Energy demand information:

Residential	Industry and commerce	Transport
Energy-use profile for different groups and areas; Electricity connections; Energy use & expenditure; End-use patterns[1]; Prices.	Employment and energy use by sector; Relative energy intensity (energy used per unit of production).	Modal split; Trip length and time; Cost and subsidies; Energy use and emissions by mode.

Local authority	Energy demand projections	CO_2 equivalent* emissions
Energy use, cost and emissions by energy source and sector: buildings, streetlights, water supply, vehicle fleet, solid waste, sewerage treatment.	Current growth rates in energy consumption from all sectors; Estimates of use at a future target date.	Calculate the CO_2 equivalent for each sector, sub-sector and overall.

*This is a way of standardising the measurement of all GHGs. The CACP software (see box below) can be used to convert emissions to CO_2e and to track emissions and reductions of GHGs.

Energy supply information:

All supply to the city	Energy sources	Energy source ownership and distribution
Coal, liquid fuels, natural gas, electricity, renewables.	Electricity generation sources: coal, nuclear, hydro, renewables.	Who owns/ is responsible for what energy source; Who is responsible for distribution?

Solid waste	Sewage	
Tonnes of waste generated and dumped; State of city's landfill sites.	Millions of litres per day.	

Clean Air and Climate Protection

ICLEI and the National Association of Clean Air Agencies, NACAA (formerly STAPPA and ALAPCO), have joined forces to build a software product to help state and local governments develop harmonised strategies to combat global warming and local air pollution. The **Clean Air and Climate Protection (CACP)** software tracks emissions and reductions of GHGs (carbon dioxide, methane and nitrous oxide) and air pollutants (nitrous oxide, sulfur oxide, carbon monoxide, volatile organic compounds and particulate matter) associated with electricity and fuel use and waste disposal. This tool can help cities to:

- Create emissions inventories for the community as a whole or for the government's internal operations.
- Quantify the effect of existing and proposed emissions reduction measures.
- Predict future emissions levels.
- Set reduction targets and track progress towards meeting those goals.
- The software contains thousands of emission factors that are used to calculate emissions based on simple fuel and energy use data, or by using information on waste disposal.

CCP participants and members of NACAA can use the CACP tool by visiting www.cacpsoftware.org

Summaries of the information will give you an overview of energy demand and supply. Each of these urban centres will require very different strategies to address their needs.

Energy projects

Identify current energy projects across all sectors, who is responsible for them and the stage that they are at.

Finding the information

These questions will help you find the information you need.

- Do the social welfare, housing, health or air quality departments collect information on energy use?
- Who else is interested in this information?
- Who pays for or taxes the resource?
- Who manages or plans the resource?

[1] End-use patterns refer to the energy used for specific services (or end uses) such as lighting, space heating, cooking. Separating this income group can also be very useful as it will help you identify what energy-efficiency projects you need where – such as time-of-use tariffs to encourage big energy users to save, ceilings in low-income houses and solar water heater bylaws in higher income areas.

Some tips:

When making estimates, be explicit about your sources and the assumptions you are making. Tend towards too much information rather than too little. Consider constantly the accuracy of your data: find out how the data was generated, examine the methodology. Try to gather data from a range of sources to improve its accuracy.

Don't be afraid to ask questions about the data you are getting – how the information is collected? who collected it and for what reason? is the data projected from a small dataset? how accurate they think the data is?

Gather facts and anecdotes that make the information real to city leaders and the community:
how much does a household spend on home energy use? how much on transport? what proportion is this of their household income? what perceptions do people have of different energy sources? how does this affect their energy use? how much local air pollution is caused by energy use?

Look for opportunities to piggy-back your energy questions on surveys that are being carried out by other departments or external organisations.

No time for a lengthy energy audit?

At a minimum you need to know the kinds and quantities of energy used in you city, a breakdown of the big energy users and some idea of who is using what – a quick survey of households can give you a picture of what energy sources poor households are using and how much energy is costing them.

Case Study 5

CCP: Using Milestone 1 to conduct a baseline emission inventory for your city

ICLEI, USA

Understanding how and where energy inputs are used within a city, in relation to the level of services provided, is important information for good city management. The Cities for Climate Protection programme (CCP) of ICLEI – Local Government for Sustainability, can assist local governments in conducting their baseline emission inventories and their emission forecasts, helping the city understand how, and from whom, to collect the necessary data.

The first of the five milestones that local governments commit to undertake when joining the CCP programme involves conducting a baseline emissions inventory and forecast. Based on energy consumption and waste generation, the city calculates greenhouse gas emissions for a base year (e.g. 2000) and for a forecast year (e.g. 2015). The inventory and forecast provide a benchmark against which the city can measure progress.

www.iclei.org/

Problems you may encounter

- No data or inaccessible data
- Energy supply information is good, but demand information is poor
- No centralised collection of energy data and no standardisation of collection systems
- Data is collected by region, not by city
- Some very basic data is missing or data is lumped together
- Good data on one sector for one year, but not for other sectors for that same year
- Different departments don't communicate with each other.

Cities for Climate Protection (CCP) 5 milestones

ICLEI's Cities for Climate Protection (CCP) campaign sets out a 5-milestone process for reducing greenhouse gas emissions from their local government operations and throughout their communities.
Milestone 1. Conduct a baseline emissions inventory and forecast.
Milestone 2. Adopt an emissions reduction target for the forecast year.
Milestone 3. Develop a local action plan.
Milestone 4. Implement policies and measures.
Milestone 5. Monitor and verify results.

The five milestones focus particularly on emissions reduction targets. It provides simple, standardised means of calculating GHG emissions, of establishing targets to lower emissions, of reducing GHG emissions and of monitoring, measuring and reporting performance. ICLEI has developed several software tools that help cities/local authorities comply with the methodology.

www.iclei.org/index.php?id=810

Step 5. Analysing your data and developing a draft plan

You have been gathering a lot of information and developing relationships with many people. Now it's time to start putting the two together.

- Firstly, identify the critical energy issues under each sector.
- Secondly, rank these issues according to your city's particular priorities.
- Thirdly, on the basis of this list, develop your draft plan of what must be done to promote a sustainable energy future for your city. List the possible measures (projects and programmes) which can address these issues and identify those that will yield the greatest benefit. These are the measures which you will ultimately include in the plan. Remember to list current projects as some of these can provide a springboard for implementation. Make your motto, 'Be ambitious and realistic!'

Overall energy issue ranking — example

Energy issue	Ranking
Access to energy sources by poor Affordability of energy Public transport – improvement and access Air quality – indoor and local	High
Renewable energy Energy efficiency Economic competitiveness (relating to energy cost) Job creation	Medium
Nuclear power Accommodating private car use	Low

This process gives you a framework for ranking of the more specific or detailed energy issues.

Specific energy issue ranking — examples

Demand overview	Ranking
Energy-related data necessary for planning is lacking – particularly demand data	Medium
As energy is a cross-cutting issue, there is currently no department responsible for or system for the collection of energy data	Medium
Etc.	
Households	
The costs of meeting a household's energy needs is a significant burden on poor households and a major contributor to poverty	High
Access to convenient, appropriate, affordable, clean and safe energy sources is limited for many poorer households – even electrified households use a mix of energy sources to meet their needs and fit their pockets. A best-mix approach should inform energy supply and management for all households	High
Many low-income houses are of extremely poor quality – and, as these households are often dependent on dirty and unsafe energy sources to heat their homes, indoor air quality is often very poor. The installation of ceilings would go a long way to addressing energy costs, air quality and health (this measure would also reduce mould which has been found to exacerbate such illnesses as TB)	High
Etc.	

Analysis

The scoring matrix

You will find it helpful to develop a matrix to compare measures using the following factors below. Place the measures along the x-axis and give each measure a score for each factor on a scale of say 1 to 5:

Factors:

- Compatibility with city goals
- Support of city's growth paths
- Social benefits
- Energy efficiency
- Carbon emissions reduction
- Local air quality improvement
- Local economic development
- Job creation
- Contribution to sustainability
- Contribution to energy security (reduction in energy demand, increase in energy supply diversity)
- Costs of programme implementation
- Funding availability
- Availability of data
- Potential for programme replication

Example of scoring matrix outline 1

	Solar Water Heaters	Energy-Efficient Lighting	Ceilings	Etc.
Compatability with city goals	5	5	3	
Support of city's growth plans	4	4	5	
Etc.				
Totals				

You can use several other analytical and quantitative tools to assist with analysis, such as cost-benefit analysis, economic and environmental impact assessments, scenario planning and integrated resource planning. The Long-range Energy Alternatives Planning System (LEAP) is extremely helpful in modelling alternatives and impacts. ICLEI's Harmonised Emissions Analysis Tool (HEAT) supports local GHG and air pollution emission reduction planning. See the box on LEAP and HEAT on page 25.

To test whether your measures contribute to sustainability, review them against the key elements of a sustainable system as indicated in the box on page 24.

Remember the key elements of a sustainable system

Consistent: the short-term actions are compatible with long-term goals and the viability of the system

Renewable: the system depends on renewable resources and operates using environmentally-benign technologies

Diverse: the more diverse and appropriate your system, the more able it is to adapt to change

Inclusive: all elements of the system are valued and used for the good of both the individual parts and the whole

Interdependent: each element of the system is both dependent on and depended on by several other elements; the greater the interconnection, the stronger the system.

Your draft plan

Your draft plan will grow from this analysis. This plan should contain the following information:

- Energy vision statements – grown from the city's vision
- Energy goals – linked to each vision statement
- Targets – linked to each goal
- Measures – what can be done to achieve these goals
- Projects – existing and potential

Example

Energy vision: A city with an efficient and equitable transport system, based on public transport and compact planning to enable all residents to access the benefits of urban life

Debating the sustainable energy and climate action plan

In order to put the implications of your sustainable energy and climate action plan up for debate, it can be very effective to use scenarios which compare your city in the future under business-as-usual, middle- and high-road scenarios (see the box on the facing page about the LEAP system a useful software tool in the development of energy scenarios).

A 2020 high-road scenario may be based on targets such as:

- 20% private car use reduction
- No days exceeding World Health Organisation air quality standards
- 20% reduction in carbon emissions
- 15% city power from renewable energy sources
- All low cost housing to have ceilings and efficient lighting
- All households to have access to basic electricity with poverty tariffs in place
- Mandatory green building standards for all new buildings
- Mandatory solar water heaters in new buildings over a certain value; all replacement geysers in houses over same value to be solar water heaters.

Goal	Focus area	Target	Measures	Projects — existing and potential
• An energy-efficient public transport system which discourages private car use	• Transport	• Total transport modal split increase of 10% for the rail, bus and taxi transport share by 2012. • Numbers of private vehicles commuting into city centre decreased by 10% by 2012 (baseline year 2005).	*Short-term (2 years)* • Establishment of Metro Transport Authority to ensure coordination of public transport projects. • Priority given to rail transport to improve standard of service. • Improve facilities at public transport interchanges. • Rapid bus transport corridors on incoming highways to be identified and implemented. *Long -term* • Dedicated bus and taxi lanes on all major commuter routes. • Development of nodes and activity spines.	• Rapid bus transit project • Park and ride • Non-motorised transport linkages • Parking charges programme in central city Etc. • Spatial development planning to support public transport systems Etc.

LEAP

LEAP or the **Long-range Energy Alternatives Planning System** is a widely-used software tool for energy policy analysis and climate change mitigation assessment developed at the Stockholm Environment Institute. LEAP allows one to develop a 'business as usual' energy model of a study area such as a city by entering current energy data, economic and population growth rates, household sizes etc. Various alternative scenarios can then be modelled, usually over a 20 to 30-year timeframe and their impact measured from an energy, environmental and economic perspective.

The outputs of this software also allows one to measure the impacts of the mass rollout of a particular intervention, such as installing solar water heaters, against a 'business as usual' alternative. LEAP is distributed at no charge to not-for-profit, academic and governmental organisations based in developing countries.

A full description of LEAP, its applications and a user guide can be found at www.energycommunity.org

HEAT

ICLEI developed the **Harmonised Emissions Analysis Tool (HEAT)** online software to support local GHG and air pollution emission reduction planning. This software provides capacity to local governments to seek to reduce GHG emissions based on sound governance, economic development, improved waste management, energy-efficiency, better urban mobility and better air quality. Beyond being a planning tool, this site offers consultants, NGOs, government agencies, academics and others free tools to translate energy, transportation and waste activities into pollution emissions.

In general the software will:

- Build an emissions inventory based on local energy use, transportation demand and waste practices
- Help a user/city build a simple emissions forecast
- Set a target/goal for reducing emissions (e.g., reduce GHG emissions by 10%)
- Quantify emission reduction activities and their co-benefits
- Develop, report and track progress made in meeting that target.

The tool is available online and data can be uploaded to contribute to the growing pool of data, which in turn can be compared, analysed and used for cumulative reporting by ICLEI.

www.iclei.org/heat and www.iclei.org/documents/Global/Progams/CCP/HEAT_Brochure_final.pdf_

Gate by Plant Design Online/flickr.com

Urban air quality

UNEP and UN-HABITAT have developed an online software toolkit, with an accompanying handbook, which is simple to use and easily accessible to all city managers, even those from developing nations. The toolkit will be of genuine help when implementing the air quality management process. The tools are drawn from 'good practice' around the world and support strategy development, action planning and implementation of Air Quality Management. The toolkit includes city case studies, mathematical models, maps and spreadsheets.

Advisors to policy-makers and non-technical government staff will be able to use this toolkit. The authors have ensured that expert knowledge is not necessary for implementation of Urban Air Quality Management. The process includes a three-step approach: improving knowledge and expertise about Urban Air Quality Management, improving strategy formulation and action planning and improving implementation and institutionalisation.

The toolkit and accompanying handbook can be downloaded from the UNEP's website at: www.unep.org/urban_environment/Publications/index.asp

Step 6. Building public and internal support: your participation process

This 'step' is of course part of a vital and ongoing process, which should start right at the outset and should be continued throughout the development and implementation of the action plan[2].

Developing and implementing a sustainable energy and climate action plan is, to many cities and local authorities, pioneering work. You will need to engage with, and educate, the public, city staff and political leaders on the plan's purpose and value. You will need help getting tasks done. You will need financial resources and you will need allies. You will also need to change mindsets and get your residents and political leaders to accept that a new way of thinking about energy is not a 'nice-to-have', but an essential step towards medium and long-term resilience and ultimately, survival.

Changing the way people live and perceive reality is a difficult and long-term process and very often the most neglected and under-valued part of processes like this one. Often, it is also the most under-budgeted component of a programme and this is the main reason why so many well-intended initiatives fail. Building support is one of the most critical aspects of your planning effort and active engagement, community empowerment, buy-in, ownership and participation are all key to an effective plan. Achieving this is often challenging as people, businesses and municipal departments may view energy and climate change policies as secondary to their core and everyday activities. It is very important, therefore, that your energy objectives share the concerns of the broader city and community.

Identifying stakeholders

There are internal and external people you will need to interact with in order to develop a good energy and climate action plan. Make a list of stakeholders from whom you need to get information and buy-in. Remember that organisations don't make decisions – people do, so focus on developing personal relationships. This is not a short-term process, so look after those relationships for the future too.

Work with those local government departments and agencies that should care about sustainability. Each department may require a different strategy, which will also be shaped by the politics and structure of your local government. You need to assess the barriers you have with certain departments. These barriers generally fall into four categories:

1. Information

There may be a lack of knowledge and information or the information may be outdated or wrong. Remember, you are now working in a rapidly developing field and information keeps on changing as new technologies and scientific findings inform policies. Again, consider joining support organisations such as ICLEI and SUD-Net to ensure that you stay abreast of developments. Make sure departments and staff have easy access to updated and factually-correct information and use mediums they will engage with e.g. web-based information, brochures, technical reports, popular information documents and other mediums which are also sensitive to cultural and language differences.

Examples of cooperative projects

Function	Their goals	Your goals	Joint project
Traffic management	Reduce congestion	Save energy	Rapid transit lanes
Fleet management	Reduce expenditure	Save energy	Procurement of hybrid vehicles
Housing/Services	Provide affordable services, improve health	Save energy	Install ceilings in low-cost housing
Finance	Reduce operating costs	Save energy	Energy-efficient retrofitting of city-owned buildings
Air quality	Reduce polluting emissions	Save energy	Cleaner public transport and cleaner vehicle fuels
Street lighting	Reduce cost of lighting	Save energy	Install energy-efficient streetlights
Traffic lights	Reduce operational costs	Save energy	Install light emitting diodes

[2] For additional helpful hints and tools on how to build public and internal support, please refer to the SCP Source Book Series: Establishing and supporting a working group process.

2. Institutional

Local government systems can be rigid and averse to change or risk; responsibilities for certain services (such as transport) may be split between city, regional and national governments, making it very difficult to implement changes at the local level. Institutional barriers can be the most difficult to deal with. Commitment from top decision-makers is required and even institutional change may be needed.

Many cities internationally have established semi-independent energy entities to drive and implement their sustainable energy projects in order to overcome the barriers within local government systems. See the section in Step 8 on energy agencies as well as case studies of these agencies in chapter 4.

3. Personnel

Staff might be feeling overworked. They may feel overwhelmed by the challenges of introducing something new. They may also perhaps feel personally threatened by the implications of change. Help bring these fears into the open so they can be properly addressed. Also look at ways of capacitating a group of core staff members who can lead this process into the future. There are many opportunities to share best practice, skills and lessons learnt from other cities who are already implementing energy and climate change programmes and action plans at the local level.

4. Financial

City financial constraints are very real, so it is important to quantify and argue the financial benefits of sustainable energy and climate change programmes and place the upfront capital requirements of some energy projects in the context of savings over time. A very difficult situation is if your local government is dependent on income from electricity sales and the electricity department is tasked with selling electricity – they will not look on electricity saving projects kindly.

Interacting with stakeholders

Set up task/partnership teams

A task team is an effective way to get people with a range of technical expertise and experience involved in the planning process. Decide whether an internal or a multistakeholder team is best for your context. You could set up a City Energy Partnership at this stage consisting of key stakeholders – this could form the seeds of a future dedicated energy implementation body.

Meet with key leaders

Meet with key leaders of businesses, utilities and interest groups to tie your work in to their specific needs – show them how promoting sustainability can help them achieve their goal. Don't try to convert them – listen to their needs and then tie them in with yours.

Link with existing groups, hold focus group workshops and public meetings

Linking energy into existing groups' meetings is an excellent way of obtaining and sharing information, as well as finding allies. You could also conduct focus group workshops with government, community and business leaders. When you have a draft of your energy plan, hold at least one public meeting with good media coverage as an overall wrap up of the consensus-building process. Don't underestimate the role that youth groups, schools and religious groups can play in mobilising communities to tackle challenges and to enable communities to accept change.

Use the media

Use the media to publicise your work and any public meetings. It is vital to make your work visible and to keep it visible. Tangible energy success stories in daily papers will capture people's attention and imagination. Piggy-back your work on other public events or media activities. Use clear, simple language and good graphics that tell a story and illustrate a point. Spend time learning more about and understanding your audience, in order to enable you to make informed choices when it comes to which messages and mediums will be most effective when targeting them.

In conclusion

A good public participation process will provide you with:

- early opportunities to discover allies and work together on difficult issues
- public ownership of the process and content
- a willingness to support subsequent implementation and to embrace change
- community empowerment through awareness and education.

Without a public participation process during your planning you may find:

- unanticipated opposition at the public hearing or adoption phase
- little or no support for the adopted plan and apathy amongst community groups
- failure to identify issues that community members consider important.

Work closely with those who don't support you – try to understand the conflict between your efforts and their goals – common ground can usually be found for at least some areas of your planning effort.

Case Study 6

The Maribyrnong by sneedy/flickr.com

A Community Engagement Framework
Maribyrnong, Australia

Maribyrnong has a formal Community Engagement Framework that outlines Council's commitment to actively engage the community in the decision-making activities of Council, particularly in decisions that directly impact on how citizens live, recreate, work, study, use services and do business.

The Framework includes a set of principles, objectives and strategies for engaging the community. There are also a specific set of objectives and strategies related to residents from culturally and linguistically diverse communities. The Framework is a 'working' document, reviewed annually to allow for any necessary modifications.

www.maribyrnong.vic.gov.au

Step 7. Finalising the plan

From your participation process you will now have a lot of input on your draft plan and/or your different scenarios. You will have a list of current and potential projects and you will have analysed their advantages and disadvantages. Now your city must decide on a set of reasonable objectives that can be implemented in the short and longer term. Your next step is to identify priority projects that fit these objectives.

Identifying priority projects

There are several approaches you can take to select priority projects and the approach that works best will depend on the nature of your city. Remember that it is very important to value what is being done already.

Each project and programme has both benefits and costs that are a mix of economic, social, political and environmental impacts. The process of deciding which impacts to rank or which should be assigned more weight should be done as a staff/stakeholder process that is approved through political processes if you want to adopt a long-term, sustainable plan. Decision-makers often value short-term gains at the expense of longer-term gains, low financial cost and political acceptability. Aim to have decisions based on the following criteria:

Analyse direct and indirect economic benefits

It is important to evaluate the cost of programme options in energy savings, business generated, jobs created and tax revenue generated. Also, to the extent that is it possible, consider indirect economic benefits such as avoided health costs, avoided fires and destruction of dwellings, reduced impacts from rising energy costs, lower risk of energy supply interruptions, local economic development, job creation and devolution of economic power.

Evaluate sustainability and impact on GHG emissions

Using the key elements of sustainability (refer to the key elements of sustainability in Step 5 on page 24), evaluate the options for their contribution to a sustainable energy system. Some options may have significant longer-term benefits, but high upfront capital costs. There may be projects which are critical to making other projects happen. The income from carbon emission trading on a project may provide a useful financial input to make a project financially viable. See page 33 on the Clean Development Mechanism and carbon trading.

Prioritise projects

When identifying priority projects, describe and quantify the related impacts and benefits to a reasonable level of detail, but be careful of using up too much of your limited resources determining those impacts. Use a simple scale of ranking, such as 1 to 5, to sort the projects. Base the score on your own or a group's opinion supported with data from your energy audit. You could use a similar scoring matrix to that outlined in Step 5 on page 23.

Sorting options

The analysis you have just completed will help you considerably in identifying priority projects. Many of the answers will become apparent as you develop your support in and out of local government. It is important to keep in close contact with your supporters during this process as you will be developing and changing implementation strategies along the way.

Adopting the final plan

As soon as you have a high level of agreement (which you should have after all your support-building efforts), take your sustainable energy and climate action plan to your city council for formal adoption. Inform all the roleplayers. It is also important to engage the media as soon as possible and arrange for opportunities for formal recognition of all who worked on the plan.

Case Study 7

Växjö, Sweden by urbanlegend/flickr.com

Fossil Fuel Free Växjö
Växjö, Sweden

Fossil Fuel Free Växjö is a programme initiated by the City of Växjö to reduce the human impact on global climate change. In 1996, the City Council of Växjö unanimously decided that local emissions of greenhouse gases should be cut by half by 2010 compared with 1993 levels and that the municipality shall become fossil fuel free. Between 1993 and 2005, CO_2 emissions from fossil fuels were reduced by 24% per inhabitant and the share of renewable energy is now over 50%.

The Fossil Fuel Free Växjö programme incorporates different types of activities, such as biomass-based district heating and power generation, smaller scale district heating, district cooling, biomass boilers for households, energy-efficient street lighting, energy-efficient building design and construction, solar panels, cycle paths, environmentally friendly cars, biogas production, etc.

Political leadership was an important starting point for the progress achieved in Växjö. All political parties have unanimously supported the targets set and researchers, industries and local-policy makers collaborated around common goals. The programme has strengthened regional competitive advantage and provided multiple benefits. The town has provided an important example to other municipalities in Sweden and abroad.

www.vaxjo.se/english/

http://unep.org/GC/GCSS-IX/Documents/Swedish-1A.pdf

Step 8. Implementing and financing the plan

It is all very well having a plan, but it is only meaningful if it follows through to implementation. You may find that there are severe capacity and institutional barriers to implementation. There may be financial hurdles to overcome. It is important to be fully aware of these constraints and build your action plan accordingly.

You will need people to do the work and it helps if the institution is structured in a way that enables it to assist. Remember that energy is a cross-cutting sector, so the institutional structure needs to reflect this by bringing the different sectors together.

Capacity and institutional development

It is vital to answer these questions:

- Who is going to be responsible for driving and facilitating the implementation of the plan? (Clarify roles and responsibilities from the outset).
- Where is this implementation 'driver' to be located?
- The 'driver' will probably start off small. You may aim for a structure like this:
  - A high- level political body such as a Mayoral Committee on Energy for Sustainable Development.
  - A task team of senior managers coordinating and overseeing project teams dealing with specific sectors (energy efficiency in buildings, transport, business, residential, access to energy for the poor, local government operations and communication).
  - It may be helpful to establish an external dedicated energy agency based on public-private partnerships to manage implementation (see the box below on energy agencies).

Energy agencies

Many of the cities that have had success with implementing sustainable energy and climate action plans have done so through the establishment of a dedicated energy agency. These agencies can be set up to achieve very particular purposes according to the needs and capacities of your city. The board or steering committee of such an agency would likely include your city, business, the local university, utility and national government. The role of the unit may be to:

- coordinate and mobilise the range of energy stakeholders around an action (implementation) plan
- advocate and lobby for policy and legislative changes
- raise and manage energy funds (from energy savings, carbon sales, government etc.)
- support the development of local energy business and related skills training
- educate and provide information to particular groups such as residents, business and industry.

It is a good idea to establish public-private partnerships and set up sector task groups which draw together those involved in particular sectors to carry out implementation in those sectors (such as housing, transport, renewable energy power production). See case studies on adjacent page.

Case Study 8

Solar Forum Barcelona by Stefan Gara/flickr.com

Implementing through a city agency – The Barcelona Energy Agency
Barcelona, Spain

The Barcelona Energy Agency was established as a consortium in 2002 with its origin lying in the European Union energy policies as established in the White Paper on Energy (1997). It is made up of various administrations that are directly involved in energy and environmental management: the Barcelona City Council, the Metropolitan Body for Hydraulic Services and Waste Treatment, the Catalan Institute for Energy and the Institute for Energy Diversification and Savings (a Spain-wide institute). With the aim to build knowledge and research, the University of Barcelona and the Catalan University Technical College, also form part of the Consortium.

The president of the Consortium is the Deputy Mayor and Chair of the Barcelona City Council's Commission for Sustainability, Urban Services and the Environment.

The main objectives of the agency include: fostering local renewable energy sources and energy efficiency, supporting the public sector in its energy work (providing information, technical support and advice) and providing information and advice to business and citizens.

This is implemented through the Barcelona Energy Improvement Plan (PMEB), which forms the general framework for the work of the Barcelona City Council in matters of energy policy and its environmental impact on the city. Within this context, the energy plan includes an energy-related and environmental analysis of the present-day Barcelona and its future trends (to the year 2010), which allows prediction of the increase of the city's energy consumption and its repercussions according to different scenarios. Consequently, the PMEB establishes a set of local action measures addressed to achieve energy savings, an increase in the use of renewable energies and energy efficiency.

www.barcelonaenergia.cat/homeeng.htm

Case Study 9

Photovoltaic panels by Schwarzerkater/flickr.com.

Implementing renewable energy in Woking Borough Council
Woking, UK

Woking Borough Council is at the forefront of decentralised city energy supply in the UK. It has pioneered the development of a network of over 60 local generators, including a co-generation and tri-generation plant, photovoltaic arrays and a hydrogen fuel cell station, to power, heat and cool municipal buildings and social housing.

The Council has achieved this through the establishment of Thamesway Ltd, an energy and environment services company solely owned by Council, which enters into public-private joint ventures to deliver its energy and environmental strategies and targets. Although Woking had been successful in implementing small-scale local community energy systems, to fully capitalise on its sustainable energy innovation, it needed the finance and expertise of the private sector to implement large-scale projects. The Council formed two companies – Thameswey Ltd and Thameswey Energy Ltd.

Developing a private network enabled Thameswey Energy Ltd to avoid charges usually associated with the use of the grid. By circumventing these costs, it has been able to fund wires and generation to deliver low-emission electricity in competition with conventional suppliers.

Decentralising their energy has enabled Woking Council to cut energy use by nearly half and Council CO_2 emissions by a massive 77%, since 1990. The key to the Council's success is the combination of technical innovation (such as combined heat and power, absorption cooling, private wire systems etc.); partnership with the private sector; financial/commercial innovation and the use of a local electricity balancing and trading system.

www.greenpeace.org.uk/MultimediaFiles/Live/FullReport/7468.pdf

www.woking.gov.uk/council/about/wbcresp

Case Study 10

Financing your plan – Toronto Atmospheric Fund
Toronto, Canada

The City of Toronto was one of the first cities in the world to commit to a target reduction of local GHG emissions. In 1990, Toronto City Council resolved to reduce community-wide CO_2 emissions by 20% by 2005. The following year the Council voted to establish the Toronto Atmospheric Fund (TAF) with an endowment from the sale of city land to assist in achieving this goal. At the request of Toronto City Council, the Government of Ontario officially enacted legislation incorporating TAF in 1992.

The fund was established to promote global climate stabilisation by financing local projects that reduce GHG emissions, promoting energy efficiency, educate the public and foster partnerships with senior levels of government, business, educational institutions and non-governmental organisations. In 2000, the City Council expanded TAF's mandate to include promotion of better air quality.

Like other City of Toronto agencies, boards and commissions, TAF is an arm's-length agency. The City Council appoints the board of directors and reviews and approves the annual budget, but the operations are conducted autonomously. TAF funds projects through grants and loans from revenue that comes from its own $26 million endowment and not from the municipal tax base. Projects financed by TAF loans have saved the city $17.5 million – over $2.7 million annually – in cumulative energy and maintenance costs.

TAF's current granting priorities fit under the following strategic programme areas:

- **FleetWise** – accelerating hybrid and electric vehicle solutions
- **LightSavers** – advancing low-carbon lighting
- **TowerWise** – improving energy efficiency in high-rise homes
- **SolarCity** – building local solar generation capacity

www.toronto.ca/taf/index.htm

Case Study 11

Leslie Nature House, Ann Arbor. www.a2gov.org

Municipal Energy Fund
Ann Arbor, USA

Since its establishment in 1998, the Ann Arbor Municipal Energy Fund has provided city facilities with a source of capital for energy-efficiency retrofits. The Energy Fund provides initial capital for new projects and receives 80% of projected annual energy savings from each installed project for five years. The five-year payment plan allows projects that have a shorter payback to help support projects with a longer payback and all savings accrued beyond the first five years remain with the departments implementing the improvements.

The Energy Commission, appointed by the Mayor together with Council approval, developed the concept for the Municipal Energy Fund. When the idea for the Energy Fund was first presented to Council, Mayor Sheldon strongly supported it, recognising the potential to save valuable tax dollars as well as precious energy resources. She actively participated, providing opening remarks at dedication ceremonies for a wide range of energy projects and programmes.

The Ann Arbor Energy Office developed the Municipal Energy Fund from a concept to a reality and is responsible for its administration under the supervision of a three-person board, which must approve all projects. The Energy Office provides the board with information from energy audits along with applications from facility managers for projects requesting energy funds. The board reviews all applications and makes final decisions on what projects to fund each year. Decisions are based on energy saving potential, improvement of the facility environment and educational or demonstrational value of the project. The Energy Office then implements the projects, often serving as the project manager.

The Fund was started with five annual investments of $US 100,000 and quickly became self-sustaining. Most installed measures have had payback periods of three to six years and projects supported by the Fund have yielded a total of 685 tonnes of annual e-carbon dioxide emissions.

www.a2gov.org/government/publicservices/systems_planning/energy/Pages/EnergyFund.aspx

Some advice for implementation

Be practical, but avoid short-term thinking

Do what can be accomplished given the support and resources available at the moment. This means looking for connections between your interests and those who make financial decisions. A risk is that you can fall into short-term thinking. Short-term plans can not only create environmental problems, but can also entrench poverty and unsustainable livelihoods. Housing land for the poor being allocated on the outskirts of cities, furthest from urban opportunities, is a distressing example of this.

Long payback periods

Long payback periods do not suit the way in which city politics works, however it is possible to obtain programmatic support for interventions that have long payback periods. Be careful of using up your resources on easy, cheap projects or 'low-hanging fruits', as this may be at the expense of projects which are more difficult, but have greater impact.

Focus on projects with the greatest impact

Identify options that are visible and show significant cost savings, while building a more sustainable urban system. If possible target a range of different sectors simultaneously to build a broad commitment and understanding of a sustainable energy future.

Locate financial resources

Fortunately, projects that rate highly in sustainability terms are often in line with other environmental and social goals. If projects meet several community goals and provide benefits to a broad group of residents, they will be easier to fund. Energy improvements are an investment that can help cities and communities improve their financial sustainability. Before looking for money think of all the ways the project will benefit the community and who will be interested in those benefits.

Multiple benefits of energy projects

A ceilings installation project for low-cost housing can offer:

- energy savings for the household
- reduced energy demand on the energy supplier
- reduced carbon emissions
- training and employment for residents
- improved health for residents
- photo opportunities for political and business leaders
- technology and business development in ceiling manufacture.

Funding for this project may come from utilities, government housing, health and social services departments, local lending institutions, international funders and/or buyers of carbon credits. Universities may carry out research and monitoring.

Generate funds

Taxes or levies

With sufficient support you may be able to acquire general funds or generate revenue from taxes or levies such as carbon tax on activities such as conferences, tax on parking bays, a levy on electricity use by business, industry and larger residential users.

Grants and loans

Some local governments offer revolving loan funds to support the development of small business – it may be possible to access these for energy-efficiency projects. Grants and matching grants may be accessible from funders for projects.

The Portland Oregon Energy Office instituted a 1% fee on all city government energy bills. This fee was used to hire an energy management coordinator for city facilities. That coordinator implemented more than three times this fee in energy savings in the first year.

Borrowing

Some local governments use borrowed money to do energy-efficient retrofits in their own facilities. The money is paid back from the energy savings, with the total cost less than the energy amount saved. It may be possible to obtain some form of 'green loan' where an institution is prepared to lend more at lower interest rates because the intervention means that the borrower's capacity to repay is enhanced.

Performance contracting

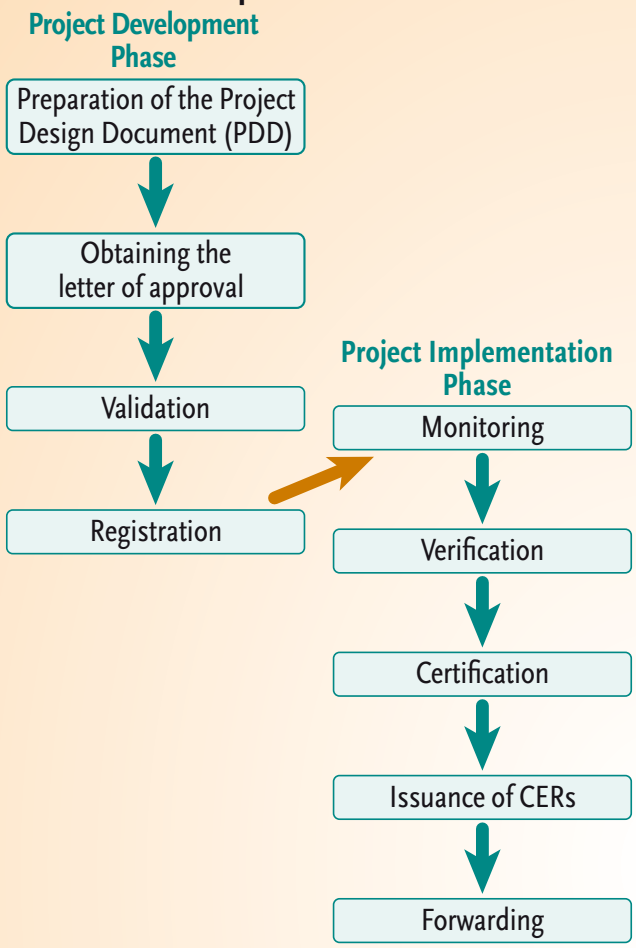
As local government can represent substantial and attractive sales potential, performance contracting allows local government to try projects without making any upfront capital investment and with minimal risk. Under this arrangement, a third party such as an energy utility provides a service package that includes the financing, installation and maintenance of energy-saving capital improvements. The customer then uses the resulting energy savings to pay for the improvements. Performance contracts are usually structured as a lease but with a guarantee that payments will not exceed energy savings.

Carbon trading

You may be able to trade in the carbon credits of your projects. These can be traded upfront or during the project life-cycle and can make a useful financial input to the project (they are unlikely to cover the full cost of projects). You can trade on the voluntary market or through the Clean Development Mechanism (CDM).

Try to get a balanced mix of grants, loans, investment funding, carbon financing etc. to spread the risk. When approaching funders for larger projects it can help to cross the risk threshold if the project is ring-fenced.

Carbon trading: The Clean Development Mechanism



History

The Clean Development Mechanism (CDM) is an arrangement under the Kyoto Protocol allowing industrialised countries with a GHG reduction commitment (called Annex 1 countries) to invest in projects that reduce emissions in developing countries as an alternative to more expensive emission reductions in their own countries.

How it works

A carbon project can only be registered if it would not have occurred without the additional incentive provided by emission reductions credits. According to Article 12 of the Kyoto Protocol, apart from helping Annex 1 countries comply with their emission reduction commitments, CDM must assist developing countries in achieving sustainable development.

CDM is supervised by the CDM Executive Board (EB) and is under the guidance of the Conference of the Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC). Countries wishing to participate in CDM projects require a Designated National Authority (DNA). The main task of the DNA is to assess potential CDM projects to determine whether they will assist the country in achieving its sustainable development goals and to issue formal host country approval.

Outline of the project process

An industrialised country that wishes to get credits from a CDM project must obtain the consent of the developing country hosting the project that it will contribute to sustainable development. Then the applicant (the industrialised country) must make the case that the carbon project would not have happened anyway (establishing additionality) and must establish a baseline estimating the future emissions without the project. The case is then validated by a third party agency, called a Designated Operational Entity (DOE), to ensure the project results in real, measurable and long-term emission reductions. The CDM Executive Board (EB) then decides whether to register (approve) the project. If a project is registered and implemented, the EB issues credits, called Certified Emission Reductions (CERs), commonly known as carbon credits, where each unit is equivalent to the reduction of one tonne of CO_2e, (i.e. CO_2 or its equivalent), based on the monitored difference between the baseline and the actual emissions.

Some concerns:

- Establishing additionality and the baseline
- Financial risks and profiteering
- Forestry has been excluded (for now)
- The inclusion of large hydro projects which many consider unsustainable
- False credits (credits from projects which would have happened anyway)
- Excessive payments for emission reductions
- Sustainability of projects

In response to these concerns the World Wide Fund for Nature (WWF) devised a 'Gold Standard' methodology to certify projects that applies strict standards. This can be found on the WWF website: www.panda.org

There are a number of other organisations that offer support, training and tools around CDM and sustainable financing for energy projects.

See Chapter 4 for more information on these.

CDM projects to date

CDM gained momentum in 2005 when the Kyoto Protocol entered into force. By November 2007, 828 projects had been registered by the CDM Executive Board. These projects reduce greenhouse gas emissions by an estimated 171 million tonnes of CO_2 equivalent (CO_2e) per year. There are about 2,600 projects in the pipeline which could by the end of 2012 produce over 2,5 billion tonnes CO_2e reductions.

Step 9. Monitoring and evaluating your plan

Your strategy and your action plan should be living documents with short-term plans being evaluated and updated every two or three years and long-term plans every five years. The energy and climate change field is such a rapidly developing and evolving area of work, so it is important to regularly check your plan with latest national, regional and international progress and new developments.

You need to evaluate your progress in order to:

- Track and quantify what has been done, measured against your targets
- Measure positive results, which will help you maintain city support
- Detect problems and make necessary changes
- Provide information for the updating of your strategy
- Adjust your action plan
- Plant the seeds of future challenges

The evaluation process must compare your objectives against your results. You want to measure both the quantity and quality of your progress.

Monitoring

Remember that your evaluation can only be as good as your monitoring. Make sure that you have an effective and sufficiently resourced monitoring plan for the programme right from the beginning. Most projects will require both quantitative and qualitative monitoring and evaluation. Many development programmes are frequently undermined by poor monitoring.

Evaluation

Evaluations can do two things:

1. Help improve the planning process and
2. Help you decide whether to continue particular programmes and projects.

For the first, you need to:

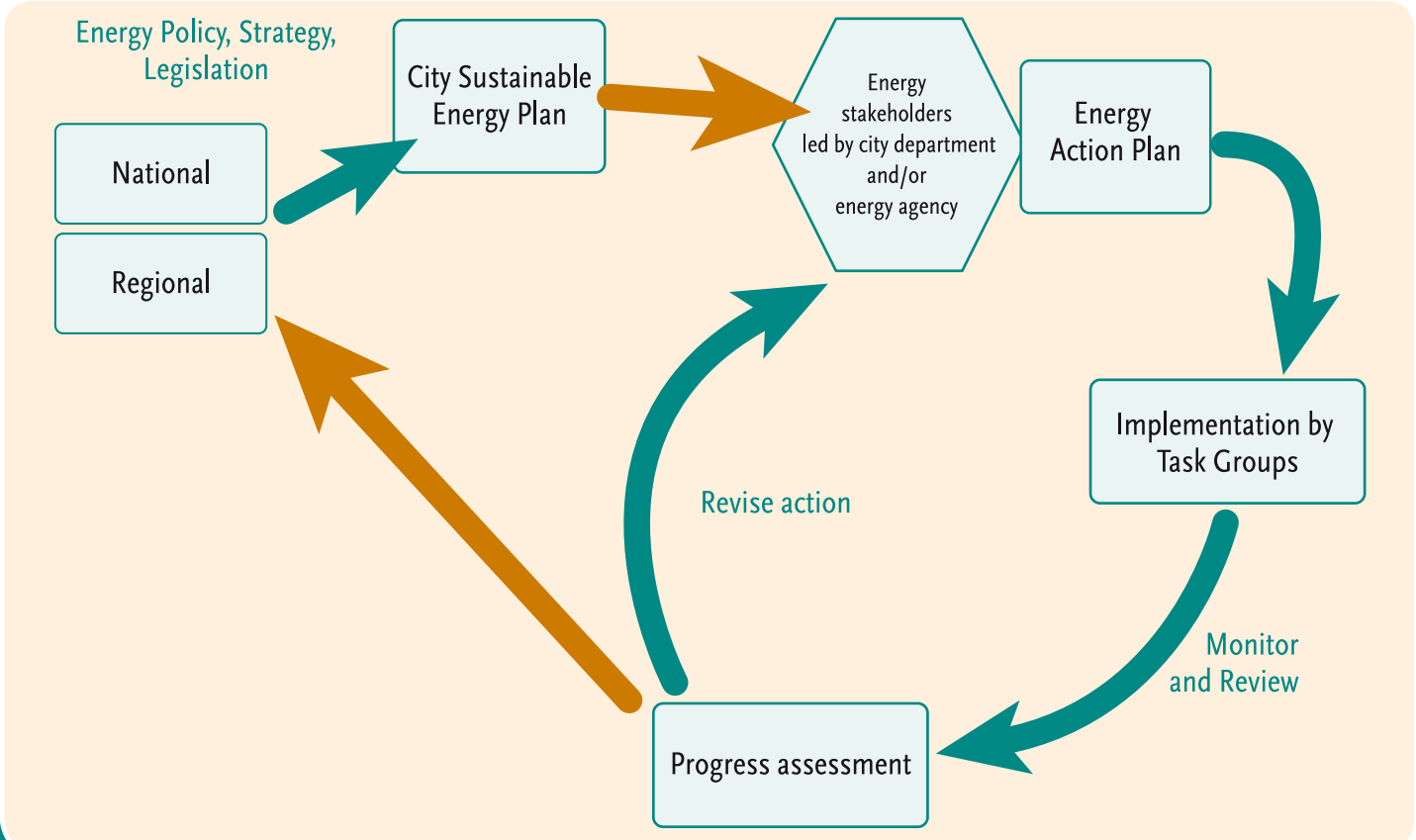
- identify strengths and weaknesses in the process
- determine which participants or groups are benefiting the most or least from the projects.

For the second, you need to:

- determine whether the project is reaching its objectives
- analyse the cost/benefit ratio of the project
- decide if the project is still appropriate
- identify who should participate in the continued project.

Look for specific measurable results such as energy saved, costs saved, poverty alleviation, environmental benefits and lessons learned. Be sure to clearly identify unforeseen benefits as well as problems.

The process may look something like this:



Response

Be ready to adapt your approach and to let go of projects which are not working. Go back to your efforts in developing programme options and investigate new methods of achieving your goals.

Step 10. Publicising the benefits

This step, like 'Step 6. Your participation process', needs to start from day 1

Why do you need to tell everyone about your projects? To build support for your sustainable energy goals and to change people's behaviour. To build pride, enthusiasm and a feeling of ownership and empowerment while building a more sustainable future. Education and publicity should be on your mind all the time. This is an area which lends itself to many creative and innovative ways of ensuring public engagement and ownership.

An evaluation is a great learning opportunity. Be open, be honest. Those activities that did not go 'according to plan' can often teach you more than those that went 'right'.

Using projects

Make use of people's natural curiosity and of their need to save money. An energy audit and retrofit of council offices can educate staff about energy efficiency and will provide information they will take home to their families and children will take to their schools. There are a number of energy audit and carbon footprint measurement tools for individuals, households, schools etc. available on the Internet.

Using the media

You have a vast array of communication methods at your disposal and they don't all cost huge amounts of money. Piggy-back on other media initiatives wherever you can. Use journalists' need for stories. Apply for awards. Make presentations to council portfolio committees. Get onto the radio and even engage radio stations to partner with you through competitions aimed at households and schools. Distribute information with the council's monthly accounts.

Let people know that you have provided more service for less money and do practical demonstrations to show them how much money they can save. Build trust and credibility by actively demonstrating gains.

Case Study 12

Auckland Viaduct, Auckland, New Zealand by Sandy Austin whanau/ flickr.com

Energy-efficiency advice for residents
Auckland, New Zealand

The residential sector accounts for nearly 13% of New Zealand's total consumer energy use. While more energy-efficient technologies are being incorporated into homes, this percentage is increasing in large cities like Auckland, as a result of the increase in the level of indoor comfort and amenities in homes. On average, Auckland households use about 7,970 kWh of electricity each year – compared to the New Zealand average of 7,800 kWh.

Auckland City Council has contributed $12,500 to the EcoWise energy-efficiency advice programme to help residents save energy, reduce costs and create drier healthier homes. The programme involves energy advisers visiting homes to conduct a free energy audit. The audit provides the resident with an accurate measure of energy consumption and losses and includes measuring the power consumption of common appliances such as heaters, fridges and computers. The adviser later provides the resident with an energy-efficiency plan, containing information and advice on energy use and where savings can be made.

The City's Council's support of this initiative fits in with the development of the sustainability strategy, the Mayoral Task Force for Sustainable Development and the City's environmental policy. Auckland City Council has also employed an energy manager to improve the organisation's energy efficiency and use of renewable energy technologies.

www.aucklandcity.govt.nz/news/council/200703/11/a08.asp

CHAPTER 3
Implementing energy efficiency and carbon mitigation measures

Now that you have been introduced to the ten steps necessary to develop and implement a sustainable urban energy plan, it will be helpful to your work to consider various best-practice projects and processes that have been undertaken by cities and towns around the world. The range of case studies presented in this chapter cover all aspects of a local governments' responsibilities and activities from city-wide planning, to transport, service provision and environmental planning.

Local governments are involved to a lesser or greater degree in the following range of activities:

- development and delivery of public housing
- ownership and management of public buildings
- passing of building plans
- water supply
- management of waste and wastewater
- installation and maintenance of public lighting and traffic lights
- spatial planning and management of city development
- transport planning and provision of public transport
- air quality management
- distribution of electricity and in some cases energy generation
- major procurement including paper, fuel, building materials etc.
- public open space management and beautification
- management of vehicle fleets including buses, refuse collection trucks and cars.

All of these activities require energy and many of them are very energy intensive. Local governments are tasked with acting in the public good and must deliver services to city residents, businesses and industries while protecting the environment and the resources on which human development depends. The case studies highlight the benefits accrued by these projects including reduced costs and carbon emissions, improved service delivery, cleaner air and improved security and consistency of energy supply.

3.1 Energy services and housing

Making public housing more energy efficient and implementing sustainable ways to meet poor homeowners' energy needs has multiple benefits. Impoverished urban dwellers are often condemned to high energy costs to keep their homes warm or cool when houses are poorly built and no consideration is given to energy-efficient construction. Attached or compact housing that takes advantage of passive solar design and includes insulated ceilings will be a direct benefit to residents who have little money to spare. Passive cooling is based on the interaction of the building and its surroundings and usually costs nothing. Before adopting a passive cooling strategy, you must be sure that it matches your local climate. Strategies will normally include natural ventilation, evaporative cooling and high thermal mass with night ventilation. In practice this means ensuring windows have sufficient overhangs, letting breezes flow through windows, and where physically possible having amounts of stone and earth absorbing daytime heat. Implementing more efficient ways to heat water and cook will also help save money in the long run. There is a huge divide between the energy-use patterns and problems of the wealthier and poorer sections of the population. The poor often are burdened with inadequate, unsafe and inconvenient energy sources, while the wealthier sector over-consume and are highly inefficient in their use of energy. A significant proportion of urban households continues to used traditional biomass (wood and dung) and there are multiple benefits to moving to cleaner fuels such as liquefied petroleum gas or kerosene.

Case Study 13

Solar Heating System by Abri Beluga/flickr.com

Providing hot water to Lwandle's low-income community using solar water heaters

Somerset West, South Africa

The Lwandle hostel is situated in a township in Somerset West in the Western Cape. The hostel, owned by the then Helderberg Municipality, originally served as a single men's accommodation for the Gants food and canning factory, which was closed in 1980. Unemployment was high and poverty extreme, with whole families living in single bunk spaces. Through an extensive community participation process motivated by the closure of the Gants factory, the community announced their primary needs as being jobs, privacy, toilets and hot water.

A community development project, led by the local municipality, was started in 1995 and came to be known as the Lwandle Hostel to Homes Project. Through the engagement of a project manager who was also a very proactive champion, the hostel was converted into family units (with some provision for singles), giving rise to 967 units owned by the local authority and available for a low rental fee. In order to meet the expressed need for hot water, 305 solar water heaters (without electricity back-up) were installed to provide hot water to 610 homes. The provision of solar water heaters was made possible through the local authority securing a low interest loan from the Development Bank of Southern Africa. Residents pay an additional fixed amount on their rentals in order to service the loan.

This is still the largest solar water installation initiative in South Africa, made possible by a supportive municipality, a proactive project manager, a cohesive community and the securing of a low interest loan.

Source: How to implement renewable energy and energy-efficiency options – support for local governments. Sustainable Energy Africa and REEEP. 2007.

Case Study 14

Meeting energy needs in Kuyasa public housing project using CDM

Khayelitsha, South Africa

Housing units in Kuyasa, a low-income housing settlement in Khayelitsha, Cape Town, are being retrofitted with solar water heaters, water-efficient showers, hot taps and drains, ceilings and ceiling insulation and energy-efficient lighting. This project is a partnership between the City of Cape Town and SouthSouthNorth (SSN), a network-based organisation operating in Bangladesh, Brazil, Indonesia and South Africa. SSN builds capacity among public and private stakeholders to deal effectively with the Clean Development Mechanism (CDM) projects.

After a 3-year process of project design by the City of Cape Town and SSN, the Kuyasa Low-Income Urban Housing Energy Project was registered as a CDM Project with the Executive Board of the UNFCCC in August 2005. This development project has been recognised by the United Nations as a Gold Standard CDM Project and is the first of its kind in Africa and one of fewer than 50 in the world. The energy-efficiency measures in the project will result in a 5% temperature increase within the buildings in winter and a 5% decrease in summer. All the measures can be translated as a potential 40% reduction in electricity usage per household and emission reductions of approximately 2.85 tonnes of CO_2 per household per year. The project will receive carbon emission reduction credits over a 21-year period.

The project has been slow to proceed due to the following reasons:

- lead time to secure additional funds
- municipality institutionally not set up to deal with the legal and assets aspects of CDM projects
- internationally the programmatic approach to CDM is just being finalised.

Currently the project has managed to secure funding from a number of partners, including the Provincial Government, ICLEI - Local Government for Sustainability and the National Department of Environment and Tourism through its Poverty Alleviation Fund. CDM funding only accounts for 20% of the Kuyasa project costs. A concern with the CDM is that it is extremely costly to package a project application and that it favours industrial projects which have greater carbon impacts and can therefore receive higher levels of finance through the mechanism.

www.dme.gov.za/dna/pdfs/pdd_kuyasa.pdf

www.capetown.gov.za/wcmstemplates/ERM.aspx?clusid=465&catparent=7105&IDpathString=6239-7095-7104-7105

Case Study 15

Honda Bay, Puerto Princesa by Storm Crypt/flickr.com

More energy-efficient homes in Puerto Princesa City
Puerto Princesa, Philippines

Puerto Princesa is a multiawarded and pioneer city for environmental initiatives in the Philippines. It is the capital and chief seaport and airport of the province of Palawan.

The rising urban population of Puerto Princesa has led to congestion in the city's bay area, threatening the people's quality of life and coastal reserve areas. Housing projects on the coast in Puerto Princesa City have been designed to reduce energy demand through increased natural light, improved ventilation, the cooling effect of the roofing material and strategically planting at least one fruit tree per household.

The anticipated annual energy savings from the use of compact fluorescent lamps (CFLs) instead of incandescent bulbs alone is 21,414 kWh (equivalent to US$35,106) and have reduced energy bills by 64%. The potential annual carbon savings is estimated to be at least 72 tonnes for the 330 households.

Other green features of the housing projects include the installation of a rainwater catchment facility that reduces the demand for water pumping, prohibiting the use of wood for the roof and interior frames and an appropriate disposal system for non-recyclables and non-biodegradables.

www.iclei.org/fileadmin/user_upload/documents/SEA/Case_Studies/Puerto_Princesa.pdf

Case Study 16

Cuba's programme for low energy and material consumption for housing
Villa Clara Province, Cuba

With housing resources scarce in Cuba due to the economic crisis in the early nineties affecting the production of building materials and aggravated by recurring hurricanes, a national programme for low energy and material consumption for Housing was established. As a result of this programme, over 50,000 new homes have been built since 1992 using the scarce resources available in a rational and sustainable manner. The technologies developed are geared towards small-scale production, with a focus on stimulating the local economy through the creation of new job opportunities.

The programme has an innovative process of technology development and transfer, which has resulted in a set of appropriate technologies for the manufacture of 'eco-materials' – building materials made with low-embodied energy, often through recycling waste at municipal level. The whole process has been organised as a south-south endeavour, as machinery and know-how come from Cuba and other countries in Latin America. Eco-materials workshops are carried out that include personnel training and a post-sale advisory service. These new techniques have been applied not only in the construction of the new housing but also in reconstruction and rehabilitation of old housing stock. Around 20 Cuban municipalities are now using these alternative building techniques.

In Villa Clara Province, for example, innovative and environmentally-sustainable building materials are being manufactured locally in small workshops, creating job opportunities and constructing an estimated 2,300 housing units. These eco-materials use recycled waste products and include micro-concrete roofing tiles, lime-possolana cement, pre-cast hollow concrete blocks, using bio-wastes as fuel and the use of bamboo in construction.

External funding of US$ 387,000 in foreign currency has been raised from a range of donor agencies including the European Commission, GTZ, Swiss Development Cooperation and private foundations for the goods that need to be purchased in foreign currency, such as certain building materials, machinery, fuel for local transport, etc. The local governments have matched these funds with local currency, which has been used for the purchase of raw materials, investments in infrastructure and the payment of salaries in the workshops. The total amount of funds provided by the local governments in the Villa Clara Province is estimated to be 2 million Cuban pesos (equivalent to US$90,000). Funds for south-south technology transfer, through workshops carried out by CIDEM and the EcoSur network, have been provided by the European Union, the Cuban Government and German NGO, Werkhof Verein.

A total of approximately 200 new direct jobs have been created, as well as a large number of indirect jobs (in masonry, carpentry, etc.), as a consequence of the boost in the local construction market.

The energy benefits of this intervention include low-energy input, minor transportation costs and substantial energy savings by the usage of an alternative binder for cement, as well as using alternative fuel and producing lower carbon emissions.

www.worldhabitatawards.org/winners-and-finalists/ project-details.cfm?lang=00&theProjectID=8CF5995B-15C5-F4C0-997B214C8DFB72F7

www.bestpractices.org/bpbriefs/housing.html

Case Study 17

Jakarta, Indonesia by Jean-Marc/flickr.com

Cash transfer programme to mitigate the impact of fuel price hikes

Jakarta, Indonesia

The number of Indonesians living on less than US$1.55 a day is 39 million, out of a total population of 222 million. With the recent fuel price hikes, it is the urban poor that are suffering the most as their meagre earnings buy them less food than before. To mitigate the impact of the fuel price hikes, the government has allocated Rp14.1 trillion for a cash transfer programme to 19.1 million low-income households nationwide, comprising 76.4 million people. Each household is to receive Rp100,000 per month and 15 kg of cheap rice until the end of 2008.

According to the government, the cash transfer, disbursed through post offices, is proceeding smoothly and the benefits had been received by almost 95% of the targeted households. The well-meaning scheme, however, has drawn criticism from community leaders and local government officials who say it might cause conflict and create social jealousy.

The recent fuel price increase enabled the government to save US$3.8 billion for the 2008 fiscal year, of which US$1.6 billion will be ploughed into the cash transfer. However, as oil prices continue to climb, efforts to balance the budget and stabilise the economy are continuing in Indonesia as well as the rest of the region.

www.nst.com.my/Current_News/NST/Wednesday/Columns/2275890/Article/pppull_index_html

3.2 Public and commercial buildings

Local governments can lead by example through reducing energy use in their buildings and by making use of better design or more efficient technologies. It is more cost effective to build 'greener' from the start, but retrofitting existing buildings and changing user behaviour can usually show results within an acceptable timeframe. Efficient building encompasses several areas from efficient design and orientation through to the technology used inside a building to make lighting, space heating and cooling more efficient. Passive solar design is used to reduce energy consumption and thus the need for extra equipment such as air conditioning and to ensure comfortable accommodation.

Case Study 18

Retrofitting municipal buildings

Ekurhuleni, South Africa

The Ekurhuleni Metropolitan Municipality (EMM) has successfully implemented various cost-saving and energy-saving measures in three municipal buildings, a result of the city's adoption of a policy on energy efficiency in council buildings and on council premises of Ekurhuleni.

The project of improving energy efficiency in EMM buildings started in June 2005 with the call to submit quotations to carry out the work to achieve the objective of saving energy and reducing GHG emissions. The leading department was Environment and Tourism but other departments were involved, including the Municipal Infrastructure Department (Electricity Directorate) and Roads and the Transport and Civil Works Department (Building Maintenance section). ICLEI secured a grant totalling R242, 761 (US$40,000) from the United States Agency for International Development (USAID) to fund this project.

The mechanisms focused on lighting and water heating including the replacement of conventional incandescent lights with compact fluorescent lightbulbs (CFLs), the replacement of cool-beam down lighters with light emitting diodes (LED) lights, the replacement of urns and kettles with hydroboils and the installation of geyser and lighting timers. CFLs are very efficient and inexpensive with high return on savings after the initial investment. They have been designed to screw into standard sockets, which allow them to be used very easily. LEDs are small, solid lightbulbs, which are extremely energy efficient. The Zip hydroboil is a wall-mounted, instant-boiling water heater. It cuts down on water bills, as there is no evaporation due to escaping steam. It also saves electricity/energy because it consumes less compared to urns. Geyser timers regulate when the water can be heated by connecting electricity to the geyser at specified times. This saves energy because water is not heated throughout the day.

This relatively small-scale retrofit project resulted in an energy saving of 328,988 kWh in one year, with a payback period of 1.2 years. The co-benefits were GHG emission reductions of 308 tonnes of CO_2e, 3 tonnes of SOX and 1 tonne of NOX.The project itself did not require a long time to implement. However, in municipally-owned buildings and municipal operations, the council procedures and policies need to be followed and this added time to the process. Since the energy-efficiency technology and equipment was relatively new on the South African market, it was not easy to find experienced tradesmen to provide the necessary services.

www.pepsonline.org/publications/Ekurhuleni%20EE%20Case%20Study%204_06.pdf

Case Study 19

Leicester town hall by u07ch/flickr.com

Reducing municipal buildings energy use through a coordinated plan

Leicester, UK

Leicester City Council has been at the forefront of the sustainable energy agenda since 1990 when Leicester's first strategic energy action plan was developed.

An energy audit conducted by Leicester determined that offices and buildings owned by the municipality consumed over 170 GWh of energy each year. As part of the larger Energy Action Plan, in 1990 Leicester announced its commitment to reduce energy use in municipal buildings by 50% by the year 2025, through increased investment in retrofit measures, as well as the design of new buildings to improve lighting, heating and ventilation standards.

The town hall that was built in 1876, for example, was retrofitted in 1994 under the Council's energy investment programme. As a result, gas usage was reduced by over 20%, representing a saving of over half a million kWh and 90 tonnes of CO_2 emissions in two years.

Leicester has also invested in intelligent metering systems, installed in over 300 administrative buildings throughout the city, to provide half-hourly monitoring of gas, electricity, water and heat consumption data. This real data is used to engage building users to make savings through changes in their behaviour.

Responsibility for delivering these improvements as set out by the Energy Action Plan is held by the Energy Management Section, which is based at the Energy-efficiency Advice Centre. The Centre also provides information and a range of energy-efficient products to the general public, while the Leicester Energy Agency (LEA) gives practical assistance to small businesses on energy-related matters.

LEA was developed in 1996 as a partnership between Leicester City Council and the Institute of Energy and Sustainable Development at Montfort University. The Agency aims to improve the energy efficiency of up to 5,000 businesses, to set up an Energy Services Company and to achieve an overall reduction in energy consumption of between 340-840 TJ [3] in Leicester.

www.leicester.gov.uk/your-council--services/ep/the-environment/betterbuildings

www.leicester.gov.uk/index.asp?pgid=15769

Case Study 20

Merchandise Mart - Downtown Chicago by mdesisto/flickr.com

15 Million square feet retrofit programme for public buildings

Chicago, USA

The City of Chicago began to audit and retrofit 15 million square feet (4.572 m^2) of public buildings with efficient equipment for heating and cooling, lighting, ventilation and appliances. The area is made up of police stations, libraries, fire stations, park facilities, transit facilities, health centres, community/cultural centres, colleges and other types of facilities that are owned by the City, the Chicago Park District, the Chicago Transit Authority or the City Colleges of Chicago.

As of June 2004, more than 5 million square feet (about 1.5 million m^2) of city-owned facilities had been audited and retrofitted. When the project is completed, energy savings to the city and its sister agencies are estimated to be $US6 million annually, with US$2 to 3 million in savings for the City alone. The annual savings upon completion is estimated to be 30,000 tonnes of CO_2 emissions, 84 tonnes of nitrous oxides and 128 tonnes of sulphur dioxide.

The City of Chicago and the Clinton Climate Initiative (CCI) will also work with the Merchandise Mart, the world's largest commercial building and largest wholesale design centre and the Sears Tower, the tallest building in America, to complete audits and subsequent overhauls to increase their energy efficiency and reduce their carbon footprints. In addition, CCI is developing a targeted programme for energy retrofits of privately-owned, multitenant housing in Chicago. Under the auspices of the City's Department of Housing, building owners will jointly contract for energy performance contracts and use future energy savings to finance the project implementation.

www.cityofchicago.org/Environment

[3] There are 1000 Gigajoules in a Terrajoule (TJ)

Case Study 21

Office occupants reduce energy use by 20% in local government building

Cape Town, South Africa

The Tygerberg Administration building in Parow, Cape Town was chosen as a lead building energy-efficiency project after an energy audit was performed and huge saving opportunities were identified. The project, initiated in 2003, aimed to reduce energy use, expenditure and GHG emissions through introducing technological interventions and the promotion of behavioural change amongst building users (city staff).

Based on an initial energy audit, a 20% savings target was established for the project. Regular project meetings were held with relevant staff members to plan for the interventions, provide feedback on successes and problem areas of the project and decide on what follow-up actions were required. Substantial support from a consultant was provided during the project implementation.

The technological interventions included the replacement of 500 incandescent light bulbs with compact fluorescent light bulbs (CFLs), installation of a solar water heater, installation of geyser timers on hot water cylinders, the replacement of some of the tea urns with insulated urns (hydroboils), installation of more efficient fluorescent tubes/ballasts and adjusting air conditioning thermostat settings and use times.

The behavioural change component of the programme involved regular information of staff members via email, a display board set up at the entrance of the building displaying savings from the project, information pamphlets and newsletters keeping staff constantly updated on project achievements and requesting staff to take action to reduce their electricity bill.

The project achieved a saving of 12,000 kWh per month amounting to annual saving of 144,000 kWh of electricity – a 22% saving. This translates to saving of R39,000 (US$5,159) and 158.4 tonnes of carbon emissions per year. Approximately 14% saving was achieved in the technical phase (when the technological interventions were implemented) while 8% was achieved in the 'staff participation' behaviour change phase.

The project reflected huge savings potential from the interventions used, shown by the project targets being easily met and a short payback period estimated at 2 years. This implied that the application of such interventions in other City of Cape Town buildings would likely be technically and financially feasible, save substantial amounts of money and reduce GHG emissions. It was difficult to determine a clear distinction between change attributed to technical interventions and staff awareness (behavioural change) due to change in staff behaviour already occurring on hearing about the project being performed, well before the behavioural changes were requested.

Source: How to implement renewable energy and energy-efficiency options – support for local government. Sustainable Energy Africa and REEEP. 2007.

Case Study 22

Guidelines for building better

San José, USA

The city of San José, the third largest city in California and home to a million people, experiences temperatures ranging form 10°C to 21°C. San José found that by properly orienting streets, sites and buildings, developers could reduce the energy used for space heating by roughly 11% and for cooling by up to 40%.

The San José Environmental Services Department has therefore developed voluntary guidelines, called solar access guidelines, to encourage solar orientation in new constructions. These solar access guidelines specify that the long axis of new dwellings should face within 30° west and 45° east of true south. Because houses in a subdivision usually face the street, planners in San José found that the easiest way to achieve solar orientation was to orient the streets with 30° of the true east-west axis. Homes in such a subdivision would have good solar orientation by default.

In 1998 The San José City Council also approved a recommendation to create a green building task-force that would recommend a green building policy for the City of José. Creation of this task-force was based on a community-initiated recommendation that the City begin to explore green building opportunities. Green building policies and programmes are designed to promote building practices that maximise the health of the occupants and minimise the negative environmental impacts associated with the design, construction and operation of buildings.

Based on discussions with area builders, developers and architects and an understanding of other green building programmes across the country, the Environmental Services Department formed three major work groups:

- **Green Building Steering Committee** – made up of representatives from key city departments
- **San José Green Building Workgroup** – a self-selected group of individuals from the community
- **Green Building Taskforce** – comprised of key building, housing and community sector members appointed by the Mayor

In June 2001, City Council adopted green building policies as developed by the members of the community with the input of city departments.

www.sanjoseca.gov/esd

www.sanjoseca.gov/esd/natural-energy-resources/gb-background.htm

Table 1: Total savings

	Saving/mth	Saving/yr
kWh/month	12,000	144,000
Tonnes CO_2	13.2	158.4
Rands	3,240	38,880

Case Study 23

Learning from termites to cool and heat naturally
Harare, Zimbabwe

The Eastgate Centre is a shopping centre and office block in downtown Harare that has been designed to be ventilated and cooled entirely by natural means. The building stores heat in the day and in the evening, the warm internal air is vented through chimneys, assisted by fans but also rising naturally because it is less dense and drawing in denser cool air at the bottom of the building. At night, the process continues, with cold air flowing through cavities in the floor slabs until the building's fabric has reached the ideal temperature to start the next day. This makes a mechanical or passive cooling system a viable alternative to artificial air-conditioning. The complex also consists of two buildings side by side that are separated by an open space that is covered by glass and open to the local breezes.

This ventilation system was achieved by the incorporation of biomimicry principles[4] into the architectural plans, using design methods inspired by indigenous Zimbabwean masonry and the self-cooling mounds of African termites. Termites build gigantic mounds inside which they farm a fungus that is their primary food source. The fungus must be kept at exactly 35°C, while the temperatures outside range from 1.5°C at night to 40°C during the day. The termites achieve this remarkable feat by constantly opening and closing a series of heating and cooling vents throughout the mound over the course of the day. With a system of carefully adjusted convection currents, air is sucked in at the lower part of the mound down into enclosures with muddy walls and up through a channel to the peak of the termite mound.

The Eastgate Centre uses less than 10% of the energy of a conventional building its size. Eastgate's owners have saved $3.5 million alone because of an air-conditioning system that did not have to be implemented. Outside of being eco-efficient and better for the environment, these savings also trickle down to the tenants whose rents are 20% lower than those of occupants in the surrounding buildings.

http://en.wikipedia.org/wiki/Eastgate_Centre,_Harare;

www.inhabitat.com/2007/12/10/building-modelled-on-termites-eastgate-centre-in-zimbabwe/

Case Study 24

Mali by Sean Mcgrath/flickr.com

Retrofitting hotels
Bamako, Mali

In May 2006, an International Finance Corporation (IFC) conducted an audit of the Chaîne Azalai Hotels in Bamako and determined that with proper technology the hotels could save up to 23% in energy and water use. Investments in cleaner technology that were identified included room keys that switch air conditioning and lights off when guests leave the rooms, efficient light bulbs and a solar water heating system.

These improvements would result in a 50% increase in net profit and could be paid off in a year and a half from cost savings.

This is the first cleaner production initiative of its type for both Mali and Burkina Faso. Given the Chaîne Azalai's leading position in Mali's tourism market, if it chooses to implement the recommended cleaner production investments, it could lead to rapid adoption of similar improvements by other players in the region's tourism sector.

www.ifc.org/ifcext/media.nsf/Content/African_Hotels_Energy_Water_Savings

3.3 Water services, wastewater and sanitation

The energy costs to run drinking water and wastewater systems – to pump, treat, deliver, collect and clean water – can represent as much as one-third of a municipality's energy bill. There are ways to improve efficiencies, save money and reduce water consumption while delivering these important services.

Using water efficiently will conserve water and energy, prevent water pollution at source and reduce costs associated with the expansion of municipal water distribution and wastewater treatment systems.

Methane, a greenhouse gas, can be an off-gas from sewerage works. Flaring this gas could increase your carbon footprint. This gas could be used productively and turned into electricity or bio-methane for transport, potentially bringing in income while reducing one's carbon footprint.

[4] This is the study of natures best ideas and how to imitate these great designs or processes to solve human challenges

Case Study 25

UNEP Sustainable Building and Construction Initiative (SBCI)

The UNEP Sustainable Building and Construction Initiative (SBCI) provides stakeholders with a common platform to promote the adoption of sustainable construction principles. Industrials, construction companies, real estate developers, financers, architects and local authorities are working with UNEP and its partners to propose energy efficiency and CO_2 emissions from buildings and to develop benchmarks for sustainable building.

This initiative provides reviews of policy instruments for reducing greenhouse gas emissions from buildings, has a key report on how buildings can play a key role in combating climate change and provides targeted policy briefings for countries and regions.

To achieve its final objective of promoting a worldwide adoption of sustainable buildings and construction practices, SBCI is implementing a 4 step process.

STEP 1 – Provide a common platform for the stakeholders
SBCI provides a common platform to all buildings and construction stakeholders for addressing sustainability issues of global significance, especially climate change.

STEP 2 – Establish baselines
SBCI establishes globally-acknowledged baselines based on the life cycle approach, with a first focus on energy efficiency and CO_2 emissions.

STEP 3 – Develop tools and strategies
SBCI will develop tools and strategies for achieving a wide acceptance and adoption of sustainable building practices throughout the world.

STEP 4 – Implementation through pilot projects
SBCI promotes the adoption of the above tools and strategies which will be evaluated through pilot projects to key stakeholders.

Source: www.unepsbci.org

Praia do Fortaleza by wbuechel/flickr.com

Saving water, saving energy, saving money, reaching more people
Fortaleza, Brazil

The Companhia de Água e Esgoto do Ceara (CAGECE) in the Northeast of Brazil in partnership with Alliance to Save Energy aimed to improve the distribution of water and the access to sanitation services, while reducing operational costs and environmental impacts.

Over four years, CAGECE saved 88 GWh of energy, improving efficiency each year. Before CAGECE instituted their energy-efficiency programme, they provided access to 442,400 households. Four years later, the utility provided 88,000 new connections over the original baseline, while decreasing total energy consumption and costs and maintaining water consumption levels. Four years of official data show savings of over US$2.5 million with an initial investment by CAGECE of only US$1.1 million. As a result of this 127% return on investment after 4 years, CAGECE was initially approved for financing by the energy-efficiency fund of PROCEL (Government Brazil Fight Against Electricity Waste Programme) to work with the World Bank to implement further efficiency measures. The Alliance helped develop five projects, including replacing motors with high performance motors, maximising pumping efficiency, suspending pumping during peak hours and increasing capacity of the current pumping stations and specifications relating to energy efficiency. If implemented these projects would add a saving of 7 million kWh per year, with a total investment of US$2 million by the PROCEL and the World Bank. The cost/benefit analysis predicts a payback period of 3.5 years. However, the financing opportunity was lost because funds were obligated to pass through the state energy utility in Ceará (COELCE) and the legal departments of COELCE and CAGECE could not come to an agreement.

Further intervention included automation of operations, rewinding and replacement of motors, maximising existing pump systems efficiency and increasing storage capacity to allow the shutdown of pumps during peak hours. An operations procedure manual was created to serve as a reference for daily performance to operations crews and CAGECE management. CAGECE established an operational control centre for the water supply system of Metropolitan Fortaleza. The objectives of the automation of the water supply system of Fortaleza were to optimise operations to reduce energy costs, improve system management by centralising control, speed up recognition of and response times to maintenance needs using sensors and by acting through controlling devices and generate system diagnostics using historical records of operational data.

www.watergy.org/resources/casestudies/fortaleza_brazil.pdf

Case Study 26

Technical interventions to save energy while delivering water
Ahmedabad, India

Capacitors[5] on water pumps in Ahmedabad are reducing power consumption by 12.6%, resulting in financial savings of over 2.6 million rupees or US$50,000 a year. The city also replaced it steel water pipes with bigger diameter polyvinyl chloride pipes, which reduced friction in the pipes and improved energy efficiency. This change alone reduced energy consumption by an estimated 1.7 million kWhs each year, saving the city more than 4.48 million rupees (about US$100,000) annually.

www.egovamc.com

Case Study 27

Drinking water pumped up by the sun
Kayrati, Chad

The rural population of Chad in 2003 was estimated at around 6.6 million living in 28,500 villages, with only 27% of all rural communities having access to a modern water point. In order to provide safe drinking water to some villages solar water pumps have been employed.

A solar-powered water pump and holding system was installed in Kayrati in 2004 as compensation for land lost to oil development. This solar-powered water tower provides clean drinking water to the 1,700 inhabitants of the Kayrati community. This system utilises a standard well pump powered by photovoltaic panels. Panels soak up rays from the sun to power an electric pump that raises water from a borehole. The water tower then brings up clean drinking water by gravity into public taps in the village.

Although a rural project, many cities have peri-urban communities that need access to clean water and this may be an option.

Source: Trying to make oil wealth work for the people, IRIN News, October 2004 and Chad National Drinking Water Supply and Sanitation Programme (PNEAR): Appraisal Report.

www.povertyenvironment.net/?q=chad_national_rural_drinking_water_supply_and_sanitation_programme

Case Study 28

Fetching water a well, India. www.usi.edu

Rainwater harvesting can save energy
Delhi, India

Rapid urbanisation and population growth have resulted in Delhi facing acute water shortages and a drastic drop in the groundwater table. A number of measures are being promoted to address the falling groundwater levels. One of these measures involves a Ministry of Water Resources programme for rainwater harvesting and recharge of the groundwater system.

The Municipal Corporation of Delhi has given instructions to make rainwater harvesting mandatory in all new buildings with a roof area of more than 100 m^2 on plots exceeding 1,000 m^2.

The potential of rooftop rainwater harvesting is approximately 125,000 litres for a plot size of 250 m^2 based on an annual rainfall of 1,000 mm. If the scheme is implemented throughout the city of Delhi the additional recharge to groundwater will be around 76,500 million litres per annum. If the water level rise from this recharge is as expected, this will amount to a saving of US$16,000 per day. Over and above this saving on conventional water supply, there will be a very significant energy saving. In floodplains the energy saving for a 1 m rise in ground water level is around 0.40 kW due to the reduced pumping needs.

Source: Measures for Ensuring Sustainability of Rainwater Harvesting, Water for Asian Cities Programme Rain Water Harvesting and Artificial Recharge to ground water: A Guide to follow. 2008

[5] A capacitor is an electronic device that can store energy in the electric field between a pair of conductors (called 'plates'). The process of storing energy in the capacitor is known as 'charging' and involves electric charges of equal magnitude, but opposite polarity, building up on each plate. Capacitors are often used in electric circuits as energy-storage devices.

Case Study 29

Veracruz, Mexico by Johnny Shaw/flickr.com

Reducing energy intensity in delivery of water and sanitation services
Veracruz, Mexico

The Metropolitan System of Water and Sanitation at Veracruz (SAS), the water utility in Veracruz, Mexico, was motivated to undertake significant steps to become more energy efficient because energy costs ranked second in total operating costs and because their service was sporadic with severe interruptions. The system serves 628,000 users and provides water and sanitation in the municipalities of Veracruz, Boca del Rió and Medellín in the state of Veracruz.

Before the project, parts of the system experienced severe interruption of service lasting up to five hours at a time. The project goal was to increase the energy-efficiency of the operating system, improve the conditions of operation and provide better service to the customer. The plan they developed helped to improve energy and water supply efficiency, while at the same time improve water service.

The project achieved savings primarily from basic supply side strategies using a variety of methods:

- Optimisation of electromechanical efficiency resulting in savings of 153,254 kWh/month, with a payback period of 1.7 years
- Leak detection and water conservation resulting in savings of 35,500 kWh/month.

The baseline energy intensity[6] taken at the beginning of the programme was 0.48 kWh/m^3. Over the development of the programme, the energy intensity had been reduced to 0.39 kWh/m^3 resulting in US$394,000 in savings for the utility.

www.watergy.org/resources/casestudies/veracruz_mexico.pdf

Case Study 30

Improving access to water and saving energy in India
Vishakhapatnam, India

Indian municipalities are facing the challenges of rapid urban expansion, increasing power tariffs and acute water shortages. At present only about two-thirds of the urban population has direct access to clean, affordable and reliable drinking water services. At the same time, municipal water utilities in India spend up to 60% of their budgets on energy used for water pumping.

Vishakhapatnam, with a population of 1.2 million, is the second largest city in the southern Indian state of Andhra Pradesh. The city has a severe shortage of water. 213 million litres per day (MLD) are required by the city, which in turn requires 340 MLD to be pumped from the source, due to waste that occurs at various points in the system. However, only 190 MLD was being supplied to the city and in some areas drinking water is supplied only once every two days.

Vishakhapatnam Municipal Corporation (VMC) wanted to augment the water supply by bringing water from a reservoir of the River Godavari from a distance of nearly 200 km. The distance from the river to the reservoir is another 56 km. VMC spent US$94 million to lay the transmission pipeline from the river to the reservoir and another US$23 million to integrate the new water received into the existing supply system.

VMC has also allocated US$3.4 million for reduction of water losses, energy efficiency and other measures. In partnership with the Alliance to Save Energy, the VMC:

- Implemented a water and energy audit study of VMC's bulk water supply system
- Built in-house technical and managerial capacity of VMC to oversee energy audits and implement energy-saving measures
- Incorporated energy-efficiency measures in the design stage of its new Godavari water works by adapting tender documents and redefining the technical specifications of pumps and motors.

VMC implemented energy-efficiency measures with an investment of only US$24,500 from its operations and maintenance funds. The measures included retrofitting pumps and motors, optimising the use of contracted demand, segregating low tension and high tension and trimming impellers. As a result of these measures, VMC is accruing an annual energy savings of 1.4 million kWh and an annual financial savings of approximately US$60,400. This has reduced VMC's annual energy bill for pumping water by about 5.4% and has reduced CO2 emissions by about 2,400 metric tonnes. The simultaneous reductions in municipal wastewater, through more effective supply and distribution, will allow the municipality to deliver water to more homes.

www.waterway.org/resources/casestudies/vishakhapatnam_india.pdf

[6] The amount of energy needed to move a cubic metre of water

3.4 Waste management and methane recovery

Good waste management practices by local governments can significantly reduce energy consumption and greenhouse gas emissions. Recycling and re-using materials reduces the energy needed to:

- dispose of these products through the waste stream (including reducing the need to transport waste) and
- produce and transport new products (also called embodied energy).

When organic waste, such as paper, cardboard, garden and food remains decompose, it produces methane, a powerful greenhouse gas. This gas produced in landfills can be captured and used as a source of energy. This is a significant means to reducing carbon emissions and is the type of project where the carbon emissions are fairly easily traded.

Garbagetruck by Pip Wilson/flickr.com

Case Study 31

The Streets of Naga City by hellochris/flickr.com

Recovering waste materials and reducing GHG emissions

Naga City, Philippines

To reduce the amount of garbage brought to the landfill or dumped into the river stream, Naga City formulated the concept of establishing materials recovery centres in 1999. The city started off with community-based and small-scale materials recovery facilities, which worked their way toward a city-wide materials recovery facility (MRF) launched in February 2004.

The facility serves as a waste processing and recycling plant that converts biodegradable waste to organic fertiliser. Low-grade composts are sold at markets for a minimal price while high-grade composts are on average US$3.50/bag. Non-biodegradables recovered by the facility are either sold or recycled. Housed at a former dumpsite converted into a controlled landfill, waste collectors who live in the area now work at the facility as waste segregators.

The MRF is made possible through a build-operate-transfer (BOT) agreement with Lacto Asia Pacific Corporation. In implementing this project, the local government invested 3.75 hectares of land, 3.5 million pesos (US$64,000) for the machineries and equipment, 5 million Pesos (US$91,000) for the infrastructure and an estimated 14 million pesos (US$250,000) every year for operational costs (i.e. collection and delivery). The partner organisation provides the equipment such as trolley, garbage bins, trommel mill, screener and conveyors.

From an average of 60 tonnes of waste collected everyday from the city, of which 40% is recyclable, about 13,862 tonnes of CO_2e emissions are reduced annually.

www.iclei.org (ICLEI case study – Local Waste Diversion)

www.naga.gov.ph

Case Study 32

eThekwini – Durban, South Africa by antiguense/flickr.com

Landfill-to-electricity project using CDM
eThekwini, South Africa

The Durban landfill-to-electricity Clean Development Mechanism (CDM) project aims to enhance the collection of methane at three landfill sites of the eThekwini Municipality: the Mariannhill site, the La Mercy site and the Bisasar Road site. Two of these sites (Mariannhill and Bisasar Road, which opened in 1997 and 1980 respectively) already collect and flare methane, but this takes place at an efficiency rate of a mere 7.4%. The CDM project aims at a collection efficiency rate of 85% at the highest level (to be reached in 2012) and of 45% at the end of the project's commercial lifetime.

The project's methane recovery will take place through the installation of approximately 180 production wells for landfill gas extraction at the three sites. Subsequently, the gas will be used for electricity generation. It is envisaged that the project will install a total electricity generation capacity of 10 MW gas-fired generators (in units of 1 MW each) at the three sites, which will produce 74.5 GWh per year. The electricity will be delivered to the South African grid, based on a power purchase agreement for 10 years with options for two additional 5-year extensions.

Durban Solid Waste, the municipal agency responsible for management and operation of multiple landfills in the eThekwini metropolitan area, will function as the technical advisor and the operational entity of the project.

www.durban.gov.za/durban/services/departments/environment/environews/greenpast

www.jiqweb.org/durban.htm

Case Study 33

Integrated waste management
Edmonton, Canada

The City of Edmonton's approach to waste management is comprehensive, integrated and sustainable. Based on public input, Edmonton developed a 30-year Waste Management Strategic Plan in 1994 that provides the overall framework for the ongoing development and improvement of waste management practices. Working in part with private sector partners, the implementation of the waste management strategy has succeeded in enabling Edmonton to divert approximately 70% of its residential waste from landfill.

Key components include household participation in recycling, a state-of-the-art co-composting facility, a materials recovery facility, a leachate treatment plant, landfill gas recovery and public education programmes. These programmes and technologies have provided an opportunity for Edmonton to work with private sector and academic partners to develop a waste management centre of excellence with a focus on education, research and technology.

Edmonton's Clover Bar Landfill Site is 1 of 33 landfills in Canada that has an active gas recovery system. It is the only site in Alberta that both recovers gas and uses it to generate electricity and 1 of only 13 such sites in Canada. The methane produced at the landfill is converted into enough electricity to meet the power needs of approximately 4,600 homes.

www.edmonton.ca/portal/server.pt/gateway/PTARGS_0_2_271_213_0_43/http%3B/CMSServer/COEWeb/environment+waste+and+recycling/waste/edmonton+waste+management+centre/Landfill+Gas+Recovery.htm

Additional Source: ICLEI Case Study – City of Edmonton, Canada: Comprehensive and Integrated Approach to Waste Management. August 2001.

Case Study 34

Sunset Dar es Salaam by phunko82/flickr.com

Landfill gas recovery at Mtoni Dumpsite
Dar Es Salaam, Tanzania

In 2004, Dar Es Salaam City Council, an urban authority, started planning for the closure of Mtoni Dumpsite. In 2005, a private firm from Italy approached the city authority to establish a gasflaring project. An initial study estimated the total avoided CO_2 emissions over a 10-year period to be about 1,033,209 tonnes, a good basis for a CDM project.

The private company and Dar Es Salaam City Council signed a concession contract in March 2005 in which Dar Es Salaam City Council grants the company, Consorzio Stabile Globus, the rights to capture and burn all biogas produced at the 'Mtoni Dumpsite' for a 10-year period. Throughout the duration of the contract, Consorzio Stabile Globus will be responsible for the construction and management of the gas extraction and flaring system, including any required investment. Dar Es Salaam City Council will continue to own and manage the landfill site.

Consorzio Stabile Globus will capture the biogas produced at Mtoni Dumpsite by setting up and operating an extraction plant comprised of a network of wells and connected pipes, running into blowers and then into torches to flare it.

www.cd4cdm.org/sub-Saharan%20Africa/Tanzania/First%20National%20Workshop/LandfillGasRecovery_Chinamo.pdf

http://cdm.unfccc.int/Projects/DB/DNV-CUK1169853184.14

Case Study 35

Marie Reiderskold/flickr.com

Production of biogas and bio-fertiliser while reducing carbon emissions
Laholm, Sweden

The Laholm Biogas Plant was built in 1992 as a measure to reduce the increasing eutrophication[7] of the Laholm Bay on the west coast of Sweden. Prior to the establishment of the plant in 1992, manure in Laholm created significant environmental problems in the area. Nitrogen was leaking into the bay, polluting it for drinking and recreational purposes and killing off marine species. As such, the goals for the project were also to produce biogas for the city of Laholm and to produce a certified bio-fertiliser for the farmers in the area. With the establishment of the plant there is now adequate storage for manure and the manure is turned into energy and fertiliser.

Laholm has a biogas plant that turns animal manure and different kinds of organic waste into bio-fertiliser and biogas. As a result, biogas is replacing around 25% of the city's natural gas consumption and is reducing GHG emissions by 3,700 tonnes per year.

The biogas feeds into the district heating network, heating industries and houses. A portion of the biogas is also sent to filling stations, to provide fuel for a growing number of light-duty vehicles and trucks. The biogas plant, Laholm Biogas AB, is a company owned jointly by the local power utility company Södra Hallands Kraft AB, the local farmers association (Vallberga Lantmän) and the City of Laholm. An upgrade of the plant in 2000 has made it possible to use 100% of the biogas, thereby avoiding previous challenges involving flaring of gas during periods when heat demand is low.

Source: Injection of Biogas into the Natural Gas Grid in Laholm, Sweden, IEA Bioenergy Task 37.

www.biogasmax.eu/media/1_biogas_upgrading__075624200_1207_19042007.pdf

[7] Eutrophication means an increase in chemical nutrients – typically compounds containing nitrogen or phosphorus – in an ecosystem. It may occur on land or in water. The term is however often used to mean excessive plant growth and decay and further effects including lack of oxygen and severe reductions in water quality, fish and other animal populations.

Case Study 36

Thailand Street Market by Atelier Teee/flickr.com

Reducing CO_2e while making organic fertiliser and liquid detergent production from waste

Thungsong, Thailand

The Municipality of Thungsong has identified and implemented measures aimed at not only managing their waste sustainably to reduce local GHG emissions, but also to benefit from the economic possibilities.

The Municipality of Thungsong collects organic wastes from the fresh market stall owners, after which they are grounded, mixed with molasses and composted for 10-20 days. This produces 3,000 litres of liquid detergent and 1,000 kg of ground fertiliser every month, providing the municipality with an estimated annual income of US$1,200 from the sale of these products.

Aside from establishing a materials recovery facility, the municipality has also initiated successfully hazardous waste management (i.e. coating of Para rubber of dangerous waste before storage), organic fertiliser production from household sewage and livestock manure and organic fertiliser and liquid detergent production from market waste.

The carbon offsets from the organic fertiliser production is estimated at 29 tonnes of equivalent CO_2. The organic fertiliser replaces unhealthy chemical fertilisers and the detergent produced is used to clean the market floor.

This initiative depends largely on sustaining waste segregation practices. Ensuring that this practice is sustained entails multiple and innovative community incentives.

https://www.iclei.org/fileadmin/user_upload/documents/SEA/CCP_Projects/Tungsong.pdf

Case Study 37

Fishing Boats by JoVivek/flickr.com

Using wastewater to power a seafood processing plant

Ratnagiri, India

An effluent treatment plant was installed in Ratnagiri, a district in Mahrashtra about 400 km from Mumbai, to treat the wastewater from the manufacturing of seafood in order to generate biogas. The plant generates 13,000 m^3 of biogas daily, replacing 4,7 kilolitres of oil from furnaces per day.

The effluent is treated in an anaerobic digester followed by further processes that allow for the re-use of the wastewater to reduce water consumption in the plant. During treatment of wastewater, biogas is generated with high percentage methane which is converted into thermal energy for the plant's in-house requirements. Not only is water consumption and energy use therefore reduced, but the closed system prevents large quantities of methane, a powerful greenhouse gas, from being emitted into atmosphere.

This is a joint project between the Ministry of Environment and Forests in India and Gadre Marine Export Pvt Ltd.

www.lr.org/NR/rdonlyres/948387B9-63A2-40ED-A902-5FE419B5C4AA/38985/MethaneRecoveryfromwastewatertreatmentinSeafoodInd.pdf

3.5 Public lighting

Converting streetlights and traffic signals to low-energy systems typically provide significant energy and operating cost savings for a local authority. These are usually considered 'low-hanging fruit' as they are quite easy to tackle and show results quickly. Traffic signals are owned and operated by local governments and run 24 hours a day, consuming a significant amount of energy. Historically these signals have used incandescent bulbs, but recently cities have taken the initiative and begun replacing incandescent signals with more efficient light emitting diode (LED) signals, which use 90% less power, last ten times longer and appear brighter than traditional incandescent bulbs. For example Denver, Colorado saves nearly US$800,000 annually in energy, materials and labour costs. In terms of emissions reduction and public health, this programme reduces pollutants by an amount equivalent to the effects of planting more than 777 acres of trees or the permanent removal of 371 cars from local roads.

Motorcyclist at night by (nz)dave/flickr.com

Case Study 38

LED lighting by 92wardsenatorfe/flickr.com

Energy-efficient street lighting in India

Guntur, India

Relative to the provision of other public services, street lighting in India consumes an immense amount of energy. The municipal corporation of Guntur was spending Rs1,072,074 (US$26,360.31) (based on the monthly average for electricity bills in 2002) for street lighting alone. An analysis suggested a significant scope for energy savings through providing an energy-efficient street lighting system in the corporation area.

A pilot demonstration project 'the Energy Efficient Street Lighting System' was initiated in March 2003. This involved using power saving instruments in four strategic locations, each device calibrated for that location's unique lighting load.

The Servo Max Power (produced by Servomax India Limited) saver devices, installed at switch points, guarantees a 25% -30% reduction in energy consumption. The devices in the four demonstration areas regulate voltage after peak hours and automatically reduces voltage during low traffic flow.

The pilot project was supported by ICLEI under an agreement with Gunter Municipal Corporation (GMC), which agreed that once the results of the pilot project were substantiated GMC would implement its recommendations across the entire city in a phased approach through an Energy Services Company (ESCO).

These devices resulted in an overall energy saving of 35%, saving 22,900 kWhs of electricity and reducing CO_2e by 23 tonnes per year.

www.iclei.org/index.php?id=1636

Case Study 39

Chaat shop blues by Sajith T S/flickr.com

Retrofitting streetlights
Jabalpur, India

With 20% of its energy bill coming from street lighting alone, ICLEI along with the Municipal Corporation of Jabalpur (MCJ) proposed an energy efficient street lighting pilot project to reduce the expenditure and improve the energy-efficiency in the existing system.

The 'Retrofit Street Lighting Pilot Project' was launched in 2002. The project was located at two important locations in Jabalpur, namely Nehru Garden, MCJ and Janki Nagar Residential Area, where 51 energy-saving retrofit tubelights were installed. The cost of the project was Rs50,000 (US$1,208.75) 70% of which was shared by ICLEI, with the remaining 30% contributed by the project consultant, Asian Electronics Ltd.

The basic concept for the project is a retrofit of the conventional streetlight system with an energy-efficient tubelight system. Jabalpur streets, walkways and parks are commonly lit with 40-W fluorescent tubelights with ballasts that consume an additional 10-13 W. To reduce energy consumption, 28-W retrofit tubelights have been introduced on the pilot project sites.

The data gathered after six months of monitoring and observations suggests that the savings associated with the retrofit is Rs35/month/tube (US$0.85) according to 10-hour illumination/day and including maintenance and labour charges. This will also lead to an annual reduction of 7 tonnes of GHG emissions.

The city is studying the feasibility of replacing 33,000 existing tubelights with new efficient 28-W tubelights, resulting in a reduced energy consumption of 3 million electrical units annually.

www.iclei.org/index.php?id=1637

Case Study 40

South Africa, Johannesburg: Night lights by kool_skatkat/flickr.com

Solar streetlights as part of regeneration plans
Johannesburg, South Africa

The streets of inner city Johannesburg might be lit by solar-powered streetlights as the Johannesburg Development Agency (JDA) adopts an environmentally-friendly lighting strategy. Established in April 2001 as a limited liability company, the JDA is an agency of the City of Johannesburg that stimulates and supports area-based economic development initiatives throughout the Johannesburg metropolitan area in support of Johannesburg's Growth and Development Strategy.

As part of an initial pilot project, three locally manufactured solar streetlights have been installed on Kenmare Street in Yeoville by Broadwing Technologies. If the pilot is a success more lights will be installed in surrounding areas and the rest of the city.

Renewable energy from the sun means independence from Eskom's coal-based power utility, which in turn means cost savings and environmental gains. An evaluation that was done jointly by Broadwing Technologies and JDA to monitor performance showed that the solar streetlights compare favourably with the cost of installation of conventional streetlights. The lifecycle maintenance costs of the installation are also favourable as the LED bulbs used in the streetlights use a lower voltage to produce a brighter light and can be used without replacement for about 20 years.

According to figures estimated by Broadwing Technologies, the City would be able to achieve a saving of 1 MW for every 12,000 or 15,000 streetlights that are retrofitted.

www.engineeringnews.co.za/article.php?a_id=131170

Case Study 41

Council Square at night, Brasov, Romania by cod_gabriel/flickr.com

Public lighting
Odorheiu Secuiesc, Romania

During communist rule, street lighting was very inefficient, if it was provided at all. In 1996, Odorheiu Secuiesc did an audit of its outdoor street lighting to find that only 42% of the light standards were in good working order.

This urged the European Commission to make an offer to the communities by establishing the collaboration CLEEN (Communal Lighting and Energy Efficiency Network), with the help of the Energie Cites Project. A pilot project was introduced to assess the feasibility of acquiring energy-saving lamps from abroad which had a much longer lifespan than domestic products. The next step was to get the consent of the government-owned electricity company to implement far-reaching changes in the lighting network. This was difficult to begin with, as the company, for obvious reasons, was not interested in reducing energy consumption.

The energy company was put in charge of acquiring high-pressure sodium vapour lamps for the city lights. Money saved was then re-invested to improve the lighting network. 75% of streetlights in Odorheiu Secuiesc have now reached European standard.

www.bestpractices.at/main.php?page=programmeme/europe/best_practices/odorheiu_secuiesc_romania&lang=en

Case Study 42

Solar-powered traffic lights by Bruce Sutherland, City of Cape Town

Combining solar power with LED bulbs for energy-efficient traffic lights
Cape Town, South Africa

The City of Cape Town embarked on a pilot project to power traffic lights by sunlight rather than electricity. Working together with the National Energy Efficiency Agency, the City installed light emitting diodes (LED) traffic lights powered by solar panels. This initiative will improve traffic flow during electricity black outs, reduce operational costs and reduce greenhouse gas emissions.

The eight-traffic light intersection in a busy industrial and commercial hub was retrofitted with energy-efficient LED lights, a monitoring unit, a solar panel and batteries as part of a three-month assessment period.

The 4 m^2 solar panel (mounted on a lamppost-height pole to prevent theft) charges the battery buried underground. It can generate 500 W. Currently an average traffic intersection uses about the same amount of power during a month as an average three-bedroomed house. Based on this, it is estimated that Cape Town's traffic lights draw the same amount of power as 1,200 three-bedroom homes. This means potential energy savings in the future would be sizeable if all traffic lights changed from halogen lights to energy-efficient LED clusters powered by the sun. These LED lights use seven times less electricity than conventional light bulbs in traffic lights and also last for at least five years, as opposed to three months.

If the pilot project, funded by the major power utility Eskom, is a success, these solar-powered traffic lights will be rolled out throughout other municipalities across the country.

www.capetown.gov.za/press/Newpress.asp?itemcode=2318

www.southafrica.info/about/sustainable/ctgreen-021007.htm

Case Study 43

3.6 Public transport and city planning

There is an obvious link between reduced vehicular travel and reduced fossil fuel use and therefore greenhouse gas emissions. Local governments need to vigorously support a shift from private to public and non-motorised transport for daily commuters. In cities where a significant percentage of commuters walk, traffic-calming measures aimed at reducing traffic speed and protection of pedestrians and cyclists are vital.

Urban form has a direct impact on energy use – and on greenhouse gas emissions. The development of compact, mixed-use neighbourhoods increases energy efficiencies, as do the increasing of densities around transport nodes and activity spines. These approaches to city planning also reduce infrastructure and service delivery costs.

Mass transit is at the heart of any smart growth policy, because it allows people to get from home to work in the most efficient, least environmentally-harmful way possible. Mass transit in the form of buses or rail can save energy, reduce pollution, reduce the need for parking, alleviate congestion and provide economical transportation alternatives. In many congested cities using mass transit can also be faster than driving a car. Bus Rapid Transit, has proven to be both cost efficient and popular with riders. In these systems, buses run on a dedicated lane separated from traffic, with its own timed traffic signals. Allowing buses to bypass car traffic congestion dramatically speeds up bus travel and makes buses highly competitive with private cars for commuters.

Cities can also run buses on biodiesel. Local governments might even consider starting a citywide waste vegetable oil collection service to run the buses. Biodiesel has many downsides however, if it is made with edible food crops such as maize or soya. When fuels are manufactured from grains and other staple crops it can push up prices of food and thus impact most on the poor. The production of feedstock for biofuel production is often also water intensive and brings other problems associated with monoculture farming.

As cities encourage downtown, transit-friendly development, they should also try to limit aggressive suburban sprawl. Limiting sprawl helps cities conserve energy and resources by decreasing commute times and thus improving air quality and community health. Finally, managing sprawl helps to keep central city residents closer to labour markets, which has overall benefits to the urban economy.

Mexico City bus by travellingred/flickr.com

Bus Rapid Transit System reduces air pollution, carbon emissions, accidents and travel time

Mexico City, Mexico

The transportation sector is the primary source of emissions in Mexico City. In 2000 the city generated 51 million tonnes of CO_2. Of this total, the transportation sector accounted for 37%. As transportation is also the largest source of air pollution emissions, many of the measures undertaken by the city focus on vehicle and other transport improvements.

In 2002 EMBARQ, the World Resources Institute's Centre for Sustainable Transport, initiated a partnership with the Government of Mexico City and the Centro de Transporte Sustentable de Mexico (CTS-Mexico) to develop the 20 km Bus Rapid Transit system. Mexico City's Bus Rapid Transit system, MetroBus, was officially opened to the public in June 2005. It transports an average of 260,000 passengers a day during the week through 36 stations on the city's longest street.

The system has replaced 350 older microbuses with 97 brand new articulated diesel buses that have eliminated 35,000 tonnes of GHG emissions and reduced passenger exposure to tailpipe emissions by 23-59%.

The system has also managed to reduce travel time by an average of 33% as well as decrease accidents by 30%. Newly elected mayor, Marcelo Ebrard and his administration are considering initiating ten more MetroBus lines.

www.df.gob.mx

www.metrobus.df.gob.mx/web.pdf

Case Study 44

Putting commuters on the TransMilenio saves energy
Bogotá, Colombia

Fifteen years ago the Colombian capital Bogotá suffered from heavy traffic congestion, no rail, no formal bus system and no plan for changes. The use of private cars was a major cause of congestion and air pollution. Although approximately 71% of motorised person trips were made by bus, 95% of road space was used by private cars, which transported only 19% of the population.

By the end of the 1990s, a new Bus Rapid Transit (BRT) system, named TransMilenio was designed and partially implemented to solve these large inefficiencies of mass transit in Bogotá. TransMilenio was launched in 2000 with the first phase comprising 40 km of exclusive busways, 57 bus stations, 305 km of roads for feeder buses, 29 plazas and sidewalks and a control centre.

One important factor in the success of TransMelinio has been the city government's strong leadership with careful design and planning. Under the leadership of then mayor, Enrique Penalose, Bogotá was transformed into a leading model for innovative, efficient and accessible transportation networks worldwide. This leadership has combined with the mobilisation of necessary funds, state-of-the-art technologies adopted to run the system, the establishment of a good management company, a sound investment in infrastructure and an efficient single fare pricing system.

By 2015, TransMilenio will have 22 lines and 6,000 articulated buses providing five million trips per day. In addition to exclusive busways, the City of Bogotá has 230 km of bike lanes with plans to increase this to 350 km of expanded sidewalks and a 17 km pedestrian zone. Among the travel demand management measures instituted are forbidding private cars to operate in Bogotá central business district during the morning and evening peak. Parking fees were increased by 100% and fuel taxes were increased by 20%. A key promotion measure is 'car-free day' held once a year on a weekday and car-free Sundays on particular roads.

The TransMilenio public transport system has become the first mass transit system in the world to be considered a clean development mechanism (CDM) in accordance with the Kyoto Protocol. The UNFCC has approved Andean Development Corporation CAF's methodology to consider the TransMilenio scheme as having a CDM component. This means that it is officially accepted that the TransMilenio system reduces the emission of greenhouse gases because of its greater efficiency in transporting passengers and due to the partial substitution of private means of transport by high quality public services. The UNFCCC-approved methodology presented by CAF and TransMilenio is applicable to other mass public transport systems in Colombia, such as the MIO in Cali, Transcaribe in Cartagena, Transmetro in Barranquilla and Megabus in Pereira. It could also be applied to similar transport systems in other countries.

www.transmilenio.gov.co/transmilenio/home_english.htm
Source: Energising South African Cities and Towns – a local government guide to sustainable energy planning. Sustainable Energy Africa. 2003.

Case Study 45

Kisumu City by Victor O'/flickr.com

Urban mobility plans
Kisumu, Kenya

Following a city consultation held in August 2004, the Kisumu City Council in collaboration with Sustainable Cities Programme (SCP), ITDG, IHE-UNESCO and the various stakeholders finalised an environmental profile and developed a city-wide urban mobility strategy that will provide a framework for area-specific action plans for selected hotspots. This is done under a new component of the SCP Programme, the Sustainable Urban Mobility (SUM) initiative.

One of these action plans involves making improvements to the main arterial road in Kisumu, Jomo Kenyatta Highway, to increase the comfort, efficiency and safety of boda-boda bicycle taxi operations; increase the efficiency of matatu mini-bus operations and to increase the safety of pedestrians. The Jomo Kenyatta highway traverses in a SW-NE direction and forms the division and backbone of the internal road network within the Kisumu Central Business District (CBD).

Improvements that were most beneficial to pedestrians included covered boda-boda waiting areas at regular intervals and raised zebra crossings to allow for safer crossings.

The SUM initiative is aimed at strengthening the technical knowledge of local authorities and their partners in the area of low-cost mobility (walking and cycling) and to institutionalise it through the SCP/environmental planning and management process.

Source: UN Habitat Sustainable Cities Programme, Sustainable Urban Mobility Component.

Case Study 46

Non-motorised transport by Shona Young

Assistance to purchase bicycles

Lima, Peru

In 1990, the Municipality of Lima set up a micro-credit programme to help low-income citizens purchase bicycles. The programme, 'Programmea de Transporte Popular de Vehiculos No Motorizados', is scheduled to extend to the year 2020.

The programme was developed in harmony with the city's Transport and Infrastructure and Urban Development Plans. The main objectives of the programme are to:

- increase bicycle use as a complementary or alternative means of transport
- reduce transport costs for low-income groups by facilitating access to bicycles
- reduce automotive environmental pollution and improve health and
- provide safe, convenient and direct non-motorised transport (NMT) infrastructure.

Public transportation costs about US$25 per month, workers earning US$ 200 per month can see their income effectively rise by 8% during the repayment period and by more than 12% once the loan is paid off.

Supported by a World Bank loan, current activities include construction of bicycle lanes, provision of credit facilities for bicycle purchase by the poor, reviews of traffic regulations to include NMT and bicycle promotion and educational campaigns for all road users. Local institutional capacity has been strengthened and the city's NMT office is developing a bikeway design manual meeting country-specific requirements.

www.ibike.org/library/america.htm

Additional Source: Alternative Urban Futures: Planning for Sustainable Development in Cities and Cities Turning to Bicycles to Cut Costs, Pollution and Crime, WorldWatch Institute. 1998.

Case Study 47

Velib' bikes, Paris by the noggin_nogged/flickr.com

Public bicycle rental programme

Paris, France

In July 2007, the city of Paris launched a new self-service 'bicycle transit system' called Velib'. Parisians and visitors alike will be able to pick up and drop off bicycles throughout the city at 750 locations – offering a total of 10,648 bikes. By 2008, there will be a 'Velib' station approximately every 250 m for a total of 1,451 locations and 20,600 bikes.

In order to use the system, users need to take out a subscription, which allows the subscriber an unlimited number of rentals. Subscriptions can be purchased by the day, week or year, at a price of, respectively, US$1,5, US$8, or US$45. With a subscription, bike rental is free for the first half hour of every individual trip and then costs one to US$6 for each subsequent 30-minute period. The increasing price scale is intended to keep the bikes in circulation.

Velib' is part of a wide-ranging plan drawn up by Paris Mayor Bertrand Delanoe to encourage residents to leave their cars at home and reduce both the pollution and the heavy traffic congestion that often affects the city's broad boulevards. The system is owned and operated by the city authorities and financed by the JCDecaux advertising corporation, in return for Paris signing over the income from a substantial tranche of on-street advertising.

http://en.wikipedia.org/wiki/V%C3%A9lib'

Source: Paris Set for Bike-Share Scheme to Cut Congestion, Planet Ark. June 2007.

Case Study 48

Reducing vehicular volume and GHG emissions
Baguio City, Philippines

Pollution from motor vehicles accounts for 62% of Baguio City's annual GHG emissions. In recent years, smog and the high particulate matter content of the city's air have threatened not only the health of the city's populace but also its main source of income – tourism.

Aside from the 23,803 motor vehicles registered in the city, some vehicles registered in neighbouring municipalities also operate within the city perimeter. In 2002, road density was recorded at 1.25 km/1000 population. This is far below the 3.9km/1000 population road density standard set by the National Economic and Development Authority.

As a result of this, in 2003 Baguio City aimed to reduce vehicular volume within their central business district by 20% through a number coding scheme. While government vehicles are allowed to pass through this district at all times, vehicles that are privately-owned and public utility vehicles are designated one day off every week from Monday through Friday, for a 12-hour period on specific routes. The last digit of the plate number determines the day-off schedule.

This practice has resulted in reducing the city's GHG emissions by 9% and saving 7.5 million litres of fuel annually.

www.iclei.org/fileadmin/user_upload/documents/SEA/CCP_Projects/Baguio.pdf

Case Study 49

Pedestrian ordinance
Busan, Korea

The city of Busan has a civic ordinance that establishes a safe and comfortable walking environment by providing for the guarantee of pedestrian rights. Some of these rights include the right to a safe and comfortable pedestrian environment and the right to actively participate in the development of improvements.

A pedestrian improvement plan is established every five years, along with an annual operational plan. The plan includes planned improvements, the establishment and expansion of pedestrian corridors, a review of current operations, operating costs and suggested financial resources.

Source: Ordinance on the Guarantee of Pedestrian Rights and Improving Environment for Pedestrians, City of Busan.

Case Study 50

Masdar World Futur Energy Summit & Renewable Carbon Free Exhibition by Arend Kuester/flickr.com

Zero-carbon Masdar
Masdar, United Arab Emirates

The Emirate of Abu Dhabi, capital of the United Arab Emirates, has taken a bold decision to invest in a long-term strategic development programme for alternative energy and sustainable energy technologies.

In April 2006, Abu Dhabi launched Masdar, a multifaceted, multibillion dollar investment project in renewable and alternative energy and clean technology. Masdar is helping to explore, develop and commercialise such future energy sources, including solar and hydrogen power. In 2008, the building of Masdar City is to begin – this is to be the world's first zero-carbon, zero-waste, car-free city, which will eventually be home to 1,500 businesses and 50,000 residents.

The development will be an integrated 6 km^2 energy, science and technology community that will be car free, with a compact network of streets that will encourage walking and complemented by a personalised rapid transit system. Surrounding land will contain, wind, photovoltaic farms, research fields and plantations, enabling the city to be entirely self-sustaining.

www.masdaruae.com

Case Study 51

The main square at Essaouira, Morocco by jonl1973/flickr.com

Compact city planning

Essaouira, Morocco

The town of Essaouira in Morocco is a port city with limited capacity for expansion or urban sprawl. The city is confined geographically and ecologically by the sea on one side and a dune forest on the other. Since its establishment in the late 1700s, the city has been carefully planned and constructed around the central *medina* which follows a geometrical pattern.

Subsequent development over time has been confined to functionalist extensions which have avoided urban sprawl, a trend which is characteristic of other developing cities. Instead, the city planners have created zones for industry, housing and civic life. The zone for housing consists of high density low-cost and middle-cost housing estates. This type of development is necessitated by the unsustainable soil conditions.

However, in recent years, continued city expansion is threatening the fragile ecosystem of the city and, with severe development constraints, a group of specialists have developed the Urban Pact of 1996. There is new emphasis on renewal of the central *medina* and the creation of a 'museum city' through the renovation and restoration of this important tourist artefact. The specialists have emphasised that the unique cultural, ecological and historical heritage of the city must be maintained and that future development must be selective and respectful of this. Further development must be absorbed and excess growth must be accommodated in satellite centres. These strategies are to ensure that the city boundary remains constant.

Source: Loeckx, A., Shannon, K., Tuts, R. and Verschure (eds) Urban Triologues: Localising Agenda 21. UN-HABITAT: Nairobi.

3.7 Air Quality Management

Climate change and air quality problems such as smog and acid rain are closely related issues. In many parts of the world, climate change is expected to result in hotter summer temperatures from global warming. Because smog forms more quickly on hotter days, climate change will inevitably lead to increased smog production. Poor air quality, combined with heat stress from hotter summer weather, will increasingly pose serious health challenges to human populations and flora and fauna.

Climate change and air quality problems are largely caused by the same activity – namely the burning of fossil fuels. In fact, burning fossil fuel such as coal, oil and natural gas is the source of virtually all emissions causing acid rain and global climate change.

Although climate change, smog and acid rain largely share a common cause, different solutions may be required to reduce these pollutant emissions. The challenge is whether we can find creative solutions that address all these problems simultaneously.

Local governments often have control over local ordinances and bylaws that govern air quality management. Through enforcement mechanisms linked to these and other powers local governments can control the burning of various fuels and vehicle specifications and thus reduce greenhouse gas and other emissions.

The Global Alliance for EcoMobility

The Global Alliance for EcoMobility is a cross-sectoral partnership for the integrated promotion of walking, cycling, wheeling and use of public transport to improve health and the urban environment, to mitigate global climate change. The initiating partners are ICLEI – Local Governments for Sustainability and Shimano Inc. Other partners in this initiative are UNEP and UN-HABITAT.

EcoMobility describes mobility without dependency on the private car. It includes:

- **walking-cycling-wheeling:**
  non-motorised means of transport such as feet, walking aids, bicycle, tricycle, velomobile, wheelchair, scooter, skates, skateboard, push scooter, trailer, hand cart, shopping cart, carrying aids and the above vehicles with supporting electrical drive (preferably powered by renewable energy)
- **'passenging':**
  using means of public transport such as escalator, elevator, bus, tram, monorail, subway, lightrail, train, cableway, ferry, collective taxi, taxi (preferably with low-emission drives)

www.ecomobility.org

Case Study 52

River and PC mall, Guangzhou, China.JPG by gruntzooki/flickr.com

Banning motorcycles
Guangzhou, China

Air pollution has become a major problem in Guangzhou, with 1.7 million tonnes of vehicle exhaust fumes emitted in Guangdong Province every year and continuing at a very high rate of increase, 10% every year.

Motorcycles, which still accounted for nearly a third of all non-walking trips in 2003, have been completely banned in the City of Guangzhou since January 2007. The ban was announced in 1998 and was implemented in phases, beginning with a moratorium on new licenses, extending to various roads and time periods, culminating nearly nine years later in a total ban.

As a result, many motorbike riders have shifted to bicycles and buses, a development that has in turn increased pressure to expand and improve bicycle facilities and bus services. Bike parking facilities are currently being retrofitted at metro stations and officials have stressed that the Bus Rapid Transit (BRT) system should include high quality bicycle and pedestrian facilities. New forms of para-transit access to bus stops like cycle rickshaws have also emerged as a popular substitute for motorcycle taxis.

According to traffic information issued by the Guangzhou traffic bureau, traffic problems in Guangzhou have been reduced by 50% and road accidents have dropped by 40% since motorcycles were banned in the downtown area.

www.itdp.org/index.php/projects/update/guangzhou_bans_motorcycles/

Case Study 53

Taxi in Philippines by Trishhhh/flickr.com

Two-stroke engine retrofits reduces energy use and carbon emissions
Puerto Princesa, Philippines

Commonly used to power taxis throughout cities in Asia, two-stroke engines are one of the largest sources of vehicular emissions in the world. There are nearly 100 million two-stroke vehicles in Southeast Asia – each producing approximately 50 times the pollution of a modern car.

A retrofit kit that significantly improves fuel efficiency and reduces emissions in two-stroke engines is being sold to taxi drivers in Puerto Princesa and Vigan, with the local governments offering micro-loans to spur adoption.

Envirofit International developed the direct in-cylinder fuel injection retrofit kit, which is estimated to reduce carbon monoxide emissions by 76%, CO_2 emissions by 35% and hydrocarbon emissions by 89%. At the same time, fuel consumption is reduced by 35% and oil consumption by 50%. Approximately half a million people are expected to benefit from this project through higher incomes and better health.

This project has required the collaboration of a diverse set of organisations. The Local Government Units (LUGs) of Vigan and Puerto Princesa have been instrumental proponents by supporting clean technologies with legislation, while international organisations such as the Asian Development Bank, World Bank and Clean Air Initiative for Asian Cities were beneficial partners. Academic institutions of Colorado State University and Don Bosco Technical College in Manila helped develop and support initial implementation.

Although two-stroke engine types have traditionally been used for motorcycles in developing countries due to the lower purchase price and the availability, in many parts of the world this technology is being phased out. These engines are replaced with four-stroke engine types, emitting much less pollutants and having lower fuel consumption.

www.cleanenergyawards.com/top-navigation/nominees-projects/nominee-detail/project/37/

www.envirofit.org/two_stroke_retrofit.html

Case Study 54

Traffic in Cairo, Egypt

Vehicle Inspection Programme reduces air pollution
Cairo, Egypt

The Government of Egypt committed itself to solve the growing problem of air pollution in the early 1990s. Since then, the United States has joined forces with the Ministry of State for Environmental Affairs and its technical arm, the Egyptian Environmental Affairs Agency (EEAA), the Ministry of Petroleum and the governorates of Cairo and Qalubeya, as well as the private sector. In 1997, the United States and the Government of Egypt initiated a new Cairo Air Quality Programme to reduce lead emissions from local smelters. As part of that programme they introduced natural gas-fueled buses which reduce diesel emission particulate pollution and instituted a vehicle emissions testing and certification programme.

This vehicle testing programme aims to regulate emissions from more than one million vehicles in and around Cairo. The programme requires drivers in the Cairo districts of Giza and Qalyoubia to receive inspection certificates from one of 19 emission-testing stations before they can register their cars. The new testing programme is part of an integrated approach to dramatically reduce the amount of pollutants in Cairo's air. Air pollution is blamed for between 15,000 and 20,000 deaths in the capital each year.

In Giza and Qalyoubia, where 650,000 vehicles are registered, car owners pay three Egyptian pounds – roughly US$50 cents – to have their cars tested. If they exceed emissions standards set by the Egyptian Environmental Affairs Agency, owners get 30 days to tune their engines or risk getting their registrations permanently cancelled.

Testing stations will eventually serve the entire Egyptian capital. Just under half of the country's motor vehicles navigate Cairo's streets each day.

http://egypt.usaid.gov/Default.aspx?pageid=15

Case Study 55

Santiago, Chile by Patrick_coe/flickr.com

'Tarjeta Negra'
Santiago, Chile

With its air trapped in a valley between mountain ranges, Santiago, with over 5 million residents, suffers from excessive particulate matter combustion emissions and various other types of air pollution. Of some 830,000 vehicles in the metro area, heavier diesel vehicles and buses account for 13% of the metro fleet, but contribute over 40% of the particulate matter.

One of the measures government use to examine the actual emissions from vehicles is through enforcement tools. Enforcement requires 'foot soldiers' deployed on the streets of the city in the form of police officers (or other authorities) with the responsibility of checking vehicles. Another possible way to strengthen the enforcement effort is to enlist citizens to contact authorities and report vehicles emitting large quantities of smoke.

In Santiago, municipal authorities provide citizens with Tarjeta Negra ('black card'), a simple card with a Ringelman opacity scale printed on it to rate visible smoke emissions from zero (low) to five (high). The Ringelman chart is a standard measure of black smoke density and was later adapted for grey, white and other colours of smoke plumes. Citizens can use this chart to determine if a transit bus is in violation of opacity standards.

If a bus number is called in, authorities quickly track down the bus and perform a snap acceleration test for opacity. The programme has not only resulted in a significant decrease in the number of buses emitting black smoke, but has raised public awareness.

http://pdf.dec.org/pdf_docs/PNADB317.pdf

http://findarticles.com/p/articles/mi_moCYH/is_/ai_89924474

Case Study 56

Tuk tuk by Luca & Vita/flickr.com

Adapting Tuk-tuks
Dhaka, Bangladesh

The number of motorised vehicles in Dhaka city has greatly grown since the mid-1990s, with a considerable increase in air pollution, especially during the dry winter months. Air pollution, especially from particulates, was mainly due to the approximately 50,000 baby taxis that used highly polluting two-stroke engines, which mixed their lubrication oil, along with the gasoline fuel creating lots of smoke.

NGOs and the media worked together to build public opinion against the polluting two-stroke three wheelers. This led to the government, with assistance from the World Bank – under its Dhaka Urban Transport Project – to start a phase-out plan for the two-stroke baby taxis, which were all imported from India. The plan involved an initial ban on further imports of the two-stroke engines (but allowed the cleaner four-stroke alternative) along with the importation of new three-wheelers that ran on compressed natural gas (CNG) instead of petrol, called Tuk-tuks. The Tuk-tuks were originally imported from Thailand, but are now manufactured at a plant near Dhaka.

The phase-out took effect from January 2003 and was immediately followed by some problems as there were not enough replacement engines available. However, with the rapid import of better engines, especially the CNG-powered ones, the situation improved. Since late 2003 almost all the polluting two-stroke engines had been replaced by less polluting ones and measurements of air pollution have shown considerable improvement over this period.

The citizens of Dhaka have strongly supported the efforts to clean the air in the city despite the great hardship endured by most as a result of the sudden transition. There are now plans to extend it to other Bangladeshi cities.

www.opendemocracy.net/globalization-climate_change_debate/article_2499.jsp

www.dhakacity.org

Case Study 57

EPM approach in air quality management
Shenyang, China

Shenyang is the political and economic centre of North East China and has a total population of 6,750,000. The city has a very cold winter climate that requires substantial heating over a period of four to five months. Shenyang was the first industrial area of modern China. Highly polluting heavy industries are concentrated there, especially metallurgy, chemicals, heavy machinery and similar activities.

Key factors affecting air quality in Shenyang include the continuing dominance of older, heavily-polluting industries, energy consumption that is increasing and the dependency on coal. The population is also steadily increasing, with motor vehicle numbers and use rising very rapidly.

The Shenyang Municipal Government (SMG) joined UNEP/UN-HABITAT's Sustainable Cities Programme in 1997 to improve environmental planning and management (EPM). Activities undertaken included:

- Collection and analysis of the air quality information as part of preparing an environmental profile (EP) for the city
- Setting up (in mid-1997) a cross-sectoral consultative group on air pollution management, consisting of 16 members from key governmental departments, peoples' congress, political consultative conference, enterprises, institutes and communities.
- Review of a proposition paper on air quality by 300 representatives who attended the Shenyang City consultation in May 1998.
- In 1996, six enterprises in Shenyang – machinery, chemical, pharmaceutical and light industry – piloted cleaner production techniques. In 1998, cleaner production audits were conducted for 100 products in 86 enterprises.
- In mid-1999, Shenhe District also set up environmental protection and disturbance complaint stations in 10 resident areas.

Air pollution in residential areas was addressed by the Air Environment Working Group. Polluting enterprises discharging large amounts of smoke and dust, particularly during the winter, were investigated for potential violations. Both municipal and district environmental protection departments coordinated supervision and management responsibilities to perform road inspection and selective inspection of motor vehicle tail gas exhaust. The use of non-leaded gasoline was incorporated to reduce lead pollution discharged from motor vehicles. All petrol stations abided by governmental notices and discontinued the sale of leaded gasoline resulting in a reduced lead discharge by 93.6%.

Since execution, prominent environmental and economic benefits have been achieved. At the same time, many enterprises established cleaner production teams to accept relevant training and guidance on cleaner production and to implement cleaner production consultations within their enterprises. In 1998, after addressing the actual conditions of enterprises, a cleaner production auditing goal aimed to audit 100 product types – reducing 10,000 tonnes of raw material loss and pollutants and creating an economic benefit of RMB 100 million Yuan.

www.unhabitat.org/list.asp?typeid=15&catid=540

Esplanade and Photovoltaic Power Plant by racEcar_yayas/flickr.com

3.8 Green energy sourcing

Electricity that is generated from renewable energy sources such as wind, solar, biomass, geothermal and small hydro, is often referred to as 'green power' or 'clean energy'. Unlike fossil fuel-based power, these sources of energy emit no or low GHG emissions. Cities around the world are taking advantage of their natural resources to source cleaner electricity. Some cities are also trying to buffer themselves against energy price volatility and ensure energy security by supporting or generating power locally using local resources.

Large cities can promote renewable and cleaner energy through the following roles they usually (not all) perform:

- Distributor or delivery of energy or electricity services or supplies to its citizens
- Owner of generation facilities
- Regulator of things like land use or building specifications
- Buyer of energy for own use
- Land or building owner

Local governments are significant purchasers of energy services and can therefore act as a catalyst for renewable energy projects. Leading by example local authorities also have the potential for their portfolio of buildings to provide long-term supply contracts as security for local renewable energy projects. Planning and developing local energy solutions involves exploring which combination of technologies makes most sense at different scales – looking at the opportunities for new and existing building typologies and uses and the relationship of a town or city to its rural hinterland. For example, small-scale microgeneration technologies such as solar PV (photovoltaic) can be complemented by efficient forms of generation.

There is an increasing need to focus on the role that smaller scale decentralised energy generation could play. Local energy (also called micro-generation, distributed or decentralised energy) is energy produced by individuals, businesses or communities for their own consumption, be it space or water heating or electricity. Such 'local energy' encompasses a broad range of technologies that are capable of helping to reduce CO_2 emissions, either because they are renewable, or because they use fossil fuels more efficiently. Examples include roof-top wind turbines, solar-heated water and household combined heat and power (CHP) systems that generate electricity in the home and use the resulting thermal energy for domestic heating. Whilst the primary aim of such energy production is for own-use there is also the potential for surplus generation to be sold for use elsewhere. The concept of local energy represents a fundamentally different approach to the current centralised mode of delivery for electricity. Changes in technology have reduced the cost of smaller scale means of energy production and made it easier for the networks to manage the connection of a larger and more diverse range of generating units. At a time of heightened concern over climate change and energy security, the potential for individuals and communities to make a direct contribution to tackling these issues is increasing.

Case Study 58

Olkaria III, Naivasha. www.emergingafricafund.com

Geothermal power supplied to the national grid
Nairobi, Kenya

There are not many examples of local level green energy projects. Most of these pertain to national level strategies. However, the following case studies are important nonetheless as they can act as examples of green energy strategies that can be implemented at both local and national government level.

Geothermal energy is playing an important role in Kenya, with about 120-MW capacity already installed. A range of further projects for 2 to 3,000 MW are under development or in a planning phase.

Exploration for geothermal resources in Kenya began in 1956 and gained momentum in the 1960s. From 1967, the UNDP in collaboration with the then East African Power and Lighting Company Ltd, conducted geological and geophysical surveys in the area between Olkaria and Lake Bogoria. The studies identified Olkaria as the most prospective area for geothermal power.

The Olkaria power stations in the Rift Valley are currently Africa's largest geothermal power stations. They generate electricity by pumping water down to volcanic hot areas and using the steam produced to drive turbines. The power generated is transmitted to the national grid via a 220-kV double circuit line to the city of Nairobi.

Geothermal is one of the low-cost energy sources of electricity generation in Kenya and currently contributes 127 MW to the national grid. KENGEN, a 100% state owned corporation, owns two power plants, Olkaria I power plant (45 MW) and Olkaria II power plant (70 MW). The third power plant is owned by Independent Power Producers (IPPs), Orpower and currently generates 12 MW.

Compared to a diesel plant generating the same amount of energy, this geothermal station would avoid several million tonnes of CO_2 emissions over the life of the project. Electricity generated by the plant will be sold under a 20-year power purchase agreement with the national power transmission and distribution utility, Kenya Power and Lighting Company Limited.

www.kengen.co.ke
www.renewableseastafrica.de/_uploads/media/1314_Geothermal%20Industry.pdf

Case Study 59

Manila (Philippines) by eesti/flickr.com

Geothermal energy
Manila, Philippines

According to the International Geothermal Association (IGA), worldwide, the Philippines ranks second to the United States in producing geothermal energy. As of the end of 2003, the Philippines had a capacity of 1930-MW of geothermal power.

Early statistics from the Institute for Green Resources and Environment stated that Philippine geothermal energy provides 16% of the country's electricity. Manila, a city of over 10 million people, gets a significant portion of its electricity from geothermal power. Geothermal operations are the most developed on the island of Luzon, where Manila and other large centres are located.

Geothermal power supplies 7% of the electricity needed for the whole island of Luzon, the most heavily populated of the Philippine islands, currently home to 43 million people. Additionally, geothermal heat is also used directly used for fish processing, salt production and the drying of coconuts and fruit, all major economic activities in the Philippines.

This is an example of an energy project driven nationally. Local governments can advocate for projects like these that have spinoffs of jobs and local economic development while being more sustainable in their area.

www.geothermal.marin.org

http://en.wikipedia.org/wiki/Geothermal_energy#Philippines