Forestry chips come from the final logging or thinning of an area of forest, with the treetops and branches collected into large piles which are covered in order to dry out. The biofuel is cut into chips before being delivered directly to the combined heat and power plant.

In order to achieve a closed-loop cycle, a large proportion of the ash from combustion is returned to the forest. The ash contains many nutrients which restore balance to the forest.

As all the heat is produced in one place, thousands of boilers and chimneys have been replaced by the Sandvik plant's modern and efficient boiler plants with flue gas purification. This reduces the emission of flue dust, acidifying substances, heavy metals and fossil carbon dioxide dramatically, resulting in the air in Vaxjo being much cleaner today than it was 25 years ago.[9]

Vaxjo, Sweden, August 2008
(CHP Plant)

Vaxjo, Sweden, August 2008
(Woodchip biomass for CHP Plant)

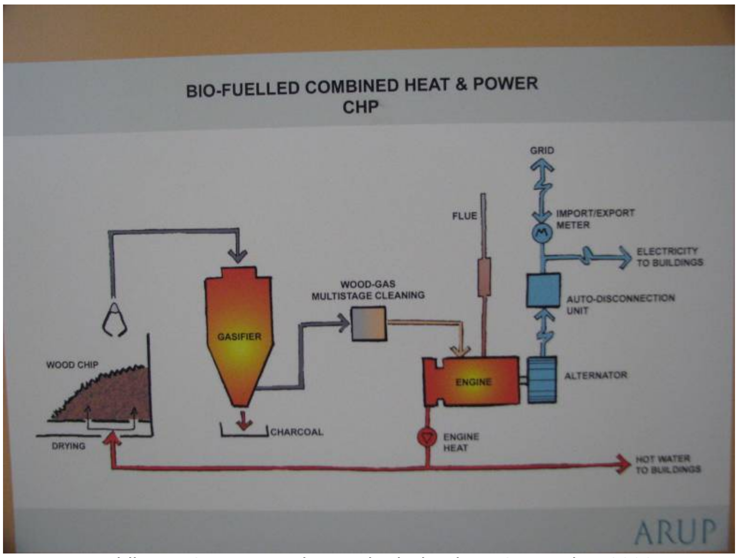
Vaxjo, Sweden, August 2008
(Generator – CHP Plant)


Vaxjo, Sweden, August 2008
(Biomass CHP Plant)

Greenwich Millenium Village, London, United Kingdom, September 2008
(Biomass Boiler)

Greenwich Millenium Village, London, United Kingdom, September 2008
(Wood pellet biomass hopper)

Greenwich Millenium Village, London, United Kingdom, September 2008
(Housing apartment with biomass boiler in bottom corner)



Beddinton, Sutton, London, United Kingdom, September 2008
(Thermal storage tank – 50kLm 90 deg C operating temperature)

RECOMMENDATION: COGENERATION

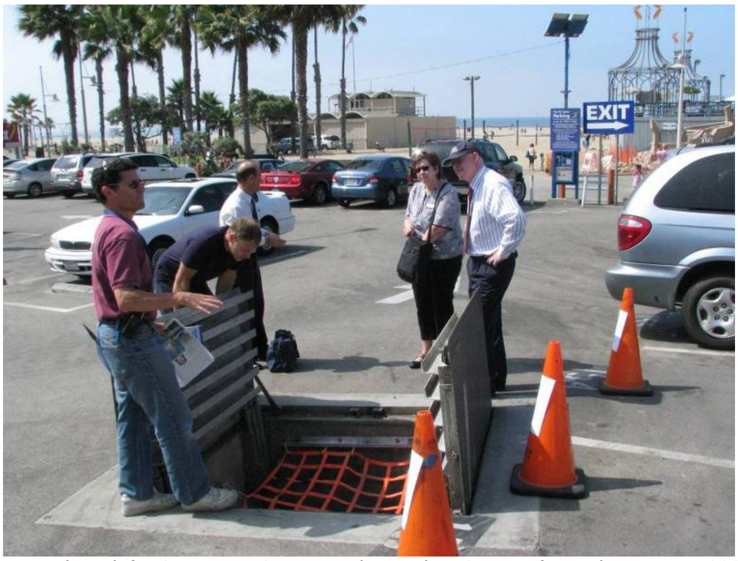
Install cogeneration for high energy community facilities such as aquatic centres and investigate viability of trigeneration for large mixed-use precincts where the demands of heating cooling can be balanced over the day.

DRAINAGE AND FLOODING

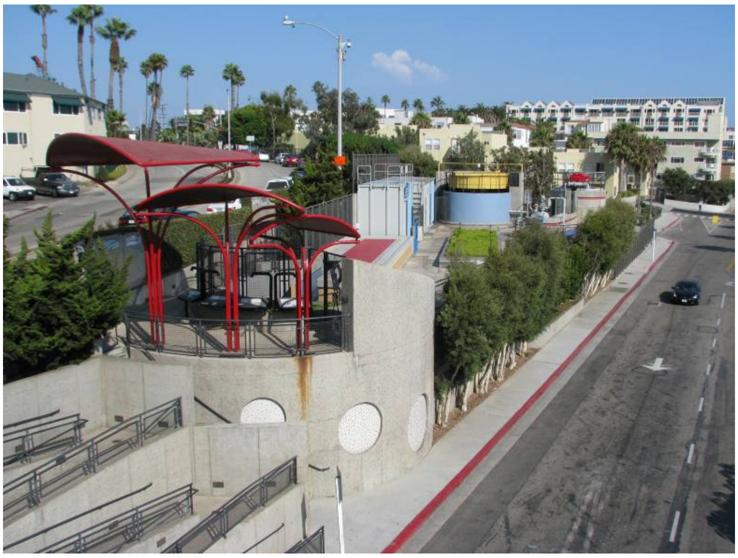
Santa Monica – United States

Santa Monica approved the *Clean Beaches and Ocean parcel tax* which will fund a comprehensive 20-year plan to improve water quality in Santa Monica Bay. This program will control local flooding by enhancing investment in stormwater infrastructure and pollution control such as the *Santa Monica Urban Runoff and Recycling Facility* (SMURRF).[5]

The Bay and its marine habitat are also protected by prohibiting the use of all non-recyclable plastic take-out food service containers. Sales of recycled water from the Santa Monica Urban Runoff and Recycling Facility (SMURRF) increased 35% to a total of 32 million gallons per year[5].



Interception Pit for SMURRF, Santa Monica, Unites States of America, August 2008



SMURRF, Santa Monica, United States of America, August 2008

Water Gardens

Water gardens use the natural contours to drain stormwater to a low point where a soak-away type area is located. The soak-away area contains appropriate plants which use the water and act as a filter to improve stormwater quality. Water gardens can eliminate the need for drainage infrastructure such as pipes and pumps. They can provide decoration with appropriate plantings as well as treating the stormwater before it enters waterways.

Ekostaden Augustenborg, Sweden

An open stormwater system decreases pressure on the drains and sewerage system, and canals and ponds provide environmental qualities that are seldom found in an urban housing area.

Rainwater from all roofs, asphalt surfaces and parking spaces in Augustenborg is now managed locally.

Water from the roofs is led into small channels around the houses and is then collected in larger canals that lead the water to ponds and wetlands. The majority of the rainwater remains in the area.

Over the course of a year, the stormwater system takes care of about 70% of the rainwater in the area which is about 65,000 m^3 of water or the equivalent of 325,000 bathtubs filled to the brim.[10]

A common reason for using open systems is because the capacity of the existing drainage system which has been gradually exceeded, resulting in flooding in cellars during heavy downpours.

Augustenborgs, Sweden, August 2008
(Surface drainage system)

Augustenborgs, Sweden, August 2008
(Surface drainage system)

<u>Storm water solutions – Hammarby Sweden</u>

All storm water, rainwater and snowmelt is treated locally in a variety of ways, and the system is referred to collectively as LOD (the Swedish acronym for "local storm water treatment").

The rainwater is drained into the canal from the surrounding apartment blocks via 'gutters'. Storm water from developed areas is infiltrated into the ground or drained to a canal. The water runs from the surrounding buildings and courtyards via numerous small gutters and is then carried on to Hammarby Sjo through a water ladder.

The green roofs seen on some of the buildings in Sjostaden collect the rainwater, delay it and evaporate it. At the same time, the small, dense sedum plants form living green areas in the city-scape.

Rainwater and snowmelt from the streets is collected and treated in a variety of different ways in Sjostadden. The most common way involves draining the water into special basins, such as closed settling tanks. The water is allowed to remain in the tanks for several hours, to allow the contaminants to settle, and then the water drains out into the canals.

Malmo, Sweden

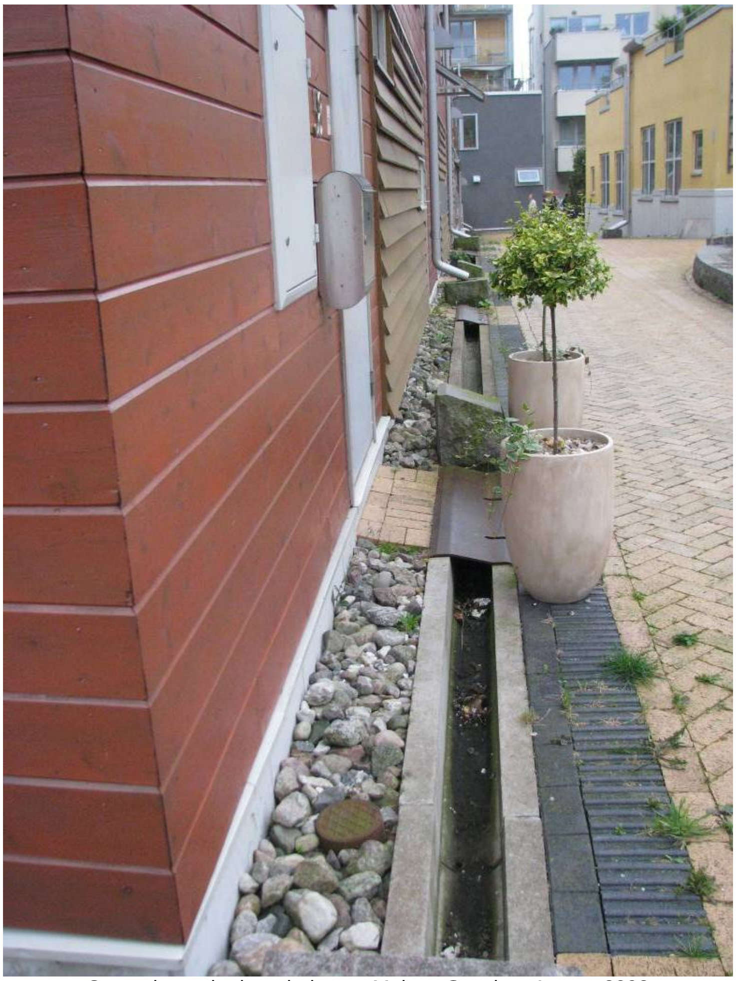
Vastra-Hamnen: BoO1 Area:

As hard areas grow and green areas shrink, less rainfall can infiltrate into the ground or be taken up by plants. Hence, the open stormwater run-off system forms an important feature in the Bo01 area in Malmo. Rain is delayed on green roofs, in ponds in the courtyards and public spaces and then transported in open channels to the sea. The visible waterways combined with trees and lush undergrowth provides exciting and beautiful qualities to an otherwise rather sterile urban environment. The ideas implemented in the Bo01 area show how to minimise the consequences of urban sprawl and make the local environment greener.

Open channel urban drainage, Malmo, Sweden, August 2008


Open channel urban drainage, Malmo, Sweden, August 2008


Open channel urban drainage, Malmo, Sweden, August 2008



Open channel urban drainage, Malmo, Sweden, August 2008

Open channel urban drainage, Stockholm, Sweden, August 2008


Open channel urban drainage, Stockholm, Sweden, August 2008

Greenwich, United Kingdom

Sensitive Urban Drainage Systems are used to avoid the risk of flooding, pollution and other detrimental impacts on the environment, to protect public health and to safeguard sources of extractable water.

The government promotes the use of “soft” sustainable drainage systems (SuDS) as the most sustainable form of surface water drainage for new developments. This involved moving away from traditional piped drainage systems to engineering solutions that mimic natural drainage processes. SuDS control surface water run-off as close to its origin as possible before it is discharged to a watercourse or to the ground. There are a wide range of techniques; including water butts, permeable / porous surfaces, grassed swales and balancing ponds, that aim to reduce problems of waterway pollution and flooding caused by conventional urban drainage systems.


Greenwich Millenium Village, London, United Kingdom, September 2000

Thames, London, United Kingdom, September 2008
(River Thames – Flood Control Gates)

RECOMMENDATION: DRAINAGE AND FLOODING

Local Government should look to installing dry weather treatment facilities for urban runoff, and preferably recycle the water for beneficial uses, i.e. irrigation or toilet flushing.

Increase the amount of open stormwater system in growing urban environments to decrease pressure on underground drainage systems and assist in improving water quality.

ROOF GARDENS

There are millions of square metres of rooftops that can easily become natural green spaces.[11]

Living green roofs can be found in many different shapes and sizes. Extensive green roofs are light-weight with a very thin layer of soil using primarily drought resistant plant species such as sedums and mosses. These roofs survive on natural rainfall and do not need more maintenance than an annual check and a limited feed with nutrition.

At the other end of the weight scale is intensive roof vegetation and gardens. These, of course, need as much maintenance, watering and weeding as other gardens.

The roofs are attractive and can give urban dwellers a positive view and also an improved microclimate. Animals and plants find habitat on the roofs in the midst all the asphalt and concrete and these roofs can compensate for lost green space on the ground, to a certain extent.

There are also financial benefits to green roofs as the roofing material lasts longer and the cost of heating and cooling the building decreases.

Roof gardens provide a green area amongst the hard surfaces of an urban environment.

Landscaped roof gardens are still regarded as experimental in the US compared to 13.5 million square metres constructed in Germany (in 2001).

The advantages of green roofs:

- Decreased pressure on the sewage and drainage system.
- Protects roofing material.
- Increases biodiversity.
- Decreases noise levels.
- Protects against intensive summer heat.
- Attractive to look at.

A green roof is sown, planted, or laid as prefabricated mats. Different moss and sedum species are the main plants used. Water needs are met by natural rainfall. The roofs need very limited management.

Augustenborg's Botanical Roof Garden in Sweden was opened in 2001 and provides information, training and research centre for green roof technology.

Increased green space and more permeable surfaces in the city results in a natural management of much of the rainwater, which leads to decreased costs for drainage and the rainwater does not need to unnecessarily increased the load on the sewage treatment works. Living roofs are a way of contributing to a more sustainable development in our cities.

Green roofs:

- Take care of rain water.
- Provide a better micro-climate.
- Increase the life expectancy of the roofing material.
- Contribute to biodiversity.
- Decrease noise levels.
- Reduce cooling and energy needs.
- Can be used for recreational purposes.
- Decrease the overheating of cities.
- Are beautiful.

The *Scandinavian Green Roof Association* is a not-for-profit organisation working to develop knowledge and spread information and inspiration about green roofs in order to improve the environment in our cities.

Augustenborg's Botanical Roof Gardens is a unique development with over 9,000 square metres of living roofs with extensive sedum roofs and imaginative inspiration gardens and a special roof for endangered plant and animal species. There is also an information centre with exhibitions on sustainable urban development.

Cities can be up to 10^{o}C warmer than surrounding rural areas; the building structures storing and giving off heat while vegetation has a cooling effect due to evapotranspiration. Heat waves are thus an urban problem. Green roofs, ie vegetation and substrate on roof-tops, can counteract urban heat island effects to a certain extent. The roofs cool the surrounding through evapotranspiration and will also cool building interiors if thermal insulation of the roof is poor. Modeling of green roofs in Toronto, Canada, suggested that extensive use of green roofs could cool the city by 1-2^{o}C.[1]

A green roof can be a 5 cm thick, light weight extensive roof, which means it can be placed on top of almost any roof with a slope less than 30 degrees. Or it can be a thicker and heavier so-called intensive green roof, which increased the number of possible functions of the roof but puts higher demands on the roof structure.

A thin roof will hold about 50% of the annual precipitation, a 15 cm roof will hold about 70%, and accordingly have higher cooling potential. After heavy rains, the roof will be water saturated, and therefore green roofs cannot be the sole solution to local flooding risks although they are important parts of local storm water systems.[1]

It is possible to irrigate green roofs using greywater during heat waves to cool the building.

In Germany, areas of gravel on grass-covered roofs act as fire barriers. Green roofs are attractive to most people, and can be an important way of adapting to climate change – as part of larger systems like local storm water management.


Roof Garden at SMURRF, Santa Monica, United States of America, August 2008


Roof Garden, Malmo, Sweden, August 2008


Green roof, Augustenborgs, Sweden, August 2008


Green roof, Augustenborgs, Sweden, August 2008

Green roof, Augustenborgs, Sweden, August 2008

Green roof, Augustenborgs, Sweden, August 2008

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Green Roof, Augustenborgs, Sweden, August 2008

Green Roof, Augustenborgs, Sweden, August 2008

Augustenborgs, Sweden, August 2008

RECOMMENDATION: ROOF GARDENS

Install green roofs on community facilities in high urban density areas to assist with insulation and also the educational message of its benefits.

WATER SENSITIVE URBAN DESIGN

Since the late 1990s, there has been an increasing number of initiatives to manage the urban water cycle in a more sustainable way. These initiatives are underpinned by key sustainability principles of water consumption, water recycling, waste minimisation and environmental protection. The integration of management of the urban water cycle with urban planning and design is known as **Water Sensitive Urban Design** (WSUD).

See below for the table of performance and cost of structural treatments.

Best Management Practices (BMP)	Sediment removal	Nutrient removal	Installation cost	Maintenance cost
Bio-retention systems	High	High	Medium	Medium
Constructed wetlands	High	High	Medium	Medium
Pervious Pavers	Low	High	High	High
Underground Sand Filters	High	Medium	High	High
Disconnected Down Pipes	Low	Low	Low	Low
Silt Traps	High	Low	High	High
Green Roofs	High	High	Very High	High

[10]

TSS – Total Suspended Solids
TP – Total Phosphorus
TN – Total Nitrogen
HM – Heavy Metals such as cadmium, copper, lead and zinc

Bio-Retention Systems

Bio-retention systems are usually shallow landscaped stormwater detention basins that use engineered soils and vegetation to treat stormwater runoff. The treated water can either be collected via slotted pipes or allowed to infiltrate into the soil. Bio-retention systems are also known as rain gardens or natural drainage systems and are able to remove significant levels of pollution (removal efficiency of 80% TSS, 60% TP, 50% TN & 80% HM)[10]. The cost to install and maintain these systems are often less than underground drainage systems and pollutant traps. Built-up urban areas can provide a challenge for rain gardens due to conflicts with services, pavements and trees.

Wetlands

Wetlands are either shallow, extended detention systems, pond-wetland or pocket wetlands that are able to reduce pollution (80% TSS, 40% TP, 30% TN & 50% HM)[5]. The cost to create wetlands can be moderate to high, however they can provide alternative benefits such as flood detention and water treatment which would be expensive to provide on their own. Wetlands are critical for the provision of sediment control and a regular flow of water. The vegetation in the wetland needs to be monitored to ensure there is good coverage during establishment, and when mature are harvested to prevent nutrient build up. In addition, gross pollutants, hydrocarbons and sediment build-up should be regularly removed and invasive vegetation controlled.

Shallow wetlands are designed so that most of the water quality treatment occurs in marshy shallow water depths. This system requires a relatively larger footprint to store the required volume of storm water runoff.

Extended detention shallow wetlands are similar to shallow wetlands with provision for extended 24 hours detention above the surface of the marsh. Plants need to be tolerant to both wet and dry periods.

Pond-wetland systems are designed with two separate cells; a pond to trap sediment and reduce velocities and a shallow marsh. Typically less land is required than for either of the previous types of wetlands.

Pocket wetlands are intended for smaller catchments and typically requires ground water as a source of water to support the wetland system.

Wetlands provide habitat for bird and aquatic wildlife whilst providing a stormwater treatment and retention system. They can also be a valuable community asset for recreational purposes.

Pervious Pavements

Pervious pavers have voids between the pavers that are filled with pervious material such as large diameter stones or coarse sand. The modular pavers are installed over a crushed rock base to provide temporary storage until the runoff can infiltrate into the underlying soils. The pollutant removal efficiency for pervious pavements is usually 80% TP, 80%TN and 90%HM. Pervious pavers should not be used to remove sediment as this can clog the pervious material within the gaps. The cost of pervious pavements are usually high compared with conventional pavements.

A porous concrete pavement is a mixture of course aggregate, cement and water that allows for water infiltration through to an underlying stone reservoir for temporary storage prior to infiltration or point of discharge. The surface has a rough texture and appearance, which is suitable for road and car park pavements, but not pedestrian surfaces.

The primary concern of porous asphalt is the potentially high maintenance cost as surfaces are easily clogged by clays, silts and oils. Rehabilitating a porous asphalt pavement is also difficult, as it cannot be resurfaced to prolong its design life. High temperatures can also reduce the porous properties of the pavement's surface.

Santa Monica, United States

Permeable pavement, Airport Park, Santa Monica, United States of America, August 2008

Underground Sand Filters

Stormwater runoff is directed into a multi-chamber structure containing a sand bed to filter out pollutants. The initial pre-treatment chamber utilises a wet pond to capture sediment and restrict oil from the sand filter chamber. The treated water is then discharged back into the drainage system.

The pollutant removal efficiency of underground sand filters is usually 80% TSS, 50% TP, 25% TN and 50% HM. The construction cost is considered to be high as well as the ongoing maintenance cost of replacing filters, pollutant and sediment removal. As such, they are most appropriate for small highly impervious sites with a high pollution risk (eg oil spills).

Disconnected Downpipes

The downpipes from house roof gutters from medium density multi-house developments can be discharged directly into gardens or lawn before overflowing to conventional drainage systems. This can result in a 50% reduction of peak stormwater flows by infiltration, evapo-transpiration of plants and evaporation to the atmosphere. Retardation of peak stormwater flows is improved while sediments and nutrients are reduced. It is important to ensure that overland flows are directed away from buildings and overland flow paths and swales are sufficient to cater for high intensity storm events.

Grass Swales

Grass swales can provide an effective low cost pre-treatment measure by bio-filtering coarse sediment and capturing gross pollutants. Whilst they don't remove finer suspended solids, they can still play an important low cost role.

WSUD Seepage pit on verge, Santa Monica, United States of America, August 2008

Augustenborgs, Sweden, August 2008
(Surface drainage system)

RECOMMENDATION: WATER SENSITIVE URBAN DESIGN

The practice of disconnecting down pipes could be considered (cautiously) provided that landscaping, soil infiltration, runoff grades and overland flow paths are all designed, constructed and maintained appropriately.

Utilise pervious pavement for car parks or large hardstand areas to reduce the amount of run-off.

RECYCLED WATER

Less water and cleaner sewage - Sweden

One of Hammarby Sjostad's goals is to reduce water consumption by 50%. 200 litres / person / day is normally used in Stockholm, but the aim is to reduce this figure to 100 litres / person / day. The eco-friendly installations (energy class A: washing machines and dishwashers, low flush toilets and air mixer taps) have reduced consumption levels to currently 150 litres / person / day.

Stormwater from roof of buildings is also collected for use in cooling towers.

Bo01 – City of Tomorrow, Malmo, Sweden

Adaption of the waste water system for recycling is based on coordination of various measures in properties in the local urban area. Solutions for the Western Harbour are coordinated with operations for the recovery of electrical energy, heat, biogas, phosphorus, and nitrogen from waste-water and sewage. Some examples include:[4]

- Recovery of energy and nutrients from sewage-treatment residue.
- A biogas reactor to produce vehicle fuel and fertilizer out of organic material.
- Household waste separated in organic and residue waste with a vacuum system.
- Residue waste burned for district heating.
- 200 dwellings with special waste sorting disposal units in the kitchen.
- Separation of waste on each property into newsprint, cardboard, metal, plastics, coloured glass, plain glass, residue waste and organic waste. By making this system easy to use and understated, residue waste is reduced by 80%.
- Waste from parks collected for composting and fermentation.
- Heavy metals and other toxic concentrations in sewage do not exceed the allowed levels for agricultural use.
- Phosphorus from sewage is recovered for agricultural use.

Sewage treatment plant sludge is converted to biogas which is used for heating and electrical energy at the plant, and as vehicle fuel.

Water – Hammarby, Sweden

Water systems in Hammarby Sweden include:

- Filtration of storm water runoff.
- Storm water basin with wetland treatment.
- Separate stormwater channel from buildings and gardens.
- Green roofs and yards collect local stormwater.

Waste and Recycling Material – Hammarby, Sweden

Waste systems in Hammarby Sweden include:

- Pneumatic waste disposal unit.
- GlashusEtt also houses a collecting point for hazardous waste.

Stormwater Irrigation System, Santa Monica, United States of America, August 2008

Hammarby Sjostad – Sweden - Eco-inspections and organically sustainable materials

Rainwater must not be contaminated with metals or oils en route to Hammarby Sjo, which is why façade or roofing materials that could release heavy metals or other hazardous substances have been avoided, and why eco-friendly oil has been used for the footpaths along Sickla Canal and stainless steel has been used for the cycle bridge.

Everyone who builds in Hammarby Sjostad must check and declare their chemical products and construction materials before work on their project begins, and eco-inspections are conducted regularly throughout the construction process.

The environmental goals for construction materials in Hammarby Sjostad are:

- choosing the best materials from resource-related, environmental and health protection viewpoints.
- pressure-treated timber may not be used.
- copper may not be used as ducting material in horizontal or vertical piping trunks in the tap water system, either indoors or out. This does not apply to wet rooms and their connections within the apartment.
- galvanised materials in the external environment shall be surface-treated.
- use of newly extracted gravel and sand shall be minimised.
- recycled materials shall be used wherever it is indicated for environmental and health reasons, provided that it is technically and economically feasible.

Beddington, United Kingdom

This One Planet Living Principle considers reducing water demand, recycling water and managing rain and waste water sustainability.

The use of water efficient appliances (low flush WCs, spray taps, etc) at BedZED has reduced mains water to 92 litres per person/day compared with the United Kingdom average of 150 litres. These water efficient appliances can be fitted to any home.

BedZED's Green Water Treatment Plant (GWTP) was designed to clean all of the site's wastewater so that the 'Green Water' effluent could be reused to flush toilets and irrigate gardens, reducing mains water demand. This combined with rain water harvesting has saved another 15 litres of mains water per person / day. Rainwater harvesting has worked well, but the costs associated with operating and maintaining the GWTP could not justify its continued operation on a commercial basis. The plant also uses more energy than conventional sewerage and sewage treatment services. As such, the GWTP was decommissioned.

The following products are uses in the bathroom:

- 2 and 4 litre dual flush toilet (typical units are 9.5 litre / flush)
- Water saving shower – 14 litres / minutes (typical units are 20 litre / minute)
- Spray taps with self regulating flow restrictors – 7 litre / minutes (typical units are 20 litre / minute)
- "A" rated washing machine 39 litre / cycle (typical units are 100 litre / cycle).

The key strategies to support sustainable water use are to:

- always specify low flush toilets and low flow taps and showers (One Planet Products
- Collect and reuse rainwater (Rainwater Harvesting Association)
- Recycle and reuse greywater, either within the building)
- Use sustainable urban drainage systems (SUDS) to manage stormwater and create habitat (CIRIA offer SUDs advice)

Beddington, Sutton, London, United Kingdom, September 2008
(Wastewater treatment system)

Santa Monica

The amount of recycled water from the Santa Monica Urban Runoff and Recycling Facility (SMURRF) used in the city increased 35% to a total of 32 million gallons per year in 2007.[5]

RECOMMENDATION: RECYCLED WATER

For community and sports centre, adopt the principle that no potable use is to be utilised for use other than for potable purposes. This will require the investment of local harvesting, storage, treatment and recycling of water.

SUSTAINABLE TRANSPORT

As we have become more affluent, our demand for travel has increased. Over the last 30 years we have seen the growth of low cost airlines, and our love affair with the car remains undiminished. Yet all this comes at a cost to the environment and our health. As a society we need to change our attitudes to travel.

In heavy traffic jams, the air quality can be poorer inside the car than out. Car users suffer up to 3 times as much pollution as pedestrian.

To tackle the impact of climate change we need to use more sustainable modes of travel such as cycling, walking and using public transport.

Friendly Fuels

The City of Santa Monica has invested significant effort in the use of more friendly fuels in its fleet. 82% of the municipal fleet has successfully transitioned to alternative fuel and the 'Big Blue Bus' is almost 100%. Alternative fuels in use in the city include Liquid Natural Gas (LNG), Compressed Natural Gas (CNG), biodiesel, hydrogen, hybrid and electrical vehicles[5].

Electric car recharging station, City of Santa Monica Fleet Car, United States of America, August 2008

Liquified Natural Gas Big Blue Bus, Santa Monica, United States of America, August 2008

Malmo, Sweden

The Western Harbour in Malmo is planned to enable transport to operate in an environmentally compatible way. Buildings close together, good service and recreation opportunities are intended to make it easy for residents to choose environmentally compatible methods of transport.[6]

Biogas refuelling station with greenroof, Augustenborgs, Sweden, August 2008

Beddington, United Kingdom

Beddington, Sutton, London, United Kingdom, September 2008
(Electric car charging station)

Car Sharing (Eco-car pool), Augustenborg, Sweden

Environmentally interested residents can drive an eco-car. Augustenborg's residents have access to a car without owning it themselves. The benefits are:

- Membership in the eco-car pool for 300 kronor.
- Cars can be rented for 25 km/h between 8 am and 10pm.
- 24 hour car hire is 199 kr
- Weekend price is 350 kr

For members in Augustenborg's Eco-car pool, it is primarily important to have access to a car and not to own the car themselves. It is both cheaper and more environmentally friendly if several people can share car ownership and drive with less environmental damage. The cars in Augustenborg's Eco-car pool run on ethanol.

The Eco-car pool was set up by local residents with support from a number of partners including the City of Malmo's and Electric Cars in Skane. The Eco-car pool is a not-for-profit enterprise with about 30 members and space for more.

Most people use the cars for a couple of hours to run a few errands. It is important to plan in advance to book the cars in time. A quick swipe of the membership card is all that is needed to get the keys from the local shop before picking up the car and later returning it to one of the four parking spaces by the main square.

The ethanol powered cars run on petrol or ethanol which is available at the industrial estate in Augustenborg or at a petrol station at Valdermarsro. Each user must ensure that the car is full when returned.[10]

Car Pooling

Councils often set the example of sustainable transport within the community.

Footpaths

Ensure good maintenance program to encourage greater pedestrian use.

Buses

Real time bus information encourages bus patronage.

The entire Big Blue Bus public transport system operated by the City of Santa Monica is equipped with bike racks at the front of the vehicles, which are manually lowered by the bus driver for riders to park their bikes.

Bicycle carrier on front of bus, Santa Monica, United States of America, August 2008

Walking

Walking has declined over the past 20 years. The distance people walk on average has fallen by about one-third. Walking is the most natural mode of transport, and one that has the least impact on the environment. Yet from 1993 to 2003 the number of walking trips fell by 20%.

Walking is free, time reliable and great for improving health and fitness. 33% of staff live within 3.2 kilometres of their office, which is ideal for walking. Council employers are now providing initiatives such as walking maps, pedometers, travel awareness events and advertising, personal safety courses, footpath and lighting improvements to encourage greater participation in walking.

Between 1994 and 2004:

- The proportions of children walking to school in Sutton, United Kingdom declined from 61% to 53%.
- While the proportion being driven to school rose by 30% to 39%.

School Travel Plans aim to reduce the number of cars used to take children to school.

A count down facility at traffic lights has been found to assist pedestrians cross the road and make them feel safer walking in the community.

<u>Public Transport, Santa Monica, United States</u>

The City of Santa Monica offers incentives for bicycling as an alternative to car use, and is committed to regional transportation solutions, resulting in an increase in the Average Vehicle Ridership.

The entire Big Blue Bus public transport system operated by the City of Santa Monica is equipped with bike racks at the front of the vehicles, which are manually lowered by the bus driver for riders to park their bikes. In addition, more than 80% of the city's municipal fleet is fueled by alternative fuels[5].

The traffic and congestion remain significant issues and the current network of bicycle lanes and paths are inadequate. Initiatives such as bike valet service parked over 16,000 bikes in 2006 for free, thus reducing vehicle traffic and emissions while improving air quality and safety in pedestrian walk areas[5].

Stockholm, Sweden, August 2008
(Buses using tram ways)

Cycling

Bicycle racks at modal interchanges (ie buses) assists increasing bike riders and use of public transport provides choice of travel.

The Netherlands has one of the most comprehensive bicycle facilities networks in the world which is justified by the large user group with over 13 million bicycles. With the high cost of owning a car, registration, fuel and with limited parking facilities the demand for cycling is extremely high as an acceptable form of transport.

The high standard of off-road cycle paths combined with signalised crossings provides an impressive standard of safety at intersections in the bicycle networks. These networks are also supported by extensive bicycle storage facilities with many located at train stations.

With a 20DKK coin inserted into the bike's holder, a city-bike is released for personal use. The coin is refunded when the bike is returned to any of the special city-bike stands in the city.

Cycling in the late 19th and early 20th centuries was a popular and cheap way to travel. Today cycling has undergone a huge revival both as a leisure pursuit and as an effective alternative to the car. Cycling is quick, time reliable and free from the stress of parking and traffic jams.

Cycling is often the quickest way to cover distances of 3.2 to 8 kilometres. 31% of staff live within this distance of their office. Initiatives include free cycle training, bike pool, cycle buddy, bicycle loans and discounts, cycle mileage rates for business travel, cycle parking and shower facilities, journey planner and traveline.

Cycle ways in Copenhagen, Denmark, August 2008

Bicycle parking in urban square, Copenhagen, Denmark, August 2008

Overflow bicycle parking, Malmo, Sweden, August 2008

Vaxjo, Sweden, August 2008
(Shelter bicycle parking for student housing)

Vaxjo, Sweden, August 2008
(Shelter bicycle parking for student housing)

Vaxjo, Sweden, August 2008
(Shelter bicycle parking for railway station)

Stockholm, Sweden, August 2008
(Bicycle hire)

Stockholm, Sweden, August 2008
(Walking Trails)

Greenwich Millenium Village, London, United Kingdom, September 2008
(Bicycle store in apartment block)

Greenwich Millenium Village, London, United Kingdom, September 2008
(Shared path)

Sutton, London, United Kingdom, September 2008
(Bicycle path line marking)

London, United Kingdom, September 2008
(Copenhagen Bicycle Lane)

<u>Bo01 – City of Tomorrow, Malmo, Sweden</u>

Malmo has a network of pedestrian and cycle routes. Buses use environmental friendly fuels and the City's maintenance vehicles are powered by electricity.

<u>How to increase accessibility without increasing the use of private cars</u>

More cars create more noise, congestion, traffic accidents and traffic jams – all negative effects on people living and staying in cities. The aim is to achieve a better use of the existing infrastructure through Mobility Management and the activities should contribute to a higher use of alternatives to the car and thus a modal shift. It's important to change behaviours, not just attitudes.

Experience shows that better results are achieved by working with:[1]

- Changing behaviours rather than attitudes
- Concrete offers rather than attractive advertisements
- Communication rather than information
- Dialogue and targeting rather than large scale marketing.

It is always desirable to make the transport system cleaner, quieter, healthier and less consuming. Sustainable urban planning is important for an effective traffic system, with a focus on four different areas: car-traffic, walking and biking, goods traffic and public transport.

<u>Vastra Sjostad - Light rail link, ferries and carpool will reduce car usage</u>

Transportation imposes a heavy environmental burden in a densely built-up city district, which is why Sjostaden offers energy-saving and attractive alternatives to private car usage. The aim is for 80% of residents' and workers' journeys to be by public transport, on foot or by bicycle by the year 2010.

Substantial investments have been made in public transport in the area, both in the form of the new light rail link "Tvarbanan" and bus traffic. Public transport has a central route running through Sjostaden, with four stops along the avenue that connects one side of the city district to the other.

Sjostaden has ferry links. The ferry, which traffics Hammarby Sjo between the southern and northern sides of Sjostaden, is run by the City of Stockholm and is free to use. The ferry runs 365 days of the year from early in the morning to late at night.

A car pool open to both residents and workers was launched in the area. Around 10% of households have joined the carpool to date, and there are 25-35 carpool cars parked in the area, with the number varying according to demand. Around 75% of the cars are biofuel cars. The aim is for at least 15% of households and at least 5% of the Hammarby Sjostad workplaces to be signed up to the car pool by 2010.

The environmental goals for transportation in Hammarby Sjostad are:

- 80% of residents' and workers' journeys shall be public transport, on foot or by bicycle by the year 2010.
- At least 15% of the households in Hammarby Sjostad shall be signed up to the carpool by 2010.
- At least 5% of the area's workplaces shall be signed up to carpools by 2010.
- 100% of heavy transportation shall be by vehicles that meet current environmental zone requirements.

Smarter Travel Sutton, United Kingdom

Smarter Travel Sutton aims to reduce traffic congestion. This awareness raising project encourages people to use the most sustainable method of transport appropriate for their journey. It promotes walking, cycling, using public transport, car sharing and car clubs.

Sutton's workplace travel plan, United Kingdom

The travel plan is a five-year strategy which co-ordinates different staff travel policies and practices, and recommends key actions the council should consider to encourage the use of sustainable transport and improve travel choice.

The action plan encourages the council to install better facilities, promote and implement incentives, review car user allowances, consider car parking charges and fewer parking spaces.

Public Transport

Public transport is usually:

- Quick and easy
- Cheaper than owning and maintaining a car
- Less stressful than driving and free from parking worries.

Initiatives include journey planner, intranet, traveline and ticket loans.

Reduce the need to travel

To reduce congestion, we need to reduce the amount we travel as well as using sustainable transport.

Sutton Council supports a workforce that reflects the local community, sources products from local suppliers, encourages the use of email and telephone communication and promotes smarter working practices.

Responsible vehicle use

Sutton Council promotes greener driving with their driving safety policy. Initiatives include top ten tips on safer greener, stress-free driving on intranet. The council uses ethically sourced bio-diesel. 100 vehicles run on 5% bio-diesel and 40 more are being trialled on 30% bio-diesel. The council discourages staff from using vehicles with larger engines by only paying the lowest two cc band mileage allowance rates. The council supports car sharing and car clubs.

Smarter Travel Sutton – Sutton Council

In partnership with Sutton Council and Transport for London, Smarter Travel Sutton is a three year 5 million pound project aimed at encouraging people living, working and studying in the borough to use more sustainable forms of transport, such as walking, cycling and using public transport.

The scheme is part of the Mayor of London's strategy to reduce congestion across Greater London, and tackle the effects this has on the economy, society and the environment in the 21st Century.
45

The UK's greenhouse emissions from air transport rose 85% between 1990 and 2002. In the UK, flights have increased by 66% in the past 25 years. This is due to the emergence of low cost airlines, cheap flights, coupled with our insatiable desire to travel. If we continue to fly, passenger growth in the UK is expected to increase from 180 million passengers a year in 2000 to 501 million by the year 2030.

Using Public Transport

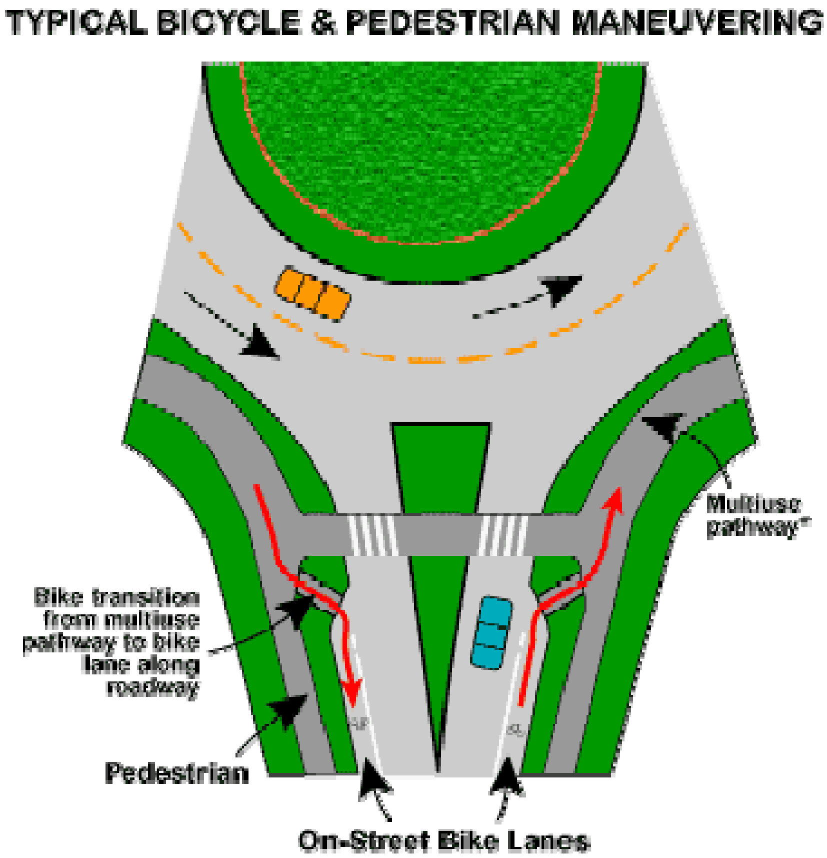
We need to increase the amount of journeys we make by public transport to reduce pollution and congestion on our roads.

"It's a Car-tastrophe"

Road traffic in England is expected to grow by 26% by 2010, 31% by 2015 and 40% by 2025 (on 2000 levels).

Milton Kenes – United Kingdom

Since 1970, the amount of car travel per head in Milton Keynes has almost tripled to ±12,000 kilometres per year (over 200 km per week). The plan for Milton Kenes forecast 45,000 peak hour car trips for a 250,000 population. Today, there are over 50,000 and this is set to increase to nearly 70,000 by 2008/09. Milton Kenes has many intersections without traffic lights and has been developed along the grid roads.



(Bicycle treatment at roundabouts)

RECOMMENDATION: SUSTAINABLE TRANSPORT

Provide higher status to sustainable transport modes such as walking, biking and public transport.

Local Governments should look to an electric fleet.

Encourage developers to implement a car share scheme as a requirement on large developments as a means to control parking and traffic congestion.

Advocate to the State Government for buses to be equipped with bike racks at the front of the vehicles.

Develop Walking Strategies at the local government level to increase the number of walking trips.

Provide shelters over major bicycle parking facilities.

OPEN SPACE

Santa Monica – United States of America

Airport Park and Euclid Park both opened in 2008 in Santa Monica. Together, they represent more than 8.3 acres of new and renovated park space. Airport Park is the first new park in Santa Monica since 1983. Santa Monica's open space system comprises 98 hectares of state beach and 26 community parks.

Airport Park, Santa Monica, United States of America, August 2008

Dog park, Airport Park, Santa Monica, United States of America, August 2008

Synthetic soccer pitches, Airport Park, Santa Monica, August 2008

Ekostaden Augustenborg – Sweden

The open stormwater management system in Ekostaden Augustenborg in Sweden has been an important factor in the design of the gardens. Both gardens and the park have been partly designed so that the stormwater can be diverted into open systems of ditches and wetlands. The open stormwater system in Ekostaden Augustenborg is designed to collect water from the gardens and the roofs of the houses into recipient canals and ditches.

All stormwater from the roofs and asphalt areas in Ekostaden Augustenborg is led into exciting channels that lead the water to an “amphitheatre” fitted with a permeable gravel bottom through which the majority of the rainwater can percolate. Many of the rooftops at the school are now green roofs.

Vastra Hamnen, Sweden – The BoO1 Area

Houses are built closer together as the ecological and sustainable principles have to use valuable ground space, efficiently. A green space factor system that has been applied ensures that not only the inner courtyards are green with plenty of vegetation and ponds – green roofs and climbing plants on the walls are also a part of the solution.

Stockholm, Sweden, August 2008
(Private open space)

Greenwich Millenium Village, London, United Kingdom, September 2008
(Private open space)

RECOMMENDATION: OPEN SPACE

Consider converting grass playing surfaces to synthetic where appropriate.

WASTE MANAGEMENT

There used to be rubbish chutes in the stairwells in Augustenborg Sweden multi-family houses from the 1950s. These are now closed and there are 15 new recycling houses for 1600 apartments.[10] The local composting and community waste separation system is the largest of its kind in Sweden.[10]

Recycling and composting[5]

For construction works, there are bins for the different waste streams that are recycled, and a composting machine for organic waste.

All residents have been provided with a container in which to collect organic waste and take it to the recycling house.

All residents have received detailed information about how the system works and how the different kinds of waste are recycled. The compost is used partly in the area and partly in maintenance and landscaping works elsewhere in the city.

There has been a major local campaign to involve residents in the development and use of the recycling and composting system, resulting in 75% of all waste going to recycling.[10]

Bo01 – City of Tomorrow, Malmo, Sweden

Household waste is separated into 9 fractions and construction and demolition waste is separated into 6 fractions. Waste is either recycled or used in energy production.

Vastra Hamnen- The Bo01 Area

The waste management system in the Bo01 area was developed with the aim to create a system that minimises the amount of waste, makes reuse and recycling possible and enables the use of waste and sewage as an energy source. Having waste separation units close to home is important. The inhabitants usually have a separation room in their house or close by, making it easy for them to sort paper and packaging materials. Food waste disposers are installed in sinks and a centralised vacuum waste chute system in neighbourhoods.

In the food waste disposer, the organic waste is grinded and disposed in separate pipes to a collector tank under ground. From there the sludge is taken to a biogas plant together with other organic waste. Through the anaerobic digester the organic waste is transformed to biogas that can be used as fuel in cars and buses or to produce heat and electricity.

Sutton Ecology Centre – Waste, United Kingdom

Litter is taken to landfill sites where it degrades, some of it taking a long time. While it is rotting, it produces gases, including carbon dioxide and methane – these are some of the very harmful greenhouse gases.

Recycling Sutton, United Kingdom

In the last 16 years, the amount that is recycled has increased 600% up from 3,980 tonnes in 1990/91 to 28,544 tonnes in 2006/07. Sutton households now recycle 31% of the waste they produce every year.

Across England, 25.5 million tonnes of household waste was collected in 2005/06. 26.7% of this waste was collected for recycling or composting.

Current United Kingdom recycling of paper, glass, plastics, aluminium and steel is estimated to save more than 18 million tonnes of carbon dioxide a year (that's equivalent to the annual use of 5 million cars).

- In 1990-91 - 5,000 tonnes of waste was recycled in Sutton
- In 1996-97 – 15,000 tonnes of waste was recycled in Sutton
- In 2006-07 - 27,000 tonnes of waste was recycled in Sutton.

Each year, about 100 million tonnes of waste is generated from households, commerce and industry. Each United Kingdom household produces over a tonne every year.

Locally bought produce requires less packaging for protection and freshness. Today many items are packaged in plastic, and plastic bags are only used once before being thrown away.

When waste is thrown away, it ends up in landfill, and releases methane as it rots. Methane is a powerful greenhouse gas, which adds to global warming. Landfill waste accounts for 40% of all United Kingdom's methane emissions.

Greenwich Council, United Kingdom

The 'Waste Hierarchy' is a step towards tackling waste disposal within the principles of sustainable development. Policies regarding waste should place an emphasis on those options at the top of the hierarchy. The waste management options are:

- Reduction
- Re-use
- Recovery, including recycling, composting and energy recovery
- Disposal.

The proportion of the Borough's municipal waste sent to landfill is about 30% compared with the London-wide rate of 73%. The Council is investigating the possibility of developing an anaerobic digestion facility in the Borough, which will enable a greater proportion of green and kitchen waste to be processed.

However the Council will also, through the review of its Waste Disposal Plan and Recycling Plan, seek to increase the use of the more sustainable options of waste reduction, reuse and recycling. The Council encourages waste reduction, reuse, recycling, and energy recovery – with waste disposal as a final option.

Waste is separated at source and recycled or used to produce heating and electricity

In Hammarby Sjostad in Sweden, there are three different levels of waste management:

Building-based separating at source:

- The heaviest and bulkiest waste is separated into fractions and deposited in different refuse chutes in or adjacent to the buildings, i.e.
    - Combustible waste – plastic, paper and other forms of non-packaging are placed in ordinary plastic bags.
    - Food waste is placed in bags made of corn starch which, unlike plastic bags, are biodegradable.
    - Newspapers, catalogues, paper, etc – left loose, not packed (not for the mobile automated waste disposal system).

Block-based recycling rooms:

- The types of waste that do not belong in the building-based refuse chutes can be left in block-based recycling rooms.
    - Glass, paper, plastic and metal packaging.
    - Bulky waste, i.e. old furniture.
    - Electrical and electronic waste. Items that require an electrical socket or batteries to function, as well as light bulbs, fluorescent tubes and low-energy light bulbs.
    - Some of the recycling rooms also have containers for textiles.

Area-based hazardous waste collection point:

- Waste that constitutes a danger to people and the environment, such as paint, varnish and glue residues, nail polish, solvents or cleaning agents, batteries and chemicals must never be placed in domestic waste or poured down the drain. It must be separated out and handed in at the hazardous waste collection point in GlashusEtt, the area's environmental information centre.

Where does the waste go?

- Combustible waste is transported to the Hogdalenverket plant in southern Stockholm where it is incinerated and recycled as heating and electricity.
- Food waste is transported to Sofielund in Huddinge where it is composted and turned into soil. The ultimate aim is for food waste to be converted into biogas and bio-fertilisers.
- Newspapers are delivered to paper recycling companies and then sent on to paper mills where they are turned into new paper.
- Packaging – paper, metal, glass and plastic packaging is recycled as new packaging or as other products.
- Bulky waste – metal is recycled, combustible bulky waste is incinerated and recycled as heating and electricity. Non-combustible waste is disposed of in landfill sites.
- Electrical and electronic waste is incinerated or recycled.

The automated waste disposal system reduces transports in the area

The waste collected in the mobile automated waste disposal system ends up in underground tanks that are emptied by a refuse collection vehicle equipped with a vacuum suction system. There are separated tanks for each fraction: combustible domestic waste and food waste.

All refuse chutes are linked by underground pipes to a central collection station to which they are carried by vacuum suction. The collection station houses an advanced control system that sends the various fractions to the right container. There is a large container for each fraction: combustible domestic waste, food waste and newspapers.

The systems reduce transports in the area, which means the air is kept cleaner than when traditional refuse collection techniques are employed. In addition, the work environment for the refuse collection workers is improved when heavy lifting is avoided.

The waste is separated into different chutes for the stationary system. The various fractions are then transported by vacuum to containers in a central collection station.

Augustenborgs, Sweden, August 2008
(Recycling station)

Augustenborgs, Sweden, August 2008
(Recycling station)

Augustenborgs, Sweden, August 2008
(Recycling station)

Stockholm, Sweden, August 2008
(Waste separation bins)

Stockholm, Sweden, August 2008
(Vacuum waste disposal chutes)

<u>Sweden - Sjostadsverket – wastewater treatment plant, evaluating new technology</u>

The wastewater that goes to the local wastewater treatment plant comes solely from housing in the area, and does not come from stormwater and industries. This means that the wastewater contains a minimum of contaminants, which makes it easier to treat and for the nutrients to be reclaimed.

<u>Biogas and biosolids extracted</u>

Organic material is separated out from the wastewater in the form of sludge at the wastewater treatment plant in Hammarby, Sweden. The sludge is carried to large digestion tanks, where it is digested. Biogas, which is the most environmentally friendly form of fuel currently available, is produced during the digestion process. The biogas produced is primarily used as vehicle fuel for inner city buses, garbage trucks and taxis. Biogas is also used in approximately 1,000 gas stoves in Hammarby Sjostad.

Once the digestion process is completed, the sludge – the biosolid – can be used as a fertiliser. The biosolid is nutritionally rich with a high phosphorus content, and is ideally suited for use as a fertiliser. It can be used on agricultural land and in the production of soil conditioners. Stockholm Water sends biosolids to northern Sweden, where they are used as filling material in mines that have been closed down.

Waste must be reduced and recycled

These days waste is no longer just waste. It is a resource that is being utilised more and more. New things are being produced from recycled materials, allowing us to be more economical with nature's resources. For example, food waste is placed in biodegradable bags made from corn starch, for composting.

The City of Stockholm's environmental goals for waste in Hammarby Sjostad are:

- Energy is to be extracted from 99% by weight of all domestic waste from which energy can be recovered, by 2010.
- The amount of domestic waste generated is to be reduced by at least 15% by weight, between 2005 and 2010.
- The amount of domestic bulky waste disposed of in landfill sites is to be reduced by 10% by weight, between 2005 and 2010.
- The amount of hazardous waste generated is to be reduced by 50% by weight, between 2005 and 2010.
- Residents are to be given the opportunity to separate their waste at source into the following fractions:
    - Materials with a producer responsibility, within the building.
    - Separated food waste and "refuse bags", within the building.
    - Bulky waste, within the building.
    - Hazardous waste, in the local area.
- By 2010, 80% of food waste by weight is to be handed in for biological treatment which utilises its component nutrients for plant cultivation and also utilises its energy content.
- A maximum of 60% (vehicle km) of waste transports and transportation of recycled materials within the area is to involve the use of heavy vehicles, in comparison with the amount transported using conventional waste management transportation.
- A maximum of 10% by weight of the total waste generated during the construction phase is to comprise waste that is disposed of in landfill sites.

RECOMMENDATION: WASTE MANAGEMENT

Provide separate bins in public spaces for the separation of waste.

Local Government to provide organic waste management on site for all community facilities.

BIBLIOGRAPHY

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3 “Environmental Program for the City of Malmo 2003 – 2008, A presentation”
4 “Catalogue of Best Practice Examples”, European Green Building Forum, April 2001
5 City of Santa Monica, “Sustainable Santa Monica – Sustainable City Report Card, Third Annual September 20, 2007
6 “Malmo - the climate conscious city, The valuable partnership”
7 “Fossil Fuel Free Vaxjo”, City of Vaxjo [14]
8 “A PPP, Public – Private Partnership (folder)”
9 “The Sandvik Plant – Everything you wanted to know but were to afraid to ask”, VEAB
10 “Ekostaden Augustenborg – the eco-neighbourhood”
11 “Green Roofs – Augustenborg’s Botanical Roof Garden”

APPENDIX A - ITINERY

MUNICIPAL ENGINEERING FOUNDATION
2008 VICTORIAN STUDY TOUR TO USA AND EUROPE
TRAVEL ITINERARY

Date	Itinerary
Thursday 14 August 2008	Depart **Melbourne** Arrive at **Los Angeles** Over night stay in **Los Angeles**
Friday 15 August 2008	Visit **Santa Monica** 10.00am – Meet & greet at Municipal offices 10.30am – Tour with Neal Shapiro (Urban Runoff Management Coordinator) 12.00noon – Lunch break 1.00pm – Tour with Shannon Parry (Sustainable City Coordinator) 3.30pm – Farwell presentation Over night stay in **Los Angeles**
Saturday 16 August 2008	Depart **Los Angeles** Stop at Denver Arrive at **New Orleans** 7.00am – 5.00pm APWEA Conference Registration Over night stay in **New Orleans**
Sunday 17 August 2008	APWEA Congress Over night stay in **New Orleans**
Monday 18 August 2008	APWEA Congress Over night stay in **New Orleans**
Tuesday 19 August 2008	APWEA Congress Over night stay in **New Orleans**
Wednesday 20 August 2008	APWEA Congress Over night stay in **New Orleans**
Thursday 21 August 2008	Tour New Orleans Over night stay in **New Orleans**
Friday 22 August 2008	Depart **New Orleans** Arrive in **Washington** Over night stay in **Washington**

Saturday 23 August 2008	Tour **Washington** Over night stay in **Washington**
Sunday 24 August 2008	Tour **Washington** Depart **Washington** Over night on flight
Monday 25 August 2008	Arrive in **Copenhagen** Tour **Copenhagen** Over night stay in **Copenhagen**
Tuesday 26 August 2008	Depart **Copenhagen** Arrive in **City of Malmo** 9.30am – Meet & greet at Municipal offices 10.00am – Bo01 tour 2.45pm – Botanical roof Garden visit Depart City of Malmo Arrive at **Copenhagen** Overnight stay at **Copenhagen**
Wednesday 27 August 2008	Depart **Copenhagen** Arrive in the **City of Vaxjo** 10.30am – Meet & greet at Municipal offices 11.00am – Greenest City in Europe tour (fossil fuel free Vaxjo) 1.30pm – City Planning - Modern Wooden City 2.15pm – Water Management 3.15pm – Visit re heating, cooling and power plant Over night stay in **Vaxjo**
Thursday 28 August 2008	Depart **Vaxjo** Arrive in **Alvesta** Depart **Alvesta** Arrive in **Stockholm** Over night stay in **Stockholm**
Friday 29 August 2008	Visit **Hammarby** 9.00am – Meet & greet at Municipal offices 1.00pm – 3.00pm – Tour of Environmental Information Centre

	Over night stay in **Stockholm**
Saturday 30 August 2008	Tour **Stockholm** Over night stay in **Stockholm**
Sunday 31 August 2008	Depart **Stockholm** Arrive in **London** Tour **London** Over night stay in **London**
Monday 1 September 2008	**London Borough of Greenwich** 9.00am – Meet & greet at Municipal offices 9.30am – Presentation from Council Town Planners 10.30am – Visit to Greenwich Millennium Village Over night stay in **London**
Tuesday 2 September 2008	**London Borough of Sutton** 8.50am – Arrive at Sutton 9.00am – Meet & greet at Municipal offices 9.30am – Presentation from Chris Reid, Executive Director for Sustainability 10.30am – Tour of various sustainable projects within Sutton including BedZed Over night stay in **London**
Wednesday 3 September 2008	**Milton Keynes** 9.05am – Arrive at Milton Keynes Central station 0.00am – Meet at City Discovery Centre 10.15 – Presentation on Milton Keynes and various developments 11.00am – Tour of Milton Keynes 12.00noon – Tour of Oxley Wood site with CDC and Wimpey Homes 1.00pm – Meet with Milton Keynes Council 3.57 – Depart from Milton Keynes Central station Over night stay in **London**
Thursday 4 September 2008	End of tour

APPENDIX B – STUDY TOUR PARTICIPANTS

AUSTRALIAN ENGINEERS STUDY TOUR
TO
USA, DENMARK, SWEDEN & UK
AUGUST 2008

OVERVIEW

Four Australian Local Government Engineers, and a tour leader from the State of Victoria, will be traveling as a group with the aim of visiting and learning from Local Authorities and related organizations in these countries. The group is particularly keen to gain an understanding of certain aspects of engineering service delivery in relation to the chosen study topics outlined below.

TOPICS

Justin Hinch	DEVELOPMENTS IN STORM WATER RE-USE PROGRAMS AND EFFECTS ON STORM WATER FROM CLIMATE CHANGE
Vicki Shelton	EFFECTS OF SEA LEVEL RISE ON FUTURE DEVELOPMENT AREAS AND EXISTING CIVIL INFRASTRUCTURE
Nick Mazzarella	ENVIRONMENTAL SUSTAINABLE DESIGN (ESD) TO ACHIEVE CARBON NEUTRAL TARGETS (ie microgeneration and cogeneration)
Michael Ellis	MIMIMISE THE IMPACT ON CLIMATE CHANGE OF NEW DEVELOPMENTS
Robert Ward	TOUR LEADER, MUNICIPAL ENGINEERS FOUNDATION VICTORIA.

ISSUES WE WOULD LIKE TO DISCUSS

- Overview of your organization to establish relative size/complexity of services, assets, budgets and issues compared to our Councils and the Victorian government sector.
- Responsibility of the organization relating to infrastructure assets i.e. split between other levels of government and the private sector.
- Trends and any other contextual issues (e.g. restructuring, reforms, legislation, industry or demographic pressures).
- Specific processes in place for managing infrastructure assets.

- Initiatives developed and implemented to address the various study areas listed above.

These will have particular focus for each study topic.

We are seeking time of the appropriate member of your organization to provide us with information of your organization's experience related to the study topics. We anticipate this will take about half a day.

We will be organising all our own travel and accommodation requirements.

TOUR PARTICIPANTS

<u>Justin Hinch</u>	**Design Engineer, Assets & Development, Horsham Rural City Council**
STUDY TOPIC	DEVELOPMENTS IN STORM WATER RE-USE PROGRAMS AND EFFECTS ON STORM WATER FROM CLIMATE CHANGE

- To find stormwater re-use initiatives that provide alternative water sources for various municipal and community functions.
- To define the technologies and methods used in the storage, treatment and delivery involved for re-used stormwater.
- To identify stormwater re-use management plans.
- Ascertain climate change effects on stormwater re-use programs and management plans.

<u>Vicki Shelton</u>	**Coordinator-Roads & Drainage Infrastructure. City of Greater Geelong.**
STUDY TOPIC	EFFECTS OF SEA LEVEL RISE ON FUTURE DEVELOPMENT AREAS AND EXISTING CIVIL INFRASTRUCTURE

- To observe and seek information from other municipalities and authorities on how they are currently managing sea level rise in relation to their existing and future stormwater management systems.
- Determine how the City can plan for new residential development and manage existing developments whilst mitigating the impact of combined stormwater flooding and sea level rise events.
- Assess different construction methods and materials used in these environments.
- Plan for and manage flood events due to more intensive storms and possible combined storm surges.

<u>Nick Mazzarella</u>	**Manager Major Projects and Activity Centres, City of Darebin.**
STUDY TOPIC	ENVIRONMENTAL SUSTAINABLE DESIGN (ESD) TO ACHIEVE CARBON NEUTRAL TARGETS (ie microgeneration and cogeneration)

- Investigate ESD practices used in community facilities to achieve carbon neutral targets. In particular, water recycling, microgeneration cogeneration and heat recovery practices.
- Seek examples of ESD using microgeneration and cogeneration in public facilities / buildings to reduce carbon footprint.
- To assess actual performance results of examples of ESD initiatives used in municipal facilities.
- Proven cases are sought to validate the numerous environmental and economic issues behind ESD initiatives.
- Investigate large scale water recycling schemes in urban settings that have benefits to community facilities.

<u>**Michael Ellis**</u> **General Manager Assets & Services, Cardinia Shire Council.**

STUDY TOPIC MIMIMISE THE IMPACT ON CLIMATE CHANGE OF NEW DEVELOPMENTS

- To learn from model developments overseas that focus on ecological sustainability a means of minimizing the impact of City development on climate change.
- Study integrated environmental solutions for developing areas that minimize energy consumption, greenhouse emissions, water consumption and waste production.
- Consider the implementation of performance measures and mitigation strategies to achieve healthy cities. Understand the roles and responsibilities of key stakeholders and methods of community engagement.

LOCAL GOVERNMENT IN THE STATE OF VICTORIA, AUSTRALIA.

Australia has a three-tiered system of Government:

<u>1. Australian Federal Government</u>
Responsible for matters such as defence, immigration and national significant roads linking capital cities. Raises income via taxes on private and company incomes, import/export duties, fuel excise and a 10% GST (VAT).

<u>2. State and Territory Governments. (Victoria is one of eight)</u>
Responsible for matters such as health, education, police and significant State roads linking population centers. Raises income via sales tax/stamp duties on property sales and fees for various services. The Federal Government allocates funds to State Departments some of which is apportioned to Local Governments. Most State owned income generating businesses (electricity, gas) were privatized or corporatised (ie water supply) in the 1990's.

<u>3. Local Government. (Victoria has 79 Local Government Authorities)</u>
Responsible for matters such as such as aged & children's care in homes, local land use planning, building regulation, local infrastructure and local roads. Income is via property rates, fees for service and other levels of government.

OUR COUNCILS AND CONTACT DETAILS

Name of Council	Setting	Population	Area (sq km)	Developed
Horsham Rural City – Justin Hinch www.hrcc.vic.gov.au justin.hinch@hrcc.vic.gov.auCity of	Rural	19,000	4263	5%
Greater Geelong – Vicki Shelton www.geelongaustralia.com.au vshelton@geelongcity.vic.gov.au	Major Regional City	206,000	1245	35%
Darebin City Council – Nick Mazzarella www.darebin.vic.gov.au nick.mazzarella@darebin.vic.gov.auCardinia	Inner Urban	130,000	55	95%
Shire Council – Michael Ellis www.cardinia.vic.gov.au m.ellis@Cardinia.vic.gov.au	Interface Metro/ Rural	60,000	1280	10%

MAP INFORMATION

Australia

60 miles	120 miles	180 miles	240 miles	300 miles	360 miles	420 miles	480 miles
100 kms	200 kms	300 kms	400 kms	500 kms	600 kms	700 kms	800 kms

A - Horsham Rural City Council - **Justin Hinch, Design Engineer, Assets & Development**
B - City of Greater Geelong - **Vicki Shelton, Coordinator-Roads & Drainage Infrastructure**
C - City of Darebin - **Nick Mazzarella, Manager Major Projects and Activity Centres**
D - Cardinia Shire Council – **Michael Ellis, General Manager Assets & Services**