VI. ENERGY SAVINGS IN THE PUBLIC SECTOR

A. Public Sector Energy Use

In many countries government authorities are responsible for a range of public services such as infrastructure provision including harbours, airports, roads, water supply, power generation, street lighting, waste disposal and sewerage. Other services include health and education services, public administration and social services. Many of these state or city-owned public services are heavy users of energy.

Public sector agencies are generally accountable to the public through a Council or a Parliament in a way that private sector agencies are not. The public generally expects the public sector to set an example to the community in the efficient use of public funds. Energy savings are an important aspect of this. As the public sector often generates power, supply side efficiency is as important as demand efficiency.

Figure 6.1: Energy use in the public sector is extremely diverse as illustrated in this figure.

The major areas of energy use in the public sector depend on the local situation and the responsibilities of that sector in the national scheme of government which are generally:

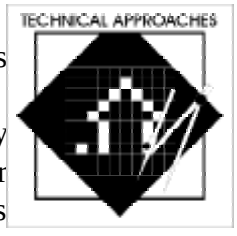
- Lighting – particularly of public areas
- Heating and cooling of buildings
- Public transport
- Construction of roads and buildings
- Sewage treatment and waste disposal
- Management of reserves and public facilities

These issues will be addressed in this Chapter although they are also covered in a different context in other Chapters.

B. Strategies for Saving Energy in the Public Sector

Although energy bills only represent about 1-2% of a local Council's budget (ICLEI, Finance Department), Councils have an enormous capacity to influence energy efficiency on a local scale, and perhaps most importantly set an example to business and the community on the issue. Local governments can influence up to 50% of local greenhouse gas emissions through direct emissions from waste or in the more general urban planning issues of transport and energy efficiency.

1. Technical Strategies



Governments are responsible for most infrastructure provision and considerable savings can be achieved by:

- Choosing materials with low embodied energy. Embodied energy is the energy consumed by all of the processes associated with the production of buildings or infrastructure, from the acquisition of natural resources to product delivery. This includes the mining and manufacturing of materials and equipment, the transport of the materials and the administrative functions
- Installing energy-efficient technologies
- Using local renewable energy supplies (see Chapter 7 for more options)

Water Supply and Sewerage

Large amounts of energy and resources are incorporated into conventional water supply and sewerage infrastructure. Embodied energy needs to be considered at the planning stage. Savings can made pumping water by adopting strategies such using high-efficiency motors and pumping to the minimum pressure required. Other tips can be found in *Managing Energy in Local Government*.

In sewage treatment pumping is also a significant energy user along with the aeration process. Energy savings can be achieved in the aeration process by controlling the operation of the aeration fan through the use of dissolved oxygen sensors, reducing the pressure drop of air pipes and employing high-efficiency motors.

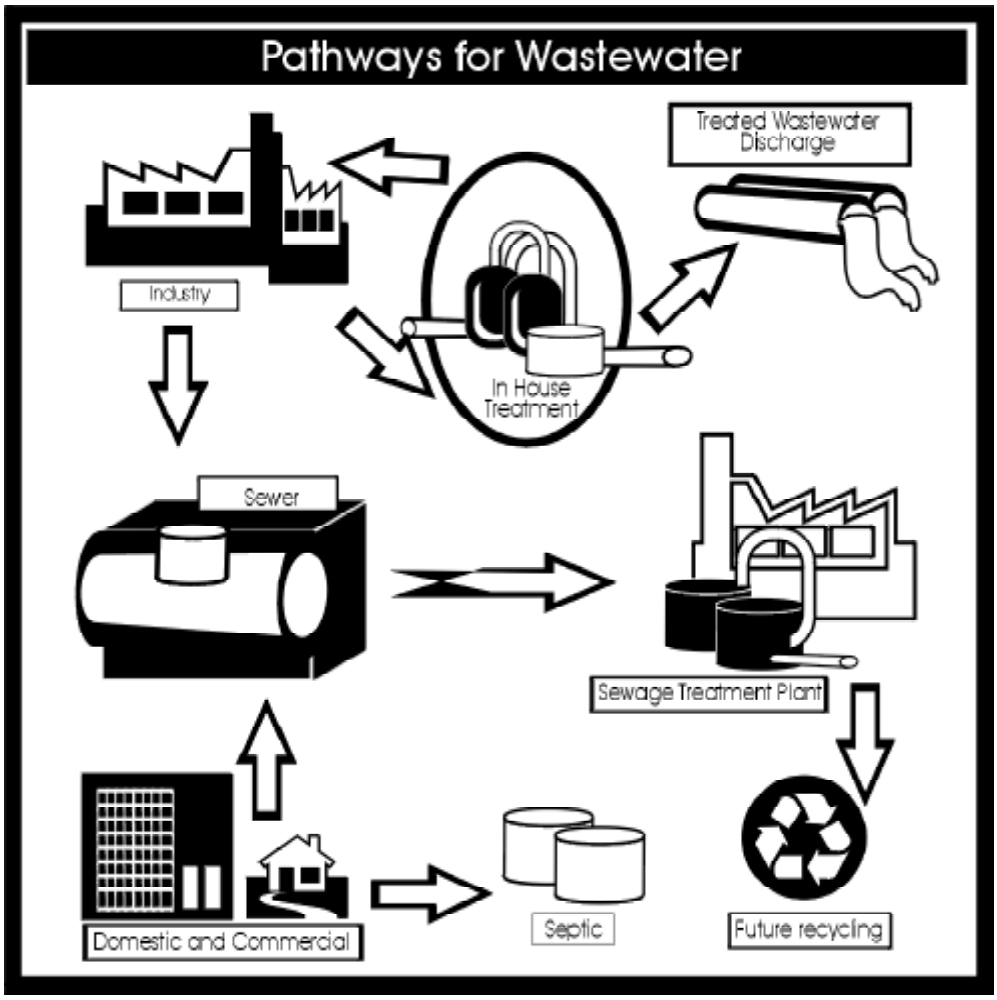


Figure 6.2: The options for the disposal of wastewater are varied as illustrated in this figure.

An alternative approach to the treatment of sewage is a constructed wetland system. In a report by Fujita Research on *Constructed Wetlands for Wastewater Treatment (Report 022)* it is stated that, "it is now recognized that constructed wetlands are an economic way of treating liquid effluent." The report points out that constructed wetlands are not widely used in developing, tropical countries which is the very environment in which such wetlands perform best as the continuous growing season means that the wetland biomass can also be harvested. These constructed wetlands can form an integrated part of the food production system in such climates. Water that has flowed through the wetland can be used to irrigate crops and/or be introduced to a fishpond. In this final stage, remaining nitrates and phosphates stimulate the growth of phytoplankton - the favorite food of the Tilapia (Oriochromis niloticus L.), a food fish becoming increasingly popular in Europe.

A US AID project is testing the development of Integrated Wetland Systems. See Case Study 45.

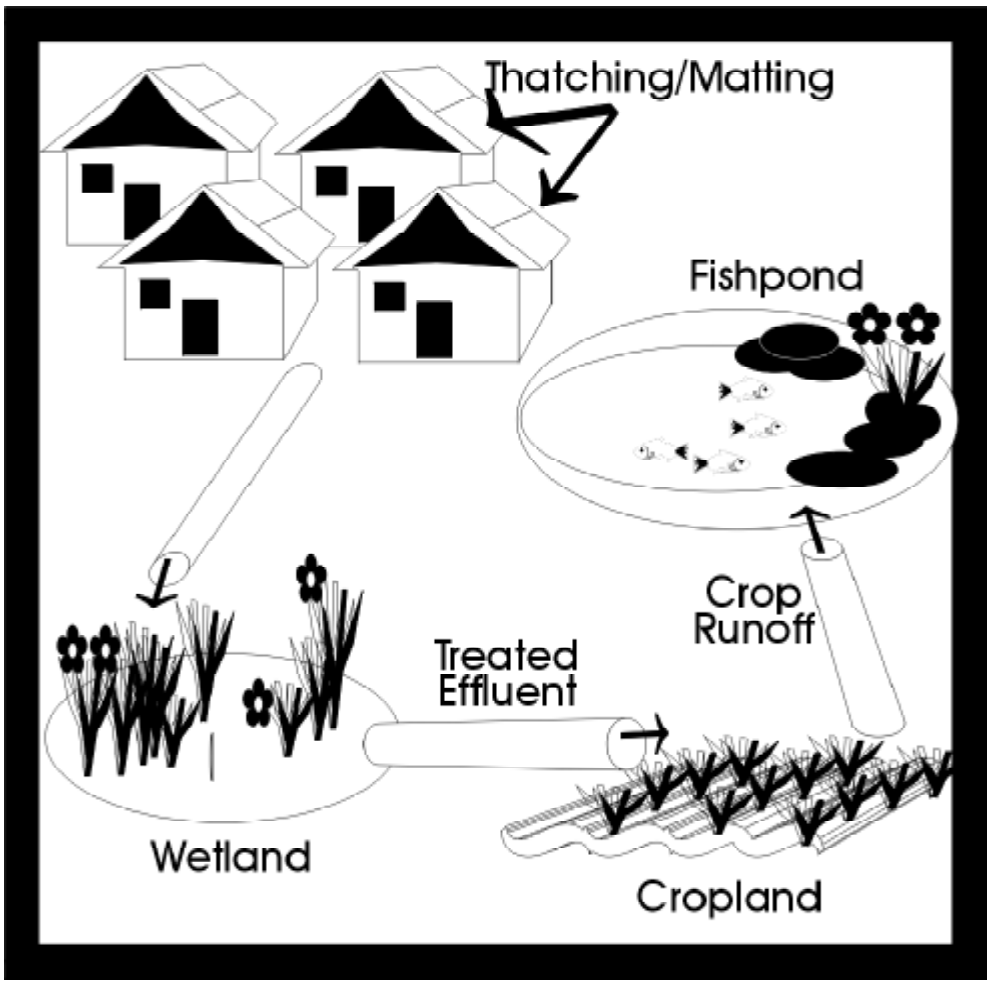


Figure 6.3: Wetlands Integrated Within a Village Food Production Cycle

Significant energy savings can also be made by using energy derived from sewage facilities to run the plants and to supply local industry (see Chapter 7 for more details on supply options).

Waste Management

Most local government authorities manage solid waste disposal facilities and much of this waste has value as recyclable resources or as a source of energy and soil conditioners. There are many different waste to energy schemes in operation or under consideration. This is a form of cogeneration which can yield considerable savings as well as social and environmental benefits. Some examples of this are provided in Chapter 7.

Street Lighting

Street lighting can be the most energy intensive service that local Councils provide and so there is significant scope for cost and energy savings by improving light efficiency. A 1999 Study by Energy Efficiency Victoria and the Sustainable Energy Development Authority found that the quality of street lighting could be improved considerably and energy consumption at least halved, by a combination of:

- More efficient lamps eg. metal halide, compact/tubular fluorescent
- More efficient luminaries which incorporates reflector design, reduced light loss in the diffuser and more accurate light distribution
- Efficient ballasts such as 'low loss' or electronic ballasts
- More accurate control of lighting times eg. by using an electronic photo-switch

See Case Study 46.

The Efficient Lighting Initiative (ELI) as mentioned previously aims to speed up the uptake of energy-efficient lighting technologies in emerging markets in developing countries. ELI is designed to lower market barriers to efficient lighting in Argentina, the Czech Republic, Hungary, Latvia, Peru, the Philippines and South Africa through a set of multi-country initiatives, local and global partnerships, and interventions suited to individual country conditions. ELI aims to motivate the government/public sector to carry out the retrofitting of street lamps to more energy-efficient versions. In the Philippines governments are being encouraged to install high-pressure sodium (HPS) lamps for street lighting, replacing the conventional mercury vapour lamps.

The electricity used to operate traffic signals has risen steadily with the growth in urban populations and motorised transport. Traffic signals are usually on 24 hours a day and the older technology normally uses high-intensity low-efficiency incandescent lamps with coloured lenses that further reduce the lamps efficiency. For traffic signals ELI's proposed specification is technology specific, specifying that to qualify for inclusion in ELI programs traffic signal systems must use light emitting diode (LED) - based products for at least the red signal. Traffic signals LEDs are energy efficient, durable and give out coloured light, removing the need for coloured lenses.

Building Design, Insulation and Air Conditioning

Significant energy savings can be achieved by careful building design or by retrofitting existing buildings. The AGO recommends that the single most important strategy in reducing the impact of embodied energy is to design long life, durable and adaptable buildings. Many of the ideas discussed previously can be applied to public buildings. Retrofitting is typically more difficult and expensive than building an energy efficient building in the first place.

Since most Council buildings have relatively long occupancy hours and aim to provide a high standard of comfort, it makes sense to incorporate a high standard of insulation into all Council buildings The smaller the building, the more energy insulation will save. More than 60% of energy use in office buildings results from heating, cooling and ventilation.

Reverse cycle air conditioners are an energy efficient heating option for small offices, however on a larger scale this may not be the case. Opportunities for savings include: ensuring the system is maintained properly for example checking thermostat setting, sealing off air leaks around doors and windows. Blinds can be used as an aid to insulation. In the winter, closing blinds at the end of the day or on a cold winter's day, cuts down on heat loss.

See a series of short retrofitting examples in Case Study 47 and an example of electrical energy savings in a municipal building in Ghana as described in Case Study 48.

Interior Lighting

Numerous strategies are available for reducing energy from indoor lighting, many of which have been mentioned before in Chapter 2. These include:

1. Operate lights only when required - most Councils practice this policy, however it is doubtful that 'turning off' is practiced all the time. Occupancy sensors – which do not cost much and are mounted near doorways sense when a room is empty and automatically turn off the lights.

2. Use of an efficient light source.
   Increasing daylight levels can reduce electrical lighting loads by up to 70%, providing that artificial lighting is controlled. Skylights are cost effective and improve user satisfaction within the workplace.

   Compact fluorescent lights are more expensive but will reduce lighting bills by up to 80%. A standard 36-watt fluorescent lamp costs about $2 to buy, but about 10 times this to operate in a building for just one year. In addition it has a shorter life, lower efficiency and poorer light colour and quicker performance degradation than a compact fluorescent. Traditional recessed fluorescent lamp fittings with acrylic plastic diffusers deliver about 50% of the light produced by the lamps.

4. Lighting systems require regular maintenance. There is a tendency to keep fluorescent lamps until they are no longer of use, by then they could be producing only a third of what they produce when new. Regular maintenance programs including cleaning of windows enables the following advantages:
   - light quality of the built environment is maintained
   - tendency to add more light fittings because of falling light levels will be avoided
   - bulk lamp replacement facilitates recycling through a special lamp crusher. Lamps that are replaced individually end up as landfill where the mercury they contain contributes to environmental contamination

5. 'Light' furnishings - Light coloured walls, ceilings and furnishings reflect more light to working areas and so need less artificial lighting to achieve required luminance. The walls in many government offices are painted white for this reason.

Office Equipment

Whilst computers and associated equipment are a smaller contribution to energy use, energy efficiency in this area will produce substantial savings. Energy use can be influenced through:

- specifications established for new equipment
- the extent to which energy saving features are utilised

Purchasing policies are important. "Energy Star" is an international standard for energy efficient equipment and can reduce energy consumption of individual products by over 50%. Printers and fax machines in this category can cut electricity use by over 65%, thus saving around $20 per unit per year in electrical costs. However, energy features do need to be installed and used, for savings to be realized. 'Sleep mode' is one of these features, 'Screen savers' do not save electricity (Energy Smart Schools *Computer Related Equipment*). All electrical equipment should be turned off overnight or when it is not required on a regular basis.

In addition there are a number of other considerations when purchasing equipment. With photocopiers it is worth comparing the rated volume with actual copying volume before purchase in order to minimise wasted energy arising from the idle times. Considering different 'styles' of equipment such as laptop computers which run on $1/10^{th}$ the energy required by desktop PC's. The extra cost of machines can be recovered very quickly through energy savings.

Kitchen Equipment and Hot Water Systems

Fridge location and maintenance are important in managing energy usage. In addition buying the right size fridge to suit needs and checking the energy labelling is important. Lower initial cost may not equate to ongoing low cost if the energy efficiency is low.

Figure 6.4: The electricity used by a two-door fridge may generate up to 1.5 tonnes of greenhouse gas and cost up to $180 per year.

The installation of a solar hot water system with a booster may reduce hot water energy usage. Every 200L of hot water used from an electric water heater uses about 6 kWh of electricity and generates about ten kilograms of greenhouse gases. Reducing heat losses from an electric storage water heater by wrapping the tank with extra insulation may save up to half a tonne of greenhouse gases and save $60 per year. In addition, many boiling water units are oversized. In most cases a five-litre unit is adequate, as it can supply 40 cups of hot water and recover temperature in a few minutes. Communal hot water systems should not be left on for 24 hours and over weekends.

Installing a timer, so that hot water systems are turned on early in the morning and off in the evening would result in reduced electricity consumption and will repay the cost of purchase quite quickly.

Streetscaping and Urban Forestry

As mentioned in Chapter 2, cities tend to heat up because of extensive heat-absorbing surfaces. Asphalt, concrete, and other building materials are very effective at absorbing light and reradiating it as infrared radiation (heat) that increases the temperature of the air. In turn this makes air conditioning systems work harder, even after sunset.

NASA scientists have found as part of the Urban Heat Island Pilot Project carried out in the 1990s that the evaporation of water absorbs a lot of heat. Plants and trees evaporate large quantities of water from their leaves. The energy needed to evaporate water is drawn from the air and from the sunlight intercepted by the leaves, thus cooling the air. Additionally, trees are very effective in shading the ground and so reduce the heating of the surface by sunlight.

Not only can people plant trees on their own properties but Councils can contribute by appropriate tree plantings along streets and public places. Trees can be used to shade buildings and pedestrian areas thus reducing the heat island effect. This could be combined with urban forestry programs which would have the added bonus of cutting transportation costs for timber.

The City of Toronto has initiated a Cool Toronto Project - Toronto's Urban Heat Island Mitigation and Adaptation Project. "Cities can be cooled by strategically placed vegetated areas.

Trees and other vegetation can shade buildings, pavements, parking lots and roofs, and naturally cool a city by releasing moisture into the air through evapotranspiration.

By protecting buildings from wind, trees can reduce heating costs in winter, and through direct shading and evaporative cooling, can contribute to reductions in air conditioning use in summer.

The use of reflective surfaces such as light-coloured roofs, roads, and parking lots are another way to cool cities. Light-coloured surfaces reflect rather than absorb heat. The more solar radiation a surface absorbs, the hotter it gets. The more radiation it reflects, the cooler it stays, and cooler surfaces can be achieved with little or no additional costs.

Strategically placed vegetation and the use of reflective surfaces will not only help cool cities during summer months, but also lower energy bills by reducing energy use (a hot roof translates into much higher air conditioning costs). This in turn reduces greenhouse gas emissions and ultimately improves air quality."

A couple of rooftop garden projects are described in Case Study 49.

2. Educational Strategies

As mentioned in previous Chapters, education strategies can be implemented to inform government employees of ways to save energy in their departmental practices and adopt energy-saving behaviours in their travel to work and their use of office equipment.

Informing Government Employees

In government workplaces ,there are numerous opportunities for saving energy. For example, the following measures could be taken to save energy in the office;

- Inkjet printers can be used for draft printing. Whilst laser printers produce higher quality images they use 5 – 10 times more energy when printing and idling.

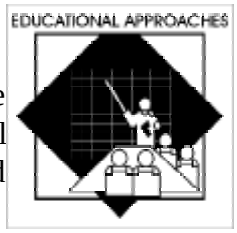
- Turning a photocopier off when not in use reduces its annual electricity use by over 60%, which equates to approx $90 per year . Making sure that computers, printers, fax machines and photocopiers are turned off at the power point during extended inactive periods of time can further reduce electrical consumption.

See Case Study 50 about an Employee Education Program in Saskatchewan, Canada.

Reporting Successes

Another way to motivate changes in behaviour and practices can be by publicising and/or recognising best-practice or innovative projects. See City Energy Challenge Case Study 51

3. Regulatory, Policy and Planning Strategies



Energy Management Programs

Governments can save energy by careful planning. A popular approach is the development of an Energy Management Program which is often tied to some financial package (See Section 4.). Energy Audits, which identify energy usage patterns and ways to save energy, are usually a part of this process. See Case Study 52

Life-cycle Costing Analysis

Life-cycle costing is an accounting tool that cities and counties can use as part of decision making and energy planning. This method of economic analysis involves basing buying decisions not just on a product's purchase price, but also on the cost of operating the item during its projected life span. Often life-cycle cost analysis (LCCA) can identify energy-efficient items that are actually more cost effective than are less efficient products with a lower initial cost.

As LCCA considers inputs that might otherwise be ignored, it gives decision makers a full and complete assessment of the costs of using a particular item. Examples of inputs that LCCA examines include annual maintenance and energy costs, fuel price escalation and inflation, periodic equipment replacement costs, salvage or disposal costs, and useful economic life. Therefore, by using life-cycle cost analysis, cities and counties can make more informed choices about the allocation of scarce resources. See Case Study 53.

Policies/Regulations for Government Buildings

Governments can set high standards for the construction of their own buildings to reduce costs and greenhouse emissions. In this way they can provide demonstrations of energy-efficient buildings thereby providing leadership in innovative building design to the domestic, industrial and commercial sectors and stimulating private sector research and development.

Equipment and Materials Procurement Policies

Some State and Local Governments have adopted policies or regulations encouraging or requiring their departments to buy energy-efficient appliances and environmentally-sound materials such as recycled paper. See Case Study 54.

The Cities for Climate Protection Program

International programs such as Cities for Climate Protection (CCP) encourage local councils to take greenhouse action in those areas over which they have direct control, and in more difficult areas such as urban planning where there is a need for local, state and urban cooperation.

The Cities for Climate Protection (CCP) is a course of action for local governments to follow, with the overall goal of reducing greenhouse emissions and air pollution with the added benefit of improving community livability. Those councils that become part of the CCP program aim to achieve the following objectives (ICLEI *Cities for Climate Protection*):

1. Establishment of an inventory and identification of key sources of greenhouse emissions in the council and community
2. Setting of an emissions reduction goal – for the achievement of an emissions reduction target
3. Development and adoption of a local greenhouse action plan to achieve these reductions - the policies and measures to achieve the emissions goal
4. Implementation of the local greenhouse action plan
5. Monitoring and reporting on greenhouse emissions and actions and measures

See Chapter 9 for further information about this program.

Vehicle Fleet Purchasing Policies

Councils can implement purchasing policies for their vehicle fleets to ensure that vehicles are only purchased if they are really necessary and more fuel-efficient or alternative fuel vehicles are purchased or substituted for existing vehicles. Purchasing policies have been adopted in place such as Denver, USA, Helsinki Metropolitan Area, and Seattle, USA. For more information see Action 2.1 in *Local Government Greenhouse Reduction Measures Research Project*.

Some Councils such as in Utah, USA and Manningham, Victoria, Australia, have implemented a bicycle fleet program providing council staff with bicycles to use on the job such as to go to meetings, to go to lunch or to link up with public transport. These fleets could be electric bicycles which would be more suitable for rangers and parking inspectors who have to cover larger distances. See Actions 2.15 and 2.20 in *Local Government Greenhouse Reduction Measures Research Project*.

3. Economic Measures

Many financial measures are available which can support and encourage energy-conservation programs. They include:

- Subsidies from National or State Government to municipal governments to implement energy programs. See Case Study 55.
- Performance Contracting which enables savings to pay for ongoing energy efficiency investments - see Case Study 56.
- Matching Grants linked with Energy Management Programs - see Case Study 57.

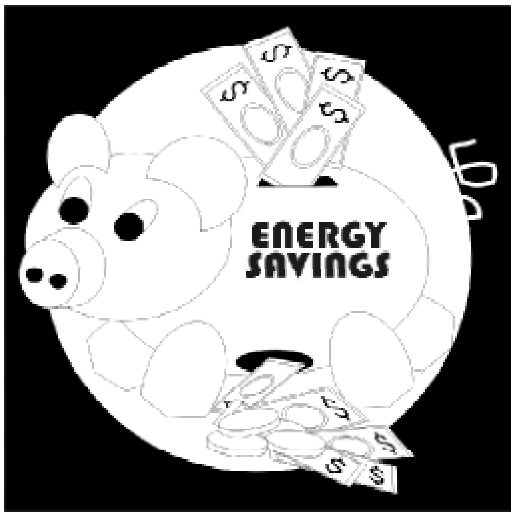


Figure 6.5: Energy banks, like piggy banks can generate savings. See Case Study 58.

4. Combined Approaches

Some Governments have initiated a range of different energy saving programs which include a combination of technical, educational, economic and regulatory strategies.

D. References and Resources

Australian Municipal Energy Improvement Facility
http://www.ncc.nsw.gov.au/environ/ameif/

CADDET Energy Efficiency. http://caddet-ee.org/

Cities for Climate Protection. http://www.iclei.org/ccp/

Saving Energy with Daylighting Systems: Maxi Brochure 14
http://www.caddet-ee.org/brochures/display.php?id=1100

Urban trees in arid landscapes: Multipurpose urban forestry for local needs in developing countries by Guido Kuchelmeister (1997) http://ag.arizona.edu/OALS/ALN/aln42/kuchelmeister.html#addl

Rooftop gardens http://www.cityfarmer.org/rooftop59.html#rooftop