ECA Sustainable Cities:

# Improving Energy Efficiency in PRISTINA Kosovo

TRACE Study






ECA SUSTAINABLE CITIES

ESMAP
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Climate Change

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*The TRACE diagnostic is part of the toolkit of the Europe and Central Asia Sustainable Cities Initiative (ECA SCI), which aims to promote sustainable development in ECA cities. Work on the report was done under the guidance of Stephen Karam (ECA Urban Sector Leader) and Samira El Khamlichi (Environmental Specialist and Task Team Leader), with a team comprised of Marcel Ionescu-Heroiu (Extended Term Consultant), Ranjan Bose (Senior Energy Specialist), Rozafa Basha (Consultant), Krenar Bujupi (Operations Officer), and Nejme Kotere (Team Assistant). Throughout the process of collecting data and writing the report, the team has enjoyed an excellent collaboration with local authorities in Pristina.*

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http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/0,,contentMDK:23050220~pagePK:146736~piPK:146830~theSitePK:258599,00.html

# Executive Summary

Pristina is in many respects somewhat of a conundrum. On the one hand, still being a relatively poor city, it is plagued by energy shortages and shortfalls of public service delivery. On the other hand it has been in recent years a testing ground for state of the art energy efficiency technologies. These experiences have provided valuable inputs for shaping policies, for tweaking and improving management of public services, and for building a stock of knowledge that other cities throughout the world could tap into.

One of the most striking things about Kosovo is that it went from a position in which it exported electricity, to one in which it now has to rely on imports to satisfy demand. Even so, demand cannot be met year-round, and power-outages are frequent – particularly in the peak-load winter months. Technical and non-technical losses (including theft of energy and non-billed electricity) ran at around 37% in 2011, and were the highest of any city with relevant data in the TRACE database.

Termokos, the district heating network in Pristina, had to cut heating delivery more than two months early in the 2011-2012 heating season, because it lacked the funds to buy the necessary fuel oil (mazut). With tariffs being stable since 2008, with mazut prices increasing from $225 in 2008 to $735 in 2012, and with a public companies law that prohibits the use of subsidies, Termokos was basically forced to cut down service three years in a row. This has repercussions not only on general customer satisfaction, but also on general system maintenance and upkeep.

The regional water system is plagued by a high share (54% in 2011) of non-revenue water, with low billing, an outdated network, and pervasive water theft. Moreover, the original system was designed initially for a city of around 30,000, and now has to serve over 450,000. This means that not only there are issues in meeting demand (with water delivery limited at 18.3 hours daily), but it has also led to a highly intensive water system – the second highest in the TRACE database. Water has to be pumped up from reservoirs to two main treatment plants, and then from the treatment plants to end-consumers. Thus, all the water that gets lost is water that has been previously pumped and treated. Moreover, there is no wastewater treatment plant in the city, and raw sewage just gets dumped in surrounding rivers.

The solid waste management sector has benefited from several investments in recent years, many in the form of donations from international organizations. However, the lack of capacity and funds to efficiently run this new infrastructure has led its quick deterioration. The regional landfill in particular, went from being a disposal site that met all basic environmental criteria, to an open dump site with no leachate collection, with no compaction of waste, and with no top soil cover. In effect, a landfill that was designed to operate until 2025 is in danger of running out of capacity fairly soon.

On the other hand, investments in a number of other areas make Pristina a study case for other cities. For example, Pristina is one of the few cities in the Western Balkans that has installed a system of LED street lights. In addition, a large stock of the municipal building stock managed by local authorities has underwent significant energy efficiency rehab work. A large majority of schools, hospitals, administrative buildings, cultural centers, have received new windows, new doors, new roofs, thermally insulated walls, energy efficient light bulbs, and energy efficient appliances. A new school, developed with municipal funds and assistance from USAID, uses some of the newest and most advanced energy efficiency technologies known today: heating is delivered year-round from hot water springs beneath the school, solar panel provide hot water and lighting for part of the building, and all light bulbs are equipped with motion-sensors, only turning on when somebody is around. A second green school will be developed shortly with assistance from the World Bank, and employed technologies are hoped to provide inspiration and examples for other similar developments.

The results of the TRACE process are a mixed bag, just as the quick findings outlined above. Thus, on the one hand there seems to be great scope for improving energy efficiency in the urban transport sector (both for private vehicles and for the public transport sector), in the district heating sector, and in the water sector. On the other hand, municipal buildings and street lighting seem to be star performers – from an energy perspective. The caveat that is in order here is that the low energy consumption in these two sectors is both a result of pro-active measures (e.g. LED bulbs and thermal insulation), but also a reflection of short-comings in the energy sector (with intermittent electricity and

heating supply), and a reflection the level of development of Pristina (with fewer energy demands).

Below is a discussion of the main recommendations made following the completion of the TRACE study, and following in-depth discussions with local authorities and other stakeholders.

***Non-motorized Transport Modes***. Pristina is an inherently walkable city. It is relatively small in size, quite compact, and developed in a radial form. As such, most neighborhoods can be reached from the center city by foot. There are also a number of initiatives (such as the Mother Theresa pedestrian walkway in the city center) that come to encourage walking. For the most part however, the center city, as well as most of the neighborhoods remain a car fiefdom, with vehicles parked on sidewalks and on most pedestrian areas that are not closed off or inaccessible. It is therefore recommended to have an in-depth city level traffic study, to identify other areas with high pedestrian traffic, and to potentially consider turning them into pedestrian areas, or areas with reduced car traffic. Such measures do not only bring environmental and quality of life benefits, but they also have powerful economic side-effects. Areas with more pedestrian traffic often lead to new business formation.

***Parking and Traffic Restraint Measures*.** With a weak public transport sector, and with few options for commuting from outside the region (e.g. much of the railway network is not operational anymore), private cars are one of the main means of getting around Pristina. As a consequence, the number of vehicles in the region has grown from around 60,000 in 2005, to around 120,000 currently. This is a dramatic increase, and is reflected daily by congested streets, traffic gridlocks, and rampant illegal parking practices. During peak traffic hours, basically the entire city is engulfed by cars. This rapid change poses a number of environmental, social, and even economic problems, and requires a proper response from city officials. In particular, a transport masterplan should be drafted to identify ways in which some of the key urban transport challenges can be tackled.

***Public Transportation Development.*** Following the 1999 war, there was basically no public transport infrastructure left in the city. The void was initially filled by small van and minibus operators, which circulated on the busiest thoroughfares. With time, local authorities took a more pro-active approach and organized together the public bus fleet and the private bus operators. Significant improvements were made in the field (e.g. a set number of routes and standard public transport prices), but many issues remain to be resolved. For example, the sector is highly fragmented, with 22 private operators; there is only one dedicate bus lane in the city; there is no unified ticketing system, which would allow people to use the same ticket (or monthly tickets) on all buses; the rolling stock is quite old, uncomfortable and polluting; and individual lines are not always serviced according to set time-tables (i.e. private bus operators often don't send the buses out when ridership is known to be low – e.g. on week-ends. Local authorities help to address those issues through a well-developed PPP arrangement, and by consolidating service provision around 2-3 larger service providers. This will not only enable economies of scale, but will also enable better service (e.g. one service provider could subsidize less profitable routes with the revenue made from the profitable ones).

***District Heating Network Maintenance***. Around 60% of the district heating network in Pristina is in need of replacement, with sections of it being over 40 years old and under-dimensioned. In terms of non-revenue heat, the system in Pristina is the least efficient of all cities with relevant data in TRACE. Reducing losses requires an overhaul of the entire the system, including the replacement of piping and the introduction of better metering. Termokos, the public company in charge of the district heating system, is already planning to revamp the network with assistance from the EU and KfW.

***District Cogeneration Thermal Network***. The fluctuations in mazut prices, and the reliance on imports for primary energy, has convinced local and national authorities to introduce a cogeneration system in Pristina. Thus, the plan is to use steam from the Kosovo B power plant outside the city, to heat water for Termokos. This would not only eliminate dependence on mazut, but it will also ensure double dividends for the energy generated by the power plant.

***Municipal Offices Audit and Retrofit Program***. A large number of municipal buildings in Pristina have already underwent significant energy efficiency improvements. There is no comprehensive audit however that shows where the biggest energy savings have been achieved, and where there still is room for improvement. A comprehensive audit and retrofit program would not only help continue the good work that has been done so far, but it would also contribute to the establishment of a database for better planning in the future. Moreover, such a database can be used to inform similar program in other cities in Kosovo and beyond.

***Mandatory Building Energy Efficiency Codes***. With state of the art developments like the Green School Pristina, local authorities want to take a more pro-active approach in ensuring that such developments are not the exception but the norm. The work that has already been done in the city can provide inspiration for other similar developments, while energy efficiency codes developed in other places can be adjusted to the local context to provide a standard platform for sustainable building development.

# Introduction

Pristina, the capital of Kosovo, is the wealthiest and the largest municipality in the country and has grown from a small trading town to a burgeoning industrial and business center. Along with the other constituencies of the former Yugoslavia, Kosovo has, since 1989, seen major structural changes that have extended into all areas of society and thus affected the living conditions of its citizens. A destructive and costly armed conflict in 1999 was ended by NATO intervention followed by direct UN administration from 1999 to 2008. Thereafter, the UN oversight has aimed primarily at establishing a new, democratic system in Kosovo for enhanced political, social and economic engagement by all citizens.

Kosovo's economy is new and dynamic. Its foundation has been transformed from a centralist and controlled economy, to a free-market economy. The goal now is to increase competition within the economy, while increasing its export capacity to reduce Kosovo's trade deficit. Although Kosovo's economy possesses rich mineral resources, agriculture is the main economic activity because of decades of under-development. All of its economic sectors are in poor health today, but policy makers are planning to boost investment and improve socio-economic conditions. The country is likely to face a difficult road ahead in terms of increasing electricity supply, which no longer meets domestic demand as a result of years of inadequate and weak management. Despite local and international investment, Kosovo lives in a continual energy crisis characterized by pollution-producing lignite power generation, an old and inefficient transmission and distribution grid, and high technical and commercial losses.

The country has two lignite fired thermal power plants, Kosovo A and Kosovo B, located in the municipality of Obiliq and is only a few kilometers from Kosovo's capital. These two power plants have a combined installed capacity of 1,478 MW, though both are out-of-date and run far below installed capacity (between 645 and 710 MW). Serious pollution is emitted from the two functioning power plants and they release 25 tons of dust and ash per hour, which is 74 times the EU standard for power plant emissions (see picture below). In Obilic alone, 30 percent of the town suffers from chronic respiratory diseases from the pollution of the two existing power plants.[1]

**Emissions from Kosovo Power Plants**

Power outages are frequent in many parts of the country and are one of the main obstacles to the country's economic development. Due to the lack of a reliable energy supply, many planned investments in Kosovo do not often materialize. Partly as a result, the unemployment rate in Kosovo is estimated to be around 43%, and continued joblessness is a major contributing factor to the prevailing high rates of poverty.

In addition to these indirect impacts of energy on economic development, access to reliable and affordable energy services—that is, heat, light and motive power—is a key factor in human development. At the household level, these services are provided in large part by electricity, which is not always available and therefore household energy demand is often not fulfilled. Imported oil products and gas (in canisters, because there is no gas network in Kosovo) for use in transport and as a source of household energy are generally reliable in supply, but not always in quality. Firewood, the third most widely used source of energy in Kosovo, is used primarily for space heating at the household level. Energy related activities are a major source of the emissions of

[1] http://www.banktrack.org/manage/ajax/ems_dodgydeals/createPDF/kosovo_c_coal_power_plant

greenhouse gases that contribute to global warming. At a more localized level, energy production and consumption are major causes of environmental pollution that has negative consequences for human health and well-being.

Energy policy in Kosovo to date has concentrated primarily on the provision of large-scale electricity supply and the transition to a liberalized electricity market. Policies to promote renewable energy and energy efficiency (EE) are lagging behind. Nonetheless, the International Energy Agency has estimated that, on average, each $1 investment in more efficient appliances and buildings avoids more than $2 of investment in power generation, transmission, and distribution infrastructure.[2] Consequently, the development of a coherent energy policy in Kosovo should inherently also include a treatment of energy efficiency issues.

In policy and practical terms, EE is a much broader field of activity. It relates not only to efficiency in energy supply systems but also to consumption. As such, EE policies could focus on:

- combustion technologies for electricity generation and district heating;
- household electrical appliances;
- industrial production equipment;
- boiler in public buildings and multi-unit residential buildings;
- thermal characteristics of buildings;
- energy use for provision of municipal services (e.g. water pumping, transportation of solid waste, street lighting);
- motor vehicles.

Different actors, stakeholders and technologies are directly engaged in each of these consumption-related applications. For example, household members select and use appliances and vehicles, while companies and municipal authorities install and maintain boilers, water treatment plants, street lighting, collection, transportation and disposal of solid waste, etc. Therefore, different policy instruments would be needed to address each area. And, priorities need to be established for immediate policy action.

[2] http://www.iea.org/press/pressdetail.asp?press_rel_id=187

The work included in this report uses a city diagnostic tool, developed by the World Bank, to evaluate EE opportunities in municipal sectors (including urban passenger transportation) in Pristina Municipality and identify priority areas for further investigation and intervention. The team recognizes that benefits (due to cost savings due to EE intervention) for the city municipal budget may be relatively small in the short term, but also acknowledges the importance for municipal government to lead by example, to facilitate an investment friendly climate to attract finance for sustainable projects and to put in place solutions to enable the Pristina Municipality to maintain economic growth for social development, improve environmental sustainability and enhance EE. This of course can only happen with a series of key elements in place: strong city leadership; a clear vision and strategy; enabling national policy environment; implementation, enforcement, and good governance.

This work is part of the efforts undertaken under the World Bank's European and Central Asia Sustainable Cities Initiative (ECA SCI). ECA SCI started in May 2010, with a knowledge exchange event in Copenhagen and Stockholm, from the premise that city-level sustainable development actions can set the stage for world-wide sustainable development. Focusing on sustainable development issues in ECA cities is particularly poignant, because they face a number of critical economic, social, and environmental challenges. ECA, for example, has some of the most polluted cities in the world. In fact, it has the highest share of pollution per unit of GDP of any other region in the world, accounting for 7.1% of the world population, 3.1% of global GDP, and 11.8% of global $CO_2$ emissions from fuel combustion. In economic terms, while ECA countries have registered some of the fastest growth rates in the past decades, they have also registered some of the sharpest economic declines in 2009 – underlining that much of the previous growth was not sustainable.

One of the major components of ECA SCI is to help city mayor and the municipal governments in the ECA region begin formulating sustainable urban energy developing strategies, in the context of cities' overall development plans. By ensuring that urban energy supply is secure, reliable, and affordable, and by ensuring demand is efficiently managed, cities can optimize operating costs, improve air quality, and improve quality of infrastructure services, while at the same time

supporting economic development and climate change mitigation objectives. This requires investigating beyond the energy sector, to all sectors (notably urban transport and water supply/sanitation) using energy in their production of urban services.

***A Note on Methodology***

This city report on Pristina builds on a city EE diagnostic assessment tool 'TRACE' (Tool for Rapid Assessment of City Energy). Developed by the World Bank's Energy Sector Management Assistance Program (ESMAP), TRACE[3] offers cities quick diagnoses of EE performance across a city's systems and sectors. It prioritizes sectors and presents a range of potential solutions embedded with implementation guidance and case studies. TRACE is a software platform for assessing EE performance of six municipal sectors or services: urban passenger transport, municipal buildings, water and waste water, public lighting, solid waste, and power and heat. TRACE does not cover industry, residential and commercial establishments. As shown in its Home Page below, TRACE consists of three principal components: an *energy benchmarking tool* which compares key performance indicators among peer cities, a *prioritizing process* which identifies sectors that offer the greatest potential with respect to EE improvement, and a "playbook" of tried-and-tested *EE recommendations* which helps select the appropriate interventions.

TRACE deployment is a 3-month long assessment process that includes several weeks of upfront data gathering and benchmarking, sector meetings and preparation of a final report. Based on TRACE results, city governments can identify early wins in key municipal sectors and start developing a city-wide or services, which are under direct municipal government control, with significant energy savings potential, and identifies appropriate EE interventions. The tool uses a software platform and it is a simple, low-cost, and practical tool to assist city governments in developing locally appropriate EE strategies.

Work on this report started with a scoping mission in Pristina in February 2012, data collection by a locally hired consultant in March-April 2012, and the implementation of the TRACE in the city from April 9 to 18, 2012. The TRACE diagnostic tool was selected because EE is often considered to be a "low hanging fruit" in sustainable development, with outcomes and benefits that are fairly easy to measure and monitor. This activity is expected to yield important dividends in helping Pristina identify investments necessary to develop as a sustainable city.

**TRACE Home Page**


During the TRACE implementation mission, interviews were held with a range of Pristina City Administration departmental staff and representatives from a range of city/state agencies and public transport operators. The field mission also involved site visits at the city's district heating plant and the landfill site. Information gathered during this period enabled a classification of each municipal sector based upon the degree of influence directly or indirectly exerted by the city authorities the potential for energy savings in the sector and relative spending on energy in each sector or service area. These enabled a detailed systematic filtering of all of the EE recommendations contained within TRACE, to examine their suitability in Pristina.

[3]For further details please visit http://www.esmap.org/esmap/node/235

# Background

Kosovo borders the Republic of Macedonia to the south, Albania to the west and Montenegro to the northwest. The remaining frontier belt is with the Central Serbian region. Kosovo has a surface area of 10,908 km$^2$, with a continental climate, with warm summers and cold and snowy winters. It is situated at an altitude of about 500 meters, surrounded by mountains.

The population of Kosovo is not precisely known. A census was completed in 2011, but only 34 out of 37 municipalities were covered. Preliminary estimates place the population at around 1.73 million. A total of around 400,000 dwellings were counted in the surveyed municipalities, and around 300,000 households. The population of the City of Pristina was estimated at around 200,000 (almost double the population of three decades ago), with around 60,000 dwellings and 40,000 households. Around 33% of the dwellings in Pristina are considered to be un-inhabited.

**Population dynamic in the ten largest cities in Kosovo**

| | City | Population | | Compounded annual growth |
|---|---|---|---|---|
| | | Census 1981 | Census 2011* | |
| 1 | **Pristina** | **108,083** | **198,214** | 3.08% |
| 2 | Prizren | 61,801 | 178,112 | 5.44% |
| 3 | Ferizaj | 37,659 | 108,690 | 5.44% |
| 4 | Peje | 54,497 | 95,723 | 2.86% |
| 5 | Gjakove | 42,031 | 94,158 | 4.12% |
| 6 | Gjilan | 35,229 | 90,015 | 4.80% |
| 7 | Podujeve | 15,894 | 87,933 | 8.93% |
| 8 | Mitrovice | 52,866 | 71,601 | 1.53% |
| 9 | Vushtrri | na | 69,811 | - |
| 10 | Suhareke | na | 59,702 | - |
| | TOTAL | 1,243,093 | 1,733,872 | 1.68% |

*Provisional.
Source: Statistical Office of Kosovo.

Kosovo has a relatively high birth rate. The average household size is 5.88, but this figure varies considerably among municipalities; the lowest average being 4.06 in the municipality of Ranillug and the highest 9.77 in the municipality of Mamushe. In Pristina, the average household size is 4.92.

The unequal development rate of social infrastructure and services in Kosovo has resulted in population migration from rural to urban areas and from urban to more developed urban areas. The most fertile rural areas, located in low plan lands, valleys, river and lake terraces, are increasingly being occupied by houses and yards, factories, roads, mines, schools, hospitals and other objects - all unplanned and often illegal constructions. As a result, Kosovo today is facing a very complex and unsustainable urbanization pattern:

- Cities in their former boundaries are unable to provide space for new investments leading to unplanned and uncontrolled urban development.
- Informal settlements become a common sight on the city outskirts with poor access to basic services and deteriorating quality of life.
- Migration from villages to towns and from towns to the capital city.
- Coupled with the process of urbanization, there is uncontrolled suburbanization around and in between the towns causing an increasing mobility and environmental problem with traffic jams and pollution.
- Private car traffic is increasing day by day due to an undeveloped and sometimes absent public transport system.

As part of the Socialist Federal Republic of Yugoslavia, Kosovo developed from a predominantly agricultural economy into one based on mining and industry. However, as the conflict between the Albanian majority in Kosovo and the Miloševic regime accelerated, neglect of the industrial base led to a return to a largely agrarian economy.

According to a World Bank 2011 study[4], income per capita fell in Kosovo by an annual average of 13 percent during the first part of the nineties to reach less than $400 per capita and per year, in 1995. The massive international response following the armed conflict in 1999,

[4] http://intresources.worldbank.org/INTECACOSUFM/Resources/776194-1265301132428/6766619-1267044234513/Kosovo_PEFA_2011.pdf

aided by a steady flow of remittances from abroad as well as domestic growth has raised the average per capita income to about $1,400 per annum. The study further reveals that Kosovo's economic growth has been solid since the end of the conflict in June 1999, attributable in part to large public investments in post-conflict reconstruction as well as an increase in private investment (albeit from a low base). GDP growth, reflecting the massive donor-funded reconstruction effort and high public and private investment, averaged 4.0 percent since the end of the conflict and reached 5.4 percent in 2008. At the same time, the rest of the Southeastern European countries were growing faster up to 2008, so Kosovo's income gap with the region widened. Growth reverted to about 4 percent in 2009 in the wake of the global economic crisis, a much better outcome than in the rest of Southeastern Europe, which suffered declines in output.

The majority of the population in Kosovo is young with a high rate of unemployment. There is a low level of economic development due to the lack of a comprehensive vision for economic development and a very slow transition of government-owned enterprises to the private sector. Industrial production and mining from the former socially-owned sectors has dropped and the increase of privately owned production enterprises is slow. Kosovo's GDP per capita is currently the lowest in Europe (1,909 Euro in 2010)[5].

The Human Development Indicator for Kosovo has increased from 0.740 in 2006 to 0.777 in 2010. However, it is important to note that, using the new methodology as per the Global Human Development Report 2010, the Kosovo Human Development Index (HDI) has been calculated at 0.700 in 2010. The growth of the overall HDI value was strongly influenced by the GDP index growth during the time-period of 2000-2007 and a significant increase in the number of high schools and university education facilities.

Despite the best intentions of Kosovo institutions and stakeholders, reconstruction and development have been slow. Persistent capacity and supply problems in the energy sector provide a clear example of the ongoing challenges to renewed economic growth, increased opportunities and enhanced quality of life in Kosovo. Significant improvements in the energy sector are vital to efforts to boost confidence and establish strong foundation for economic and human development.

[5] http://www.mfa-ks.net/?page=2,119

### National Energy Efficiency Strategy

Energy is a key economic sector in Kosovo economy, notably because of Kosovo's large lignite mining and electric power generation potential. The current energy situation is particularly noteworthy given that Kosovo, at one time a net exporter of electricity, has now no reserve capacity, and power outages are frequent at peak demand periods.

Policy makers are under increasing pressure and are looking for constructive answers to identify appropriate priorities regarding:

- investment in existing infrastructure;
- improvements in electricity supply;
- improvements in relationships between energy consumers and suppliers, by increasing communication with improved collection rates;
- potential reduction in energy demand through conservation and EE measures; and
- increasing public awareness about the existing problems in energy sector as well as energy conservation measures.

The current energy policy in Kosovo is focused primarily on determining methods and strategies to improve the quality, reliability and scope of the electricity supply. There are three major factors at play:

- insufficient production from the existing power plants, compounded by the relatively frequent losses of entire production units from the system for repair, and the lack of back-up capacity;
- high technical losses in outdated and overloaded transmission and distribution systems; and
- high non-technical losses caused by theft of electricity, inaccurate metering and (in some cases) an absence of meters, and non-payment of bills by end-users.

Recognizing this energy supply challenges, in 2005, the Kosovo Assembly first adopted its Energy Strategy for the years 2005-2015. This strategy was reviewed in 2009 and following months of discussion in the Kosovo Assembly the Energy strategy was revised for 2009-2018. The Revised

Energy Strategy (RES) was approved by the Kosovo Assembly on April 1, 2010. The RES aims at achieving effective management of existing energy resources and protection of the environment.[6] The RES focuses on enhancing the security of energy supply according to European Standards, as well as on the diversification of energy resources. The strategy aims also at stimulating rational utilization of energy, promoting EE, promoting development of renewable energy resources and introduction of new technologies that do not cause irreparable damage to the environment, thus respecting the application of internationally accepted environmental standards.

As numerous studies have shown, Kosovo has considerable potential to improve EE by reducing technical and commercial loses on the supply side, and reducing demand at the end-user level. Reductions in commercial loses will bring down electricity consumption because unmetered households use electricity considerably more than those households that are metered. Addressing theft and non-payment for consumption of electricity by metered households would reduce demand, and will also have the important effect of increasing the revenues of the power utility. A large proportion of commercial loses is actually electricity that is consumed but not paid for. Improvement of billing and collection levels for electricity consumed represents a significant challenge for the government institutions.

From an end users perspective, market penetration of energy efficient appliances in households and businesses and fuel-efficient motor vehicles may need fiscal and/or financial incentives to reduce energy demand. This is already recognized in current strategy. The economic rationale for public support for market penetration of energy efficient appliances and improved thermal insulation of buildings in Kosovo include the following: (i) the need for electricity demand reduction in the short term, and (ii) a reduction in the indirect costs related to subsidizing consumption of electricity, and (iii) the longer-term imperative of reducing $CO_2$ emissions.

Many people are not fully aware of the problems of fuel quality and many privately owned vehicles are old and fuel-inefficient. (For example, over half of the vehicles in Pristina are over 15 years old.) In addition, there is an increasing trend towards private vehicle use, even for short journeys, and away from public transport use. This trend persists despite the high cost (relative to incomes) of petrol and diesel. Public support schemes like, raising awareness and access to information, and perhaps commercial finance may be sufficient to encourage investment in EE.

New buildings regulations are planned to be introduced that include provisions for ensuring improved thermal characteristics of new buildings; they will not, however, apply to existing buildings.

EE improvements are considered an important an element of the Revised Energy Strategy of Kosovo 2009-2011, conducted in accordance with the Law on Energy No. 2004/8. Policy development, organization, regulation and management of the energy sector in the Republic of Kosovo are based on a set of laws generally in compliance with the European Union (EU) acquis on energy. In particular, the Law on EE was adopted by the Constitution of Republic of Kosovo and a draft National EE Plan for the period 2010-2018 has been prepared. Based on Article 65 (1), this Law (No.04/L–016) will regulate the issue of EE, preparation and approval of EE plans and their implementation, determination of roles, duties and responsibilities of the institutions. The Law also addresses the obligations deriving from the Energy Community Treaty and the European integration process. In this respect, a number of measures are envisaged to be undertaken for the completion of energy sector restructuring and reforming in line with the EC directives and other applicable legislation. This would enable the sector to become not only financially self-sustainable but also able to attract private investments and contribute significantly to faster and sustainable economic and social development of the country. Specifically, the draft law on EE (Law No. 04/L-016 dated 23 June 2011) issued by the President of the Assembly of Republic of Kosovo addresses the following components in the EE strategy:

**Duties and Responsibilities of the Institutions**

***Ministry of Energy and Mines***

Article 4: The Ministry of Energy and Mines (MEM) is obliged to: (a) establish the Kosovo EE Agency (KEEA); (b) establish the Commission for Certification of Energy Auditors and Managers, whose duties and responsibilities are provided with sub-legal act; (c) develop EE policies as part of the Kosovo Energy Strategy; (d) scrutinize and submit for

[6] Although, it is acknowledged in official policy documents that the environmental impacts of existing electricity generation are a lesser priority.

approval to the Government the Kosovo plan for EE in compliance with Directive 2006/32/EC, reviewed in three years period and report on its implementation to the Government every three years; (e) develop an EE National Action Plan, in line with Directive 2006/32/EC. The Kosovo plan for EE as well as the report for its implementation will be submitted to the Energy Community Secretariat.

Article 5: The Kosovo Energy Efficiency Agency (KEEA) will be an executive institution within the Ministry and will be based in Pristina. The KEEA shall be funded by the Budget of the Republic of Kosovo, pursuant to the Law on Management of Public Finances and Accountability.

***Kosovo Energy Efficiency Agency***

Article 6: The KEEA is responsible to: (a) propose to the Minister the policies to promote the EE; (b) develop and maintain the database on EE; (c) develop the system of monitoring implementation of the National EE Plan and achievement of the indicative targets for energy saving; (d) propose to the Minister the National EE Plan; (e) prepare the Progress Report on the Implementation of the National EE Plan; (f) guide and support municipalities for preparation of the municipal EE plans and their progress reports; (g) promote EE through public awareness campaigns; (h) provide recommendations on necessary improvements to national and municipal EE plans; (i) prepare its Annual Work Report for the Minister; (j) cooperate with the Ministry and other relevant institutions in implementing EE plans; (k) support participation of interested parties in undertaking EE initiatives; (l) propose to the Ministry improvement and completion of legal and regulatory frameworks on EE, with a view of approximation with relevant European standards on EE; (m) support municipal energy offices on matters related to EE planning and promotion, and implementation of various EE programs at municipal levels; (n) promote information and education activities in the field of EE, in cooperation with ministries responsible for energy, construction and education.

***Establishment and Functioning of the Commission for Certification of Energy Auditors and Managers***

Article 7: The MEM shall establish the Commission for Certification of Energy Auditors and Managers, and, by sub-legal act, shall set its organizational structure, responsibilities and duties. The Ministry is responsible for the institutional development and progress of the energy auditing process for a three year period, from the date of establishment of the Commission for Certification of Energy Auditors and Managers. After this period according to a special sub-legal act approved by the Minister, the auditing process shall be developed by non public sector.

**Energy Efficiency Plans**

***Kosovo Energy Efficiency Plan***

Article 8: The Kosovo EE Plan is an obligatory document for implementation, which is prepared by KEEA, in compliance with requests of Directive 2006/32/EC and those of the Energy Community Secretariat and shall submit it for review to the Minister who shall submit it for adoption to the Government. The implementation plan for EE shall be prepared by KEEA and shall be submitted for review to the Minister who shall submit it for adoption to the Government. Submission of the report to the Energy Community Secretariat shall be conducted based on request of the Secretariat.

***Energy Efficiency Municipal Plan***

Article 9: The Municipal Energy Offices shall develop the Municipal EE Plan, in line with the instructions of the KEEA. The Municipal EE Plan shall be adopted by the Municipal Assembly and delivered to the KEEA. The Municipal Energy Offices shall develop the Municipal EE Plan Implementation Progress Report, in line with the instructions of the KEEA. The Municipal EE Plan Implementation Progress Report shall be adopted by the Municipal Assembly and delivered to the KEEA. Procedures and terms of municipality plan preparations and reporting for their implementation shall be defined with sub-legal act approved by the Minister.

**Energy Efficiency Measures**

***Public Sector Energy Management***

Article 10: The public sector is obligated to use energy efficiently. For the implementation, the Government shall issue necessary secondary legislation, as proposed by the MEA.

**Energy Efficiency Measures Funding**

Article 11: To support measures defined in Kosovo plan for EE, the MEA should - (a) ensure funding possibilities from the Budget of the Republic of Kosovo; (b) seek for financial support from relevant international financial and development organizations, in the framework of programs and projects on promoting EE; (c) propose inclusion of EE funding in bilateral cooperation agreements, as often as it is possible. To support measures for promoting EE defined in municipality plans for EE, municipalities should ensure funding possibilities within the Municipal Budgets or through donations. . Whenever required, the Ministry shall plan for budgetary co-funding of EE funds created in the framework of cooperation with international multilateral or bilateral development institutions.

***Energy Auditing***

Article 12: As proposed by the MEA, the Government shall approve necessary secondary legislation on energy auditing, in line with EU directives.

**Transitional and Final Provisions**

***Implementation of EU Directives for Energy Efficiency***

Article 13: the MEM shall present for Government approval the necessary legal acts for implementation of EU Directives provisions, regarding the EE, which are binding for the Republic of Kosovo as a party of the Energy Community Treaty.

***Transitional Provisions***

Article 14: The MEM shall establish the KEEA within six months from the date of entry into force of this Law.

***Final Provisions***

Article 15: With a view of implementation of this Law, the MEM shall prepare and issue sublegal acts within six months after entry into force of this Law. Acts provided for in Article 13 of this Law shall be prepared in compliance with timelines set forth by Decisions of the Ministerial Council of Energy Community.

***Entry into force***

Article 16: This law enters into force fifteen days after publication in the Official Gazette of the Republic of Kosovo.

There is a wide range of international organizations active in Kosovo and co-ordination is reported to be increasing with a view to improved targeting and aid efficiency. The principal sources of funds and assistance in implementing reforms of the energy sector include global bodies, the EU and bi-lateral initiatives from many countries. Aid and other assistance are received from the Federal German Agency GIZ, KfW, the USAID, the European Commission and the World Bank.

## Urban Growth and Energy Challenges in Pristina

Pristina is the capital and largest city of Kosovo covering an area of approximately 572 km². Since 1980s, Pristina has experienced a considerable population growth from around 108,083 inhabitants in 1981 to around 198,214 in 2011 (annual average growth of 3.08%).

Pristina has a humid continental climate, with very warm summers and cold and often snowy winters. The warmest month of the year is July, with an average temperature of 27°C (81°F). The coldest month of the year is January, when temperatures average -5°C (23°F).

The municipality of Pristina is the administrative, political, economic and cultural centre of Kosovo. The city hosts around half of all national economic activities, with over 13,000 businesses operating within the municipality. Based on Ministry of Trade and Industry data, around 54% of those businesses are involved in trade and catering services, 15% in transport, 8% in real-estate, and 4% in production.

The administration of municipality of Pristina is organized around a Head Quarter and 33 local offices providing services at the community level, of which 15 are located within the city boundary and 18 in rural areas that cover 42 villages. All the roads connecting major villages with the urban centre are asphalted. Pristina city and most of the villages are connected to the water supply and sewage system although the municipality faces serious difficulties with water and electricity supply. The city does not have a waste water treatment plant. There is no river passing through the city of Pristina now but there was one that passed through the centre. The river now flows through underground tunnels

and through Pristina's suburbs in the north and in the south and is let out into the surface when it passes the city.

Considerable institutional reforms at the municipality level resulted from the Law on Local Self Government promulgated in 2008 and changes to the electoral system. The City of Pristina has 11 departments and department directors: administration; health and social welfare; education; culture, youth and sports; finance and property; economy and development; urbanism, construction and environment protection; local infrastructure; public services, protection and rescue; cadastre; and inspection. The Mayor is now directly elected, while the Assembly members are elected through a proportional voting system based on open election lists.

The 2011 Municipal Budget of Pristina is around $75 million, and Pristina is the single biggest municipal budget organization in Kosovo amounting to 17.8% of all municipality budgets.[7] Nevertheless, resources (both pecuniary and non-pecuniary) are considered to be insufficient to be able to address the immediate social, infrastructural and public services challenges of a growing capital city.

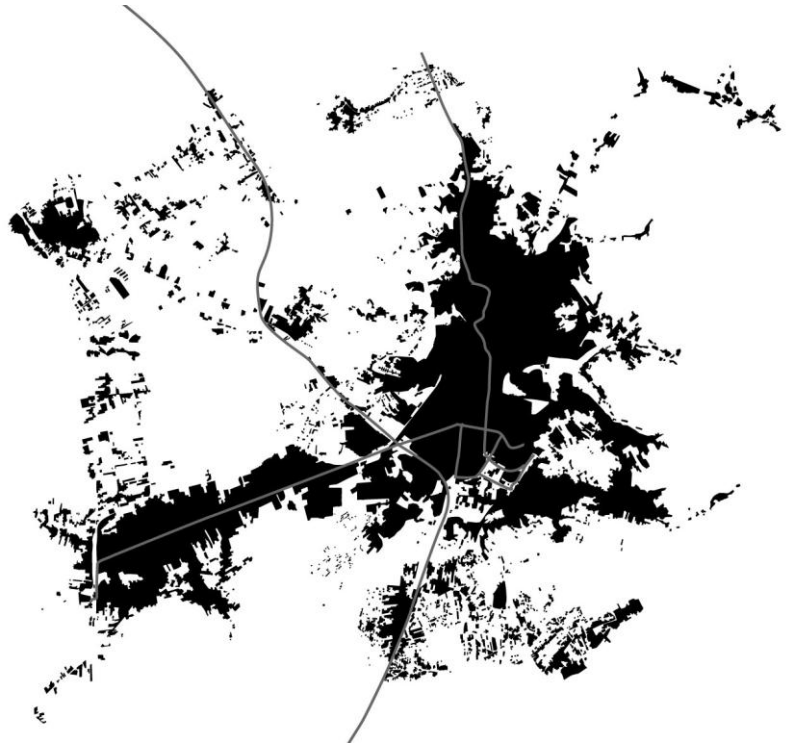
For example, urban planning tools are not strategically used to influence energy usage patterns in a city. It is generally known that the denser a city is, the more energy efficient it will be. A dense city makes travel by foot and by bicycle easier; it makes public transport more efficient and economical; it reduces the cost of delivering public services such as water, wastewater, and district heating; it limits the number of light poles required to light streets and public spaces; it lowers transport times and fuel expenditure for garbage trucks.

Pristina is a growing city and needs to address how it can avoid urban chaos and reduce sprawl. City sprawl, with new communities springing up around the city, has put a strain on public services provision. Many of these new communities go further and further up the surrounding hills and are not easily served by public transport.

Low-density settlements also make it more difficult to adopt energy-efficient district heating for residential and commercial buildings. In addition, the lifestyles, and corresponding energy use profiles of urban middle and upper income class residents in Pristina increasingly mimic those of their counterparts in the developed world.

As the map below evidences, Pristina has fragmented and lower density peri-urban areas, dominated by individual homes built in generally unplanned communities. Servicing these low density areas requires higher energy costs and a higher overall operational costs. Moreover, many of these peri-urban communities are also generally lower income, with a higher share of unpaid bills.

**Pristina Urban Mass**



Making public services in Pristina more energy efficient in requires thus not just market mechanisms (e.g. proper pricing for delivered services), but also good urban planning at the metropolitan level (with stricter zoning), proper enforcement (e.g. to ensure that rendered services are

[7] http://intresources.worldbank.org/INTECACOSUFM/Resources/776194-1265301132428/6766619-1267044234513/Kosovo_PEFA_2011.pdf

actually paid for), and the right social mechanisms to ensure affordability for lower income groups.

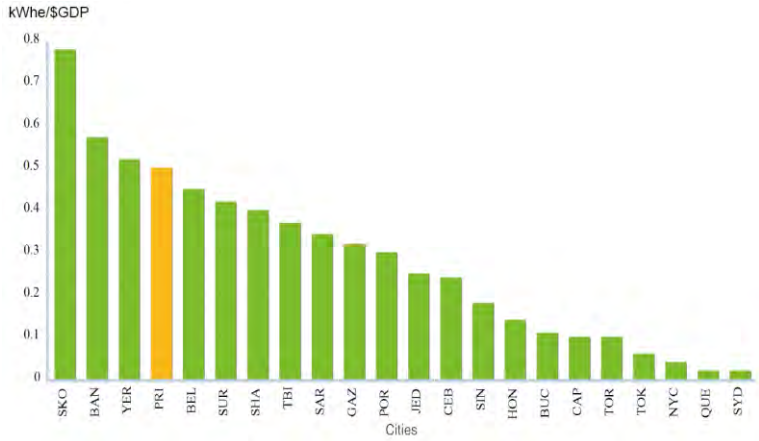
**Peri-urban Developments in Pristina**

As the city and its economy have grown in recent years, so have its energy demands. From generating electricity exports in the past, Kosovo now has to rely on imports. Electricity supply does not always meet demand, and power outages are frequent. As a consequence, most commercial and institutional consumers have electricity generators that kick in when the power is out (see images below).

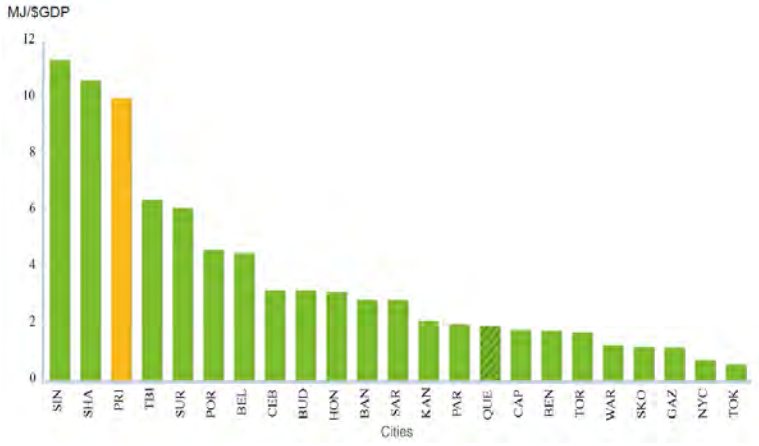
**Electricity Generators in Pristina**

Much of this high energy demand can be attributed to the growth of the previous decade (with electricity consumption almost doubling from 2000 to 2010), but much of it can be attributed to the legacy of the communist past. As the figures below highlight, Pristina has a very energy intensive economy, with a high share of electricity and primary energy consumed for every unit of GDP produced. In fact, Pristina shares this trait with a number of other cities in Eastern Europe (e.g. Banja Luka, Yerevan, Belgrade, Tbilisi, Sarajevo). With energy being highly subsidized in communism, the economic infrastructure was not developed with energy efficiency in mind. Issues pertaining to the upgrading of the economic infrastructure (e.g. more energy efficient factories) go beyond the scope of the TRACE analysis, but they should be considered nonetheless by local authorities when drafting medium and long-term development plans.

**Electricity Consumption per GDP**




**Primary Energy Consumption per GDP**



## Sustainable Pristina

The following analysis and recommendations are primarily about how Pristina can become a more sustainable city. The focus will be on energy efficiency, but the scope of the analysis goes well beyond that. Energy has the benefit of being easy to quantify and to measure, and is a good binding element for thinking about a city in a holistic way. Almost everything that is done in a city requires some form of energy input.

Consequently, TRACE (Tool for Rapid Assessment of City Energy) is not just a tool for assessing potential energy and cost savings, but it is also a tool that allows local authorities and policy makers to think about cities as a whole. Ultimately, TRACE is a diagnostic tool that allows cities to become more sustainable.

There are six municipal service areas that are the focus of this tool: urban transport, municipal buildings, water and wastewater, power and heat, street lighting, and solid waste. For each of these service areas, TRACE requires the collection of a number of indicators.

Energy and cost savings potential are assessed through a relatively simple benchmarking process. Basically, the indicators selected for Pristina are compared with similar indicators from other cities included in the TRACE database. For comparison purposes, cities can be selected based on level of development, based on climate, or based on population. The cities that do better than Pristina on a particular indicator become a benchmark that Pristina itself can aspire to. For example, if several cities have a lower energy consumption per street light pole, it is an indicator that local authorities in Pristina could achieve energy savings in the 'Street Lighting' sector (e.g. by replacing energy inefficient light bulbs with more efficient ones). The energy and cost savings potential is calculated for each of the six service areas. Based on where the biggest cost savings could be achieved a priority list is being drawn. The priority list then feeds into a list of recommendations that are likely to have the biggest impact, for the lowest amount of effort and resources invested.

Preliminary on-site interviews and field visits have helped give a more rounded picture of sustainability challenges and opportunities in Pristina. The following sections include a quick analysis of each of the six sectors analyzed with TRACE, along with some key findings.

### Public Transport

After the end of the Kosovo War in 1999, public transportation in Pristina had to be organized from scratch. Initially, public transport was run by a myriad of private initiatives, with individuals running minibuses, vans, and private cars throughout the region. Over a couple of years the municipality got more involved in the sector and worked on structuring the sector along a number of lines, with a designated number of buses running those lines.

By 2006, private operators were consolidated in a number of small companies, which gradually replaced minibuses and vans with regular buses. However, these consolidated bus operators, some of which had 15 individual shareholders, were subject to internal strife and eventually ended up in disbanding into several small operators again.

Currently, the public transport system in Pristina is run by the municipality (through its Trafiku Urban Department) and by 22 private operators. Trafiku Urban operates 13 buses along the most profitable routes in the city. Because the law on public companies does not allow it to receive public subsidies, Trafiku Urban is obliged to balance its budget every year from the revenues it generates from ticket sales. This is an unusual situation as most public transport systems throughout the world, including in the vast majority of developed cities, require some level of subsidization to offer affordable public transport options.

The lack of subsidies has pushed Trafiku Urban to outsource operation of the other public transport lines to private operators. The latter run 125 buses, minibuses, and two-part large buses along routes designated by Trafiku Urban, and charging ticket prices that were set by the municipality. A four tariff zone system is in place, with €0.40 being charged for most routes within the city and its main suburban areas, and €0.50, €0.80, and €1.50 being charged respectively for longer routes in the region.

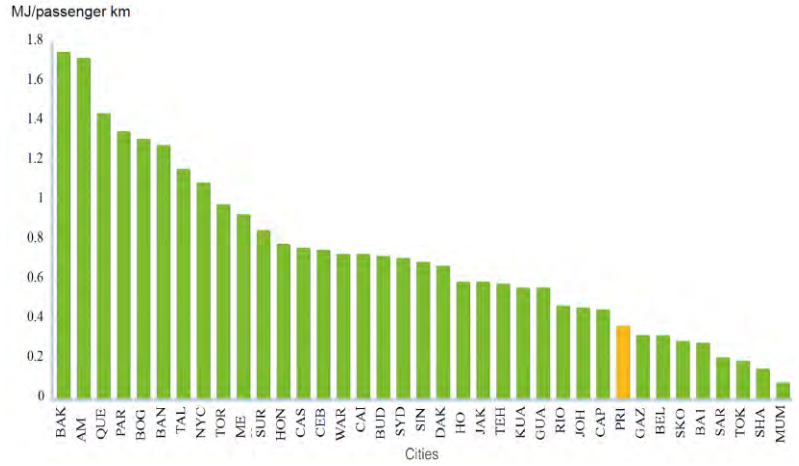
A total of 37 routes are currently in place, but only 31 are effectively operational. Of these, Trafiku Urban estimates that 15 are profitable lines, 8 are self-sustaining lines, while 11 are unprofitable lines. The private operators have to generate a profit by finely balancing revenues generated from profitable lines with revenues from lines that are considered to be less profitable.

The way they do this is by trying to send buses out when ridership is expected to be high, and reduce operations when business is slow. What

this leads to in effect is that many lines end up not being serviced during the week-end, and the designated frequency of buses is not respected. Thus, if in the agreement with Trafiku Urban a private bus operator committed to service a particular line every 15 minutes, they may end up servicing the line every 5 minutes when ridership is high, and every half an hour when ridership is low. This way private operators maximize the number of passengers per trip, and try to hedge the rising fuel costs. In just a few years, the price of Diesel in the country grew from around €1 per liter to around €1.4.

Consequently, both public and private operators in Pristina have to run their buses efficiently, in order to generate a profit. As the figure below illustrates, Pristina has one of the most fuel efficient public transport fleets of any city with relevant data in the TRACE database – although less efficient than some other Western Balkan cities.

**Public Transport Energy Consumption**




However, running the public transport buses in an efficient way, to minimize fuel costs and maximize profits, comes at the price of what public transport should strive to achieve – offering citizens an affordable, convenient, reliable, and comfortable means of getting around town and easier access to opportunities (e.g. work and school). In the long run, lack of public investment in the sector could lead to its deterioration.

Because of lack of investments in previous years, buses running in Pristina are on average 20 years old (see pictures below). For the most part they are second hand vehicles, of different makes and types, bought independently by the myriad of operators in the city. All of the operators service these buses on their own, and fuel efficiency is generally considered to be low. In addition, most buses are equipped with old engines that are quite polluting.

**Buses in Pristina**


For their part, both public and private operators expressed their desire to renew their bus fleet, but indicated that the way the system is now organized does not allow them to do improve the situation. The public bus company indicated that it would require an influx of capital (subsidies, donations, loans) to upgrade the existent infrastructure, as it is now barely breaking even. Private operators indicated that if operation licenses would be extended from the current 5 years, to 10 years, it would be easier for them to access bank loans for the procurement of new fuel efficient buses.

Trafiku Urban does acknowledge the plight of private operators, but stresses that longer licenses should only be offered when the system is organized in a better way. In particular, local officials want to consolidate the public transport system around 2-3 operators, which could both take advantage of economies of scale, and ensure that both profitable and un-profitable routes are run properly. As such, Trafiku Urban considers a public-private partnership arrangement, where it would solely keep a management role, and would offer its infrastructure (bus depot, maintenance garage, etc.) for the use of 2-3 private operators.

Such an arrangement is nothing more than an idea right now, and until the sector will be restructured, there are a number of issues, whose solving could help make the sector more efficient.

For starters, private bus operators indicate that it would be good to have more dedicated bus lanes, which would allow public buses to navigate city traffic more easily. Right now, only the Bill Clinton Boulevard has such a dedicated bus lane. On all of the other routes, public buses have to fight with general traffic, and frequent stops hike up their fuel expenditure. It is estimated that every stop in traffic costs the operators €1.5 (or almost four bus tickets), because the engine has to be revved up again to get the heavy bus rolling.

Local authorities recognize the benefits of dedicated bus lanes, but indicate that only two other thoroughfares in the city are large enough to accommodate them. Moreover, an in-depth traffic study is required to assess the effect of bus-only lanes, as well as the possibility of allowing only bus and pedestrian traffic on some streets in the city.

**Taxis in Pristina**

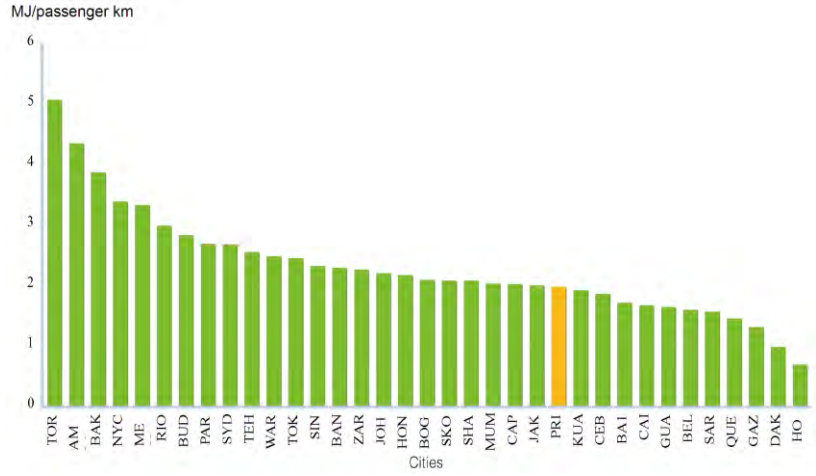

Another issue that is frequently brought to the fore by both public and private operators is the high incidence of illegal operators. These often run the dedicated bus routes and steal away customers from the licensed buses. One can frequently see them in bus stations, signaling to passers-by the lines they run. The police try to control the problem, giving fines and sometimes sequestering the vehicles of illegal operators, but they are far from eradicating the problem. The drivers they catch most often claim that they have no other means of generating an income for themselves and their families.

It is not clear how many illegal public transport operators run in the city, but it is known that in addition to the licensed buses, there are an additional 600 licensed taxis run by private individuals, and 300 taxis run by licensed taxi companies. 15% of registered businesses in Pristina claim transport as their main object of activity.

## Private Vehicles

Given recent increases in fuel prices, and the relatively low incomes of people in Kosovo, energy consumption in the private transport sector in Pristina is relatively low – or at least at the lower end of the spectrum of cities with relevant data in TRACE (see figure below). The car is however, as in most developing countries, a status symbol, and most people strive to own one. Consequently, car ownership has increased dramatically in recent years, with the number of licensed vehicles almost doubling in the Pristina region (which includes several surrounding municipalities) since 2005 – to around 120,000 currently.

**Private Transport Energy Consumption**




A large majority of newly registered cars are second hand cars imported from abroad. In 2012, around half of the vehicle stock in Pristina was older than 15 years. Older cars are considered to be more polluting, and tend to be less fuel efficient. As people's incomes will rise, car ownership is likely to grow too. This will put additional pressure on already congested streets, and will strain an infrastructure that was not developed for such a vehicle load.

**Pedestrian Environment in Pristina**

To assess some of Pristina's key urban transport challenges, a study was commissioned by the World Bank in 2008. The study drew a number of conclusions and identified a number of key issues in the city. One of the most important challenges was the issue of parking. As car ownership has continued to soar, people found less and less spaces where they could park these cars – particularly in the city center. Other noted issues included the lack of proper traffic management in the city, and the lack of local capacity to deal with urban transport challenges.

While traffic congestion is mainly a nuisance for drivers, congested sidewalks is a nuisance for everybody. One of the first observations one can make in Pristina, is the ubiquity of cars everywhere – both on streets and on sidewalks. Without a proper parking policy in place, people park their cars wherever they find an available space. As a consequence, most of the sidewalks in Pristina's center are taken over by cars (see images above). A walk though Pristina cannot be done without having to venture on streets and take on-coming car traffic. This is obviously not only a nuisance for pedestrians, but also a critical traffic safety issue.

On-side-walk parking is many cases doubled by the disappearance of side-walks due to the lack of proper planning regulations, and due to the poor enforcement of existing planning regulations. As the image below evidences, sidewalks often disappear, as people extend their property lines on public land. After the war in 1999, sidewalks have started disappearing throughout the city because of the lack of local oversight.

**Side-walk Encroached by Private Developments**


From a traffic point of view, many intersections are poorly designed to handle all the traffic flow they receive, and many traffic lights and signals are not synchronized to the traffic challenges the city is facing today. For example, traffic management should be done one way for 60,000 cars,

and another way for 120,000. With the dramatic expansion in car ownership, traffic management in the city has to be updated too.

In particular, some of the good initiatives that have already been implemented could be used as a spring-board for improvements in the system as a whole. For example, part of the Mother Teresa Boulevard was turned into a pedestrian walk-way (see image below), which has quickly become a favorite pastime spot for people in Pristina.

**Pedestrian Street in Pristina (up) and Proposed Extension (down)**

Given the success of this investment, local authorities have decided to extend the pedestrian area, to the point where the Mother Teresa Boulevard met with the George Bush Street. Similar initiatives could be started in other city areas with heavy pedestrian traffic. Even if streets would not be converted to pedestrian walkways, local authorities could consider hampering traffic flow in certain areas, and restricting parking.

All in all, it is safe to say that the city needs a comprehensive traffic management study, which would not only outline some of the key urban transport challenges in Pristina, but it would also outline a clear action plan of how these challenges could be tackled. Such a traffic study should be repeated at regular intervals, given that car ownership is likely to continue to grow in the future, and transport challenges will evolve too.

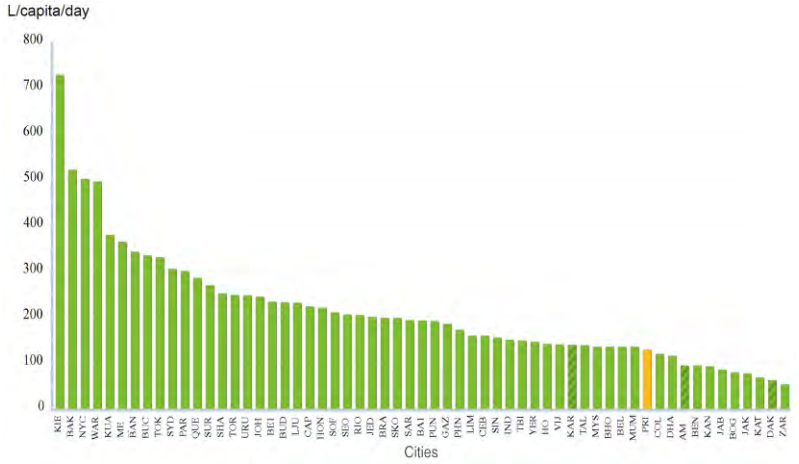
## Water and Waste Water

Water and wastewater services in Pristina are offered by a regional public water company. The Regional Water Company “Prishtina” is owned by the Government of Kosovo and serves the City of Pristina and 8 additional municipalities. In total, the company provides water service to 103,000 customers and a population of around 450,000 (40% of all people that receive water services in Kosovo). There is no proper wastewater treatment in the region, with raw sewage being dumped in the local river system.

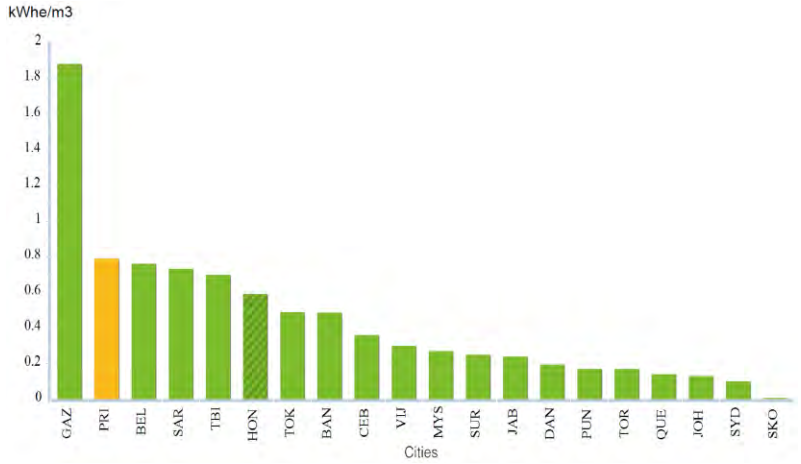
The water system was originally designed in 1961 for the city of Pristina, serving a population of 38,593. Water was drawn from a reservoir located close to the city. As the municipal population grew, another reservoir was added in 1979. Since then, the system was continuously expanded.

Currently, water consumption in the region is relatively low. When compared to other cities in the TRACE database, Pristina is at the low end of the spectrum (see figure below). However, this relatively good performance cannot be attributed to the good performance of the system, but rather to the intermittent water supply. Currently, water in the region is delivered only 18.3 hours per day (water supply is usually stopped at 10:00 PM), and water pressure is often low when water is delivered.

**Water Consumption**




**Energy Density of Potable Water Production (kWhe/m$^3$)**




The fact that water demand is not met by adequate supply can be attributed to several factors. For one, the service area was expanded aggressively in recent years, without an expansion of water supply sources. Thus, the number of customers doubled in 8 years, from 51,490 consumers in 2005 to 103,000 in 2012. In addition, the system was originally designed for a much smaller customer base. As a consequence, the piping network that was put in place is of a smaller scale than current needs require. In particular, the diameter of water and wastewater pipes is too small to accommodate current flows.

To address current demand issues, and to allow a continued expansion of the system (currently only 90% of people in Pristina receive water service), the water company is working with international donors to finance the development of another reservoir and an additional water treatment plant.

In addition to increasing supply, the leadership of the water company wants to improve the energy performance of the system. As the figure below indicates, the water system in Pristina is the second most energy intensive of all the cities with relevant data in TRACE. Much of this energy intensity can be attributed to how the system was originally designed.

The Regional Water Company “Prishtina” draws most of its water from 2 reservoirs – Batlava and Badovci. Batlava is the main water source, servicing around 60% of all customers, situated around 27 kilomters away from Pristina, and being 108 meters below the level of its treatment plant. The Badovci reservoir is situated around 7 kilometers from Pristina, and 96 meters below the altitude of the water treatment plant it supplies.

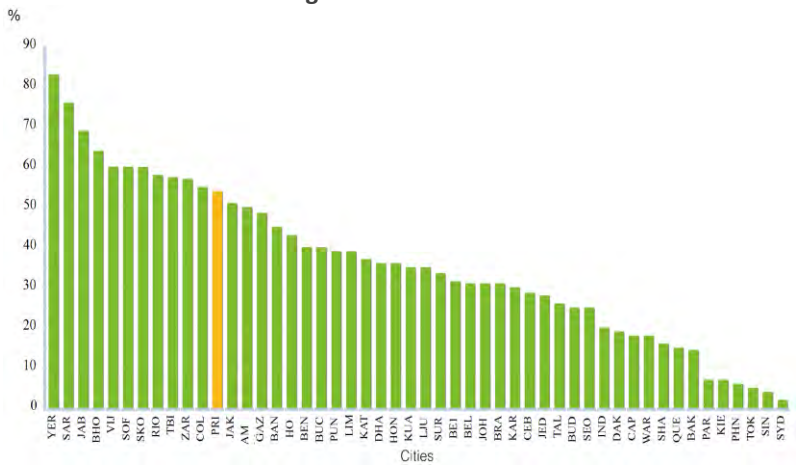
The fact that the water reservoirs are situated below the level of the treatment plants, means that water has to be pumped up before it is treated. Both reservoirs deliver water to their respective pumping stations, from where the water is delivered for treatment. From the water treatment plants, the water is delivered by gravity to other pumping stations, which deliver it to the rest of the city.

In addition to these main water reservoirs, water is also drawn from several underground sources, as well as from several rivers in the area. In total, there are 22 pumping stations servicing the water system. These pumps consume around $3.9 million of energy every year, and they represent around 38% of the company’s operational costs.

The treated water is delivered to end-consumers through a system of 800 km of water piping, and wastewater is collected by a system of 340 km of pipes. Much of the water that gets delivered (around 54% of

produced water) is lost in the system. In fact, Pristina has one of the highest shares of non-revenue water of any city with relevant data in the TRACE database (see figure below).

**Percentage of Non-Revenue Water**




Since much of the water that gets lost in the system is previously, pumped, treated, and then pumped again, reducing the share of non-revenue water is not only of environmental concern (i.e. reducing the wastage of a precious resource), but also of economic concern. The energy cost of non-revenue water is around $2 millions. Also, since the current system cannot meet existent demand, water pumps have to work continuously, as water needs to flow through the network continuously. This means that the water company cannot take full advantage of the lower electricity prices during the night (i.e. most of the water could be pumped and treated when energy costs are lowest).

To improve system performance, the water company plans to take several measures. For one, much of the distribution network has to be replaced. Not only is a good share of the piping old and leaky, but it is also of a smaller diameter than what the current capacity of the system actually requires. To address the issue, national authorities are working with KfW on a general system upgrade. In a first phase, €8 million will be allocated for the rehabilitation and modernization of the water distribution system. In a second phase, €17 million will be invested in further network upgrades, including the introduction of meters throughout the system. In a third phase, €35 million will be allocated for the development of a third reservoir and another water treatment plant. This last investment is hoped to solve the demand issues the region is currently facing.

In addition to losses in the network, much of the water is lost because of illegal connections. It is not clear how much of the distribution losses can be attributed to poor network efficiency, and how much to illegal connections. It is believed however that water theft is wide-spread at the regional level.

Of the water that actually makes it to registered customers, only 68% is finally billed. A large number of consumers cannot afford to pay for the services, some consumers contest the bills they receive, while others simply refuse to pay.

The table below gives a breakdown of the tariff system in Pristina. The tariffs are set by the national Regulatory Office for Water and Waste and adjusted on a regular basis, according to the Price Index of Consumption published by the National Statistical Office. At the current level, the water tariffs are smaller than the tariffs practiced in other countries, but still relatively high for an important share of the population. Technically, the Ministry of Work and Social Affairs has to cover water tariffs for people that cannot afford to do so, but this rarely happens in practice.

**Water and Wastewater Tariff System in Pristina**

| | | Volumetric Tariff | |
|---|---|---|---|
| | **Fixed Tariff** | **for Water** | **for Wastewater** |
| Residential | 1 €/month | 0.3546 €/$m^3$ | 0.0446 €/$m^3$ |
| Non-residential | 3 €/month | 0.8332 €/$m^4$ | 0.1049 €/$m^4$ |

In addition to affordability issues, metering also poses a number of problems. To begin with, only 80% of consumers are metered, and of those that are metered, only a small fraction have individual metering (usually businesses, institutions, and some individual households). For the most part, apartment blocks have only one meter for the entire building. This often raises problems when bills are sent to individual households. Without individual metering, bills are divided by the number

of households, regardless of how big these households are. Thus, a household of two has to pay the same bill as a household of five. Many people consider this way of billing unfair, and contest the charges. Such cases often end up in court, where they linger for up to 3 years, with significant financial and transaction costs for the water company. In total, around 10,000 court cases currently await a solution.

For its part, the water company wants to improve metering, with over 20,000 meters to be installed in coming years, with assistance from KfW. They also indicate that many of the apartment buildings where poorly designed originally, with each individual apartment requiring over 4 meters for as many water main. Also, the water company indicated that it could really benefit if individual municipalities would help with tariff collection and enforcement. For example, in Pristina, people cannot register their cars if their property taxes have not been paid. This measure could be expanded to included obligation of being up-to-date with water tariffs, as well as tariffs for other public services, before a car can be registered. Based on the experience with collection of property taxes, it is estimated that such a policy measure could increase water and wastewater tariff collection by 30%.

In 2011, the Regional Water Company "Prishtina" billed water for around $10 million, and had operational expenses of around $9.7 million. However, even though operational expenses are covered from charged tariffs, the company operates at a loss because the amortization of previous investments reached around $4.5 million in 2011.

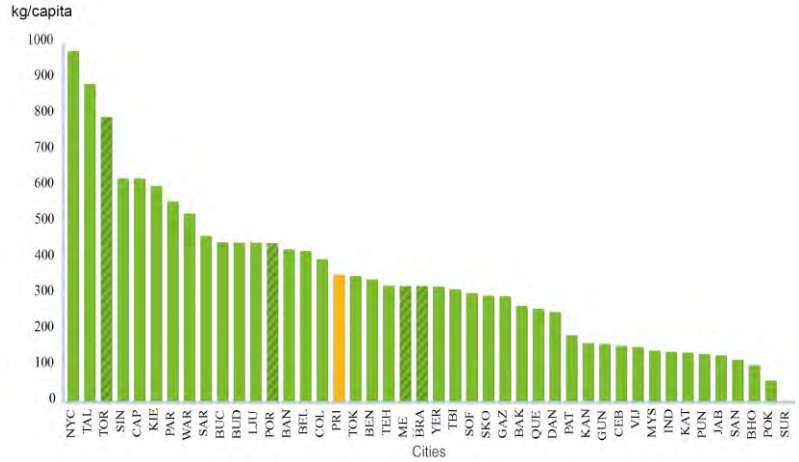
In addition to proper metering and billing the water company in Prstina has identified the following key energy efficiency tasks it hopes to achieve in the future: 1) reducing the cost of water delivery; 2) adding frequency converters to all pumps to reduce energy spikes; 3) ensuring water supply to 100% of citizens in the region.

## Solid Waste

Solid Waste Management services in Pristina are carried by two public companies. Pastrimi is municipally owned (78% by the municipality of Pristina and 22% by other served municipalities) and is responsible for waste collection and transport. KMDK is owned by the national government and is in charge of operating and managing the regional landfill, along with three other regional landfills in Kosovo, and a transfer station.

Overall, the quantity of waste generated in the city is quite high – higher than in larger and more developed cities (see figure below). Of the generated waste in the city, around 86% is captured. All of the waste is delivered to the regional landfill. There is no recycling – neither at the source, nor at the disposal site. Much of the waste that is not captured ends up in illegal dumpsites or is littered in and around the city.

**Waste per Capita**




In terms of energy efficiency, Pastrimi tries to organize collection routes in a way that minimizes travelled distances. Route planning is also enabled by the fact that the landfill is situated 12 km away from the city – which means there is no need for a transfer station. In addition, all of the trucks that run routes in Pristina are equipped with GPS devices, which allows Pastrimi officials to monitor their movements from the center. There is however no technology in place that would allow the optimization of routes on a permanent basis (i.e. as the city is expanding and changing).

All in all, Pastrimi has 50 garbage trucks, 22 of which service the City of Pristina. 15 of these trucks are relatively new (produced in 2009), while the rest were produced before 2000. Some of the trucks are around 30 years old. On average, these trucks consume around $75,000 worth of fuel per month. By renewing the rolling stock, these fuel expenses could be reduced by a significant margin. Moreover, Pastrimi officials indicated that it is important to have rolling stock of the same

make. This would allow maintenance costs to be kept at a minimum, as it would easier to procure spare parts, and mechanics would not have to learn the intricacies of several types of trucks. As of now, the Pastrimi garbage fleet is quite diverse (see pictures below).

**Pastrimi Garbage Trucks**

Another way of reducing fuel costs is by increasing the number of containers. Right now there are around 1,450 waste bins distributed throughout Pristina. Because this number is insufficient, garbage trucks have to run extra shifts. To sufficiently cover existing demand, the number of bins should increase to around 1,900. Moreover, Pastrimi officials have indicated that there is a need to educate people about proper waste disposal. Garbage trucks now have to spend a lot of time at individual collection spots because of the way trash is thrown away. Every additional minute spent at those collection points translates into additional fuel being used, which amounts to a considerable amount of money over the long term. With Diesel prices have grown by 30%-40% in recent years, it is therefore critical to run collection in an efficient way.

In addition to improved logistics and collection, fuel usage can be decreased by reducing the amount of waste that needs to be disposed of. One of the most important ways of doing this is by reusing and recycling waste. Right now there is no recycling going on in Pristina. Two private companies have expressed interest in making use of generated recyclables, but it is not clear when and how they will commence operations.

**Waste Bins in Pristina**


All collected waste is transported and disposed of at the Pristina Regional Landfill, which is 12 km away from the city. The landfill, along with 5 other regional landfills in Kosovo was established in 2005 with an investment from the European Agency of Reconstruction. The landfills were designed to conform to basic environmental standards, and for the first years of their operation they were managed by private companies.

The way these private companies managed those landfills was found to not respect design parameters, and after a while they were transferred under governmental control. Public management could not address some of the underlying operational and sustainability issues, and now the Pristina landfill does not respect many of the basic environmental standards it was designed to respect.

For one, a liner system that would prevent leachates from seeping into the ground was not put in place after a couple of years. As a consequence, waste leachates now permeate into the ground and they have turned the soil around the landfill into a swap. This makes it very hard for garbage trucks to access the landfill. Pastrimi officials indicate that their trucks often come back with damages from the landfill, and they have to spend considerable time and money repairing them.

**Pristina Regional Landfill**

The landfill itself has 7 machines that were purchased to help manage waste at the dumpsite. Over the years, 6 of these machines were damaged, and only one remains in use. The landfill operators lack both the funds and the experience to fix these complex machines.

With only one bulldozer left to push waste around, disposal happens in a haphazard way. Although the landfill is designed to be operational until 2015, waste is now dumped very close to the weighbridge and there is no proper access road to the dump site – garbage trucks have to force their way through marsh like conditions in order to get as close to the waste mound as possible.

Since waste is no longer covered with a layer of soil, the Pristina landfill operates as a de facto open dump site, with waste being strewn away by wind. This makes the landfill both a health and environmental hazard.

Remedying some of the many issues the landfill has requires an infusion of capital and better collection rates. Right now, the disposal tariff is €6 per ton. The tariff was set in 2008 by the Regulatory Office for Water and Waste and has not changed since. However, in the mean time, the price of Diesel has grown from around €1/liter to around €1.40/liter. Since the landfill machinery consumes around 200,000 liters of Diesel every year, operational costs have stacked up quite quickly, while revenues have lagged.

Moreover, while tariffs have not changed since 2008, many SWM operators refuse to pay them. Rather than dumping waste at the official landfill, some operators simply discard it at illegal dump sites. Such wild dumps and littering grounds have started to sprout up around Pristina, and some are in the middle of existing communities (see image below), posing a significant health hazard.

**Illegal Dumpsite**

For their part, waste collectors complain that they themselves have issues collecting waste tariffs. For example, Pastrimi charges households a flat rate of €4.80, but it has no way of enforcing collection. While the electricity distribution company can disconnect bad payers, Pastrimi cannot prevent bad payers from dumping waste in their bins. Quite the contrary, they often have people who are not their customers us their bins.

Over the years, the amount of debt Pastrimi has to collect from bad-payers has reached over €15 million. Trying to collect this debt involves high transaction costs (with individual law suits having to be started for each bad payer), and prolonged and cumbersome trials. On average, it takes courts 3 years to resolve such a case.

As far as waste collection from the businesses is concerned, Pastrimi often finds itself in competition with private waste collectors, which can offer better rates because they often forgo paying the landfill disposal site, and just dump the waste in wild dump sites. Nonetheless, in 2010, Pastrimi had operational costs ($4.8 million) that were lower than billed

incomes ($5.6 million), and even when accounting for amortizations, it had managed to keep a balanced budget.

To improve overall system efficiency, Pastrimi officials have recommended the following measures: 1) have the municipality be responsible for collecting bills, and tying the possibility of registering cars to having all bills paid; 2) reducing the number of regional landfills in Kosovo to 1-2, to make better use of economies of scale and improve their overall operational efficiency.

## Municipal Buildings

The City of Pristina manages a stock of 112 municipal buildings, of which the majority are educational and health buildings. Most of these buildings were built in the communist years, and as such tend to be relatively energy inefficient. Building techniques employed by communist regimes throughout Eastern Europe were more attentive to cost considerations than to quality aspects. It was generally considered more important to quickly develop more schools, than to develop fewer schools with an improved energy consumption (e.g. heating profile). Since energy was heavily subsidized anyway, energy efficiency considerations rarely were a key design feature.

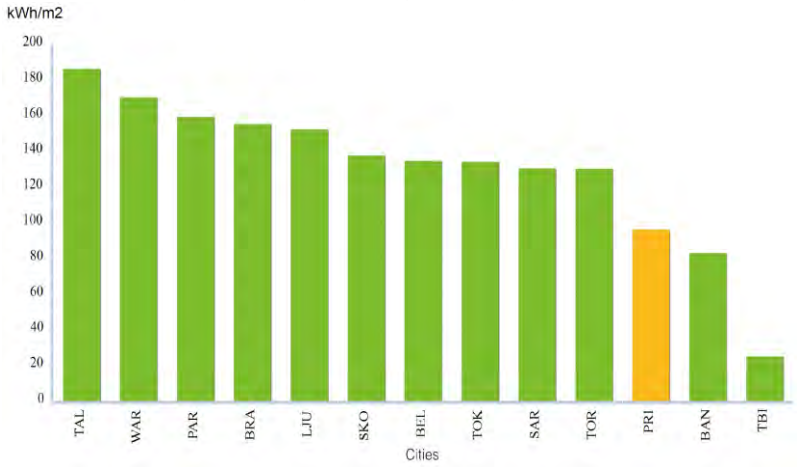
**Energy Consumption in Municipal Buildings in Pristina, in 2010**

| | | | Electricity Consumption | | Heating Consumption | | Energy Expenditure | |
|---|---|---|---|---|---|---|---|---|
| | Number | Area | (kWh/year) | (kWh/ year/m2) | (kWh/year) | (kWh/ year/m2) | ($/year) | ($/ year/m2) |
| Educational | 61 | 155,417 | 4,681,021 | 30.1 | 16,879,240 | 108.6 | 2,322,948 | 14.9 |
| Administrative | 19 | 17,633 | 1,112,685 | 63.1 | 287,284 | 16.3 | 144,455 | 8.2 |
| Cultural | 8 | 3,120 | 178,458 | 57.2 | 0 | 0.0 | 16,313 | 5.2 |
| Health | 24 | 17,483 | 1,687,189 | 96.5 | 1,417,730 | 81.1 | 298,346 | 17.1 |
| | | | | | | | | |
| TOTAL | 112 | 193,654 | 7,659,353 | 39.6 | 18,584,254 | 96.0 | 2,782,062 | 14.4 |

Nonetheless, municipal buildings in Pristina seem to be good energy performers. When compared to other cities in the TRACE database, buildings in Pristina seem to consume both less electricity and less heat per square meter (see figures below). For example, although winters in Pristina tend to be quite harsh, municipal buildings in the city consumed only 96 kWh/$m^2$/year in 2010.

Energy consumption varied from building to building, with a higher average heating consumption for schools, and a higher electricity consumption for hospitals. Presumably, many of the hospitals use electricity to generate heat, as their heating consumption should have been higher. Hospitals have to operate 24/7 and every day of the year, and they consume energy constantly. However, energy consumption is generally low not only for health centers in Pristina, but for all municipally managed buildings.

**Municipal Buildings Heating Consumption**




Part of this low energy consumption can be explained by the improvements municipal buildings have received in recent years. With the financial and technical assistance of donors, and with own and governmental funds, many of the municipal buildings in Pristina have been thermally rehabbed (see pictures below). Many buildings have received a new thermal envelope on the exterior walls, they got more energy efficient window panes, better insulated roofs and basements, and more efficient heating equipment.On the other hand, the low heating values are also owed to some of the shortcomings of the heating system in Pristina. In the year 2010, when the energy consumption in municipal buildings was collected, heating delivery from the district heating plant was only 35%

of normal heat delivery rates (i.e. the average for the previous decade). Heat service was stopped almost 2 months before schedule, and only 3 hospitals received heat through the end of the heating period (April 15th).

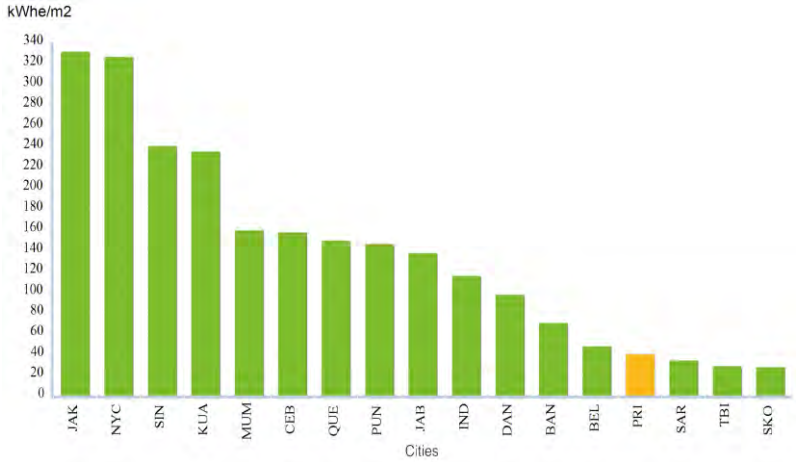
**Municipal Buildings in Pristina**

Termokos, the district heating company in the city, is a public company, and public companies in Kosovo cannot receive subsidies according to the laws in effect. However, while heating tariffs are set by the Energy Regulatory Office of Kosovo, and they haven't changed since 2008, fuel prices fluctuate according to market rules. Thus, Termokos has found itself in the position of having to deliver heat at the same tariffs, but having to buy heavy oil (mazut) at prices that have tripled in less than three years. Consequently, heat delivery was reduced dramatically, and all municipal buildings, with the exception of the 3 hospitals connected to the district heating system, received less heat. A similar trend has continued through 2011 and 2012, with mazut prices continuing to reign high.

Another reason for the relatively low heating consumption in municipal buildings in Pristina, is the fact that many of these buildings rely on electricity (e.g. all of the cultural buildings stock) for heating purposes. As such, some of the energy used for heating is captured under electricity usage.

However, even if some of the electricity used goes to heating buildings in the cold months, electricity usage is still low when compared to other cities in the TRACE database (see figure below). Again, this phenomenon can partly be explained by the improvements these buildings have benefited from in recent years, but they are also a reflection of the power outages the country is frequently subjected to.

**Municipal Buildings Electricity Consumption**




Similarly, the same way buildings switch to electricity for heating when the district heating network is not working, they switch to primary fuel powered electricity generators, when the power goes out. Almost every municipal buildings in Pristina has an auxiliary power generator, which kicks in when the power is out.

## Public Lighting

The street lighting sector in Pristina has underwent significant improvements in recent years. With financial and technical assistance from donors, the municipality has started an ambitious program to improve the performance of the network. In 2011, for example, 20% of all light poles in Pristina were equipped with state of the art LED technology (see table below)

**Distribution of Street Light in Pristina, by Bulb Technology**

| Type of Bulb | Power of Bulb (Watt) | Number of Lighting Bodies |
|---|---|---|
| LED-90W | 90 | 700 |
| LED-60W | 60 | 150 |
| LED-30W | 30 | 385 |
| Mercury Vapor-150W | 150 | 299 |
| Mercury Vapor-125W | 125 | 2,094 |
| Mercury Vapor125W, in parks, squares, and other public spaces | 125 | 881 |
| CFL-Fluorescent Bulbs | 60 | 108 |
| High Pressure Sodium | 250 | 892 |
| High Pressure Sodium | 150 | 761 |

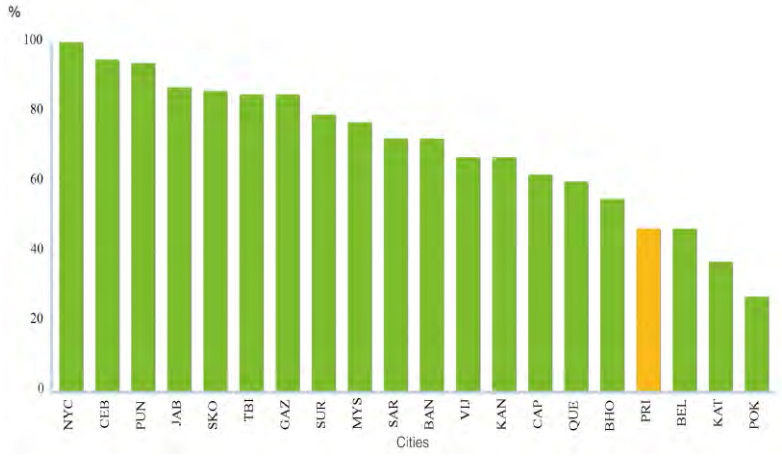
There are few cities even in the developed world that have introduced LED technologies in their street lighting system, as the performance of these bulbs is not yet known, and many local authorities wait to see what the experience of other cities will be with these technology. The City of Pristina however, has taken the conscious decision to move forward with this technology to ensure that double-expenses will be avoided in the future – i.e. replacing inefficient bulbs with an intermediate technology (e.g. high pressure sodium bulbs), only to then upgrade to LED.

Consequently, local authorities plan to replace the remaining stock of inefficient mercury vapor bulbs (52% of the entire stock) with LED technology. Around 26% of the streets lights in Pristina are now equipped with high pressure sodium (HPS) bulbs. This is an efficient technology that is widely used in the region, for replacing mercury vapor bulbs. LED bulbs have a longer life-span, and a lower energy consumption than HPS bulbs, but they are also considered to generate a lower light intensity and to require higher maintenance costs. However, few cities have long-term experience with LED street lighting technology, and Pristina will be in a good position to not only know how to best make use of this technology, but to also provide lessons to other cities.

**High Pressure Sodium Street Lights in Pristina**


Apart from the use of LED technologies, local authorities are also contemplating the introduction of solar powered street lights. Such solutions have been successfully tested by some of the municipalities around Pristina, and they are considered to be a solution for the extension of the public lighting network in the city.

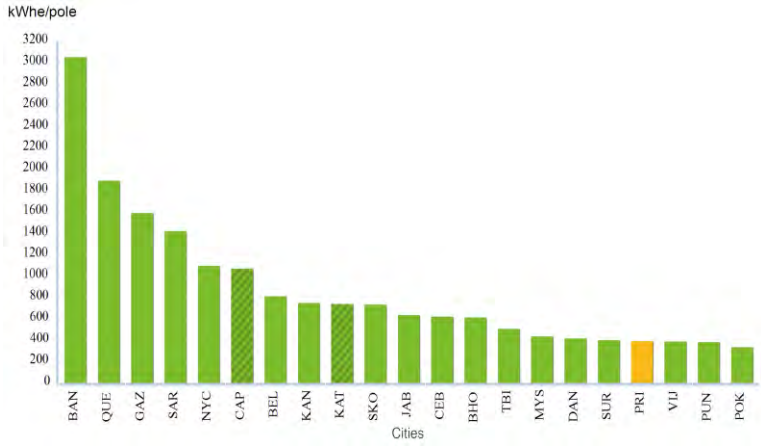
**Percent of City Roads Lit**



Around 53% of streets in Pristina are not covered with street lighting – one of the highest percentages of any city with relevant data in the TRACE database (see figure aboce). Consequently, one of the key tasks in this sector will be to extend service in coming years – especially considering the rapid expansion of the city.

As far as the performance of the existent network is concerned, a quick comparison with other cities indicates that Pristina has quite an efficient street lighting system. Thus, it has one of the lowest electricity consumption per light pole of any city with pertinent data in TRACE (see figure below).

**Electricity Consumed per Light Pole**




Part of the good system performance can be explained by some of the inherent attributes of employed technologies. Thus, almost a half of the existent system runs on energy efficient LED and high pressure sodium bulbs. Moreover, most street lights are equipped with-photo sensitive devices that only turn on the lights when it's sufficiently dark outside.

On the other hand, the frequent power cuts that plague the country as a whole, as well as targeted energy savings programs (with parts of the street lighting system turned off during the night), indicate the good performance of the system may also be attributed to the energy security issues Kosovo is facing. A more accurate picture of how the street lighting sector in Pristina is performing would require an analysis of the system operating at full capacity (i.e. with every street light on when outside conditions demand it).

Improving system performance should also include a full audit of street lights and street conditions. Such an audit could, among others identify whether optimal conditions for lighting are created. It doesn't matter if street lights are equipped with the best bulb technology, if they can't serve the purpose they are meant to serve – i.e. lighting streets at night. As the picture below indicates, wires and un-authorized constructions/additions can block the path of light, creating sub-optimal lighting conditions.

**Mercury Vapor Street Light in Pristina**

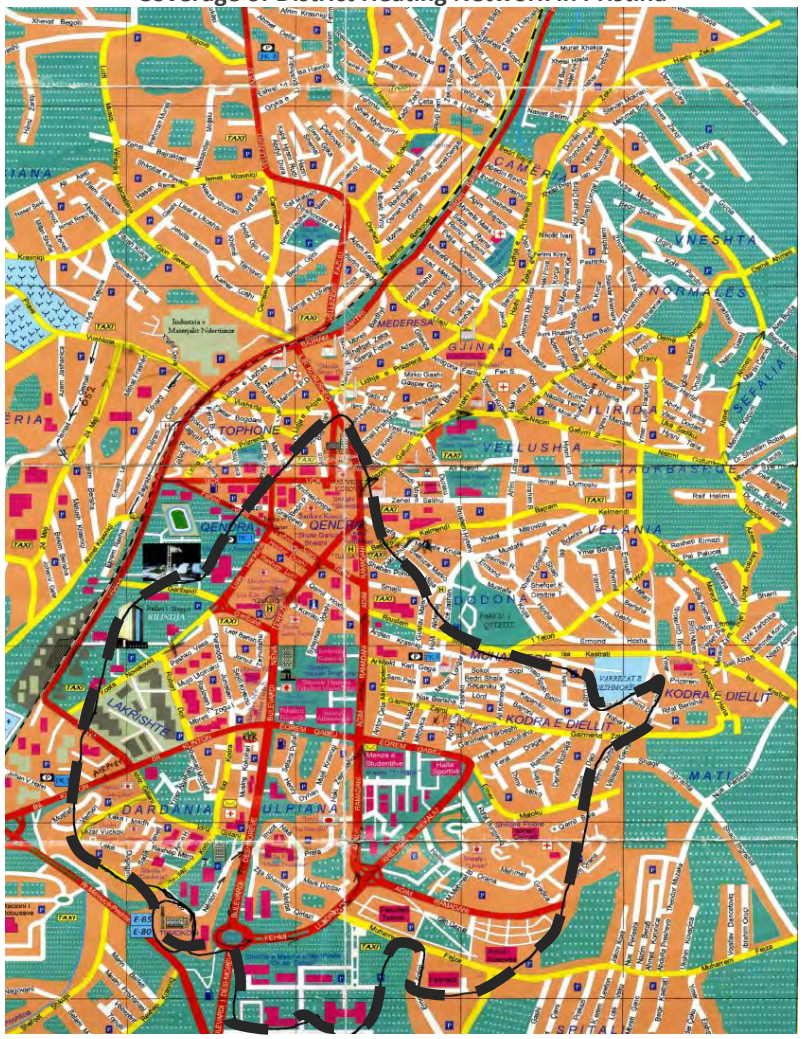
## District Heating

District heating in Pristina is provided by Termokos, a local public utility company. Termokos was established in 1970 with a small capacity, and with a network of steel pipes with classic insulation. Over time, the system has continuously expanded, with more and more buildings added. In 2010, of the around 40,000 households in Pristina, 11,000 were connected to the district heating network – 27% of the total. The map below shows exactly which areas in the city are serviced by Termokos.

Currently, the district heating network in Pristina is serviced by two boilers, each with a capacity of 58 MW. The main hospital in the city is serviced by another two boilers, each with a capacity of 7 MW. There is

another small heating center, with a capacity of 1.63 MW in one of Pristina's neighboring municipalities. The total distribution network is 65 km in length, delivering heat to 257 sub-stations.

**Coverage of District Heating Network in Pristina**




Source: Termokos Prishtina

Termokos is responsible for the primary distribution network, from the district heating plant to the substations, while end-consumers are responsible for the secondary network, from the sub-stations to the radiators. Heat is delivered 6 months per year, from October 15ht through April 15th.

In the 2008/2009 heating season, the amount of heat delivered by Termokos was around 112 GWh. Since then, heat delivery has continually declined (see table below). In the 2010/2011 heating season, delivered heat was almost four times as low as three years prior.

**Performance of Pristina District Heating System**

| Year | Produced Heat (MWh) | Delivered Heat (MWh) | Technical and Distribution Losses (MWh) | % T&D Losses |
|---|---|---|---|---|
| 2011 | 36,277 | 28,087 | 8,189 | 22.50% |
| 2010 | 73,780 | 62,591 | 11,189 | 15.20% |
| 2009 | 129,156 | 111,900 | 17,256 | 13.40% |
| 2008 | 82,932 | 66,602 | 16,330 | 19.70% |

This dramatic decrease in heating output can be explained by the rising energy costs in recent years, and the relatively static revenues. Heating tariffs are set by the Energy Regulatory Agency of Kosovo, and since 2008 they stand at €0.84/$m^2$/month for households, and at €1/$m^2$/month for non-residential users (a small number of customers are metered and billed at €45.50 per MWh). In the same time frame however, the price of a ton of mazut has grown from €225 to €735 – more than tripling in less than three years.

Given that heating tariffs are charged based on heated surface (i.e. around 709,000 $m^2$ of residential area and 462,000 $m^2$ of non-residential area), and given that these tariffs have staid static over the previous years, Termokos cannot reasonably expect to receive incomes higher than around €6.4 million per year. In another word, its revenues are static.

Consequently, when its main expense (for fuel oil) is increasing, it has no option but to reduce heat delivery or run at a loss. Since public companies in Kosovo are not allowed to receive subsidies, Termokos has decided to reduce heat delivery in recent years. In the 2011/2012 heating season, for example, the heating season was stopped short on

February 6th, although it has been a particularly harsh winter. Only hospitals received uninterrupted heat delivery, with the other customers left to fend for themselves.

**Fuel Oil (Mazut) Used by Termokos**

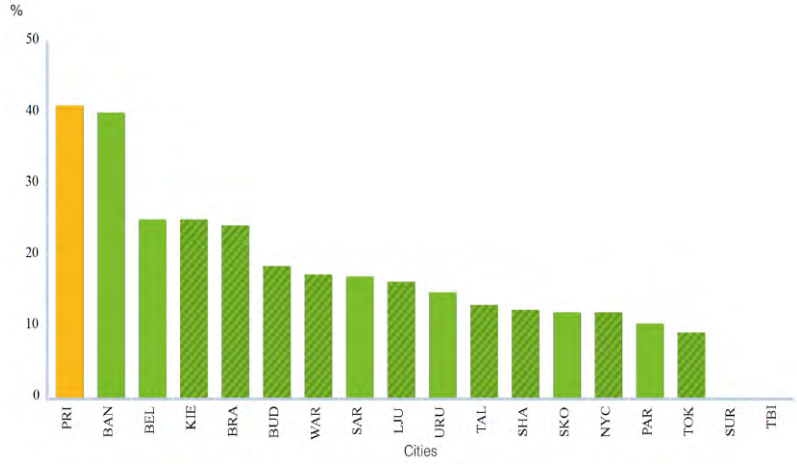
| YEAR | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | TOTAL |
|---|---|---|---|---|---|---|---|---|
| 2001/02 | 1,000 | 1,698 | 2,755 | 2,425 | 1,510 | 1,607 | 707 | 11,702 |
| 2002/03 | 382 | 1,006 | 1,926 | 1,877 | 2,126 | 1,311 | 416 | 9,044 |
| 2003/04 | 489 | 1,409 | 2,332 | 3,106 | 2,576 | 1,795 | 594 | 12,301 |
| 2004/05 | 182 | 1,580 | 2,585 | 2,883 | 2,492 | 1,921 | 856 | 12,499 |
| 2005/06 | 360 | 1,683 | 2,957 | 3,625 | 2,661 | 2,088 | 570 | 13,943 |
| 2006/07 | 538 | 1,989 | 2,772 | 2,491 | 2,136 | 1,812 | 365 | 12,102 |
| 2007/08 | 690 | 1,866 | 1,974 | 2,249 | 1,637 | 859 | 46 | 9,320 |
| 2008/09 | 25 | 1,534 | 2,301 | 3,084 | 2,494 | 2,169 | 536 | 12,143 |
| 2009/10 | 751 | 1,675 | 2,291 | 2,224 | 1,827 | 569 | 0 | 9,337 |
| 2010/11 | 574 | 1,063 | 1,273 | 587 | 621 | 0 | 0 | 4,119 |
| 2011/12 | 0 | 856 | 1,624 | 1,698 | 854 | 0 | 0 | 5,032 |
| **Monthly Average** | **454** | **1,487** | **2,254** | **2,386** | **1,903** | **1,285** | **372** | **10,140** |

In order to break even, Termokos can only afford to pay for heating oil the amount that is left after covering staff wages (around €1.2 million yearly) and administrative, maintenance, and operation expenses (around €1.7 million yearly). This means that every year the company has about €3.5 million yearly for mazut. With an average consumption of 12,000 tons of mazut every year, Termokos cannot afford to pay more than around €300 per ton. Obviously, at the current fuel prices, the district heating company cannot survive without central government subsidies, or without an increase in heating tariffs.

Raising heating tariffs may be faced with resistance from people, as heating costs already represent a considerable burden on a family's budget. For example, for an average-sized apartment of 60 square meters, a family has to pay €50 per month. With the average monthly salary being around €250, this is a considerable cost burden.

Even today, only about 68% of the amount billed by Termokos is collected, and only 51% of households pay their bills. When non-billed heat is added to the technical and distribution losses registered in the system, the percent of non-revenue heat from the network comes up to around 41% - the highest share of any city with relevant data in the TRACE database (see figure below).

**Percent Heat Loss from the Network**




Reducing these system losses requires not only network maintenance and upgrade, but also better metering and enforcement of heating tariffs. Termokos officials indicate that individual metering may be too costly and technically challenging for residential users (because apartment blocks have a double pipe system in place, with one pipe delivering heat to all apartments, and another pipe collecting used hot water), but non-residential users can opt for individual metering.

For people that don't pay their bills, enforcement measures are relatively limited. Individual users cannot be disconnected from the network, without disconnecting an entire apartment building. Such a measure is obviously extreme and hard to implement. It is not unheard of however, and in 2009, 13 apartment blocks were disconnected from the network because the households living there failed to pay their bills.

# Energy Efficiency Recommendations

Based on the opportunities and challenges in Pristina, a range of recommendations were derived for relatively high underperforming sectors that would enable improvements in energy consumption efficiency and reduce costs. Often, local authorities find it difficult to accurately determine which sectors and recommendations should be prioritized for action. This activity was undertaken using a prioritization process which forms the second module of the TRACE tool and described below.

### Identifying City Government Priorities

The following factors in-built in TRACE were taken into account in prioritizing the six service areas or "sectors" for action in Pristina:

- *Greatest Potential for Improvement*: Sectors that have the most potential for EE improvement are identified. To this end, 'improvement' was defined as a factor of:
  - current energy expenditures on a given sector (municipal and estimated citywide expenditures); and
  - energy saving potential (based on benchmarking work conducted as a part of the study).
- *Scope of Control or Influence of the City Government*: While city governments may be able to implement several measures that reduce energy consumption, the impact may be limited if the sector represents a small fraction of city-wide energy. The degree to which the city government can affect energy consumption in various sectors varies significantly from city to city. Thus, in the sector prioritization process, the level of influence a city ultimately has in improving EE in each sector is extremely important.

To prioritize specific actions and recommendations that have been derived through the program, or additional recommendations that may be developed at a later date, the following factors should also be considered by the city government:

- *Resource Constraints*: Within each sector, multiple fiscal and human resource constraints which will hinder the success of programs.
- *Compatibility with Other Development Goals*: In addition to the improvement of EE and reduction of a city's carbon footprint, the city government would also seek to improve the city's environmental, social and economic conditions. Therefore, EE and low carbon activities that would most effectively help the city achieve these parallel objectives would be given a higher priority.
- *Timing*: Given other on-going initiatives in the city, it is useful to identify those activities which would be the most complementary in the short, medium, and long-term.

***Sector Prioritization***

TRACE software uses the following method to prioritize programs using the following three factors.

1. *Energy Spending Information:* This information was obtained either from six sectors—urban passenger transport, municipal buildings, water and waste water, public lighting, solid waste, and power and heat—and city budget offices or through the conversion of energy use across the city into a value.
2. *Energy Efficiency Opportunity:* Key Performance Indicators (KPIs) from the benchmarking process have been chosen that are most indicative of the energy use across a particular sector or subsector. To define opportunity, a calculation is automatically undertaken to establish the mean value of each of the better-performing cities in the peer group, providing a goal or target for the city; this is termed the 'relative energy intensity' of the sector.
3. *The Control or Influence that the City Authority:* This factor is determined by establishing the extent of influence that the city authority has in each sector. This ranges from minimum (where national governments have full/greater control) to maximum influence (i.e. full budgetary and regulatory control).

The table below indicates the amount of energy spent in each of the six sectors, the relative energy Intensity, and the level of local control the municipality has over these sectors. The energy costs savings potential is calculated by multiplying the three factors described above and presented in the last column in the table below. The results of energy

use analysis and prioritization of sectors were discussed with city officials and finalized before getting into selecting a number of recommendations to making the city energy use in an efficient manner and reduce energy costs.

| Sector | Energy Spending 2011 (US$) | Relative Energy Intensity (%) | Level of Local Control* | Savings Potential (US$) [PRIORITY] |
|---|---|---|---|---|
| **Private Vehicles** | 66,180,457 | 24.7% | 0.45 | 7,362,394 **[PRIORITY 1]** |
| **District Heating** | 5,009,538 | 29.3% | 0.90 | 1,321,015 **[PRIORITY 2]** |
| **Municipal Buildings** | 2,389,100 | 24.6% | 0.95 | 665,135 **[PRIORITY 3]** |
| **Public Transport** | 3,854,801 | 15.7% | 0.80 | 484,163 **[PRIORITY 4]** |
| **Potable Water** | 3,850,140 | 39.4% | 0.15 | 227,543 **[PRIORITY 5]** |
| **Solid Waste** | 836,209 | 24.7% | 0.75 | 344,137 **[PRIORITY 6]** |
| **Street Lighting** | 415,085 | 30.3% | 0.95 | 119,482 **[PRIORITY 7]** |

*0 = no control; 1 = full control;

TRACE contains a playbook of 58 EE recommendations applicable across all sectors analyzed above. The recommendations themselves are not meant to be neither exhaustive nor normative. They simply outline a number of policies and investments that could help local authorities in Pristina achieve higher EE standards. Following the sector by sector analysis, each individual recommendation was reviewed to establish its applicability in the context of the City of Pristina. This filtering process helped focus the process on those recommendations that are both viable and practical. These recommendations were boiled down to 7, spanning all of the municipal service areas or sectors. Each of these recommendations and their relevance for the City of Pristina are discussed below.

### Urban Transport

The economic development in and around Pristina, and the associated growth in the motor vehicle fleet and its use, is placing a severe and increasing strain on the urban transport infrastructure. Reliable data on the exact number of registered vehicles is not readily available. There are estimated to be approximately 80,000 registered vehicles in the city, and some 200,000 vehicles operating within the municipal boundaries on any given weekday. In Pristina region, comprising 476,000 inhabitants from 7 adjacent municipalities[8], the total number of vehicles registered has grown over 18% annually (from 64,156 registered motor vehicles in 2005 to 124,781 in 2009)[9], which is much higher than country's average. Moreover, Kosovo is likely to continue experiencing rapid growth in vehicle ownership and use in a range of between 3 – 6 percent respectively.[10]

With a growing economy and resulting rapid increase in number of vehicles, the average daily traffic on the main roads leading up to Pristina is very high. The key routes linking the north and south of the country, and the key route linking the west all go through Pristina centre. This causes through traffic to merge with local traffic leading to heavy traffic jams in and around Pristina. The proposed solution is the construction of a ring road around Pristina, which the city government is seriously considering. However, according to technical experts, there are urgent investments that are needed in the area of traffic management and control, capacity building and data collection, road safety, and urban public transport.

[8] Fushe Kosove (34,718 inhabitants); Gllogoc (58,579); Gracancie (11,006); Lipjan (57,474); Novoberde (6,720); Obiliq (21,548); Podujeve (87,933).

[9] http://www.tmt.unze.ba/zbornik/TMT2010/076-TMT10-165.pdf

[10] http://ec.europa.eu/enlargement/archives/seerecon/kdc/080701%20Transport%20-%20FINAL.pdf

***Non-motorized Transport Modes***

Pristina is inherently a walkable city – not too large in size, relatively compact, and developed in a radial pattern. Most neighborhoods can be accessed from the city center with an easy stroll. However, what is increasingly recognized as a critical quality of life factor, cannot be taken advantage of properly. A large majority of Pristina's sidewalks are occupied by parked cars. At peak traffic times, walking through Pristina feels more like a slalom than a stroll. In cases where sidewalks are completely taken over by cars, people inevitably have to take to the streets, dodging on-coming traffic and fighting for space (see for example picture below).

**Difficult Pedestrian Environment in Pristina**

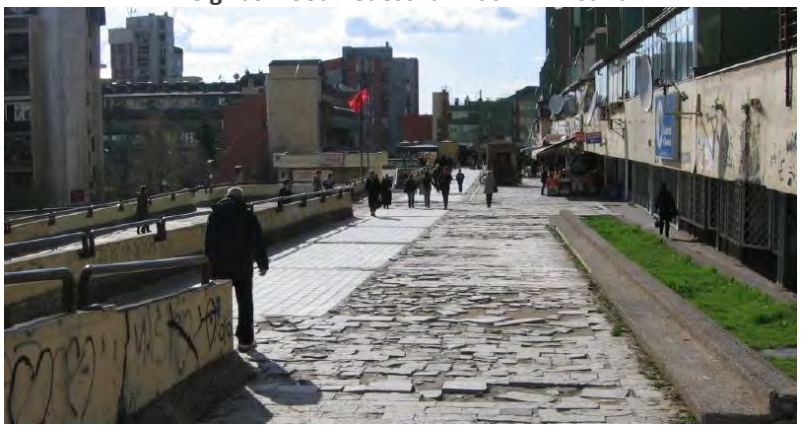

Throughout the world, city streets are increasingly understood as a democratic space, where the amount of space occupied by one car, can take away the space from 10-20 people. Cities like Pristina can learn from the mistakes of cities in the West, and instead of designing a car oriented urban space, they should strive to create cities for people. Regulations that restrict car traffic and parking may receive some initial backlash from drivers, but they ultimately help create better cities.

Traffic policies could be doubles by investments in non-motorized infrastructure. Bike lanes may be too early to think of in Pristina, but pedestrian paths are already a reality. The establishment of the Mother Theresa pedestrian walkway in the center of the city is considered to be a success, and now local authorities are working on expanding the walkway – to the point where it meets the George Bush Boulevard (see image below).

**Extension of Pedestrian Path**

Other areas in the center city, particularly those that currently enjoy a lot of pedestrian traffic, could be closed down to car traffic, or they could be designed to handle less traffic. In addition to areas in the center city, there are a number of neighborhood pedestrian areas (see pictures below).

**Neighborhood Pedestrian Path in Pristina**



Some of these neighborhood walkways were developed over thoroughfares, particularly to separate pedestrians away from traffic. They make the neighborhoods more walkable, more accessible, and more pleasant.

At the same token however, few of these neighborhood pedestrian areas have received any care in recent years. Strategic investments in upgrading and improving these pedestrian areas could not only improve the quality of life of the people living there, but they can also encourage the emergence of new businesses. Good urban spaces are frequented more often by people, and spaces with a lot of pedestrian traffic are business friendly environments. Thus, the development of non-motorized infrastructure makes not only environmental and social sense, but also economic sense.

***Parking and Traffic Restraint Measures***

The level and volume of traffic is growing at a significant rate in Pristina, with the highest levels on the primary road network around the city. City transport planners in Pristina need to give increasing attention to the possibility of reducing downtown use of cars by such means as limited parking, higher parking charges and tolls, sale of special central area permits or licenses, or a complete ban on automobiles on selected streets. Among the possible benefits of these auto restraint schemes is less congestion: even if only a small percentage of automobiles are eliminated from central area streets during peak hours, traffic speeds, both for the remaining automobiles and for buses and other forms of public transport, may improve significantly.

There is a severe parking shortage in city center. Reduced use of cars in the central area of Pristina will alleviate air pollution and other environmental problems there and help to conserve energy. The following three types of parking restraint measures generally practiced in different countries can be considered by the city authorities in Pristina:

- *Planning Measures:* The city authority needs to introduce planning measures which determine car parking provision for residential and office developments. Introducing maximum parking allowances with low car-to-unit ratios discourages private-car acquisition and use. Such measures do not affect the existing parking provision, however, and so need to be supported by additional measures. While areas of intervention can be defined, larger coverage is more effective as it has less potential to overwhelm surrounding areas. A gradient approach solves this by making requirements less stringent from the centre to the periphery. These measures safeguard energy use and efficiency in design and thereby bear no immediate cost to the city authority. The London case study presented in the Annex provides further details.

- *Parking Fees:* The City Authority can think of introducing charges for on-street parking. Implementing a charging regime for car parking and formalizing parking arrangements will enable the parking stock to be controlled and generate a revenue stream for sustainable transport measures. This type of approach requires a supporting system for enforcement, e.g. traffic wardens who issue fines to perpetrators, and are politically very sensitive measures. The San Francisco case study presented in the Annex provides further details.

- *Park and Ride Measures:* The City Authority may consider promoting multimodality by providing Park & Ride locations at key interchanges. By linking parking to public transport use, the necessities of non-inner city residents are considered. The success of Park & Ride is linked to availability of public transport and unavailability of cheap parking in central locations. The perceived cost should be lower than that of driving the entire way. Measures of this kind often require major capital investment in infrastructure by the city authority with respect to 'Park & Ride' locations on the periphery of the city, bus terminals and additional buses. The Oxford case study presented in the Annex provides further details.

Directly restraining road traffic through travel demand management is therefore critical. However, little has happened in this area due to a number of critical factors: (i) lack of an attractive high quality public transport alternatives that provide the same level of convenience and time saving which a private car offers; (ii) lack of staff for design and enforcement; (iii) political unwillingness to implement and enforce. To

be more effective, a range of traffic restraint instruments need to be planned as part of a comprehensive city transport strategy, for which city government needs to take effective action. The new challenges of environmental and financial sustainability thus require government to increase their understanding of the process through which transport impacts the environment, while extending and refining the range of fiscal and regulatory instruments to address the problem.

In Europe, car free central districts have contributed to a remarkable increase in the quality of urban life and of the attractiveness of central districts. The City Authority can also impose vehicle-type bans which exclude entire vehicle categories from circulation. But such direct controls are not without problems. It is hard to make a case for private car restraint measures. "Non-auto days", as put in place by Mexico City, selective license plate enforcement as done by the City of Athens, or "no-driving days – one-day rest" as in Puerto Princesa City (the Philippines), have shown perverse effects in rescheduling activities or encouraging increased car ownership rather than restraining total amounts of traffic.

International experience suggests that the use of market instruments in demand management has the advantage over a purely administrative approach by allowing decentralized decision making to select the form of adjustment best suited to individual preferences. While the calculation of "right prices" of externalities remains controversial, the available evidence does suggest optimal charges for urban road use sustainability above those prevailing at present even in Western Europe.

***Public Transport Development***

There is currently no coherent policy or strategy to guide the development of the transport sector in Kosovo. The development of the bus based public transportation network and its reorganization is one of the key priorities for Pristina municipality. The city public bus company 'Traffiku Urban', which is owned by Pristina Municipality, currently operates 12 lines with 30 old (average age: 17–27 years) buses within the city and its periphery (17 of these buses are sub-contracted to other operators). Twenty five private companies operate a further twenty five lines (and 6 lines are currently not in operation), with 125 buses (53 mini bus, 70 standard sized bus, 12 articulated buses). All these 155 city buses put together provide an average of 1,025 trips daily.

Some of the key problems that the city municipality regularly encounter with city bus operators include: (a) daily interference of illegal bus operators with designated city bus operators that create frequent conflicts resulting in trip delays; (b) not all private operators work under one association; (c) the technical condition of most of these old buses running on EURO 1 emission standards, operated by both the private and public companies, is very poor, resulting in unreliable and low quality service with limited access for underprivileged; (d) buses stop to pick passengers anywhere, further exacerbating congestion and road safety conditions; and (e) no coordination between the various companies, no route integration, and no common ticketing or information system.

Recognizing a fragmented public transport system in place with low quality service, the city transport department is currently developing a proposal for 'Reorganization of Public Transport' in Pristina. The proposal aims to introduce: (a) electronic modern system of selling tickets; (b) unified system of ticketing, where passengers can use one ticket for all lines; (c) new fuel efficient buses with minimum emissions; (d) heating and cooling facility to increase level of comfort for commuters; (e) age limit of 25 years as prescribed by the Transport Law; (f) good service checkups for all buses.

Some of the key elements considered in the proposal include: (a) city public transport should be managed under one organization; (b) reduction of number of private operators; (c) approval of new regulations for public transport operation; (d) traffic police should be responsible for continuously managing public transport; (e) better timing and respecting the designated lines by the operators; (f) possibilities to use monthly tickets in different lines; (g) shorter travel time; (h) reduce expenses for transport operators; and (i) increase in safety.

International experience suggests urban public transport can be improved in many ways that are consistent with the fiscal capabilities of even the poorest countries. Giving priority to public transport in the use of road space makes public transport faster and more financially viable. For example, bus lanes and automatic priority at intersections can improve public transport performance significantly, but these solutions tend to suffer from inadequate enforcement by police, who are

untrained in traffic planning and management. In contrast, exclusive bus ways in developing countries have proved to be capable, except in very high traffic volume corridors, of performance nearly equivalent to rail-based systems but at much lower cost. Supply costs can be reduced through competition between private sector suppliers. Regulated competition in the bus market has worked well in cities such as Buenos Aires and Santiago—but care is needed in system design. Total deregulation in Lima, although it has increased supply, has worsened road congestion, the urban environment, and user safety and security. The lesson is that it is not privatization or deregulation per se that improves public transport, but rather the introduction of carefully managed competition, in which the role of the public sector as regulator complements that of the private sector as service supplier.

To make public transport attractive, local authorities should think of developing a service infrastructure, such as improved bus stations and terminals, improved passenger information systems, use of intelligent transport systems for monitoring and control, and most important to improve access to its services. It is useful to lay down standards for accessibility in terms of the distance within which public transport access points should be available. This necessitates the use of personal transport. This can be done by planned integration of public and personal transport operations. Typically this calls for good parking facilities at public transit stations and easy access to public transport from there. The 'Park & Ride facilities that exist in many developed countries seek to achieve this.

Traffic signal priority for buses at all traffic lights, developing bus tracking and passenger information system (through provision of interactive terminals, bus stop schedule displays, and use of satellite based global positioning systems) can go a long way in improving bus speeds, reducing waiting times at bus stops and in scheduling journeys. Experience has shown that faster moving buses, short waiting times (10 minutes or less), and reliable service, increase bus ridership as well as helping reduce air pollution significantly. The recent experience of the bus schedule LCD board displays in Tbilisi, Georgia can be a good learning experience for Pristina on what can be achieved with innovative, affordable, and well implemented measures.

Clearly, urgent reforms are inevitable for sustainable solutions to Pristina's challenge of urban transport services by addressing the following objectives: (i) to bring about better integration of land use and transport planning so as to improve access to jobs, education, etc.; (ii) to encourage public transport and non-motorized transport so that the dependence on personal motor vehicles is reduced; (iii) to offer central government support for investments in public transport systems; (iv) to have a more coordinated approach to management of urban public transport; (v) to provide concessions for the adoption of cleaner fuel and bus propulsion technologies so that the pollution caused by public transport gets reduced.

## District Heating

Energy wise, district heating is one of the most important sectors in Pristina, as it serves 27% of all households in the city, and it requires significant local public spending on fuel oil (mazut) for heating. As such, all of the heat that is lost in the system translates into squandered local funds. Moreover, the fact that annual revenues are more or less fixed (heating tariffs are charged based on heated area), means that increasing energy costs can lead to poorer service for end-consumers – the way it happened in previous years. Improving the energy efficiency of the district heating system in Pristina could be done through both upgrades and improvements of the distribution network, and by reducing or eliminating the dependence on mazut. Local authorities are pursuing both avenues.

### *District Heating Network Maintenance*

Parts of the district heating network in Pristina are over 40 years old. Over the years, several improvements were brought to the network. For example, 40% of the piping was replaced, and 95% of substations received heat exchangers. However, due to the depreciation of the remaining pipeline and the boilers, technical and distribution losses remain high – 22.5% in 2011. Moreover, the rising prices of mazut put Termokos in a difficult financial position. For example, the company was able to allocate funds for replacing 7,000 meters of piping in 2010. In 2011, by comparison, only 500 could be replaced, and heat delivery was cut short because of the inability to buy mazut.

Around 60% of the district heating piping is old, generally made out of steel, with sections that are corroded through, and with classic glass fiber insulation that has fallen off in sections. Replacing these old piping

sections is the first step that should be taken before other measures (such as cogeneration) are considered.

**District Heating Piping with Classic Insulation, in Pristina**

Termokos, has already purchased pre-insulated piping for replacing the old network (see image below), but it needs to identify the funds required to put the new pipes in place. Some of the network sections that will be replaced, will receive larger diameter pipes, to accommodate the future extension of the network. Several high-rise neighborhoods have sprung up throughout Pristina, and several buildings have requested to be branched to the network. Servicing these areas requires more capacity, and more capacity requires bigger pipes.

**Pre-insulated Hot Water Pipes**

As local authorities plan to expand the district heating network, they should also carefully think about keeping the customers they have. As the experience of other cities in Eastern Europe shows, households de-branch themselves from heating networks when they perceive they are unjustly charged – i.e. when they pay for heat that gets lost in the system, or for heat that they never end up using (e.g. if they are on vacation). Resolving such issues requires better metering (at the individual consumer level wherever possible) and the possibility of adjusting heat to one's desire.

***District Cogeneration Thermal Network***

The dramatic increase of mazut prices, means that the cost of energy production for Termokos is now 2.4 times higher than the cost of selling the energy. Moreover, although mazut is relatively cheaper than other fuels, it registers higher price fluctuations, and it requires relatively high storage costs. Basically, to be able to use mazut for heating, Termokos has to first heat up the heavy fuel, to keep it at a set temperature and viscosity. This means that an additional boiler is used just to heat up the fuel that is used in the two main boilers. With all of the mazut having to be imported, this also has significant repercussions on the local and national trade balance.

**Termokos Plant and its Mazut Containers**

Consequently, with the assistance of funds from the EU and KfW, Termokos plans the development of a cogeneration system. The idea is to use steam from the Kosovo B power plant and eliminate the reliance on mazut. This would provide a double-dividend locally, with primary energy that is now used only to generate electricity, being used to also generate heat. Total investments for the cogeneration network are estimated at around €28 million.

## Municipal Buildings

The municipal building stock in Pristina has underwent significant improvements in recent years. With the assistance of donors and using local public funds, schools, hospitals, and administrative buildings have received new windows, new roofs, thermally insulated walls, energy efficient light bulbs, and new energy efficient appliances. For example, in 2012, over €6 million have been allocated for the rehab of Pristina's 67 schools.

Overall, the building stock managed by the municipality is quite energy efficient – both in terms of heat and electricity consumption. However, some of this efficiency can be attributed to the frequent energy shortages that plague Pristina, and Kosovo as a whole. For example, in recent years, only hospitals have benefited from heating throughout the entire heating season.

Even at the current energy usage, the energy performance of municipal buildings can be improved. Technically, buildings can become energy neutral (i.e. they generate all energy that they require), or they could even become net energy contributors. To achieve such high standards, it is important to do a full audit of the building stock, and identify areas where EE improvements can achieve the highest dividends. In addition, improved energy efficiency codes can ensure that all new municipal buildings are good energy performers.

### *Municipal Buildings Audit and Retrofit*

Many municipal buildings in Pristina have already underwent significant energy efficiency work. There is no clear tally however of the energy savings these improvements have lead to. Also, with energy supply being irregular, it is likely that current energy usage levels are deceiving – as they do not reflect actual demand. A full audit of the building stock, and continuous monitoring of energy performance, can offer a better idea of where further energy savings could be achieved.

A menu of possible building improvements can already be found in the city. For example, a state of the art school – The Green School, was recently finished in the city, with funds contributed from the municipal budget and from USAID. The school follows standards that would be best practice in any developed country. For example, heating is ensured by using geothermal water, which is drawn from a source 125 meters beneath the school. The geothermal water is used to provide floor and wall heating at a constant temperature throughput the year. On a cold late April day in 2012, after the end of the heating season in Pristina, it was one of the few schools in the city that was heated at comfortable levels.

**Green School Pristina**

Solar panels on the roof help heat sanitary water and they power light bulbs in bathrooms and in the gym. All the lights in the building, including on the corridors, are motion-sensitive and only turn on when somebody is around.

There are plans to develop another green school in Pristina with assistance from the World Bank. It is hoped that the building standards and technologies that are, or will be used in these green schools, will

inspire the construction of other green buildings and provide ideas for the retrofit of the existing building stock.

***Mandatory Building Energy Efficiency Codes for New Buildings***

Buildings account for about one-third of worldwide energy consumption, and much of this consumption footprint is locked in through the building design and construction. Building energy standards are an important tool to improve EE in new buildings. Building energy standards set requirements for EE. Some countries refer to their building energy regulations as codes and others call them standards. Standards vary between countries in several respects including the extent of their coverage, the specific requirements, means of attaining compliance and the enforcement system. Some EE standards issues are discussed below:

- *Extent of Coverage:* Building energy standards, at a minimum, usually cover insulation, and thermal and solar properties of the building envelope (walls, roofs, windows and other areas where the interior and exterior of a building interface). Most standards also cover heating, ventilation and air conditioning, hot water supply systems, lighting, and electrical power. Some cover additional issues such as the use of natural ventilation and renewable energy, and building maintenance. In some countries, not all the issues are considered in a single standard. Within these broad categories, there are also numerous differences in what the specific requirements cover. Some countries have significant detail about the need to minimize condensation on insulation. Some countries (like India or Japan) have detailed requirements based on different types, sizes or orientations of buildings, for example, while others have simpler requirements for a broader range of buildings. The United States, India and Canada all have commercial building energy codes derived from standards produced by the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), although specific requirements vary by country.

- *Specific Requirements:* The specific EE requirements for new buildings vary between countries. For example, regarding lighting efficiency requirements in commercial or large buildings, Australia has the most stringent requirements (7 to 10 watts per square meter), followed by India and the United States (both 10.8 to 11.8 watts per square meter), and China (11 watts per square meter). Japan and the Republic of Korea (South Korea) do not regulate lighting power density per se, although they regulate other aspects of lighting efficiency. It is more difficult to compare energy efficiency requirements for the building envelope because of varying climate conditions and construction practices. Japan has the most stringent requirements for windows in commercial buildings, while in the United States requirements for roofs of single-family homes are particularly strong.

- *Means of Attaining Compliance:* Building energy standards typically provide property owners some flexibility in meeting the EE requirements. This is important because the standard can be more stringent without impinging too severely on the ability of property owners to adapt buildings to their needs. There are several approaches to providing this flexibility. In many countries including India, the United States, Canada and Australia, the codes have four classes of requirements. The first are mandatory requirements that must be satisfied regardless of any other factors for a building to be considered in compliance. The majority of these codes are then made up of prescriptive requirements that are similar to the mandatory requirements in that they provide specific values and details. However, building designers may be allowed to “trade-off” some of the prescriptive requirements with others regarding the building envelope. The codes then provide rules on what can be traded-off and how. Finally, these codes also provide an option for compliance based on building energy performance instead of the prescriptive requirements. This last option allows a building designer to install less energy-efficient windows but a more energy efficient air conditioning system, for example, if the total designed energy use falls within the required norms. There are several approaches to establishing the baseline for comparison under the building energy performance method. The United States uses cost as its reference metric, while some

other countries base the reference metric on energy consumption. South Korea and Japan take a different approach, establishing both mandatory requirements and a point system for a whole range of energy issues related to buildings. Each new building must have a minimum number of points either in total or by category. Buildings that exceed the minimum point requirement may be eligible for certain benefits, such as relaxation of some zoning rules.

- *Enforcement Systems:* Enforcement is critical for the standard to have an effect. Not all countries have mandatory building energy standards. India, for example, has a voluntary code. Japan's standards are also technically voluntary, although Japan has recently adopted penalties for non-compliance that blur this distinction. The United States, Canada and Australia all adopt building standards at the local level. Not all jurisdictions in the United States and Canada have adopted their nation's model building energy codes. China has mandatory national codes, but provinces have the option to adopt more stringent local codes. Some important issues regarding enforcement and the related impact of the code on energy use include: the point of compliance (design and/or construction stage), how buildings are reviewed or inspected and by whom, penalties and other incentives for compliance, training and information on the code, compliance tools such as code compliance software and inspection checklists, and equipment and material testing and ratings. In the United States, Canada, Australia and South Korea, for example, the building design must be approved, and inspectors check the building for compliance at least once during construction. In Japan, the reviews only occur at the building design stage. China uses a combination of government employees and certified companies to check building designs and inspect the buildings for compliance. There is no single answer as to which system produces the highest level of compliance. For example, Japanese officials believe that Japan attains a high level of compliance in actual construction because Japan has a very well developed system of training and information dissemination on the building energy standards. Anecdotal evidence in the United States and other countries indicates that inspections do play an important role in attaining high levels of compliance. The U.S. Department of Energy is now developing methodologies to measure and track compliance. The stringency of the national system for testing materials and equipment for their EE properties can also have a marked impact on the final energy consumption of a building. Most countries have a system of certified laboratories that test materials and equipment (like windows and air conditioners) and rate them for efficiency. These ratings then determine if the equipment in a building meets the building energy standard. Testing procedures vary between countries, and there is anecdotal evidence that even in countries with well established systems, ratings can differ by 10% or more based on the testing procedures. Building energy standard compliance rates vary significantly between countries. What constitutes compliance may also vary, and not all countries consistently publish compliance data. That said, countries usually have lower compliance rates soon after they adopt or revise a standard, and when their enforcement system is not fully developed.

Pristina municipality has expressed a desire to improve EE in construction of their new buildings. More efficient new buildings will mean lower operating costs and emissions. Buildings can last 30 to 50 years or longer, and much of the energy consumption footprint is set with the initial design and construction of the building. Thus, building energy codes are an important tool for ensuring wise energy use. Countries stand to gain by learning from the experience with building energy codes in other countries. This goes beyond just looking at specific requirements, where certainly there are measurable differences. Countries can also learn from the implementation strategies and programs employed elsewhere are presented in the Annex.

ECA Sustainable Cities:

# Improving Energy Efficiency in PRISTINA

## Kosovo

TRACE Study

**Annexes**

SUSTAINABLE CITIES

ESMAP

Energy Sector Management Assistance Program

World Bank Institute

Climate Change

## ANNEXES: DETAILED RECOMMENDATIONS

## ANNEX 1: NON-MOTORIZED TRANSPORT MODES

**Description**

Non-motorised transport modes have zero operational fuel consumption and require low capital costs for implementation. In addition to improving the health of users, their use reduces noise pollution and improves air quality.

Benefits include improved air quality, lower operating costs for users and providers, and lower infrastructure requirements.

**Attributes**

**Energy Savings Potential**
100,000-200,000 kWh/annum

**First Cost**
> US$1,000,000

**Speed of Implementation**
> 2 years

**Co-Benefits**
Reduced carbon emissions
Improved air quality
Enhanced public health & safety

**Implementation Options**

| Implementation Activity | Methodology |
|---|---|
| Pedestrianization | The City Authority pedestrianizes networks of streets or larger city areas. Either permanent or temporary, the closure of streets to motor vehicles increases public awareness of non-motorised modes and removes noisy and polluting vehicles, as well as creating opportunities for street markets and other initiatives. The City Authority researches the feasibility and probable take-up from origin and destination surveys, existing mode splits, and subsequently designs networks to suit commuting patterns and local/neighbourhood travel. See Oxford case study for further details. |
| Dedicated networks | The City Authority includes dedicated cycle / walking route networks in its transportation or city land use plans. Replacement or reservation of rights-of-way in new-built areas creates the necessary conditions for adopting non-motorised modes that may otherwise be less favoured if roads cater to cars only. The key to success is the linkage of cycle and pedestrian networks at local level, and the quality of the environment provided, that requires good drainage and adequate lighting and shading. See Bogota case study for further details. |
| Microcredits | The City Authority makes micro credits available which can be used to increase the ownership of bicycles. Increased cycle ownership can have significant financial benefits to low-income workers who may no longer be |

| | |
|---|---|
| | dependent upon expensive, inefficient and infrequent public transport. See Lima case study for further details. |
| Rental programs | The City Authority introduces bicycle rental programs which provide bicycles on demand for a fee. The key factor for success to is the setting of tariffs that encourage use as well as security procedures that avoid and penalise theft. Registered-user schemes require a credit card or bank details of users, but are not necessarily open to all. Non-registered user schemes are more flexible, but more open to abuse. Branding of bicycles and facilities can create revenue for local authority. See Paris case study for further details. |

**Monitoring**

Monitoring the progression and effectiveness of recommendations, once implemented, is fundamental to an accurate understanding of their value over the longer term. Where the CA implements a recommendation a target (or set of targets) should be defined that indicates the level of expected progress over a given timescale. At the same time a monitoring plan should be designed. The monitoring plan does not need to be complicated or time consuming but should, as a minimum, cover the following aspects: identification of information sources, identification of performance indicators, a means of measurement and validating measuring equipment or processes, record keeping protocols, a schedule for measurement activity (daily, weekly, monthly etc.), assignment of responsibilities for each aspect of the process, a means of auditing and reviewing performance and finally, establishment of reporting and review cycles.

Some suggested measures that relate specifically to this recommendation are as follows:

- Perform surveys of the number of cycles in circulation by using traffic counters on roads and cycle lanes.
- Determine the mode share of people travelling in the area or city.
- Determine KPIs such as % non-motorised transport mode, modal shift, km of dedicated cycle/walking infrastructure, take-up of cycle promotion schemes by analysing registers of subsidies

**Case Studies**

**Pedestrianization with road closures, Oxford, England**

European Commission, Directorate General for the Environment (2004). "Reclaiming city streets for people: Chaos or quality of life?", available online from http://ec.europa.eu/environment/pubs/pdf/streets_people.pdf

The main retail streets have been fully pedestrianized, while other through roads in the central area are only accessible to buses and pedestrians. The adoption of a step by step, integrated approach to the implementation of the road closure program has been seen as

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| critical to the success of the significant road space reallocation element of the scheme. Opposition to the USD 6 million scheme was raised most notably on the basis that traffic congestion on two key routes in the city would worsen, as well as from retailers concerned about delivery access and trade levels. These concerns were attended to via an extensive consultation process and an effective publicity campaign prior to the implementation of the scheme. This included leaflets, advertisements on buses, city-wide poster boards, and a series of press releases |
| **Dedicated cycle network, Bogota, Colombia**<br>C40 Cities (2010). "Bogota, Colombia: Bogota's CicloRuta is one of the most comprehensive cycling systems in the world", available online from http://www.c40cities.org/bestpractices/transport/bogota_cycling.jsp<br>CicloRutas is considered a unique cycling network where design has taken the topography of the city into consideration in order to create maximum flow and function (manmade and natural features, hills, waterways, parklands, essential facilities). In a period of just 7 years, following an investment of USD 50 million, the use of bicycles on the network increased by more than 268%. CicloRutas plays an important role for lower income groups, as more than 23% of the trips made by the lowest income group in the city are by walking or by bike. The development of CicloRutas has also helped to recover public space along riverbanks and wetlands, as for many years the city's wetlands were occupied by illegal settlements. |
| **Bicycle micro credits, Lima, Peru**<br>ICLEI (2009). "Case study 46: Assistance to purchase bicycles - Lima, Peru" in Sustainable Urban Energy Planning: A handbook for cities and towns in developing countries, available online from http://www.unhabitat.org/pmss/listItemDetails.aspx?publicationID=2839<br>In 1990, the Municipality of Lima set up a micro-credit programme to help low income citizens purchase bicycles. By saving on daily public transportation costs, workers can see their income effectively rise more than 12% once the loan is paid off. In order to enhance the success of the program, efforts have been made at standardizing the use of bicycles in the city. Actions to achieve this have so far consisted of the development of a manual of technical standards for the design and planning of cycle ways. |
| **Bicycle rental, Velib, Paris, France**<br>C40 Cities (2010). "Paris, France Velib - a new Paris love affair", available from http://www.c40cities.org/bestpractices/transport/paris_cycling.jsp<br>Paris launched a 24/7 cycle hire scheme through Velib; a public private partnership between the city of Paris and a company led by a major advertising group. Users must purchase a subscription by day, week or year, and bike rental is free for the first half hour of every individual trip, after which it costs a fixed rate. The increasing price scale ensures the bikes are kept in circulation. Notably, the City of Paris generates revenues from the project without any investment (which cost USD 108 million). The public-private partnership is the reason for this success, with the private company paying operating costs plus rights to advertising space to the City, funded by advertising revenues. |

| Tools & Guidance |
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| Sustrans (2007). "Technical guidelines for the development of cycle facilities" A series of guidance documents for professionals on the details of bicycle network design. Available online from http://www.sustrans.org.uk/resources/design-and-construction/technical-guidelines |
| Transport for London (2010). "London Cycling Design Standards" A guidance document for designing to reduce barriers to cycling, in order to support road safety targets. Available online from http://www.tfl.gov.uk/businessandpartners/publications/2766.aspx |

## ANNEX 2: PARKING RESTRAINT MEASURES

**Description**

Restricting parking availability discourages car use and provides an incentive to use more sustainable modes of transport, including public transport.

Removing vehicles from circulation reduces fuel use and reduces congestion effects.

**Implementation Options**

| Implementation Activity | Methodology |
|---|---|
| Planning measures | The City Authority introduces planning measures which determine car parking provision for residential and office developments. Introducing maximum parking allowances with low car-to-unit ratios discourages private-car acquisition and use. Such measures do not affect the existing parking provision, however, and so need to be supported by additional measures. While areas of intervention can be defined, larger coverage is more effective as it has less potential to overwhelm surrounding areas. A gradient approach solves this by making requirements less stringent from the centre to the periphery. These measures safeguard energy use and efficiency in design and thereby bear no immediate cost to the city authority. See London case study for further details. |
| Parking fees | The City Authority charges for on-street parking. Implementing a charging regime for car parking and formalizing parking arrangements will enable the parking stock to be controlled and generate a revenue stream for sustainable transport measures. This type of approach requires a supporting system for enforcement, e.g. traffic wardens who issue fines to perpetrators, and are politically very sensitive measures. See San Francisco case study for further details. |
| Park & Ride facilities | The City Authority promotes multimodality by providing Park & Ride locations at key interchanges. By linking parking to public transport use, the |

**Attributes**

**Energy Savings Potential**
100,000-200,000 kWh/annum

**First Cost**
< US$100,000

**Speed of Implementation**
> 2 years

**Co-Benefits**
Reduced carbon emissions
Improved air quality
Enhanced public health & safety
Increased employment opportunities

| | |
|---|---|
| | necessities of non-inner city residents are considered. The success of Park & Ride is linked to availability of public transport and unavailability of cheap parking in central locations. The perceived cost should be lower than that of driving the entire way. Measures of this kind often require major capital investment in infrastructure by the city authority with respect to 'Park & Ride' locations on the periphery of the city, bus terminals and additional buses. See Oxford case study for further details.<br>Complementary implementation activity: Planning measures |

**Monitoring**

Monitoring the progression and effectiveness of recommendations, once implemented, is fundamental to an accurate understanding of their value over the longer term. Where the CA implements a recommendation a target (or set of targets) should be defined that indicates the level of expected progress over a given timescale. At the same time a monitoring plan should be designed. The monitoring plan does not need to be complicated or time consuming but should, as a minimum, cover the following aspects: identification of information sources, identification of performance indicators, a means of measurement and validating measuring equipment or processes, record keeping protocols, a schedule for measurement activity (daily, weekly, monthly etc.), assignment of responsibilities for each aspect of the process, a means of auditing and reviewing performance and finally, establishment of reporting and review cycles.

Some suggested measures that relate specifically to this recommendation are as follows:

- Perform surveys of parking stock and usage.
- Perform traffic surveys of number of vehicles in circulation by using traffic counters.
- Determine the average travelling speeds on the main transport corridors.
- Determine the mode share of people travelling in the area or city.
- Perform statistical analysis of rate of growth of car registration data.

**Case Studies**

**Parking standards, London Plan, London, UK**

London (2010). "Chapter 6: Transport" in The London Plan, available from http://www.london.gov.uk/shaping-london/london-plan/docs/chapter6.pdf pp.160-161.

The London Plan establishes maximum parking guidelines for residential development. It stipulates that all developments in areas of good public transport accessibility should aim for significantly less than 1 parking space per unit. The main challenge continues to consist of ensuring that these standards are supported other measures which reduce car dependency, both within the development and in the

surrounding area, e.g. improved and increased public transportation accessibility.

**SFpark curbside parking, San Francisco, USA**
Institute for Transportation and Development Policy (2010) "U.S. Parking Policies: An Overview of Management Strategies", available online from http://www.itdp.org/documents/ITDP_US_Parking_Report.pdf
San Francisco Municipal Transit Agency's (SFMTA) installed new electronic, multi-space meters in 2009 and will activate parking spot sensors attached to the pavement sometime in 2010. The aim is to use pricing to help redistribute the demand for parking. The heart of SFpark is a Data Management System which sorts a tremendous amount of data collected from the networked array of remote sensors in all 6,000 parking spots. These wireless sensors can detect whether a spot is occupied by a vehicle and report parking occupancy information in real time to a central computer. The project will produce valuable data about the effect of meter pricing on occupancy. By 2010 the project will encompass 6,000 of San Francisco's 25,000 metered curbside parking spots in seven pilot neighborhoods.

**Parking fees, Aspen, US**
Source: Victoria Transport Policy Institute (2010). "Parking Pricing Implementation Guidelines", available online from http://www.vtpi.org/parkpricing.pdf
The city used to suffer from high levels of congested on-street parking. In order to reduce the effects of the "ninety-minute shuffle" (where locals and downtown commuters moved their vehicles every 90 minutes to avoid a parking ticket), the city introduced charges for on-street parking using multi-space meters. Parking fees are highest in the center and decline with distance from the core. The city had a marketing campaign to let motorists know about the meters, including distribution of one free prepaid parking meter card to each resident to help familiarize them with the system. Motorists were allowed one free parking violation, and parking control officers provide an hour of free parking to drivers confused by the meters.

**Park-and-Ride, Oxford, United Kingdom**
Oxford City Council (2009). "Park and Ride Transfer", available online from http://www.oxford.gov.uk/PageRender/decTS/Park_and_Ride_occw.htm
Oxford city has five Park-and-Ride sites serving the city's shoppers, visitors and commuters. These sites used to charge for parking to provide income to cover operational costs, but were not able to generate additional money for repairs or improvement. In order to achieve savings, the management of the Park-and-Ride sites was transferred to Oxfordshire county, resulting in efficiency savings of 250,000 GBP per year for the city administration. These savings were achieved primarily through economies of scale, and by sharing the cost of providing the service with taxpayers across the County, and not just those in the city - both of which used the facilities.

**Tools & Guidance**

Victoria Transport Policy Institute (2010). "Parking Management: Strategies, Evaluation and Planning" A comprehensive guidance document for planning and implementation of parking management strategies. Available online from http://www.vtpi.org/park_man.pdf

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| Victoria Transport Policy Institute (2010). "Parking Pricing Implementation Guidelines" A guidance document for implementation of parking pricing with details on overcoming common obstacles. Available online from http://www.vtpi.org/parkpricing.pdf |
| Spillar, R. (1997). "A Comprehensive Planning and Design Manual for Park-and-Ride Facilities" A guidance document for the planning and design of Park-and-Ride facilities. Available online from http://www.pbworld.com/library/fellowship/spillar |
| **Water Treatment Plant, San Juan, Puerto Rico**<br><br>http://www.energy.ca.gov/process/pubs/sanjuan.pdf<br><br>The San Juan Water District's Sidney N. Peterson Water Treatment Plant was built to be energy efficient and is operated to encourage energy and water conservation among customers and staff alike. The district even created an incentive program for its employees that rewards them with a percentage of the first year's savings from new cost-cutting techniques that they identify. A state-of-the-art facility, the Peterson plant uses gravity flow to minimize pumping needs for a 120-mgd modular filtration system. Initial plant designs specified 15 horsepower backwash motors instead of 100 horsepower units, which reduced construction costs by 33% and lowered filtration energy requirements by 75%. A supervisory control and data acquisition (SCADA) system optimizes day-to-day performance and energy efficiency. To save more energy and money, district staff replaced standard-efficiency motors with energy-efficient motors to save $5,000 per year. They also installed variable-frequency drives on flocculation and chemical feed pump motors to save $11,000 per year and launched water conservation education, promotion, and enforcement programs. Avoided pumping due to water conservation measures saves around $50,000 per year. |
| **USAID funded Ecolinks Project, Galati, Romania**<br><br>http://www.munee.org/node/62<br><br>As part of a USAID funded Ecolinks Project, the Cadmus Group assessed the city's water supply system and discovered that a series of energy conservation measures could save roughly $250,000 per year in electricity costs. Low cost measures included trimming impellers to better match pumps and motors with required flows and pressures. Moderate cost measures included leak detection and reduction and limited pump replacement. A series of pumps replacements were recommended. For one pump's 5,854 hours of annual operation, it used roughly 2,500,000 kWh. A replacement pump and motor set could save roughly $55,000 per year. For another pump with 6,000 hours of annual operation and consuming 3,000,000 kWh per year a replacement pump and motor set could save roughly $42,000 per year. Cadmus also estimated that reducing the height of the discharge would decrease the static head between the wet well in a low voltage pump station and the actual discharge. If the height of the reservoir were an average of 1 meter below the discharge and the discharge were lowered, roughly 10 percent of the pumping costs could be eliminated. The cost of the measure would include labour and minimal parts (pipe extensions). This measure would save roughly 100,000 kWh/yr or $5,000/yr. |

| Tools & Guidance |
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| Kitakyushu Initiative: A report focusing on building the capacity of the local governments to overcome the urban environmental and water problems. http://kitakyushu.iges.or.jp/docs/sp/water/4%20Overview_Analysis.pdf |
| Pump Efficiency Calculator: An online calculator tool to work out exactly how much could be saved by replacing a fixed speed damped or throttled centrifugal load with a variable speed drive controlled solution. http://www.abb.co.uk/cawp/seitp202/c253ae5e6abf5817c1256feb0053baf7.aspx |
| ESMAP Public Procurement of Energy Efficiency Services - Guide of good procurement practice from around the world. http://www.esmap.org/Public_Procurement_of_Energy_Efficiency_Services.pdf |

## ANNEX 3: TRAFFIC RESTRAINT MEASURES

**Description**

Discouraging potential drivers from using their cars leads to fewer cars in circulation. This encourages people to use alternative modes, which in turn will increase their viability (increased public transport patronage for example).

Removing vehicles from circulation reduces fuel use and reduces the need for road space.

**Attributes**

**Energy Savings Potential**
100,000-200,000 kWh/annum

**First Cost**
US$100,000-1,000,000

**Speed of Implementation**
1-2 years

**Co-Benefits**
Reduced carbon emissions
Improved air quality
Enhanced public health & safety

**Implementation Options**

| Implementation Activity | Methodology |
|---|---|
| Blanket bans | The City Authority imposes blanket bans. Possible types of blanket bans include vehicle-type bans which exclude entire vehicle categories from circulation; or licence plate bans, by which certain number plates are banned from circulation. A weakness of licence plate bans are that they tend to result in wealthier residents purchasing second cars, not only negating the aims of the ban, but thereby also disadvantaging those with lower incomes. See Guangzhou case study for further details. |
| Licensing | The City Authority rations permits. The establishment of quotas for private vehicles allows for only a certain number of vehicle registrations over a given period of time. However, as demand for cars tends to be inelastic, this often results in very high purchase prices for the licenses - a mechanism which favours the wealthy and marginalizes the lower income brackets of society. See Singapore case study for further details. |
| Civic initiatives | The City Authority sanctions and encourages 'no-driving days' to educate and lead by example. Participation in these initiatives is voluntary, however, and therefore not enforceable. See Puerto Princesa case study for further details. |

**Monitoring**

Monitoring the progression and effectiveness of recommendations, once implemented, is fundamental to an accurate understanding of their value over the longer term. Where the CA implements a recommendation a target (or set of targets) should be defined that indicates the level of expected progress over a given timescale. At the same time a monitoring plan should be designed. The monitoring plan does not need to be complicated or time consuming but should, as a minimum, cover the following aspects: identification of

information sources, identification of performance indicators, a means of measurement and validating measuring equipment or processes, record keeping protocols, a schedule for measurement activity (daily, weekly, monthly etc.), assignment of responsibilities for each aspect of the process, a means of auditing and reviewing performance and finally, establishment of reporting and review cycles.
Some suggested measures that relate specifically to this recommendation are as follows:

- Perform traffic surveys of the number of vehicles in circulation pre- and post-implementation.
- Determine the mode share of people travelling in an area or the city.
- Collate registration data of users to paid schemes or voluntary schemes.
- Perform statistical analysis of rate of growth of car registration data.

**Case Studies**

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| **Vehicle bans: Motorcycle ban, Guangzhou, China**<br>Institute for Transportation and Development Policy (2008). "Case study: motorcycles in Guangzhou", available online from http://www.itdp.org/documents/Guangzhou%20Case%20Studies%20-%20Motorcycles%2015-Sep-08.pdf<br>Motorcycles have been completely banned in the City of Guangzhou. The ban was implemented in phases, beginning with a moratorium on new licenses, extending to various roads and time periods. Gradual implementation has been crucial to allow time for the public to adapt, and efficient supply of additional infrastructure/services has supported the induced modal shift. Many motorbike riders have shifted to bicycles and buses, and cycle rickshaws have also emerged as a popular substitute. Road accidents have dropped by 40% since the initial implementation of the ban. |
| **Rationing, Singapore, Singapore**<br>Sustainable Urban Transport Project (2010)."The Vehicle Quota System in Singapore", available online from http://www.sutp.org/index2.php?option=com_content&do_pdf=1&id=1582<br>Singapore fixes the number of new vehicles allowed for registration. Potential buyers need to bid for a non-transferable licence, which entitles them to own a vehicle for a fixed number of years. The scheme had to be modified soon after implementation to safeguard against speculative action. The licences used to be transferable and within the first two months of the first round of release, 20% changed hands in "buy and sell" transactions with speculators making sizable profits of up to S$5000. As the rationing system does not control annual mileage, the success of the rationed registration in limiting vehicle usage has been dependent on support from other traffic restraint measures, such as high road tolls, parking fees, and electronic road pricing. |
| **No-driving days, One Day Rest, Puerto Princesa, Philippines**<br>ICLEI (2001). "Vehicular Reduction Strategy for Air Pollution Prevention and Climate Change Mitigation; A Case of Puerto Princesa City, Philippines", available online from http://www.iclei.org/index.php?id=1193<br>Introduced as part of a zoning and rerouting, this program stipulates a one day rest for tricycle drivers in the central business district. Regulation of illegally operated tri-cycles is a major impediment, as enforcement irregularities pose questions of inequality between illegal and legal tri-cycle taxi drivers. Furthermore, the income potential of those who comply with the rest day is lost to the illegal operators |

**Tools & Guidance**

| **Tools & Guidance** |
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| Sierra Club of Canada (2001). "How to Stage a Car Free Day In Your Community" A guidance document for preparing and planning a community-driven car free day. Available online from http://www.worldcarfree.net/wcfd/documents/cfd_howto.pdf |

## ANNEX 4: PUBLIC TRANSPORT DEVELOPMENT

**Description**

Develop or improve the public transport system and take measures to increase its accessibility and use. Public transport achieves lower emissions per capita than private cars, and has the potential to provide equitable transport network. A reduction in the number of private vehicles in circulation can lower emissions and improve air quality.

**Attributes**

**Energy Savings Potential**
> 200,000 kWh/annum

**First Cost**
> US$1,000,000

**Speed of Implementation**
> 2 years

**Co-Benefits**
Reduced carbon emissions
Improved air quality
Enhanced public health & safety

**Implementation Options**

| Implementation Activity | Methodology |
|---|---|
| Bus priority | The City Authority establishes dedicated bus priority measures. This enables buses to bypass traffic queues enhancing their reliability and journey times. There are a range of measures including bus lanes and priority at junctions that could be implemented. See the Bogota case study for further details. |
| Signalling | The City Authority invests in the necessary infrastructure for bus-priority signalling. Such systems are linked to buses via transponders which use GIS information, and favour the circulation of approaching buses either by extending green lights for buses or by shortening cycle for cars. |
| Information | The City Authority provides good quality passenger waiting facilities and as well as good information services. The provision of real-time bus countdown information allows users to understand and manage waiting times. These services enhance the attractiveness of public transport. |
| Operations | The City Authority invests in the necessary infrastructure for electronic ticketing. This allows for use of multiple buses within a given amount of time with one ticket, reducing the cost of travel, putting buses within the reach of the poorest, while attracting a wider patron base, when in combination with other modes, such as heavy rail or metro. |
| Planning regulations & guidelines | The City Authority links development densities to public transport availability and funding. The City Authority reviews the city's zoning ordinances and considers making the following changes: Increase the permitted floor area ratio/ plot ratio on sites located near public transport hubs. In areas where it is |

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| | appropriate re-zone single-use lands to allow multiple uses on the same site. Allowing higher densities of development along well-served public transport corridors creates a patron base for public transport and can be used in combination with other planning measures, such as capping parking provision to residential and office buildings, thus discouraging car use. Developers are required to show how a new development links to the existing or planned public transport network in order to gain planning permission. See the Curitiba case study for further details. |
| Subsidies | The City Authority subsidizes travel on public transport. In certain areas this can provide an incentive for people to use public transport. |

**Monitoring**

Monitoring the progression and effectiveness of recommendations, once implemented, is fundamental to an accurate understanding of their value over the longer term. Where the CA implements a recommendation a target (or set of targets) should be defined that indicates the level of expected progress over a given timescale. At the same time a monitoring plan should be designed. The monitoring plan does not need to be complicated or time consuming but should, as a minimum, cover the following aspects: identification of information sources, identification of performance indicators, a means of measurement and validating measuring equipment or processes, record keeping protocols, a schedule for measurement activity (daily, weekly, monthly etc.), assignment of responsibilities for each aspect of the process, a means of auditing and reviewing performance and finally, establishment of reporting and review cycles. Some suggested measures that relate specifically to this recommendation are as follows:

- Perform surveys of public transport passenger numbers.
- Determine mode share of people travelling in area or city.

**Case Studies**

**BRT system, Bogota, Colombia**

Source: ESMAP (2009). "Good practices in city energy efficiency: Bogota, Colombia - Bus Rapid Transit for Urban Transport Energy", available online from http://esmap.org/esmap/sites/esmap.org/files/Bogota_Case_Study_020310.pdf

With the completion of its first two phases, the TransMilenio BRT system serves about 1.5 million passengers every day and has city-wide fuel consumption by 47%. Key success factors have been city-wide comprehensive planning of infrastructure, use of state-of-the-art technologies, implementation of a variety of design features to accommodate high volumes of passengers, and the use of a simple single price faring system. It does not require subsidies for operation - these are fully covered by fares. The project's capital cost totalled USD 240 million. The system is managed by a company which was set up by the Mayor, but runs independently from the city administration. While the company is in charge of all planning, maintenance and construction of infrastructure as well as organizing of schedules of bus services, buses and drivers are contracted

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| through private firms, resulting in a complex but innovative management structure. |
| **Land Use and Public Transport Planning, Curitiba, Brazil**<br>Source: World Bank (2010). "Curitiba, Brazil -- Cost Is No Barrier to Ecological and Economic Urban Planning, Development, and Management . In ECO$^2$ Cities: Ecological Cities as Economic Cities, pages 169-182." available online from http://www.esmap.org/esmap/sites/esmap.org/files/CS_Curitiba.pdf<br>The case of Curitiba, Brazil, shows that cost is no barrier to ecological and economic urban planning, development, and management. Curitiba has developed a sustainable urban environment through integrated urban planning. To avoid unplanned sprawl, Curitiba directed urban growth linearly along strategic axes, along which the city encouraged highdensity commercial and residential development linked to the city's integrated master plan and land use zoning. Curitiba adopted an affordable but innovative bus system rather than expensive railways that require significant time to implement. Curitiba's efficient and well-designed bus system serves most of the urban area, and public transportation (bus) ridership has reached 45 percent. The city now has less traffic congestion, which has reduced fuel consumption and enhanced air quality. The green area has been increased, mainly in parks that have been created to improve flood prevention and through regulations that have enabled the transfer of development rights to preserve green areas and cultural heritage zones. |
| **Linking development densities to public transport availability, Curitiba, Brazil**<br>Source: Rabinovitch, J. (1992) "Curitiba: towards sustainable urban development", Environment and Urbanization, Vol.4 (2) pp. 62-73<br>Curitiba's Master Plan integrated transportation with land use planning. Zoning laws are used to direct linear growth by attracting residential and commercial density along a mass transportation lane. High-density residential and commercial development is permitted within walking distance of stops, with much lower densities elsewhere in the city. The city's central area is partly closed to vehicular traffic, and pedestrian streets have been created. In addition, a strict street hierarchy safeguards the right of way for the current BRT, which has significantly contributed to the success of the transportation network. |
| **Integrated urban planning and efficient resource use, Singapore**<br>Good practices in City Energy Efficiency: Eco$^2$ Cities - Land and Resource Management in Singapore, available online http://www.esmap.org/esmap/node/1230<br>Singapore is an island city-state at the southern tip of the Malay Peninsula. With a limited land area of 700 square kilometers and a population of 4.8 million, Singapore has become developed because of innovative urban planning integrated with the efficient use of land and natural resources. Singapore's small size poses challenges related to the availability of land and natural resources. To optimize land use, Singapore promotes high-density development not only for businesses and commercial entities, but also for residential structures. High density lends itself to higher economic productivity per unit of land and facilitates the identification of green spaces and natural areas for preservation. Furthermore, high-density development has translated into greater use of public transportation as major business, commercial, and residential areas are well connected to an integrated public transportation network. In 2004, public transportation as a share of all transportation modes during morning peak hours reached 63 percent. The significant use of public transportation helps reduce greenhouse gas emissions. High public transportation ridership also means Singapore has been able to recover all public transportation operating costs from fares, a feat achieved only by Hong Kong, China, and by Singapore among modern, highly developed cities. |

**Integrated regional urban planning, Auckland, New Zealand**
Good Practices in City Energy Efficiency: Eco$^2$ Cities - Integrated Regional Urban Planning in Auckland, available online http://www.esmap.org/esmap/node/1227
The interconnectedness of national and local Auckland issues (such as housing and education) with growth and innovation and the major required investments (particularly in land transport) have created complex and difficult issues among multiple authorities. Despite Auckland's importance to the New Zealand economy and the areas of common interest, such as transportation and energy provision, the national government did not initially play a close role in directing regional and local government planning. Concern emerged that, without agreement on an overarching regional strategy and framework, decision making in the region could become ad hoc and adversarial if each stakeholder tried to have a say from a narrow perspective and without viewing the region as a whole. As a result, there was a clear need for coordinated strategic planning across the Auckland Region to ensure that Auckland would be able to remain competitive in today's globalized world. The response involved a process undertaken in 2001 to prepare a regional growth strategy that aimed to provide a vision of what Auckland could be like in 50 years.

**Tools & Guidance**

Public Transport Authority Western Australia (2009). "Bus Priority Measures Principles and Design" A guidance document for planning bus priority methods and approaches. Available online from http://www.pta.wa.gov.au/PublicationsandPolicies/DesignandPlanningGuidelines/tabid/109/Default.aspx

Transport for London (2006). "Accessible bus stop design guidance" A guidance document for designing bus stops which help make boarding easier for passengers. Available online from http://www.tfl.gov.uk/assets/downloads/businessandpartners/accessibile_bus_stop_design_guidance.pdf

## ANNEX 5: DISTRICT HEATING NETWORK MAINTENANCE AND UPGRADE PROGRAM

**Description**

Many cities already have established district heating networks. The primary plant (boilers), may be operating at low efficiencies, or the pipework distribution networks may have poor or no insulation thereby losing thermal energy or considerable amounts of water through leakage. Advances in materials, boiler design or alternative system configuration (for example, improved heat exchange) mean that higher efficiencies can be achieved, and there are various different methods for detecting leaks. More energy can be delivered to the end user through primary plant upgrades, pipework repair and replacement and better insulation.

The aim is of this recommendation is to develop a program for maintenance and retrofits to upgrade boiler plant, pumps, pipework or insulation.

District energy networks are inherently more efficient than individual systems, but further energy efficiencies could be gained through repairing pipework and upgrading insulation, delivering more resource, operational cost and carbon emission savings.

- **Attributes**

**Energy Savings Potential**
> 200,000 kWh/annum
**First Cost**
> US$1,000,000
**Speed of Implementation**
> 2 years
**Co-Benefits**
Reduced carbon emissions
Efficient water use
Improved air quality
Financial savings
Security of supply

**Implementation Options**

| Implementation Activity | Methodology |
|---|---|
| Feasibility Study | The City Authority establishes appropriate partnerships to undertake a feasibility study. The CA should engage a team that includes network planners, power and heat engineers, environmental specialists and financial advisors to ensure the feasibility study captures all pertinent aspects.<br>The feasibility study establishes the technological and financial viability, as well as procurement and policy options. It establishes the baseline city energy expenditure associated with power and heat supply and the efficiency of their distribution across the network(s). Technical ability, procurement methodology, incentives and taxes should also be given consideration.<br>Each option should be appraised against the specific requirements and capabilities of the CA. |
| Direct expenditures & procurement | The City Authority invests in the maintenance of the network as well as upgrades of the infrastructure where necessary. The main expenditures associated with a replacement program are the capital cost of plant and the civil works to access networks where the pipework is buried. The City |

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| | Authority can pay for these items directly out of the city budget, and recoup the investment through lower primary fuel costs.<br>The City Authority invests in the maintenance of the network as well as upgrades of the infrastructure where necessary. The main expenditures associated with a replacement program are the capital cost of plant and pumps and the civil works to access networks where the pipework is buried. The City Authority can pay for these items directly out of the city budget, and recoup the investment through lower primary fuel costs. |
| Energy Services Company | The City Authority contracts with an Energy Services Company (ESCO) to assume management of the district heating network, and maintain and investing in repairs to ensure consistent and efficient supply to users. The benefit of this approach is that the CA does not have to commit to significant financial investment in the project or retain ownership of the project related risks. There are a number of potential ESCO contractual structures and it is recommended that if the City Authority explores the various advantages and disadvantages of each.<br>See Jiamusi case study for further details. |
| Legal or Statutory | The City Authority passes legislation or creates policy that requires minimum efficiency levels in both the generation and supply infrastructure of the district heating network. The efficiency levels should be set to ensure that the replacement program is staggered, targeting the worst performing assets first. |

**Monitoring**

Monitoring the progression and effectiveness of recommendations, once implemented, is fundamental to an accurate understanding of their value over the longer term. Where the CA implements a recommendation a target (or set of targets) should be defined that indicates the level of expected progress over a given timescale. At the same time a monitoring plan should be designed. The monitoring plan does not need to be complicated or time consuming but should, as a minimum, cover the following aspects: identification of information sources, identification of performance indicators, a means of measurement and validating measuring equipment or processes, record keeping protocols, a schedule for measurement activity (daily, weekly, monthly etc.), assignment of responsibilities for each aspect of the process, a means of auditing and reviewing performance and finally, establishment of reporting and review cycles. Some suggested measures that relate specifically to this recommendation are as follows:

- Establish baseline energy losses due to pipework and pumps(kWh/annum)
- Establish baseline water losses due to pipework and pumps(l/annum)

- Establish the City Authority goal for losses (kWh/annum) due to potential network upgrades
- Compare actual program performance with targeted performance

**Case Studies**

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| **District heating network pipe maintenance, Seoul, Korea**<br>DBDH, Direct Access to District Heating Technology "Seoul Metropolitan District Heating Network", http://www.e-pages.dk/dbdh/12/<br>Established in 1985 by a public corporation, the district heating network in Seoul supplies 10,604 GWh of district heating and cooling to 832,000 households, commercial buildings and public buildings. During its first five years of operation, the network suffered from service interruptions caused by construction failures as pre-insulated pipe construction had only just been introduced in Korea and construction skills were too low to assure a good quality pipe construction. By the mid 2000s, 300 km of pre-insulated pipelines (20% of the total length) were around 20 years old, and investigation into pipe construction failure showed that these were mainly caused by loose casing joints (51%) and the use of improper materials (21%). In order to improve the reliability of the supply network, and thereby reduce the cost of water and energy losses, the company invested in improving pipe construction skills and used a leak detection system which enables them to locate 'defaults'. As the leak detection system does not work well with the old pipes, faults are also located by means of "thermal graphic camera" and "injection gas to pipelines" methods. |
| **District heating network upgrade, Jiamusi, China**<br>DBDH, Direct Access to District Heating Technology "Dalkia Management of Jiamusi Urban Heating Network"<br>http://dbdh.dk/images/uploads/pdf-news/hotcool_1_2010_low.pdf<br>Due to a chronic lack of funds, the Jiamusi district heating network had for many years suffered from reduced maintenance, which had resulted in large energy and water losses. As interruption of service and low in-door temperature were the norm, the operator of the network, Jiamusi Heating Company (JHC), experienced increased dissatisfaction from its users. In May 2007 JHC, which was owned by the municipality, signed a 25-year agreement with an energy services company to take responsibility for the management of the network. A large-scale initiative to improve performance and upgrade the network's facilities was implemented. The heat supply temperature was raised; 90 new substations were built; and a SCADA (Supervisory Control and Data Acquisition) system was installed, enabling real-time management of the substations and the network, and resulting in improved optimization of energy efficiency and user's comfort. As a result, water losses were reduced by 30%, and energy consumption by 13.5%. By improving service quality, the company improved its customer relationships and was able to reduce the bad debt rate from 7% to 2%. The network has begun expansion and after two years of operation, it has increased its supply from 5.5 million sq. m (29% of the total heating surface) by 56% to 8.6 million sq. m. |

**Tools & Guidance**

| **Tools & Guidance** |
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| DHCAN "District Heating System Rehabilitation and Modernisation and Modernisation Guide" projects.bre.co.uk/DHCAN/pdf/Modernisation.pdf. A guidance document for technical improvements resulting in higher energy efficiency and reduction of primary energy use. It attempts to set out |

| Tools & Guidance |
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| a range of solutions from low-cost to high-cost, with consideration of financial circumstances, and links this to the fundamental need for a strategic view. |
| IEA "Coming in from the Cold- Improving District Heating Policy in Transition Economies" http://www.iea.org/textbase/nppdf/free/2004/cold.pdf. A document which summarises the institutional experiences of district heating rehabilitation, with focus on delivering clear policy on district heating. |
| ESMAP Public Procurement of Energy Efficiency Services - Guide of good procurement practice from around the world. http://www.esmap.org/Public_Procurement_of_Energy_Efficiency_Services.pdf |

## ANNEX 6: DISTRICT COGENERATION THERMAL NETWORK

**Description**

Upgrading power plants so that low grade waste heat is captured and used in district heating networks improves the energy efficiency of each plant by utilising an energy source that would otherwise be rejected to the environment, as well as enabling a continuous supply to the user. The aim of this recommendation is to develop a district steam or hot water networks in high density areas in relatively close proximity to new or existing power plants.

Waste heat from power stations represents a significant resource and can deliver lower cost energy as well as carbon reductions.

Power sector regulations, which are implemented at a national level in many countries, can sometimes be a barrier to implementing cogeneration in district heating.

**Implementation Options**

| Implementation Activity | Methodology |
|---|---|
| Feasibility Study | The City Authority establishes appropriate partnerships to undertake a feasibility study. The CA should engage a team that includes network planners, power and heat engineers, environmental specialists and financial advisors to ensure the feasibility study captures all pertinent aspects. The feasibility study establishes the technological and financial viability, as well as procurement and policy options. It establishes the baseline city energy expenditure associated with power and heat supply and the efficiency of their distribution across the network(s). Technical ability, procurement methodology, incentives and taxes should also be given consideration. Each option should be appraised against the specific requirements and capabilities of the CA. |
| Network Installation | The City Authority invests in the development of a district heating network. The main expenditures associated with a cogeneration heat network are the capital cost associated with the installation of the pipe network, modifications to the end user's equipment and also to the power plant itself. The City Authority can pay for these items directly out of the city budget, and recoup the investment by acting as the network operator and/ or heat supplier.<br>See Kotka case study for further details. |

- **Attributes**

**Energy Savings Potential**
> 200,000 kWh/annum

**First Cost**
> US$1,000,000

**Speed of Implementation**
> 2 years

**Co-Benefits**
Reduced carbon emissions
Improved air quality
Enhanced public health & safety
Increased employment opportunities
Financial savings
Security of supply

| | |
|---|---|
| Energy Services Company | The City Authority contracts with an Energy Services Company (ESCO) to provide finance and ownership of the project, as an alternative to direct expenditure. The benefit of this approach is that the CA does not have to commit to significant financial investment in the project or retain ownership of the project related risks. There are a number of potential ESCO contractual structures and it is recommended that if the City Authority explores the various advantages and disadvantages of each.<br>See Aberdeen case study for further details. |
| Statutory Requirement | The City Authority passes legislation or creates policy that requires utilisation of waste heat from power stations through a thermal network. This implementation action can be used when the City Authority does not wish to own the district generation network.<br>It should also be noted that in many countries, power sector regulations, which are often national, can act as a barrier to co-generation at the district level. Where this is the case, the CA can work with national government and other stakeholders to find statutory enabling solutions.<br>See Copenhagen case study for further details. |

**Monitoring**

Monitoring the progression and effectiveness of recommendations, once implemented, is fundamental to an accurate understanding of their value over the longer term. Where the CA implements a recommendation a target (or set of targets) should be defined that indicates the level of expected progress over a given timescale. At the same time a monitoring plan should be designed. The monitoring plan does not need to be complicated or time consuming but should, as a minimum, cover the following aspects: identification of information sources, identification of performance indicators, a means of measurement and validating measuring equipment or processes, record keeping protocols, a schedule for measurement activity (daily, weekly, monthly etc.), assignment of responsibilities for each aspect of the process, a means of auditing and reviewing performance and finally, establishment of reporting and review cycles. Some suggested measures that relate specifically to this recommendation are as follows:

- Establish the baseline primary energy demand to meet the thermal requirements within the proposed network area (kWh/annum).
- Establish the expected primary fuel saving through implementation of heat network (kWh/annum).
- Compare actual program performance with targeted performance.

**Case Studies**

**District heating network, Kotka, Finland**

C40 (2010). "Kotka: District heating", http://www.c40cities.org/bestpractices/energy/kotka_heating.jsp

The local energy company which develops and operates the city-wide district heating network is 100% owned by the CA. The district heating and combined heat and power production (CHP) are sourced by renewable and recycled energy sources and natural gas. Recent investments in a large waste-to-energy incineration facility have further strengthened the role of district heating as a form of power generation for the city. Currently, the network has 55% of the market share for heating in Kotka. Despite high investment costs (USD 215 million) the fuels (wind, biofuels and peat) are cheaper for Kotka Energy to purchase than oil, coal or natural gas. As domestic waste used for incineration has a negative price, CHP production is highly profitable for the CA. Turnover was estimated at 29m Euro in 2006, of which 25m Euro went on fuel and operational costs. The cost of establishing a system like that in Kotka is estimated at 150m Euro (USD 215m).

**Social housing district network ESCO, Aberdeen, UK**

PEPESEC (2009). "Community Energy in Scotland Aberdeen City Council", http://casestudies.pepesec.eu/archives/73

In order to cost-effectively deliver affordable heating to social housing in need of refurbishment and upgrading, the Aberdeen CA proposed a district combined heat and power scheme. The required funding was estimated to be very high, and as operating a combined heat and power scheme was not regarded as a core competency of the CA, there was a desire to obtain and involve appropriate expertise in the delivery of the network. A not-for-profit ESCO was initiated to develop and manage the network. The contractual relationship between the ESCO and CA is regulated by a framework agreement, which sets out the general obligations of the ESCO to supply heat to the CA, for onward supply to housing tenants. Separately, the ESCO can, and has, entered into Heat Supply Agreements with private owner-occupier properties. As a measure to persuade tenants to save energy, heat usage is not individually metered and users are charged a flat rate. As a supplementary measure, the CA has provided controllable heating systems and face-to-face advice on how to be energy efficient. Notably the scheme has ensured tenant and community participation in the delivery of heat energy, and has also resulted in works being carried out on properties which might not otherwise have been possible for 10 years or more.

**District heating network, Copenhagen, Denmark**

Copenhagen Energy (2010). "District heating in Copenhagen: An energy efficient, low carbon and cost effective energy system", http://dbdh.dk/images/uploads/pdf-diverse/District_heating_in_Copenhagen.pdf

In 1976, the national government passed the Electricity Supply Plan. This established a national policy requiring electricity generating stations to increase their energy efficiency by recovering and reusing waste heat, rather than exhausting useful thermal energy to the oceans and atmosphere. Combined heat and power (CHP) was established as the standard for electricity generation. In 1979, a new heat supply act was implemented which started a heat planning process in the municipalities - it enabled municipalities to dedicate a certain area to district heating, and to make it mandatory for households to connect to district heating. In 1984, the five Mayors of Copenhagen, Frederiksberg, Gentofte, Gladsaxe and Taarnby decided to scale up and set up a common wholesale district heating network. As a result, take up rates are almost 100% .The heating price, which is a pool system price, is identical for all five municipalities, and has basically been kept at the same level throughout the whole of the project's lifetime.

**District heating network, Bishkek, Kyrgyzstan**
"Supporting CHP and district energy system development in Asia" (2009)
http://www.powergenworldwide.com/index/display/articledisplay/370226/articles/cogeneration-and-on-site-power-production/volume-10/issue-5/features/supporting-chp-and-district-energy-system-development-in-asia.html ; ADB project report (2002)
http://www.adb.org/documents/studies/power_heating_kgz/power_heating_project.pdf
ADB has provided funding for the rehabilitation of the Bishkek district heating system which serves the capital of Kyrgyzstan. The project was co-funded with various parties including the World Bank which provided a soft loan to overhaul and increase the generating capacity of the CHP unit, while ADB provided a $30 million loan to upgrade the Bishkek heat distribution system. Rehabilitating and modernizing the Bishkek district heating network began in 1997 and took 10 years to complete. The break up in 2001 of Kyrgyz National Energy Holding Company, which operated the entire CHP district heating system, into seven joint stocked companies caused delays to the project work schedule including lengthy delays replacing outdated heating pipes in various parts of Bishkek.
Rehabilitating the Bishkek heating system also involved repairing and upgrading seven of the systems 19 pumping stations with variable speed pumps, and the renovation of 2,280 heating substations. The Bishkek district heating system was installed during the Soviet era along with heating systems in several other Soviet republics.

**Tools & Guidance**

| **Tools & Guidance** |
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| DHCAN (2005). "District Heating System Institutional Guide". A guidance document summarising the main institutional arrangements that reflect the specifics of district heating, and discusses their rationale and development in a changing business environment. http://projects.bre.co.uk/DHCAN/pdf/InstititionalManage.pdf |
| ESMAP (2000). "Increasing the Efficiency of Heating Systems in Central and Eastern Europe and the Former Soviet Union". http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2000/12/15/000094946_00112105321115/Rendered/PDF/multi_page.pdf |
| Risoe National Laboratory for Sustainable Energy (2010). "STREAM" An energy scenario modelling tool which can be used to provide a quick insight into the different potential energy mixes, which can include the dispatching of power plants in the electricity sector and the district heating system. http://streammodel.org/downloads.html |
| ESMAP Public Procurement of Energy Efficiency Services - Guide of good procurement practice from around the world. http://www.esmap.org/Public_Procurement_of_Energy_Efficiency_Services.pdf |

**Monitoring**

Monitoring the progression and effectiveness of recommendations, once implemented, is fundamental to an accurate understanding of their value over the longer term. Where the CA implements a recommendation a target (or set of targets) should be defined that indicates the level of expected progress over a given timescale. At the same time a monitoring plan should be designed. The monitoring plan does not need to be complicated or time consuming but should, as a minimum, cover the following aspects: identification of information sources, identification of performance indicators, a means of measurement and validating measuring equipment or processes, record keeping protocols, a schedule for measurement activity (daily, weekly, monthly etc.), assignment of responsibilities for each aspect of the process, a means of auditing and reviewing performance and finally, establishment of reporting and review cycles. Some suggested measures that relate specifically to this recommendation are as follows:

- $/m2 - Benchmark annual energy cost on a per-square-meter basis for all municipal office buildings.
- kWhe/m2 - Benchmark annual electrical energy consumption on a per-square-meter basis for all municipal office buildings in the city.
- kWht/m2 - Benchmark annual heating energy consumption on a per-square-meter basis for all municipal office buildings in the city.
- $/yr saved - aggregate total energy savings generated through the life of the program.

**Case Studies**

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| **Model for Improving Energy Efficiency in Buildings, Berlin, Germany**<br>http://www.c40cities.org/bestpractices/buildings/berlin_efficiency.jsp<br>The City of Berlin in partnership with Berlin Energy Agency (BEA) has pioneered an excellent model for improving energy efficiency in buildings. They project manage the retrofit of public and private buildings, preparing tenders for work that will guarantee reductions in emissions. CO2 reductions of an average 26% are written into the public retrofit tenders so that winning Energy Systems Companies (ESCOs) must deliver sustainable energy solutions. 1,400 buildings have so far been upgraded, delivering CO2 reductions of more than 60,400 tonnes per year - these retrofits cost the building owners nothing - and the buildings make immediate savings. |
| **Internal Contracting, Stuttgart, Germany**<br>http://www.c40cities.org/bestpractices/buildings/stuttgart_efficiency.jsp<br>Stuttgart saves around 7200 tonnes of CO2 each year through an innovative form of internal contracting, making use of a revolving fund to finance energy and water-saving measures. The city is able to reinvest savings directly into new activities, creating a virtuous circle of environmental improvements and emissions reductions. |
| **EU and Display Campaign Case Studies**<br>http://www.display-campaign.org/page_162.html |

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| The European Display Campaign is a voluntary scheme designed by energy experts from European towns and cities. When started in 2003 it was initially aimed at encouraging local authorities to publicly display the energy and environmental performances of their public buildings using the same energy label that is used for household appliances. Since 2008 private companies are also encouraged to use Display for their corporate social responsibility CSR activities. |
| **Energy Management System, Frankfurt, Germany**<br>http://www.managenergy.net/download/r164.pdf<br>In 1996 the City of Frankfurt (Building department) entered into a contract with a private company to install and operate an energy-management system (EMS) for the city hall (Romer), Paulskirche and Museum "Schirn". The goal of the project is to reduce the costs for energy- and water as well as the CO2-emissions.<br>Based on the annual costs of 2.6 Million DM in 1992/1993 the potential cost reductions were estimated to be approximately 320,000 DM per year. To reach these cost savings an investment of 1 Million DM for control equipment was necessary. Repayment of the invested capital will be provided from the energy savings (54%) over a period of 8 years. The remaining 46% will reduce the operating costs for the buildings. |
| **Energy Efficient Office of the Future (EoF), Garston, UK**<br>http://projects.bre.co.uk/envbuild/index.html<br>The new Environmental Building at Garston was built as a demonstration building for the Energy Efficient Office of the Future (EoF) performance specifications, drawn up by a number of companies representing the manufacturers, designers and installers of building components and the fuel utilities, as part of the EoF project run by BRECSU.<br>A key part of this specification is the need to reduce energy consumption and CO2 emissions by 30% from current best practice. Air conditioning is not used in the new building - the major energy consumer in many existing office buildings. Other savings will be made by making better use of daylighting and by using the building's 'thermal mass' to moderate temperatures. |
| **Tools & Guidance** |
| EU LOCAL ENERGY ACTION Good practices 2005 - Brochure of good practice examples from energy agencies across Europe.<br>http://www.managenergy.net/download/gp2005.pdf |
| ESMAP Public Procurement of Energy Efficiency Services - Guide of good procurement practice from around the world.<br>http://www.esmap.org/Public_Procurement_of_Energy_Efficiency_Services.pdf |
| Energy Conservation Buildings Code provides minimum requirements for the energy efficient design and construction of buildings and their systems. http://www.emt-india.net/ECBC/ECBC-UserGuide/ECBC-UserGuide.pdf |

## ANNEX 7: MUNICIPAL BUILDINGS AUDIT AND RETROFIT PROGRAM

**Description**
Develop an audit and retrofit program focused on all Offices to survey and implement opportunities for energy efficiency retrofits and upgrades. The benefits of the program will be cost savings for municipal government offices and reduction in carbon footprint of the CA. The program will identify immediate savings opportunities, and implement rapid payback items to yield cost savings that can go to other municipal services.

**Implementation Options**

| Implementation Activity | Methodology |
|---|---|
| Identify Offices Program Leader | Identify a CA staff position or hire a new position to be responsible for execution and delivery of energy efficiency projects in municipal office buildings. This individual must be able to work across agencies, understand building systems and manage subcontractors. |
| Identify Preliminary Opportunities | Using results from the Benchmarking Program or data collected on office buildings by Office Program staff, identify preliminary opportunities for energy efficiency such as: new lighting systems, new air conditioning systems, new heating systems, new computers, server cooling opportunities, etc. Offices buildings can be more complex buildings and can have a high variety of system types, for example some may have simple window A/C (or no A/C) and others may have larger central A/C systems with chillers, cooling towers, air handlers and ductwork. |
| Perform Detailed Energy Audits | Walk through a variety of office buildings to identify specific energy efficiency opportunities across the following end-uses and activities:<br>• lighting systems<br>• air conditioning systems<br>• heating systems<br>• computers<br>• server rooms and cooling of servers<br>• appliances (water cooler, fridge, vending machines) |

- **Attributes**

**Energy Savings Potential**
> 200,000 kWh/annum
**First Cost**
> US$1,000,000
**Speed of Implementation**
1-2 years
**Co-Benefits**
Reduced carbon emissions
Improved air quality
Enhanced public health & safety
Increased employment opportunities
Financial savings

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|---|---|
| | The Municipal Offices EE Spreadsheet includes estimation methods for energy efficiency potential for offices which includes equipment retrofits, behavioural changes (turning lights off, heating set points, time of operation, etc.) and procurement guidelines. |
| Set Budget and Requirements | Allocate budgets for energy efficiency upgrades in municipal office buildings. Combining upgrades with natural building renovations tends to be the best use of limited financing. For example if a new roof is required due to leaks, this is a good time to add insulation and white roof; or if new windows are being installed they could be upgraded to highly insulated windows using Office Building Energy Efficiency Program funds.<br>Alternatively contracts may be set up with Energy Service Companies (ESCOs) who will pay for the first cost of the upgrades and will share in the savings from the retrofits. |
| Design Retrofits / Upgrades | Considering the benchmarking data, detailed energy audits and budgetary constraints, design retrofits, equipment replacement and renovation upgrades specifically for each building. |
| Hire Contractor to Implement Retrofits | Prepare an RFP for mechanical or electrical contractors to bid on the retrofit projects. Combining a large number of similar retrofits across dozens of office buildings will allow the CA to obtain economies of scale and quality assurance with lower overheads. Alternatively prepare a RFP and award an energy service contract to a private company (ESCO) who will guarantee energy savings, put forward the initial investment, and share future savings with the CA. |
| Verify Retrofit and Performance | Walk through and verify each construction project has been performed per the specifications in the energy efficiency retrofit RFP. Continue to collect electricity and heating bills for each building with improved systems and compare to historical data. |

**Monitoring**

Monitoring the progression and effectiveness of recommendations, once implemented, is fundamental to an accurate understanding of their value over the longer term. Where the CA implements a recommendation a target (or set of targets) should be defined that

indicates the level of expected progress over a given timescale. At the same time a monitoring plan should be designed. The monitoring plan does not need to be complicated or time consuming but should, as a minimum, cover the following aspects: identification of information sources, identification of performance indicators, a means of measurement and validating measuring equipment or processes, record keeping protocols, a schedule for measurement activity (daily, weekly, monthly etc.), assignment of responsibilities for each aspect of the process, a means of auditing and reviewing performance and finally, establishment of reporting and review cycles. Some suggested measures that relate specifically to this recommendation are as follows:

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- kWht/m2 - Benchmark annual heating energy consumption on a per-square-meter basis for all municipal office buildings in the city.
- $/yr saved - aggregate total energy savings generated through the life of the program.

**Case Studies**

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| **Model for Improving Energy Efficiency in Buildings, Berlin, Germany**<br>http://www.c40cities.org/bestpractices/buildings/berlin_efficiency.jsp<br>The City of Berlin in partnership with Berlin Energy Agency (BEA) has pioneered an excellent model for improving energy efficiency in buildings. They project manage the retrofit of public and private buildings, preparing tenders for work that will guarantee reductions in emissions. CO2 reductions of an average 26% are written into the public retrofit tenders so that winning Energy Systems Companies (ESCOs) must deliver sustainable energy solutions. 1,400 buildings have so far been upgraded, delivering CO2 reductions of more than 60,400 tonnes per year - these retrofits cost the building owners nothing - and the buildings make immediate savings. |
| **Internal Contracting, Stuttgart, Germany**<br>http://www.c40cities.org/bestpractices/buildings/stuttgart_efficiency.jsp<br>Stuttgart saves around 7200 tonnes of CO2 each year through an innovative form of internal contracting, making use of a revolving fund to finance energy and water-saving measures. The city is able to reinvest savings directly into new activities, creating a virtuous circle of environmental improvements and emissions reductions. |
| **EU and Display Campaign Case Studies**<br>http://www.display-campaign.org/page_162.html<br>The European Display Campaign is a voluntary scheme designed by energy experts from European towns and cities. When started in 2003 it was initially aimed at encouraging local authorities to publicly display the energy and environmental performances of their public buildings using the same energy label that is used for household appliances. Since 2008 private companies are also encouraged to use Display for their corporate social responsibility CSR activities. |

**Energy Management System, Frankfurt, Germany**
http://www.managenergy.net/download/r164.pdf
In 1996 the City of Frankfurt (Building department) entered into a contract with a private company to install and operate an energy-management system (EMS) for the city hall (Romer), Paulskirche and Museum "Schirn". The goal of the project is to reduce the costs for energy- and water as well as the CO2-emissions.
Based on the annual costs of 2.6 Million DM in 1992/1993 the potential cost reductions were estimated to be approximately 320,000 DM per year. To reach these cost savings an investment of 1 Million DM for control equipment was necessary. Repayment of the invested capital will be provided from the energy savings (54%) over a period of 8 years. The remaining 46% will reduce the operating costs for the buildings.

**Energy Efficient Office of the Future (EoF), Garston, UK**
http://projects.bre.co.uk/envbuild/index.html
The new Environmental Building at Garston was built as a demonstration building for the Energy Efficient Office of the Future (EoF) performance specifications, drawn up by a number of companies representing the manufacturers, designers and installers of building components and the fuel utilities, as part of the EoF project run by BRECSU.
A key part of this specification is the need to reduce energy consumption and CO2 emissions by 30% from current best practice. Air conditioning is not used in the new building - the major energy consumer in many existing office buildings. Other savings will be made by making better use of daylighting and by using the building's 'thermal mass' to moderate temperatures.

**Tools & Guidance**

| **Tools & Guidance** |
|---|
| EU LOCAL ENERGY ACTION Good practices 2005 - Brochure of good practice examples from energy agencies across Europe. http://www.managenergy.net/download/gp2005.pdf |
| ESMAP Public Procurement of Energy Efficiency Services - Guide of good procurement practice from around the world. http://www.esmap.org/Public_Procurement_of_Energy_Efficiency_Services.pdf |
| Energy Conservation Buildings Code provides minimum requirements for the energy efficient design and construction of buildings and their systems. http://www.emt-india.net/ECBC/ECBC-UserGuide/ECBC-UserGuide.pdf |

## ANNEX 8: MANDATORY BUILDING ENERGY EFFICIENCY CODES FOR NEW BUILDINGS

**Description**

This project is a city-specific green building guidelines or certification program to encourage the use of green building technologies. The guidelines can be based on previously established systems such as LEED (USA), BREEAM (UK), CASBEE (Japan), Green Mark (Singapore), Estidama (Abu Dhabi) or many others. It should focus on energy efficiency, but should also cover water conservation, urban heat island effect (green roofs), indoor air quality, and many other aspects of green buildings. The program can take many forms such as: voluntary guidelines, minimum building standards, an incentive program for private developers. The benefit of this program is to advance higher quality building design and construction and promote energy efficiency for all of the buildings in the city, saving money, saving water, and making better buildings to live and work.

**Attributes**

**Energy Savings Potential**
> 200,000 kWh/annum

**First Cost**
< US$100,000

**Speed of Implementation**
> 2 years

**Co-Benefits**
Reduced carbon emissions
Efficient water use
Increased employment opportunities
Financial savings

**Implementation Options**

| Implementation Activity | Methodology |
|---|---|
| Assess opportunities | Assess the climate, building types, real estate market and construction industry for green building opportunities. Evaluate other green building guidelines in the region and globally and identify the most relevant strategies |
| Perform cost - benefit analysis | Assess the general costs of each of the green building strategies in the specific city in terms of new construction for code-based design versus green building design strategy. Provide ranges of additional cost as well as ranges of savings and co-benefits of the strategy beyond pure financial benefits. |
| Draft Guidelines (voluntary approach) | Create a custom green building design guidelines that are city-specific guidelines and respond to the conditions of the city as researched above (climate, construction practices, safety, financial, market, etc.). The design guidelines can be distributed to the public and encouraged to be used voluntarily by progressive developers, designers and building owners. |
| Draft Incentive Program (Incentivized | Along with the design guidelines, create a program to incentivize the construction of exceptional green building design by providing tax credits, |

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|---|---|
| approach) | zoning benefits, quicker approvals or other tertiary benefits that the development community will respond to. |
| Draft Green Building Code (mandatory approach) | If a voluntary approach or an incentive-based approach does not seem likely to succeed, and the design and construction community responds better to mandatory requirements, then reform the guidelines into the form of a code and find ways to update the local building code to include requirements of green building design.<br>See Seattle case study as an example of best practice. |
| Public outreach | Distribute the draft guidelines to the real estate community, construction community, design community, and residents and citizens of the city. Along with the guidelines produce. |
| Enact Green Building Ordinance | With public comments integrated, a full set of technical and financial analysis completed, and potentially a small number of demonstration projects to point to, enact a law, ordinance or executive order to implement the green building guideline/incentive program/code. |

**Monitoring**

Monitoring the progression and effectiveness of recommendations, once implemented, is fundamental to an accurate understanding of their value over the longer term. Where the CA implements a recommendation a target (or set of targets) should be defined that indicates the level of expected progress over a given timescale. At the same time a monitoring plan should be designed. The monitoring plan does not need to be complicated or time consuming but should, as a minimum, cover the following aspects: identification of information sources, identification of performance indicators, a means of measurement and validating measuring equipment or processes, record keeping protocols, a schedule for measurement activity (daily, weekly, monthly etc.), assignment of responsibilities for each aspect of the process, a means of auditing and reviewing performance and finally, establishment of reporting and review cycles. Some suggested measures that relate specifically to this recommendation are as follows:

- kWhe/m2 - benchmark electrical energy consumption on a per-square-meter basis.
- kWht/m2 - benchmark heating energy consumption on a per-square-meter basis.
- $/m2 - Benchmark energy cost on a per-square-meter basis for all buildings.
- Number of buildings certified under (new/other) codes.

**Case Studies**

**Energy Efficiency Codes in Residential Buildings, Tianjin, China.**
Source: ESMAP (2011). "Good Practices in City Energy Efficiency: Tianjin, China - Enforcement of Residential Building Energy Efficiency Codes", available online from http://www.esmap.org/esmap/node/1280
Tianjin is one of the most successful Chinese cities in compliance enforcement of building energy efficiency codes (BEECs). Results of recent annual national inspections organized by the Ministry of Housing and Urban and Rural Development (MoHURD) indicate that compliance of BEECs in new residential and commercial buildings in Tianjin is close to 100 percent, compared to the 80 percent average across nearly three dozen large cities inspected by MoHURD in 2008. More remarkable is the fact that, in terms of building envelope thermal integrity, the currently enforced residential BEEC in Tianjin (identified as DB29-1-2007) is 30 percent more stringent than what is required by the pertinent national BEEC (identified as JGJ 26-95).

In 1997, Tianjin introduced its first mandatory residential BEEC (identified as DB29-1-97), which is equivalent to the requirements of the JGJ 26-95, the national model BEEC for cold climate regions enacted in 1995. DB29-1-97 was enforced from 1998 to 2004. Enforcement actually began on January 1, 2005; it was based on an earlier version which was updated and reenacted on June 1, 2007. This case study covered five years of enforcement of DB29-1-2007, from 2005 to 2009.

Tianjin's efforts to go beyond national BEEC requirements marked a departure from the mostly central government-driven BEEC regulation of the past in China. Tianjin began piloting residential BEEC in the late 1980s, despite the fact that it has taken about 15 years for Tianjin to achieve a high degree of compliance. Tianjin has demonstrated the importance of the following factors in achieving BEEC compliance: (i) a well-established building construction management system, (ii) standardized and structured procedures for compliance enforcement, (iii) broad-based capacity of the construction trades to meet compliance requirements, including technical skills and availability of parts and materials, (iv) consumers' ability and willingness to pay for the costs of BEEC compliance, and (v) local government resources, support, and commitment to implementing increasingly stringent BEECs.

**Low-energy Building Standards, Münster, Germany**
Source: ESMAP (2011). "Good Practices in City Energy Efficiency: Low-energy Building Standards through Sale of City-owned Land, Münster, Germany", available online from http://www.esmap.org/esmap/node/1170
By mandating low-energy building standards in sales contracts of city-owned land, the City of Münster (Germany) caused a market transformation that led to 80 percent of all new buildings constructed in 2010, even those not built on city-owned land, to follow the city's energy efficiency requirements.

**Austin Energy Green Building (AE/GB), Austin, USA**
http://www.austinenergy.com/energy%20efficiency/Programs/Green%20Building/index.htm
http://www.c40cities.org/bestpractices/buildings/austin_standards.jsp
In 1991, Austin Energy Green Building (AE/GB) developed the first city-wide tool for evaluating the sustainability of buildings in the U.S. It is made up of four programs, covering single family homes, commercial, multi-family and governmental or utilities buildings. As a market transformation

program it provides technical support to homeowners, architects, designers and builders in the design and construction of sustainable buildings. Using green building rating tools specifically developed for Austin, along with the LEED and Green Globes national rating tools, Green Building's staff assist design teams to establish green building goals, review plans and specifications, make recommendations for improvements, and rate the final product on its impact to the environment and community.

AE/GB has produced $ 2.2 million in annual financial savings from reduced energy costs to consumers. The initial investment of $1.2 million for the project came from an annual budget (including a $50,000grant from the US Department of Energy). The AE/Gb has also reduced energy consumption by 142,427 megawatt hours and reduced demand on the utility's generation resources by 82.8 megawatts. These energy savings have resulted in the reduction of power plant CO2 emissions by 90,831 tons, NOx by 87.6 tons, and SOx by 17.4 tons.

**Sustainable Building Action Plan, Seattle, USA**

http://www.c40cities.org/docs/casestudies/buildings/seattle_green.pdf

Under the Sustainable Building Policy, Seattle requires that all new city buildings over 5,000 square feet meet new state LEED (Leadership in Energy and Environmental Design) building ratings, which measure the sustainability of buildings. The city provided financial, height and density bonuses for private projects meeting LEED. Seattle implemented programs such as the Sustainable Building Action Plan (with key strategies to promote green buildings), the Density Bonus (offering downtown commercial, residential and mixed use developments greater height and/or floor area if a green building standard of LEED silver or higher is met), and the City LEED Incentive Program (providing financial incentives for energy conservation, natural drainage/water conservation, and design and consulting fees for LEED projects). Between 2001 and 2005, the city provided incentives of over $4.3 million for projects implementing LEED standards. The standards have produced average reductions of 35% in energy use and 6.9 million KWh/annually for LEED Municipal buildings. Other benefits from the scheme included an average reduction of 1,067 CO2e tonnes per LEED building, along with an annual average financial saving of $43,000 per LEED building.

**Green Building Guidelines, Cape Town, South Africa**

http://www.capetown.gov.za/en/EnvironmentalResourceManagement/publications/Documents/DRAFT City of Cape Town Green Building Guidelines.pdf

The City of Cape Town plans to enact a bylaw by 2012 to call for environmentally-friendly building methods. The Draft Green Buildings Guidelines will form the core of the planned bylaw, actively promote resource efficient construction of new or renovated buildings in Cape Town to minimise the negative environmental impacts of the built environment, whilst maximising positive social and economic impacts. In the long-term the City will work towards design manuals and legislation to ensure the implementation of green buildings. The Green Building Guidelines document is aligned with the Green Building Council of South Africa, which has incorporated the Green Star Rating system of the Green Building Council of Australia. It is envisaged that the City of Cape Town will also incorporate the Green Star Rating system in the future. The guidelines for the implementation of green buildings are specific to Cape Town, including advice on site selection, design and construction phases, sustainable resource management, waste management, urban landscaping, human health and safety and visual mitigation measures.

| Tools & Guidance |
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| http://www.epa.gov/region4/recycle/green-building-toolkit.pdf |

## ANNEX 7: LIGHTING TIMING PROGRAM

**Description**

Public lighting usually only has two states of operation, i.e. 'on' and 'off', and only switches between these states in the early evening and early morning. The demand for lighting varies significantly throughout the day, however, with periods of very little use of public space during the middle of the night. A program with strategic timing and/or dimming tailored to the specific needs for lighting in specific areas can significantly reduce energy consumption whilst still delivering appropriate levels of lighting for e.g. providing safety and sense of security in public areas. An intelligent monitoring system can be used to adapt the levels of lighting according to varying weather and activity levels. The aim of this recommendation is to identify public space usage patterns and adjust the lighting system levels accordingly. Often lighting timing programs are integral to a full audit and retrofit program, but for cities that already have energy efficient public lighting systems, a lighting timing program may still be a small and effective program.

Lighting timing programs can reduce energy consumption, and subsequent carbon emissions as well as operational costs. Such programs often also increase the design life of light bulbs, reducing maintenance requirements and associated costs. The use of intelligent monitoring systems also enables quick detection of faults, allowing for quick replacement, enhancing the quality of the public lighting service.

**Implementation Options**

| Implementation Activity | Methodology |
|---|---|
| Study illumination timing alternatives | Prepare a study to estimate the types of streets and luminaires that have the opportunity to have reduced timing and dimming during late night hours. |
| Install timers and dimmers on existing street lights | Allocate funding to implement upgrades and retrofits for dimming and timing opportunities. Roll out upgrades over the course of multiple years to achieve 100% coverage of all city public lighting and street lighting installations.<br>See Kirklees and Oslo case studies for further details. |
| Standards for new lighting | Set up timing and dimming standards for new installations of public illumination and street lighting that confirm to global best practice for |

**Attributes**

**Energy Savings Potential**
> 200,000 kWh/annum

**First Cost**
< US$100,000

**Speed of Implementation**
< 1 year

**Co-Benefits**
Reduced carbon emissions
Enhanced public health & safety
Increased employment opportunities
Financial savings

| | |
|---|---|
| | energy efficiency and IESNA illumination guidelines. |
| Monitor and publish energy savings | Measure on an annual basis the energy savings achieved by this program and encourage private sector owners to follow the model of the CA. |

**Monitoring**

Monitoring the progression and effectiveness of recommendations, once implemented, is fundamental to an accurate understanding of their value over the longer term. Where the CA implements a recommendation a target (or set of targets) should be defined that indicates the level of expected progress over a given timescale. At the same time a monitoring plan should be designed. The monitoring plan does not need to be complicated or time consuming but should, as a minimum, cover the following aspects: identification of information sources, identification of performance indicators, a means of measurement and validating measuring equipment or processes, record keeping protocols, a schedule for measurement activity (daily, weekly, monthly etc.), assignment of responsibilities for each aspect of the process, a means of auditing and reviewing performance and finally, establishment of reporting and review cycles. Some suggested measures that relate specifically to this recommendation are as follows:

- Hours per year street lights are illuminated at maximum output.
- Hours per year street lights are illuminated at less than 50% of maximum output.

**Case Studies**

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| **Control system for public lighting, Kirklees, UK**<br>http://www.kirklees.gov.uk/community/environment/green/greencouncil/LightingStoryboard.pdf<br>Instead of switching off street lights at certain times of the day, as has been done by other CAs, the Kirklees CA decided instead to dim lights to varying levels throughout the day. This was done partly because not switching public lighting off completely during times of low activity would provide increased safety in the community by preventing crime. Retrofit systems were installed on each existing lighting pole which used wireless technology to monitor and dim the street lights. The retrofitting of these systems simply required the addition of a small antenna to the lamp heads, which plugged into the electronic ballast with no need for additional wiring. Generally the lights are switched on 100% at 7pm, thereafter dimmed to 75% at 10pm, and then to 50% at midnight. If the lights are still on at 5am, they are increased again to 100% lighting. By dimming the lights gradually, eyes are able to adjust to lower lighting levels, and the dimming is barely noticeable. The remote monitoring system also provides accurate inventory information and enables street lighting engineers to identify failed lamps quickly and easily. This reduces the need for lighting engineers to carry out night scouting and has also reduced other on-site maintenance costs. A dimming of lights as implemented in Kirklee can save up to 30% of the electricity used annually. By replacing 1,200 lights, Kirklee CA estimates savings of approx USD 3 million in energy costs per year. |
| **Intelligent outdoor city lighting system, Oslo, Norway**<br>http://www.echelon.com/solutions/unique/appstories/oslo.pdf |

An intelligent outdoor lighting system has replaced PCB and mercury containing fixtures with high-performance high-pressure sodium lights. These are monitored and controlled via an advanced data communication system which operates over the existing 230V power lines using specialist power line technology. An operations centre remotely monitors and logs the energy use of streetlights and their running time. It collects information from traffic and weather sensors, and uses an internal astronomical clock to calculate the availability of natural light from the sun and moon. This data is then used to automatically dim some or all of the streetlights. Controlling light levels in this way has not only saved significant amount of energy (estimated at 62%), but has also extended lamp life, thereby reducing replacement costs. The CA has been able to use the monitoring system to identify lamp failures, often fixing them before being notified by residents. By being able to provide predictive failure analyses based on a comparison of actual running hours versus expected lamp life, the efficiency of repair crews has been increased. 10,000 replacements have cost the CA approx. USD 12 million. Currently the program saves approx USD 450,000 in running costs per year. However, it is estimated that if the program is rolled out to the entire city, the increased economies of scale will yield a payback period of less than five years.

**Motorway intelligent lights retrofit, Kuala Lumpur, Malaysia**
http://www.lighting.philips.com.my/v2/knowledge/case_studies-detail.jsp?id=159544
The project implemented a lighting solution for highways leading to Kuala Lumpur International Airport. The total length of the dual carriage highway covers 66 km. The main requirement for the project was that each individual lamp along the entire 66 km stretch of highway should be independently dimmable. This called for a network linking all 3,300 positions to a central control facility. There was also a need for greater maintenance efficiency while ensuring optimal visibility without compromising on visual comfort on the road. An intelligent lighting system that uses telemanagement control was employed. Telemanagement makes it possible to switch or control every individual light point in the system from a central PC. It also enables specific dimming profiles adjusted to suit conditions on the road for different lamps, instant reception of failure messages, and the creation of a database where all system data is stored. It allows a significant reduction in energy consumption in addition to the 45% savings as a result of the use of dimming circuits.

**Tools & Guidance**

N/A

## ANNEX 8: INTEGRATED PUBLIC LIGHTING ASSESSMENT PROGRAM

**Description**

Existing public lighting is often highly inefficient, using high energy consumption technologies, and lacking the strategic coordination of placement and operation of lighting. An audit of the existing stock as well as assessing running and maintenance operations, will help identify appropriate measures to significantly increase energy efficiency. Interventions that include new technologies and retrofitting will also increase the design life of luminaires, which reduces both the requirements and costs of maintenance. The aim of this recommendation is to enable a holistic assessment of the lighting system as a whole to identify areas for improvement across the network.

**Implementation Options**

| Implementation Activity | Methodology |
|---|---|
| Appoint Inventory Leader | Hire, or allocate staff with the skills, experience and personality required to be able to gather a wide variety of data from many departments across the city administration.<br>Alternatively hire an external consultant as a leader for the below activities. |
| Identify Inventory Requirements | Define essential and desirable information useful for a street lighting inventory database. Key data points are required to contextualize the information. Data may include:<br>• Street Name and Pole Number<br>• Pole types and Luminaries types<br>• Lamp type and wattage and lumen output<br>• Park lighting lamp type inventory<br>• Monument lighting lamp type inventory<br>• Traffic Signal lamp type inventory<br>• Street Signage lamp type inventory |
| Collect Data | Hire staff positions to begin the arduous process of requesting data, receiving data, checking data, and collecting primary data by visiting street lights and other lighting features.<br>Alternatively write an RFP and award a contract with a specific scope of work to gather energy benchmarking data for all municipal buildings. |

**Attributes**

**Energy Savings Potential**
100,000-200,000 kWh/annum

**First Cost**
< US$100,000

**Speed of Implementation**
< 1 year

**Co-Benefits**
Reduced carbon emissions
Enhanced public health & safety
Financial savings

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|---|---|
| Analyse and Interpret Data | Conduct an analysis of collected data to ensure accuracy and begin to identify opportunities. Some examples of analysis include:<br>• compare kWh/ pole<br>• compare lumens / Watt for different lighting source types<br>• compare $ / Watt for initial cost<br>• compare $ of lifetime operational cost per lamp |
| Publish Inventory Publically | The boldest statement to show leadership in Public Lighting energy efficiency is to publish energy performance data to the public, press, voters, and potential political opponents. This last stage of the program may be many years after the commencement of the program when the data shows improvements and tells a good story of progress toward efficiency in government operations. The CA could then challenge (or require as some cities have begun to do) private owners to benchmark their lighting installations and publish their results. |

**Monitoring**

Monitoring the progression and effectiveness of recommendations, once implemented, is fundamental to an accurate understanding of their value over the longer term. Where the CA implements a recommendation a target (or set of targets) should be defined that indicates the level of expected progress over a given timescale. At the same time a monitoring plan should be designed. The monitoring plan does not need to be complicated or time consuming but should, as a minimum, cover the following aspects: identification of information sources, identification of performance indicators, a means of measurement and validating measuring equipment or processes, record keeping protocols, a schedule for measurement activity (daily, weekly, monthly etc.), assignment of responsibilities for each aspect of the process, a means of auditing and reviewing performance and finally, establishment of reporting and review cycles. Some suggested measures that relate specifically to this recommendation are as follows:

- % street lights inventoried for luminaries type and lamp type.
- % public parks and monuments lighting inventoried for luminaries type and lamp type.
- % traffic lights inventoried for luminaries type and lamp type.
- % signage lighting inventoried for luminaries type and lamp type.

**Case Studies**

**Energy Efficiency Public Lighting Project, Vietnam**

http://www.gefonline.org/projectDetails.cfm?projID=1106; http://www.c40cities.org/bestpractices/lighting/vietnam_lighting.jsp

The Vietnam Energy Efficiency Public Lighting Project (VEEPL) is a national 10-year program which audits, installs and promotes the use of energy efficient lighting in streets, schools and hospitals, where all costs from installation, operation, maintenance, and electricity are covered by the

national government. At a capital cost of US$ 15 million, the program is projected to yield annual financial savings of about US$ 13 million (based on an electricity tariff of US$ 0.056/kWh). By means of strengthening both the technical and policy support for a transition to more energy efficient public lighting in Vietnam, the authorities are looking to set up a sustainable long-term lighting industry. Measures which have been introduced to remove barriers have included the establishing of standards which define energy-efficient public lighting and building policies; improvements made in testing capabilities of the local lighting laboratories; the education of the public about the benefits of energy efficient public lighting; and having brought private and public industry and stakeholders around the table to agree on minimum standards of energy efficiency in lighting.

**Energy efficient public lighting, Gaia, Portugal**
http://www.managenergy.net/download/nr20.pdf
Gaia Municipality enacted a study with the main objective of reducing energy consumption in public lighting across the municipal area. The project was divided into four phases. The first phase evaluated existing public lighting conditions and available energy efficient technologies. The second phase developed a pilot project to confirm the theoretical results of flux control systems. This was followed by a third phase, where a financial model for project implementation was developed. Finally the project was implemented using a third party financing model. A communication campaign was then enacted in order to disseminate the information on the project. The preliminary study found that the best technical solution was the installation of flux control systems. These typically save 20-30% of energy and increase the life span of lamps by up to 30%. The first stage of the project saw the installation of 30 flux control equipments inducing energy savings of up to US$ 45,000. The total investment was approx. US$ 225,000, which will lead to payback period of 5 years, not considering savings in maintenance costs.

**Tools & Guidance**

"Lighting the Way": A Local Government Guide to Energy Efficient Public Lighting on Minor Roads, Australian Government, Department of Environment and Water Resources. http://www.iclei.org/fileadmin/user_upload/documents/ANZ/CCP/CCP-AU/EnergyToolbox/lightingtheway.pdf

## ANNEX 9: FUEL EFFICIENT WASTE VEHICLE OPERATIONS

**Description**

Improving the working practices of waste vehicles and their crews can reduce fuel use per tonne of waste collected and transported. An assessment of current waste collection systems will be required to identify what alterations can be made. Upgrades can include improvements to driver training, route planning and/or management of service.

This recommendation offers the potential for affordable but reasonable energy use improvements without the need for vehicle fleet replacement or expansion, as options for improvement can be made via softer actions such as better management and planning.

Direct benefits include reduced fuel use, better productivity leading to increased vehicle payloads and reduced numbers of heavy goods vehicles in residential areas, and release of resources to collect more or segregated waste from larger or additional areas.

Indirect benefits include reduced accident rates and lower air emissions.

**Attributes**

**Energy Savings Potential**
>200,000 kWh/annum

**First Cost**
< US$100,000

**Speed of Implementation**
< 1 year

**Co-Benefits**
Reduced carbon emissions
Improved air quality
Enhanced public health & safety
Increased employment opportunities
Financial savings
Improved working conditions
Reduced waste vehicle traffic

**Implementation options**

| Implementation Activity | Methodology |
|---|---|
| Set fuel use reduction targets for waste collection and transportation fleets | The city authority sets targets for fuel-efficiency of waste collection and transfer operations. Defining targets over 5-year periods is an effective approach; for example, reduce fuel use per tonne of waste by 20% in 5 years. The city authority can appoint a Fleet Manager or a Maintenance Manager to measure fuel use, total waste collection quantity per year and distance travelled in order to set a baseline KPI for fuel-efficiency of operations. This should be completed for individual vehicles and the entire fleet. This system can be established internally and used in conjunction with the "Waste Vehicle Fleet Maintenance Audit and Retrofit" recommendation.<br>See Oeiras case study for further details. |
| Route selection optimisation | Encourage waste operators to appoint resource or utilise in-house capability to plot out and digitise all collection points and routes on a map base. This is best done using a Geographic Information System (GIS) and it is important to seek route optimisation improvements, for example, ensure all waste vehicles are full at disposal points, eliminate vehicle backtracks and minimise long distance haulage of waste in small |

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| | vehicles. Consider alternative modes of transport such as via waterways to save energy and reduce heavy traffic on roads. The city fleet manager should regularly review routes with operators to ensure best use of resources.<br>See Trabzon, Daventry, Oeiras and Paris case studies for further details. |
| Continued driver training and improvement | The city authority requires waste operators to provide a driver training and improvement programme in conjunction with the human resources team and fleet manager. A staff training team can be employed to create and manage an accredited training programme after an initial assessment.<br>The city authority might also appoint a third party to install vehicle trackers and monitor all drivers following staff training. In addition, encourage operators to incentivise good driving where possible, for example, by providing drivers with a share in fuel costs saved.<br>This implementation activity works well with educating operators about the benefits of efficient operations.<br>See General Santos City and Oeiras case studies for further details. |
| Inform operators about the advantages of fuel-efficient operations | The city authority raises awareness amongst operators about the benefits of fuel-efficient operations. This can be done by one-to-one sessions or arranging a conference for key players in waste sector showcasing the energy and cost-savings from efficient operations including eco-driving, correct operation of vehicles, route optimisation, bulk transfer stations, etc. Set up a website or have an officer available to provide more information and advice after the event.<br>See Maribor and General Santos City case studies for further details. |
| Incentives: charging | The city authority levies a surcharge on waste, for example a gate fee or eco-taxes for waste disposed at landfills. This is used to generate revenue and direct to new infrastructure improvements and waste monitoring/policing department. This implementation activity might also be used to encourage fleet operators to ensure that vehicle movements to landfills are kept to operationally efficient levels.<br>See Paris and Italian Local Authorities' Waste Management case study for further details. |

**Monitoring**

Monitoring the progression and effectiveness of recommendations, once implemented, is fundamental to an accurate understanding of their value over the longer term. Where the CA implements a recommendation a target (or set of targets) should be defined that indicates the level of expected progress over a given timescale. At the same time a monitoring plan should be designed. The monitoring plan does not need to be complicated or time consuming but should, as a minimum, cover the following aspects: identification of information sources, identification of performance indicators, a means of measurement and validating measuring equipment or processes, record keeping protocols, a schedule for measurement activity (daily, weekly, monthly etc.), assignment of responsibilities for each aspect of the process, a means of auditing and reviewing performance and finally, establishment of reporting and review cycles.
Some suggested measures that relate specifically to this recommendation are as follows:

- Fuel use per tonne of waste collected and transferred and per km travelled
- Improvement in fuel use per tonne of waste collected and transferred

Measure current performance utilising data from Maintenance Department, where feasible. If this information is not readily available, it is advisable to measure current fleet performance over a reasonable period, for example, annual reviews over 5 years.
Produce monthly management targets and schedules to help identify how the program is performing and the magnitude of effort that will be required to achieve initially set KPI.

**Case Studies**

**Energy Study on Oeiras' Municipal Fleet, Oeiras, Portugal**

ManagEnergy 2010 "Good Practice Case Study: Energy Study on Oeiras' Municipal Fleet, Portugal"
http://www.managenergy.net/download/nr263.pdf

The Municipality of Oeiras (CMO) worked in partnership with the Technical University of Lisbon (IST) on a project to carry out a review of the current performance of the municipal fleet, which included waste collection trucks. The objectives were to assess the fuel consumption by vehicle type, establish performance indicators (km/L), propose simple measures to improve efficiency (eco-driving training), study the potential of implementing alternative fuels (biodiesel and natural gas), and perform an environmental assessment. In the absence of complete data, the project used refuelling data and mileage records to estimate the total fuel consumption of waste collection trucks and its impact on the municipality's budget. A more advanced fleet management system was planned for the later phases, utilising technologies supported by GPS to allow for better control over fleet operations and improve the data available. The total project costs amounted to US$ 45,384, fully supported by the Municipality.

By the end of 2006, the project allowed OEINERGE (the project coordinator) to estimate that simply by processing the existing used frying oils in the County into biodiesel and using it to fuel some of the fleet's waste trucks, a reduction of approximately 10% in fossil fuel consumption could be achieved. In addition to allowing the municipality to understand the full functionality of the waste vehicle fleet and helping identify the potential problems in its management, the project has an important role for best practice dissemination, emphasising the importance of accurate data recording and monitoring to introduce fuel and cost savings.

**Route Optimization for Solid Waste Collection, Trabzon City, Turkey**

Global NEST 2007 "Route Optimization for Solid Waste Collection: Trabzon (Turkey) Case Study" http://www.gnest.org/Journal/Vol9_No1/6-11_APAYDIN_388_9-1.pdf

As part of the municipal solid waste management system, a study was undertaken to determine whether waste collection costs could be decreased through route optimization in Trabzon. Data related to present spending, truck type and capacity, solid waste production, number of inhabitants and GPS receiver data for each route were collected and recorded (using GIS software) over 777 container location points. The solid waste collection/hauling processes were optimised using a shortest path model with "Route View Pro" software. The optimization process produced fuel savings of 24.7% in distance and 44.3% in time for collection and hauling. The improvements also provided savings of 24.7% in total expenditure

**MasterMap Integrated Transport Study, Daventry, United Kingdom**

Ordinance Survey 2010 "Optimising waste collection using OS MasterMap Integrated Transport Network Layer Case study" http://www.ordnancesurvey.co.uk/oswebsite/products/osmastermap/layers/Docs/DAVENTRY.pdf

Daventry local authority worked with the Northamptonshire Waste Partnership (NWP) to rationalise the number of domestic waste collection routes from nine to eight, reducing diesel costs by 12% and increasing spare capacity by 14% without increasing labour hours. The project was carried out by an external environmental advisory and management company using the OS MasterMap Integrated Transport Network (ITN) Layer with Road Routing Information (RRI) - which includes detailed road routing and drive information such as width, height and weight restrictions, taking account of delays from left and right turns and intersections. This allowed each waste vehicle route to be optimised by balancing the workload between routes on a daily or on a weekly basis. The system enabled optimisation of existing waste collection procedures, resulting in increased spare capacity which could be retained for areas of new housing growth, in turn reducing the need for new routes. The project produced savings of over US$ 154,136 per annum for Daventry alone (not including savings by neighbouring local authorities). Since the project was funded by procuring regional public funds, the overall savings are identified to be greatly in excess of the sum of the contract value and authority time.

**Eco-Driving Project, Maribor, Slovenia**

Recodrive 2009 Press Release, "Eco-driving leads to fuel savings in waste management in Maribor, Slovenia" http://www.recodrive.eu/index.phtml?id=1039&study_id=2596

Maribor's public waste collection, management and transport company (Snaga) conducted a comprehensive 3 month training programme for drivers to implement and test eco-driving. Carried out as part of the EU-wide "Rewarding and Recognition schemes for Energy Conserving Driving, Vehicle procurement and maintenance" (RECODRIVE) project, the programme achieved an average 4.27% reduction in fuel consumption over 8 months. The savings in fuel costs were used to provide wage bonuses to fuel-efficient drivers. In addition, by making additional changes in their optimised routing plan, Snaga is able to collect the same amount of waste in the same area using one less vehicle. The RECODRIVE project also constitutes information dissemination to achieve fuel savings beyond 10% in municipal fleets across Europe. Participating fleet owners further the RECODRIVE concept by inviting other fleet owners to hands-on workshops and conferences on eco-driving and fuel-efficient vehicle operations. Despite being an EU-wide scheme, RECODRIVE's knowledge hub (internet-based information dissemination) could be applied on a city-wide scale to achieve fuel efficient-operations amongst municipal waste management operators.

**Garbage Collection Efficiency Project, General Santos City, Philippines**
USAID "Introducing Measures To Improve Garbage Collection Efficiency" http://pdf.usaid.gov/pdf_docs/PNADB349.pdf
USAID "Moving Towards an Integrated Approach to Solid Waste Management" http://pdf.usaid.gov/pdf_docs/PNADB344.pdf
General Santos City Solid Waste Management Council organised a series of hands-on workshops to formulate ways of improving efficiency of the current collection system and management of dumpsite operations. Formerly, waste collection was concentrated only in the CBD with no regular routing or collection schedule. With the help of various stakeholders, the city formulated new collection schedules and routes and identified pre- and post-collection intervention strategies for the community. Routes were modified to reduce the number of left turns and U-turns taken by the trucks to increase speed of collection and reduce accidents. The number of staff per compactor truck was reduced from five to a maximum of three people, and waste collection trips were reduced from six trips to two-three trips per day. The enhanced collection efficiency allowed coverage of a wider area without increasing the number of trips, accelerated waste collection and provided more time for vehicle maintenance and crew rest. High levels of community representation and coordination of working groups were key to producing more efficient solutions to the current collection system. The above improvements were complemented by simultaneous campaigns for segregation and recycling. The city government also improved management of the dumpsite while a new landfill is being prepared.

**Isseane EfW and Materials Recycling Facility, Paris, France**
The Chartered Institution of Waste Management "Delivering key waste management infrastructure: lessons learned from Europe" http://www.wasteawareness.org/mediastore/FILES/12134.pdf
The Associate Parliamentary Sustainable Research Group, "Waste Management Infrastructure: Incentivising Community Buy-in" http://www.policyconnect.org.uk

In 2008, the Isseane EfW (Energy from Waste) and Materials Recycling Facility was opened on the banks of the Seine by SYCTOM (Intercommunal Syndicate for Treatment of Municipal Waste) to replace an existing incinerator that had been in operation for over 40 years. The project was approved by the municipal council of Issy-les-Moulineaux in July 2000 with a total investment cost of US$ 686 million, which will be financed over a seven year period by a type of prudential borrowing, based upon gate fee revenues from the communes. Isseane is conceived on a proximity principle so that waste travels no more than six miles to be treated. The design of the facility also takes traffic movements into careful consideration. Waste deliveries taking place below ground level to control dust, noise and odour levels. The location of the facility makes use of the river Seine, with barges taking away inert bottom ash from the incineration process for use in ancillary projects.

**Local Authorities' Waste Management, Italy**
The Chartered Institution of Waste Management "Delivering key waste management infrastructure: lessons learned from Europe" http://www.wasteawareness.org/mediastore/FILES/12134.pdf

Waste services in Italy are delivered through public bodies known as 'ATOs' which are funded directly by local authorities, responsible for defining the services required to manage local authority waste streams. New waste management infrastructure is often funded directly from the local authorities' own resources, although for large facilities there may also be some private finance, in effect through a form of prudential borrowing. In some cases waste facilities or services may be procured through a tendering process from private sector waste management companies, with

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| contracts in place either directly with a local authority or the relevant ATO. An ATO can also fund a waste infrastructure project either in part or completely, through the use of eco-taxes. The CONAI scheme, for example, raises US$ 324million annually from an eco-tax on all packaging that sets aside funds for new waste infrastructure. |
| **Tools & Guidance** |
| "Integrated Toolbox for fleet operators" http://www.fleat-eu.org/downloads/fleat_wp3_d32_toolbox_updated.pdf |
| "Policy mix for energy efficient fleet management" http://www.fleat-eu.org/downloads/fleat_wp3_d33_policymix_final.pdf |
| RECODRIVE online knowledge hub http://www.recodrive.eu/window.phtml?id=1008&folder_id=38 |

## ANNEX 10: WASTE LANDFILL GAS CAPTURE PROGRAM

**Description**

Landfill gas, or biogas, is a natural by-product of the decomposition of organic waste (such as food waste, green waste and paper) in landfills. If captured, it can be used as a source of energy through the generation of electricity and/or heat or by being processed for gas supply.

Landfill gas capture has the potential to provide alternative energy sources for municipalities. Reduced fuel consumption and energy use as a result of good planning and allocation of suitable facilities. Gas from landfills that contains a high proportion of methane, which can be converted to electricity or used to power vehicles as an alternative fuel. As methane is a potent greenhouse gas, reducing the volume released into the atmosphere has significant environmental benefits.

**Implementation options**

| Implementation Activity | Methodology |
|---|---|
| Feasibility study for landfill gas capture | A feasibility study establishes the technological and policy framework to implement a landfill upgrade program across the city. This should consider:<br>• Gas yields and generation rates over the next 10, 20, 30 years<br>• Technology<br>• Capital and operational costs<br>• Procurement options<br>• Finance options<br>• Operation and management requirements<br>• Coordination with environmental programmes<br>The establishment of appropriate partnerships is central to the success of the study - partners can include national and regional government with industrial and technical support from private sector companies, research companies, or universities. These partnerships help garner support for expansion of the initiative and inform how the program fits into the larger policy and commercial framework. If there is an existing general directive to support programs such as gas capture from landfill, the feasibility study should be formulated to fit with these policy prescriptions.<br>Other municipality cost centres can also benefit from the study if biogas displaces other types of fuels, e.g., biogas-powered bus fleet. |

**Attributes**

**Energy Savings Potential**
>200,000 kWh/annum

**First Cost**
> US$1,000,000

**Speed of Implementation**
> 2 years

**Co-Benefits**
Reduced carbon emissions
Improved air quality
Enhanced public health & safety
Increased employment opportunities
Financial gain
Operational efficiency

| | |
|---|---|
| | See Ho Chi Minh City case studies for further details. |
| Planning Policy Coordination / Regulation | The coordination of landfill gas capture programs with wider urban plans and planning policy allows the City Authority to develop a high level plan for gas capture, and through the policy system, the responsibility for developing landfill gas capture can be passed onto various bodies including developers or landfill operators. Planning policy that relates to gas capture should be developed in the context of the wider policy framework and existing resources, e.g. technical capability, landfill retrofit potential.<br>See California, Hong Kong and Ho Chi Minh case study for further details. |
| Procurement Program | The City Authority institutes a procurement policy or guidelines that allow a third party to install and operate a gas capture system on existing or new landfills. This implementation activity has good synergies with Kyoto Protocol Mechanisms: Joint Implementation and the Clean Development Mechanism, and these and other routes for obtaining financial support should be investigated. Coordination with environmental regulations is essential, as some programs require close monitoring to ensure they are safe and don't negatively impact the environment.<br>See Hong Kong, Dar Es Salaam and Ethekwini case studies for further details. |

**Monitoring**

Monitoring the progression and effectiveness of recommendations, once implemented, is fundamental to an accurate understanding of their value over the longer term. Where the CA implements a recommendation a target (or set of targets) should be defined that indicates the level of expected progress over a given timescale. At the same time a monitoring plan should be designed. The monitoring plan does not need to be complicated or time consuming but should, as a minimum, cover the following aspects: identification of information sources, identification of performance indicators, a means of measurement and validating measuring equipment or processes, record keeping protocols, a schedule for measurement activity (daily, weekly, monthly etc.), assignment of responsibilities for each aspect of the process, a means of auditing and reviewing performance and finally, establishment of reporting and review cycles.
Some suggested measures that relate specifically to this recommendation are as follows:

- Increase in volume of gas captured (litres/annum)
- Increase in MW electricity produced

Asses gas quantities produced. Establish targets for gas generation rates for the next 10, 20, 30 years in phases.

**Case Studies**

**Landfill gas recovery program, Tianjin, China**

Source: ESMAP (2009). "Tianjin, China - Landfill Gas Capture for Electricity Generation – A Case Study", available online from http://www.esmap.org/esmap/node/661

The city of Tianjin, the fifth largest city in China, has implemented a project to recover landfill gas (LFG), which was otherwise being released into the atmosphere, and burn pretreated LFG for electricity generation. The project was located at the Shuangkuo Landfill, one of five municipal waste landfills in Tianjin. The planned capacity of the project is 4.3 MW which is being installed in stages. The first generator, 1.03 MW, started operation in May 2008, currently utilizing 500-600 cubic meters of landfill gas. The electricity produced is being sold to the North China Power Grid under a long-term contract. Through the project, the city was able to use waste to generate revenues and gain local environmental benefits.

The project was initiated by the Tianjin Municipal Government, which has invested CNY46.7 million (US$6.9 million) in the project. The project has been implemented and is being operated by a specially created entity, the Tianjin Clean Energy and Environmental Engineering Co. Ltd. (TCEE). The project will obtain revenues from the sale of electricity which, over the project's life, will amount to CNY245.2 million (US$36.2 million). The project has been registered as a CDM project under the Kyoto protocol and reached an agreement with the World Bank to purchase the certified emission credits (CERs) from the project.

The successful implementation of the project provides an excellent demonstration of the technology and the institutional mechanisms for LFG recovery and electricity generation, which can be applied to many other large Chinese cities.

**NENT Landfill Gas Utilisation Scheme, Hong Kong, People's Republic of China**

Source: Environmental Protection Department, The Government of Hong Kong, available online from http://www.epd.gov.hk/epd/english/environmentinhk/waste/prob_solutions/msw_lgu.html

Hong Kong has implemented large-scale schemes to extract gas from landfill sites in order to help reduce the use of fossil fuels in the town gas production process. The North East New Territories (NENT) Landfill Gas Utilisation Scheme is one of the largest off-site landfill gas utilisation schemes in the world, helping to minimise the use of fossil fuel in the town gas production process and reduce the release of methane into the environment. Landfill gas (LFG) is recovered from the NENT Landfill and used for on-site energy demands (electricity for site facilities and heat for wastewater treatment), whilst surplus landfill gas that is not utilised on site is used for the landfill gas export scheme. A LFG treatment plant has been installed at NENT landfill to treat the raw landfill gas, removing CO2, hydrogen sulphide and non-methane hydrocarbons. The product gas (80% methane) is then delivered to the Towngas production plant through a 19km underground pipeline. The scheme produces annual reductions of up to 135,000 tonnes of C02e emissions annually. An agreement to construct the LFG treatment plant is held between the contractor of the NENT Landfill, Far East Landfill Technologies Limited (FELT) and the Hong Kong and China Gas Company Limited (HKCG). FELT and HKCG have invested US$ 10.4 million in the LFG treatment plant and US$ 19.6 million in the gas pipeline respectively.

**Sanitary Landfill Gas CDM Project, Ho Chi Minh City, Vietnam**

UNFCC "CDM Project 1913: Phuoc Hiep I sanitary Landfill gas CDM project in Ho Chi Minh City" http://cdm.unfccc.int/Projects/DB/DNV-CUK1214915267.84/view

R.E.E. Mechanical & Electrical Engineering Joint Stock Company "Ground Breaking Ceremony the project to recover methane emitting from the landfill

and to generate power according to the Clean Development Mechanism" http://www.reeme.com.vn/Eng/tincongtyen.php?Idtin=39
Ho Chi Minh City has contracted KMDK (Vietnam) Co. Ltd to develop projects for methane recovery and power generation from the three landfills of Phuoc Hiep, Cu Chi Ward and Dong Thanh, under the Clean Development Mechanism (CDM). At the three municipal landfills, REE and KMDK South Korea are the main partners responsible for the installation of landfill gas (LFG) collection systems, LFG flaring facilities, leachate recirculation systems and electric power generation facilities. One of the projects (at the Phuoc Hiep I landfill) involved the installation of a full-scale LFG collection system to monitor the flare systems, quantity and quality of gas available from the site. KDMK provided further support by producing a feasibility study and design report on landfill gas collection efficiency.
The CDM projects by KMDK produce 42 million KWh/ year to supply nearly 20,000 households and reduce CO2e emissions by 252,000 tonnes each year. Their estimated total capital investment has been between US$ 25 - 30 million. Socioeconomic benefits from the project include new technology development, local employment and minimized explosion risks by controlling methane emission.

**Durban Landfill-to-Electricity Clean Development Mechanism, eThekwini, South Africa**
eThekwini Municipality http://www.durban.gov.za/durban/services/cleansing/gastoelec
UN HABITAT, ICLEI, Sustainable Energy Handbook
http://www.iclei.org/fileadmin/user_upload/documents/Africa/Programs/Energy_and_Climate_Change/Sustainable_Energy_Handbook_Low_Res.pdf
South African Government Online "Minister Peters launches component two of the Durban Landfill Gas to Electricity Clean Development Mechanism (CDM) project, the first landfill gas to electricity in Africa" http://www.info.gov.za/speeches/2010/10012616251001.htm
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 by installing 180 production wells for more efficient landfill gas extraction. The project aims at a collection efficiency rate of 85% at the highest level and 45% at the end of the project's commercial lifetime, over the three landfill sites. The captured methane gas is to provide fuel for the production of 10MV of electricity for supply to the South African municipal grid. Durban Solid Waste (DSW), the municipal agency responsible for management and operation of multiple landfills in the eThekwini metropolitan area, is the technical advisor and the operational entity of the project. The total cost for the integrated 3-site project is US$ 13.8 million, producing an estimated 350,170 tonnes CO2e reduction at one of the project's landfills (Bisasar Road Landfill).The project is funded from an estimated total project income revenue of approximately US$ 620,000 per month, realised from the sale of carbon credits and methane-generated electricity under a long-term power purchase agreement to Durban municipality.

**Landfill Gas Recovery and Electricity Generation Project, Dar Es Salaam, Tanzania**
UNFCC "CDM Project CDM Project 0908 : Landfill gas recovery and electricity generation at "Mtoni Dumpsite", Dar Es Salaam, Tanzania
http://cdm.unfccc.int/Projects/DB/DNV-CUK1169853184.14
UN HABITAT, ICLEI, Sustainable Energy Handbook
http://www.iclei.org/fileadmin/user_upload/documents/Africa/Programs/Energy_and_Climate_Change/Sustainable_Energy_Handbook_Low_Res.pdf
Geneva Trade and Development Forum "Clean Development Mechanism as Tool for Sustainable Development: Case Study of Tanzania"http://www.gtdforum.org/download/Case%20Study%20Tanzania.pdf
The Dar Es Salaam City Council was approached by a private firm from Italy to establish a gas recovery and energy generation project at the Mtoni Dumpsite to reduce methane emissions, as a basis for a CDM project. The city authority granted the private firm, Consorzio Stabile Globus (CSG) the

rights to capture and burn all biogas produced at the landfill over a 10 year period. CSG held responsibility for the construction and management of the gas extraction and flaring system, by setting up and operating an extraction plant. Annually, the project is estimated to reduce emissions by 202,271 tonnes C02e and generate about 200,000 carbon credits. Total investment costs for the project are approximately US$ 5.3million. Revenue from electricity sales and revenue from sale of carbon credits (US$ 2.65 -3.18 million) the expected return on investment is 2 years. CSG invested in the project whilst the city council continued to own and manage the landfill site, making the landfill capture program economically feasible for the city authority.

**Altamont Landfill and Resource Recovery Program, California, USA**
Waste Management World 2010 "Green Giant" http://www.waste-management-world.com
The Altamont Landfill and Resource Recovery Facility in northern California are owned by the private corporation Waste Management Inc., who commission the world's largest landfill gas (LFG) to liquefied natural gas (LNG) plant. Waste Management and Linde North America (a leading global gases and engineering company) joined ventures to build a LNG facility costing US$ 15.5 million, receiving state grants from the California Integrated Waste Management Board, the California Air Resources Board, the California Energy Commission and the South Coast Air Quality Management District. The plant provides enough fuel to power 60% of Waste Management's LNG vehicles in California, reducing Waste Management's dependence on foreign fossil fuel and introducing a domestic green energy source to the fuel market. An estimated 18 million litres of Altamont biofuel is produced annually, reducing CO2 emissions by an estimated 27,000 tonnes per year.

**Tools & Guidance**

United States Environmental Protection Agency tool "Landfill Gas to Energy Benefits Calculator" http://www.epa.gov/lmop/projects-candidates/lfge-calculator.html