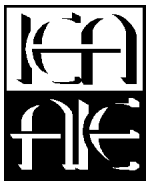

International Energy Agency

Promoting Energy Efficiency Best Practice in Cities

- A pilot study -

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Nigel Jollands of the IEA coordinated this project.

Contents

Glossary

The following definitions are used in this report:

- *Energy Efficiency* means a change to a particular energy use that results in a net benefit per unit of energy consumed.
- *Local Government* refers to any authority that provides a range of fundamental services to a local population based in an urban setting.
- *Programme* refers to a particular energy efficiency policy or measure, implemented by a local government
- *Case Study* refers to a particular programme proposed for evaluation
- *Best Practice* is determined by application of the criteria developed in this report.

Executive summary

There is a strong rationale for IEA engagement with cities and local governments on the issue of energy efficiency. In May 2007, The IEA Governing Board called on the IEA "to promote … energy efficiency goals and action plans *at all levels of government*". In addition, cities are large and growing energy users; City Authorities (CAs) themselves use significant amounts of energy; CAs, are important implementing agents for national energy efficiency policy, as well as being a vehicle for implementing IEA energy efficiency policy recommendations. Through their experience on the ground, CAs can provide important lessons in energy efficiency policy implementation. The IEA energy-related expertise means it is well placed to add significant value to promoting the best practice policies and measures that cities are currently involved in.

Past attempts to document best practice energy efficiency in cities have been piecemeal, lacked transparency and a clear set of criteria for identifying best practice.

This working paper presents the results of a pilot study aimed at testing a method of collating, evaluating and reporting energy efficiency policy practice in cities. The pilot study involved:

- Developing a set of clearly defined criteria for evaluating energy efficiency policies and measures;
- Designing a survey and distributing it to city authorities;
- Analysing results.

This pilot project is the first attempt to address the lack of rigorous and transparent approach to defining best practice in city energy efficiency programmes. The project has provided interesting insights into a range of exciting projects being implemented in cities around the world. However, the potential exists for far greater benefit.

The study has found that it is possible to collate the detailed information needed to identify best practice energy efficiency projects in cities. However, gathering the data is not easy. The data is often not recorded in an easily accessible format. Nor is it easy to get city officials to allocate time to the necessary data collation given the many other competing demands on their time.

A key area that this project identifies as requiring urgent attention is the development of a common data management format for energy efficiency projects by CAs. Further work could also focus on refining the criteria used to define best practice, and broadening the scope of projects beyond energy efficiency.

1 Background – the IEA and cities

Over the last few years, there has been an increased interest in cities and their energy use – driven in part by climate change concerns. Prominent examples include the:

- *International Council for Local Environmental Initiatives* (ICLEI). ICLEI boasts 628 member cities and runs a range of programmes including the Cities for Climate Protection™ (CCP) Campaign. The CCP assists cities to adopt policies and implement quantifiable measures such as energy efficiency to reduce local greenhouse gas emissions, improve air quality, and enhance urban liveability and sustainability. More than 800 local governments participate in the CCP;
- *Clinton Foundation's Climate Initiative*[1] which was launched in August 2006 which aims to help cities "fight against climate change in practical, measurable, and significant ways";
- *C40 Large Cities Climate Leadership Group*[2] which is a group of the world's largest cities committed to tackling climate change. The C40 group has partnered with the Clinton Foundation;
- *ENERGY STAR Challenge* which has a strategic focus on local governments. The aim is to encourage local governments to promote the call-to-action to improve the energy efficiency of America's commercial and industrial buildings by 10% or more;
- OECD's *Urban Development programme* which assesses trends and challenges of urban regions, and promotes sustainable urban development;
- Joint UN-HABITAT - UNEP *Sustainable Cities Programme* which promotes environmental, social and economic sustainability of cities[3];
- Institute of Global Environmental Studies *Urban Environmental Management Project*[4] which focuses on Asian cities and aims to generate discussion on the role of cities in achieving sustainable and cleaner utilisation of resources and energy;
- Sierra Club's Energy Efficiency Solutions for Cool Cities campaign[5];
- *European Green Cities Network*[6] (EGCN) which aims to reach full market effect for the solutions provided for efficient urban housing regarding energy, resources, spatial planning, integration of renewables into buildings, etc.

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[1] www.clintonfoundation.org

[2] www.c40cities.org - is comprised of the following cities: Addis Ababa, Bangkok, Beijing, Berlin, Bogotá, Buenos Aires, Cairo, Caracas, Chicago, Delhi, Dhaka, Hanoi, Hong Kong, Houston, Istanbul, Jakarta, Johannesburg, Karachi, Lagos, Lima, London, Los Angeles, Madrid, Manila, Melbourne, Mexico City, Moscow, Mumbai, New York, Paris, Philadelphia, Rio de Janeiro, Rome, Sao Paulo, Seoul, Shanghai, Sydney, Toronto, Tokyo, and Warsaw.

[3] http://www.unhabitat.org/categories.asp?catid=369

[4] http://www.iges.or.jp/en/ue/pdf/megacity03/HTML/3.html

[5] http://www.sierraclub.org/globalwarming/coolcities/energy.asp

[6] http://www.europeangreencities.com/about/about.asp

Evidence of such wide ranging activity raises an obvious question: why is there so much attention on cities, City Authorities (CA) and their energy use, and why should the IEA consider working with CAs?

The role of local governments is gaining increasing importance in the IEA. In May 2007, The IEA Governing Board called on the IEA "to promote … energy efficiency goals and action plans *at all levels of government*". In addition to this mandate from the IEA Governing Board, there are at least six reasons:

a) *Energy consumption in cities is significant – and growing rapidly*. Towns and cities consume significant amounts of energy. According to the UN-Habitat[7] half the global population today lives in urban areas. However, town and city dwellers consume 80% of all commercial energy produced globally. And as a result, cities offer a huge resource for energy efficiency improvement.

b) *City Authorities are significant energy users in their own right.* CAs are significant energy users in their own right, albeit their areas of responsibility may vary. CAs are responsible for a major part of national energy consumption. For example, in the USA, "Government agencies spend more than $10 billion a year on energy to provide public services and meet constituent needs — while grappling with tightening budgets."[8] A significant proportion of this energy spend is by city authorities. For example, Sydney's local government spent around A$53 million on energy in 2006 to provide urban services for their population of around 4.3 million people.

c) *City Authorities play an important role in energy efficiency leadership and implementing national energy efficiency policies.* For example, many CAs are responsible for implementing the energy efficiency requirements of building codes.

d) *City Authorities influence city energy use indirectly.* This influence is principally through CAs' urban planning functions and its consequent impact on urban form and transport infrastructure.

e) *City Authorities are currently looking for guidance.* As a result, several national governments and local government associations have developed a range of guidance material for CAs (see for example, Kern (2005), the Austrian Energy Agency (2008) and ICLEI (2008)).

f) *City Authorities can be important implementing agents for existing IEA energy efficiency policy work.* Several of the IEA energy efficiency policy recommendations relate to areas that, in some countries at least, are the responsibility of local governments. These can include energy efficiency requirements for building codes, outreach to SMEs and vehicle fuel-efficiency testing.

[7] UN-Habitat. 2006. The case for better energy planning in growing cities. Habitat Debate **12**:6.

[8] http://www.energystar.gov/index.cfm?c=government.bus_government_local

As a result of the rationale for IEA involvement in the cities and energy issues, the Secretariat has initiated a work programme in this area with four themes (see box 1). The first part of this work programme focuses on Theme 1; namely, identifying and evaluating best practice energy efficiency programmes in cities. This project is a collaborative effort between the *International Energy Agency* (IEA) and *ICLEI – Local Governments for Sustainability* (ICLEI) and is funded by Southern California Edison.

Box 1: IEA energy efficiency policy and local governments – four themes

1. Best Practice: Documenting local government best practice in energy efficiency policies and measures
Aim: To identify locally operational best-practice energy efficiency policies and measures for local government.

2. Enhancing local government-national government partnerships for energy efficiency
Aim: To enhance local government-national government partnerships to achieve improved energy efficiency.

3. Benchmarking local government energy efficiency
Aim: To improve the understanding of energy end use in local government by:

- Identifying and addressing methodological issues associated with local government energy efficiency benchmarking;
- Collecting, analysing and reporting relevant energy end-use data.

4. Modelling city energy use
Aim: to identify the scope for city actions to promote and achieve improvements in energy efficiency (demand and supply side) and renewable energy. Specifically, the modelling exercise will aim to:

- establish cities as an important focus for energy policy
- estimate the size of global city energy spend
- estimate of the energy saving/renewable energy potential within cities
- identify the impact of locally implementable energy efficiency/renewable energy policies and measures.

2 Energy efficiency best practice in cities

City governments share a common interest to improve the quality of life of their citizens. Policies implemented by city governments affect the economic, environmental and social conditions within the city so it is imperative that those policies are effective and suited to the particular city. There is clearly scope for city governments to share their experiences of the effectiveness of particular policies and so avoid the mistakes of others.

Determining what constitutes a *best practice* approach depends on the criteria used to evaluate the programme. For some, cost effectiveness is the key factor. For others, the level of CO_2 savings might be important. It is important that the criteria used to define *best practice* take into account the broad implications of policy.

There have recently been a number of other projects that share the specific objective of identifying 'best practice' energy efficiency programmes in cities. These other projects include: the *Best Practice Analysis* (Clinton Climate Initiative, 2007), the *Good Practice on Local Energy Action* (European Commission Directorate-General for Energy and Transport, ManagEnergy Initiative) and the *Best Practice Catalogue* (City Instruments Programme).

These projects have provided cities with valuable energy efficiency or greenhouse gas mitigation information, but the lack of clear and consistent criteria means it is difficult for cities to compare similar projects in order to assess the most effective approach. The use of a consistent assessment framework is essential to assist cities to:

- identify potential projects of relevance to their city;
- understand the possible financial and environmental impacts of projects;
- select projects likely to deliver the greatest benefit at the least cost.

2.1 Aims of the project

The overall aim of this project is to pilot an approach to evaluating energy efficiency projects currently being implemented by cities, in order to identify those that are suitable for other cities to adopt. The project utilises the expertise of IEA in energy efficiency assessment and ICLEI's role of advocating sustainable development policies to its local government membership.

More specifically, the project will:

- develop a useful set of criteria for evaluating energy efficiency case studies. The criteria will attempt to enable the assessment of benefits across multiple areas of interest to city governments;
- pilot the application of these criteria to a selection of energy efficiency projects being implemented in cities.

This project is useful for cities and national governments. For cities, a rigorous evaluation of energy efficiency projects from other jurisdictions can help them in the process of filtering potential projects. National governments could also find the best practice approach useful. National governments are often approached to assist with funding of local energy efficiency projects. National governments could draw on the approach used in this report to help them identify best practice projects for potential funding assistance.

2.2 Expected outcomes

There were two key outcomes expected of this pilot project:

1. Increased uptake of energy efficiency projects by cities. Demonstrating the benefits of action, using a rigorous assessment approach, provides cities with the detailed technical and financial data needed to prepare a business case.
2. A possible on-going project that continues to collect data on best practice examples. Although the focus of this phase of the project is on energy efficiency, a similar approach could be developed in later phases for the assessment of renewable energy and other measures that have a greenhouse gas mitigation benefit. Any on-going work in this area is outside the IEA core budget and will require extra resources.

2.3 Parties involved

The current project is a collaboration of IEA and ICLEI, utilising information from a range of cities across eight countries in addition to that compiled by Energie-Cités and the European Commission. Of the countries included in this project, only India and Latvia are not members of the IEA.

ICLEI is an international association of local governments and national and regional local government organizations that have made a commitment to sustainable development. Of the cities included in this project, only Graz is not a member.

The following cities have contributed information, ether directly or indirectly, for the project:

- Adelaide, Australia
- Austin, United States
- Berkeley, United States
- Berlin, Germany
- Christchurch, New Zealand
- Dunedin, New Zealand
- Graz, Austria
- Gwalior, India
- Riga, Latvia
- Stockholm, Sweden
- Sydney, Australia

Information from the Energie-Cités Best Practice database and the European Commission ManagEnergy Initiative's Good Practice on Local Energy Action was used where sufficient data was not able to be obtained from the cities themselves within the timeframe of the project.

3 The evaluation criteria

The project adopts a quantitative evaluation approach to compare programmes using defined metrics. While this requires more detailed technical and financial data than a qualitative assessment, it is an important step in the move toward a more rigorous approach that can be used to support effective policy development by cities.

The chosen criteria represent the most relevant aspects of a programme – time, effectiveness and viability. The chosen criteria are well-known indicators that have clearly defined metrics, leading to a programme evaluation process that is relatively straightforward.

To determine whether a programme represents best practice or not, each criterion has been assigned an arbitrary benchmark. Programmes that meet the return on investment *and* two other benchmarks will be deemed best practice. Programmes that do not achieve a minimum of three benchmarks will not be deemed best practice and will be automatically excluded from the IEA-ICLEI project.

Although the benchmarks were arbitrarily chosen for the purpose of this pilot project, they can be refined as more data is collected. More appropriate benchmarks will be developed over time through on-going analysis of programme data.

The criteria used to assess projects were:

- Implementation timeframe;
- Energy savings;
- Greenhouse gas emission reductions;
- Return on investment;
- Transferability.

3.1 Implementation timeframe

This is defined as the time taken for the policy or the measure to first deliver energy efficiency improvements. The timeframe includes the entire time taken to develop the policy proposal, gain approval and implement the project. This criterion is measured in months, with **a benchmark of 12 months**.

3.2 Energy savings

The total energy saved as a proportion of the total energy that would have been consumed without the programme. The total energy refers to all energy saved or consumed during the lifetime of the programme[9]. This criterion is measured as a percentage, with **a benchmark of 20%**.

In order to generate a baseline of energy use, had the programme not been implemented, it was assumed that the trend in energy consumption prior to the commencement of the programme would have continued in the absence of the programme.

3.3 Greenhouse gas emission reductions

The total CO_2e saved as a proportion of the total CO_2e that would have been emitted without the programme. The total CO_2e refers to all the CO_2e saved or consumed during the lifetime of the programme. This criterion is measured as a percentage, with **a benchmark of 20%**.

In order to generate a baseline of greenhouse gas emissions, had the programme not been implemented, it was assumed that the level of emissions in the year prior to the commencement of the programme would have continued in the absence of the programme. Greenhouse gas emissions were calculated using national emission factors for either Scope 1 (natural gas) or Scope 2 (electricity, grid average).

3.4 Return on investment

A measure of the cost-effectiveness of the programme, using the *return on investment* (ROI) over 10 years. The initial investment required and the subsequent savings are discounted to values in the year the programme commenced and the return over 10 years compared to **a benchmark of 0%**, which indicates the excess return over long term interest rates.

The following discount rates are used:

- Initial investment - the national long term interest (government bond) rate, applicable in the country in which the programme is being implemented and in the year the programme commenced. These values were sourced from the *OECD Economic Outlook No. 82 database*, with the exception of Latvia which was sourced from NationMaster. The use of this measure enables the investment return to be compared to the alternative 'risk-free' investment.
- Financial savings – the average national inflation rate for the ten year period over which the programme is analysed. These values were also sourced from the *OECD Economic Outlook 82 database*, with the exception of Latvia which was sourced from NationMaster. The use of this measure takes into account the reduced value of energy savings in future years.

[9] In this pilot study, we assumed energy use remained constant into the future. Any future study would need to normalise for climate expectations etc.

3.5 Transferability of project

City governments need to know if policy measures implemented elsewhere are potentially suitable for their city. Examples of policies implemented in other cities will be most relevant if the cities have similar priorities, as determined by their energy use or greenhouse gas emission profiles. ICLEI assists many hundreds of city governments around the world to develop greenhouse gas emission profiles, which are used to set the strategic direction of their efforts to reduce emissions.

Although not an assessment criterion in this pilot project, an important consideration for a city seeking to adopt a programme that has been demonstrated to be effective elsewhere is the regulatory framework and technical capacity required to support it. Local governments around the world have many similarities but it cannot be assumed that all cities possess the same regulatory capacity. The ease with which a measure can be transferred to other jurisdictions can depend on the similarity of the regulatory frameworks across jurisdictions.

Cities were asked to provide an assessment of the transferability of the programme they had implemented, using the following scale:

1 – The programme cannot be physically transferred due to the need for specific environmental conditions;

2 – The programme can be transferred but at significant cost;

3 – The programme can be physically implemented with minimal cost.

A qualitative assessment of transferability was made by ICLEI using programme information, where data was not available from the cities themselves.

4 Pilot project process

The pilot project consisted of three steps:

- Programme selection;
- Survey design;
- Collation of results and analysis.

4.1 Programme selection

Many potential programmes were canvassed and classified as either 'energy efficiency', 'renewable energy' or 'alternative transportation'. Due to the time constraints of this phase of the project, only the energy efficiency programmes were considered for further evaluation. Renewable energy and alternative transportation programmes may be assessed in a future phase, using a similar approach.

Forty six programmes were initially considered for inclusion, but this was refined to 26 due to the similarity of many of the programs. In order to ensure a balance of countries represented, a number of potential programmes in the United States were not pursued in this phase. Ultimately, 17 cities were asked to provide information on 19 different energy efficiency programs.

Programmes were not selected on the basis of previously reported benefits, but as a representative sample to be used to assess the potential for the more rigorous quantitative analysis approach used in this project.

4.2 Survey design

The data required to support an analysis of programmes using the criteria above was identified. This consisted of energy source affected by the program, energy unit cost, cost, energy savings, year of implementation, greenhouse emissions and emission reductions.

Following the identification of data needed, a survey was developed. Cities that were invited to participate were asked to provide data in a format that would facilitate transfer to an analysis tool developed for the study.

Cities were also asked to provide a brief description of the programme and an assessment of the ease with which the programme could be implemented in other cities. This assessment of transferability was subjective, but provides an indication of whether specific regulatory changes may be required to implement the program.

The survey was emailed to key contacts in each city, together with a covering letter of invitation, with a response requested within three weeks. Follow-up was required in order to get sufficient information for most cities and, in a number of cases, other sources of information were used to supplement that provided by the cities. See Appendix A for the Survey document developed for the pilot project.

4.3 Collation of results and analysis

Programme information was compiled for 11 case studies, which was considered to be an acceptable outcome given the constraints of the pilot project timeframe and the nature of the information being requested.

The data reported by cities, either in a survey response or indirectly via other sources of information, was entered into the analysis tool designed for the pilot project.

The Analysis Tool developed for the pilot project is available on request.

5 Findings

A brief comparison of the case studies is presented in the Summary Table below, followed by a further table for each of the case studies containing more detail.

5.1 Best practice programmes summary

The following programmes met the benchmarks set for inclusion as Best Practice programme examples. Note that, due to a lack of available information, the implementation time criterion was not used to exclude programmes from this table.

5.2 Findings - all programmes

The following tables present information on all programmes assessed for this pilot project. The reason for a programme not meeting the criteria for best practice is noted below each table.

City	Project	Implementation time	Energy saving[10]	GHG reduction[11]	ROI
Berlin	EPC for Schools	Not available	20%	20%	117%
Christchurch	Swimming Complex Heating	Not available	100%	100%	100%
Dunedin	Pool Heat Recovery	20 months	39%	31%	54%
Gwalior	Street lighting efficiency	Not available	25%	25%	65%
Riga	Efficient Lighting Initiative	15 months	48%	48%	11%
Stockholm	LED Traffic signals	18 months	90%	90%	134%
Sydney	Library Retrofit	12 months	46%	46%	89%

[10] Energy saving compared to the total energy that would have been consumed without the programme, over the ten years of the analysis.

[11] Emission reduction compared to the total greenhouse emissions that would have been emitted in the absence of the programme, over the ten years of the analysis.

5.2.1 Adelaide Detail

Country	Australia	
City	Adelaide, South Australia	
Responsible agency	City of Adelaide	
Project description	Adelaide is progressively installing LED traffic signals at 107 intersections. Approximately 14 intersections are being changed each year through to 2009.	
Year commenced	2002	
Investment ($US)	$1,115,000 over 10 years	
Impacts	Energy saving (%[12])	59%
	Greenhouse emission saving (tonnes)	1,078
	Greenhouse emission reduction (%[13])	57%
	Financial savings ($US p.a.)	$115,300
	Return on Investment (10 years)	-29%
Transferability	3/3. Readily adopted by other jurisdictions, but a trial recommended to ensure illumination level is acceptable to road safety authorities. No specific regulation required.	

This project failed to meet the *Return on Investment* criterion because it was implemented over a period of 8 years. This reduced the benefit of the programme, when measured over the ten years following the first year of implementation.

5.2.2 Austin Detail

Country	United States	
City	Austin, Texas	
Responsible agency	Austin Energy	
Project description	The City resolved that cost effective demand side management was to be the first priority for meeting new load growth. Rebates and incentives are available to businesses to improve the efficiency of equipment that contributes to peaks in power demand.	
Year commenced	1982, but detailed information available from 2003.	
Investment ($US)	$181,200,000 over 10 years	
Impacts	Energy saving (%)	1%
	Greenhouse emission saving (tonnes)	77,200

[12] Percent energy savings is calculated as described in Section 3.2

[13] Percent CO_2 savings is calculated as described in Section 3.2

	Greenhouse emission reduction (%)	1%
	Financial savings ($US p.a.)	$6,602,000
	Return on Investment (10 years)	-66%
Transferability	2/3. The programme may be adopted in other cities, but needs citizen support where the utility is publicly owned. Will be most effective in regions with hot and humid summers, where the peak is caused by air conditioning. Requires investment priority to be diverted from energy supply infrastructure, so is probably most suited to publicly owned, vertically integrated utilities.	

5.2.3 Berkeley Detail

Country	United States	
City	Berkeley, California	
Responsible agency	City of Berkeley	
Project description	The Energy Conservation Ordinance applies to residences at the time of sale or lease. Approximately 700 housing units per year are required to be retrofitted to improve energy efficiency prior to the new occupancy.	
Year commenced	1980, but detailed information available from 2003.	
Investment ($US)	Annual budget allocation of $71,000 from City.	
Impacts	Energy saving (%)	15%
	Greenhouse emission saving (tonnes)	340
	Greenhouse emission reduction (%)	15%
	Financial savings ($US p.a.)	$108,800
	Return on Investment (10 years)	63%
Transferability	3/3. Readily adopted by other jurisdictions where housing stock is relatively old and inefficient. Benefit will be greatest where heating and cooling loads are high. Requires City regulation.	

This project failed to meet all criteria because it is reported as being continually implemented, which makes it impossible to align the reported savings with a particular level of initial investment. The results shown above could be regarded as an artefact of the assessment method.

5.2.4 Berlin Detail

Country	Germany
City	Berlin
Responsible agency	Berliner Energieagentur GmbH (Berlin Energy Agency)

Project description	Pools of school buildings are offered by tender for Energy Performance Contracts. This ensures that some buildings with less attractive energy saving opportunities are not ignored.	
Year commenced	2001	
Investment ($US)	$1,500,000 over 10 years	
Impacts	Energy saving (%)	20%
	Greenhouse emission saving (tonnes)	907
	Greenhouse emission reduction (%)	20%
	Financial savings ($US p.a.)	$342,000
	Return on Investment (10 years)	117%
Transferability	3/3. Potentially adopted by other jurisdictions where public buildings (not limited to schools) are relatively inefficient. Benefit will be greatest where heating and cooling loads are high. Also requires a good energy monitoring system and a competitive EPC industry.	

5.2.5 Christchurch Detail

Country	New Zealand	
City	Christchurch	
Responsible agency	Christchurch City Council	
Project description	A swimming pool complex that was previously heated using LPG now uses landfill gas or heating and cogeneration. The gas is captured and piped from a nearby landfill, from where the gas previously escaped to the atmosphere. The methane capture component of the project was credited with 200,000 Emission Reduction Units that were subsequently offered for sale on the international market.	
Year commenced	2007	
Investment ($US)	$2,900,000	
Impacts	Energy saving (%)	100%
	Greenhouse emission saving (tonnes)	63,358
	Greenhouse emission reduction (%)	100%
	Financial savings ($US p.a.)	$630,000
	Return on Investment (10 years)	100%
Transferability	2/3. Some opportunity for replication, but requires the landfill and a suitable facility to be reasonably close. This project requires the landfill gas to be transported 3.7km.	

Note that the landfill gas used as a replacement energy source in this programme is regarded as waste product. The energy savings refer to the reduction in fossil fuel

energy used. The greenhouse emission reduction also refers to the reduction in emissions associated with the LPG used previously.

5.2.6 Dunedin Detail

Country	New Zealand	
City	Dunedin	
Responsible agency	City of Dunedin	
Project description	The installation of a heat pump at a public swimming pool was matched to the waste heat stream in order to extract and return energy to the pools, lowering net energy costs by 18%. The reduction in heating gas costs was partially offset by an increase in electricity use.	
Year commenced	2007	
Investment ($US)	$711,000	
Impacts	Energy saving (%)	39%
	Greenhouse emission saving (tonnes)	598
	Greenhouse emission reduction (%)	31%
	Financial savings ($US p.a.)	$118,400
	Return on Investment (10 years)	54%
Transferability	3/3. Particularly suited to cold climates, where the heating load is high. Also requires the pool to be enclosed in order for the heat to be reclaimed.	

5.2.7 Graz Detail

Country	Austria	
City	Graz	
Responsible agency	Graz Energy Agency	
Project description	The pilot project phase, Green Light Graz 1, was implemented in main streets and involved replacing 720 lamps that were quite old. The measures consist of lamp reconstruction, lamp change, installation of control systems and the change of associated equipment to modern technology. A further 15,000 lamps will be changed in the four years from 2007 to 2010, but this analysis is of the pilot project only.	
Year commenced	2005	
Investment ($US)	$1,310,000 over 10 years	
Impacts	Energy saving (%)	56%
	Greenhouse emission saving (tonnes)	85

	Greenhouse emission reduction (%)	56%
	Financial savings ($US p.a.)	$48,800
	Return on Investment (10 years)	-60%
Transferability	3/3. Suitable for any city with older street lighting infrastructure. Graz used the *Thermoprofit* model, whereby the investments were pre-financed and were refinanced from the energy cost savings. After 15 years, when the works have been paid for, the city benefits from the full energy savings.	

This project failed to meet the *Return on Investment* criterion because it is reported as being continually implemented, using an EPC financing model which makes it impossible to align the reported savings with a particular level of initial investment. The results shown above could be regarded as an artefact of the assessment method.

5.2.8 Gwalior Detail

Country	India	
City	Gwalior	
Responsible agency	Gwalior City	
Project description	Street lighting accounted for 20% to 30% of total energy consumed by the city government and cost $400,000 per year. The City has implemented an efficiency programme is able to be accredited under the Clean Development Mechanism (CDM) and is hopeful that a similar approach can be used in 13 other cities in Madhya Pradesh.	
Year commenced	2005	
Investment ($US)	$500,000	
Impacts	Energy saving (%)	25%
	Greenhouse emission saving (tonnes)	1,195
	Greenhouse emission reduction (%)	25%
	Financial savings ($US p.a.)	$97,400
	Return on Investment (10 years)	65%
Transferability	3/3. Readily transferred to other cities for financial, greenhouse and CDM benefits, when done in an eligible country.	

5.2.9 Riga Detail

Country	Latvia
City	Riga
Responsible agency	Latvian Academy of Sport Education

Project description	An Energy Services Company (ESCO) was used to renovate the indoor lighting at the Academy. Improvements in the quality of lighting were made in both the sports hall and viewing balcony. This improved player safety, spectator comfort and reduced energy usage.	
Year commenced	2003	
Investment ($US)	$45,400	
Impacts	Energy saving (%)	48%
	Greenhouse emission saving (tonnes)	30
	Greenhouse emission reduction (%)	48%
	Financial savings ($US p.a.)	$6,850
	Return on Investment (10 years)	11%
Transferability	3/3. An ESCO model is suitable for many applications where the City itself does not have the financial resources to fund a project. The ESCO needs access to capital, typically from a commercial financial institution. No regulations were required.	

5.2.10 Stockholm Detail

Country	Sweden	
City	Stockholm	
Responsible agency	City of Stockholm	
Project description	LED traffic signals were installed to replace 27,000 incandescent lamps at 530 traffic control points. Before installation proceeded, the LED technology was tested under the conditions of extreme cold, humidity and salty air in the city.	
Year commenced	1996	
Investment ($US)	$3,000,000	
Impacts	Energy saving (%)	90%
	Greenhouse emission saving (tonnes)	1,537
	Greenhouse emission reduction (%)	90%
	Financial savings ($US p.a.)	$713,900
	Return on Investment (10 years)	134%
Transferability	3/3. Readily adopted by other jurisdictions, but a trial recommended to ensure illumination level is acceptable under local conditions. No specific regulation required.	

5.2.11 Sydney Detail

Country	Australia	
City	Sydney	
Responsible agency	City of Sydney	
Project description	A major library in the city was retrofitted to replace inefficient low voltage down-lights and the air-conditioning control system. Relatively minor works were required, at minimal cost, but the return has been significant.	
Year commenced	2007	
Investment ($US)	$22,100	
Impacts	Energy saving (%)	46%
	Greenhouse emission saving (tonnes)	82
	Greenhouse emission reduction (%)	46%
	Financial savings ($US p.a.)	$4,580
	Return on Investment (10 years)	89%
Transferability	3/3. Readily transferable to cities around the world, most of which operate several libraries. Extent of benefit will depend on the inefficiency of current equipment.	

6 Outcomes

A range of methods could potentially be used to analyse the result of this project. The challenge of combining the criteria used into one assessment of 'best practice' could be resolved by multiplying each criterion by a weight. However, given the subjective nature of the weighting process, it was decided that this was not appropriate. An alternative approach is to use graphical representation of a programme's performance against the criteria. An approach to summarising the results of the projects against 3 of the quantified criteria is given below:

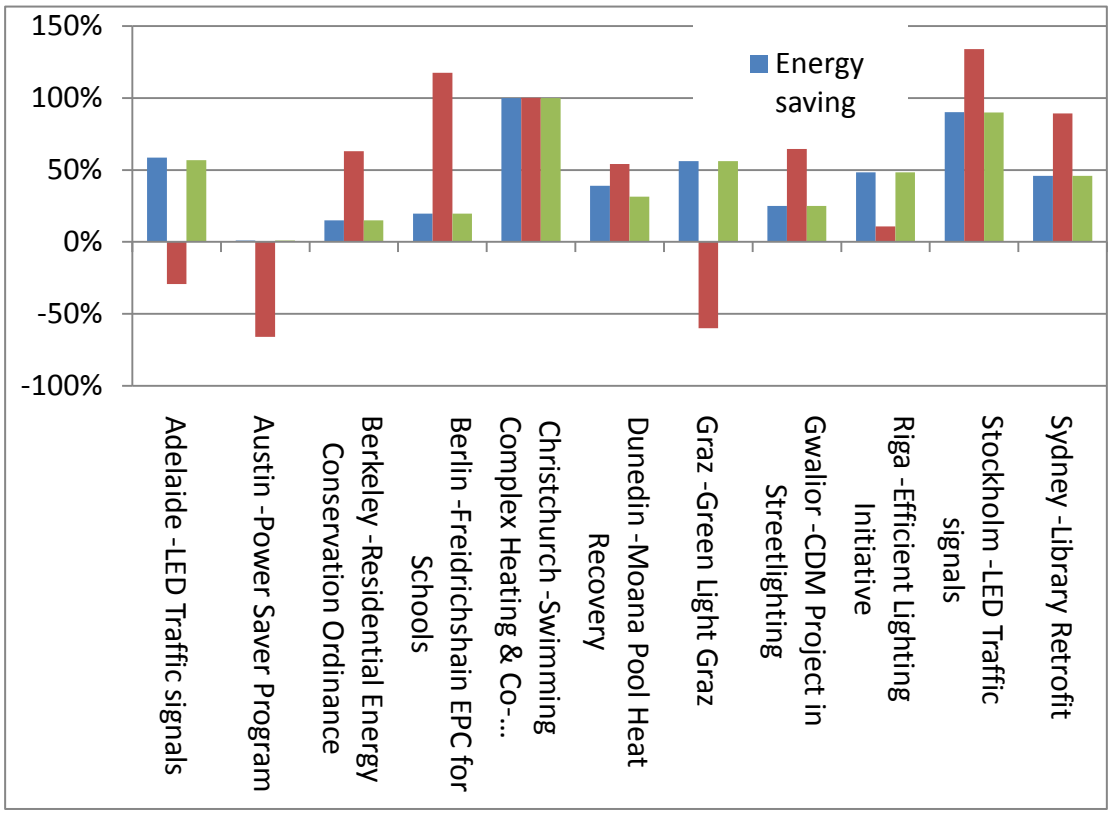

Figure 1: Summary of projects against three criteria

The programmes are compared here under each of the assessment criteria.

6.1 Implementation timeframe

All of the five programmes for which this information was available required a planning and implementation period of at least 12 months.

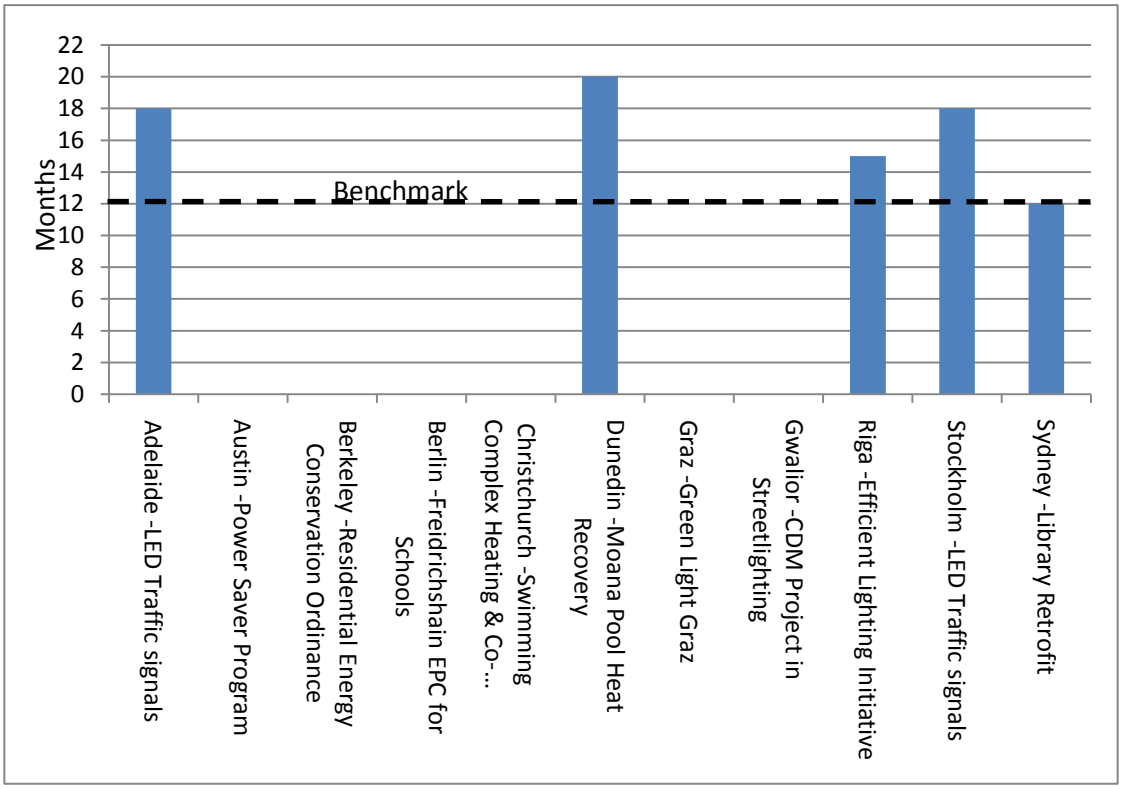

Figure 2: Implementation timeframe

This period was used for:

- an assessment options to address the inefficiency that had been identified through the compilation of a greenhouse gas inventory;
- an assessment of the potential benefits of those options;
- gaining the support of city decision-makers;
- arranging a suitable means of financing the project;
- a tender process;
- infrastructure works.

The two indoor energy equipment retrofit projects, in Riga and Sydney, required the least time to implement, due to the relatively minor infrastructure changes needed. The LED traffic signal projects took the longest due to the need to ensure that the technology provided an acceptable level of safety for road users.

6.2 Energy savings

The percentage saving in energy achieved by the programmes varied greatly, from just 1% to 100%, but most were in the range of 20% to 50% of business as usual energy use.

The Austin Energy programme was reported against a baseline of the entire city energy consumption, rather than just the energy consumed by those businesses in receipt of subsidies to install more efficient equipment. The 1% saving reported for this programme is probably understated.

The programme at the Christchurch city swimming complex involved replacing LPG heating with a cogeneration system using landfill gas. It has been assessed as providing a 100% reduction in energy use and greenhouse gas emissions, due to the landfill gas being regarded as a zero carbon fuel source. The additional greenhouse benefit from the landfill gas no longer escaping to the atmosphere has not been taken into account in this analysis, on the basis that a range of other management options, such as flaring, are available. The actual benefit of this programme is that the landfill gas is being used as a replacement energy source.

The finding that most programmes provided energy savings of between 20% and 50% demonstrates the large number of opportunities that exist to significantly reduce energy consumption in cities.

6.3 Greenhouse gas emission reductions

All programmes analysed, except Christchurch and Dunedin, involved an improvement in the efficiency of electricity use. Because a grid average electricity emission factor was used in this analysis, the greenhouse savings are very similar to the energy savings.

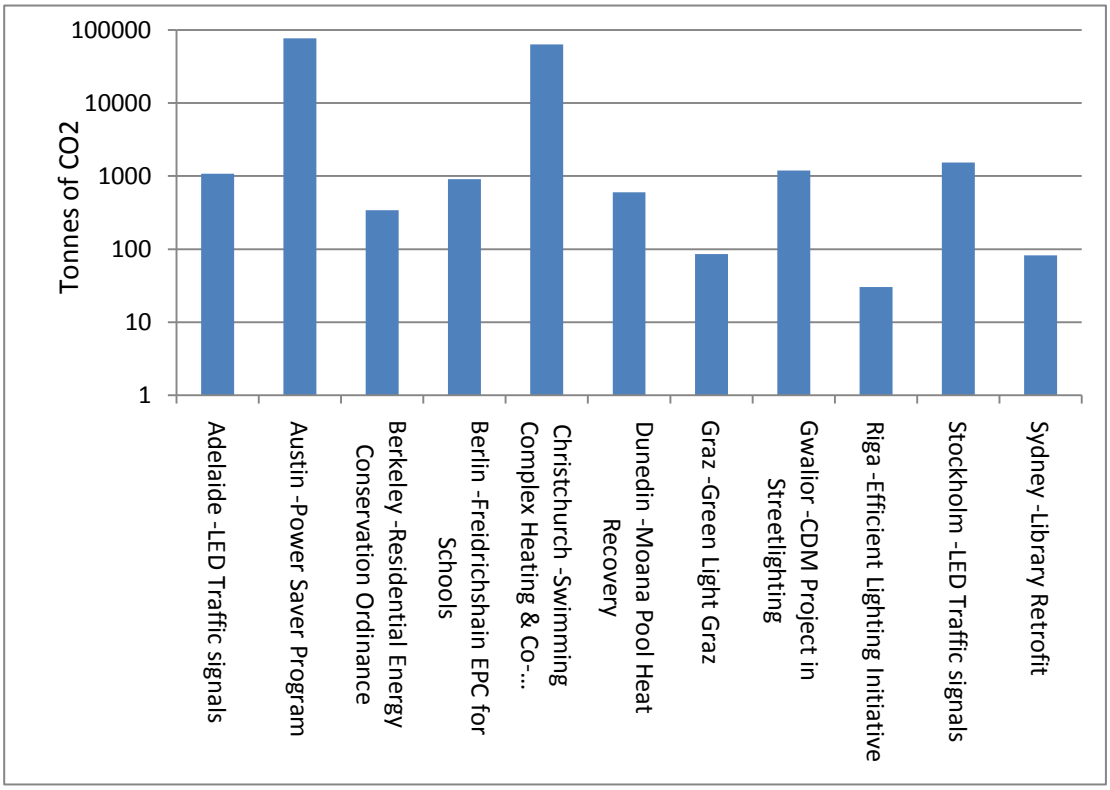

Figure 3: Greenhouse gas emission reductions

6.4 Return on investment

The financial analysis used in this pilot project is intended to highlight the excess return from the project compared to the return that could have been obtained by investing the money in long term bonds at the rate available in the year the programme commenced. The benchmark of 0%, indicating that the programme provided a net benefit, was exceeded by all except those in Adelaide, Austin and Graz. As noted earlier, the assessment method used here may have disadvantaged those projects requiring on-going investment.

The range of positive returns shown by the programmes assessed here was between 11% in Riga and 134% in Stockholm. In general, a higher rate of return is demonstrated in cases where the investment is made at the start of the project and the energy savings are high.

The value of rapid programme implementation is demonstrated particularly well by comparing the benefits of the LED traffic light programmes in Adelaide and Stockholm. The ROI of the two similar programmes has been far greater in Stockholm due to the Swedish programme being implemented rapidly, whereas the Adelaide programme involves a progressive roll out of the technology to suit budget limitations.

The returns are also highest where the inflation rate is low, so that the dollar value of future energy savings is not diminished to any significant extent.

6.5 Transferability

Of the cities that responded to this question in the survey, all except Austin regarded their programme as being readily transferable. The rating of 2 given by Austin reflects the cost of the programme and that it is most suitable for a utility in an area with hot and humid summers.

Information sources used for this pilot project, in cases where the city itself did not respond to the request for information, indicated that most programme were readily transferable. The exception to this was the Christchurch programme, which was designed to take advantage of the proximity of a landfill and a suitable heat load in that city.

7 Future direction

This pilot project is the first attempt to address the lack of rigorous and transparent approach to defining best practice in city energy efficiency programmes. The project has provided interesting insights into a range of exciting projects being implemented in cities around the world. However, the potential exists for far greater benefit. Key areas have been identified through this project that require further work:

- Project data management;
- Refinement of criteria;
- Broaden scope;
- A feedback mechanism.

7.1 Data management

While some cities were well placed to provide the requested information, others were clearly challenged by the detail requested. Although the data access issues encountered were undoubtedly a function of the short timeframe of the project, the response received by more than one city was that the level of detail was simply not available.

The data management issues raised by this pilot project could be resolved by a consistent method for the storage of programme data at the local government level, together with the capacity to access the data when required.

The project also highlighted the need for programme assessment methods to be comparable. While many cities have successfully reported qualitative information on programmes to other agencies, they were less able to provide data to satisfy the strict quantitative assessment criteria tested in this pilot project.

7.2 Refinement of criteria

There are many potential benefits of programmes that are of interest to cities, in addition to the environmental and economic elements assessed in this project. It is within the mandate of most city governments to protect and enhance the amenity of the area they govern to improve the quality of life of residents. There may be potential to include certain social indicators in a future assessment.

It has been noted in this report that the criteria of *return on investment* may have disadvantaged programmes implemented over a period of years. Further work is required in order to determine which measure of financial benefit is most appropriate for the full range of projects being implemented by cities.

While the general framework of assessment used here is applicable, further work is required to define the appropriate criteria for programme assessment.

The development of benchmarks to assess *best practice* is facilitated by data from many similar programmes. Once the assessment framework is further defined, information from many more case studies is required to enable the development of benchmarks that are based on programme experience rather than being arbitrarily set as was the case for this pilot project.

7.3 Broaden scope

This pilot project has focussed on energy efficiency and attempted to gather accurate financial, energy and emissions data. However, there are two areas where this project could benefit from a broader scope. First, the project could usefully extend its scope beyond energy efficiency to include the many programmes being implemented by cities involving the use of renewable energy and alternative transportation. Second, the project could also usefully expand its scope to investigate some of the 'softer' aspects of the programmes surveyed. That is, it would also be useful for the project to help shed light on the motivations, perceived barriers and other factors involved in pursuing energy efficiency or renewable energy investments.

7.4 Feedback mechanism

Information on *best practice* programmes needs to be disseminated to other cities. It needs to be both readily accessible and relevant to their city, in order that it can be used in strategic planning processes.

The effective sharing of information would be assisted by a centralised, global database that enables relevant case studies to be identified. The most relevant information is that from analogous cities, so a key aspect of any feedback mechanism is the assessment of transferability.

To achieve this, there may be scope to more closely align the assessment method developed in this project with the IEA Demand Side Management work programme. Of particular relevance is the DSM Programme Task XVIII: DSM and Climate Change (2007), which includes a component of improving data management and the development of a database to enable users to identify a range of options to improve energy efficiency and reduce the emission of greenhouse gases. In addition, it may be useful to include these and further local-government policies in the IEA energy efficiency policies and measures database

(http://www.iea.org/textbase/pm/index_effi.asp).

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Appendix A – copy of survey cover letter and survey

Dear <mail merge>

Re: Promoting Energy Efficiency Best Practice in Cities

We are writing to request your assistance on a major local government energy efficiency project.

The 'Promoting Energy Efficiency Best Practice in Cities' project is a collaborative exercise between the International Energy Agency (IEA) and ICLEI – Local Governments for Sustainability. The IEA provides international energy policy advice focusing on energy security, economic development and environmental protection. ICLEI is an international non-profit association of more than 700 local governments and their national organisations that have made a commitment to sustainable development. For more information on the roles of both the IEA and ICLEI please visit: www.iea.org or www.iclei.org respectively.

The purpose of the 'Promoting Energy Efficiency Best Practice in Cities' project is to collect, evaluate and publish a meaningful compilation of case studies of best practice. The case studies represent prominent examples of energy efficiency policy and measures undertaken by local government from around the world. The objective in undertaking such a project is to encourage local governments to further improve the energy efficiency of their operations - by considering adopting some of the innovative ideas contained in the compilation for their own jurisdiction. Once completed, the results of the 'Promoting Energy Efficiency Best Practice in Cities' project will be made available free of charge to all local governments.

Your <mail merge> has been identified as a prominent example of an energy efficiency policy or an energy efficiency measure, and as such, we would like to include it in the 'Promoting Energy Efficiency Best Practice in Cities' project. However, in order for this to happen, we require more information on your programme. It would be much appreciated if you could please complete the attached survey and return it by 31 January 2008.

If you have any questions regarding the survey or the 'Promoting Energy Efficiency Best Practice in Cities' project - please do not hesitate to get in contact with: andred.saker@iea.org.

Thank you for your time.

Kind Regards

Nigel Jollands, PhD
Principal Administrator
Energy Efficiency Division
International Energy Agency

Wayne Wescott
Chief Executive Officer
ICLEI – Local Governments for Sustainability
Oceania Secretariat

Part 1: Programme Description

1.	Name of programme (please amend as necessary)		
2.	Please provide a contact person for the survey (so that we can contact you if required; this information will NOT be published)	Name: Position: Telephone: Email:	
3.	Date of survey completion (dd/mm/yyyy)		
4.	What agency/organisation is responsible for the programme?	Organisation Name: Website:	
5.	Please write a description of the programme by answering the following questions. An example of a description is provided at the conclusion of the survey.	What does the programme aim to achieve and how will the programme achieve this aim?	
		Who are the stakeholders of the programme?	
		Where is the programme located? (i.e. country, city, suburbia etc.)	
		In what year did the programme first deliver benefits?	

Part 2: Programme Indicators

			Energy Savings	Unit (GJ or kWh)
1.	If possible, please estimate the energy savings (the total for all energy types) per year throughout the duration of the programme.	Year 1 of the programme Year 2 Year 3 Year 4 Year 5 Add extra rows if needed		

			Energy Savings	Unit (GJ or kWh)
2.	If possible, please estimate the energy consumption (the total for all energy types) per year that would have been consumed if the programme had not been implemented	Year 1 of the programme Year 2 Year 3 Year 4 Year 5 Add extra rows if needed		

			Tonnes of CO_2 saved
3.	If possible, please estimate the CO_2 savings per year throughout the duration of the programme.	Year 1 of the programme Year 2 Year 3 Year 4 Year 5 Add extra row if needed	

			Tonnes of CO_2 emitted
4.	If possible, please estimate the CO_2 emissions (the total from all sources) per year that would have been emitted if the programme had not been implemented	Year 1 of the programme Year 2 Year 3 Year 4 Year 5 Year 5 Add extra rows if needed	

		Energy Cost	Unit (e.g. $/GJ or $/kWh)
5.	Please specify the energy cost (per unit), in your national currency, for the fuel source affected by the project (i.e. electricity, natural gas etc.).		

Part 3: Financial Consideration

			Amount	Currency
1.	What are the costs, in your national currency to the programme throughout its duration? Please include, where applicable, the development cost, operation cost and any decommissioning cost.	Year 1 of the programme Year 2 Year 3 Year 4 Year 5 Add extra row if needed		

Part 4: Transferability

1.	Given the scale below, how transferable is your programme to other domestic or international jurisdictions? 1. The programme cannot be physically transferred due to the need for specific environmental conditions 2. The programme can be transferred but at significant cost (see below) 3. The programme can be physically implemented with minimal cost. The cost could be a result of the need to: implement a local or national legal framework, undertake campaigns to change people's attitudes or behaviour in order for the programme to be accepted, attract and retain skilled labour to implement and/or operate the programme or extensively modify existing infrastructure in order to accommodate the programme – despite the fact that it can be physically transferred.	Please indicate in the top space the **number** between 1 and 3 that best corresponds to your programme, and in the bottom space provide an **explanation** for your answer.	

Part 5: Comments

Please write in the space below if the programme has any other significant features that would help distinguish it from other programmes. For instance, the programme could have a high degree of innovation or could have considerable environmental, economic or social co-benefits or side effects.

Please attach any documents (such as reports etc.) that you think would be of use to the 'Promoting Energy Efficiency Best Practice in Cities' project. Likewise, if there is a website that has additional information on your programme, please enter the address below.

http://