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Improving Energy Efficiency in BRAȘOV Romania

ROMANIA
REGIONAL DEVELOPMENT PROGRAM

TRACE City Energy Efficiency Diagnostic Study


Municipal Buildings


Water and Wastewater


Solid Waste Management


Public Transport


Public Lighting


Power and Heat

Regio
PROGRAMUL OPERAȚIONAL REGIONAL

Inițiativă locală. Dezvoltare regională.

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The findings, interpretations, and conclusions expressed in this report do not necessarily reflect the views and position of the Executive Directors of the World Bank, the European Union, or the Government of Romania.

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TRACE (Tool for Rapid Assessment of City Energy) was developed by ESMAP (Energy Sector Management Assistance Program), a unit of the World Bank, and is available for download and free use at: http://esmap.org/TRACE

ROMANIA
REGIONAL DEVELOPMENT PROGRAM

ESMAP
Energy Sector Management Assistance Program

Executive Summary

After the 1989 Revolution, Romania began its transition from a centralized system to a market based economy. Today the country is a member of the European Union (EU) and NATO. After more than a decade of economic restructuring and political change, the country has taken significant steps towards catching up with the economic performance of more developed EU countries. Although radical reforms brought about significant changes in recent years, the standard of living of Romanians is still behind the EU average.

Brașov is one of cities where such disparities are less obvious. This has to do with the relative proximity to București, the wealthiest area in the country (around 160 kilometers away from the capital city), its strategic trade location (along some of the main European routes including the second largest one, running from France to Kyrgyzstan), and also its revenues, which are the highest in central Romania. Despite of the recent economic crisis and economic decline, Brașov County's GDP has gone up in recent years, at 33% growth rate between 2008 and 2012, ranking second in the country. However, like all other cities in Romania, Brașov has suffered from demographic decline, although the city does benefit some from its location along the București-Ploiești-Brașov growth corridor, which is the most densely populated and most developed area in the country.

The economic development in the transition period after the end of the communist regime has led to significant changes in the social and economic life of the residents of Brașov. Some of these developments have positively affected people's life, whereas a few came along with inconveniences and difficulties. For instance, closing down several important industrial plants in the city (most notably, Tractorul Brașov) has led to an increase in the number of unemployed people, and a difficult process of economic restructuring. Today the local economy is driven by the construction and service sectors, which employ almost two thirds of the labor force in the city and metropolitan area.

Similar to a country-wide trend, the rising number of cars in the has caused heavy traffic congestion, increased fuel consumption, and led an increase in greenhouse emissions from transport. Commuting has become difficult for both private and public vehicles. The main challenges in the transport sector include: parking, modernization of the bus fleet, and the development of non-motorized transport by building more bike lanes in the city and expanding the pedestrian networks. This sector has a significant potential for energy savings, and therefore the city authorities should look into appropriate measures to decrease the fuel consumption and reduce greenhouse emissions. The district heating sector faced serious challenges and incurred heavy losses once the large industrial facilities were closed down. In addition to the loss of several large customers, tens of thousands of residential customers have also disconnected from the centralized heating plant. Now the system is undergoing a number of changes and attempts to reestablish itself as the key heat provider in the city. Under a mixed private and public management, the district heating sector is making serious efforts to improve the quality of services and regain lost market. However, the hot water heavy losses in the oversized, obsolete network are an area for the government to look seriously into and try to address.

Like every other city in the country, municipal buildings constitute one sector that requires proper measures towards improving energy efficiency – particularly in health care and education facilities managed by the City Hall. A benchmarking of the municipal building stock, along with audit and retrofit measures should be performed in order to identify the highest savings potential and proper intervention measures. At the same time, although the water system covers the entire city and important investments have been done in recent years (such as household water meters and new pumping stations) the network has a high non-revenue water share. Although the city has implemented the selective collection of waste, the amount of recycled waste is still very low.

There are also many positive things that Brașov has successfully accomplished recently. Almost all streets in the city are lit, and the local government is currently implementing the first intelligent lighting system in the country. Although the city has given up on trams, they have been replaced with trolleybuses, which are a good addition to the public transport system. Brașov has a system of good pedestrian networks, and the local administration has plans to continue expanding them in the future. A sophisticated parking payment system, through text messages, has just been implemented, and new parking facilities in the city will be built very soon. The generation of solid waste is comparable to other cities

in the region and some of the organic waste is used to produce energy. The heat and hot water production have been taken over by a private company, and there are future plans towards improving the distribution network and related services, in an attempt to bring back some of the customers that the system has lost over the past decade. Rehabilitation work has been performed in some schools, health care and social assistance facilities in the city, and in a few cases the old hot water systems have been replaced with renewable energy systems. Nonetheless, further work needs to be done in order to decrease energy consumption and reduce heating bills.

As everywhere in the country, electricity tariffs are regulated by the national government, who is still subsidizing the energy price for domestic users. The liberalization of the energy sector is under way with industrial consumers and, starting in 2013, it will begin to affect non-domestic users as well. Hence, the subsidies are going to be gradually eliminated by the end of 2017, when the liberalization of the market is expected to be complete. As of now, the central government is encouraging energy production from renewable sources, and Green Certificates are provided to such producers. Not in the least, Brașov has a sustainable energy action plan (SEAP) that has been submitted to the European Union a few years ago, under which the local administration has taken a commitment toward reducing energy consumption by 32% by 2020.

In the short and medium term, the Brașov authorities plan a number of projects aimed at reducing the energy consumption in the city, and, ultimately, at improving quality of life for city residents. The plans include purchasing highly efficient rolling stock for the public transport (including the possibility of hybrid buses), developing non-pedestrian networks, building park-and-ride facilities, expanding the parking lots in the city, improving the street lighting system, and reducing hot water losses in the district heating system.

This report is based on the implementation of the TRACE tool in Brașov in February 2013 and it outlines some ideas on what the city could further do to improve its energy efficiency performance. TRACE (Tool for Rapid Assessment of City Energy) is a simple and quick diagnostic tool that is used to assess a city's energy performance in six service areas (urban transport, municipal buildings, water and wastewater, solid waste management, public lighting, and power and heat) and to provide recommendations for improving energy efficiency. In each of the service areas, TRACE uses a benchmarking algorithm to evaluate energy cost savings potential and, factoring in the level of influence of local authorities, it prioritizes what the authorities should do according to where the biggest savings can be achieved.

To complete data collection and to get a more comprehensive idea of issues in the city, a World Bank field trip was organized in February 2013. The implementation of TRACE in Brașov was carried out in close collaboration with local authorities and public and private utility services providers. At the end of this quantitative and qualitative analysis, several recommendations were drawn out. These recommendations are summarized below.

District Heating Maintenance and Upgrade

In recent years, the district heating system in Brașov has undergone serious changes. The number of customers came down drastically from 80,000 in the 2000s, to only 12,000 apartments at present. Today, the district system has the smallest number of clients in the country, but the third lowest price for heat. Although some rehabilitation work has been done and the efficiency of the system has slightly improved, the losses in the transmission and distribution network are still very high. Therefore, in the short- and medium-term, the TRACE recommendation suggests that the city government should continue the rehabilitation work and upgrading of the network, and the modernization of boilers and pipelines, in order to improve the overall efficiency of the system. In this way, losses will be reduced, the quality of services will improve, and the company could gain back some of the lost market.

Non-Motorized Transport

Local authorities should encourage non-motorized transport options in Brașov and boost efforts to improve and expand related infrastructure. The two main priorities in this respect should be the development of more pedestrian areas and the expansion of the bike path network. If more people walk or bike, they will rely less on private vehicles, and, ultimately, this will translate into lower fuel consumption. Moreover, investments in non-pedestrian network can help raise the quality of life in the city and

also could encourage business development in and around the newly established pedestrian areas, including additional leisure and entertainment spots, such as restaurants and shops. Additionally, bike rental programs should be encouraged, along with incentive schemes (e.g., microcredits) for citizens, including members of marginalized and low-income communitites, to purchase their own bicycles.

Public Transport Development

The TRACE recommendation is for the local public administration to adopt measures that encourage people to use public transport to cut down on fuel consumption and achieve energy savings. In order to do that, Brașov should develop the public transport system in the city and make it more attractive to people. The city government has already drafted plans to invest in the modernization of the public transport fleet and replace vehicles whose life cycle has reached its limits. At the same time, the City Hall is focused on modernizing a number of five bus terminals and implementing a traffic management and monitoring system that is expected to improve the quality of public transport services in the city. E-ticketing will be implemented, buses will be equipped with GPS and GIS systems, and screens in the bus stops will display information on bus schedules, helping passengers better plan their trips. Also, based on the TRACE recommendations, city authorities may consider the option of bus rapid transit that would give priority to public transport vehicles, as well as dedicated bus lanes to bypass traffic congestion. A faster, reliable, and comfortable public transport system would attract more users and help them switch away from the current extensive reliance on private vehicles.

Parking Restraint Measures

As the number of private cars in Brașov has gone up, traffic has increased heavily, and existing parking lots can no longer accommodate the growing number of vehicles. Local authorities are already considering a number of measures aligned with TRACE recommendations. Specifically, one of the immediate measures the city government is considering is the development of “park and ride” facilities, aimed at promoting multimodality by linking parking to public transport. People who travel to the city will drive their cars to these facilities, from where they will take public transport to get to their workplace. At the same time, the dearth of parking spots will be also addressed, as the municipality is building parking facilities in the city that will be able to accommodate over 600 cars, including with EU structural funds. In addition, TRACE recommendations advise the local authorities to also take into account hiking prices for parking spaces in the city center and set a parking allowance for new residential and corporate developments.

Municipal Building Benchmarking Program

Like most cities in Romania, Brașov does not have a database tracking the energy performance of municipal buildings. TRACE recommends, as a first step, the development of a municipal building database to get an idea of which buildings offer the greatest saving potential. This can be done through a benchmarking process, using a number of key indicators. Eventually, by publishing the analysis and updating the data on a regular basis, this process will enable competition among building managers and, eventually, lead to a productive exchange of data and collaboration.

Municipal Buildings Audit and Retrofit

The next step recommended by the TRACE analysis is a full audit of the buildings administered by the City Hall. This would help draw a plan for how resources can be allocated to improve the energy performance of municipal buildings in the city. The results could prompt the local administration to allocate funds for energy efficiency upgrades, purchasing new equipment, and performing renovation work on certain buildings. Few educational facilities in the city have been rehabilitated so far and there are plans to carry on this work in the future.

Street Lighting Timing Program

The main TRACE recommendation for increasing the efficiency of the street lighting program is the introduction of a lighting-timing program. The Brașov authorities have already taken steps in increasing the system’s efficiency. First, mercury lamps were replaced with more efficient sodium vapor ones. Second, the city government is implementing an intelligent lighting system. Brașov will be the first city in Romania to have such a sophisticated street lighting network. Sensors will be installed on lighting poles and will allow the light to be adjusted for specific needs of a

particular area, according to varying weather, activity levels, and time of day. In addition, these sensors will be connected to a SCADA monitoring system that will make possible the detection of any damage to the service, prompting a timely response to address the problem.

Active Leakage of Water and Pressure Management

The TRACE results suggest that losses in the water sector could be overcome through a leakage detection and pressure management program. The city government should consider implementing a leakage program that could help with the provision of minimal pressures and encourage a more sustainable use of water resources. It could also reduce the ground contamination in the sewage network. The pressure management is helping reduce treatment and pumping costs. Such a program should be developed in partnership with organizations and/or coalitions of non-profit entities to gain access to their experience and expertise in order to implement the most appropriate improvements to the pipe and pumping infrastructure.

Background

The 7th largest country by population in the European Union (EU), Romania is located in Southeastern Europe, in the lower basin of the Danube River. It has a stretch of coastline along the Black Sea and also incorporates within its borders much of the Danube Delta. Romania neighbors Hungary, Serbia to the West and South West, Bulgaria to the South, the Republic of Moldova to the East, and the Ukraine to the North and East. Almost 50% of Romania's territory is part of the Carpathian Mountains range. The country has a temperate continental climate, with hot summers and cold winters. As part of the communist bloc countries for nearly half a century, Romania brought down the authoritarian regime with the 1989 Revolution, and then it began its transition from a centralized system towards democracy and market economy by implementing a series of structural changes and reforms. If initially the economy was centered on agriculture, during communism it gradually shifted to an industrial one, ultimately making significant steps towards a service-based economy over the past two decades. In 2004 Romania joined NATO and three years later it became a member of the EU.

After a period of massive economic restructuring and political change, the country has taken significant steps to catch up with the economic performance of more developed EU countries. Although government policies and radical reforms brought about significant improvements, income levels of Romanians are still behind the average level in the EU countries. In addition, the disparities within Romania mean that there are significant differences in terms of standards of living between the country's regions. The country is divided into 41 counties, plus the capital city, București (Bucharest), and into eight development regions (although regions do not yet have formal administrative powers, as of June 2013). Apart from Bucharest, each development region is includes a growth pole center (city), and comprises four to seven counties. Despite of being among the most populous countries in Europe, Romania has experienced a decline in population in recent years. The stable population has declined by 12% over the last decade, from nearly 22 million to a little over 19 million, according to the preliminary results of the 2012 census. However, the population decline did not necessarily come as a surprise. After Romania joined the EU, many Romanians left the country to pursue better opportunities in Western Europe. Other factors responsible for this decline are the aging of population as well as a significant rise in the number of the families with no children. Romania is predominantly urban, although the urbanization level is still below that of countries in Western Europe; half of the population resides in municipalities, cities and towns, while up to 10% lives in the capital city.

According to the preliminary results of the 2012 census, the most populous cities in Romania are the following:

Table 1. Ranking of select Romanian cities by population

City	2012 census	2002 census / Rank	
București	1,667,985	1,934,449	(#1)
Cluj-Napoca	309,136	318,027	(#3)
Timișoara	303,708	317,651	(#4)
Iași	263,410	321,580	(#2)
Constanța	254,693	310,526	(#5)
Craiova	243,765	302,622	(#6)
Galați	231,204	298,584	(#7)
Brașov	227,961	283,901	(#8)
Ploiești	197,522	232,452	(#9)
Oradea	183,123	206,527	(#11)

Source: National Institute of Statistics, 2012 Census (http://www.recensamantromania.ro/rezultate-2/)

National Energy Efficiency Legislation

Romania's energy consumption per capita is almost twice as low as the average in the EU, at 1.6 toe (ton of oil equivalent). Between 1990 and 2000, energy consumption fell by an average of 5% per year, and then increased slightly after 2000 by 1.3% per year. At the beginning of the economic crisis in 2009, energy consumption dropped by 14%, and then increased by only 1.3% in 2010. Amid the economic recession, the country's GDP followed a similar decreasing trend and fell by 8.3%. Energy efficiency at the national level has increased significantly between 1990 and 2000, from 23% to 39%. It is a consequence of the rising share of high efficiency power sources (hydropower) in the electricity mix, as well as

improving efficiency of thermal power plants. However, it still remains lower than the EU average.

In the early 1990s, Romania created its first institutional framework for energy efficiency when the **Romanian Agency for Energy Conservation**, the country's main specialized body in the field of energy efficiency, was established. Ten years later Romania adopted the National Energy Efficiency Strategy, a document outlining steps to be taken to increase energy efficiency. In the 2000s, Romania ratified the Kyoto Protocol to the United Nations Conventions on Climate Change, under which the country has committed to cut its emissions of greenhouses gases, between 2008 and 2012, by 8% compared to 1989 levels.

The **Romanian Fund for Energy Efficiency** became operational in 2003 and ever since it has provided subsidies for investments to 27 energy efficiency projects promoted by large industrial operators, totalizing $14.4 million.[1] In order to comply with EU requirements, the Government transposed the Directive No.2006/32/EC regarding energy efficiency among the end users and energy suppliers into national legislation, requiring EU member states to undertake steps to reduce energy consumption by at least 9 % for 2008-2016, as compared to consumption for the previous five years.

The Energy Road Map for Romania was approved in 2003 during the negotiations for EU membership. Pursuant to EU directive on energy reduction, the **First Energy Efficiency Action Plan** for the period 2007-20102 set an energy saving target of 2.8 Million toe by 2016, and it further aims for 1.5% annual reduction for the period 2008-2016. The intermediate target of 940,000 toe by 2010 was far exceeded, as Romania achieved 2.2 Million toe in energy saving. The plan document foresees great potential for energy savings for the industrial sector through voluntary long-term agreements between industrial agents and the Government, in addition to investments in equipment to oversee energy consumption. Estimates indicate that EU countries that have implemented such agreements reached 10 to 20% in energy savings. Large consumers must carry out energy audits and energy efficiency improvement programs, while an energy balance must be produced every year for those consuming 1,000 toe/year and every two years for those who use between 200 and 1,000 toe / year. From 2000 onward, an energy saving certificate has been issued for all new buildings, single-family dwellings, and apartments that are sold or rented. Heat insulation work benefitted from tax breaks and co-financing was provided for renovation work.

The Second Energy Efficiency Action Plan[3] is yet to be approved. EU member states were supposed to submit the second energy efficiency plans by June 2011, but Romania failed to do so. The available draft focuses on energy savings in the primary energy and power sectors, and promotion of energy from renewable sources.

The First National Strategy for Energy Efficiency for 2004-2015[4] set an ambitious 40% target in energy intensity reduction for the period 2005-2014. Decrease in energy intensity should be achieved through programs promoting high energy standards for new installations, as follows: 41% in buildings, 29% in the energy sector, 16% in industry, and 14% in transport. A few years later, the **National Strategy for Energy Efficiency for the period 2007-2020**[5] set further targets to reduce energy intensity by 41% through 2020 by advancing feasible solutions to cover the country's future energy demand at a lower price. By then, estimated primary energy savings and reduction of losses should achieve anything between 25% and 40% (20-25% in industry, 40-50% in buildings, and 35-40% in transport) by improving efficiency in the power sector. The energy saving target was set to 3.4 Million toe by 2020. In this context, 1.9 Million

[1] Romanian Fund for Energy Efficiency http://www.free.org.ro/index.php?Itemid=112&id=96&lang=ro&option=com_content&task=view

[2] First Energy Efficiency Plan for the period 2007-2010 available at: http://ec.europa.eu/energy/demand/legislation/doc/neeap/romania_en.pdf

[3] Second Energy Efficiency Action Plan available at: http://www.minind.ro/dezbateri_publice/2011/PNAEE_12_cu_anexe_2_11082011.pdf

[4] The First National Strategy for Energy Efficiency for the period 2004-2015 available at: http://www.minind.ro/domenii_sectoare/H163-04.html

[5] National Strategy for Energy Efficiency for the period 2007-2020 - updated version for the period 2011-2020 available at: http://www.minind.ro/dezbateri_publice/2011/Strategie_2007_actualizata_2011_01092011.pdf

toe saving is expected to come from fuel substitutions, 800 ktoe from high efficiency co-generation (Combined Heat and Power), and 600 ktoe from new coal-fired units.

The main objective of the **National Strategy Regarding the Thermal Power Supply of Cities**[6] approved in 2004 addresses key issues concerning energy efficiency of the heating system. The thermal power supply system is built on obsolete technologies and old pipeline networks, with low energy efficiency, very high losses (35 % on average), in addition to high production, transport, and distribution costs. Poor insulation of buildings adds another 15% to the losses. Actions meant to increase energy efficiency include implementation of large scale co-generation plants, modernization of network, diversification of primary energy used for thermal power production, and installation of meters in residential buildings. Resource consumption for the centralized heating systems should diminish by 612,000 tons. However, the modernization of the entire heating system is very costly and it requires investment of billions of Euros.

The Strategy for Use of Renewable Energy Sources,[7] approved in 2003, encourages energy production from renewables in order to increase the share of electricity produced from such sources. Romania's potential of renewable energy sources is estimated at 14,718 ktoe. However, the development of such energy potential is constrained by obsolete technological limitations, economic efficiency, and environmental restrictions. Therefore, the plan is pushing for transfer of unconventional technologies from experienced companies, joint-ventures, and private public partnerships. The target shares for renewable energy sources out of the total energy consumption were set at 33% for 2010, 35% for 2015, and 38% for 2020. Use of renewable energy could result in 1.8 Million toe energy saving from primary sources by 2020. **The National Renewable Energy Action Plan**[8] outlining the renewable energy national policy was drafted in 2010, in the very difficult context of the economic crisis. It encouraged the use of liquid bio-fuels, liquid gas, geothermal and clean energy, as well as the integration of biogas into the natural gas grid and retrofitting technologies. The Directive 2009/28/EC on renewable energy set the national target for the share of energy from renewable sources in gross final production of energy at 24% for 2020. The expected total energy consumption in 2020 was set at 30,278 ktoe, of which 7,267ktoe in renewable energy. Targets for specific industrial sectors have been designed, such as 10% for transport, 22% for heating, and 42% for electricity.

Romania received non-reimbursable funds from the European Bank for Reconstruction Development (EBRD) to help companies open credit lines for energy efficiency projects. The country also receives financial support through the Operational Sector Program for Boosting Economic Competitiveness, aimed at increasing energy efficiency. Small and medium-sized enterprises may receive up to 65% financial support for a period of three years to help them obtain environmental certificates for appliances and office equipment.

Government Ordinance 22/2008[9] regarding energy efficiency and promotion of energy from renewable energy sources to end consumers requires local public administrations in towns with a population greater than 20,000 people to produce action plans to generate the most efficient energy savings in the shortest period of time (3 to 6 years). Similarly, companies and local and central government units owning more than 25 vehicles must develop fuel consumption monitoring and management programs.

[6] National Strategy regarding the thermal power supply of cities http://www.termopitesti.ro/HG%20882-2004.pdf

[7] The National Strategy for Using of Renewable Sources was approved by Government Decision 1535/2003 available at: http://leg-armonizata.minind.ro/leg_armonizata/energie/HG_1535_2003.pdf

[8] The National Renewable Energy Action Plan – available at (in Romanian) http://www.minind.ro/pnaer/PNAER_29%20iunie_2010_final_Alx.pdf English version is available at http://ec.europa.eu/energy/renewables/action_plan_en.htm (click on "Romania").

[9] Government Ordinance 22/2008 available at: http://www.dreptonline.ro/legislatie/og_eficienta_energetica_consumatori_finali_surse_regenerabile_energie_22_2008.php#

The National Multiannual Program for the Thermal Rehabilitation of the Residential Buildings Built between 1950 and 1990 started in 2005 and was improved each year. The program is coordinated by the Ministry of Regional Development and Public Administration (MRDPA) and it is developed in partnership with local authorities. It aims at increasing the energy performance of buildings, improving the quality of life for inhabitants and, not in the least, contributing to a better townscape. Public buildings and dwellings built between 1950 and 1990 are very poorly insulated and offer low thermal comfort, causing significant loss of energy. The key beneficiaries of the program are owners' associations. Thermal insulation can reduce maintenance costs for heating and hot water consumption and decrease heat loss and consumption. It can achieve up to 25% energy efficiency, while the heating bills are expected to drop by 40% during winter time. Moreover, in the summer, rehabilitated buildings can better keep the appropriate thermal comfort of the dwellings without additional costs for air conditioning. A guide regarding how the rehabilitation work should be done is available on the Ministry's website[10].

A few years later, **Government Ordinance 18/2009**[11] regarding the thermal rehabilitation of blocks of flats added more consistency to the program by specifying the minimum level of the thermal rehabilitation. The execution work is financially supported from Government's state budget (50%), the local budget (30%), and by owners' associations (20%). Since 2009, MRDPA provided funding equivalent to USD 190 million (RON 660 million) for the rehabilitation of 3,500 multi-story residential buildings in over 100 municipalities and cities. The law allows for the local city councils to grant **tax exemptions** on residential buildings for owners who have performed rehabilitation work from their own funds.

At the end of 2012, **Government Emergency Ordinance 63/2012**[12] brought some changes to the rehabilitation program coordinated by the MRDPA. According to new regulations, residential buildings within municipalities that have applied for funding through the Regional Operational Program (Priority Axis 1 Development of Growth Poles– Intervention Axis 1.2 Thermal rehabilitation of residential buildings) will not receive further support through the thermal rehabilitation multiannual program. However, the good news is that the program has been extended to houses that have been developed between 1950 and 1990. The new regulation also clears the way for local authorities to establish the so-called "thermal rehabilitation tax." This tax will be paid by buildings that did not have any financial contribution to the rehabilitation process.

Following the success of the rehabilitation program, the Government thought about reducing the public funding accessible for such projects, and loans with government guarantee were made available. According to **Emergency Ordinance 69/2010**[13] owners associations must have 10% down payment, while the rest is covered from a bank loan. The owners' associations pay back the loan from the savings obtained over the heating bills before the thermal insulation work is complete. This new program includes old buildings built between 1950 and 1990, those developed after 1990, and individual homes.

The **Directive 2010/31/EU**[14] **on the energy performance of buildings** requires Member States to adopt a methodology for calculating the energy performance of the buildings, that should include thermal characteristics, heating insulation, water supply, air-conditioning installations, built-in lighting installations, indoor climatic conditions, and

[10] The guide is available at: http://www.mdrt.ro/userfiles/constructii_ancheta_publica_contr429_contr411.pdf)

[11] Government Ordinance 18/2009 available at: http://www.mdrl.ro/_documente/lucrari_publice/reabilitare_termica/OUG_reabilitare.pdf Methodological regulations available at: http://www.mdrl.ro/_documente/lucrari_publice/reabilitare_termica/Norme.pdf

[12] Government Emergency Ordinance 63/2012 available at: http://www.mdrt.ro/dezvoltare-regionala/programul-operational-regional-2007-2013/-8748

[13] Emergency Ordinance 69/2010 approved by Law 76/2011 available at: http://www.dreptonline.ro/legislatie/oug_69_2010_reabilitarea_termica_cladirilor_locuit_finantare_credite_bancare_garantie_guvernamentala.php

[14] Directive 31/2010/EC available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32010L0031:EN:NOT

not in the least, electricity produced by co-generation. The EU law concerns both existing and new buildings. The law exempts historical buildings, worship facilities, temporary buildings, residential buildings intended for a limited annual time of use, and stand-alone buildings of which the surface area does not exceed 50 square meters. The main objective of the law is to have all new buildings close to nearly zero-energy by December 2020. The same criteria are applicable by December 31, 2018, to new buildings occupied and owned by public authorities. Member States should come up with national plans that put into practice the definition of a nearly zero-energy building, and the intermediate targets for improving the energy performance of new buildings by 2015. At the same time, Member States must issue energy performance certificates that should include the energy performance of the building along with recommendations for cost improvements. This certificate should be available when renting and selling a building/unit. The municipal buildings with a total floor area of over 500 square meters and buildings of the same size frequently visited by public must display the energy performance certificate in a prominent place where it can be clearly visible. After July 9, 2015, the 500 square meters threshold will be lowered to 250 square meters.

As part of EU requirements, Romania adopted **Law 372/2005** addressing the energy performance of residential buildings. An **energy performance certificate** is issued based on the final energy consumption of buildings and apartments. The country also transposed into national legislation EU Directive 2003/30 EC[15] on the promotion of the use of bio-fuels or other renewable fuels for transport. **Government Emergency Ordinance 1844/2005**[16] established a 2% share of renewable energy in the transport sector by the date of Romania's accession to EU (2007) and a 5.75% share by 2010.

The **Government Emergency Ordinance 70/2011**[17] establishes social protection measures for the cold season, helping low-income residents pay the heating bills. The Government is assisting people who use the district heating system, as well as heating systems using a different type of fuel, be it natural gas, wood, coal, etc. The financial aid range for single people and families with low income benefitting from aid from the state budget can range between 10% and 90%. Local city budget can also provide financial support between 7% and 63% of the total heating bill.

Sixty-one cities in Romania are signatories of the **Covenant of Mayors**, the mainstream European movement involving local and regional authorities voluntarily committing to increasing energy efficiency and use of renewable energy sources on their territories, as well as reducing CO_2 emissions by 20% by 2020. Participants to the Covenant must submit a **Sustainable Energy Action Plan (SEAP)** outlining actions they plan to undertake with regard to energy savings. 22 out of 61 cities have submitted their SEAP to Brussels, namely: Aiud, Sântana, Petroșani, Făgăraș, Zlatna, Moinești, Arad, București (District 1), Arad, Baia Mare, Timișoara, Cugir, Satu Mare, Vaslui, Alba Iulia, Bistrița, Mizil, Slobozia, Brașov, Râmnicu-Vâlcea, Avrig, and, more recently, Cluj-Napoca.

Energy Sector

At the end of 2012, Romania's installed capacity of electrical power plants was 18,481 MW, while the net available power was 15,998 MW, according to Transelectrica.[18] The netto power provided was 11,424 MW, and domestic consumption accounted for 7,413 MW. In February 2013 the split of domestic consumption by types of energy production showed that the largest share is based on coal (33% - 2,593 MW), followed by hydro carbons (23.9% - 1,877 MW), hydro energy (24.8% - 1,948 MW), and nuclear (18.1% - 1,419 MW). Wind energy is relatively lacking, with only 0.3% or 24 MW.

[15] Directive 2003/30/EC available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:123:0042:0042:EN:PDF

[16] Government Emergency Ordinance 1844/2005 available at: http://ngo.ro/pipermail/mediu_ngo.ro/2006-February/004597.html

[17] Government Emergency Ordinance 70/2011 regarding social protection measures in the cold season.

[18] Planul de perspective al RET – Perioada 2010-2014 si perspectiva 2019 http://www.transelectrica.ro/PDF/Planul%20de%20Perspectiva%20al%20RET%202010-2014-2019%2013dec.pdf

The electricity sector is unbundled, with several players in the field. There are quite a few companies in charge with production, a significant number of distributors, and a noteworthy number of suppliers. However, there is only one player responsible for energy transmission and who owns the entire transmission network, Transelectrica, a state-owned company. Energy production is divided into seven major producers, namely Complexul Energetic Oltenia,[19] Complexul Energetic Hunedoara, Nuclear Electrica, CE Arad, SC Electrocentrale Deva, Hidroeletrica, and OMV Petrom. CEZ, ENEL Energie Muntenia, Enel Energie, E.ON, and Electrica Distributie (with its three branches, namely Electrica Distributie Transilvania Nord, Electrica Distributie Transilvania Sud, and Electrica Distributie Muntenia Nord) are the distribution companies. Energy distributors are by default energy suppliers. Accordingly, the main suppliers are Electrica Furnizare, CEZ, ENEL Energie (responsible for Dobrogea and Banat zones), ENEL Energie Muntenia, and E.ON Energie Romania. Of 177 energy suppliers registered in the country, only 20 companies are actually active.

The Romanian Energy Regulatory Authority (ANRE)[20] was established in 1999 and is the regulatory body in the field of electricity (including heat produced in co-generation) and natural gas. The Agency is dealing with licensing, issuing technical and commercial regulations, and protecting of the interests of consumers and investors. The agency regulates tariffs for energy and natural gas for domestic and non-domestic clients, approves the calculation methodology to set up tariffs and prices, and sets tariffs for captive consumers (those who cannot choose the energy provider). It also establishes tariffs for electricity companies, transmission and distribution systems and for activities associated with heat production through co-generation. **OPCOM** is the Romanian energy market operator established in 2000, as a joint stock company subsidiary of the Romanian Transmission and System Operator, Transelectrica. The company is providing the framework for the commercial trades' deployment on the wholesale electricity market; it exercises the role of Day-Ahead market operator and administrator of the Green Certificates, as well as of the greenhouses emissions certificates trading platform. The **Green Certificate** is a mechanism promoting energy produced from renewable sources such as from hydro used in power plants with installed capacity up to 10 MW of wind, solar (photovoltaic), geothermal and natural gas associated, biomass, biogas, gas from the landfill waste fermentation and from fermentation of sediment from sewage treatment of used waters. A number of certificates are annually available. The Green Certificate has unlimited validity, and it can be traded separately from the electricity associate through bilateral contracts or on the green certificates centralized market. The price varies from 27 EUR (to protect the producer) to 55 EUR (to protect the consumer). At the end of 2012, 300 Million Green Certificates were available in Romania for the period 2013-2019. The EU approved in July 2012 an additional distribution of 71.4 Million Green Certificates for greenhouse emissions for 2013-2019.

Notably, the **legislation on green certificates** suffered substantial changes in June 2013, lowering incentives for green energy production and dropping the requirement that large industrial consumers pay part of their costs in the green energy sector. For every green MW produced, hydropower producers with installed capacity under 10 MW will now receive one certificate (instead of three previously), solar power producers will get four (instead of six, previously), and wind power producers will receive one (instead of two). These changes were adopted in response to pressures from large industrial consumers, who noted that Romania had one of the more generous support schemes in the EU, to the detriment of the local industry that had to bear the higher costs of energy inputs.

Following the legislative elections in December 2012, the new structure of the Government includes a **Delegated Minister for Energy**, a new institution expected to add more consistency to the country's energy policies.

[19] Complexul Energetic Oltenia was established in 2012 after the merger of four large energetic companies, namely Societatea Nationala a Lignitului Oltenia Tg. Jiu, Complex Energetic Turceni, Complex Energetic Craiova, and Complex Energetic Rovinari.

[20] More information on ANRE available at: http://www.anre.ro/

Liberalization of the natural gas and electricity markets

The Memorandum of Understanding agreed with the IMF, the World Bank, and the European Commission in March 2012 opens the market for electricity and natural gas. The regulated price for electricity for domestic and non-domestic consumers will be gradually eliminated by 2017, while for natural gas the same principle will be applied by 2018.

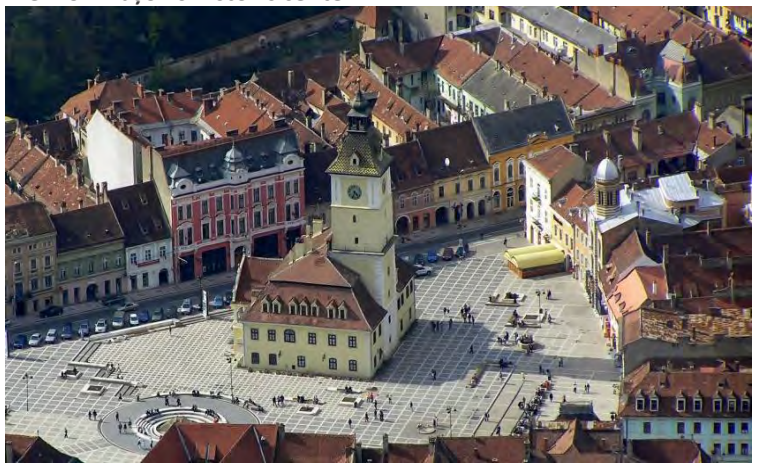
The price increase for natural gas for non-domestic consumers (economic agents and industrial consumers) is going to be 35% for years 2013 and 2014 altogether. For domestic consumers, the price will go up by 10% in 2013, by another 10% in 2014, and by 12% each year from 2015 through 2018. Electricity prices will go up gradually, in parallel with the increasing of the quota of electricity traded in the free market. The price of electricity for *non-domestic* consumers went up already starting in September 2012, when the quota traded in the free market increased by 15%, with an additional 30% in January 2013. The elimination of regulated tariffs will be complete by January 2017. *Domestic* consumers will pay more starting July 2013. By the end of 2017 when the gradual elimination of regulated price will be concluded, domestic consumers will be able to choose their energy supplier. The supplier must introduce the "competitive market component" to the final bill, providing to the clients information that should help them choose the best offer, such as prices depending on voltage, tariffs for transport and distribution, payment methods and due days, and meter readings.

Brașov Background

Brașov is situated in the center of Romania, in the historical province of Transylvania, right in the curvature of the Carpathian Mountains, about 160 kilometers north of București. It is the capital of the county with the same name. The climate in Brașov is temperate-continental, but a bit colder than in other parts of the country, because of its location in a mountainous area.

The city is located at 625 meters altitude above the sea level, in the Bârsei Depression, facing two mountains – Piatra Mare and Postăvarul – and is bordered by three hills (Tâmpa, Straja, and Dealul Cetății). It is the only city in Romania that includes a natural reservation under its administrative area (Tâmpa). Poiana Brașov, perhaps the most popular ski resorts in Romania, is located 12 kilometers from Brașov, and is an administrative unit of the city. Brașov is situated in the center of Romania at the crossroad of the commercial roads connecting the Balkans to the rest of Europe, right where communication roads are connecting the South to North and West to East. Brașov is crossed by some of the main European roads (E60, E68, and E81) and the Pan-European Corridor IV – Railway (connecting Romania to Western Europe), and is also well connected to the national railway network. The city is included in the final leg of the Transylvania Highway (Autostrada Transilvania), from Brașov to Borș, aiming to link the city with the Western border of the country. Only one portion of the highway (around Cluj-Napoca), consisting of 52 kilometers, is now operational; the rest of the construction has been delayed because of lack of funding and contractual issues. Plans have also been hashed to develop a new highway, from Brașov to Comarnic, linking with the București-Ploiești highway, and comprising 64 kilometers. Construction of this new motorway is intended to be completed under a public-private partnership.

View of Brașov's historic center



Source: herutzu.wordpress.com

According to the 2012 Census, Brașov is the 8th most populous city in Romania, with 226,961 inhabitants. The population registered a

downward trend by 20% compared to the 2002 census, when there were over 283,000 people living in the city, and an even more pronounced decrease over 1992, when Brașov was the second most populous city in the country. The city's ethnic composition includes 7.1% Hungarians and 0.5% ethnic Germans. The municipal area is spread over 267 square kilometers. The Brașov Metropolitan Area comprises 14 localities: three municipalities (Brașov, Codlea, and Săcele), three cities (Predeal, Râșnov, and Ghimbav), and eight communes (Bod, Halchiu, Sânpetru, Cristian, Vulcan, Hărman, Prejmer, and Tărlugeni). Poiana Brașov, one of the most popular mountain and ski resorts in the country is located 12 kilometers from Brașov, and it is under the administration of the city. The Metropolitan area is spread over 1,360 kilometers and accounts for a population of 335, 668. As of 2007, the highest density of population in the metropolitan area, between 199 and 999 people per square kilometer, was along the Săcele-Brașov-Codlea corridor. Brașov city is split into three administrative areas: 12 neighborhoods comprising the main part of the city; Stupini, the 13th neighborhood of the city, with specific economic features; and the mountain resort Poiana Brașov. [21]

During the interwar period, Brașov became a significant industrial center in the region, headquartering one of the largest factories in the country, including the airplane manufacturing plant – IAR Brașov – which produced the first Romanian fighter planes. During the Communist times the plant was converted to manufacture agricultural tractors and it was renamed "Tractorul." In the 60s and 70s the city became very industrialized due to the development of the heavy industry sector. One of the main plants at that time was Roman Brașov, where German MAN AG trucks were manufactured, as well as domestic trucks and coaches. The industry sector has declined in the transition period after 1989, as many factories closed down and many people lost their jobs. However, there are still a few plants manufacturing trucks and agricultural machinery, auto-parts, hydraulic transmissions, and assembling helicopter parts, such as the IAR-Ghimbav facility.

Today, the local industry relies on cosmetics, textiles, shoes, construction materials, and food processing. One of the largest brewery factories in the country, Ursus, is operating in the city. Brașov used to be home to a chocolate factory that has been recently shut down. The pharmaceutical sector has picked up in the recent years, after a multinational company, GSK, established a production site in the city. Two of the largest employers in the metropolitan area are Schaeffler, a private company producing rolling bearings, and Reparatii Vagoane CFR, dealing with repairing and maintenance work for train wagons. The upcoming construction of the airport near Brașov city, at Ghimbav, is expected to enhance the economic development of the city and attract more investments to the region.

The demographics of the metropolitan area changed in recent years, following a decreasing trend in the country. If between 2002 and 2007 the decline in population in Brașov city was less than 10,000 people, from 2007 until the last census in 2012, the number of city residents registered a more pronounced decline. The main reasons for the population loss are the external migration to Western Europe and internal migration (primarily to București). In addition, many people have moved from the center city to one of the suburbs around Brașov. This could perhaps explain why in few of the adjacent localities, like Cristian, Hărman and Sânpetru, the population has gone up by 14%.

Brașov followed the same trend as the rest of the country, with a 40% drop in the level of the active population. Conversely, in the same period of time, the active population in the metropolitan area was somewhere between 30 and 50%, with the highest figure in Brașov city. By 2007, 75,000 people had lost their jobs in the wider metropolitan area. The most affected was the industrial sector. In Brașov two thirds of manufacturing workers were laid off.

The same declining tendency has been noticed in the agriculture sector, where four of five people lost their jobs. But the losses in these two sectors were compensated by the increasing number of new hires in construction and service areas. Today, more than 60% of the employees in the wider metropolitan area work in the service sector, while 39% are employed in industry and only one percent are still engaged in agriculture.

Brașov is an important academic center, gathering thousands of students in its six universities. The city is home to the Black Church, the main Gothic style monument in the country and one of the largest Lutheran worship places in the region, and also of the first Romanian

[21] The Status of Brașov city available at http://www.Brașovcity.ro/documente/public/Statut-Mun-Bv-Extras.pdf

school built in 1495. The mountain resorts near Brașov, such as Poiana Brașov, Predeal, and Bran attract annually a significant number of domestic and international tourists.

The Black Church

Source: City Hall Brașov

Local Energy Efficiency Laws

The city is actively involved in energy projects and is part of a number of energy-related organizations. Brașov has been one of the beneficiaries of the **Rehabilitation Program of Residential Buildings Built between 1950 and 1989** coordinated by the former Ministry of Regional Development and Tourism. Under this program aimed at increasing energy efficiency in the apartment buildings built during the communist regime, the city was granted close to RON 24 million for the thermal insulation of more than 5,400 apartments in 132 multi-story residential buildings.

The Local Council Brașov is granting **tax breaks** for owners who have thermally rehabilitated their residential buildings on their own expenses: they benefit from a 20% reduction of the building tax they owe to the local budget over a period of minimum seven years.[22] In addition, people who renovate their building façade on their own expenses benefit from a **tax exemption** on the building taxes for a period of five years.

The Management of Energy and Environment Agency Brașov (ABMEE) is an independent non-profit organization promoting energy efficiency and it was established in 2003, with support from the European Commission Program SAVE II, a tool fostering rational use of renewable energy and advancing energy efficiency in the transport sector. ABMEE is one of the eleven local agencies organized in Romania benefitting from EU support. The agency, which is acting under the city government, is primarily promoting energy efficiency decisions and the use of alternative energy, acting as an intermediary between local and national players in the energy market. AMBEE is assisting local authorities in the design of energy projects and the distribution of public information on energy conservation. The agency is involved in creating a database on energy and environment indicators as a basis for sustainable development programs. ABMEE was involved in the preparation of the Sustainable Energy Action Plan (SEAP) of Brașov city, submitted to the European Union under the Covenant of Mayors, and is currently acting as a monitoring structure for the implementation of the plan. Other activities of the local energy agency include monitoring of energy consumption in public buildings, organizing trainings and public campaigns in the field of energy, etc. The president of the agency is the Mayor of Brașov.

The Board of Directors gathers local stakeholders in the field of energy, including the City Hall and some of the public service operators, such as the Local Transport Authority, solid waste operators, the electricity provider, the street lighting operator, the Environment Protection Agency Brașov, the National Regulatory Authority for Energy (ANRE), and the Technical University Brașov. One of the projects the agency is currently working on is “Bambini” (children), aiming to teach the kids about simple mobility measures and inspire parents to use their private vehicles less, so they can pass to their children the eco-friendly mobility concepts from a very early age. In partnership with the European

[22] County Council decision available at: https://extranet.Brașovcity.ro/Registratura/Hotarari/Detaliu.aspx?registru=HOT-HCL&nr=99&an=2012

Commission and some academic and non-profit organizations, including the Technical University of Crete and Sofia Energy Center from Bulgaria, the local energy efficiency agency provides training for technical personnel and electricians interested in acquiring knowledge and becoming proficient in installing photovoltaic solar systems.

A few years ago, the **Commission for Energy Efficiency** was organized within the Brașov City Hall to supervise new constructions in the city and monitor the tender procedures for projects targeting energy efficiency.

Brașov was among the very first Romanian cities that have signed the Covenant of Mayors, right after the Convention was launched. By signing this document, the city has agreed to reduce energy consumption and greenhouse emissions. Under the **Sustainable Energy Action Plan** (SEAP), a document that has been submitted to Brussels in 2010, the city government assumed responsibility to achieve a very ambitious target of cutting down greenhouse emissions by 32% by 2020, and reduce the overall energy consumption by 12%, compared to 2008 levels. In absolute figures, Brașov aims to reduce the energy consumption by almost 300,000 MWh, cut off 292,000 tons of CO2, and produce 92,000 MWh of clean energy. The plan lays down around 110 measures and their implementation requires RON 1.7 billion investments (approximately 404 EUR million). According to SEAP, the target sectors for improving energy efficiency are buildings - equipment/facility (municipal, residential, and tertiary buildings), public transport, local energy production from renewable energy, heating & cooling system, and green procurement guidelines.

The energy action plan was among the first approved documents submitted by Romania and the first among the seven growth poles in the country. The SEAP must be updated every two years. The city is receiving financial support from the Swiss Government to review the energy action plan. Recently, the Romanian-Swiss Fund awarded EUR 10 million to implement projects aiming to reduce energy consumption and decrease the levels and amount of carbon emissions. Romanian and Swiss experts will analyze and review the document. The first assessment indicates that the city was able to reduce the greenhouse emissions by 7%, i.e., 1,525 tons of CO2, from the rehabilitation work on schools and other education facilities. Energy savings were also made in the street lighting sector (12.1%) and public transport (5%). After 10 buses with energy recovery system entered service recently, the local public transport authority managed to reduce greenhouse emissions by 88 tons of CO_2. The most significant reduction of greenhouse emission, 70%, was achieved in the district heating sector, where the heat produced in environmentally friendly co-generation replaced the heat produced in old, highly polluting coal-based plants.

The priority objectives of **the Energy Program of Brașov 2010-2012** include the goals and targets the city has committed to reach. By 2016 the city aims to reduce the energy consumption of end users and public service utilities by a total of 20% by 2020. The city also plans to have at least 20% of energy used in the city come from green energy in the same timeframe. Starting in 2011, the city requires certain minimum energy performance indicators applicable to all projects implemented in the city. Not in the least, by 2011, the local public administration was supposed to prepare the carbon emission balance of the city in order to assess what would be the necessary measures Brașov should take in order to reduce the greenhouse emissions by 20% by 2020. Later on, the figure was reviewed upward, from 20% to 32% by 2020.

Brașov city is holding the chairmanship of **Orașe Energie Romania** (the Romanian "Cities Energy" network), a non-profit organization acting as a supportive structure at the national level for the Covenant of Mayors. The network is gathering 32 municipalities from across the country, interested in improving energy efficiency in public services, increasing the use of renewable energy, and promoting environmental protection. From 2009 through 2013, Brașov held the vice-presidency of "**Energy Cities"**, a European association of local authorities active in the field of sustainable energy development. The association was established in 1990 and gathers more than 1,000 towns and cities from 30 European countries. They focus on strengthening the role and skills of municipalities in the field of sustainable energy, influencing EU policies in the field of energy, environmental protection and urban sectors, and developing initiatives through the exchange of experiences, transfer of know-how and joint implementation of projects.

Urban Growth and Energy Challenges in Brașov

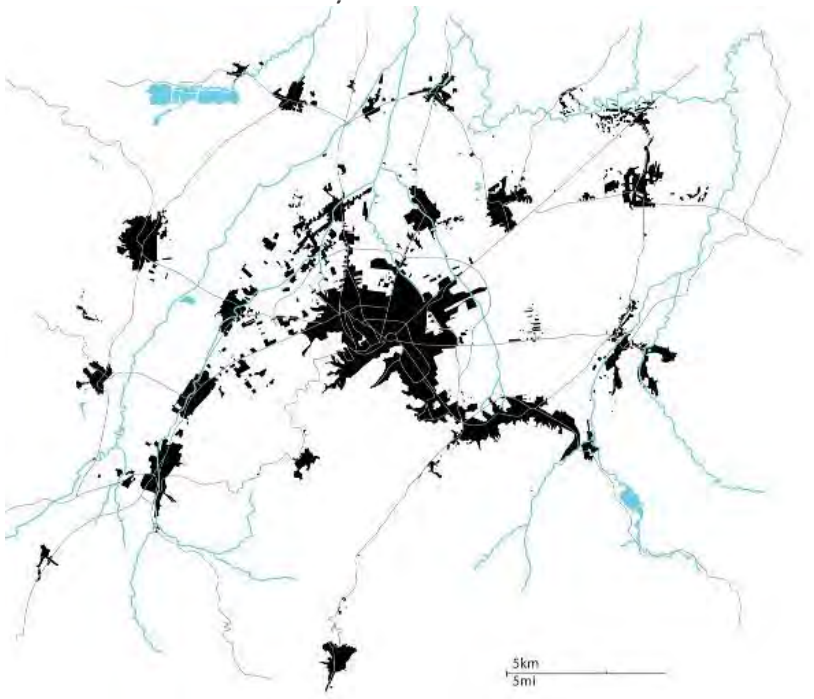
While the TRACE tool does not directly address this issue, one of the most efficient ways of encouraging energy efficiency in cities is by promoting dense development patterns and compact urban expansion. This can be done by strategically using spatial planning tools. The less dense and the more scattered a city is, the larger its energy expenditure will be. Basically, without density public transportation is less viable and more people rely on private cars for commuting; commutes in private cars tend to be longer in sprawled areas and city streets tend to congested, with cars spending more time in traffic.[23] Water and sewage networks have to cover a much wider area, requiring more energy for pumping and water delivery. Garbage trucks have to run longer collection routes and spend more time delivering waste to disposal sites. The street lighting network has to cover a greater number of streets and consume more energy. A district heating network becomes less viable in areas with small density because of the high production and distribution costs, and because heat losses are larger when the distribution network is bigger.

Of course, as a World Bank study has shown, the large majority of cities worldwide (whether they are located in the developed or the developing world), are losing density. As more people come to rely on cars, they are also more willing to move further away from city centers. With an increase in expandable incomes, they can also afford larger homes.

Local authorities are not powerless in addressing those challenges. They have a number of tools they can use to ensure that the loss in density is not too pronounced and that the city expands in an organized, compact, and sustainable fashion. The challenge is of course to do spatial planning at the metropolitan level. Even if sound planning tools are well implemented in the center city, if they are lacking or are poorly implemented in peri-urban areas, the growth pole as a whole suffers.

Overall, the Brașov growth pole is relatively compact, with few scattered settlements. Nonetheless, the southern part of the growth pole where the Tâmpa Mountain is located, has very few developments. This lends the city an elongated development pattern, from east to west, along the mountain ridge.

Brașov's urban mass



As the city will continue to grow and develop, it is important to use spatial planning tools to address, to some extent, this elongated form. One of these tools is brownfields redevelopment. Brașov has a number of unused or underused industrial sites scattered throughout the city, which can be redeveloped and could provide an alternative to greenfield development.

[23] In fact, the dramatic decrease in density in Brașov is one of the main reasons why the tram network became less efficient and was ultimately removed.

Sustainable Brașov

The following analysis and recommendations are about how Brașov can become a more sustainable city. Although the focus will stay on energy efficiency, the scope of the analysis goes beyond that. Energy is quite easy to quantify and measure, and is also a great binding element for thinking about a city in a broader manner. Pretty much everything that is done in a city needs some form of energy input. Therefore, TRACE (Tool for Rapid Assessment of City Energy) is not just a tool for assessing potential energy and cost savings, but it is also an instrument that allows local authorities and policymakers to think about cities as a whole. Eventually, TRACE is a diagnostic tool that helps cities become more sustainable.

TRACE is focusing on six municipal service areas: urban transport (public and private), 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. Some of these indicators are energy related (such as the fuel consumption of the public transport fleet), others are not (e.g., the urban transport modal split). The indicators on energy help analyze energy and cost savings potential in each sector, while the non-energy indicators give a more clear picture of these public utility services, and help choose the most appropriate recommendations so that they go beyond just energy issues.

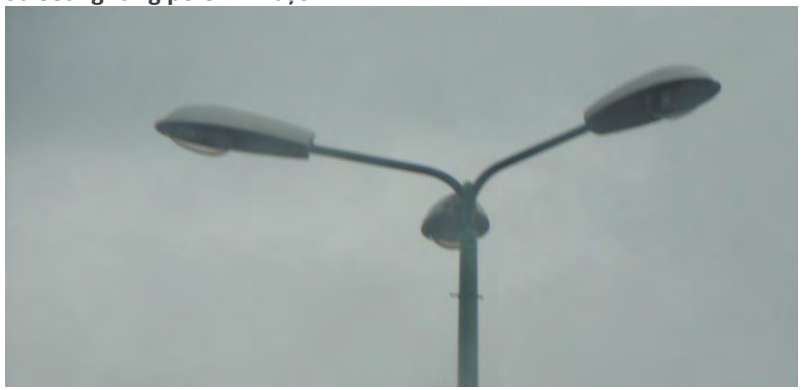
Energy and cost savings potential are assessed through a benchmarking process. Individual indicators selected for Brașov are compared with similar indicators from other cities included in the TRACE database. This comparison can be made in different ways. Hence, cities can be compared based on level of development, climate, or population. Those cities that do better than Brașov on a particular indicator can become a benchmark that Brașov itself can aspire to. For example, if several cities have lower energy consumption per passenger kilometer in the public transport sector, it is an indicator that the local government of Brasov could achieve energy savings in the 'Public Transport' sector (by modernizing the bus fleet, purchasing energy efficient rolling stock, etc.). The energy and cost savings potential is calculated for each of the six service areas. Consequently, a priority list is prepared based on where the most significant cost savings could be achieved. The list leads to a set of recommendations that are likely to have the most significant impact with regard to energy efficiency, for the lowest amount of effort and resources invested.

The TRACE team completed on-site interviews and field visits that have helped form a more accurate picture of sustainability, challenges, and opportunities in Brașov city. The sections below include a concise analysis of each of the six sectors assessed with TRACE, along with some salient findings.

Street Lighting

The street lighting system in Brașov is performing well. It is operated by a private ESCO (Energy and Saving Company), Flash Lighting Services. In 2005, the company signed a concession agreement with the City Hall for ten years, from 2005 through 2015, to modernize, expand the street lighting network, optimize the energy costs, and provide system maintenance services. Old mercury based lamps have been replaced with modern, more efficient sodium vapor ones. Today there are over 14,000 lighting poles spread across the city. More than 97% of the 500 kilometers of streets in the city are lit.

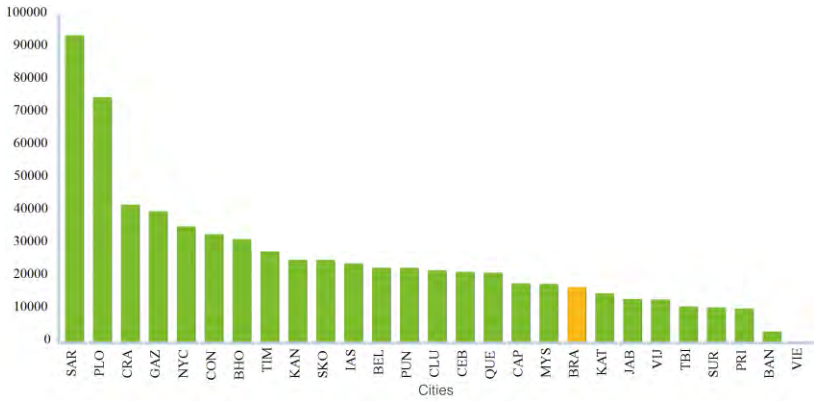
Street lighting pole in Brașov



Replacing old mercury bulbs with sodium vapor bulbs helped reduce the energy consumption of the system and improved the overall efficiency of the street lighting in the city. If in 2008 the electricity consumption for street lighting accounted for almost 10,000,000 kwh, four years later it

went down by almost 20%, to 8,124,300 kwh. With a consumption of 550 kwh per lighting pole, Brașov is doing better than most of the cities in the TRACE database with similar climate and human development index - including Belgrade, Sarajevo, Belgrade, and Ploiești - and is slightly behind Craiova, Cluj-Napoca, and Pristina. When it comes to electricity consumed per kilometer of lit roads, the city is performing reasonably well. The electricity consumption per lighting pole accounts for 16,671 kwh, a figure which places Brașov on the lower side of the TRACE database, as the city is doing better than other comparable Eastern European localities.

Energy Consumed per Km of Lit Roads (Kwh/km)



The expenditure for the entire street lighting system in 2012 (including lighting of buildings, holiday lighting, and operating the fountains) cost the municipality $1.8 million, which accounts for 1% of the city budget.

A pilot project for an intelligent lighting system, called Smart Flash City, has been implemented by the City Hall and Flash Group (the street lighting operator) in October 2010. The project was implemented in Crinului, Neptun, Apollo, and Avram Iancu streets that had both car traffic and pedestrian network. Special devices were installed in each of these streets lighting poles so they could adjust the light intensity depending on the traffic or pedestrian activity, but also stop the lighting of the buildings at night if there was no one walking in the area and no cars were passing by. The tele-management system can open and turn off the street lighting from distance. The operation schedule is pretty flexible and it can be programmed for the entire network or just few streets, depending on the weather and season. This innovative system identifies in real time any un-authorized interventions on the lighting poles, and is able to detect illegal branching.

The public administration has ambitious plans to improve the street lighting in Brașov. The most important project in this respect, which will be implemented soon, is expanding the street lighting intelligent system throughout the city, with financial support from the 2007-2013 Regional Operational Programme. The value of the project is RON 10.8 million and implementation will take up to 19 months. The city has been awarded the project and the work will begin very soon. In this way, Brașov will be the first city in Romania to have such an intelligent and performing lighting system, which would not only save energy but it will bring down greenhouse emissions, a target that the city government has taken on under SEAP.

All light poles in the city will be equipped with sensors

The special devices which will be installed at the lower part on each of the street lighting poles will be connected to a SCADA-like system managed from a central location. This will allow the adjustment of light intensity based on the time of the day and actual traffic conditions. The tele-management devices can start off the lighting from one pole or from many poles, depending on the needs, and also dim the light whenever

necessary. Such an innovative and performing system will also increase the intensity of light in high transit areas, including markets, plazas, and neighborhoods with a high crime rate. The SCADA system will be operated and controlled from the City Hall, by the local electricity operator, Electrica Distributie Transilvania. It will be able to prompt timely response to any damage to the system and service interruption. Currently, it may take several hours and sometime up to day for the street lighting operator or Electrica to sort out the problem, unless someone from the neighborhood makes a call and points out the issue. Once the new intelligent lighting system will be implemented, it is expected to have a 30% drop in energy consumption as well as a reduction of energy bills by 300,000 RON annually.

Before the final decision regarding this project was made, local authorities had to clarify the property of streets and lighting poles in the city, and shed light on the issue with regard to number of the lighting poles. The actual number of the lighting poles was different from the one recorded in the city's land registry. In order to clarify this issue, the city authorities had to perform an inventory of the lighting poles in Brașov. The city government is planning on issuing a law stating that all the streets and street lighting poles in Brașov are the property of City Hall.

Municipal Buildings

Given that updated data on municipal buildings energy consumption and expenditure were not yet available, the analysis is based on 2008 figures available in the Sustainable Energy Action Plan. All municipal buildings in Brașov are administered by the city government, and they sum up a floor area that is around 5% of the total building stock in the city. The total floor area of municipal buildings is a little over 204,000 square meters, as indicated in the Brașov Integrated Urban Development Plan (IUDP).[24] According to Brașov County School Inspectorate, there are 110 educational units[25] in Brașov city, including 60 kindergartens and day cares, 27 schools, 5 high-schools, 14 national colleges, 4 sports schools, and one theological seminary. One educational unit may include more than one building, such as sports hall, dining halls, dormitories, art and performance halls, building annexes, etc. The public property assets include a number of administrative buildings in the city center and a few health care facilities.

The Children's Hospital in Brașov

Source: spitalcopiibrasov.ro

According to SEAP figures, total electricity consumption in municipal buildings in 2008 was 5,994,000 kwh, which would account for only 29.36 kwh per square meter (considering the overall floor area provided by IUDP). In the same year, public buildings in Brașov consumed 7,378,000 kwh of thermal energy for heating (is the equivalent of 6,343 Gcal), which would account for only 36.15 kwh per square meter. Both figures are very small, which should normally stand for very efficient energy consumption. However, the figures seem to be unrealistic given the available floor area (over 200,000 square meters), but also compared to what municipal buildings from similar cities normally spend.

Data obtained from local authorities indicate that the City Hall paid a little over $910,000 for the electricity consumed in buildings under its management, while the heating bill amounted to $453,269. Thus, the

[24] Integrated Development Plan available at http://Brașovcity.ro/documente/public/constructii-urbanism/planul-integrat-de-dezvoltare-urbana.pdf

[25] Brasov County School Inspectorate info available at http://www.isjbrasov.ro/retea-scolara/21/harta-scoli.html

energy expenditure for electricity and thermal heating accounted for $1,363,945.

As the SEAP report has shown, not all municipal buildings are connected to the district heating system, and many of them use individual micro-heating units and other heating sources based on natural gas. In 2008 the natural gas consumption in public buildings was 47,996 MWh which equals to 172,785 GJ. At an average tariff of RON 33.4 per 1 GJ (in 2008), the calculation shows that the city government paid roughly RON 5.7 million (approximately $2.2 million) for the natural gas bill.

Most of the measures in the SEAP with regard to municipal buildings target energy performance improvements.

Photovoltaic panels

Source: finantistii.ro

To this end, the city government outlined a series of projects to be implemented by 2020 to help reduce greenhouse emissions and cut down energy and heating bills. The targets include the modernization of administrative facilities, installing photovoltaic panels on education units to cover the partial energy consumption with renewable energy sources, and endowing municipal buildings with solar and thermal equipment for the preparation of hot water. The city government has actively supported energy savings and encouraged buildings (both public and private) to be proactive in trying to save energy. Quite a few steps have been taken in this respect to fund renovation and thermal rehabilitation work, and replace the classical heating systems with green energy-based equipment.

For instance, in 2012 seven kindergartens and schools received money from the city budget for energetic rehabilitation work. Thermal rehabilitation and insulation work was performed at educational units, while four schools and kindergartens which were using heating stoves were connected to the district heating system.

Rehabilitated school in Brașov

Source: mytext.ro

In 2010, three buildings hosting sport and social assistance activities in Brașov (namely the sports hall, the center for elderly people, and the center for homeless people) managed to reduce their energy consumption for the production of hot water and heat by using solar energy, as part of a national program aimed at replacing the classical heating system with those using renewable energy. These buildings managed to save 128,000 cubic meters/year of natural gas, which amounted for approximately RON 140,000/year, in addition to a 77 tons reduction in greenhouse emissions.

At the same time, four day care centers in the city, catering to almost 400 children, entered into a program that supports the use of renewable energy by producing hot water using solar panels. Priority was given to those education facilities that operate throughout the year (including in the summer) and have the possibility of installing solar panels on the building, as well as a good positioning of the building towards the sun. The energy produced from solar panels reduced the natural consumption by 60% a year. Following the installation of the solar panels, the energy consumption for all day care centers amounted to around 254,000 kwh/year, the equivalent of RON 30,000 per year; there have

been 152,954 kwh per year in energy savings, which amount to RON 18,000.

Another major project currently under way in Brașov city is developed with the support of the Regional the Operational Programme 2007-2013, and is related to the rehabilitation and modernization of the Remus Răduleț Technical College.

Remus Radulet High-School, Brașov

Source: brasov.net

It is the only project focusing on the rehabilitation of the high-school campus in Center Region, funded through European funds. The total cost of the project amounts to RON 14 million, of which 12 million from the ROP. The project implementation timetable spans 28 months. It is a very complex project that includes rehabilitation of the dorms, modernization and purchasing of new equipment for laboratories, and the expansion of the sports hall.

A number of 17 educational units recently entered a thermal rehabilitation process, and the work is expected to be completed soon. Among these buildings are six kindergardets and seven high-schools. The municipality will spend RON 13 million from the city budget for the rehabilitation work, in addition to RON 3.6 million for sanitation and repairing work.

In 2010 the local agency on energy efficiency finalized the energy performance certificate of the City Hall building, as required by Law 372/2005 on buildings energy performance.

The City Hall Brașov

Source: casafatului.ro

The calculation was based on the achievement of specific indicators. Thus, for its certified building the City Hall has been awarded energy class B (close to C) - good to very good - and energy class B (very good) for the reference building.

Power

There are 177 electricity suppliers in Romania of which only 10% are actually active. Six energy supply companies are operating in Brașov. The largest of these is Electrica Furnizare Transilvania Sud, which is supplying 90% of the electricity in the city. The company was established in 2011 as one of the largest electricity suppliers in Romania, covering the central part of the country, and catering for six counties: Brașov, Covasna, Harghita, Mureș, Sibiu, and Alba.

The losses in the distribution and transmission system are 11%, while the commercial losses amount to roughly 2%, the national average. The company caters to 121,000 domestic customers, 7,000 economic agents, and 30 large clients from the industry sector. The total amount of electricity sold in Brașov city in 2012 amounted to 427 million kwh of which 389.7 million kwh was supplied by Electrica Furnizare.

Electricity distribution network

Source: punctual.ro

For instance, in October 2012, the electricity requirements to satisfy the needs of the domestic clients in the city was 13.3 GW/ hour on average, while the amount supplied to economic agents was 10 GW/hour, and for large industrial clients 12 GW/hour. The consumption varies from month to month and from the hot to the cold season. For instance, in October, domestic consumers used 17 million kWh of electricity, almost 20% more than in January, when the consumption dropped to 13.2 million kwh. One of the explanations for this difference could be that some people who have individual micro-heating units could have used these more in the winter than in the summer.

The average price for 1 kWh of electric energy in 2012 was RON 0.43 without VAT. At the beginning of 2013 the Romanian Energy Regulatory Authority (ANRE) regulated the price for captive consumers (the domestic clients who do not have the technical capability to choose the electricity provider and connect directly to the network). Some economic agents fall in the same category of captive consumers, so they use the same tariffs set by ANRE. The price of electricity depends on actual consumption, time of day, type of electricity, level of voltage, and type of consumer. For instance, for a low voltage electricity of up to 1 kV, the tariff starts from RON 0.1738 without VAT (if reserved in advanced), and it can go up to 0.8165 in the peak time.

People with low income pay the “social tariff”, which is a reduced tariff applicable since 2008 only to domestic consumers with a monthly income less than or equal to the minimum wage. They can pay as low as RON 0.2008 for 2 kWh a day and go as high as RON 0.9502 if they exceed 3 kwh per day. The average tariff for economic agents and industrial consumers ranges between RON 0.2788 and RON 0.8502 per kWh. The tariffs at night for high voltage equal or above 110 kV from 10 PM through 7 AM are lower (RON 0.2230 per kWh), compared to the tariffs in the peak time (RON 0.4878 per kWh).

A few years ago, in 2009, the Technical University of Brașov commenced a project to build the Development Research Institute GENIUS (Green Independent Energy Campus), a self-sustainable energy education facility dedicated exclusively to the study and research activities on renewable energy (solar, photovoltaic, and geo-thermal). Eleven laboratories are dedicated to the study of renewable energy and they aim to achieve energy autonomy. The studies focus on combined classical and renewable energy solutions to produce heat and electricity.

Campus GENIUS, Brașov

Source: marketwatch.ro

The first buildings of the campus were inaugurated in 2012. The campus is supporting a “zero-energy” building concept and is endowed with special equipment capable of supplying thermal and electrical energy based on solar panels, photovoltaic panels, heating pumps, and biomass. The campus includes a Green Data Center in partnership with IBM and is the

the first green campus of its kind in the country. The project was financed from the Operational Program for Increasing Economic Competitiveness (POSCCE), with a total value of EUR 24 million, benefitting from support from the state budget as well as the university's own resources.

A number of green energy projects have been already developed in Brașov County and some are under way. The first photovoltaic park in the county was developed at Ucea de Jos, a village about 90 kilometers from Brașov city, where a Czech company invested approximately RON 9 million for an energy facility with an installed capacity of 5 MW. A German company, in partnership with a few Romanian private investors who have already opened one of the largest photovoltaic parks in Eastern Europe at Isaccea in Tulcea County, is planning to develop a rooftop photovoltaic project in Brașov city with an installed capacity of 536 Kwh. Currently, another photovoltaic project, managed by a Swiss company, is under way at Ucea. The project is spread across 420 hectares and requires investments of EUR 250 million.

Public Transport

Local public transport in Brașov is organized by the Local Transport Authority Brașov (Regia Autonomă de Transport), an autonomous company under the city government. The public transport system includes buses and trolleybuses. In 2006, local authorities have decided to give up the tram network, which used to serve only one route in Brașov (connecting two neighborhoods in the city – Rulmentul and Tractorul). The reasons behind the decision had to do with the deterioration of existing infrastructure and with financial aspects, given the closure of many large local industrial plans. After some deliberation, public administration managers considered that the rehabilitation of the tram network, along with the replacement of the old, noisy trams with new rolling stock, would have been too costly for the city.

Currently, the transport in the city is organized along 37 routes operated by buses and midi-buses, and 8 routes served by trolleybuses from 5:30AM through midnight during weekdays, and from 6:30 AM through 10:30PM during weekends and holidays.

Bus operating in Brașov

Since 2006, trolleybuses have replaced the only tram route in the city. At present, the public transport fleet comprises 258 buses and trolleybuses. The public transport network connects the downtown area to all neighborhoods in the city, allowing passengers to get to the closest station within a 5 to 10 minute timeframe, by foot. In 2006, City Hall Brașov and RAT Brașov received a EUR 15 million loan from the European Bank for Reconstruction and Development (EBRD) to modernize the public transport system and replace old buses with modern vehicles. 109 buses of different capacity compliant with EURO 3 greenhouse standard emissions were bought, of which 28 small buses and 81 large and medium vehicles.

There are 25 large capacity vehicles with a length of 18 meters, ready to accommodate 130 passengers. The rest of the fleet consists of medium capacity buses of 12 meters length, with a seating and standing capacity of 90 people. All 109 buses that have been purchased in 2006 reached 75% of their life cycle. The public transport fleet has also some small buses that can carry up to 70 people.

In 2011, RAT Brașov purchased 15 BMC EURO 5 diesel buses of standard capacity from Turkey for which the company paid RON 14.5 million. These buses run on a special fuel that contains just a very small amount of sulphate. Initially, this fuel used to be brought in from Indonesia, but since 2013 it had become available at some Romanian oil producers. The fuel is kept in special containers in the RAT Brașov depot,

where each bus has its own labeled recipient. The buses running on EURO 3 diesel are receiving the fuel directly from the gas pumps located inside the bus depot.

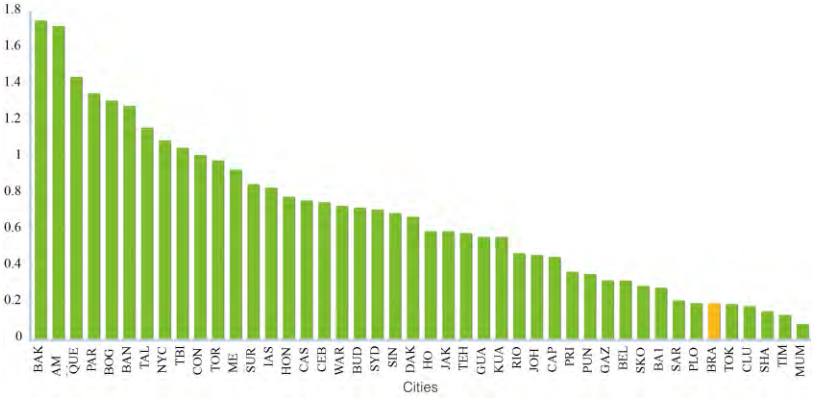
The bus fleet has another 33 MAZ buses whose life cycle has reached 92%. In addition, there are 45 MAZ buses which have been bought in early 2000s and which have exhausted their life cycle entirely. There are also two types of 15 MBO buses with a capacity between 106 and 162 passengers and an occupancy ratio of 65%. The trolleybus fleet comprises 38 vehicles of which 11 vehicles have a length of 12 meters, while the rest are standard size second hand, old Volvo and MAN trolleybuses. The total length of trolleybus routes is close to 95 kilometers. The length of the bus routes in the city is 440 kilometers. In addition, 147 kilometers are operated by BMC buses.

In 2012, the annual spending on fuel to operate the bus and trolleybus fleet was over $ 10.6 million, which roughly accounts for a third of RAT Braşov's annual operational budget. The diesel expenditure was $6.6 million, while the rest of $4 million is the cost for electricity. The amount of diesel necessary to operate the bus fleet in 2012 amounted to almost 4 million liters. In 2012 RAT Braşov paid an average price of RON 5.75 per liter of diesel, including VAT. In the same year, the company paid approximately RON 0.359 per kwh of electricity for trolleybuses.

Trolleybus in Braşov

Overall, the energy consumption from 2008 to 2012 went down by 7 %, to 4,143 toe (Tons Equivalent Oil), which enabled the local transport company to cut down the fuel expenditure by 7%. One of the explanations is that the traffic flow in the city had improved, so buses and trolleybuses did not have to spend too much time waiting in traffic.

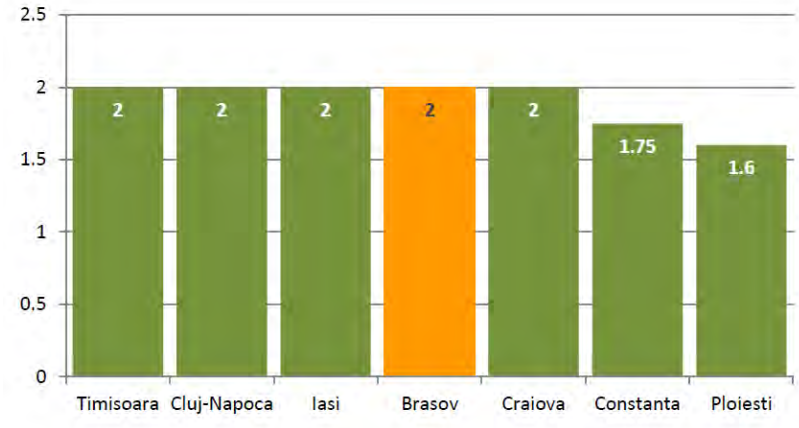
Public Transport Energy Consumption (MJ/ passenger km)



Braşov is doing very well in terms of energy efficiency in public transport, accounting for only 0.194 MJ per passenger kilometer. This figure puts the city among the top performers in the TRACE database. The public transport energy intensity of the city is the same as for Ploiesti, and much lower compared to other European cities with a similar Human Development Index and climate, such as Budapest, Skopje, or Warsaw.

Passengers pay a flat tariff of RON 2 per trip, similar to most of the growth poles in Romania, except for Constanța and Ploiești, where the ticket price is slightly lower.

Public Transport Tariff (RON/trip)



Source: Local transport authorities from the seven growth poles

As in many cities in Romania, Brașov Local Council provides ridership incentives for certain categories of citizens. Former political prisoners and people who have been persecuted by the communist regime, war veterans, former participants to the 1989 Revolution, and children under the age of five ride for free. Students have 50% discount for monthly passes, while school kids get 25% off. The City Hall subsidizes public transporation for retired people with a pension lower than RON 800. They receive 10 free rides per month and a 50% discount when purchasing tickets.

Starting in 2014, the buses will need to be replaced. RAT Brașov hopes that the next ROP financial programming 2014-2020 will help modernize both the bus and trolley bus fleet. By 2015, the local transport company will complete the reimbursement of the EBRD loan, and so they will be able to focus entirely on purchasing new rolling stock. Some thought is given to purchasing hybrid buses that operate on clean fuel and with less impact on the environment. In this way, RAT Brașov aims to fulfill the commitments the municipality had taken once it signed the Covenant of Mayors – i.e., to reduce energy consumption and greenhouse emissions by at least 20% by 2020. Overall, the public transport sector needs roughly EUR 100 million to meet the targets set with regard to cutting down fuel consumption and lowering greenhouse emissions. RAT Brașov and the city government are hoping that the ROP 2014-2020 will allow them to purchase new rolling stock. Given its good pervious credit performances and the proven capability to pay back loans in time, the public transport company could apply for loans of up to a fifth of the EUR 100 million necessary to invest in the modernization of the fleet.

A traffic and monitoring system of the public and private transport currently operates within City Hall, but local authorities are considering an integrated traffic management and monitoring system that could provide a better administration of the transport system in the city. An application was submitted by the City Hall and RAT Brașov to the Regional Operational Programme 2007-2013 and is currently under evaluation. Local authorities have ambitious plans in the upcoming future to modernize the public transport in the city, buy new rolling stock including hybrid buses, and improve the overall efficiency of the system. Projects outlined in this respect will likely be included for ROP 2014-2020 funding, and are targeting the construction of five terminals with park and ride facilities, e-ticketing systems, and expanding the public transport in the metropolitan area. Not in the least, RAT Brașov is thinking to take further steps and train the bus drivers on driving more carefully, with fewer breaks and less speeding, as a way of cutting down fuel consumption.

Private Transport

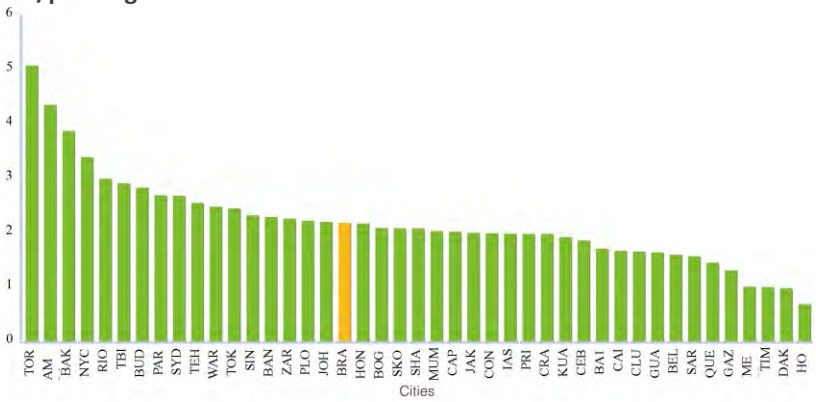
As with many other cities in Romania, traffic in Brașov is quite congested. More than two decades of transition and economic development along with investments in the region pushed for a rapid expansion of the private vehicle stock.

The city's location along the București-Ploiești-Brașov growth corridor, the access of people to better opportunities, the proximity to the mountain resorts, have all brought more development to the area and have subsequently provided more expendable income for people. In this context, the number of private vehicles in the city has gone up significantly. People bought more cars in recent years and used them not

only for commuting to their workplace in or outside the city, but also for leisure, traveling to and from mountain resorts.

Nowadays there are almost 100,000 cars registered with the Traffic Police Bureau Brașov. For a population of 227,961 people, the number of cars indicate that there is one vehicle for every 2.3 people. One third of cars use diesel, while two-thirds run on gas.

Private transport energy consumption
MJ/passenger km



The fuel consumption for private cars in 2012 exceeded 44.2 million liters, for which USD 80 million were spent. Given this figure, there is no wonder that the private transport energy consumption of Brașov is pretty high, i.e., 2.1739 MJ passenger kilometers, placing the city in the first half of the TRACE database. Indeed, the energy intensity of the city is lower than some of other European cities such as Budapest, Paris, and Warsaw, but is at least 50% higher than in some other cities (e.g., Cluj-Napoca, Sarajevo, or Belgrade).

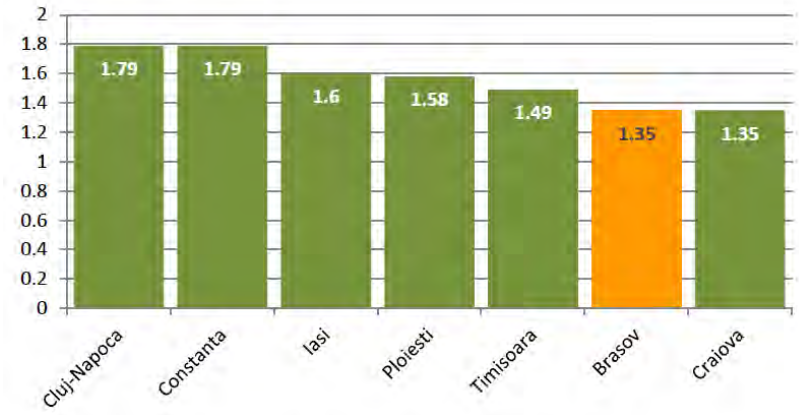
As of 2012, there have been almost 1,600 registered taxis in the city and around 1,000 mopeds. The City Hall has stopped issuing taxi authorizations since 2012 because the number of cars reached the ceiling allowed by the local legislation.

Taxis in Brașov

Source:todoinbrasov.blogspot.com

A few years ago, the City Council adopted a law limiting the number of taxis in Brașov to one car for 1,000 people. Based on the population of the city, the maximum number of cars allowed should be around 2,300. However, as this threshold has already been reached, the local government is not issuing any new licenses. Taxis must obtain authorization from City Hall, which is also responsible for regulating the price and the color of cars. The regulation says that the cars used as taxis should not be more than five years old. Most of the cars charge RON 1.35 per kilometer, one of the cheapest rates in the country.

Taxi tariffs (RON/km) in Growth Poles



Source: Taximetre.ro

Approximately one third of private cars in the city are between 6 and 10 years old. A little over a fifth of the fleet is between 11 and 15 years old, and 13% between 16 and 20 years old. Almost 17% of the cars are older than 20 years, whereas 12% are between 3 and 5 years old, and only 2% are up to two years old. Like all cities in Romania, Brașov is taking part in the national scrappage program ("Programul Rabla"), which offers people who bring old cars a premium for buying a new car. Since its inception in 2005, the program has played an important role in helping renew the vehicle fleet in Romania. For instance, in 2010 a number of 186,854 old cars have been scrapped and the vouchers have been used to purchase almost 60,000 new vehicles.

Like in other growth poles, the city lacks information on the transport mode split. The local government does not have information on how many people use public transport, how many walk, and how many of them commute using their own cars. City authorities should document information on trips, to understand exactly how many people complete trips and commute in the city and by what means. Without documenting such information, it is almost impossible to do proper transport planning.

The road length in Brașov city is 500 kilometers, of which 430 kilometers have been rehabilitated in recent years. There are also a number of parking facilities in the city, both private and public.

Parking spots in Brașov

The public parking spots owned by the City Hall have been taken under concession by a private company. Due to the lack of parking and the increasing number of cars, the municipality has to come up with a plan to expand the parking system in the city and accommodate more cars. To this end, the city government thought about unblocking the parking spaces from the city center that have been allotted for public institutions and private companies. During business hours they should be used by the entities that have been entitled to park their cars, but afterward these parking spots should be made available to everybody else. At the beginning of 2013 the City Hall Brașov started auctioning over 2,800 parking spots that have been leased to residents who missed to pay their due fees. The first leg of the auctioning was organized between March and May 2013 and should be continued in the summer, if necessary. So far, almost 35,000 residents have rented out parking spots from the City Hall. Of these, 1,423 have been given for free to disabled people and other groups.

In April 2013, Brașov joined a number of select cities in the country (including Timișoara, Arad, Oradea, and Satu-Mare) that have implemented a simple and attractive payment method for parking by mobile phone. The driver sends a text message with the registration number of his/her car, and instantly receives a text message with the

confirmation of the payment, including the confirmed time of parking. The parking time can be extended using the same method, by simply sending a text message. Now the payment for parking can be done both by putting parking meters and by sending an SMS.

Parking in Brașov by meters and text messages

Sources: newsbv.ro; ciocalau.ro

However, the price is different when paying by cell phone than using coins. Those who use the parking meters pay RON 1.5 per hour, whereas people who pay through their cell phones are charged with EUR 0.4 per hour plus VAT (roughly 1.8 RON plus VAT). The flat rate per 12 hours of parking from 8 AM through 8 PM is EUR 2.60 plus VAT. The city government is planning to ease the payment system and modernize the parking meters to give people the option to also pay with bills, in addition to coins.

The City Hall has been very active in applying for EU funds to expand and improve the parking system in Brașov. In the near future it is expected that the city will benefit from approximately EUR 10 million from structural funds, including ROP 2007-2013 funds, to build a number of new parking lots. This will add up a few hundreds of new spots to the already existing parking facilities in the city and Poiana Brașov, the mountain resort administered by the Brașov local government, easing up the painful parking issue for both city residents and tourists. Soon after the contracts will be signed, parking facilities will be built in areas such as Spitalul Militar and Biblioteca Județeană, Dealul Warthe, as well as in Poiana Mică.

Location of the upcoming parking near the County Library

Source:adevarul.ro

The City Hall already secured 2007-2013 ROP funding for building a multi-level parking structure in Poiana Brașov and now the tender for choosing the construction company is under way.

Serious efforts have also been targeted at developing a good pedestrian network. Recently, city authorities have developed the main pedestrian area in the historical center, surrounding the Sfatului Plaza and the Republicii Street area. In 2008, at least 10 streets in the city center have been closed to car traffic and streets were repaved with cobblestone. This project cost EUR 4.5 million, with support from the ROP 2007-2013.

Pedestrian network in Sfatului Plaza

Now Diaconu Coresi, Sfântul Ioan, Michael Weiss, Ludwig Roth, and Paul Richter are a few of the streets that have become essentially pedestrian. The car traffic is restricted to only residents who live in the area and drive their vehicles to the backyard of their buildings. Once pedestrian works were completed, the municipality focused on the restoration of the building façades in the downtown area, including in the Republicii and Mureșenilor Streets and the adjacent small streets and allies. When the city authorities banned the traffic in some parts of the city, they had in mind the level of noise and vibrations that could have a negative impact on the old, beautiful historical buildings. In order to protect these buildings from noise and pollution, the local government decided to operate only small buses in the city center.

However, Brașov is not doing well in terms of its bicycle network. There are only 15 kilometers of dedicated lanes for bicyclists. Moreover, even this small network is not in the best shape, as it has not been rehabilitated in a long time.

Bike lane in Brașov

Despite this, the residents are very pro-active with respect to the use of bicycles, and they have petitioned the local government to push the city managers to take the necessary steps to improve and expand the bike paths in the city. The StudentOBike project was launched in 2010, providing 100 bicycles to students to help them commute between the University's buildings in the city. Immediately after, the municipality made available another 100 bicycles to be used for free for two hours daily. In 2010, the municipality in partnership with a commercial bank and Green Revolution Association launched a new bike program. 50 bicycles are available at the docking station located in the city center in Piata Sfatului the main pedestrian plaza in Brașov. The project aims to encourage biking in the city and determine people to rely less on their private cars.

In April 2013, the feasibility study for the construction of two bike lanes comprising a total of 7 kilometers in Poiana Brașov was approved by the city government. The construction of the new bike network and

docking station is expected to be completed within 22 months. The upcoming network for bicyclists is expected to make the mountain resort more attractive to tourists. In the past couple of years there have been discussions regarding the expansion of the bike network to the metropolitan area, between Brașov and Râsnov via Cristian. The project has been abandoned, however, due to a lack of available land for building the network in Cristian.

District Heating

The district heating sector in Brașov is managed by two operators: Bepco, a private company producing hot water and heat, and Tetkron, the heat distributor and supplier, a public company under the city government. Before 1989, the district heating system of Brașov was one of the largest in the country, spread over 30-40 hectares, located just 6 kilometers away from the city center.

The district heating plant, known better as CET (Thermal Electrical Center) was commissioned in the 1980s, using Russian technology, and it was managed directly by the national government. The plant became operational in 1990. CET was designed as an oversized steam producer based on coal to serve the industrial sector in the region. In those days, the plant operated 90% on coal and 10% on natural gas, with a very small scale of heat produced in co-generation. The total installed capacity of the plant was 100 MW electrical and 370 MW thermal. The plant was catering primarily to the industrial sector, which was spread over 100 hectares, with a total of 50,000 employees. At that time, 60% of the customers were represented by industrial factories, and only 40% were domestic clients living in communist-style residential buildings. The latter accounted for a little over 36,000 apartments in 1990.

After 1989, there have been times when the plant was running out of fuel and had no money to buy the fuel (coal) to produce heat. People were freezing in cold residential buildings because the plant could not provide them with heat.

Old CET facility

The political pressure was high and the national government used to send trains of coals to Brașov in order to provide the plant with fuel to restart the heat production.

Part of the problem with CET was related to production, part was concerning the distribution system. Once the local industry died and many plants in the Brașov region were closed down (e.g., the Tractorul factory), CET started incurring heavy losses. Soon after, the centralized heating system gradually lost a significant number of customers – most of which switched to micro-heating units. In 2002, the main heat transmission and distribution network was taken over by the City Hall. For a few years, the City Hall covered the losses, about EUR 14 million per year. However, in 2010, the plant went bankrupt and was shut down.

In addition to CET, another natural gas-based district heating plant, Metrom, was providing thermal energy to 10% of customers in the region (around 22,000 customers in total). More than 19,000 apartments in Brașov received hot water and heat from 30 decentralized sub-plants. Overall, in the 1990s, almost 80,000 apartments in the city were connected to the district heating system, which supplied thermal energy based on steam. By the beginning of the 2000s, all district heating facilities in Brașov supplied less than 15,000 customers (6,000 apartments were

connected to CET, 500 to Metrom, and only 4,000 received heat from decentralized sub-stations).

In 2010, Bepco, a private company, took over the CET facilities under a 15-year concession agreement with the city government. The company started the heat production in 2011, and currently the main heat producer in Brașov. The company is using CET and METROM platforms, but also the mini-plants located in the Cartierul Nou neighborhood. Bepco has also invested EUR 33 million to generate new business, and to this end has built new power plants based on co-generation.

Bepco's co-generation plant

The investment took place in two phases. During the first leg of the investment process, the company spent EUR 21 million to build four new, modern power co-generation plants, and replaced the two old facilities, CET and Metrom. During the second phase the company completed the construction and become operational. The installed capacity of the co-generation plant is 42.7 MW electric, and 107.9 MW thermal, and it is designed to cater to 20,000 apartments. The new plants are of a modular type and can expand their production and serve more clients, if necessary.

Tetkron is the hot water and heat both distribution and supply company in Brașov. The company was established in 2011 and has 99% shares from the City Hall Brașov. As of 2013, Tetkron is operating a network of 328 kilometers of pipelines, of which 69 kilometers for transport and 259 kilometer for distribution. The hot water network and pipelines are owned by the city government. Today, Tetkron is providing hot water and heat for 15% of the existing apartments in the city – 12,000 of 80,000.

District heating pipe

Source: brasov.net

Technically, Tetkron is buying hot water from Bepco and further delivers it to the customers in the city. There is a commercial contract between Tetkron and Bepco, which involves also the City Hall. The overall production cost for the hot water/heat is RON 244.62 per Gcal. Tetkron is paying Bepco RON 150 per Gcal including VAT, and sells it for RON 170 per Gcal to the population. The difference from RON 170 to RON 244.62 per Gcal (the production cost) comes in the forms of subsidies from the city budget. The economic agents and other type of customers pay RON 393 per Gcal. Brașov has the third highest price for heat of all the seven growth poles (see figure below), and the smallest number of customers – 12,000.

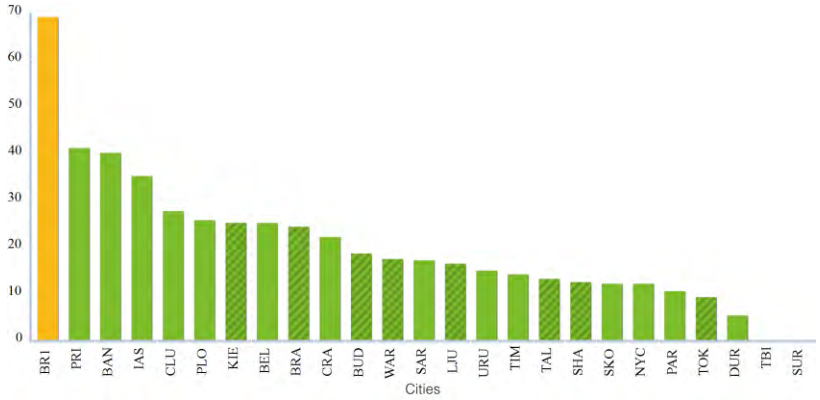
Heat Tariff (RON/GCal)

Source: ANRSC

This is a huge drop from the early 1990s when 80,000 apartments were connected to the centralized heating system. In 2010, when Bepco was just about to take over the heat production there were 26,800 apartments connected to the district heating system. But in the summer of 2010 a massive disconnection took place, with more almost 10,000 apartments leaving the district heating plant in favor of individual micro-heating units. The City Hall failed to inform Bepco that disconnections were under way, and the company found about it while these were ongoing. In the past few years, only a thousand people disconnected from the district heating plant, a smaller number compared to previous time period. Currently, 12,000 apartments are connected to the district heating system operated by Bepco.

After Bepco took over the old district heating plant, the company managed to increase its efficiency, from only 25% in the early 90s to 75% today. But despite of the good performance in this respect, in 2012 the losses in the transport and distribution system went up to 69%, of which 50% are losses in the transmission network, and 39% in the distribution network. This figure is the highest in the TRACE database among cities that operate district heating systems. It is much higher than any other comparable city in Europe: almost double as in Pristina and almost three times more than in Cluj-Napoca.

Percent of heat loss from the network



At the beginning of 2013 the losses came slightly down to 64%. The losses in the system are higher in the winter than in summer, as is to be expected. For example, the total hot water loss due to leakages in the pipelines and non-payments of bills amount to 42 cubic meters per hour in the winter, and then go down to 25 cubic meters per hour in the summer. Of the 1,100 cubic meters of hot water injected in the pipes during winter time, 42 cubic meters are gone every hour. The volume of the transmission pipes is 11,300 cubic meters. The transport pipes are older than the distribution network, therefore incurring more losses. The total expenditure to produce heat is around EUR 16 million, of which 60 to 70% goes for fuel (natural gas).

The heat supply company, Tetkron, is incurring heavy losses, as the network is old and obsolete, and leakages in the transmission and distribution system are high. Therefore, Bepco, the heat producer, gave Tetkron a commercial discount of EUR 2 million, as a financial support for the supply company to help improve its network. The money accounts for 40% of the Tetkron's annual operational expenditure.

From the mid-2000s onward, a massive disconnection from the district heating system took place in Romania. However, according to the Public Service Utility Regulatory Authority (ANRSC), between May 2007 and December 2011, the number of apartments disconnected from the district heating plants in the country decreased every year. For instance, in

2007, there were 41,878 apartments disconnected from the district heating system, and the number came down to 40,064 apartments in 2008. In 2009, only 32,582 apartments disconnected from the heating system. This trend created the false impression that the evolution of the de-branching is positive and will keep smoothing as people would connect back to the system. But the surprise came in 2010, when the total number of apartments disconnected in the country went up to 59,035 – 81% higher than in 2009. In 2011, the number went up by a further 19% over the previous year.

There are good news too, though, as some people chose to connect back to the centralized system. From 243,991 apartments that have been disconnected from the system between 2007 and 2011, around 10% (28,544) decided to connect back. Only in 2011, a number of 10,013 apartments connected back to the system, with 232% more than in 2010.

Residential buildings in Brașov

Source: realitatea.net

There are two major reasons responsible for the disconnections from the district heating system in Romania: the low price of natural gas and the poor quality of hot water and heat services. There is also an individual preference for controlling the heat level, which is perceived to be easier when owning a micro-heating unit than when relying on the centralized system. These factors are the same culprits in Brașov. Once the industrial plants were closed down, many people lost their jobs and moved out of the city. Population numbers also went down, while quality of heat and hot water services became increasingly poor. Since the plant used to produce hot water only in the winter, people often did not receive hot water in the summer. Even when hot water was available, it could not get through the upper floors. Therefore, it was not a surprise to anyone that once individual micro-heating units were made available in Brașov many residents switched to them.

Micro-heating units have replaced central heating for many consumers

Source: ziareromania.ro

However, switching to these micro-plants might have worked out in the short term, but it does not seem to be a feasible solution in the long run, as the price of natural gas is going up and will keep doing so as part of the liberalization process to be completed by 2017. Since 2011, the number of customers connected to the centralized heating plant went slightly up, as the people started reconnecting back to the system. In addition to the growing natural gas prices, another incentive for reconnection is the improved quality of services. Now hot water is available to all apartments in the building, including upper floors, at any given time of the day.

In the future, Bepco is thinking about starting an incentive pilot program to determine people to reconnect to the centralized heating system. The company is planning to allow some of the apartments who switched to individual heating units to reconnect to the centralized system and, at the same time, stay connected to their plants. In this way, people will have the chance to compare the centralized heating system with the micro-heating units, and then see which one works best for them.

The main concern of the local authorities and heat operators is to address the losses in the transmission and distribution network, improve the overall efficiency of the system, and increase the quality of services to customers. An upcoming project with a loan from the European Bank for Reconstruction and Development is targeting the rehabilitation of the district heating network. In the future, there are more projects in the pipeline targeting the upgrading of the district heating network.

Potable Water

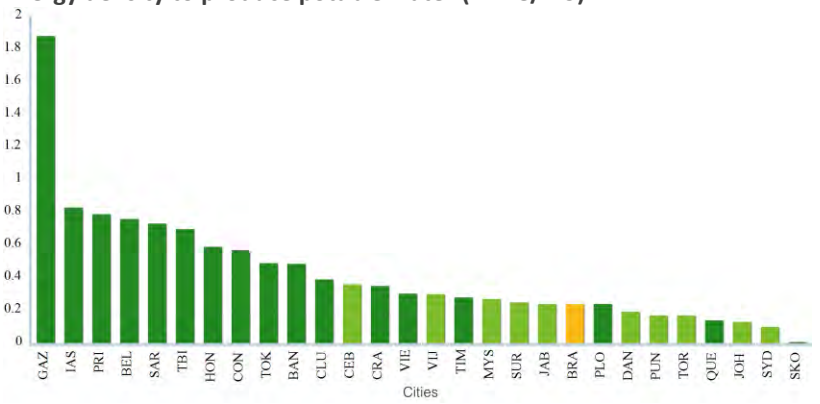
The water sector in Brașov, both potable and waste water, is managed by a public company under the County Council Brașov. Apa Brașov is a regional operator, with 49% shares from the Brașov County , 49% shares from all municipalities to which the company is catering water, and 2% shares from the company's employees. The company is responsible for producing, pumping, treating and distributing potable water, as well as managing waste water treatment.

Apa Brașov is using both underground and surface water sources. The water is drawn from many sources, including underground wells, spring water, and lakes. The company is buying the raw water from the Water Management Service Brașov (SEGA) and from the National Administration for Land Improvement (ANIF). Part of the water is delivered by gravity, part is pumped from underground wells. While the water drawn from underground wells is stored in reservoirs and is only treated with chlorine before being supplied to the population, the water from other sources needs more intensive treatment. For instance, lake water must be both treated and chlorinated. There are several pumping stations and only one potable treatment plant serving the City of Brașov, located near Tărlung Lake. The pumping stations are at least 12 years old and need to be modernized, and some of them have to be replaced entirely.

As of 2010, the overall annual water production for Brașov was around 25 million of cubic meters, for which almost 6,000,000 kWh were used. The company sold a little over 14 million cubic meters. The water distribution network of the company throughout Brașov County is exceeding 1,040 kilometers. Around 772 kilometers are covering the urban area in the county, including Brașov city. Half of the water network in the city is pretty old, as some of the pipelines have been built in the 19th century.

The energy expenditure for producing and treating water amounts to 4.42% of the total operational budget of Apa Brașov. On average, approximately 0.24 kWh are necessary to produce one cubic meter of drinking water. This figure puts Brașov in the lower side of the TRACE database, among the cities with the most efficient potable water system. From this perspective, Brasov is performing similarly to Ploiești, and better than other cities with a similar Human Development Index, such as Cluj-Napoca or even Vienna.

Energy density to produce potable water (kwhe/m3)

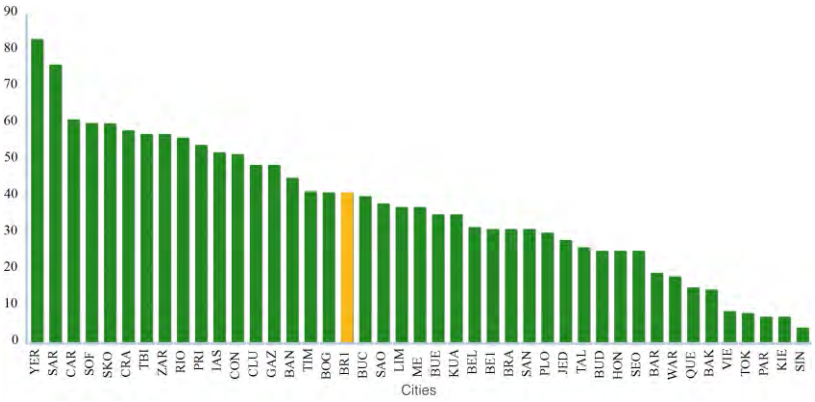


In 2012, the energy consumption for producing potable water in the entire area operated by Apa Brașov ranged between 0.43 kwh per cubic meter and 0.59 kwh per cubic meter. In 2010, the water consumption per capita in Brașov city was 176 liters per day. The city was performing better

than similar cities within the TRACE database, such as Cluj-Napoca or Sarajevo, but there are some cities in the region with lower figures, like Ploiesti or Pristina. In 2012, water consumption per capita improved, as figures went down to only 120 liters per day, an equivalent of approximately 4 cubic meters of water per month.

A SCADA system is connected to the pumping stations and water network operated by the company. Losses in the water system account for an average of 40%. This figure places Brașov in the first upper half of the TRACE database. There are cities that are doing better than Brașov, such as Ploiesti, Budapest, and Ljubljana, and cities that are doing worse, such as Cluj- Napoca, Banja Luka and Gaziantep.

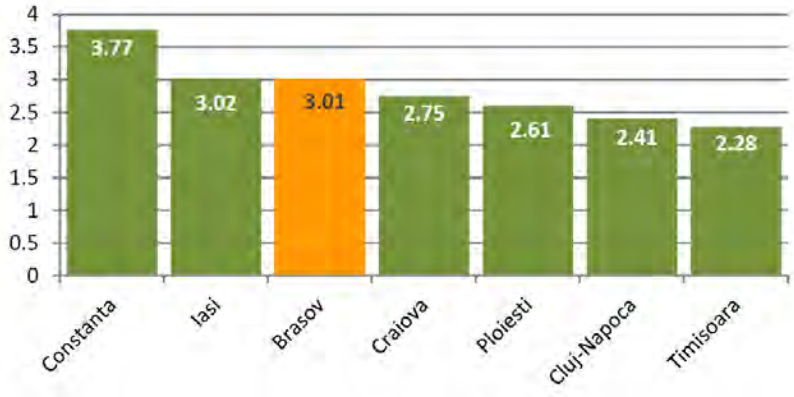
Percentage of non-revenue water



Although the energy performance of the water system is quite good compared to other cities in the TRACE database, leakages in the systems are quite significant. Most losses are due to old pipes. Although half of the water network in the city has been rehabilitated, the leakage rate still varies between 10 and 20% in metered areas. The losses can go up to 50% in some of the areas where the pipe network is very old and where there is no metering system.

The tariffs for water are based on expenditure related to production and distribution. As of 2010, the domestic consumers in Brașov paid RON 2.63 without VAT per cubic meter of potable water and RON 1.59 RON for one cubic meter of waste water. In 2011, Apa Brasov slightly increased the tariffs to RON 3.47 including VAT per cubic meter for domestic customers, and RON 2.39 including VAT for waste water. As of 2013, the tariff applied to the population in Brasov for potable water is in the higher range compared to the other growth poles (see figure below).

Water Tariff (RON/m^3 without VAT)



Source: ANRSC

Since the early 1990s, the company has invested heavily in improving the water network and increasing the overall efficiency of the system. Since then, Apa Brașov has accessed between EUR 80 to 100 million for system investments from different grants and loans (e.g., from the European Bank for Reconstruction and Development (EBRD), from EU pre-accession and structural funds, as well as other funding sources). Between 1995 and 2001, the company worked on an USD 18 million (approximately EUR 13.5 million) rehabilitation project within the Municipal Utilities Development Program (MUDP), with EBRD support. Under this project, 82.9 kilometers of old water network connections were rehabilitated and almost 47 kilometers new connections were built, covering a total of 166 streets in the city. The water filtration hall within the Tărlung Water Treatment Plant was upgraded, which almost doubled the treatment capacity (from 370 liters per second to 600 liters per second). Four new reservoirs were put into function, three of them with a capacity of 5 million liters each, and one with a capacity of 2.2 million liters. Water meters were also

installed in more than 6,500 residential buildings and households in the city. In order to be able to supply water to the city, including during dry periods, the capacity of drilling wells doubled by replacing a number of 30 old underground pumps. As of today, 97% of the domestic customers in Brașov are connected to water meters. In early 2000s the company received EUR 3.4 million through the Large Scale Infrastructure Facilities component of the EU PHARE Program for the modernization of the water network and the rehabilitation of the sewage system in the City.

Another important project was funded through the ISPA Program and targeted the treatment of drinking water and wastewater collection in Brașov and neighboring localities. The total value of the project exceeded EUR 58 million. The project was developed during 2002 and 2010, and had four components. The first one dealt with the rehabilitation of the water treatment plant at Tărlung Lake. It increased the treatment capacity of the plant to a maximum flow of 2,200 liters per second, even when the water is very turbid. Other improvements include the monitoring and automation of the entire technological process.

Water treatment plant in Brașov County

Source: judbrasov.ro

The other component focused on the development of the water sewage network, sewer collectors and water supply in the region, including development of the drinking water distribution network in Tractorul and Stupini neighborhoods. It covered the construction of 76 kilometers of drinking water network and 8.72 kilometers of new sewage pipes in the city. In addition, the project included the installation of waste water flow meters equipped with data transmission connected to the company's integrated collection and control center. Under this component, 4,550 water meters were bought and installed. The third component of this large project increased the distribution efficiency of additional water flow treated in the Tărlung treatment plant, and rehabilitated the water supply network in Triaj neighborhood. Finally, the last component focused on eliminating flooding risks during rainfalls and gravitational transport to the waste water treatment.

In order to reduce the share of non-revenue water, Apa Brașov and its stakeholders need to further invest in the water network. Currently, a large project of RON 796 million (approximately EUR 186 million) focusing on the rehabilitation of the water and waste water sector in Brașov County is under implementation. The project is funded through Environmental Operational Program, with co-financing from a reimbursable loan of RON 80 million from EBRD guaranteed by Brașov County. The project is expected to be completed by the end of 2013, and is targeting the rehabilitation of old pipes, the extension of the drinking water network, the construction of a new pumping station and two new reservoirs, the rehabilitation of a treatment plant and the construction of two more facilities, the extension of the sewage network, the construction of 10 waste water pump stations, the rehabilitation of a waste water treatment plant, and the construction of four more plants.

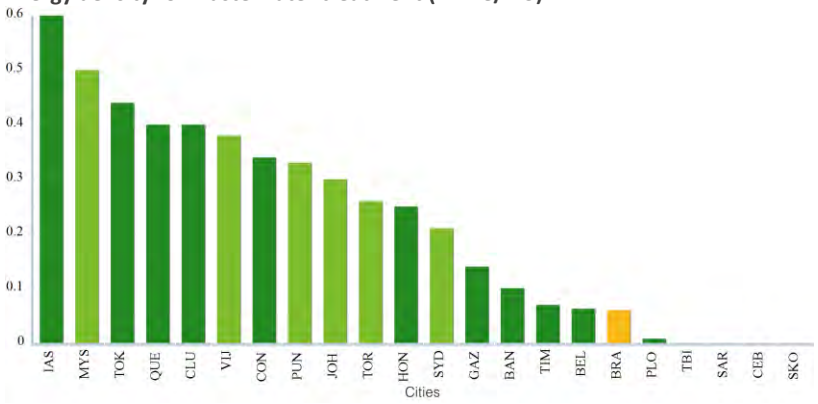
Waste Water

The waste water sector is managed by Apa Brașov, the same company in charge with the potable water sector in the city. There are two waste water treatment plants serving the City, of which one is located in the outskirts of Brașov.

The waste water sector is very efficient and requires a small amount of energy – only 0.06 kwh for treating one cubic meter of water. Thus, in the TRACE database, Brașov ranks among the most efficient cities. The most noteworthy aspect about the waste water treatment plan is that the facility is able to produce biogas. The biogas is going through a

filtration system that has the capacity to generate electricity. The installed capacity of the plant is 230 kWh. The plant is producing 180 kWh of electricity, which accounts for 80% of the necessary energy to run the plant. The energy produced is used to operate the waste water treatment facility. As of 2011, the tariff for one cubic meter of waste water was RON 2.39 including VAT.

Energy density for waste water treatment (kWhe/m3)



Over time, the treatment plant was modernized and rehabilitated in order to comply with EU environmental protection standards, and to improve the overall efficiency of the system. One of the first rehabilitation and upgrading works took place towards the end of the 1990s, and it was implemented through EBRD's Municipal Utilities Development Program with USD8 million. Treatment capacity increased by up to 1,620 liters per second and the biological treatment technology was replaced with a new aeration system. In addition, a new ecological lagoon (the first of its kind) was built. The lagoon complies with EU environmental standards requirements and stores sludge resulted from the waste water treatment process.

Later on, another project continued to improve the performance of the plant. This included, among other, the rehabilitation of de-sanding screens, of primary sludge pumps, of sludge digesters, the modernization of old tanks, and the construction of a new water treatment plant that could produce biogas. The project also further increased the treatment capacity from 1,620 liters per second to 2,200 liters per second, and improved the parameters of the treated flow. In addition, in 1999, Apa Brașov received USD1 million in financial support from the Danish Government to improve the sludge treatment and disposal in the facility on the Bârsa brook. A sludge treatment plant and an ecological lagoon for de-watered sludge were built, thus reducing substantially the risk of environmental pollution.

Waste water treatment plant in Brașov County

Source: kissfm.ro

Solid Waste

The solid waste system, including both collection and operation of the landfill, is managed by the private sector. There are primarily two companies, Urban and Comprest, both sharing almost equal business shares in the waste collection in Brașov city. A very small share is held by a third company, Cibin. The only eco-framed solid waste landfill in Brașov County is located at Săcele, approximately 19 kilometers far from Brașov city. The landfill is managed by Fineco, a company for which one of the main shareholders is Comprest. The ownership of the landfill is split between the local administrations of Săcele and Fineco.

A few years ago, the county managers thought to include the landfill managed by Fineco in the Solid Waste Master Plan of Brașov County, and in addition, build a new solid waste dumping facility at Făgăraș.

Meanwhile, the EU came up with a proposal to build two incinerators for domestic waste in Romania, of which one was to be located in Brașov County. The revision of the Master Plan indicated that a new landfill would not be required anymore, as additional waste would be brought to the incinerator. The ambitious EUR 140 million plan proposes the burning of 270,000 tons of organic waste annually, and in the process produce energy, obtain green certificates, and sell heat to the heating system of Brașov. However, in the meantime the number of clients connected to the district heating went down by a large margin. The incinerator would be a feasible solution provided there is high number of customers connected to the centralized heating system. Moreover, of the 270,000 tons collected annually in Brașov County, more than a third is processed at the sorting station and burning facility owned by Urban in partnership with Lafarge, a cement company. Given these circumstances, an incinerator plant is not the most efficient solution in the near term.

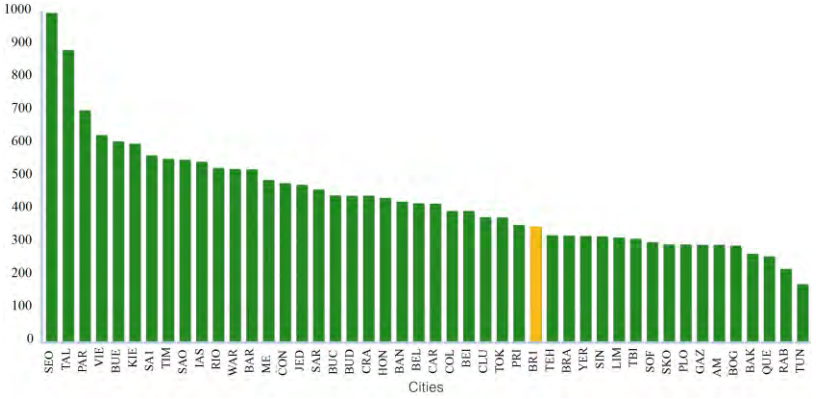
In 2012, the total amount of solid waste generated in Brașov city by residents and economic agents (excluding industry) was 79.3 million kilograms. Of this, almost 32 million kilograms were collected by Urban, approximately 44 million kilograms by Comprest, whereas Cibin's share was a little over 3 million kilograms.

Fineco landfill facility

Source: adevarul.ro

The overall annual solid waste amount generated per capita in Brașov (including all types of customers – residential, economic agents, and public institutions) is 347 kilograms, a figure that places Brașov in the middle of the TRACE database (average). Of the total of 347 kilograms of solid waste produced in the city, a third (122 kilograms) is generated by domestic customers only.

Waste per capita (kg/year)

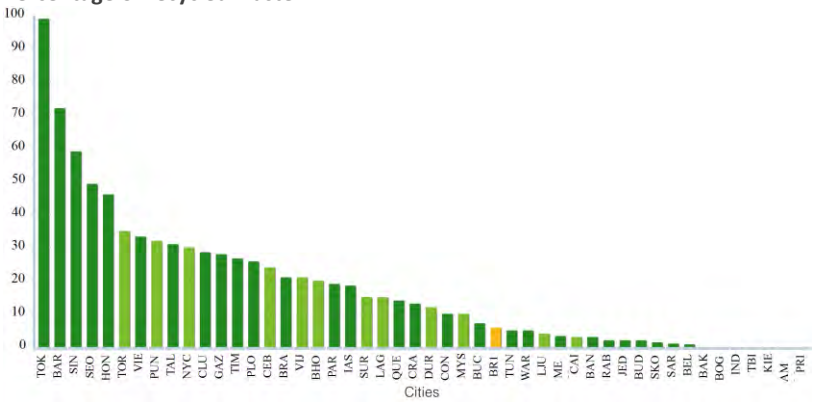


Urban, one of two main private companies in charge with the collection of solid waste, was established in 2001 and it is operating in the field of solid waste collection, transportation, and disposal in several cities in Romania. The company has a concession agreement with the City of Brașov to operate the solid waste collection in the city. Urban is catering to approximately 97,000 residential customers and 2,300 economic agents and public institutions in the city. Overall, the company is responsible for 40% of solid waste collection in the city. Comprest, the other solid waste operator has around 100,000 domestic customers.

Selective collection in the city is done through containers of different colors, placed in front of residential buildings. Urban had placed 75 such selective collection platforms, where containers of 2.5 cubic meters are available, and another 92 collection platforms where people can dump the recycling waste in smaller containers of 1.1 cubic meters. The waste collection at the source is done through three different bins. The green ones are for bottles, the yellow for plastic and metals, and the blue for paper and cardboard. Plastic has the highest rate of collection, followed by paper and glass. The trucks are picking up the recyclables a couple of times a week. However, despite the solid waste operators'

efforts, the recycled waste rate in Brașov is less than 6%. This is one of the lowest rates in this respect within the TRACE database. The recycled waste share in some of the cities in the region, like Bratislava and Ploiești, is three and four times time higher than in Brașov.

Percentage of recycled waste



It would be important for local authorities to take serious steps towards addressing this issue, by organizing public awareness campaigns, and by teaching people to be aware and mindful about recycling waste. It would also be worth assessing how much of the recycled waste is picked up by informal networks of collectors. Alternative systems with underground collection containers – such as the one in Slatina – can be further explored.

The company usually operates 18 solid waste trucks, but when there is a higher demand, the company can bring more vehicles from neighboring cities where the company operates, including București. The average age of the truck fleet operating in Brașov is seven years. In 2012, the annual fuel expenditure for the collection, transport, dumping of the solid waste in Brașov city cost Urban RON 1.8 million including VAT, representing about 8% of the total operational budget.

The tariff paid by domestic customers for the collection of waste is RON 8 per person per month including VAT, whereas economic agents and public institutions pay RON 49 without VAT per cubic meter. The tipping fee that Urban is paying at the waste processing facility at the landfill site at Săcele is RON 80 per ton.

Urban garbage truck

Neither the city nor the county has a compost station. Urban built a sorting station in partnership with Lafarge, a large cement company, for which the two entities invested more than EUR 1 million. After the organic waste is separated at the sorting station, Urban takes the remains to the landfill managed by Fineco. The landfill is only 3 kilometers from Urban's sorting station, which is located 10 kilometers from the city center. Overall, the amount waste taken to the landfill accounts for 80% of the total waste collected. The part of the organic waste recuperated following the sorting process is supplied to Lafarge. The cement company is using the energy generated by the waste to operate the factory.

Despite the low collection rate, recycling proves to be a profitable activity. Standard rates for different types of recyclables are ranging from RON 100/ton for colored glass bottles to 1,950 transparent plastic bottles (PET) and EUR 80 per ton of paper and cardboard (more details about tariffs for recycled waste in the table below). The plastic bottles and other recyclable materials are sold on the private market.

Type of recyclable waste	Tariff
PET transparent	RON 1,950/ton
PET colored	RON 1,000/ton
PET blue	RON 1,000/ton
Glass colored bottles	RON 100/ton
Glass transparent bottles	RON 200/ton
Cardboard and paper	EUR 80/ton

Source: Urban Brașov

Energy Efficiency Recommendations

TRACE is a tool that allows for the estimation of energy savings potential in different city service areas by benchmarking the performance of a city against other cities with similar characteristics, such as climate, population, or Human Development Index. For example, energy consumption per street light pole in Brașov was compared to similar consumption of other cities within the TRACE database with similar climate. The energy savings potential with regard to street lighting in Brașov was calculated using a method that factored in the cities that performed better than the city, and the degree to which these cities performed better. The more information is available in the TRACE database, the better results it can provide. Currently, TRACE has data on almost 100 cities, which allows for good comparisons.

The energy saving potential is also determined by the level of local control. The more control local public authorities have over a particular service area, the higher the energy saving potential. Like in many cities in Romania, in Brașov some public utility services are managed by the city itself, whereas some others stay with the private sector or they are regulated at the national level. Solid waste, including the landfill operation, is managed by the private sector, and so the City of Brașov does not have any significant say in this matter. The potable water sector is under public management, in which the largest shareholder is the County Council Brașov; other municipalities to which the water company is catering also have shares in the water company. The district heating is split between the private and public sector, as the production of heat is managed by a private entity, whereas the transmission and distribution of heat is done by a public entity. The city also has very little influence over the energy sector, as policies and regulations are decided by the Government at the national level. “Private vehicles” is another service area where the local level of control was considered low. In this sector the policies and decisions are taken by the Government, with limited scope for local involvement.

After the saving potential for each sector was calculated, a sector prioritization was done in TRACE, based on the amount of savings potential. The sectors with the largest energy savings potential in Ploiesti are “District Heating,” “Public Transportation,” “Private Vehicles,” ”Street Lighting,” and “Water.” “District Heating” is the sector with the highest potential of energy efficiency gains, although this field is controlled by both the private sector and the city government. The sector with the second highest potential of energy saving is “Public Transport,” a domain under the City Hall Brașov. The third sector with significant saving potential is “Private Vehicles”, although the local public administration does not have much control over this sector. The next area with a good potential of energy savings as highlighted by TRACE is “Street Lighting,” which is under local municipality control. The “Water” sector is under the County Council Brașov, but since the City Hall Brașov has some shares in the water company, it can influence some decisions. Although TRACE has identified some saving potential regarding “Solid Waste,” the sector is under private management with limited local control.

Sector prioritization

City Authority Sector Ranking

Rank	Sector	REI%	Spending (US $)	CA Control	Score
1	District Heating	35.0	15,030,303	0.75	3,945,454
2	Public Transportation	25.1	10,690,472	0.95	2,553,346
3	Street Lighting	25.2	1,899,923	0.95	454,841
4	Municipal Buildings	0.0	0	0.95	0

City Wide Sector Ranking

Rank	Sector	REI%	Spending (US $)	CA Control	Score
1	Private Vehicles	22.3	80,134,661	0.10	1,788,478
2	Solid Waste	35.3	1,197,382	0.60	254,238
3	Potable Water	25.0	925,765	0.60	138,864
4	Wastewater	20.0	139,060	0.60	16,687
5	Power	5.0	0	0.10	0

All priorities identified by TRACE were presented and discussed with local public administration officials. A number of eight recommendations have

been highlighted, and these will be discussed in more detail in the next sections.

District Heating Network Maintenance

The TRACE analysis indicates that district heating has the highest energy saving potential. It is the sector where proper investments and measures (e.g. the rehabilitation of the district heating network) would bring the most significant cost savings for local authorities, and most significant energy savings for the city as a whole. At the same time it is important to note, as was done in the case of Cluj-Napoca that an in-depth cost-benefit analysis of district heating maintenance work should be done before commencing such an endeavor. District heating rehabilitation work is costly, and in an environment where the large majority of people have de-branched themselves from the system, it is worth considering the potential long-term impact.

The ultimate objective of such measures would be to reduce the leakages in the network and improve overall efficiency of the system. This can be achieved through a maintenance program targeting the repair and upgrade of boilers, pumps, pipes, and insulation. An initial investment of USD 1 million over two years can prompt up to 200,000 kwh in energy savings annually. A feasibility study prepared in partnership with an appropriate team including network planners, heat & power engineers, and financial advisors could indicate the technological and financial viability of the maintenance work. Subsequently, the local government could approach an energy saving company that could implement the maintenance project with its own funds. In addition, local authorities could pass legislation that will require a minimum efficiency level within the generation and supply infrastructure of the district heating network.

Operated by a mix of public and private management, in which the heat producer is a private entity, while the supplier is a public company, the district heating system in Brașov has undergone significant changes recently. From one of the largest operators in the country in the early 1990s, having 80,000 customers connected to its hot water pipes, the district heating structure shrunk soon after the local industrial base collapsed. After the heating plant went bankrupt and eventually was shut down, the heat production was taken over by the private sector. Today, the district heating user base in Brașov is the smallest of all similar systems in other growth poles with only 12,000 customers (apartments).

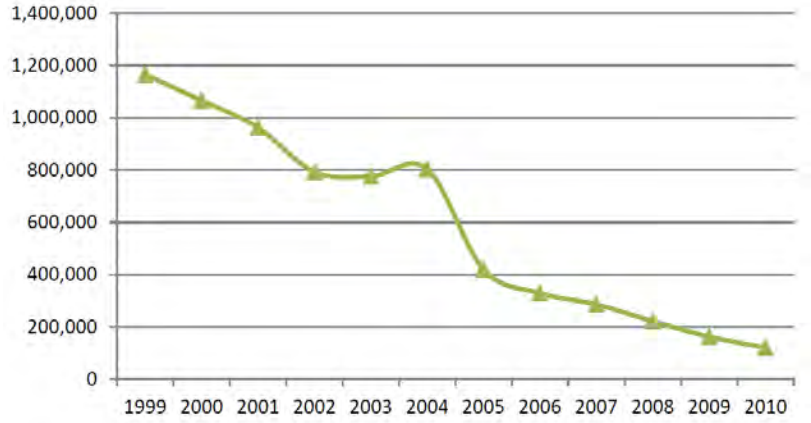
The state-owned Brașov CET was closed down after it went bankrupt

Due to the oversized, obsolete network, as well as leakages in poorly maintained pipelines, the losses incurred by the district heating operator are around 64% - one of the highest rates in the country. Although the heat price paid by population is the third lowest in Romania, the losses in the transmission and distribution network make the district heating operations quite inefficient. That is why the local administration, who owns the pipeline network, may consider improving the efficiency of the system by performing network maintenance and rehabilitation work. The network rehabilitation should result in a better functioning of the centralized heating structure, increase the comfort for residents in their apartments, and, not in the least, reduce disconnections from the system and make people reconnect to the plant.

The closing down of large industrial facilities in the city and the disconnection of thousands of apartments from the district heating have led to a significant decrease in the demand for heat. For instance, the heat produced in Brașov reached its peak in 1999, when 1.16 million Gcal were

distributed to the customers in the city. Gradually, the heat production went down. 962,887 Gcal were distributed in 2001, 775, 909 Gcal in 2003, 420, 996 Gcal in 2006, and 222,041 Gcal in 2008. The lowest figure was achieved in 2010, with only 120,140 Gcal, almost ten times less than the amount in late 1990s.

The evolution of Gcal distribution in Brașov City for 1999-2010



Source: National Institute of Statistics

The good news is that the number of customers has been stabilized at 12,000, as no disconnections have occurred in 2012. On the contrary, a small number of people started connect back to the district heating system, mainly because the micro-units have become difficult to sustain, as the natural gas price has gone up. In order to attract back more customers, the district heating operators must improve quality of services and reduce the losses in the network by rehabilitating the water pipes.

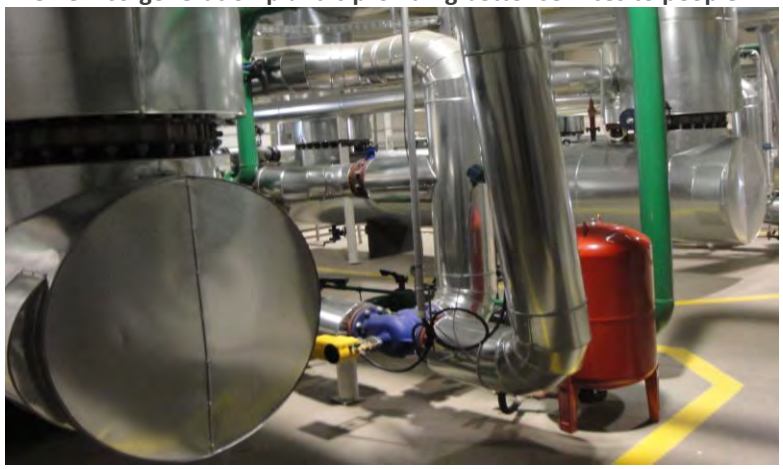
Unlike in many other cities in Romania where the system was built in the 60s and 70s, the centralized heating structure in Brașov has a little over 20 years. However, the quality of the material used for the pipelines was poor, as they leak hot water during both transmission and distribution. Bepco, the private heat producer, is focusing on how to reduce these losses and make the system attractive to people, in an attempt to regain market share.

District heating pipes

Source: mytext.ro

Bepco, the heat producer, and Tetkron, the heat supplier, are working together to make sure that the centralized heating system will be kept alive in the future and that local government will stick to the commitments to further support the system. One of the reasons for maintaining the district heating system alive in the future has to do with the 12,000 customers who receive hot water and heat from the district heating operators. Most of these customers in old communist residential buildings are people with low incomes, and they could not afford to switch to individual heating units, if the centralized system stopped operating. Moreover, the city is located in the heart of the mountains where winters are longer than in other parts of the country, and so people need to rely on heat for a longer period of time.

The new co-generation plant is providing better services to people



A network rehabilitation project, financed with a EUR 12.5 million EBRD loan, is currently under way. Another project is targeting the rehabilitation and upgrading of the small sub-plants. The project is expected to be executed with EUR 2 million grants from the Romanian-Swiss Fund, for which Brașov is competing against other cities in Romania.

However, one of the main investments that the district heating system needs is the rehabilitation of the distribution system inside residential buildings. More specifically, it is important to make the switch from vertical heating networks to horizontal ones. In addition, heat meters and allocators should be installed in all apartments, so people can control the level of heat. Such an ambitious plan requires over EUR 120 million investments. In addition, in the future, the co-generation system should be consolidated and expanded.

Both the operators and the local government are looking into getting back the lost market share and making former customers reconnect to the district heating system. Bepco is thinking of starting an incentive pilot program to persuade people to come back to the centralized system. The district heating operators are targeting some of the apartments that have switched from centralized to individual micro-heating units. The company would allow apartments to reconnect to the centralized system and, at the same time, stay connected to their individual heating units.

Thermally rehabilitated building with some apartments disconnected from the district heating system in Brașov

Source: newsbv.ro

Having both options, people would get the chance to see which system is most efficient and works best for them. It is expected that the thermal rehabilitation performed on a few thousands of apartments within old residential buildings in recent years actually increased heating efficiency, and so it increased the satisfaction of the clients. As such, this would be a good motivation for people to reconsider moving back to the centralized heating system. A few owner associations have already approached the district heating supplier asking for technical support to reconnect back to the centralized hot water and heat distribution system, and more are expected to do the same in the future.

In addition to these current efforts, based on the TRACE analysis, local authorities could consider passing legislation or creating policies that require minimum efficiency levels in both the generation and supply infrastructure of the district heating network. The efficiency levels should make sure that the replacement program is staggered, and the first assets targeted are actually those that perform the worst and that need immediate attention.

As of now, it seems that the model of having two companies in charge with the operation of the district heating system may work to some extent. However, in the future, it may be more efficient if the entire operation of the centralized heating structure will stay with only one company, an entity that could have the capabilities and the means to be in charge of the entire process, from production to distribution. In any situation, the agreement between the city government and the operator should be conducted in a transparent, equitable manner to ensure that all parties are fulfilling contractual obligations.

Jiamu District Heating Network (example)

The Jiamusi district heating network in China is a good example of how an energy service company could help improve the performance of the network and also increase satisfaction of clients with regard to hot water and heat services. The management of the network was taken over by an energy saving company that implemented a large scale initiative to improve performance and upgrade the network's facilities. The upgrading work included, among other things, a SCADA system, enabling real-time management of the sub-stations and the network, and resulting in improved optimization of energy efficiency and users' comfort. As a result, water losses were reduced by 30% and energy consumption by 13.5%. The relationship with customers has also improved and the percentage of late-paying customers was reduced from 7% to 2%.

Urban Transport

TRACE identified the urban public transporation as one of the sectors with significant potential for energy efficiency gains in Brașov. The city managers have in mind a series of initiatives that seek to improve the public transport in the city, bringing in less poluting vehicles, improving traffic, and providing citizens with good quality transport services. Therefore, the TRACE recommendations bellow fall mostly within the scope of what the local public administration is alredy undertaking, or is planning to take on in the near future.

These measures include: traffic restraint measures, improving the public transport network, and expanding the pedestrian network in the city. In addition to that, Brașov should establish a database with key transport indicators, which are easy to update and to monitor. For example, at the very basic level, it is important to know the modal split in the city – i.e., what means are used by people for daily commutes (e.g., private vehicles, public transport, or biking and walking). Documenting the number of commuters and understanding the means of transportation is vital information for any city in order to prepare a comprehensive mobility plan. A good mobility plan can form the foundation for developing a sustainable transport network. The Ministry of Regional Development and Public Administration is working with the EBRD to prepare mobility plans for all seven growth poles and București.

Public Transport Development

This main TRACE recommendation focuses on the need to develop a modern and safe public transport system. Developing a good public transport would not only provide citizens with better quality services, but would also reduce the use of private vehicles and encourage people to use buses and trolleybuses for daily commutes. At the end of the day, this can help reduce fuel consumption, improve air quality, and increase the standard of life for Brașov's residents.

This ambitious goal can be achieved by implementing an efficient set of measures, including giving priority to public transport vehicles over private cars, creating special signaling for buses, introducing e-ticketing, providing passengers with useful information about bus schedules, and not in the least, establishing better urban planning policies and regulations. Some of these measures are already under implementation, while the city government should consider putting into practice additional tools that could have a positive impact on the public transport network in the city.

The public transport system in Brașov is currently run by two means of transportation: buses and trolleybuses. Brașov is one of the cities in Romania that has lost their tram network. At the end of 2005 local

authorities have decided to remove the tram lines because of financial considerations and because the infrastructure was quickly deteriorating and was difficult to maintain. Instead of investing in the rehabilitation of the tram tracks, the city government focused on modernizing the existing bus and trolleybus fleet and on improving the overall quality of public transport services.

There are 253 buses and trolleybuses serving 45 routes within the city. According to the National Institute of Statistics, the number of buses in Brașov has fluctuated quite a bit in the past decade: from 141 in 2000 it dropped to 126 in 2004, and then went gradually up to 256 in 2011. Currently, there are 215 buses in operation, each of them with an average travelling distance of 125 kilometers per day. The number of trolleybuses also changed over the course of the past years, as it came down from 131 in 2000 to only 45 in 2011. As of now, there are 38 trolleybuses operating in the city, serving eight routes; each trolleybus is running on average 82 kilometers per day. The loss of the 58 trams (the full fleet in 2005) was compensated by the introduction of both buses and trolleybuses.

One of the main priorities for the local government with regard to public transport is to renew the fleet. The city must replace the vehicles that have reached the end of their life cycle. For instance, most of the 109 buses that were purchased in 2006 have reached 75% of life cycle and they need to be replaced with new modern rolling stock starting in 2014. The city has already begun investing in the modernization of the public transport fleet, and it is advised to continue to do so in order to make the public system more accessible, more attractive, and more comfortable.

In 2011, the public transport fleet was renewed with 15 BMC buses equipped with EURO 5 diesel catalyst, and plans are to continue in this direction. Overall, the public transport authority needs around EUR 100 million in order to modernize the entire bus and trolleybus fleet in Brasov. RAT Brasov, the company in charge with the public transport, has ambitious plans of purchasing hybrid buses and highly efficient trolleybuses. The local authorities hope that purchasing of new rolling stock would become eligible under the financial programming of the ROP for the period 2014-2020. Of course, EU funds will not be enough for the renewal of the entire fleet.

New public transport vehicle

Source: brasov.net

One of the main projects to be developed in the immediate future is the modernization of five bus terminals: Noua neighborhood - Brazilor Street; Roman neighborhood - Poienelor Street; Rulmentul neighborhood - 13 Decembrie Street; Saturn neighborhood – Saturn Boulevard; and Triaj neighborhood- Hărmanului Street. The value of the project is RON 34.3 million, of which almost 28 RON million comes in grants from the 2007-2013 ROP. The feasibility study has already been prepared, the project was evaluated, and now the city government is waiting to sign the contract.

Once the contract is signed, the modernization work will start off in the summer of 2013. The implementation of the project will take 18 months. All 119 bus stops in the city will be equipped with LCD screen displaying relevant information about the bus routes, schedules, arrival times, delays, and other travel related information. This information will allow passengers to better plan and manage their trips, enhance attractiveness of the public transport, and thus increase the number of users.

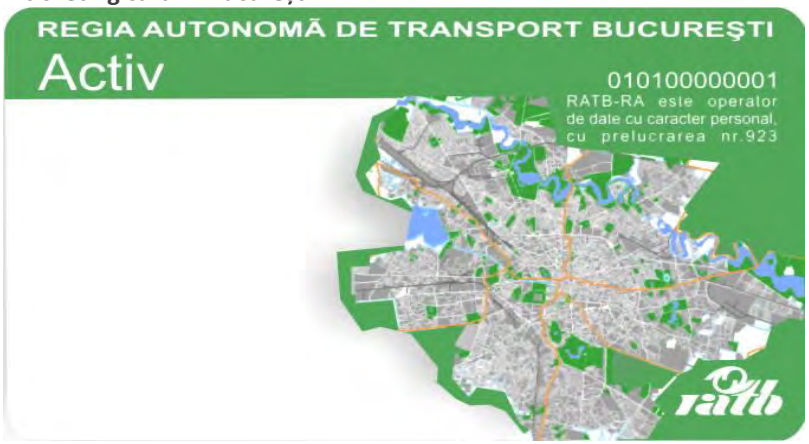
This bus terminal will be modernized with ROP funds

Source:kissfm.ro

The good news is that if a bus is late, it will be given the "green light" to pass through intersections and help with the traffic flow. In addition, all buses will be equipped with GPS and GIS integrated systems that would be centrally controlled from a new monitoring center. Adding such equipment on the buses would cost the municipality and the local transport authority an additional RON 4.5 million, as EU funds cannot be used for purchasing such devices. This equipment will contribute to the better management of the bus fleet. It would also help improving the traffic flow of public vehicles in the city, especially during the rush hour.

Another important project expected to be implemented soon is e-ticketing – i.e., paper tickets will be replaced by electronic cards. The system is implemented already in a few cities in the country, including București and Timișoara. The cost of the project is RON 31.5 million, of which 20.3 million comes in grants from the ROP 2007-2013. E-ticketing could be used for more trips and means of transportation within a given amount of time, but also for the future park-and-ride facilities the city is planning to build in the immediate future.

E-ticketing card in București



Source: ratb.ro

E-ticketing will not only reduce the cost of travel and encourage more people to use public transport, but also provide support for revenue collection, and will give the local authorities reliable figures on how many people use public transport on a day-to-day basis. A similar system is already implemented in a few cities in Romania, including Bucharest. In the capital city, people use e-ticketing for all public transport trips in the city. The e-card can be used for public transportation above ground, such as buses, trolleybuses, and trams, but it has an option to be charged and utilized as a monthly pass for the underground metro as well.

The plans concerning the development of the public transport in the city include employing an integrated traffic management system. A dispatcher and a command and control room will be located in the City Hall, from where the traffic in Brașov will be monitored with the support of video cameras installed throughout the city. The system will help the city authorities ensure and improve traffic safety in the city, identify traffic congestions and bottlenecks, and then take the proper actions for rapid interventions to ease up the traffic.

RAT Brașov has forward-thinking measures to make the public transport more energy efficient and reduce fuel consumption. One way of doing so is by training the drivers to operate the buses more carefully and

efficiently and achieve a 2% in fuel consumption. The company has a computer-based system through which they can monitor the daily and monthly diesel consumption, and see if there is any fluctuation and whether the consumption is going up or down. RAT Brașov will enforce a reward system for the bus drivers who achieve a significant diesel reduction and win the monthly contest in this regard. The company will consider a salary raise of 10% for the drivers who successfully bring down the monthly fuel consumption and make the highest savings. Not in the least, expanding the public transport to the wider metropolitan area is another priority for the city government of Brașov, as the local government wants to ensure good connections to adjacent local communities.

These current plans and efforts are well aligned with several TRACE recommendations, but there are also some additional suggestions that local authorities should consider. For example, a complementary solution for achieving a better, more attractive public transport is to develop special infrastructure for bus-priority signaling. Transponders that use GPS systems are linked to buses, and give them priority at green lights.

In addition, local authorities may also consider setting up dedicated bus lanes. Such dedicated lanes will allow buses to bypass traffic, enhancing their reliability and reducing travel times. Cities that have developed a good network of dedicated bus lanes were able to successfully manage public transport traffic, attract more people toward public means of transportation, and increase system efficiency. Such initiatives could be accompanied by a few information campaigns to raise citizens' awareness of the benefits of the public transport.

Not in the least, local authorities could also consider improving some of the current planning regulations. In some cities, in order to obtain planning permits, developers must show how a new construction/building links to the existing or planned public transport networks. For example, Curitiba, a city in Brazil, encouraged high-density residential and commercial development around and within walking distance of transit stops, with lower densities elsewhere in the city.

Non-Motorized Transport

One of the main TRACE reccommendations made to city managers is to encourage and expand the non-motorized transport infrastructure in Brașov, including pedestrian areas ("pedestrianization") and dedicated cycle/walking lanes. Additionally, bike rental programs should be encouraged, along with incentive schemes for citizens to purchase their own bicycles, including – particularly in marginalized, poor communities – potential microcredits for bike purchases.

These TRACE recommendations are meant to create a virtous circle whereby public mentality regarding the use of non-motorized transportation gradually evolves away from the status quo, which is heavily dominated by the use of private vehicles, toward a healthier, more efficient, and more prosperous environment. Indeed, the experience of countless cities around the world proves that, for instance, pedestrian areas stimulate local businesses. Over the medium-to-long term, as more and more people turn to non-mototized transportation, others will also realize the benefits of this alternative way of getting around (i.e., lower cost, faster times, cleaner air, healthy exercise, etc.).

Local authorities in Brașov have already begun to implement some of the measures recommended above and have ambitious plans for building up current efforts in the near future and for the 2014-2020 programming period. For example, the main pedestrian area in Brașov includes over 15 streets and alleys in the historical city center, from Republicii Street to Sfatului Plaza where the famous Black Church is located. The municipality has restored the façade of some old, historical buildings benefitting from ROP 2007-2013 support. Today this area is the main attraction in the city for both local residents and tourists, not only for its pedestrian network, but for its commercial activities, such as shops, restaurants, bars, service stores, and souvernir boutiques. The number of pedestrians in the area has gone up and businesses and business activity in the area have increased substantially, as the whole area has increased in quality of life standards. Indeed, as business activity improves, more and more building owners are renovating their properties to take advantage of tax breaks guaranteed by the local authorities, thereby generating even more business. For the fufure, local authorities could look at other areas where pedestrian areas could be created. In particular, they

could consider residential neighborhoods, which are often neglected when such projects are pushed forward.

In addition to enlarging pedestrian areas, the city government is looking into improving and expanding the bike lane network. The city has only 15 kilometers of dedicated lanes for bicyclists, and part of the network is damaged and needs to be rehabilitated. The city has a docking station in the city center in Piața Sfatului, where people can rent 50 bicycles during the summer. This is part of a project the municipality has developed in partnership with a commercial bank and a non-profit organization. The "I Velo" biking program is operational in the summers only, in many cities in Romania, including Timișoara, Cluj-Napoca, and București.

Developing and expanding the bike infrastructure in the city is one of the City Hall's priorities when it comes to the transport sector. In 2012, local authorities prepared the documentation for a tender aimed at designing the bike network to connect the main neighborhoods in the city. The future network will connect areas and streets along public institutions and plazas to mountain trails and leisure areas.

I Velo docking station in Piața Sfatului

Source: green-report.ro

Just recently, local authorities have approved the feasibility study for the construction of 7 kilometers of bike lanes in Poiana Brașov, the mountain resort under the administration of the City of Brașov. The new bike network and docking station are expected to be ready in the next 22 months, and will provide tourists with the opportunity to admire the scenic views of the region while biking.

Currently, the local government is working to finalize the technical project. The total value of the project is RON 4.68 million, including VAT, while the annual maintenance cost is expected to amount to RON 42,000. The new bike paths include signaling and docking stations and parking spots for the bikes. Resting platforms with belle-views will be created at every 1.5 kilometers. Of course, this will not change significantly the pattern of transportation for people, nor reduce considerably the level of fuel consumption.

Bike networks will be built in Poiana Brașov

Source:paginibrasovene.ro

However, people tend to use the bike lanes once they are there. In time, once some people start using bicycles for their transportation needs, others could get encouraged to bike, and so increase the popularity of this non-pollutant transportation mode. For example, Critical Mass movements, which aim to popularize biking and to encourage safety for bikers in traffic, have spread throughout the country (particularly in larger cities, such as București and Cluj-Napoca) and are gaining in popularity.

City managers are also concerned to change people's mindset on bicycles and bikers, and want to encourage people to endorse this efficient means of transportation. The city authorities are determined to work on making bicycles and bicyclists traffic participants with equal rights, encouraging drivers to pay proper attention to them on the streets, and pedestrians to watch out for them on dedicated portions of sidewalks (issues that are requested through Critical Mass events in several Romanian cities). Therefore, the investments in new bicycle infrastructure should also take into consideration traffic safety issues.

Critical Mass event in Cluj-Napoca

Source: https://www.facebook.com/criticalmass.cluj?fref=ts

Regardless of how developed and lengthy the bike infrastructure will be, people are not going to take this mode of transportation into consideration if they believe it is unsafe. Bicyclists are often victims of accidents, as drivers do not always see bicyclists in time. In order to increase safety for bicyclists the new bike lanes should be developed to have a "buffer" of parked cars. On-street parking spots could be developed so as to also accommodate bike lanes – particularly on large corridors in the city, where sufficient space exists.

In addition to these much welcomed measures and future plans, the Brașov City Hall should also consider projects for facilitating bike ownership. Other cities around the world have adopted microcredit programs that allow poorer residents to acquire a bike and gradually pay it back at favorable interest rates. This is particularly appropriate for younger citizens with low incomes, as well as for members of marginalized and poverty-stricken communities. This measure would complement the current bike rental program, which can also be expanded to fully current demand and promote even stronger bike ridership.

Parking Restraint Measures

The TRACE analysis recommends local authorities in Brașov to put measures in place that discourage the use of private vehicles and provide incentives for using alternative modes of transportation. Fewer cars on the streets would translate in lower fuel consumption and less traffic congestion. Lower energy consumption can be achieved by developing park and ride facilities aimed at promoting multimodality by linking parking to public transport, and by setting parking allowances for new residential and corporate developments.

The number of cars in Romania has increased dramatically after the fall of the communist regime, which has created significant problems with regards to traffic and parking. Most of the parking lots were built several decades ago when the number of cars was much smaller, and so currently they cannot accommodate the growing number of cars. Brașov has been no exception in this respect. The number of cars in the city has increased in the past couple of decades, which has led to traffic congestion and inconveniences regarding parking in the city. With the increase in the number of city residents' cars and the flow of tourists driving in their own vehicles, the streets in the city center are congested and the demand for parking spots has been on the rise. Moreover, the construction of a planned airport near Brașov, at Ghimbav, is expected to bring more cars into the region and aggravate the already congested traffic in the city. Therefore, the city authorities have had to find solutions to accommodate the parking demand and now they are expanding on existing measures.

The new system of paying for parking by sending a text message from the cell phone has been implemented very recently, hence facilitating the payment method, and making it easier and more accessible to people. Now the payment can be done by merely sending a text message with the car details and also by introducing coins into the parking meters. Further projects are tackling the parking issue by building a

number of parking lots in the city with EU funds, thus expanding the parking spots by at least 1,000 in the next couple of years.

One of the solutions TRACE recommends for countering traffic congestion is the park and ride concept, which promotes multimodality by linking parking to public transport. The city managers have already considered this option and the five bus terminals that will soon be modernized with EU funds in the city include such park and ride facilities. People who commute into Brașov from suburban and peri-urban areas will be able to drive their cars to these parking facilities, from where they can take public transport to their workplace.

A multi-story parking will be built near the Military Hospital

Source: informator.md

In addition, new parking facilities will be built in the city and Poiana Brașov with support from ROP 2007-2013 funds. In the near future, the city expects to receive approximately EUR 10 million in grants to expand the parking system and improve traffic. Some of these projects have been evaluated and the contracts are expected to be signed soon. The implementation work would start within three months after the contracts are signed and will be completed in approximately two years, before the end of 2015 (the end of the implementation period for projects funded by 2007-2013 structural funds). Two parking facilities will be built in the next couple of years in the city and one in Poiana Brașov.

One of the future parking lots in Brașov is in the city center, near the Military Hospital. The total value of the project is RON 24.2 million with 2% co-financing from the City Hall. It is going to be a seven-floor parking structure, which will accommodate 310 cars. The other project included in 2007-2013 ROP is the new parking on Warthe Hill, located in the city center, just behind the County Library. It will be a "green parking structure," as it will be integrated in the green landscape surrounding the parking site.

The future "green parking" near the County Library

Source:adevarul.ro

The facility will be integrated within the surrounding landscape, and plants and grass will be planted on the roof as well on the sides of the building. In fact, the only visible component will be the entrance and the sides of each floor, which will make the facility look like a green hill. The four-level parking structure will have 322 parking spots spread over nearly 12,000 square meters. Eight designated parking spots for disabled people will be included on the first floor.

A new parking facility will also be built in Poiana Brașov and the public bus terminal will be expanded. The overall cost of the project is

RON 24.4 million plus VAT, and it is expected to help improve the traffic to, from, and within the mountain resort. The multi-level underground and surface parking will spread over nearly 10,000 square meters of which almost 3,000 square meters on the underground levels. The parking will accommodate 434 cars, and will have six designated spots for microbuses, two for buses, and six for tour buses. It will also include 80 square meters of bike network, in addition to another 50 meters of parking spots for bikes. At the entrance, a screen will display the number of free spots, showing the available places where a car could be parked. The access to the parking will be made from DN 1 E, the main national road connecting București to Brașov.

Finally, based on the current TRACE analysis, the city government should also consider introducing parking provisions for residential and corporate developments. A maximum parking allowance with low car-to-unit ratios could discourage private-car acquisition and use. London is a good example where this measure has been successfully implemented. In areas where there is bus connectivity the city government allocates less than 1 parking spot per unit. Although this option should be quite convenient for the local public administration as it does not require immediate investments from the city budget, it should be coordinated with expanding public transport in the area, as necessary.

Municipal Buildings Benchmarking

One of the main recommendations the TRACE team has made to most local authorities where the tool has been implemented, including in Brașov, is the need for a municipal buildings energy database, where all municipal buildings energy data can be tracked and monitored. Without a proper energy database in place, it is very hard to implement EE programs. More specifically, one cannot know if energy efficiency investments were indeed effective if it is not clear how much energy buildings consumed before and after the interventions. Most of local authorities in cities where TRACE has been implemented do not have a proper and reliable data base on the buildings they administer (e.g. data on schools, kindergartens, hospitals, public administration offices, cultural centers, social assistance and sport facilities). Brașov, like many other cities in Romania, does collect basic indicators on the municipal buildings it administers, indicators that would allow it to identify where EE programs are most opportune.

A proper and efficient analysis on the energy saving potential would require some basic information regarding the surface area of the buildings, the annual electricity and heating consumption, and the energy savings accomplished after renovation or thermal rehabilitation work has been performed. Although local authorities in Brașov pay for electricity and thermal energy bills, they do not have a clear, easily accessible picture about the amount of energy actually consumed in these buildings and about how these energy expenditures could be decreased. Moreover, the data on energy consumption will be very useful for local authorities when they will apply for ROP 2014-2020 funds, where energy efficiency will be one of the most important pillars. Under the next ROP financial programming, municipalities will be able to access funds that could help improve the overall energy efficiency of their cities by lowering the energy bills and, thus, save some money for the city budget.

School 13, one of the buildings managed by local authorities in Brașov

Source: looms.ro

The municipal building benchmarking process should include first of all a database consisting of a series of specific information that should include type of construction, date of the construction and renovation or rehabilitation (if the case), floor area, type of heating, information on electricity, heating, and water utility bills in the recent years. The data should be published and updated on a regular basis to enable competitions among building managers and open the paths for productive exchange of data and cooperation. Such database is also valuable in benchmarking buildings against each other and determining where is the highest potential in terms of energy savings at the lowest cost.

A small dedicated team within City Hall and a team of external consultants could be assigned with responsibilities to prepare this full audit of municipal buildings, with support from several departments within the local public administration, like economic and technical divisions. At the end of the day, the analysis should identify the most suitable energy saving options. The database could be very useful for the local public administration to perform an audit of the municipal buildings in the city and then to prioritize buildings for retrofitting.

The TRACE analysis includes several different models that the local government could look at when organizing the benchmarking process (see annex). In Bulgaria, for example, benchmarking was done through the Municipal Energy Efficiency Network, an association of thirty-five cities that promotes a successful municipal energy plan through an energy database and a training program for municipal officials. The energy efficiency information system has two components – a database and analysis, respectively. The database, which is a Microsoft Access application, contains objective, technical information, while the analysis has a series of non-technical information, such as financial, institutional, and regulatory documents, generated at the national level. The information is organized into three categories: municipality-wide consumption, site-specific consumption, and municipality-wide production.

Municipal Buildings Audit and Retrofit

Once the municipal building benchmarking is done, the next step the city management in Brașov should take into consideration is an audit and retrofit process. This could enable cost savings in municipal buildings, while also reducing the carbon footprint of the city.

The building audit is targeting specific energy consumption for end users and activities, such as computers, lighting, air conditioning and heating systems, etc. Depending on results, the city government may have to allocate money for energy efficiency upgrades, purchasing of new equipment, and some building renovation. The retrofit program can be executed in a cost-effective manner by involving Energy Service Companies (ESCOs), which will pay for the first cost of the upgrades and will share in the savings from the retrofits. Audit and retrofit programs make a great impact on energy savings, as studies show that the reductions can go down to as much as a fourth of the initial consumption.

Andrei Șaguna National College has been rehabilitated

Source:dcnews.ro

In recent years, the city government has actively supported energy savings and encouraged buildings, both public and private, to be proactive and save energy in any of its forms. Quite a few steps have been taken in this respect – e.g., renovation and thermal rehabilitation work and the replacement of classical heating systems with green energy-based

equipment. Rehabilitation work has been performed on quite a few education facilities in the city, while some schools have been connected to the district heating system. A few municipal buildings, including social assistance facilities, have replaced their classical heating system with those using solar and geothermal energy, a process that has led to significant reduction in energy bills.

Some of this rehabilitation work has been done with support from the 2007-2013 ROP. The city government is hoping that other similar projects will become eligible for EU funding in the 2014-2020 programming period.

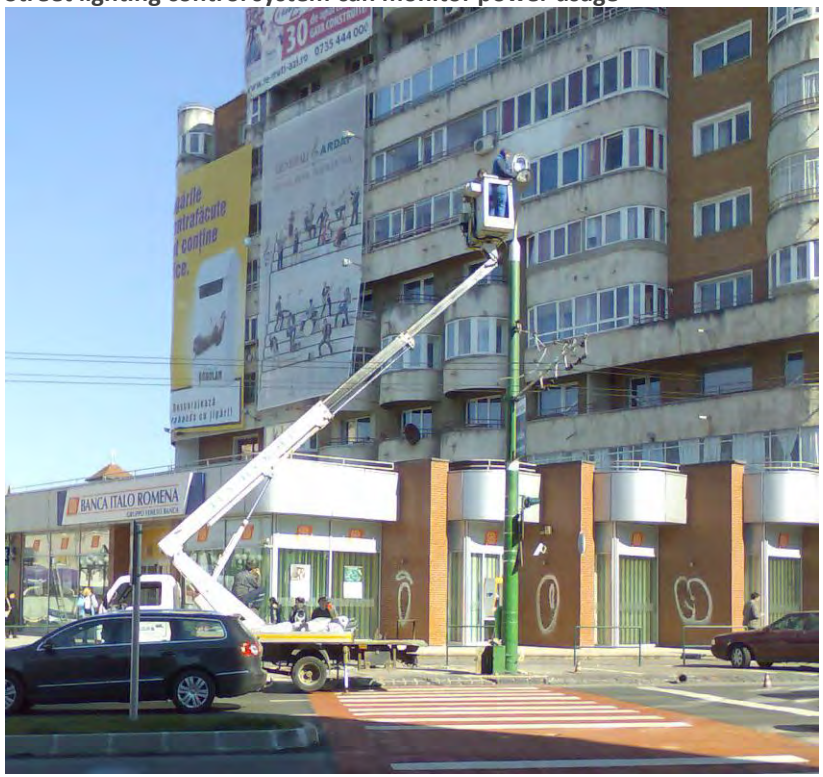
As an example, a successful model for improving energy efficiency in buildings has been developed in Berlin. In partnership with the Berlin Energy Agency, the city government managed the retrofit of public and private buildings by preparing tenders for work that will guarantee reductions in emissions. The public retrofit tenders require an average of 26% greenhouse reduction so that winning Energy System Companies (ESCOs) must deliver sustainable energy solutions. Under this program, 1,400 buildings have been so far upgraded at no cost to owners, managing to have more than 60,400 tons per year in CO2 reductions, and generate substantial savings, including in the short term.

Street Lighting Timing Program

The TRACE analysis recommends building on the city government's current efforts for improving the public lighting system. A very efficient, inexpensive method of reducing electricity consumption for public lighting is the street lighting timing program, a system that can be tailored for the specific needs of a particular area. Lighting timing programs can reduce energy consumption and, subsequently, carbon emissions and operational costs. In addition, such programs can increase the life of light bulbs, reducing maintenance requirements and associated costs. Also, they could enable timely detection of faults, allowing for quick replacement. This measure requires relatively small initial capital investments that can prompt energy savings between 100,000 kwh and 200,000 kwh within a year.

The street lighting system in Brașov is performing reasonably well compared to other cities in the TRACE database. Over the course of time, the street lighting provider has modernized lighting in the city in order to increase the overall efficiency of the system and provide citizens with better services. Old mercury bulbs have been replaced with more energy-efficient sodium vapor bulbs. As a consequence, the electricity consumption came down by 20%, a significant step towards meeting the overall goals of the city's Sustainable Energy Action Plan (SEAP).

Street lighting control system can monitor power usage



Source: newsbv.ro

But there is still room for improvement and a street lighting timing program can help the city achieve further energy savings. The local public administration has already considered innovative methods through which

street lighting electricity consumption can be diminished. The city managers are currently in the process of implementing one of the most innovative programs that will not only improve the system's efficiency and cut down the greenhouse emissions, but also increase safety for city residents. With financial support from the 2007-2013 ROP, Brașov will be the first city in Romania to implement an intelligent street lighting system. A pilot project has been already deployed since 2010 in a few areas in Brașov. Now this system, which is also implemented in countries like Turkey, Switzerland, and the United Arab Emirates, will be expanded throughout the city. Special devices with sensors will be installed on each of the street lighting poles.

A tele-management system will allow for adjusting the light intensity depending on traffic or pedestrian activity in the area. It will open and turn off street lighting remotely and, depending on weather conditions, it will enforce a flexible operation schedule, since it can target the entire network or just few streets. The intensity of lamps will vary depending on the daylight intensity; for instance, during nighttime, the brightness of streetlamps will be higher than in the evenings.

Example: Light dimming program in Kirklees, UK

For example, the city of Kirklees, UK, was able to dim lights to varying levels throughout the day by installing retrofit systems on each existing lighting pole and wireless technology to monitor and dim the street lights. The retrofitting process simply required to add a small antenna to the lamp heads, which plugged into the electronic ballast, with no need for additional wiring. As a consequence, the lights are switched on 100% at 7PM, 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 to ensure safe conditions for the morning commuters.

The Brașov local authorities have similar plans. The intelligent street lighting in Brasov, including the new equipment, will be monitored through a high-performing SCADA system from a control room which will be located within the City Hall. In the first stage of the implementation of this intelligent lighting system, 46 video cameras in 25 locations in the city will be installed to help identify any suspect and criminal activity in the area and prompt immediate intervention from the Police, if necessary. Cameras will be set up in neighborhoods where the rate of criminal activity is higher, such as Noua, Bartolomeu Nord, and Tractorul, but also in the city center, an area very popular for the city residents as well as tourists. In addition, panic buttons will be displayed on the lighting pillars and will be connected to the dispatching and monitoring room from the City Hall. The new innovative lighting system will be able to identify any damage of the system (pillar) and service interruption. The problems will be reported immediately to the monitoring center and will have an appropriate and timely solution.

The most noteworthy aspect about the new monitoring and light dimming program is related to the potential of energy savings. In the first year of implementation, the electricity bill for the street lighting will come down by USD 100,000, which can be translated into an effective saving of approximately 450,000 kWh. The system could also promptly identify any illegal branching and other non-approved activities on the lighting poles. At the same time, one of advantages of this performing and innovative structure is its resilience, as it should allow for the intelligent development of few applications that are related to the street lighting and road network.

Active Leak Water and Pressure Management

The TRACE analysis recommends the implementation of an active leak detection and pressure management program. A leakage detection program could enable the provision of minimal pressures and encourage a more sustainable use of water resources. This can be accomplished through a partnership with other stakeholders (e.g., non-profits, universities, private firms) who already have the required experience and expertise. A complementary water pressure management program is also recommended.

As noted earlier in this report, although the water sector is controlled by the County Council Brașov, and the municipalities to which Apa Brașov caters have limited shares in the company, this

recommendation could help Brașov and other cities in the region promote measures aimed to improve the efficiency of the system. The regional water operator in Brașov County has invested heavily in the rehabilitation of the system and has implemented a series of projects covering a wide range of areas, from renovation and modernization of the water distribution network to building new pumping stations and the installation of water flow meters and increasing the capacity of water treatment. The company continues the rehabilitation process in the future, hoping to further benefit from different financial schemes, including EU structural funds.

Rehabilitation work on water pipes

Source: http://posmediu.catd.ro/index.php/comp-proiect/18?ml=1 8

However, the company and its stakeholders should look into solutions to reduce the water losses to make the system more efficient and provide better services to the customers. In the medium and long run, there are a few issues that need to be addressed for the system to become more efficient. Some of these issues pertain to replacement of old pipes, expansion of meter connections to all customers, and not in the least, modernization of some of the old pumping stations.

Brașov, together with other municipalities, may influence the company and the Brașov County Council to take some measures that would benefit all citizens.

In the short- and medium-term, with an initial investment of up to USD 1 million (approximately EUR 755,000), local authorities could consider the implementation of an active leak detection and pressure management program. This measure could help not only reduce water, but also enable energy savings. The active detection program could be done using modern techniques, such as ground microphones and digital leak correlators, as well as demand management valves and meters. In sewage systems, leak detections could significantly reduce risk of ground contamination.

At the same time, pressure management programs can be efficient for reducing the treatment and pumping costs by minimizing the required delivery pressure and leakage. The pressure management program is suitable for large networks with several small leaks that would be difficult and expensive to locate and repair.

Digital water leak correlator

Source: halmapr.com

One of the most efficient ways to implement such detection systems is through partnership programs. The local public administration could partner with organizations and/or coalitions of non-profit entities to gain access to their experience and expertise in order to implement the most appropriate changes to the pipe or pumping infrastructure. Often times, public organizations build public-private-partnerships to undertake research, educational programs, and policy advocacy, design and implementation of energy-efficiency projects, and promotion of technology development.

Few cities in Romania have worked out such partnerships to successfully reduce the water leaks in the system. Iași is a good example in this respect. The local water company partnered with a US environmental provider to develop a pilot leak detection program and a water conservation project in addition to a public outreach campaign, for a total investment of less than USD 120,000. This leak detection program was a pre-requisite for the implementation of an infrastructure program that was to be implemented in Iași County. In addition, the citizens were encouraged to take part in water conservation efforts. The study showed that three of the leaks identified were responsible for a water loss of 60,000 cubic meters per year, accounting for USD 24,000 losses. At the end of the day, this project contributed to a much larger program to improve the overall efficiency of the water system in Iași County that eventually reduced the water losses by 8 million cubic meters and saved USD3 million (approximately EUR 2.25 million) per year.

Another similar program was developed with USAID support in Galați, where the study identified that conservation measures could save up to USD 250,000 (EUR 190,000) per year in electricity costs. The study included low and medium cost measures, such as trimming impellers to better match pumps and motors with required flows and pressures.

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Instrumente Structurale
2007 - 2013

Annexes
Improving Energy Efficiency in BRAȘOV Romania

ROMANIA
REGIONAL DEVELOPMENT PROGRAM

TRACE City Energy Efficiency Diagnostic Study


Municipal Buildings


Water and Wastewater


Solid Waste Management


Public Transport


Public Lighting


Power and Heat

Regio
PROGRAMUL OPERAȚIONAL REGIONAL

Inițiativă locală. Dezvoltare regională.

Detailed Recommendations from TRACE

Improving Energy Efficiency in Brașov, Romania

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ANNEX 1: District Heating Network Maintenance & 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. 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.
Direct expenditures "Municipal Buildings" where education and health care facilities are under the city government control have a good energy saving potential. & 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 Authority can pay for these items directly out of the city budget, and recoup the investment through lower primary fuel costs. 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. 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

District heating network pipe maintenance, Seoul, Korea

DBDH, Direct Access to District Heating Technology "Seoul Metropolitan District Heating Network", http://www.e-pages.dk/dbdh/12/

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 DBDH, Direct Access to District Heating Technology "Dalkia Management of Jiamusi Urban Heating Network" http://dbdh.dk/images/uploads/pdf-news/hotcool_1_2010_low.pdf 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
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 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.

Tools & Guidance
http://www.esmap.org/Public_Procurement_of_Energy_Efficiency_Services.pdf

ANNEX 2: 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 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 through private firms, resulting in a complex but innovative management structure.

Land Use and Public Transport Planning, Curitiba, Brazil

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

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

Source: Rabinovitch, J. (1992) "Curitiba: towards sustainable urban development", Environment and Urbanization, Vol.4 (2) pp. 62-73

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 Good practices in City Energy Efficiency: Eco^2 Cities - Land and Resource Management in Singapore, available online http://www.esmap.org/esmap/node/1230 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

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 3: 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 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
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
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
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
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
C40 Cities (2010). "Paris, France Velib - a new Paris love affair", available from
http://www.c40cities.org/bestpractices/transport/paris_cycling.jsp
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

Tools & Guidance
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 4: 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.

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

Park & Ride facilities	The City Authority promotes 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. See Oxford case study for further details. 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.

SF park 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

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
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

ANNEX 5: Building Benchmarking Program

DESCRIPTION

Develop a municipal buildings energy benchmarking program which collects and reports on an annual basis the energy use, energy bills, water use, water bills, floor areas, and names of building facility managers (if any). The goal of the program is to identify the highest energy intensive buildings in the CA portfolio so as to focus on the best energy efficiency opportunities. The benefits of the program are to use energy efficiency program resources most effectively and to spend time and money on the easy wins first. The program will also establish annual data for use in energy/carbon footprint for municipal operations.

This recommendation is best-suited to larger cities with the size and capacity to implement such a program. Regular monitoring and analysis of building energy consumption and identifying improvement opportunities is a good starting point for most cities. However, setting a proper benchmark requires detailed analysis because similar buildings can have significantly varying underlying factors, for example, types of tenants, occupancy density (people per square metre).

- **ATTRIBUTES**

Energy Savings Potential
100,000-200,000 kWh/annum
First Cost
< US$100,000
Speed of Implementation
1-2 years
Co-Benefits
Reduced carbon emissions
Efficient water use
Improved air quality
Financial savings

IMPLEMENTATION OPTIONS

Implementation Activity	Methodology
Appoint Benchmarking Leader	Appoint, or allocate 1-2 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. Alternatively hire an external consultant as a leader for the below activities.
Identify Benchmarking Requirements	Define essential and desirable information useful for an energy benchmarking database. Electricity bills are only one part of the benchmarking database, and many other key data points are required to contextualize the information. Data may include: • building name and address • electrical, gas, water utility account numbers

	• electrical, gas, water utility bills for past 3 years • building floor areas • energy and water meter locations and associated floor areas • date constructed and date of major renovation • building facilities manager (if any) • building heating, cooling, lighting system types
Set data collection strategy	Set up an efficient process to collect data for the database. Identify which department and which individuals are likely to have access to desired information. Define which data should be collected every year and set up a method to receive the data every year. Set up a method to check and verify data and allow time for validation. Some data may not exist in CA departments, and if so, primary data must be collected by Benchmarking Team (i.e. floor areas, areas allocated to meters)
Begin collecting data	Appoint junior staff to begin the arduous process of requesting data, receiving data, checking data, and collecting primary data from the source. Alternatively write an RFP and award a contract with a specific scope of work to gather energy benchmarking data for all municipal buildings. Data can be stored in spreadsheets or dedicated energy software tools. Care should be taken to ensure quality checks are undertaken at a detailed level to ensure accuracy of data entry.
Analyse and Interpret Data	Conduct an analysis of collected data to ensure accuracy and begin to identify opportunities. Some examples of analysis include: • compare kWh/m2/yr electricity consumption by building type • compare kWh/m2/yr heating energy by building type • compare total $/m2/yr energy consumption by building type Starting with buildings with the highest and lowest performance, verify the floor areas allocated to the utility meters and note any special situations which may increase or decrease energy use (server rooms, unoccupied space, renovations, etc.)

Formulate a Bespoke Benchmark	The results of the analysis stage must be used to formulate a benchmark suitable for the underlying factors affecting energy use in the city. This is required as these factors may vary significantly from city to city and between different buildings. These factors could include: • types of tenants • occupancy density (persons/m2) • building energy management This benchmarking is usually doen for the purposes of building labelling. See Singapore case study for further details.
Present Benchmarking Internally	One of the most significant motivators for energy efficiency in building operations is peer pressure as no building owners or operators want to be seen as having the worst performing buildings. So sharing building energy intensity internally across departments and operators will inherently improve energy consumption. This will also allow operators to share experiences to allow knowledge sharing across the CA.
Publish Benchmarking Publically	The boldest statement to show leadership in building energy efficiency is to publish energy performance data to the public, press, voters, and potential political opponents. This last stage of the benchmarking 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 building owners to benchmark their buildings 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:

- kWhe/m2 - annual electrical energy intensity by type of building (Schools, Offices, Residential, Hospital, Misc)
- kWht/m2 - annual heating energy intensity by type of building
- $/m2 - annual energy cost intensity by type of building

CASE STUDIES

Energy Efficiency in Public Buildings, Kiev, Ukraine

Source: ESMAP (2010). "Good Practices in City Energy Efficiency: Kiev, Ukraine - Energy Efficiency in Public Buildings", available online from http://www.esmap.org/esmap/node/656
Under the Kiev Public Buildings Energy Efficiency Project, 1,270 public buildings in the city of Kiev--including healthcare, educational and cultural facilities—were retrofitted with cost-effective, energy-efficiency systems and equipment. The project focused on the supply-side, such as automation and control systems, and demand-side measures, including installation of metering and weatherization, as well as a sound heating tariff policy. The project was undertaken by the Kiev City State Administration (KCSA). Savings from the retrofitting were estimated at 333,423 Gigacalories (Gcal)/year by 2006--normalized by degree/days in the base-line year--or about a 26% savings compared to the buildings' heat consumption before the project. These upgrades also improved the buildings' comfort level, helped foster an energy efficiency services industry, and raised public awareness of the importance of energy efficiency.
The project cost US$27.4 million and was financed through a World Bank loan, Swedish Government grant, and KCSA funds. Based on the project's success, many other cities in Ukraine have requested information on the project and expressed interest in implementing similar ones for their public buildings.

Building Energy Efficiency Master Plan (BEEMP), Singapore
http://www.esu.com.sg/pdf/research6_greece/Methodology_of_Building_Energy_Performance_Benchmarking.pdf
http://www.bdg.nus.edu.sg/BuildingEnergy/energy_masterplan/index.html
The Inter-Agency Committee on Energy Efficiency (IACEE) report identified strategic directions to improve the energy efficiency of the buildings, industries and transport sectors. The Building Energy Efficiency Master Plan (BEEMP), formulated by the Building & Construction Authority (BCA), details the various initiatives taken by the BCA to fulfil these recommendations. The plan contains programmes and measures that span the whole life cycle of a building. It begins with a set of energy efficiency standards to ensure buildings are designed right from the start and continues with a programme of energy management to ensure their operating efficiency is maintained throughout their life span. The BEEMP consists of the following programmes:

- Review and update of energy standards
- Energy audit of selected buildings
- Energy efficiency indices (EEI) and performance benchmark
- Energy management of public buildings
- Performance contracting
- Research and development

Energy Smart Building Labelling Programme, Singapore
http://www.e2singapore.gov.sg/buildings/energysmart-building-label.html
The Energy Smart Building Labelling Programme, developed by the Energy Sustainability Unit (ESU) of the National University of Singapore (NUS) and the National Environment Agency (NEA), aims to promote energy efficiency and conservation in the buildings sector by according recognition to energy efficient buildings. The Energy Smart Tool is an online benchmarking system that can be used to evaluate the energy performances of office and hotel buildings. It enables building owners to review the energy consumption patterns within their buildings and compare them against the industry norms. An Energy Smart Building Label, reviewed every three years, is awarded to winners as part of an annual awards ceremony.
Apart from helping to reduce energy consumption and carbon emissions within the buildings sector, Energy Smart Buildings stand to:

- Reap energy savings due to active energy management
- Enjoy higher satisfaction levels by occupants
- Enhance the company's corporate image

Municipal Energy Efficiency Network, Bulgaria
http://www.munee.org/files/MEEIS.pdf
Thirty-Five Bulgarian cities have established the Municipal Energy Efficiency Network (MEEN). EnEffect is the Secretariat of the Network. Since April 2001, MEEN has admitted four municipal associations as collective members. In order to create a successful municipal energy plan, MEEN promotes the development of two key elements: an energy database and a training program for municipal officials.
General information is collected into municipal "Passports". This information is gathered through surveys of various organizations and entered into a database, or energy efficiency information system (EEIS). The EEIS has two layers: database and analysis. The database, a Microsoft Access application, contains objective, technical information, and the analysis contains non-technical information, such as financial, institutional and regulatory documents generated at the national level. This information is organized into three categories: municipality-wide consumption, site-specific consumption, and municipality-wide production.

Energy Management Systems in Public Building, Lviv, Ukraine

Source: ESMAP (2011). "Good Practices in City Energy Efficiency: Lviv, Ukraine - Energy Management Systems in Public Buildings", available online from http://www.esmap.org/esmap/sites/esmap.org/files/Lviv%20Buildings%20Case%20final%20edited%20042611_0.pdf

The Ukrainian city of Lviv was able to reduce annual energy consumption in its public buildings by about 10 percent and tap water consumption by about 12 percent through a Monitoring and Targeting (M&T) program to control energy and water consumption. This generated an estimated net savings of 9.5 million UAH (US$1.2 million) as of 2010. The M&T program was launched in December 2006 and became fully operational by May 2007. It provided the city management with monthly consumption data for district heating, natural gas, electricity and water in all of the city's 530 public buildings. Under the program, utility use is reported and analyzed monthly; targets for monthly utility consumption are determined annually based on historical consumption and negotiations on an adjustment (in cases of foreseeable changes in consumption patterns). Actual consumption is reviewed monthly against the target, with deviations spotted and acted upon immediately and the performance of buildings is communicated to the public through a display campaign.

The M&T program achieved significant savings with minimal investment and recurring program costs. These utility bill reductions have been valuable in light of fiscal constraints and increasing energy prices. The program benefited from a crucial initial condition where most of the city's public buildings were already metered for energy and water consumption and that the city had been collaborating with international aid programs in municipal energy since the late 1990s.

Strong city government leadership and commitment were key success factors of Lviv's public buildings energy and water M&T program. A new Energy Management Unit (EMU) was established within the city administration and resources were mobilized to train all personnel with line responsibility on building utility use in an administrative division, unit, or building. The M&T system established responsibility, created transparency, and enabled informed control of energy and water use in public buildings, laying a solid foundation for sustained improvements in energy and water efficiency.

Public Building Energy Management Program, Lviv, Ukraine
http://www.ecobuild-project.org/docs/ws2-kopets.pdf
As part of the Energy Efficiency Cities of Ukraine initiative, launched in 2007 as initiative of 4 cities, sopported by MHME, NAER and and European Associationof local authorities "Energie-Cites", Lviv has promoted sustainable energy policy and action plans at a local level. The city has developed a Public Building Energy Management Program through the Energy Efficiency Cities of Ukraine initiative. These involve regular data gathering through various agencies and a subsequent monitoring and analysis of building energy consumption in order to identify easily achievable improvement opportunities.

SMEU Software, Romania
http://www.munee.org/files/SMEU-romania.pdf
The SMEU software was created to set priorities for municipal energy action plans and to assess global energy costs and consumption. The goal of this software is to gather, organize and use energy data so that decision-makers could analyze trends in energy use by consumers and by resources and accurately predict the energy budget for the following period.
The SMEU software divides data into individual and interacting modules to collect data on various aspects of the energy cycle. The Locality Module collects information on an annual basis, including area, population, and average temperature, as well as general information on the municipality such as number of buildings and number of dwellings per building.

NYC Greener Buildings, USA
http://council.nyc.gov/html/releases/prestated_4_22_09.shtml
New York City Municipal Buildings were benchmarked for Energy Efficiency. The project, initiated on December 9, 2009 with the passage of the "Greener, Greater Buildings Plan" (formally known as Intro. No. 476-A, Benchmarking Energy and Water Use), puts the city at the head of a national effort to improve building energy efficiency aimed at reducing America's carbon footprint and its use of highly pollutive fossil fuels to generate electricity.
The project used the U.S. Environmental Agency's (EPA's) Energy Star Portfolio Manager energy management tool, which is integral to the LEED (Leadership in Energy and Environmental Design) certification process, as established and managed by the U.S. Green Building Council, or USGBC.
The Plan aims to reduce the city's total carbon footprint by 30 percent by 2030 (originally 2017), with five percent of that reduction coming from government, commercial and residential building. After the initial phase is completed, building owners will be required to benchmark yearly.

TOOLS & GUIDANCE

Tools & Guidance
Target Finder helps users establish an energy performance target for design projects and major building renovations. http://www.energystar.gov/index.cfm?c=new_bldg_design.bus_target_finder
Portfolio Manager is an interactive energy management tool to track and assess energy and water consumption across the entire portfolio of buildings. http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

Tools & Guidance
A presentation by Berlin Energy Agency on Berlin's Energy Saving Partnership - "a Model of Success" , June 29th, 2010. http://siteresources.worldbank.org/INTRUSSIANFEDERATION/Resources/305499-1280310219472/CArce_BEA_ENG.pdf
Energy Efficient City in Russia: Workshop Proceedings, June 2010. A guidance document for Preparing, Financing and Implementing Municipal Energy Efficiency Programs. http://www.esmap.org/esmap/sites/esmap.org/files/Russia%20EE%20Cities%20Proceedings%20ENG%20080210.pdf

ANNEX 6: 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: • lighting systems

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

	• air conditioning systems • heating systems • computers • server rooms and cooling of servers • appliances (water cooler, fridge, vending machines) 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. 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:

- $/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

Model for Improving Energy Efficiency in Buildings, Berlin, Germany http://www.c40cities.org/bestpractices/buildings/berlin_efficiency.jsp 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

http://www.c40cities.org/bestpractices/buildings/stuttgart_efficiency.jsp
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
http://www.display-campaign.org/page_162.html
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 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.

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

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.

	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 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

Control system for public lighting, Kirklees, UK

http://www.kirklees.gov.uk/community/environment/green/greencouncil/LightingStoryboard.pdf

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
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

Tools & Guidance
N/A

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TOOLS & GUIDANCE

Tools & Guidance
N/A

ANNEX 8: Active Water Leak Detection & Pressure Management

DESCRIPTION

Develop a leak detection and pressure management program to minimize losses along the following systems:

- Extraction works and pipelines
- Long distance water transmission mains
- Distribution networks
- Sewage pumping mains
- District cooling networks
- Irrigation networks

It is anticipated that most systems would already be subject to passive leak detection, i.e. identifying leaks through visual observation, but that provides limited information and benefits. This recommendation therefore focuses on a pro-active and more thorough leak detection program to locate and repair leaks. The following techniques could be used:

- Ground microphones
- Digital leak noise correlator
- Acoustic logger
- Demand management valves, meters and zoning
- Mobile leak detection programs
- Basic acoustic sounding techniques

In addition excess pressure can be reduced by installing:

- Flow modulating valves on gravity networks
- Pump controls and/or pressure sensors to modulate a pump's relative performance to suit the daily variation in flow demand, thus maintaining maximum efficiency and minimum energy use.

A leakage detection program can facilitate the provision of minimal pressures and encourage, through less wastage, a more sustainable use of water resources. In sewerage systems, identification and elimination of leaks can also significantly reduce risk of ground contamination.

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
Efficient water use
Enhanced public health & safety
Increased employment opportunities
Financial savings
Security of supply

Pressure management can cost-effectively reduce treatment and pumping costs by minimizing the required delivery pressure and leakage. It is particularly suited to pumped mains and may require estimates of how demand changes over the day. Appropriately rated pressure reducing valves will in turn reduce the flow through leaks and the total flow that must be delivered by the pump upstream at the source/treatment works. This solution may be particularly appropriate in gravity flow networks. The key advantage of pressure management over leak detection is the immediate effectiveness. It is most appropriate where the network is expansive and features multiple small leaks that would be difficult and expensive to locate and repair.

IMPLEMENTATION OPTIONS

Implementation Activity	Methodology
Feasibility Study	The City Authority can help to establish appropriate partnerships to undertake a feasibility study to assess leakage levels across the network(s). The CA should engage a team that includes network planners, water and utilities engineers and financial advisors to ensure the feasibility study captures all pertinent aspects. The feasibility study helps to establish the technological and financial viability, as well as procurement and policy options. Options should be appraised against baseline city energy expenditure associated with water leakage; monitoring flows and demands to refine value and pump controls accordingly. Technical ability, incentives and taxes should also be given consideration.
Direct expenditures & procurement	Where the potable or wastewater network is owned or run by the City Authority, the CA pays for upgrades to the utility infrastructure, directly out of the city budget or through separate funding mechanisms. The advantage of this strategy is that having the legislative authority to take ownership of the intervention will facilitate compliance with local legislation, policies and obtaining planning permission. The main expenditure associated with pressure management will be

	mainly the acquisition and installation costs of the equipment (i.e. valve, control fittings).
Build-Own-Operate-Transfer (BOOT)	If the City Authority lacks ability to access capital and technical expertise, a Build-Own- Operate-Transfer (BOOT) type contracting mechanism may be deemed most suitable to implement an initiative. The Request For Proposals (RFP) calls upon bidders to implement efficiency measures and provide funding for the project, with remuneration paid through the resulting savings. This 'shared savings approach' is common in the electricity industry. The contractor is required to provide a basket of services including financing of capital, design, implementation, commissioning, operation and maintenance over the contract period as well as training of municipal staff in operations prior to handover. This sort of arrangement can be complex to set up and it can also be difficult to find an organisation willing to take on the risk associated with this form of partnership. Case Study: Emfuleni, South Africa.
Efficiency Standards	The City Authority regulates the Water Companies to meet leak reduction targets and ensure their pipes meet required standards of operational efficiency.
Community led implementation	The City Authority liaises with the local community to increase understanding of the benefits of leak detection initiatives. Simpler, less technical methods of leak detection and reporting provide a considerable opportunity for community involvement and participation. In so doing, amenity will be maximized and leaks may be identified more quickly. In turn, the baseline infrastructure may also be safeguarded against vandalism or poorly implemented operation and maintenance. This

	activity may be complemented by offering subsidies to those who take part or by passing on the associated monetary savings to the community through reduced water rates.
Partnering Programs	The City Authority liaises with established organizations and/or coalitions (frequently non-profit such as Alliance to Save Energy) to gain access to their experience and expertise in order to implement the most appropriate changes to the pipe/pumping infrastructure. Such organizations often undertake research, educational programs, and policy advocacy, design and implementation of energy-efficiency projects, promotion of technology development and deployment, and/or help to build public-private partnerships. Difficulty can arise where the partnering organisations do not have access or influence over the funds required to implement the initiatives. Case Study: Galati & Iasi, Romania; Phonm Penh, Cambodia.

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:

- % Unaccounted for water (UFW): Measures the percentage of the water lost, due to leakages, wastage, theft, mechanical errors in meters at the source or human errors in correctly recording the meter reader, out of the total treated water produced.
- % Volume of water leakage per kilometre of water main per day: Measures the average volume of water leakage per kilometre of water main per day during the reporting period.
- Length of water mains inspected for leakages: Measures the total length of water mains inspected for water leakages during the reporting period.
- Properties affected by low water pressure: Measures the total number of properties affected by low water pressure due to aged pipe network or repair works during the reporting period.

CASE STUDIES

Pilot Leak Detection and Abatement Program, Iasi, Romania
http://www.resourcesaver.com/ewebeditpro/items/O50F1144.pdf
With an EcoLinks Challenge Grant of $46,820, Regia Autonoma Judeteana Apa-Canal Iasi (RAJAC) partnered with a U.S. environmental technology provider, Cavanaugh & Associates, to develop a pilot leak detection and abatement program. The total project investment was $118,074. The program trained RAJAC personnel in leak detection, implemented a leak detection system and developed a water conservation program and public outreach campaign. This pilot leak detection and abatement study was a prerequisite for the implementation of an infrastructure program. Awareness of new technology was significantly increased through training and seminars. The company's public awareness-raising program encouraged and enhanced consumers' capacity to participate in water conservation efforts. Environmental and economic benefits were derived from the more efficient use of water and energy resources. In the short-term, it was estimated that three of the leaks identified in the pilot scheme were responsible for a water loss of 60,000 m3/year and a revenue loss of $24,000. Since the equipment used during the pilot project cost approximately $20,000 and no further significant investments were needed to eliminate the leaks, the payback period for the equipment was less then one year. This project contributes to a larger effort to improve water efficiency throughout Iasi County that will ultimately reduce water loss by 8 million m3 and provide a savings of $3 million per year, however, this level of savings, would require significant investment in the infrastructure.

USAID funded Ecolinks Project, Galati, Romania
http://www.munee.org/node/62
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.

Pressure Management, Emfuleni, South Africa

Energy and Water Efficiency in Municipal Water Supply and Wastewater Treatment in Emfuleni, South Africa
http://www.watergy.org/resources/publications/watergy.pdf

The Sebokeng/Evaton pressure management project use a Build-Own- Operate-Transfer (BOOT) type contracting mechanism because the municipality had only limited access to capital and lacked the technical capacity to implement the project. The savings in water were so significant that both the municipality and contractor gained, with 80% of the savings accruing to the municipality and the remaining 20% used as remuneration to the contractor for services provided over a five year period. As the installed infrastructure is permanent in nature and has a design life of at least 20 years, the municipality will continue to achieve savings well beyond the initial five year period. The staff also benefit from access to additional expertise and training. This project reduced water losses by over 30%, saving about 8 mega-litres per year with an equivalent financial value of around $3.5 million. These water savings also translate into energy savings of around 14,250,000 kWh per annum due to the reduction in energy required to pump water. The project clearly demonstrated that the intervention of a suitable technology with a shared savings arrangement could succeed in low income communities; a private firm providing financing for technical innovation at no cost to the municipality received remuneration from sharing the resulting savings in water purchases.

Good Practices in City Energy Efficiency. Emfuleni Municipality, South Africa: Water Leak Management Project (Case Study)
http://www.esmap.org/esmap/node/663

The water supply project in South Africa's Emfuleni Municipality resulted in lower costs for water--including lower energy costs associated with water supply--and also improvements in the municipality's financial status through a new leakage management system for bulk water supply. Innovative pressure management technology was applied to the water supply system of two low-income residential areas, yielding significant savings in water and energy costs for pumping and treating water for distribution. The payback period was only 3 months and financial savings, from both reduced energy use and water losses, was estimated at US$3.8 million per year for a lifetime of 20 years. Under the performance contracting arrangement employed to finance and implement the project, the municipality retains 80% of the water and energy cost savings during the first five years and 100% of the savings thereafter. The project has been hailed as a great success for South Africa. It clearly demonstrates that the use of suitable technology under a shared savings arrangement can succeed in low-income communities. A private firm providing financing for technical innovation--at no cost to the municipality--received remuneration from sharing savings in water purchases. The contractor provided a basket of services, including financing of upfront investment capital, design, implementation, commissioning, operations and maintenance (O&M) over the contract period, as well as training municipal staff in operations prior to handover of the installation. The project resulted in substantial financial savings that led to a "win-win" situation, both for the municipality and contractor, through a successful public private partnership (PPP).

Water Pressure Management Program, Sydney, Australia

http://www.sydneywater.com.au/OurSystemsAndOperations/WaterPressureManagement/index.cfm

Sydney Water has a water pressure management program to target those areas where pressure levels are well above average and there is

a history of water main breaks. Excessive water pressure can lead to water main breaks and cause leaks in the city's water system. Water pressure management aims to adjust water pressure levels in the supply system to achieve more consistent pressure levels which will reduce the number of watermain breaks, improve the reliability of the water supply system and conserve water. The Water Pressure Management program is an important part of Sydney Water's leak prevention program and the New South Wales Government's Metropolitan Water Plan.

Water Supply and Drainage Project, Phnom Penh, Cambodia
http://www.adb.org/water/actions/CAM/PPWSA.asp
http://www.adb.org/water/actions/CAM/Internal-Reforms-Fuel-Performance.asp
Asian Development Bank's (ADB) Phnom Penh Water Supply and Drainage Project provided the opportunity for PPWSA, the government-owned water supply utility, to partner with ADB and demonstrate its capacity for catalyzing water sector reforms. To phase out non-revenue water, i.e. consumers gaining access to water supplies for free, PPWSA started metering all water connections. It gradually equipped each network with a pressure and flow rate data transmitters that provide online data for analyzing big leaks in the system. They also set up a training centre to respond to in-house training needs. PPWSA renewed old pipes using state-of-the-art materials and labour from PPWSA staff. PPWSA also institutionalized performance monitoring, coming up with progress reports and performance indicators on a regular basis and annually subjecting its accounts and procedures to an independent audit. The project advocated the transfer of more managerial autonomy to PPWSA to enable it to use its own funds on maintenance and rehabilitation programs. The result of the project was that PPWSA became financially and operationally autonomous, achieved full cost recovery, and transformed into an outstanding public utility in the region.

TOOLS & GUIDANCE

Tools & Guidance
N/A