



TIMIȘOARA



MINISTRY OF REGIONAL DEVELOPMENT
AND PUBLIC ADMINISTRATION



GOVERNMENT OF ROMANIA



EUROPEAN UNION

Improving Energy Efficiency in TIMIȘOARA 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



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>.





Executive Summary

Why a study on energy efficiency?

The main impetus for this report (and for the reports prepared for the other six growth poles) is a request received from the Ministry of Regional Development and Public Administration. The request came within the context of on-going preparations for the 2014-2020 Programming Period, with Energy Efficiency being one of the major themes of the Europe 2020 strategy, and a critical priority for all EU Member Countries. Within Romania, local authorities that will want to access energy efficiency funds under the 2014-2020 Regional Operational Programme will need to first prepare energy efficiency strategies. The TRACE tool is specifically targeted at local authorities, and is a good instrument for drafting such strategies.

What is TRACE?

The Tool for Rapid Assessment of City Energy (TRACE) is a simple and practical tool for conducting rapid assessments of energy use in cities. The tool helps prioritize sectors with significant energy savings potential, and identifies appropriate energy efficiency interventions across six sectors—transport, municipal buildings, water and wastewater, public lighting, solid waste, and power and heat. It is a simple, low-cost, user-friendly, and practical tool that can be applied in any socioeconomic setting.

The advantages of TRACE

TRACE is one of the most powerful energy efficiency tools, specifically developed for cities. It is simple, easy to implement, and quite intuitive, and it allows a quick assessment of energy savings potential in six key public service areas: urban transport; water and wastewater; municipal buildings; street lighting, power and centralized heating; and, solid waste management. The tool can be implemented relatively quickly and is not data- or cost-intensive. Moreover it allows local authorities to get a rapid assessment of their city's energy performance, and to identify sectors that may be subjected to a more in-depth analysis.

The limitations of TRACE

The fact that TRACE is simple and easy to implement, also means that there are limitations with respect to the depth of analysis. For example, the tool may identify District Heating as the a priority sector in terms of potential energy savings, but it does not go into detail on the required costs to complete district heating rehabilitation projects. Thus, even if the energy savings potential is assessed to be high, the costs may be even higher, and an investment in the sector may not be warranted. Similarly, although TRACE specifically focuses on the service areas that fall within the purview of local authorities, the tool cannot factor in the institutional and legislative mechanisms that need to be in place to make a specific energy efficiency recommendation possible.

Boundaries of studied area

While this work focuses on the growth poles in Romania, the analysis was limited to the boundary of the center city. The reasoning for this is quite simple: it is prohibitively difficult to collect individual indicators for all the constituent localities of a metropolitan area. In most cases, this would have required in-depth discussion with over 20 localities, ensuring that all these localities had the required indicators for a particular service area, and ensuring that they used the same methodology for the calculation of these indicators. Nonetheless, the sector analysis and recommendations took the metropolitan scale into consideration, and the section on sound urban planning practices was done at the full metropolitan level.

Summary of findings

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 toward 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.

Timișoara is an important national transportation hub along the Pan-European Corridor IV, located in the western part of Romania. The city is well connected to the capital city, București (Bucharest) and other



major cities in Romania, as well as to Serbia and Hungary. This makes Timișoara one of Romania's main gateways to the West, which enabled strong cultural and economic ties to neighboring countries. This made the city become a multicultural and economic hub among the three countries. Besides its major road and railway network, the city is home to the second largest airport in the country in terms of air traffic, from where flights operate daily to București and a few other major cities in Romania, as well as to a number of destinations in Europe.

Timișoara is one of the main economic centers in the western part of Romania, with a local industry relying predominantly on the manufacturing sector. In the transition period, due to its proximity to the West, the city attracted a number of significant investments in the region. Several foreign companies from the food-processing and auto-motive industries, as well as the services sector, poured into the city and the wider metropolitan area. Today, Timișoara is host to 20 of the largest foreign companies established in Timiș County.

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 Timișoara. Some of these developments have positively affected people's lives, whereas a few came along with inconveniences and difficulties. Unlike other localities in Romania that lost inhabitants, Timișoara is one of the few cities where population actually increased (by 0.5%).

Similar to a country-wide trend, the rising number of cars in the past two decades has caused heavy traffic congestion, increased fuel consumption, and high level of greenhouse gas emissions. Commuting has become a difficult task for both private and public vehicles. Today the main challenges in the transport sector are the modernization of the bus, tram, and trolleybus fleet, and improving the traffic flow. There are two major barriers to the development of urban transport in the city: the Bega Channel, crossing Timișoara from one side to another; and the railway network passing through the city center. The urban transport sector has a significant potential for energy savings, requiring appropriate measures in order to decrease fuel consumption and reduce greenhouse gas emissions. The highest potential of savings stays with the district heating sector. Although the losses incurred in the network in Timișoara are smaller than in most of the cities in Romania, the hot water pipes require

rehabilitation. Like every other city in the country, municipal buildings in Timișoara demand proper measures toward improving energy efficiency – particularly in health care and education facilities managed by the city government. A benchmarking of the municipal building stock, along with audit and retrofit measures, is required in order to identify the highest energy savings potential and optimal interventions. The local authorities have already started an audit program, which should be continued.

There are indeed many positive things that Timișoara has successfully accomplished to date. For one, although it incurs significant losses in the network, the water sector covers the entire city and water connections are metered. In recent years, the water network was expanded and the water plants and wastewater facilities have been modernized. Another sector that is doing well in Timișoara is solid waste. The city residents are responsive to the selective collection system that has been implemented a few years ago. More than 95% of the streets in the city are lit, and the network has been expanded to new emerging residential areas. Currently, the LED bulbs are being tested under a pilot project covering the lighting poles along the Bega Channel. Timișoara has a functional public transport system, including trams, trolleybuses, and buses, in addition to a good non-pedestrian network. The municipal authorities have concrete plans to further expand on the existing bike lanes and walkways. Some of the historical buildings in the city center have been renovated. Rehabilitation work has been performed in residential buildings too, as well as in some of the public facilities, including schools, healthcare and social assistance facilities. Further plans aim to carry on with the thermal insulation of residential buildings. Nonetheless, in parallel, additional work needs to be completed in order to decrease energy consumption, reduce heating bills, and enable the city to become more efficient.

As with all other cities in the country, Timișoara does not have regarding significant influence over the electrical power sector. Tariffs are regulated by the national government, which 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 domestic users as well. Specifically, the subsidies are going to be gradually eliminated by the end of 2017, when the liberalization of the market is expected to be complete. Energy production from renewable sources is



encouraged, and Green Certificates are provided to producers, although the award of some certificates has been postponed until 2017.

For the short and medium term, the local public authorities want to implement a number of projects aimed at reducing energy consumption in the city and, ultimately, bettering the quality of life of the residents of Timișoara. Some of these projects include improving traffic flow in the city and mitigating traffic congestion, purchasing highly fuel-efficient rolling stock, developing more pedestrian networks, and further upgrading the street lighting system.

This report is based on the implementation of the TRACE tool in Timișoara in April 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 & 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.

In order to complete data collection and to get a more comprehensive idea of all these issues in the city, a World Bank field trip was organized in April 2013. The implementation of TRACE in Timișoara has been 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 formulated, as summarized below.

District Heating Maintenance and Upgrade

The TRACE analysis encourages city managers to continue to support the district heating system and keep on investing in the rehabilitation of the network. Two-thirds of the residents of Timișoara are connected to the district heating system. The number of customers has been fairly stable in the recent years. The district heating plant is undergoing a large refurbishment that is expected to improve the efficiency of the system. The next step the city managers should focus on is the rehabilitation of

the network in order to diminish the losses in the hot water pipes. In the short- and medium-term, this TRACE recommendation suggests that the city government should continue the rehabilitation and upgrading of the network, and replace the old pipes. In this way, losses will be reduced, the quality of services will improve, and the district heating operator will be able to keep the customers happy, and may even win back some of the lost market and attract new clients.

Non-Motorized Transport Development

The first recommendation made by TRACE with regard to urban transport encourages the Timișoara City Hall to continue to develop non-motorized commuting options in the city and expand the related infrastructure. The end goal is to have more people walking and biking and fewer using their private vehicles. In order for this to happen, the city should increase the existing number of pedestrian paths and dedicated bike lanes. Improving accessibility through fuel-free means of transportations will raise quality of life in the city, but also encourage business development around the newly established pedestrian areas, including additional leisure and entertainment spots, such as restaurants and shops. The two main pedestrian areas in the city center are good examples in this respect. They gather shops, markets, and entertainment spots, and, thus, they turned the areas into some of the most popular locations in the city. Cycling should also be encouraged by building more bike lanes in the city, wherever the road infrastructure allows it.

Public Transport Development

Another TRACE recommendation made to the local public administration of Timișoara is to continue to develop the public transport in the city. The authorities should continue the modernization of the public transport fleet, and purchase new, energy-efficient rolling stock. Expanding the public transport in the metropolitan area would provide better connectivity between Timișoara and the neighboring localities, and, eventually, help increase the number of public transport users. At the same time, this TRACE recommendation encourages additional measures, such as dedicated bus lanes to bypass traffic congestion. At the end of the day, a reliable and comfortable public transport system would appeal to



people and make them rely more on buses and trams, incentivizing more and more of the Timișoara residents to leave their cars at home.

Parking Restraint Measures

This TRACE recommendation encourages the city government of Timișoara to carry on its efforts aimed at containing the increasing number of private cars pouring into the city. One of the best ways to deal with traffic congestion is the development of “Park and Ride” facilities. This is a very efficient method to promote multimodality by linking parking to public transport. People who travel to the city drive their cars to these facilities, from where they take public transport to get to their workplace. In addition, local authorities should think about building more parking spots and hiking the prices for parking, especially in the city center. However, before such facilities are developed, one has to have a better understanding of commuting patterns in the larger metropolitan area, and the extension of public transport infrastructure should precede the development of such facilities.

Traffic Flow Optimization

As everywhere else in the country, traffic congestion is a major problem for both Timișoara residents and city managers. This TRACE recommendation aims to tackle the traffic congestion issue by suggesting to the local government to focus on measures channeled at changing driving patterns, by optimization of traffic signaling, or by means of information. For example, information displayed through GPS or radio-based systems could inform drivers about route switching options and the availability of parking spaces. In the long run, local authorities should take steps toward completing the city’s ring road to ease traffic congestion and provide commuters with alternative commuting routes. A new traffic management and monitoring system is already under way, in line with city authorities’ goal to improve the quality of urban transport in Timișoara.

Street Lighting Timing Program

This TRACE recommendation for increasing the efficiency of street lighting targets the introduction of a lighting-timing program in Timișoara. After replacing the mercury lamps with more efficient sodium vapor bulbs, the local public administration is currently implementing a pilot project with

LED lamps along the Bega channel. The city government is thinking to further improve the system and reduce electricity consumption. One of the best and least costly solutions for reducing energy consumption is the street lighting timing program. The light can be adjusted for specific needs in a particular area, according to varying weather and activity levels. For instance, more light is needed in the evenings when more people are out than in the nighttime when there is less activity on the streets.

Municipal Building Benchmarking Program

Like most cities in Romania, Timișoara does not have a consistent database tracking the energy performance of municipal buildings that are managed by the City Hall. One of the first steps recommended by TRACE in order to address this issue is the development of a municipal building database that should provide information on which buildings have the greatest saving potential. This can be done through a benchmarking process, using a number of key indicators. By publishing the analysis and updating the data on a regular basis, this process will enable competition among building managers and, eventually, lead to collaboration and a productive exchange of data and best practices for saving energy.

Municipal Buildings Audit and Retrofit

After the benchmarking process is complete, the next step recommended by the TRACE analysis is a full audit of the public building stock in Timișoara. A municipal building audit is currently under way. Completing this process would help draw a plan for how resources can be allocated to improve the energy performance of municipal buildings in the city. The results would enable the local administration to allocate funds for investing in energy efficiency upgrades, purchasing new equipment, and performing renovation work on certain buildings. Some of the schools and kindergartens which are administered by the City Hall have already been renovated and the local government plans to carry on this work and renovate some of the educational and cultural facilities. These positive efforts should be strengthened going forward.

Prioritizing Recommendations

The process used by the team to get to the recommendations presented above was twofold. On the one hand, the TRACE tool has a step-by-step



mechanism analysis system, which enabled the team to identify a number of priority sectors. The chosen priority sectors usually included those with a high energy and money savings potential, and sectors where local authorities had a high degree of control. Sectors which were either under the control of private operators, or the control of county councils or national level authorities, were usually not considered.

For each of these priority sectors, the team has chosen a number of key recommendations, based on the discussions with the public utility operators, and based on the site visits and data collection. In turn, these recommendations were discussed with local authorities, and a limited number of priority recommendations (usually around 10), were selected from the list prepared by the team.

In some cases, local authorities have chosen priority sectors and recommendations that did not necessarily offer the highest savings potential. A more in-depth discussion on each of those recommendations, including the position of local authorities is discussed in the Energy Efficiency Recommendations Section. The Matrix below provides a snapshot of the priority sectors and recommendations chosen for the City of Timișoara.

Cross growth pole comparison

Having the benefit of implementing TRACE in seven of the largest cities in Romania, the team identified a number of common challenges, and a number of common approaches for addressing energy efficiency issues. For example, it became quite obvious that almost every city with a district heating in Romania has issues running this system in an efficient manner. District heating systems in Romanian cities were almost exclusively built before 1989, and they now have large segments of o leaky and poorly insulated pipes. Moreover, the district heating systems were not built to also serve large industrial facilities (which now are largely gone), and they were not designed for individual metering (i.e. with a vertical distribution system in apartment blocks, instead of a horizontal system). Because of the losses in the system (which ultimately get reflected in the monthly bill), because heating cannot be adjusted or turned off when not needed, and because of the high and growing price of thermal energy, many people have decided to de-branch themselves from district heating networks. Virtually, every growth poles has witnessed disconnections

from the centralized heating system, as people have resorted to individual heating options (e.g., individual gas powered heating units). In some cities, such as Brașov, the share of people who de-branched from district heating represents a large majority of the population; in other cities, such as Constanța, the number of people who left the centralized heating system is lower.

Priority sectors for energy efficiency improvements in growth poles

	Brasov	Cluj	Constanta	Craiova	Iasi	Ploiesti	Timisoara
Private Vehicles	3	1	1	2	2	3	2
Public Transport	2	2	3	1	4	4	4
District Heating	1	5	2		1	2	1
Municipal Buildings	5	3	4	3	3	5	5
Street Lighting	4	4	5	4	5	-	3
Solid Waste Management	-	-	-	-	-	-	-
Water and Wastewater	6	-	-	-	-	-	-
Local Authority Management	-	-	-	5	-	1	-

For most growth poles, urban transport (private vehicles and public transport) was identified as a key sector, although cities like Iași and Timișoara (which have the largest tram networks in Romania outside Bucharest), generally have energy efficient public transport systems and as such have this sector lower on the priority list.

Generally, solid waste management, as well as water and wastewater, did not make it on the priority list of growth poles. For one, solid waste management systems in Romania tend to largely be operated by private companies, and energy efficiency improvements in these systems are accrued by these private operators. On the other hand, water and wastewater systems are generally run by public companies, with county councils being the majority shareholders.



Matrix with Energy Efficiency priorities and proposed programs

PRIORITY 1 District Heating	Energy spending in the sector		Potential savings	
	\$36,000,000		\$6,900,000	
1. District heating maintenace and upgrade	Responsible Institution	Cost	Energy savings potential	Time of implementation
	Colterm	\$\$\$	***	> 2 years
PRIORITY 2 Private Vehicles	Energy spending in the sector		Potential savings	
	\$59,600,000		\$1,430,000	
2. Non-motorized transport modes	Responsible Institution	Cost	Energy savings potential	Time of implementation
	City Hall	\$\$\$	**	> 2 years
3. Parking restraint measures	City Hall	\$	**	> 2 years
4. Traffic restraint measures	City Hall	\$\$	**	1-2 years
5. Traffic flow optimization	City Hall	\$\$	***	> 2 years
PRIORITY 3 Street Lighting	Energy spending in the sector		Potential savings	
	\$2,100,000		\$750,000	
6. Street lighting timing program	Responsible Institution	Cost	Energy savings potential	Time of implementation
	City Hall	\$	***	< 1 year
PRIORITY 4 Public Transportation	Energy spending in the sector		Potential savings	
	\$4,600,000		\$660,000	
7. Public transport development	Responsible Institution	Cost	Energy savings potential	Time of implementation
	RATT	\$\$\$	***	> 2 years
PRIORITY 5 Municipal Buildings	Energy spending in the sector		Potential savings	
	\$1,650,000		\$815,000	
8. Municipal buildings benchmarking program	Responsible Institution	Cost	Energy savings potential	Time of implementation
	City Hall	\$	**	1-2 years
9. Municipal buildings audit and retrofit	City Hall	\$\$\$	***	1-2 years



Also a number of the growth poles had drafted or were in the process of drafting Covenant of Mayors SEAP reports (e.g., Braşov, Cluj-Napoca, Timişoara), while others (e.g., Ploieşti or Craiova) were considering to start the process.

All in all, every growth poles that has been part of this study has undertaken energy efficiency measures in the past years, and all have good practice lessons they can share with other cities.

The importance of good urban planning for energy efficiency

While TRACE does not explicitly deal with this issue, urban planning plays a crucial role in energy efficiency. Cities that promote and encourage a dense and compact urban development pattern tend on the whole to be more energy efficient. On the whole, dense cities require less investment in public services infrastructure development and maintenance (roads, water networks, sewer lines, street lighting, solid waste management, public transport, etc.), they allow higher profitability for public transport operators (since every transit stop serves on average more people than in less dense cities), they enable walking and biking as means of commuting, they discourage car use and transport-related pollution, they can help lower greenhouse gas (GHG) emissions, they require less energy expenditures for the delivery of key public services (e.g., pump costs for water, fuel costs for garbage collection). It is estimated that the energy consumed for transport needs in a city with a density of less than 25 people per hectare may reach an annual average of 55,000 mega joules per person. By comparison, in an urban area with a density of 100 people per hectare, this figure is about three times lower.¹ Consequently, a separate section on spatial planning was introduced in the report, discussing some key related issues for each city studied. A more complete analysis of spatial planning challenges in Romanian cities is included in the *Enhanced Spatial Planning* report.

¹ European Environment Agency. 2006. *Urban sprawl in Europe: The ignored challenge*. Copenhagen: European Environment Agency (Report No. 10/2006).



Methodology

The Tool for Rapid Assessment of City Energy (TRACE) TRACE consists of three principal components: (i) an **energy benchmarking** module which compares key performance indicators (KPIs) among peer cities (ii) a **sector prioritization** module which identifies sectors that offer the greatest potential with respect to energy-cost savings, and (iii) an **intervention selection** module which functions like a “playbook” of tried-and-tested EE measures. These three components are woven into a user-friendly software application that takes the city through a series of sequential steps: from initial data gathering to a report containing a matrix of energy efficiency recommendations tailored to the city’s individual context, with implementation and financing options. The steps are as follows:

1. Collection of Candidate City Energy Use Data

TRACE contains a database of 28 key performance indicators (KPIs) collected from over 100 cities. Each of the data points that make up these KPIs is collected prior to the application of the tool and, as TRACE is launched, this collection of information will grow with current and reliable data.

2. Analysis of City Energy Use Against Peer Cities

The performance of a city is compared with a range of peer cities—selected by the city based on population, climate, and human development—to determine their performance in each of the six sectors (3-6 KPIs per sector). The benchmarking process provides an overview of energy performance so the city can assess its relative rankings against peer cities in each sector. The Relative Energy Intensity (REI), or in simpler terms the percentage by which energy use in a particular sector could be reduced, is calculated using a simple formula. The formula looks at all the cities that are performing better on certain KPIs (e.g., energy use per street light), and estimates the average improvement potential. The higher the number of cities in the database, the more accurate the final result are.

3. Assessment and Ranking of Individual Sectors

During the city visit, a number of meetings and interviews are conducted to collect additional data across city departments and agencies, augmenting benchmarking results with contextual information. At the end of the first phase, a prioritization process takes place to identify sectors with the greatest technical energy savings potential. Energy costs are also weighed, as is the ability of city authorities to control or influence the outcome. Priority sectors are reviewed in detail in the second phase.

The main frame of TRACE

The screenshot displays the TRACE software interface. At the top, it reads "Energy Efficient Cities Initiative" and "Tool for Rapid Assessment of City Energy" with a "Save" button. The interface is divided into three main columns:

- Energy Benchmarking:** "Compare the performance of your city to others". It includes buttons for "Benchmark Data" and "Benchmark Results".
- Sector Prioritization:** "Identify the sectors with highest priority". It includes buttons for "Relative Energy Intensity", "Sector Energy Spending", "City Authority Control", and "Sector Priority Results".
- Energy Efficiency Recommendations:** "Find ways to improve your city's energy efficiency". It includes buttons for "Recommendations", "Initial Appraisal", "Energy Savings Assessment", and "Review".

At the bottom, there is a "TRACE Tool for Rapid Assessment of City Energy" logo and a "User Guide & Documents" button.



4. Ranking of Energy Efficiency Recommendations

TRACE contains a playbook of over 60 tried and tested energy efficiency recommendations in each of the sectors. Some examples include:

- Buildings | Lighting Retrofit Program
- Organizational Management | Energy Efficiency Task Force, Energy Efficient Procurement
- Power & Heat | Solar Hot Water Program on Buildings
- Public Lighting | LED Replacement Program for Traffic Lights
- Transport | Traffic Restraint in Congested Urban Areas, City Bus Fleet Maintenance
- Waste | Waste Management Hauling Efficiency Program
- Water & Wastewater | Pump Replacement Program

The TRACE Benchmarking Module



Recommendations are then assessed based on five different factors: *finance; human resources; data and information; policy, regulation and enforcement; and assets and infrastructure*. This step helps cities better rank measures that are within its capacity to implement effectively. TRACE then enables recommendations to be plotted on the basis of two attributes on a 3x3 matrix (energy savings potential and first cost), with an additional filter that enables the user to sort recommendations based on implementation speed.

Recommendations in each priority sector are quantitatively and qualitatively evaluated based on key data, including institutional requirements, energy savings potential, and co-benefits. Those recommendations carried forward will be supported by implementation options, case studies, and references to tools and best practices.

5. Report Preparation and Submission

A Final City Report records the city review, along with city background information and various aspects of the city visit included in introductory sections and annexes. The report includes:

- City background information, such as city contextual data, key city development priorities, energy efficiency drivers, barriers etc.
- An analysis of the six sectors, including a summary of the benchmarking results.
- A summary of sector prioritization based on city-owned and city-wide scales
- A draft summary of recommendations provided as the City Action Plan
- An Annex section, with a more in-depth discussion on energy efficiency recommendations and best-practice cases.

The Final City Report enables the city to move forward with the most feasible recommendations in a structured manner to allow the city to eventually improve its overall rankings, performance, and save money.



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 July 2013). Apart from București each development region includes a growth pole center (city) and comprises four to seven counties. Despite being among the most populous countries in Europe, Romania has experienced a decline in population in recent years. The stable population has gone down by 7.1% over the last decade, from 21.6 million to 20.1 million, according to the final 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 opportunities in Western Europe. Other factors responsible for this decline are the aging population as well as the significant rise in the number of 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 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	1,883,425	1,934,449 (#1)
Cluj-Napoca	324,576	318,027 (#3)
Timișoara	319,279	317,651 (#4)
Iași	290,422	321,580 (#2)
Constanța	283,872	310,526 (#5)
Craiova	269,506	302,622 (#6)
Brașov	253,200	298,584 (#8)
Galați	249,432	283,901 (#7)
Ploiești	209,945	232,452 (#9)
Oradea	196,367	206,527 (#11)

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

National Legislation regarding Energy

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 percent, 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% from 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.² 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 2007-2010 set an energy saving target of 2.8 Million toe by 2010, 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

² Romanian Fund for Energy Efficiency
http://www.free.org.ro/index.php?Itemid=112&id=96&lang=ro&option=com_content&task=view

³ First Energy Efficiency Plan for the period 2007-2010 available at:
http://ec.europa.eu/energy/demand/legislation/doc/neeap/romania_en.pdf

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 onwards an energy saving certificate has been issued for all new buildings, single-family dwellings and apartment 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 Plan⁴ 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 2004-2015⁵ 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 following: 41% in buildings, 29% in the energy sector, 16% in industry, and 14% in transport. Few years later, the **National Strategy for Energy Efficiency for the period 2007-2020**⁶ 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 lowest 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 toe saving is expected to come from fuel substitutions, 800 ktoe from high

⁴ Second Energy Efficiency Action Plan available at:
http://www.minind.ro/dezbateri_publice/2011/PNAEE_12_cu_anexe_2_11082011.pdf

⁵ The First National Strategy for Energy Efficiency for the period 2004-2015 available at: http://www.minind.ro/domenii_sectoare/H163-04.html

⁶ 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



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**⁷ 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 euro.

The Strategy for Use of Renewable Energy Sources,⁸ approved in 2003, encourages energy production from renewable sources 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**⁹ outlining the renewable energy national

⁷ National Strategy regarding the thermal power supply of cities
<http://www.termopitesti.ro/HG%20882-2004.pdf>

⁸ 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

⁹ The National Renewable Energy Action Plan – available at (in Romanian)
http://www.minind.ro/pnaer/PNAER_29%20iunie_2010_final_AlX.pdf English

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 support from the European Bank for Reconstruction Development (EBRD) to help companies open credit lines for energy efficiency projects. The country 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 22/2008¹⁰ 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.

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

version is available at
http://ec.europa.eu/energy/renewables/action_plan_en.htm (click on "Romania").

¹⁰ Government Ordinance 22/2008 available at:
http://www.dreptonline.ro/legislatie/og_eficienta_energetica_consumatori_finali_surse_regenerabile_energie_22_2008.php#



(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 website¹¹.

A few years later, **Government Ordinance 18/2009**¹² 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 MDRAP 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**¹³ brought some changes to the rehabilitation program coordinated by the MRDPA. According to new regulations, residential

¹¹ The guide is available at:

http://www.mdr.ro/userfiles/constructii_ancheta_publica_contr429_contr411.pdf

¹² 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

¹³ Government Emergency Ordinance 63/2012 available at:

<http://www.mdr.ro/dezvoltare-regionala/programul-operational-regional-2007-2013/-8748>

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**¹⁴ 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 on the energy performance of the buildings** requires¹⁵ the Member States to adopt a methodology for calculating the energy performance of the buildings, that should include thermal characteristics, heating insulation, water supply, the air-conditioning installations, the built-in lighting installations, indoor climatic conditions, and not in the least, electricity produce by co-generation. The EU law is concerning both existing and new buildings. The law is exempting the 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 building close to

¹⁴ 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

¹⁵ Directive 31/2010/EC available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32010L0031:EN:NOT>



nearly zero-energy by December 2020. Same criteria are applicable by December 31st, 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 nearly zero-energy building, and the intermediate targets for improving the energy performance of new buildings by 2015. At the same time, the Member States must issue an 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 this could be clearly visible. After July 9, 2015 the 500 square meters threshold will lower 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 EC¹⁶ on the promotion of the use of bio-fuels or other renewable fuels for transport. **Government Emergency Ordinance 1844/2005**¹⁷ 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**¹⁸ establishes social protection measures for the cold season, helping low-income residents pay the heating bills. The Government is supporting 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

¹⁶ Directive 2003/30/EC available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:123:0042:0042:EN:PDF>

¹⁷ Government Emergency Ordinance 1844/2005 available at: http://ngo.ro/pipermail/mediu_ngo.ro/2006-February/004597.html

¹⁸ Government Emergency Ordinance 70/2011 regarding social protection measures in the cold season.

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 CO₂ 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, Petrosani, Făgăraș, Zlatna, Moinesti, Arad, București (District 1), 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 netto available power was 15,998 MW, according to Transelectrica.¹⁹ 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 almost nonexistent, with only 0.3% or 24 MW.

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,²⁰ Complexul Energetic Hunedoara,

¹⁹ RET Plan - Period 2010-2014, and perspectives for 2019 <http://www.transelectrica.ro/PDF/Planul%20de%20Perspectiva%20al%20RET%202010-2014-2019%2013dec.pdf>

²⁰ Complexul Energetic Oltenia was established in 2012 after the merger of four large energetic companies, namely Societatea Nationala a Lignitului Oltenia Tg. Jiu,



Nuclear Electrica, CE Arad, SC Electrocentrale Deva, Hidroelectrică, and OMV Petrom. CEZ, ENEL Energie Muntenia, Enel Energie, E.ON, and Electrica Distribuție (with its three branches, namely Electrica Distribuție Transilvania Nord, Electrica Distribuție Transilvania Sud, and Electrica Distribuție 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)²¹ 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.

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. Energy producers receive a Green Certificate for each MW of energy produced from renewable energy and sent to the national grid. The law is forcing suppliers to purchase a mandatory quota of green certificates from the total amount of electricity distributed to the end users. 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 Certificates for greenhouse emissions for 2013-2019.

Recently, in June 2013, the Romanian government reviewed the compensation scheme granted to renewable energy producers, and cut off the number of green certificates, as a „temporary suspension” until March 2017 for hydro and solar/photovoltaic energy, and by January 2018 for wind energy²². The new provisions, which are effective July 1st, 2013, are amending the Law 220/2008 for promoting energy from renewable sources. The new law is cutting down the number of green certificates. For each 1 MWh produced, the new small hydro plants with an installed capacity of less or equal to 10 MW will receive one green certificate less, same for the wind energy plants. In case of solar energy facilities, the number of green certificates was cut down by two. In this way, the new small hydro plants would get 2 certificates instead of three, the solar plants would be awarded four certificates instead of six, while the wind facilities would receive one certificate instead of two.

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.

Complex Energetic Turceni, Complex Energetic Craiova, and Complex Energetic Rovinari.

²¹ More information on ANRE available at: <http://www.anre.ro/>

²² More information available at: http://media.hotnews.ro/media_server1/document-2013-04-2-14540999-0-proiect-privind-suspendarea-schemei-sprijin.pdf



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.

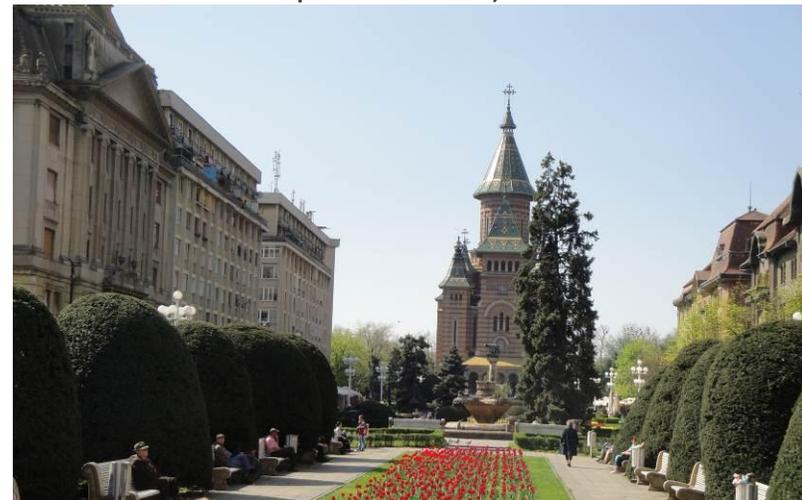
Background Timișoara

Timișoara is the main economic, social, and cultural center in the western part of Romania, located in the historical region of Banat. The city, which lies in the Western Plains and along the Bega channel, is the capital of Timiș County, which borders Serbia and Hungary. Timișoara is located approximately 100 kilometers away from the crossing point into Hungary and less than an hour drive from Serbia. Like everywhere else in Romania, the climate in Timișoara is temperate-continental, with some sub-Mediterranean influences, very hot summers, and mild winters.

The city is an important regional road and railway hub, connecting Timișoara to București and other major cities, as well as Romania to Hungary and Serbia, and further to Western Europe. It is

located along the Pan-European Corridor IV linking Germany to Turkey, and at the juncture of four national main roads. In addition, it is on European route 71 crossing ten countries from Spain to Georgia via Bucharest, and on European route 671, connecting Timișoara to Debrecen in Hungary via Oradea. The city has the oldest and the densest railway network in Romania, with over 91.9 kilometers of lines for 1,000 square kilometers of territory, although some of the components are no longer operational due to low demand and lack of maintenance. A number of nine railway branches from Timișoara are connected to several domestic destinations in Romania, in addition to a few to Serbia and Hungary. The airport is located just a few kilometers away from the city center, at Ghiroda, and is the second largest airport in the country in terms of air traffic, after București.

Opera Plaza in Timișoara



A number of domestic and international flights operate daily to București, Iași, and Constanța, as well as to several destinations in Europe.

The city’s location near the border with Hungary and Serbia enabled Timișoara become a multicultural and economic hub among the three neighboring countries, a position that has been formally



acknowledged with the 2004 establishment of the Danube-Kris-Mureş-Tisa (DKMT) cross-border Euro-region spread over 71,000 square meters and bringing together approximately 5.2 million people. Timișoara is the largest economic, social, and commercial center of this Euro-region.

The municipal area of Timișoara occupies 130 square kilometers, which account for 13% of the wider metropolitan area, and has a density of 2,350 people per square kilometer. Timișoara is one of the few cities that did not lose people in the last decade. According to the 2012 census, it has 319,279 inhabitants, a little less than half the population of Timiș County. The population recorded a 0.5% increase from the previous census. 5% of the people residing in the city are ethnic Hungarians, while Serbs and Germans accounts for 1.3% each.

The growth pole Timișoara is located less than 700 kilometers away from 15 European capital cities. The metropolitan area amounts to 365,777 people spread across 1,070 square kilometers. In addition to Timișoara, it comprises a number of 15 communes, namely Becicherecu Mic, Bucovăț, Dumbrăvița, Dudeștii Noi, Ghiroda, Giarmata, Giroc, Mosnița Nouă, Orțișoara, Pișchia, Parța, Remetea Mare, Săcălaz, Sânmihailu Român, and Șag. Over the past years, a small migration to suburban areas within the metropolitan areas has been observed. Some of the communes have recorded an increase in number of people as a result of such migration, like Dumbrăvița, Ghiroda, Sânmihailu Român, and Ghiroc. At the same time, a low level of cross-border migration has been observed in Timișoara, as some of the city residents moved to Hungary and Serbia. The share of the active age group in the city (between 20 and 64 years old) accounts for 70 %, while in the metropolitan area it is only 64% on average. In some of the rural communities, such as Orțișoara, Pișchia, Sânmihailu Român and Mosnița Nouă, the share of elderly people is higher.

In the transition period, Timișoara attracted a number of important investments. Several foreign companies from the food-processing industry, auto-motive sector, and the services sector poured into the city and the wider metropolitan area. 17 of the largest foreign companies in Timiș County are headquartered in Timișoara, with another three big economic players active in the wider metropolitan area. By the mid-2000s, the foreign investments in Timișoara amounted to EUR 753 per capita, compared to EUR 450 per capita at the level of the county.

Most of these investments come from the EU countries, especially from Italy, Spain, and France. Large European and hardware retailers, such as Carrefour, Billa, Metro, Lidl, Selgros, and Praktiker, telecommunications companies (e.g., Alcatel, Siemens, Elba-Philips), food processing groups (e.g., Coca-Cola), beauty care companies (Procter & Gamble and Yves Rocher), and other multinational corporations have opened locations in the city. Smithfield Foods, the world's largest pork processor and hog producer has two subsidiaries in Timișoara and Timiș County.

Trade holds an important share of the local economy, in addition to industry, which accounts for a third of the overall revenues in the region. There are eight industrial zones in Timișoara where factories and plants cover several sectors from electronics, chemical, and automotive to food processing and textile industries. Automotive and telecommunications are the most active and dynamic players in the region.

At the same time, many of the small and medium enterprises in the city have emerged as the main suppliers for Romanian and international companies, such as Siemens, Continental, and Alcatel. Similar to other growth poles in Romania, the services sector has developed significantly in recent years in Timișoara, accounting for half of the revenues. By the end of the 2000s, half of the people were employed in this sector, 38.7% in industry, 13% in constructions, and 3.5 % in agriculture. The local economic development in the region has been reflected accordingly in the unemployment figures. For instance, in 2007, the unemployment rate in Timișoara was among the lowest in the country, with only 1%.

Not in the least, Timișoara has a good reputation for its several universities and medical centers, cultural facilities (including the Opera House), but also for its large number of beautiful, well-preserved historical buildings in the city center.



Historical buildings in Piața Unirii in Timișoara



Local Energy Efficiency Laws

Timișoara has been one of the beneficiaries of the **Rehabilitation Program of Residential Buildings Built between 1950 and 1989**, coordinated by the Ministry of Regional Development and Public Administration (MRDPA). As part of this program aimed at increasing energy efficiency in communist-era apartment blocks, between 2009 and 2011, the city was granted RON 21 million for the thermal insulation of 3,751 apartments within 103 residential buildings. This is the third largest amount of money received among the growth poles, after Cluj-Napoca and Brașov.

The local public administration is supportive of energy efficiency programs. To this end, the Timișoara City Council grants **tax breaks** for a period of seven years for apartment owners who perform rehabilitation and thermal insulation work on their expense. Some tax exemptions are also awarded to property owners who replace the classical heating systems with renewable energy ones by installing solar panels, heating pumps, and individual micro-heating units running on bio-mass. Also, owners who renovate the façade of their buildings benefit from tax breaks for a period of five years.

Timișoara is one of the 62 Romanian cities signatories of the Covenant of Mayors, the mainstream European movement that brings

together thousands of local and regional authorities committed to increasing the energy efficiency of their municipalities by diminishing the energy consumption, as well as to promoting the use of renewable energy. Under the **Sustainable Energy Action Plan (SEAP)**, a document that has been submitted to Brussels in June 2010, the local government undertook the challenge to reduce the energy consumption by 20% by 2020 and achieve important energy savings. The plan targets an average 20% reduction of energy consumption from the main sectors in the city, including transportation, power, solid waste, water, residential, and industry. For instance, the city aims to achieve 22% in energy savings in the transport sector (the equivalent of 58,890 tons of CO₂), 35% in power sector (172,740 tons of CO₂), 6% in the field of solid waste (137,000 tons of CO₂), and 5% in the water sector (43,000 tons of CO₂). The overall target is to reduce greenhouse emissions by approximately 315,000 tons by 2020.

In 2011, the **Timiș Management Energy Association (AME)**, an association promoting the energy efficiency and renewable sources was established under the Timiș County Council, with support from Intelligent Energy Europe, an EU tool fostering rational use of renewable energy sources and advancing energy efficiency in the transport sector. Among AME founders are the Timiș County Council, the Local Council Timișoara, Colterm (the district heating operator), the Federation of the Property Owners Associations, the Timișoara Chamber of Commerce, and Polytechnic University of Timișoara. 75% of the financial contribution was provided by the EC, while 25% came from local stakeholders. The main partners are Energy Tyrol Agency, the Environmental and Energy Agency of France, the European Federation of Agencies and Regions for Energy and Environment, and the Romanian Energy Regulatory Authority (ANRE). The organization prepares energy certificates for buildings, provides consulting services on energy efficiency and rational use of energy, and shares information with relevant stakeholders about the renewable energy potential of Timiș County. AME Timiș provides the list of the energy auditors in the county.

In March 2013, the organization launched the Energy Master Plan for Timiș County, which includes a study on the renewable energy potential of the region. In the future, the agency has ambitious plans to prepare energy-related integrated plans together with the neighboring



counties, i.e., Caraș-Severin, Arad, and Hunedoara, and with the City of Csongrád in Hungary. Also, AME Timiș is thinking about exploring renewable energy related opportunities in the solid waste and water sectors. One such initiative targets geothermal energy, which is readily available in the counties in the western part of Romania.

At the same time, the organization wants to attract investors to develop energy efficiency projects under Public Private Partnerships, using waste heat recovered from the plastic plants engaged in the region's automotive sector. The energy estimated to be produced in co-generation is between 60 and 100 MW (electricity and thermal).

A municipal building audit is currently under way. In the immediate future, AME Timiș will install 1,000 sensors on municipal buildings in Timișoara to measure electricity intensity and consumption. The first building to be equipped with such sensors is the Administrative Palace hosting the Timiș County Council and the Prefecture.

Urban Growth and Energy Challenges in Timișoara

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 using spatial planning tools strategically. The less dense and the more scattered a city, the larger its energy expenditure becomes. Basically, without density, public transportation is less viable and more people rely on private cars for commuting. Also, commutes in private cars tend to be longer in sprawled areas and city streets tend to get 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. Last but not least, the district heating network becomes less viable in areas with small density because of the high production and distribution costs, and because heat losses tend to be proportional to the

network size. Such examples, and others, suggest that there are significant benefits of compact, carefully planned urban growth and nearly every key area in the TRACE analysis is deeply tied to density patterns and trends.

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.

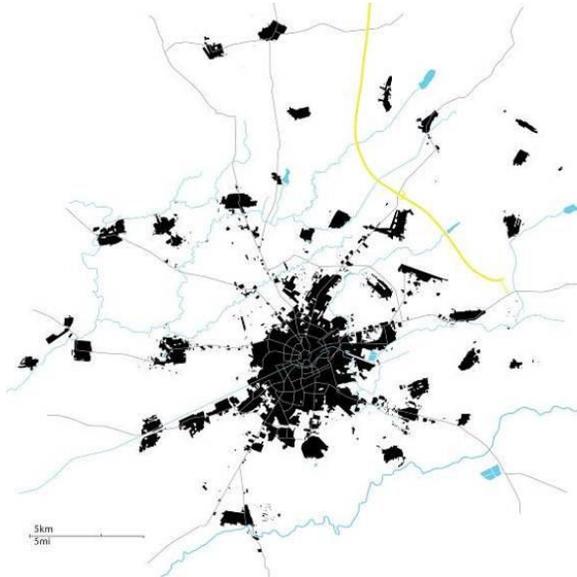
Local authorities are not powerless though in addressing those challenges. They have a number of tools they can use to ensure that the loss in density is not too pronounced and that the city expands in an organized, compact, and sustainable fashion. The challenge is of course to do spatial planning at 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.

In the case of Timișoara, the city's economic profile, largely based on manufacturing, has encouraged the expansion of urban mass toward the larger metropolitan area. This partly explains why some of the neighboring localities have expanded their mass significantly between 1992 and 2012: while all of them have registered positive growth, some of them show impressive figures (138% expansion for Dumbrăvița, 53% for Moșnița Nouă, and 34% for Giroc). The good news is that Timișoara has responded to this pressure to grow outward (an inherent by-product of its evolving economic profile) in a relatively coherent manner. Specifically, it has followed a radial development pattern through concentric rings around the main urban core. In some sense, it helps that the growth pole's topography is relatively flat, so there are few natural barriers to a rational, concentrated, concentric expansion. The one exception is a large forest to the North-East of the city, although in this case it is relatively easy to design ways to get through and/or around this constraint, which will become more and more stringent as Timișoara grows. Indeed, both images below suggest confirm that the city has stayed relatively compact, which is a promising sign in terms of its energy efficiency.

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



Timisoara's urban mass



At the same time, the risks of urban sprawl and significant energy inefficiencies are particularly high for a city like Timișoara. The flat terrain allows for expansion into all directions, which – if left unguided – could result in a chaotic pattern of growth. Smart policies in spatial and urban planning can help promote a more compact development pattern, which means lower costs for public transportation, water, energy, heat, and gas delivery, solid waste management, etc. By contrast, chaotic expansion on green-fields outside the city will mean reduced density and higher expenditures for providing needed services to the areas' residents. As the number of commuters grows so does congestion and pollution. And if the quality of life is perceived to be decreasing, the city will be increasingly exposed to the risk of losing its most critical resource needed for continued economic growth – its people. This is why achieving sustainable development and building a highly efficient city are critical tasks for local authorities. In reaching these aims, they should deploy spatial planning as a powerful instrument for guiding the city's expansion to maintain the current positive trends in terms of a compact, concentric growth.

A green barrier to urban expansion



Source: Google Maps



Timișoara Sector Analysis

Street Lighting

The street lighting system in Timișoara is operated by two private operators. Elba is responsible for the northern part of the city, while AEM is managing the street lighting in the southern part of Timișoara. Both companies signed in 2005 a concession agreement for 10 years covering operation, modernization, and maintenance services. Also, the companies are in charge with: expanding the service to those parts of the city which are not lit, providing the illumination during celebrations (such as Christmas and New Year), and the lighting of buildings. The contract with Elba totals almost RON 30 million, while the agreement with AEM is a little over RON 28 million, without VAT.

Today, there are 21,041 lighting poles spread across the city. In recent years, the street lighting expanded to new residential areas in Timișoara. Currently, 610 kilometers of streets are lit, more than 95% of the streets in the city. The operators have replaced 99% of the mercury bulbs with modern sodium vapor-based lamps.

Lighting pole in Timișoara



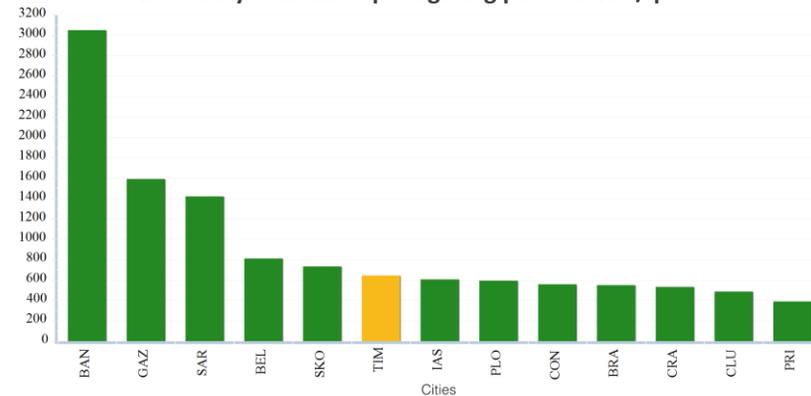
As a result, the efficiency of the street lighting system increased by 30%. However, in absolute terms, this has not translated into any electricity

savings because the lighting coverage area expanded and additional lighting poles have been installed.

In 2012, the electricity consumed for street lighting throughout the year (including holiday lighting and building illumination) amounted to 13.5 million kWh, for which the City Hall paid almost RON 7 million, including VAT. The City Hall buys electricity from Enel, the electricity provider, at different tariffs, depending on the time of the day. Electricity consumed during day time, from 7AM through 10 PM, costs 0.5380 RON per kWh (without VAT), and is cheaper in the nighttime, between 10 PM and 7 AM, at 0.3175 RON per kWh (without VAT).

With a consumption of 645 kWh per lighting pole, Timișoara is doing better than other cities in the region, including Banja Luka, Sarajevo, and Skopje, but is behind other growth poles in Romania, such as Craiova, Cluj-Napoca, and Brașov. When it comes to electricity consumed per kilometer of lit roads, the city is performing reasonably well. The electricity consumption per lighting pole amounts to 22,290 kWh, a figure that places Timișoara in the middle of the TRACE database, at a level that is comparable to other East-European cities. It is the highest energy consumption among the growth poles, comparable to Iași and Ploiești.

Electricity consumed per lighting pole - kWh/ pole



Depending on the light intensity outside, the street lighting starts automatically at 5:30 PM in winter season, and at 9:30 PM in the summer



time, and, usually, it lasts until morning (at 7 PM or earlier). The street lighting is controlled by Enel, the electricity provider. The company owns 80% of the lighting poles in the city (the rest of them are the property of the City Hall) and is also responsible for repairing the overhead electric cables when they get damaged. There are 280 electricity distribution points in the city that measure energy intensity of the street lighting.

Timișoara is currently implementing a lighting dimming system under a pilot project on Republicii Street in the city center, aimed at reducing the light intensity by 30% in the nighttime, between 1 AM and 5 AM. However, although the sensors installed on the lighting poles were supposed to reduce the light intensity, in reality the system is not working properly. The intensity is not lowered, and the light supply to the pole is interrupted instead. Such shortcomings may be inherent for an early testing phase, but can and should be addressed further down the road.

The city authorities are also testing a high-tech system under a pilot project developed in the northern part of the city, where 54 lighting poles have been equipped with LED bulbs. This new, modern and efficient LED-based technology has helped diminish the bulb intensity from 250 to 150 Watt. A few LED-based bulbs have been installed in the Rozelor Park, the Bălcescu Park, and Piața Sinaia, and on a few buildings in the city. The light intensity for lighting these buildings now requires 4 kWh, as opposed to 6 kWh before the replacement of bulbs. In the near future, the LED-based lighting system will expand to the banks of the Bega Channel.

However, the local government is still reluctant to expand the LED bulbs to all poles in the city because this high-tech system requires special maintenance and incurs high costs. Moreover, none of the street lighting systems in Romania operate entirely on LED. Therefore, there is no first account experience about how this system actually performs. So far, all performance-related reports are based only on feedback provided by LED producers, who, of course, are interested to present only the system's positive aspects.

In the medium run, there is a need to invest in the street lighting electricity distribution network, as the current infrastructure is old and obsolete. However, in order to do so, the local government should own the electricity transmission and distribution infrastructure, which, as of now, is mostly under Enel. The city government is considering addressing this issue and taking over the street lighting electricity network. Once it would

have control over this infrastructure, it would focus on improving the energy distribution system all the way to the lighting pole. Moreover, this would help with the maintenance interventions to the poles, and increase the overall efficiency of the system.

According to the Sustainable Energy Action Plan (SEAP) prepared in 2010, the local public administration in Timișoara is considering installing photovoltaic and solar panels that could produce some of the energy needed to operating the street lighting system.

Power Sector

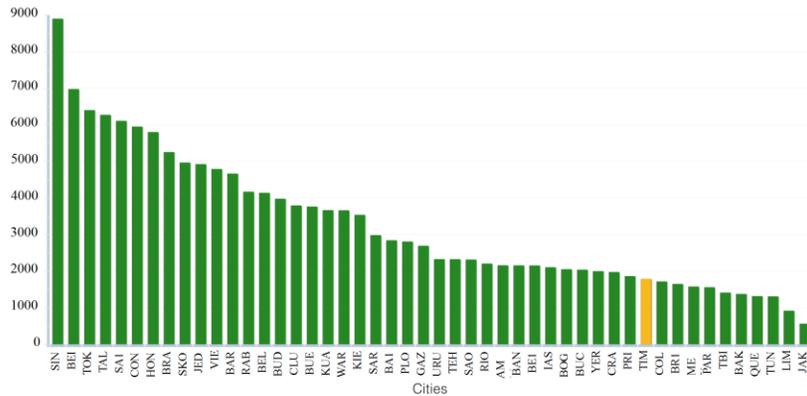
The major electricity operator in Timișoara is Enel, an Italian energy group operating in Romania since 2005. The company is one of the largest private investors in Romania in the energy field. Enel caters to 2.7 million people in three main regions in Romania - Muntenia Sud (including București), Banat, and Dobrogea - accounting for a third of the energy market in the country. Just like other important energy players in Romania, Enel is responsible for both distribution and supply of electricity. It is currently implementing a five-year project with a total value of 800 million EUR aimed at modernizing the electricity distribution infrastructure. Enel Banat is supplying electricity to four counties, namely Timiș, Caraș-Severin, Hunedoara, and Arad. The national average losses in the distribution and transmission system account for 11%, while the commercial losses are 2%.

Given that updated data on the power sector in Timișoara was not available, the TRACE analysis is based on 2008 figures from the Sustainable Energy Action Plan. At that point in time, the total amount of electricity distributed in Timișoara amounted to 590,000,000 kWh, of which 220,000,000 kWh was sold to domestic consumers and 302,000,000 kWh to economic agents and the industrial sector. The electricity consumption for the latter is 967 kWh per year per capita, against 703 kWh per year per capita for the domestic/residential sector.

Overall, the city is doing well in terms of electricity consumption. With an average of 1,789 kWh per person, Timișoara is on the lower side of the TRACE database, performing better than other cities with a similar Human Development Index, including București, Ploiești, or Craiova. It is the second lowest consumption among the growth poles, after Brașov.



Primary electricity consumption per capita – kWh/capita



At the beginning of 2013, the Romanian Energy Regulatory Authority (ANRE) set the price for captive consumers (the domestic clients who do not have the technical capability to choose the electricity provider or 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 consumer category. The average price is around RON 0.4 per kWh.

People with low income pay the so-called *social tariffs*, available since 2005 for all domestic consumers whose monthly revenue is less than or equal to the minimum wage. As of January 2013, they can pay as low as RON 0.2008 for 2 kWh per day, RON 0.4820 per kWh if they consume between 2 and 3 kWh a day, and RON 0.9502 per kWh if they exceed 3 kWh daily. For those domestic consumers who choose the monomial price - a single tariff regardless of the amount of energy consumed - the electricity costs RON 0.4820 per kWh at low voltage (up to 1 kV), and RON 0.3748 per kWh at medium voltage (between 1 and 110 kV).

Those who want to go by a reserved tariff may end up paying anything between RON 0.1640 per kWh and RON 0.6062 per kWh (without VAT), depending on the time of the day.

Electricity pillars



Source: cotidianul.ro

Some consumers choose the monomial tariff, consumption included. They must pay RON 0.3614 per kWh at low voltage, in addition to a daily charge of RON 0.4992; for high voltage electricity the tariff is RON 0.2810 (without VAT), in addition to RON 0.4270 for the daily plan.

Finally, the captive consumers may opt for different tariffs for day and night. In addition to the daily reservation tariff of RON 0.1738, they pay RON 0.5757 per kWh (without VAT) during daytime and RON 0.1872 per kWh in the nighttime for low voltage electricity, and RON 0.4545 per kWh during daytime and RON 0.1472 kWh during nighttime for medium voltage power. Economic agents and industry operators, known as eligible consumers, pay as low as RON 0.2190 per kWh (without VAT) for average duration of use at high voltage. The tariff can go as high as RON 0.9191 per kWh (without VAT) for small duration of use at low voltage.

Timișoara is engaged in research and development of green energy, promoting pioneering projects in the region. One of such projects is the Renewable Energy Research Institute (ICER-TM) developed by the Polytechnic University of Timișoara with support from the Sectoral Operational Program Competitiveness and Regional Development European Fund. The RON 63 million project supports the study of



renewable energy by providing the necessary infrastructure for performing researches and analysis with regard to wind and solar energy.

Renewable Energy Institute in Timișoara



Source: opiniatimisoarei.ro

The project includes the modernization and upgrading of 5 existing labs, establishing 18 new facilities, and purchasing of high-tech research and development equipment. The research covers a wide range of areas, from photovoltaic cells, development of bio-gas and conversion into electricity to solar-based batteries and digital equipment for renewable energies. The beneficiaries of the research and products developed by the institute are large companies, high-tech small and medium enterprises, universities, and students. On the same note, the National Institute of Research for Electrochemistry and Condensed Matters is currently building renewable energy laboratories where 30 specialists will develop, build, and test high-performing classical and hybrid photovoltaic panels. The institute has been established with EU support and it is expected to become one of the most innovative facilities of its kind in Eastern Europe.

In May 2013, a group of researchers from the Veterinary University of Timișoara, renewable energy experts from Austria, and Romanian businessmen thought about developing a pilot project to produce bio-fuel from agricultural residues, such as corn cobs and straw. This process requiring a special computer-based technology has been successfully implemented in Scandinavian countries. Timiș County has a large agricultural surface with a great potential for producing biomass

from agricultural and industrial activities. Of 700,000 hectares of agricultural land and 500,000 hectares of arable land, 80,000 hectares are not used at all. If this initiative will follow through, it will be the first project as such developed in Romania. Currently, the Veterinary University of Timișoara is implementing a EUR 2 million experimental project on producing bio-fuel at Voiteg, a locality in Timiș County.

The county has a great renewable energy potential and attracts many investors. For example, a private investor developed a 19,000 square meters photovoltaic park at Buziaș in 2012.

Photovoltaic park at Buziaș



Source: replicaonline.ro

The investment amounted to EUR 2 million and included 3,800 solar panels, with an installed capacity of 1 MW, able to cover the energy requirements of 1,000 households. The company was the first to deliver energy produced from solar sources to the national grid. The same company opened a photovoltaic park with an installed capacity of 9 MW at Oravița, in neighboring county Caraș-Severin, and is considering similar investments in Timiș County. There are other photovoltaic projects under way covering an installed capacity between 1 and 32 MW. A large photovoltaic project, called Lovrin 3, is under implementation, and involves setting over 43,000 solar panels with an installed capacity of 9.9 MW across 240,000 square meters. The Timiș County is further planning to develop a 45 hectares photovoltaic park at Covaci under a Public-



Private Partnership with private investors and Transelectrica, the national electricity transmission company.

Municipal Buildings

The municipal building stock of Timișoara comprises 228 education facilities (kindergartens, school, and high-schools & national colleges), three hospitals, seven performing art centers (such as the City Philharmonic and the Theater), two large sports-halls, and two social housing units. In addition, there are a number of administrative offices, including the City Hall, the Local Police, the Directorate for Social Assistance, and the Local Finances.

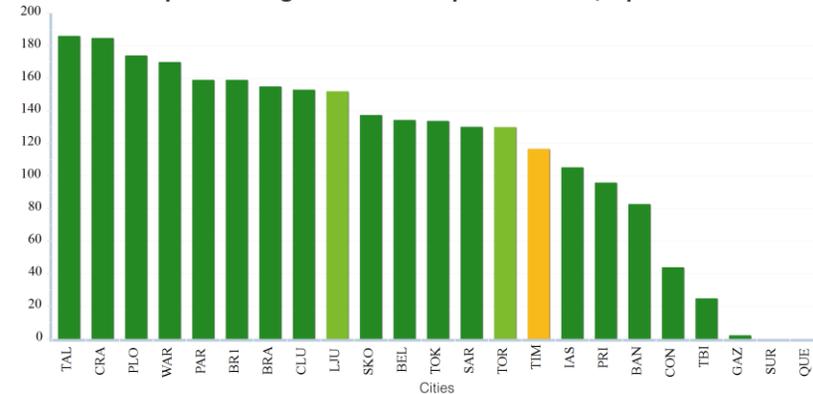
The theater building in downtown Timișoara



Source: artactmagazine.ro

The floor area of the municipal buildings in the city is 377,697 square meters. The total electricity consumption in these units in 2012 was 7,631,307 kWh, which amounts to 20.2 kWh per square meter. The figure is comparable to other cities in the TRACE database, including Cluj-Napoca and Constanța. The electricity bill cost the city budget RON 5.4 million. When it comes to thermal heating, the average consumption is 116 kWh per square meter.

Municipal buildings heat consumption – kWh/square meter



Schools and kindergartens use less heat, about 114 kWh per square meter, as they operate only a limited number of hours daily. The hospitals run 24/7, including equipment that requires significant energy use, and so they consume more, even as high as 630 kWh per square meter. The municipality paid RON 12.5 million for the heat consumed in municipal buildings. Overall, the energy expenditure for all municipal buildings in Timișoara cost the city budget nearly RON 18 million (approximately USD 5.1 million). But not all municipal buildings are connected to the district heating system. Many of them use individual micro-heating units and other heating sources based on natural gas. According to SEAP, in 2008, the natural gas consumption in public buildings amounted to 422,000,000 kWh, the equivalent of 1,512,200 GJ.

The local public administration has sought to improve the energy efficiency of municipal buildings. To this end, rehabilitation and renovation work has been performed on a number of kindergartens, schools, and cultural facilities in the city. This has included renovation and upgrading of technical installations, hydro-insulation, replacing old woodwork with double glazed windows and doors, and insulation of roof tops. Currently, there are two large projects under way at “Nikolaus Lenau” and “Emanuil Ungureanu” high schools. In the near future, the city government plan to renovate two more education facilities hosted by historical buildings, namely the Jean-Louis Calderon high-school and the C.D Lloga National College. Rehabilitation projects are subject to the city



budget and often the funds only cover basic maintenance, rather than complex rehabilitation work. At the same time, a few building rehabilitation projects in Timișoara have benefitted from EU support. Some of the hospitals and medical centers have been renovated in recent years, with support from programs designed for health-care facilities.

One of the education facilities that have been renovated in recent years is the “Grigore Moisil” National College of Computer Science, hosting primary, secondary and high school students (1,600 in total). There are three buildings in the facility: one is dedicated to primary and secondary school, one to the high school, and one old building to the library and the sports hall. In addition, there is a building in a different location, where the high school managers plan to have the secondary school moved, in the near future. This would allow all primary and secondary school students to study in the morning shift.

“Grigore Moisil” National College in Timișoara



The high school building was erected in 1952 on a floor area of 2,289 square meters. The facility hosting the primary and secondary school is spread over 6,000 square meters and was built in the 1970s. The sports hall and the library have only 460 square meters, but they are more than 100 years old. Finally, the fourth building located on Gh. Doja Street has almost 1,500 square meters, and was also built at the beginning of the 20th Century. All buildings are connected to the district heating network.

The renovation on the main two buildings started in 2007, and it was completed with financial contribution of the City Hall and a substantial donation from the parents’ association. The monthly electricity bill comes to roughly 10,000 RON. In 2012 electricity bill for the high school amounted to RON 44,000, while the thermal energy cost almost double - RON 81,000. During winter, the energy expenditures go as high as RON 20,000 per month for thermal heat, and decrease significantly in the summer when the building uses a little electricity (mainly for IT labs). In the winter months, the expenses for all utilities (electricity, heat, water) amount to RON 48,000. Although the renovation did not reduce the energy bills significantly compared to the previous years, replacing of woodwork helped better preserve the heat and increased the comfort level in the building. In the near future, the school managers hope to find resources to renovate the library and the sports hall, as well as the other building located on Gh. Doja Street.

District Heating

The district heating sector is managed by Colterm, a public company under the city government in which the only shareholder is the Timișoara Local Council. A 49-year concession agreement signed with the city government makes Colterm responsible for the production and distribution of heat, as well as collection of revenues. The hot water network is owned by the City Hall.

Colterm caters to 72,000 apartments in the city covering 200,000 people, about two thirds of the population of Timișoara. The rest of 100,000 in the city use individual micro-heating units or wood-based fire systems. The hot water and heat is produced in two facilities. One of them, located in the city outskirts on Calea Șagului, is running on coal and natural gas; the other plant is in the city center and operates on natural gas and in co-generation. The total length of the network is 223 kilometers.

The district heating network in Timișoara was established in 1940. Over the course of time, Colterm managed to rehabilitate and upgrade half of the distribution network. The transmission pipelines are pre-insulated, preventing hot water leakages. The average life-cycle of the pipelines is 15 years.

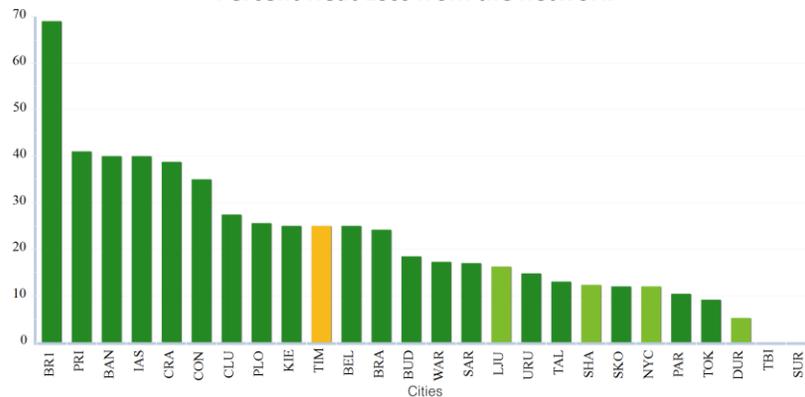


Colterm district heating plant



The rehabilitation work helped reduce the losses in the network. In 2012, the losses accounted for 25%, a figure that places Timișoara in the lower side of the TRACE database. The city performs better than all other growth poles in Romania, including Brașov, Craiova, Ploiești, and Cluj-Napoca. However, there is room to improve compared to other cities in the region (e.g., Skopje, Ljubljana, and Budapest).

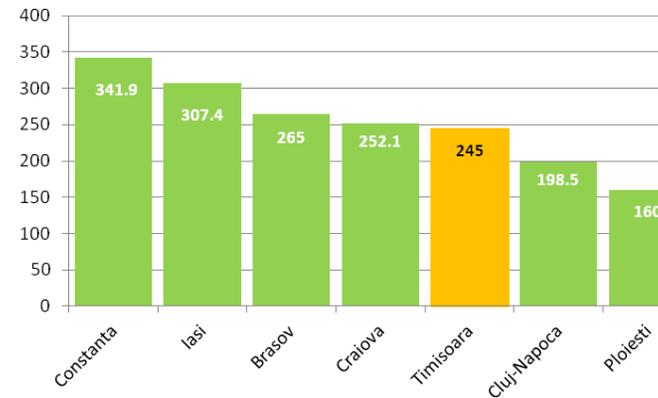
Percent Heat Loss from the network



In 2012, the cost of production of heat was RON 173 per Gcal, while the full tariff (including distribution costs and VAT) was RON 325 per Gcal. Currently, the population pays RON 251.17 per Gcal (with VAT), including the subsidies borne by the City Hall. The tariff has slightly gone up compared to 2012, when people paid RON 245 per Gcal, the third lowest price among the growth poles in Romania, after Ploiești and Cluj-Napoca.

The annual heat production is between 700,000 and 800,000 Gcal. For instance, in 2012, it amounted to 738,154 Gcal, of which 630,154 Gcal was distributed to domestic consumers.

Price for heat in 2012 (RON/Gcal)



Source: ANRSC

The total operational budget to run the district heating system was RON 200 million. About 54% (RON 119 million) goes on fuel necessary to produce heat. Of this, RON 87 million goes on natural gas, RON 30 million on coal, and a very small amount (RON 542,000) on crude oil. The revenue collection process is going well, and only 3% of the people do not pay their heating bills in time.

One of the main challenges to Colterm is the payment of subsidies from the City Hall. Between 2007 and 2011 Colterm received only 80% of the subsidies. For example, at the end of December 2012, the company was still waiting to receive one-third of the money from the local budget. The late payments of subsidies triggers further delays, as the



company cannot pay off the taxes it owes to the central budget. Another problem is related to disconnections from the centralized district heating system. In recent years, about 7% of the customers switched to individual natural gas-based heating micro-units.

Over the course of time, Colterm made serious efforts to rehabilitate and modernize the hot water pipes. The company took a RON 32 million loan to partially upgrade and rehabilitate the primary and secondary network. For the year 2013 the company plans to modernize the 15-year old SCADA system under a EUR 1.7 million project.

A large EUR 72 million refurbishment of the district heating plant in Timișoara is under way. Half of the funds are grants from the Sectoral Operational Program Environment, 45% from the Ministry of Environment, while 5% is the contribution from the local government. The project is targeting the refurbishment of the district heating plants by upgrading a number of eight transportation pumps, two hot water boilers, three steam boilers for heating, and modernization of desulphurization equipment.

But there are other ways to improve the energy efficiency of the system. The rehabilitation work performed on residential buildings helped tackle several things: increase energy efficiency of the buildings, improve comfort level of the residents, and reduce the heating bills. Timișoara was one of the beneficiaries of the residential rehabilitation projects coordinated by the Ministry of Regional Development and Public Administration. Between 2008 and 2010 a number of 64 residential buildings built between 1950 and 1989 comprising 2,500 apartments received financial support for thermal insulation work. Currently, there are 765 residential buildings that have requested financial support from the City Hall to insulate the apartments. 60% of the funds are grants from EU funds, while the rest of the money comes from the local budget, with a small contribution from owners. On average, the owners should pay between EUR 500 and EUR 800 per apartment.

But the number of applications is high and the money limited. There is EUR 8 million allotted for the immediate future and the City Hall must choose the first batch of buildings to be included in this rehabilitation program. Priority will be given to the buildings located on the main roads in Timișoara. The main target of the rehabilitation process is reduction of energy consumption by 40% over a period of 5 years.

Energy efficiency is expected to be achieved through a process that primarily includes thermal insulation, in addition to double-glazed windows and insulation of the rooftop and basement.

Rehabilitated apartment building in Piața Mărășești



Such investments have had a great impact on energy consumption, on heating bills, and not in the least, on residents' level of comfort. For example, one of the residential buildings in the Meziad neighborhood used to consume 181 kWh per square meter; after rehabilitation, the consumption dropped to less than half, to only 74.6 kWh per square meter. The heating bills also dropped drastically.

Besides enhancing energy efficiency and lowering heating bills, there is a whole lot more at stake when it comes to rehabilitation work. This has got to do with the subsidies borne by the City Hall. The lower the heat consumed by people, the lower the overall amount of subsidies. The more residential buildings will be rehabilitated and the heating bills will come down, the more the subsidies for heat will decrease and reduce the burden on the city budget. The savings could then be used for other projects that the city needs.



Water Sector Potable Water

The water sector in Timișoara performs fairly well. Both potable and wastewater is managed by Aquatim, a regional operator organized as a public company with 904 employees under the Timișoara Local Council. 99% of the shares belong to the City of Timișoara, and 1% to the Timiș County Council. The company caters for 460,000 customers in Timișoara and 53 localities throughout Timiș County. The length of the potable water supply network has 634 kilometers, while the sewage pipes have 536 kilometers. The water network belongs to the City Hall. Most of the network is old; some pipes are 90+ years old. Although the water network expanded during the communist regime, the work was rather sloppy. In 2012, the company celebrated 100 years since the first pumping station in Europe became operational, and this is still in operation today.

The potable water sources in Timișoara are both underground and surface points of supply. The company operates with three treatment plants supplying for Timișoara. Two thirds of the water comes from the Bega Channel and gets treated at Bega Water Treatment Plant located in the city.

The Bega Channel, one of the main water sources for Timișoara



Source: www.abruptblog.wordpress.com

One third of the water comes from underground sources and it gets treated at two water plants at Urseni and Ronat. At times, the water from Bega is very dirty, and therefore it requires severe treatment together with a high level of chlorination.

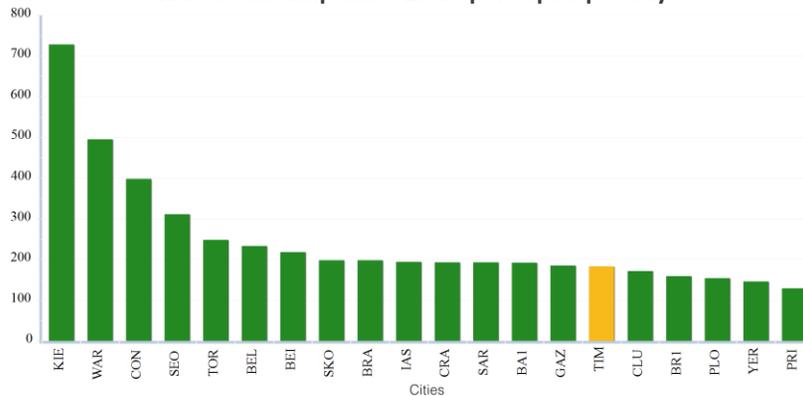
Metering devices were installed starting in the early 2000s. First, remote water reading meters were set in 2008. A few years later, 2,200 new, modern radio-frequency water meters were installed on 100 streets in residential areas. This allows for an accurate collection of consumption data from a distance of up to 200 meters, and helps reduce maintenance costs. Between 2008 and 2012, a GIS-based SCADA system allowing for the digital mapping of the water supply and sewage network was implemented throughout the city. The water flow and pressure can be measured from 25 water connections points. The system can detect any decrease in the water pressure at the pumping station and, thus, the problem can be remedied in a timely fashion. The metering system reduced water consumption by 50% compared to levels registered during the communist regime. Currently, around 90 kilometers of pipes in Timișoara are monitored and 100 old connections have been replaced. In recent years, approximately 2,000 pipe bursts and damages in the pipelines have been fixed, including the replacement of 2 kilometers of network.

In 2012, the amount of potable water distributed in Timișoara amounted to 21,288,495 cubic meters. The overall consumption in the city is 183 liters per capita per day, a figure that places Timișoara rather in the lower side of the TRACE database, close to cities like Sarajevo or Gaziantep. From this perspective, Timișoara performs better than other cities in the region, including Sofia, Budapest, or Craiova, but the water consumption is higher than in other growth poles in Romania, such as Ploiești and Cluj-Napoca.

However, when it comes to water consumption only in the residential sector, the city is doing fairly well with 115 liters per capita per day recorded in 2011. This figure is a third of the water consumption of two decades ago. Over 80% of the treatment processes are automatically monitored and so the energy usage has come down.



Water Consumption – Liters per capita per day

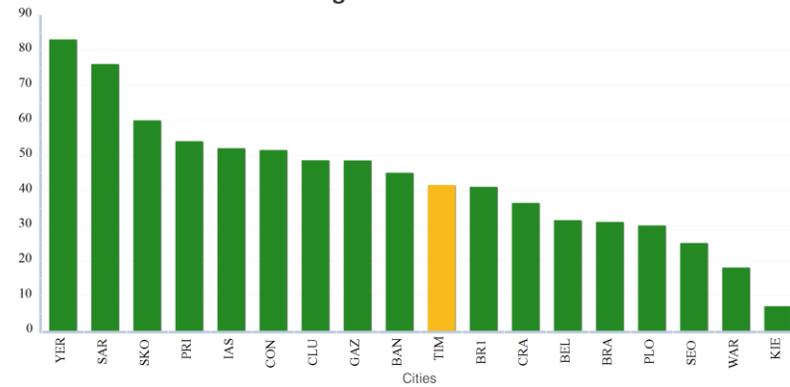


Today, the catchment, treatment, and water supply process requires 0.27 kWh of electricity per cubic meter of water, a figure putting Timișoara in the lower side of the TRACE database comparable to cities with the same Human Development Index. The energy consumption to treat a cubic meter of potable water in Timișoara is comparable to other cities in the region, like Brasov and Ploiești, and less than in Cluj-Napoca, Craiova, or Pștiina.

When it comes to water losses in the network, Timișoara’s performance falls within the range of most cities in Romania, which is between 40% and 60%. The water losses depend on the accuracy of measurement tools, a factor that can influence the result up to 10%. For instance, the water meters in residential buildings are different from the devices installed in apartments, and therefore an accurate measurement should take into consideration such discrepancies. In 2012, the non-revenue water in Timișoara accounted for 41.5%, a figure fairly high in the TRACE database. The performance is comparable to other Romanian cities, including Brașov and București, and it is better than other localities in the region, such as Pștiina and Tbilisi. However, the water losses in Timișoara are higher than in some of the growth poles, like Ploiești and Craiova.

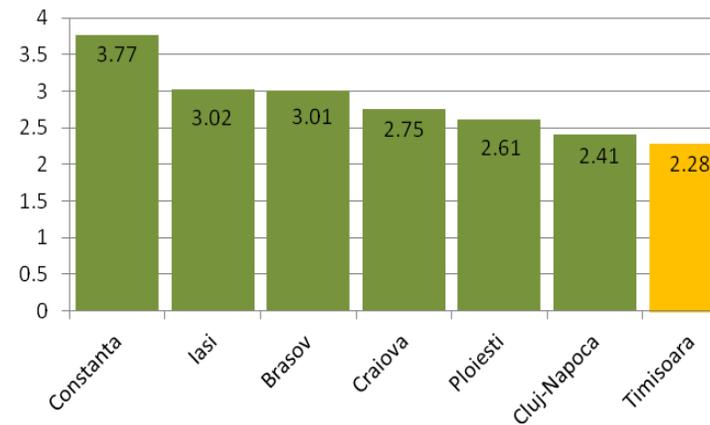
The water tariffs in Timișoara are the second lowest in the country, after Târgu-Jiu. One cubic meter of potable water is sold for RON 2.28 RON without VAT.

Percentage of non-revenue water



On average, it is estimated that 3-4% of the family budget goes on water expenditure, including potable water and sewage services. The tariffs must be approved by the Intercommunity Development Agency, the organization gathering all localities to which Aquatim caters water and sewage services, and also by the Timișoara City Hall.

Water tariffs RON/cubic meter (without VAT)



Source: ANRSC



The final approval comes from the Public Utilities Regulatory Authority (ANRSC). Low tariffs help the company focus on investing in expanding the network and improving the system and the quality of services.

Over the course of time, the company has been preoccupied to improve the water network in the city, reduce the water losses, and increase the quality of services. In 2013, a large project of EUR 119 million with support from Sectoral Operational Program Environment is expected to be completed. EUR 13 million comes from the state budget, EUR 2 million from the local budget, and EUR 15 million is Aquatim’s contribution. The main objective is expanding the water supply in 10 localities in the Timiș County, hoping to achieve 99% water coverage in the region. The main components of the project include 7 new and rehabilitated water catchment facilities, 7 new wastewater treatment facilities, 34 extensions and rehabilitation of feed pipes, rehabilitation of 102 kilometers of water supply network, and 10 new pumping stations. 169 kilometers of wastewater network will be expanded or rehabilitated, in addition to building or upgrading 29 pumping stations and a new, modern sludge treatment facility in Timișoara. At the end of the day, 390,000 customers will benefit from improved water services in Timiș County.

Aquatim has a department dedicated to EU-funded projects, where a young team tracks down financing opportunities and prepares proposals. In addition, the company established a non-profit organization in partnership with a number of water institutes and organizations from European countries, aimed at helping students put into practice the theoretical knowledge they gather in school. Such best practices are worth continuing in the future.

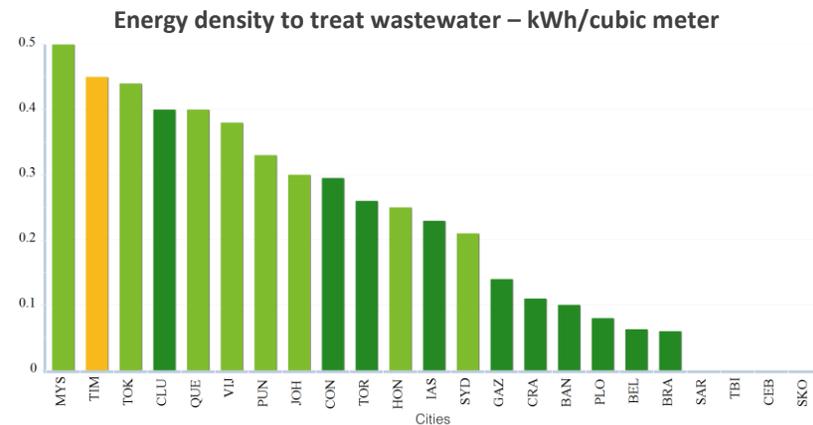
Wastewater

The first wastewater treatment plant in Timișoara was built in 1912 and it is still operational. In recent years, the system was upgraded through a EUR 45 million project with support from the EU pre-accession ISPA program, the EBRD, and the company’s own funds.

Approximately EUR 31 million went to the rehabilitation and refurbishment of the wastewater treatment plant in Timișoara, which caters to the city and neighboring localities, as to ensure appropriate quality of water discharged into the Bega channel, in compliance with EU

regulations. The project included rehabilitation of the mechanical line, construction of a biological treatment facility and sludge treatment lines, and construction of a water quality control lab. Other works included rehabilitation of 7 kilometers of sewage network and expansion of 10 kilometers of wastewater collection system in a few residential areas - including Mehala - Bucovina, UMT, Iosefin, Stadion, Freidorf, Piața Crucii, and Constantin Brâncoveanu neighborhoods.

The amount of energy necessary for treating wastewater is among the highest in the TRACE database, i.e., 0.45 kWh, a figure similar to Cluj-Napoca.



There are cities in Eastern Europe and Romania that perform better and need less energy for treating wastewater, such as Craiova (0.11 kWh per cubic meter) and Brașov (0.06 kWh per cubic meter). The figure recorded by Timișoara is the highest among the seven growth poles.

The sewage lines of the wastewater treatment are maintained through combined vacuum and jetting cleaners. According to the performance indicators, 8 kilometers of sewage pipes must be cleaned every month, a target that has been achieved up to 85% by 2011. During the refurbishment process 40 storm water inlets and 30 damaged sewer connections were replaced, and 7,000 clogged sewers were cleaned up. The upgrading work targeted the construction of modern mechanical and biological treatment facilities, and an expansion of the treatment capacity.



The mechanical treatment of wastewater uses coarse and fine screens, equipped with cleaning, a waste compaction and storage system, sand removal tanks, in addition to fat and grease removal facilities. The sand is flushed and stored in special containers and the fat and grease are stored into a concentrator. The biological treatment includes the process of denitrification and removal of phosphorus. Unlike other facilities in the country, the wastewater treatment plant in Timișoara does not have the capacity to produce biogas because the underground water features do not allow it, as carbon concentration is very low.

Wastewater treatment plant in Timișoara



Source: www.tion.ro

In the future, Aquatim will focus on rehabilitation of the water network and will continue to invest in the modernization of the system. At the same time, the company will expand the water network to all localities in Timiș County where water and sewage services are not available.

Solid Waste

The solid waste sector in Timișoara is administered by both the private and the public sector. The collection of solid waste is managed by Retim, a joint venture between the City Hall and a private company. The landfill is currently managed by a public company that belongs to Lugoj City Council, but starting this summer it will be operated by Retim.

A company with 600 employees, Retim is in charge with the collection, recycling, and transportation of solid waste in Timișoara and other localities in Timiș County, catering for a total of 550,000 people. It is a mix company with 50% shares belonging to the City Hall and 50% to RWE Romania, a private entity managing the solid waste sector in several cities across the country. The company has signed a concession agreement with the city government to operate the solid waste in the city up until 2018.

Retim garbage truck



Source: www.newstimisoara.ro

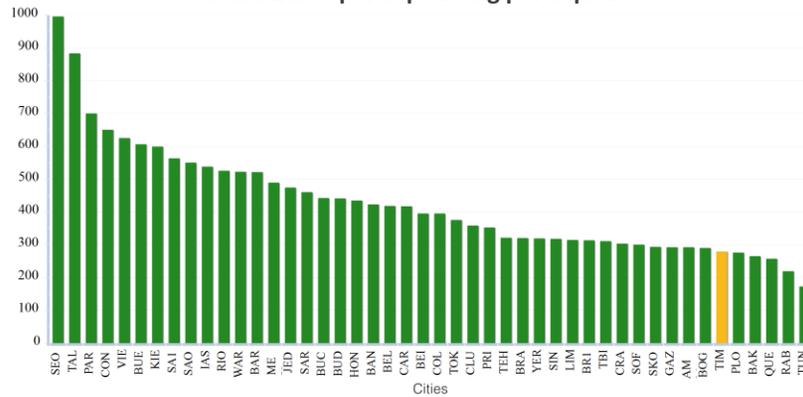
At present, it has 46,041 contracts with more than 33,000 households and 4,804 owners' associations in residential buildings. The company caters to 276,000 people in Timișoara, in addition to 50,000 students and 8,000 economic agents. Retim has invested important resources in the solid waste collection and processing infrastructure, as well as in a number of modern trucks. A sorting station was built in 2011 under a EUR 5 million project. Currently, there are two sorting facilities in Timiș County: one is located 10 kilometers away from the city center, and the other one is in Brad.

The waste generation per capita in Timișoara is among the lowest in the TRACE database compared to cities with similar Human Development Index. With 293 kilograms per capita, Timișoara is



performing similarly to Ploiesti, and much better than most of the cities in the region. In 2012, the solid waste generated in Timișoara amounted to 89,000 tons. The waste generation and collection dropped between 2008 and 2012. For example, in 2009 there were 129,000 tons collected, while the amount of waste dropped to only 90,000 tons in 2012, of which 78,000 was organic waste.

Solid waste per capita – kg per capita



Approximately 40,000 tons of garbage is dumped yearly at the landfill at Ghizela, while the rest of the solid waste is recovered. There are two factors responsible for this decrease: the economic crisis (people have less money to spend on food and goods) and the increasing rate of recyclable waste.

Timișoara implemented selective collection in 2008, initially under a door-to-door system. Subsequently, the company purchased large containers of different colors and placed them throughout the city. In addition, plastic bags were distributed to people to separate the organic waste from the recyclable garbage. In 2010 an aggressive public campaign helped raise awareness regarding the selective collection system. The campaign was a success, and so the amount of selective collection gradually went up from one year to another. If in 2008 the recycled waste amounted to only 1,000 tons, a year later it rose about six times, to more than 6,700 tons, and in 2012 it exceeded 11,000 tons.

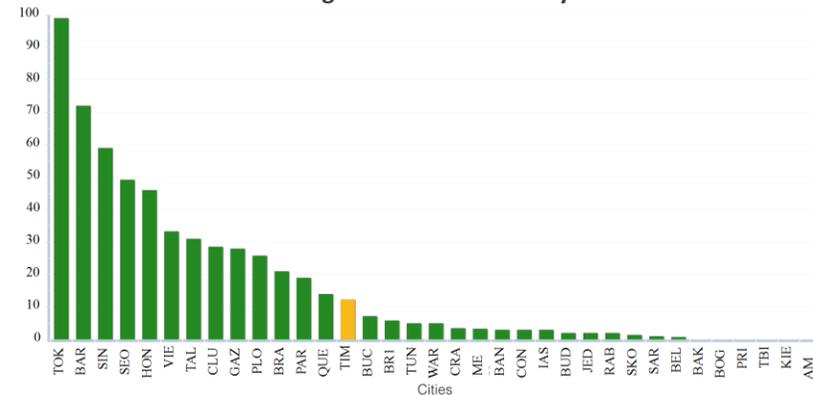
Trash bins for selective collection in Timișoara



Source: opiniatimisoarei.ro

Currently, the percentage of solid waste collection in Timișoara, from plastic, metal, papers, and glass, accounts for 12%. The city performs better than București and Brașov, but is behind other cities in the region, including Cluj-Napoca and Ploiești.

Percentage of Solid Waste Recycled



However, the total amount of the waste that is eventually recovered is, actually, higher. About 45% of the organic waste that goes to the sorting



station is recovered and subsequently sent to Holcim, a cement factory that uses it to produce energy. In the future, Retim plans to send the waste recovered to Colterm, the district heating company.

People pay RON 150 per cubic meter for services related to collection and transportation of solid waste. If a customer does not pay the bill for three consecutive months, the contract is cancelled. The tipping fee at the landfill is RON 55 per ton. The collection and transportation of solid waste is handled by 66 new trucks equipped with EURO 5 catalyts. The fleet is fairly new, as most of the trucks were purchased in 2012. All trucks are equipped with GPS systems monitoring the collection and transportation process. 90% of the total of 1.2 million liters of diesel consumed annually by Retim is used to cover services in Timișoara, which translates into USD 1.8 million. Recycling activities are profitable. The paper is sold for up to EUR 100 per ton, while the plastic bottles can generate anything between EUR 200 and EUR 250 per ton.

The new eco-framed landfill is located at Ghizela, about 50 kilometers away from Timișoara. The land is the property of the municipality of Ghizela and it is currently managed by a public operator under the Lugoj City Council, but starting this summer it will be taken over by Retim. The landfill is spread over 58 hectares and it is part of the Solid Waste Integrated Management Plan for Timiș County, a project of RON 177 million, developed with EU financial support.

According to the master plan, the landfill will cater to the entire county. It is expected to be completed by the end of 2014, and will include a new sorting station, four transfer stations (at Timișoara, Jimbolia, Deta, and Făget), and a bio-gas facility. Currently, a Mechanical Biological Treatment (MBT) station is operational, processing around 65% of the bio-degradable waste from Timiș County (without Timișoara). More than half of the waste released from the MBT station is taken over by the Horticulture Division of the Timișoara City Hall, while the rest is used to cover the old, non-compliant landfill at Parța, a facility that has been shut down in 2009. The landfill at Ghizela has five cells; each cell is spread over 7 hectares, with a capacity of 5 million cubic meters. The filling can be reached within five years.

Under the Master Plan, the selective collection will be introduced throughout Timiș County. A few dozen trucks and some equipment

operating the collection, transferring, and transportation of waste to the landfill will be purchased.

The landfill at Ghizela



Source: www.opiniatimisoarei.ro

For instance, the transfer station in Timișoara will be equipped with 6 containers of 32 cubic meters capacity each, and 14 smaller containers of 14 cubic meters capacity each. Collection centers will be developed at Jimbolia, Deta, and Făget. In addition, tens of thousands of trash bins will be distributed throughout the county (e.g., 278 igloo-type containers of 1,100 liters capacity for glass, over 44,000 large trash bins for organic waste, and nearly 36,000 bins for compost collected from the households).

Urban Transport

Public Transport

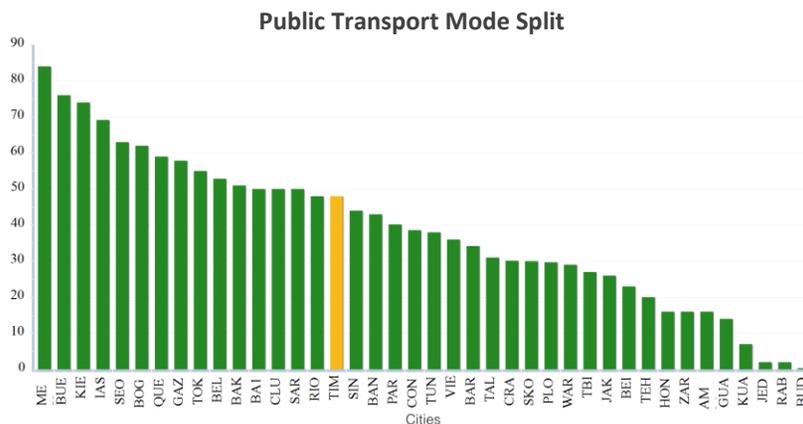
The local public transport is organized by the Local Transport Authority Timișoara (RATT), an autonomous company under the city government. The company was established in 1869, when the city operated the first electrical tram in Europe. The public transport system in Timișoara includes buses, trolleybuses, and trams. Currently, the transport is



organized along 8 routes operated by buses, 7 trolleybus routes, 9 tram routes, and 8 express routes.

In addition, there are four routes connecting the city to a few localities in the wider metropolitan area, namely Giarmata, Becicherecu Mic, Sânmihaiu Român, and Ghiroda. Trolleybuses and trams account for 70% of the public transport network in Timișoara, and buses for the rest (30%). Almost half of the commuters in the city rely on public transport. The figure is comparable to other cities in the TRACE database, like Cluj-Napoca, Sarajevo, or Bajna Luka. The city is performing better than some of the growth poles, such as Craiova or Constanța.

The bus fleet includes 85 Mercedes vehicles. Of these, 55 are standard buses of 12 meters length, compliant with EURO 3 & 4 greenhouse gas standard emissions, with a total seating and standing capacity of 103 people.



The average occupancy ratio of buses is 41%. The vehicles are equipped with air conditioning, ensuring a constant temperature of 25 degrees Celsius in both winter and summer time. Four of these buses have completed their life-cycle and need to be replaced.

In addition, there are 30 long buses of 18 meters length, compliant with EURO 5 greenhouse gas standard emission. They can carry up to 143 passengers, but their occupancy ratio is usually less than a third. Although the bus capacity is under-used and the frequency of buses

should increase in order to gather more passengers, the transport policy set the service frequency at 15 minutes.

There are 50 new, modern SKODA type trolleybuses that have been purchased a few years ago from the Czech Republic, with a capacity of maximum 81 passengers. Their occupancy ratio is 65%, higher than of the buses. Trolleybuses are equipped with synchronized engines that can redistribute energy to the network. The overhead electrical network has not been modernized and it incurs significant losses.

Trolleybus in Timișoara



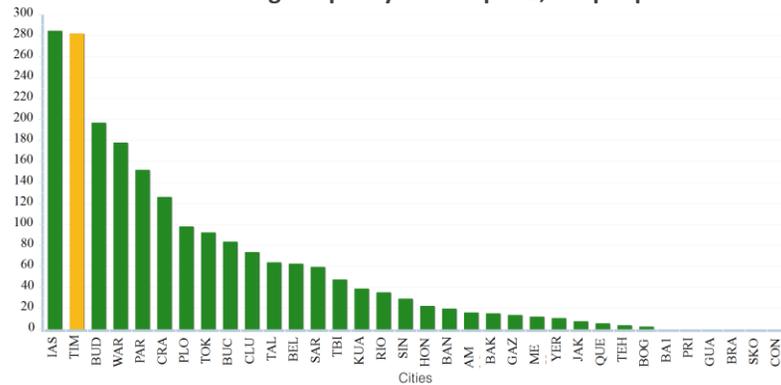
The most popular and efficient means of transportation in the city is the tram. Half of the people riding public transport use trams. The tram network is one of the most extensive in the country, with 90 kilometers single track. The high capacity transit in Timișoara is also the second highest among the cities with a comparable Human Development Index within the TRACE database, with almost 282 kilometers for 1,000 people. It is also the second highest figure among the seven growth poles, after Iași.

The fleet comprises 60 trams, each of them carrying up to 219 people. Their average occupancy ratio is 42%. Half of the tram network has been modernized under a EUR 50 million project, with support of EUR 10 million from the city budget. Another EUR 7 million project dealing



with the modernization of 800 meters of tram tracks is currently under way.

Meters of High Capacity Transit per 1,000 people



In the future, the local government and RATT plan on expanding the tram network to the wider metropolitan area, although careful analyses of density patterns are recommended before making the final decision on this.

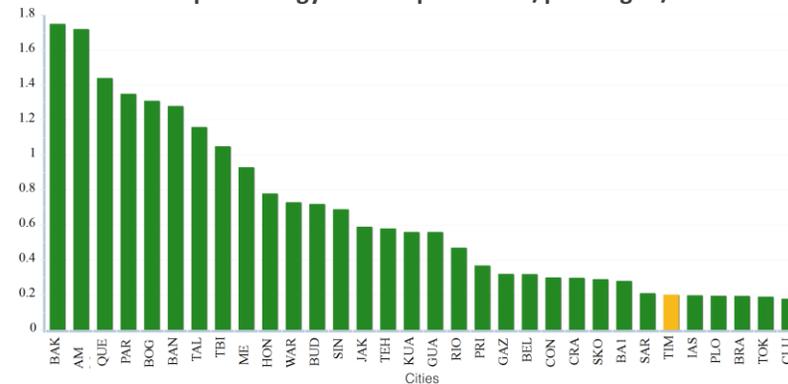
Tram in Timișoara



When it comes to energy consumption, the public transport is doing well, with only 0.2015 MJ per passenger, a figure that places Timișoara among

the most efficient cities with similar Human Transport Development within the TRACE database. The energy consumption per passenger in Timișoara is similarly to Iași and Ploiești; it is higher than Cluj and lower than Craiova and Constanța.

Public Transport Energy Consumption – MJ/passenger /kilometer



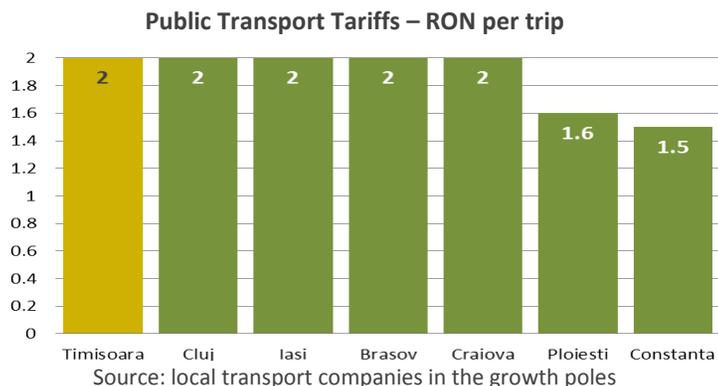
The fuel expenditure necessary to operate the entire bus fleet, including diesel and electricity, amounted to RON 15.4 million in 2012 (approximately USD 4.6 million). Half of the money went to acquire 1.6 million liters of diesel, while the rest were used to purchase 12.3 million kWh of electricity for trams and trolleybuses. The fuel expenditure for trams was twice as high as for trolleybuses. The public transport fare in Timișoara is similar to that of other growth poles in Romania, i.e., RON 2 per trip.

As in many other cities in Romania, some categories of citizens ride for free and discounts are offered to city residents. For example, they can benefit from a 20% discount on a monthly pass if they have a local ID. Students of 19 years old and younger can ride for free.

The same rule is applied to all students of up to 26 years old who are enrolled in universities within the city, but and also for those up to 30 years old enrolled in a doctoral program. 50% of the monthly pass is subsidized by the City Hall, while the other half by the Ministry of Education. Retired people ride for free. Blood donors receive a 50% discount for the monthly pass, only for a period of one month. War



veterans, participants to the 1989 Revolution, and people with minimum wage also do not pay for the public transport in Timișoara.



Over the course of time, RATT and the local government joined efforts to modernize the network in the city and introduce new, user-friendly elements to make the system more attractive to people. One such element is e-ticketing, an innovative and accessible way to pay for the ride. This helps the public transport authority to gather more accurate information about the number of passengers using public vehicles and also tends to improve the collection of revenues.

E-ticketing in Timișoara



Source: ratt.ro

E-ticketing functions like some sort of debit card the users can put money on and it can also be used to pay some of the entertainment services in the city, like theater or cinema.

The electronic card was used to pay the parking in the city until the new system by text message was enforced. People who use e-ticketing get a 10% discount on the public transport fare. They can pay the ticket directly from their cell phones, from designated kiosks, and also on the bus. A pilot project allows people riding the bus to and from the airport to purchase the ticket directly from machines located on buses.

Electronic screens displaying Information on tram, bus, and trolleybus routes and real-time countdown were installed at waiting facilities, allowing passengers to plan and better manage their trips.

Screen displaying information on tram schedule



Currently, the public transport vehicles are not being given priority in traffic. In fact, often, private cars have priority. For instance, sometimes trams must wait a few good few minutes at the red light to let private cars pass. The upcoming traffic management plan that the City Hall is working on will address this issue.

In the near future, the city government is planning to expand the public transport to the metropolitan area, and some first steps have been already taken to this end. The city was awarded a RON 17 million project with support from the 2007-2013 Regional Operational Programme to



expand the trolleybus network to Dumbrăvița, a locality in the metropolitan area. A similar project of RON 24 million will expand the trolleybus service to Ghiroda, should the municipality access the necessary funds.

Private transport

Like everywhere else in Romania, traffic in Timișoara is not an easy task, neither for cars, nor for pedestrians. The city’s proximity to Hungary and Serbia, the investments brought in during the last two decades, access to better opportunities – all have brought more development into the region, which has translated into higher income compared to other parts of the country. This led to an increase in the number of cars in the city, a situation which generated traffic congestion.

Traffic congestion in Timișoara



The number of cars has significantly gone up in the last two decades, from 150 vehicles per 1,000 people in 1990 to 457 cars per 1,000 people in 2005. At present, on average, there are 575 cars for 1,000 people, and overall more than 138,000 vehicles in the city. In addition, over 40,000 cars are transiting Timișoara daily.

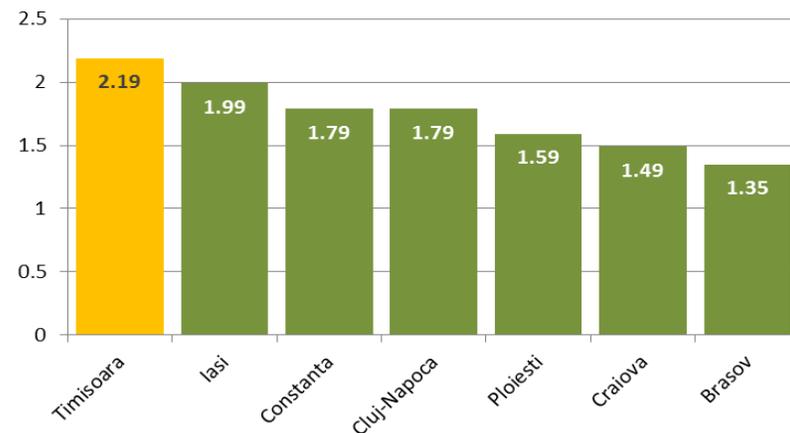
One third of cars registered in Timișoara run on diesel, while the rest use gas. Approximately one-third of private cars in the city are between 6 and 10 years old, and almost a quarter between 11 and 15 years old. 16% of the private vehicles registered with the local police department are between 16 and 20 years old, while a fifth of the fleet is older than 20 years. Less than 2% of the cars are new, up to two years old,

while 9% are between 3 and 5 years old. Like all cities in Romania, Timișoara takes part in the national scrappage program (“Programul Rabla”), which offers people who bring old cars a premium toward buying a new car. Since its start in 2005, the program has played an important role in helping renew the vehicle fleet in Romania. For instance, only in 2010 almost 190,000 cars were scrapped and the vouchers were used to purchase almost 60,000 new vehicles.

There are 1,719 mopeds and 2,200 taxis in the city. Taxis must obtain authorization from the City Hall, which also regulates the tariffs. The city government cannot issue permits for cars older than 10 years. However, no taxi permits have been issued since 2007, as the city has exceeded the number of cars allowed by law, i.e., 4 taxis per 1,000 people.

The tariffs cannot go beyond the ceiling established by the Timișoara Local Council at RON 3.39 per kilometer. There are different tariffs for day and nighttime. Most of the taxis in the city charge RON 2.19 per kilometer during daytime. It is the highest tariff among the seven growth poles. The nighttime fare is higher, RON 2.49 per kilometer, whereas for outside city trips customers must pay RON 2.79 per kilometer.

Taxi tariffs (RON/km) in Growth Poles



Source: Taxi companies from the seven Growth Poles



With a consumption of 1.91 MJ per passenger kilometer, Timișoara performs better than many cities in the TRACE database, including Skopje, Brașov and Craiova. However, there is room to improve, if compared to Banja Luka and Sarajevo. The figure is the second lowest among the seven growth poles, after Cluj-Napoca.

In 2012, the fuel consumption for private cars amounted to nearly USD 60 million. 40% of the residents in Timișoara commute by private cars and only 12% use non-motorized transport. The number of people biking has been steadily increasing in recent years.

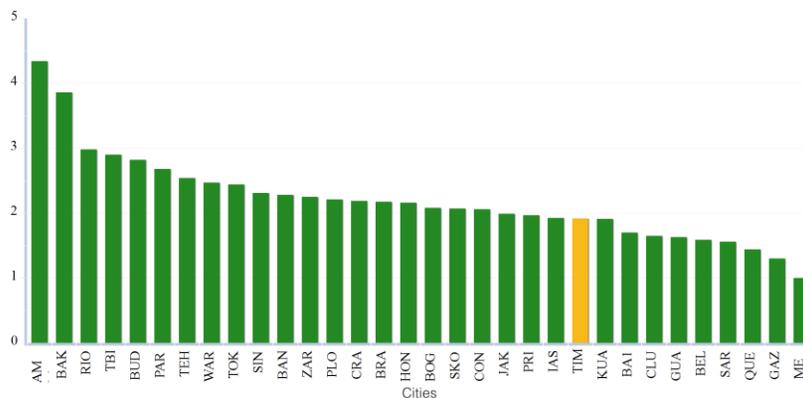
The city authorities have been supportive of non-motorized transport and developed the necessary infrastructure. The sidewalks have been expanded in order to allow for the construction of bike lanes. Currently, Timișoara has 50 kilometers of bike network and two docking stations from where people can rent 200 bicycles. Like in many other cities in Romania, the *I Velo* project is implemented in Timișoara in partnership with a commercial bank.

I Velo docking station in downtown area in Timișoara



Initially, the city managers were rather reluctant to promote the use of bicycles because the law does not clearly state the related traffic regulations.

Private energy consumption MJ/passenger/kilometer



People can rent bikes for a few hours or a full day provided they can present a valid ID. The rental rate is EUR 3 for a day and it goes down if they use the bicycles for just a few hours.

I velo taxi in Timișoara





In the future, the city government plans to expand the bike network and develop bike lanes and rentals spots along the Bega Channel. One of the main challenges to bicyclists is crossing the intersections.

Although the city has some dedicated bike lanes, cycling is allowed on the entire road network. Besides the two docking stations, there are no specially designated parking spots for bicycles, other than the facilities that belong to the *I velo* program. At present, the cycling potential is not fully exploited yet, and city managers have concrete plans to improve the network, which would include building new bike lanes on existing sidewalks, wherever the road infrastructure permits it.

Bike lane in Timișoara



Timișoara has quite a few pedestrian areas in the city center and some of them have been recently modernized. Two of the most popular in Timișoara are the Opera Plaza, covering the section from the Opera House to the Cathedral, and the Piața Unirii area.

Several bars, restaurants, and shops are lined along the pedestrian walks, surrounded by beautiful historical buildings, many of them recently renovated. Parking in the city is fairly well organized. There are a few underground private and public parking spots in the city. In addition, there are 400 parking spots dedicated for taxis. There is a deficit of parking spots comparing to the existing number of cars, and the taxis worsen the parking issue in Timișoara. They run more than 8 hours a day,

as they should, therefore more cars are out on the streets that need to park somewhere.

Piața Unirii, a very popular pedestrian area in the city center



Source: opiniatimisoarei.ro

In March 2013, Timișoara joined a small group of cities in Romania, like Oradea, Arad, Târgu-Mureș, and Satu-Mare that have introduced an easy, attractive parking method by SMS. People pay the parking by sending a text message with the registration number of the car and they receive a message confirming the payment and the parking time.

Timișoara is divided into three areas with different tariffs. For example, the parking in the red area (the city center), is the most expensive, EUR 0.5 plus VAT per hour. The first 15 minutes are free. In the yellow area that goes beyond the downtown area parking costs EUR 0.35 plus VAT per hour, while in the blue area, which corresponds to the periphery of Timișoara, the tariff is EUR 0.25 plus VAT per hour. Parking by SMS works during the week from 8 AM through 5 PM. During the weekend, parking is free.

But despite several parking facilities in the city, there are still cars parked on narrow secondary and tertiary roads, not only causing congestion and sometimes hampering pedestrians, but also narrowing the



possibility of exploiting existing road resources. In the future, the local public administration will work out solutions to restrain traffic in the city.

government wants to sort out this issue by elevating the railway network, an action that would require approval from the Romanian Railway Society.

Parking sign by SMS in Timișoara



At the same time, in some parts of the city the walkways are limited and pedestrians need to cross the street even in the absence of red light or dedicated crossing signs.

The city has five rings and nine radials. None of the rings is closed yet. The radials are partially open, which allows for heavy transit traffic in the city, including in the downtown area. There are two barriers to transport development in Timișoara. One of them is the railway line, located in the northern part of the Timișoara, dividing the city into two.

There are four railway stations in the city, of which two are located in the city center. The freight transportation transits Timișoara through the very heart of the city, causing major inconvenience to the transport flow. Hence, the railway, which belongs to the Romanian Railways Society and the Ministry of Transportation, is adding up to the traffic congestion in the city, obstructing transport development. The local

Railway in downtown Timișoara



Source: www.opiniatimisoarei.ro

The other obstacle to transport development in Timișoara is the Bega Channel, crossing the city from one side to another. The channel used to be navigable on 44 kilometers until a few decades ago, but this is no longer the case, because of its poor technical condition. Crossing the channel is often not convenient, as there are only a few bridges and crossing points available. Although the peri-urban areas are connected to the city center, the existing links do not suffice. The transport network between the peri-urban and urban area is not well organized, as there are no transfer points to meet passengers' needs.

The traffic signaling is based on LED lights. Currently, there is no traffic monitoring by video equipment, but city managers plan to introduce a SCADA system and monitor traffic through video cameras.



Private vehicle (left) and tram signaling (right) in Timișoara



In some parts of the city, there are a number of pedestrian user-friendly intelligent crossings. Pedestrians can request to cross the street by simply pushing a button and then wait for the color to change. This system allows passengers to monitor passing traffic while waiting for the signal to cross.

Pedestrian user-friendly intelligent crossing in Timișoara



A number of 230 video cameras will be installed in the city, helping monitor the main intersections. As of now, there are 90 intersections in Timișoara, but the city government plans to expand them up to 130 in the near future. The tender for a new traffic management system is under way. The ultimate goal of this project is to reduce fuel consumption by 40% and lower average car speeds to 50 km/hour.

So far, only 25% the city's beltway has been completed, connecting Calea Clujului Street to Arad. The rest of 75% belongs to Timiș County Council and the Ministry of Transport. It is expected that the beltway would be completed with support from the next ROP. Also, city managers hope to close the ring roads with money from the upcoming structural funds for the period 2014-2020.

Located outside Timișoara, the airport is linked to the city through a two-lane street and a belt-ring. The commuting to and from the airport is made by bus and private cars. Sometimes, the traffic to the airport is very congested and the time to get there from the city center is nearly the same as the duration of a short flight.

Traian Vuia Airport



Source: www.pressalert.ro

The regional buses that run from Timișoara to a few localities within the metropolitan area do not enter the city. Their first and last stop in Timișoara is at the terminals located right on the city outskirts.

To some extent, the relative proximity to the highway connecting Timișoara to Arad is a burden, because it allows more cars to pour into the city. The City Hall wants to build a road from the highway to the downtown area in order to de-congest traffic in the city. There are also plans to build a freeway for heavy traffic connecting Timișoara to Szeged in Hungary.



In 2005, the City Hall prepared a master plan for transport. The document, called “Timișoara Vision 2030”, was presented as a coherent plan aimed at improving and developing the transportation network in the city and suburbs, where more and more people live, work, study, work, and spends their leisure time. The primary goal is to achieve a sustainable integrated transport in Timișoara, which would translate into increased mobility, improved means of transportation within the city and in the suburbs, as well as better quality of services.

Timișoara – Arad Highway



Source: www.mews.ro

The local public administration wants to turn Timișoara into a multimodal transport center, and connect the city not only to the metropolitan area but to other regions in the western part of Romania, as well as to Hungary and Serbia.

The document identified 10 areas of interventions to improve public and private traffic flow in the city, and make the public transport more attractive to people. Among the main areas of intervention are road infrastructure, public transport development, traffic management, integration of the railways into the city network, and rehabilitation of the Bega Channel navigable.



Energy Efficiency Recommendations

TRACE is a tool that allows for the estimation of energy savings potential in different 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 Timișoara was compared to similar TRACE data on other cities with a similar climate. The energy savings potential with regard to street lighting in Timișoara 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. So far, TRACE has data on almost 100 cities, which allows for good comparisons.

The level of local control also determines the energy saving potential. 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 Timișoara 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. For instance, solid waste is managed both by the City Hall and the private sector - the collection of waste is under a mixed management between the city government and a private firm, whereas the landfill is operated by a public company but soon will be taken over by the private sector. The city has very little influence over the energy sector, as policies and regulations are decided at the national level. "Private vehicles" is another service area where the level of local control is considered low. In this sector the national Government decides on the policies and takes the major decisions, with limited scope for local involvement.

After the saving potential for each indicator was calculated, a sector prioritization was done in TRACE, based on the amount of energy that could be saved. The sectors with the largest energy savings potential in Timișoara are, in this order: "District Heating," "Private Vehicles," "Street Lighting," "Public Transportation," "Municipal Buildings", and "Wastewater." The most promising sector is "District Heating", fully under city government control. The second highest potential for energy savings is "Private Transport," a domain in which the local government does not

have much control. "Street Lighting," a sector under the Timișoara City Hall, can achieve the third highest expected savings. Another area with a good potential of energy savings as highlighted by TRACE is "Municipal Buildings," a sector under municipality control. Although "Water" is another domain that could achieve some energy savings, the sector is performing well and further modernization of water infrastructure will be able to help improve the overall system's performance. Also, TRACE has identified some saving potential regarding "Solid Waste," the sector under both private and public management.

Sector prioritization

City Authority Sector Ranking

Rank	Sector	REI%	Spending CA (US \$)	Control	Score
1	District Heating	20.0	36,094,701	0.95	6,857,993
2	Municipal Buildings	52.1	1,644,546	0.95	814,140
3	Street Lighting	37.3	2,105,938	0.95	747,239
4	Public Transportation	15.9	4,611,906	0.90	663,290
5	Potable Water	36.7	1,290,598	0.75	355,240
6	Wastewater	47.0	214,585	0.75	75,782

City Wide Sector Ranking

Rank	Sector	REI%	Spending (US \$)	CA Control	Score
1	Private Vehicles	24.0	59,592,777	0.10	1,430,461
2	Solid Waste	36.9	1,818,182	0.80	537,140
3	Power	43.7	0	0.25	0

All priorities identified by TRACE were presented and discussed with local public administration officials. A number of nine recommendations were highlighted, and these will be discussed in more detail in the sections below.

From the get-go it has to be mentioned that all recommendations made in this section should be seen as indicative, not as normative. While the TRACE tool enables a quick overview of key energy efficiency issues within a municipality, it does not provide an in-depth analysis of each sector. For example, in most studied cities, the sector with the highest energy savings potential was district heating. Obviously, achieving higher savings in this sector usually also entail high costs. These costs may



outweigh potential benefits, and may not warrant investments in the sector. Also, if people continue to de-branch from the system, any investments done to rehabilitate the network may be nothing more than wasted money.

Similarly, urban transport recommendations should ideally have an urban mobility plan at their foundation (EBRD is in fact supposed to prepare mobility plans for all seven growth poles and București). The recommendations made in this report are general in nature and draw on a pre-defined list of proposed interventions in the TRACE tool. These recommendations should be viewed by local authorities as an indication of what could be done to improve their city's energy performance and reduce the city's energy bill. The decision to actually implement a recommendation or not should be done only after a comprehensive feasibility study is completed. For example, the development of a bike network may have the adverse effect of reducing the share of people who use public transport instead of reducing the number of people who commute by private vehicles.

Lastly, energy efficiency interventions should not be viewed or conceived in a vacuum. Often, energy efficiency interventions have benefits that cross sectors. For example, improving the public transport network, will not only encourage a more energy efficient commuting options, but it could also improve quality of life, help boost local economies, and enable poor and marginalized communities better access to opportunities. In the same vein, interventions that aim to improve the energy efficiency of a municipal building could be done in tandem with retrofits that make these buildings more resilient to disasters.

District Heating Maintenance and Upgrade

The TRACE analysis indicates that district heating has the highest energy saving potential. This recommendation made to the city government of Timișoara shows the importance of keeping the district heating system alive and upgrading the hot water and heat network. The main objective is to reduce the leakages in the hot water pipes and improve the system's overall efficiency. This can be achieved through a maintenance program targeting repairing and upgrading of boilers, pumps, pipes, and insulation of pipes. In addition, the local authorities should pass legislation that

would require minimum efficiency level of generation and supply infrastructure of the district heating network.

Like in many other cities in Romania, the thermal energy consumption in Timișoara has dropped over the last decade. Closing down the state-owned companies and the disconnection of a number of apartments from the district heating structure has led to lower demand for heat. For instance, according to the National Institute of Statistics, the heat produced reached its peak in 2001, when over 2 million Gcal were distributed in Timișoara. Subsequently, the production gradually went down. In 2003, only half of the amount Gcal sold in 2001 was distributed in the city, i.e., 1.1 million Gcal. The heat consumption dropped to 934,829 Gcal in 2008. It continued to go down to 845,229 Gcal in 2009, and even lower, to 813,160 Gcal in 2010. In recent years, heat consumption has been stabilized to anything between 700,000 and 800,000 Gcal per year. In 2012, annual consumption amounted to 738,154 Gcal. Lately, 7% of the district heating customers switched to natural gas-based individual micro-heating plants. The losses incurred in the transmission and distribution network account for 25%, a figure that could be contained with a set of measures focusing on maintenance and upgrading work.

In line with the TRACE recommendation, the city government and Colterm are already implementing a large refurbishment project aimed at improving the overall efficiency of the system. The project targets upgrading of eight transportation pumps, two hot water boilers, three steam boilers for heating, and modernization of desulphurization installations.

The pumps and water boilers have been already upgraded. The modernization work of steam boilers and the desulphurization are expected to be completed in the summer of 2013. After the entire project is concluded, the company wants to implement the new EU environmental standards in the district heating sector. The next step the local government will focus on is the modernization of the hot water pipes through a EUR 25 million program targeting the district heating networks in seven cities in Romania. However, one type of investment the local government should look into is the rehabilitation of the network in residential buildings by switching from vertical pipes to the horizontal model.



Colterm plants are undergoing major refurbishment work



Source: www.opiniatimisoarei.ro

Heat meters and allocators should be installed in all apartments, so people can easily control the level of heat. In addition, thermal rehabilitation work on residential buildings should also help improve the overall efficiency of the system and increase the level of comfort in apartments. A pilot project as such was implemented in a couple of residential buildings in Craiova. The City Hall was in charge of the thermal rehabilitation of the buildings, whereas the district heating operator made the changes to the distribution system.

As a result, the heat consumption came down by 40%. The heating bills dropped, the quality of services improved, and the level of comfort in the apartments went up. Colterm designed a similar project in Timișoara to change the hot water and heat distribution system in 20 apartments. The project aims to lead by example for other residential buildings in the city and it is expected that in the near future more buildings would switch to horizontal distribution system.

In addition, continuing the thermal rehabilitation of the residential buildings would provide for the right path for achieving energy savings. Hundreds of apartment buildings need rehabilitation work. In 2013, the first batch of apartments will undergo rehabilitation work with EU support. Subsequently, the city government hopes that the next

programming period of the ROP will enable it to continue such projects, and more residential buildings will be thermally insulated.

Horizontal distribution pipe in a rehabilitated building in Craiova



At the same time, the local public administration should consider investing in the network to contain the 25% losses in the distribution pipes. Despite of rehabilitation of some of the pipes, leakages are still there. In the medium and long run, pipes insulation and modernization of the network will help reduce hot water losses and improve the overall efficiency of the system.

Urban Transport

Urban transportation is the sector with the highest potential for energy efficiency gains in Timișoara, as identified by TRACE. It is also one of the priority areas of intervention for local authorities. The municipality already has a number of forward-thinking initiatives in this sector, including expansion of non-motorized transport, traffic management master plan, improvement of the transport network, and addressing the parking issue. To a large extent, the recommendations fall within the scope of the efforts the local authorities are already undertaking, or are planning to carry out in the near future. The sections below will discuss each recommendation in more detail.



In addition, relevant stakeholders in the city should establish a database with key transport indicators. Such indicators should include the basic information related to transport modal split in the city, as to document how many people use public transport, how many walk or bike, and how many rely on their private vehicles to commute. This information is vital for every city in order to prepare a comprehensive mobility plan that should be 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 the capital city, București.

In line with such goals, the main objective of the city manager for the 2014-2020 Timișoara Integrated Development Plan is the development of the transport network, in correlation with urban planning. In the future, local public administration aims to improve the urban transport system in the city, as well as increase attractiveness of the public transport.

Non-Motorized Transport Modes

One of the top priorities for local authorities in Timișoara is expanding the non-motorized transportation network. Currently, approximately 12% of the commuters in Timișoara bike or walk, but the target is to increase this figure in the years to come. An efficient non-motorized transportation with zero fuel consumption and low infrastructure investments is good for the environment, reduces pollution, improves air quality, and benefits for people's health. With an initial investment of USD 1,000,000 over a two-year implementation period, potential annual savings of 100,000 to 200,000 kWh can be achieved.

The city already has a fairly good pedestrian network. The Opera Plaza and Piața Unirii are two of the most popular leisure and entertainment areas in Timișoara, attracting city residents and tourists. The walkways and historical buildings in the area have been rehabilitated. The local public administration wants to expand on the pedestrian network and bike lanes, and thus, have more people walking and cycling. To this end, the city managers plan to set up a few kilometers of bike lanes along the Bega Channel, on the route from the Old City – the Bega Channel – and the Green Forest in the northern part of the city.

Bike lanes will be developed along the Bega Channel



Source: www.geografice.info

Docking stations will be built on the water banks from where people will be able to rent out bicycles based on an ID and a small fee.

The “I velo” model developed in partnership with a commercial bank will be expanded on the future bike lanes along the Bega Channel. Also, as part of the rehabilitation of the Michelangelo Bridge, several bike lanes and pedestrian sidewalks will be developed on the streets toward the main intersection in the area.

Critical mass in Timișoara





The upcoming rehabilitation of the historical center will expand on the walking lanes. The existing network will be enlarged by a number of 14 streets. They will be closed for the traffic and will allow only pedestrians and bicyclists. The pedestrian networks help raise the quality of life in the city and stimulate business development. Not only do they help pedestrian traffic go up, but they also increase substantially the businesses and leisure & entertainment activities in the area. The existing pedestrian networks in the city center gather several leisure and entertainment places, such as hotel, restaurants, bars, shops, service stores, art exhibition venues, in addition to fountains and benches where people can enjoy and relax.

More pedestrian networks will be built in Timișoara



The Opera Plaza and Piața Unirii are today one of the most popular areas in the city. For example, the Opera Plaza hosts a few of the cultural institutions in the city, which are adding to the attractiveness of the city.

Parking Restraint Measures

The TRACE analysis recommends local authorities in Timișoara to discourage the use of private vehicles and support alternative modes of transportation by imposing more restrictive parking measures in certain areas in the city. Fewer cars on the streets would translate into 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. For instance, a maximum parking allowance with low car-to-unit ratios could discourage private-car purchases and use. This solution is convenient as it does not require immediate investments from the city budget, and it can be implemented wherever there is public transport connection available. Such measure has been successfully tested in many European cities. For instance, in certain areas in London where there is bus connectivity the local government allocates less than 1 parking spot per unit. However, this practice should be coordinated with expanding public transport in the area, if necessary.

One of the best practices that have proven to be very useful in dealing with traffic congestion is the Park and Ride concept. Although this is a costly measure and involves serious capital investment, it is a very efficient way to promote multimodality by linking parking to public transport. The local public administration of Timișoara plans to build a number of eight Park and Ride facilities in the city. People who travel to the city drive their cars to these facilities, from where they take public transport to get to their workplace. It is crucial that such Park and Ride facilities are built in locations where public transport is available. In addition, cheap parking should not be available in center areas. The cost of transport, including parking fees, should be lower than that of the fuel used for the entire distance.

Bus terminals can be replaced with Park and Ride facilities



Source: oradetimis.ro; wikipedia.org



Closing down for traffic a number of 14 streets will further restrict the access of cars in the city center and reduce parking in the area. In addition, the Timișoara City Hall should consider hiking prices for the parking spots in the downtown area, thus discouraging people to drive their cars into the city center, and rather use the public transport, or simply bike or walk. Not in the least, the municipality should consider expanding the parking spots in Timișoara by building underground facilities in order to accommodate the growing number of cars in the city.

Traffic Restraint Measures

Another important recommendation made by TRACE to the public authorities of Timișoara is about curbing private car usage and replacing it with more sustainable, efficient, and less costly means of transportation. As the number of cars will continue to rise, it is expected that fuel use will go up, and so will greenhouse gas emissions. City authorities should act accordingly as to reduce private vehicle usage and replace it with more sustainable, efficient, and less costly measures. The increase in the number of cars should be contained by measures that would induce people to turn to other means of transportation, e.g., buses, trams, biking, and walking, and discourage them from using their private vehicles. Such options would lead to traffic decongestion, less fuel consumption and reduced costs, as well as to a cleaner, healthier environment. To this end, traffic can be restrained in many ways. A few infrastructure projects aimed at improving traffic in the city are under way. More projects are in the pipeline, as noted in the Timișoara Vision 2030 document.

An underground passage will connect Vasile Pârvan and Peștalozzi boulevards, through a 15 EUR million project with EU support. The Michelangelo underground passage will have two lanes, one each way. Red lights will be installed in the main intersection, and streets leading to it will be expanded to three lanes. The project also includes the rehabilitation of Michelangelo Bridge that crosses the Bega Channel between The Children’s Park and Rose Park. Bike lanes and pedestrian sidewalks will be set on all streets connected to the intersection.

Construction site at Michelangelo passage in Timișoara



Source: newstimisoara.ro

Another way to curb traffic is by imposing taxes to enter the downtown area. For example, the city of London imposed a “congestion charge” during week days from 6 AM through 7:30 PM, and cars that want to get into the city center during these hours must pay a fee. In an attempt to curb traffic in Timișoara, the City Hall tried to set a fee for all heavy vehicles and private cars entering the city center. But transport companies and car owners challenged the local council decision in court and the municipality had to withdraw the proposal. The city government also tried to set up staggered working hours in order to reduce peak time traffic congestion, for instance from 7AM to 3PM, but it was not acceptable to the community.

The local government could learn from good practices in terms of traffic restraint measures implemented in other cities. For example, the municipality of Cluj-Napoca has introduced some restrictions for private inter-regional buses, limiting them only to a couple of stops in the city. Once the Park and Ride facilities and intermodal terminals will be built, Timișoara may consider banning the inter-regional buses from entering the city. In addition, enforcing some speed zones in the downtown area could also help discourage traffic. For example, the local administration of



Craiova imposed some stricter speed limits in the city center, up to 40 kilometers per hour.

At the end of the day, reducing the speed limit in some zones could be just one component of a bigger plan that city managers may take into consideration in view of restricting private car use and favoring the flow of public transport, cycling, and walking in designated areas, by establishing the so-called “environmental islands.” These may consist of a few streets in certain parts of the city, and they may be the result of some measures conceived to prohibit and penalize the access of private vehicles’ access in designated areas, and reduce the amount of space available for private cars.

Brera-Garibaldi area in Milan turned pedestrian



Source: www.epomm.eu

One of the biggest “environmental island” projects in Italy was developed in the Brera-Garibaldi neighborhood located in the heart of Milan. This very busy and congested area was turned into an urban pedestrian network. Heavy traffic was eliminated, a new road hierarchy was created, innovative traffic calming solutions were implemented, public transport routes were enhanced, street parking was reorganized, and the existing cycle routes were developed.

The local government of Timișoara can go even further and set up “no driving days” to educate and lead by example, actions to which people could participate voluntarily. For example, the city of Puerto Princesa in the Philippines is restricting tricycles in the downtown district on a certain day of the week.

Public Transport Development

One of the main TRACE recommendations made to Timișoara is to advance the development of a modern and safe public transport. This would not only provide citizens with better quality services, but it would also reduce the use of private vehicles and, instead, encourage people to ride public vehicles. Once people would rely more on public transportation, it would significantly reduce the fuel consumption, diminish the number of private cars in circulation, improve air quality in the city, and increase the quality of life for the residents of Timișoara.

The public transport development aims to ensure mobility by increasing connectivity between the city center and the outskirts, and integrating the network with the traffic management system. The public transport in Timișoara is operated by trams, buses, and trolleybuses, and connects the downtown area to all parts of the city and even to a few localities in the wider metropolitan area. In the last decade, the city government and the local transport authority were preoccupied to modernize the public transport rolling stock, by purchasing new buses and trolleybuses. However, some of the vehicles of the public transport fleet are fairly old and need to be replaced. Efforts should continue to this end, and keep improving the public transport system to increase its accessibility and use.

One of the big ambitions of local authorities is to establish a multimodal transport center in Timișoara and improve connectivity in the city and the metropolitan area, but also between Timiș and neighboring counties. More inter-county/regional roads should be built between Timiș, Arad, and Caraș-Severin counties. In addition, a couple of ring roads and a beltway in Timișoara should be built, as to improve access and ease traffic flow in the downtown area. Given the city’s proximity to the border of three countries, the local government wants to turn Timișoara into an important railway transport center, interconnecting Romania, Hungary, and Serbia.

Modernization of the electric transport and its expansion to the neighboring localities are some of the authorities’ main priorities for the near future. At the same time, a tender will be organized soon for purchasing small and medium-sized, efficient buses to operate on the secondary routes in the city. At present, there are bus routes linking



Timișoara to four neighboring localities, namely Sânmihaiu Român, Ghiroda, Gîramata, and Becicheicu Mic.

Medium-sized bus in Oslo



Source: en.wikipedia.org

The city managers also want to expand the public transport to other localities in the wider metropolitan area as to improve access to and from Timișoara. There are several residents living in the wider metropolitan area who work and study in Timișoara, and they should be provided with a good public transport connection as an alternative to private cars. Thus, traffic congestion on access roads to Timișoara will be reduced, especially during rush hours. Soon, a RON 17 million project aimed at expanding the trolleybus network to Dumbrăvița, a commune about 6 kilometers far from the city, is going to be implemented. The project will include expanding the fixed infrastructure and assets, such as electrical overhead wiring and poles. The Timișoara City Hall has submitted a RON 24 million proposal under the 2007-2013 ROP to operate trolleybus service to Ghiroda, a commune about 7 kilometers away from the city. With support from ROP 2007-2013, tram service will be introduced to the metropolitan area by developing 6 kilometers of double track to Moșnita, a commune near Timișoara. Currently, the local transport authority is waiting to receive the environmental permits to start the construction work. Similarly, another plan targets building the tram network to Sânmihaiu Român, about 16 kilometers from Timișoara.

The Tram network will be expanded in the metropolitan area



In the long run, the city plans to develop the trolleybus network in those parts of Timișoara that are not presently covered by this service. At the end of the day, the ultimate goal is to use fewer buses and rely more on trolleybuses, which are more efficient and less-costly. Future plans include building a tram connection to the airport. In addition, eight transport terminals will be modernized in order to get connected to the public and private networks. E-ticketing should be integrated with the parking system and with the future park and ride facilities.

Another ambitious project in the long run would include the Bega Channel into the public transport network. The Bega was the first navigable channel in Romania at the beginning of the 18th Century. According to the 2030 Vision Timișoara document, the municipality is thinking to introduce the service of small boats (vaporetto) and build four port-stations. But first the city needs to clean the water, which is a very costly process.

One of the issues to be addressed in the immediate future is giving public transport priority over private transport. Today, although both private and private transport has equal priority in traffic, in reality private transport gets preferential treatment. Often times, trams are waiting for minutes at the red light to let private cars pass. This will be addressed by the upcoming traffic management program. The city should go even further and think about developing dedicated bus lanes that will give priority to buses at intersections.



Bus lanes in Los Angeles



Source: www.laist.com

Such lanes will enable buses to bypass traffic congestion, and enhance their reliability while reducing travel times. Giving priority to public transport would provide an important incentive for switching means of transportation. Moreover, cities that have a good network of dedicated bus lanes have managed to tackle in a productive way bus traffic issues. Also, special infrastructure for bus-priority signaling should be considered. This system is linked to buses via transponders that use GIS information, and can help the flow of approaching buses either by extending green lights for them or by cutting down the cycle for cars. At present, passengers in Timișoara are informed about real-time bus countdown information displayed on screens at waiting facilities, allowing people to plan and better manage their trips, enhancing the attractiveness of the public transport, and thus increasing the number of users.

Local authorities may consider changing some of the planning regulations as well. For instance, in order to obtain planning permits, developers should be able to show how a new development links to the existing or planned public transport network. Also, allowing higher densities of development next to well-served public transport corridors can create a good base for public transport and should be used in connection with other planning measures, such as capping parking provision to residential and office buildings.

Last but not the least, the local transport authority and the City Hall should organize information campaigns to increase awareness on the

benefits of the public transport. To this end, such campaigns should focus on promoting public transport as a reliable, fast, comfortable, safe, cheap, and accessible means of transportation in comparison to other transportation modes.

Traffic Flow Measures

The last TRACE recommendation regarding urban transportation is related to improving traffic flow as part of increasing the efficiency of the urban transport system in Timișoara. As elsewhere in Romania, traffic congestion is creating lots of trouble for Timișoara residents. Traffic management can be improved by working out solutions aimed at minimizing the distance traveled, and, thus, reducing fuel consumption. Up to 200,000 kWh energy can be saved every year with a minimum investment of USD 100,000 to USD 1 million, aimed at changing driving patterns by technical optimization of traffic signaling or by means of information.

The municipality of Timișoara is currently implementing a project aimed at reducing traffic congestion in the city. The intelligent traffic management system is expected to achieve several things: increase efficiency of the public transport, better regulate traffic along public transport corridors, increase speed of the public transport, improve traffic safety, and, not in the least, reduce the greenhouse gas emissions. The main benefits of the system will be translated in cutting down waiting times at intersections, decreasing travel times, timely informing the passengers on bus schedule and routes, improving traffic flow, and setting up a centralized management system for public transport users. Among the components of the traffic management program are public transport vehicle location system, fleet management system, and real time information on public transport schedule.

Public transport will be the main beneficiary of the traffic management program. From a command center, monitoring agents will keep an eye on intersections, and inform the local police whenever traffic congestion is detected. A system allowing the automatic location of vehicles will be implemented. This will increase efficiency of traffic monitoring, boost operation of the public transport fleet, and provide timely information on bus schedule, technical issues and delays. More



specifically, information can be displayed through the Variable Message Signing (VSM).

Variable Signing Messages system



Source: en.academic.ru

This system informs bus drivers about delays, route switching options, and directional signing to destinations. Screens displayed in the bus will tell passengers about next stops and available connections to other public transport routes. VSM or radio data systems will inform private vehicle drivers about delays, route switching options, directional signing to destinations, and availability of parking spaces. This system will allow people to choose the most suitable means of transportation, decrease travel time and delays, and cut down the number of accidents.

The city managers are thinking about elevating the railway station in the city center in order to better plan the urban transport and improve traffic congestion, as well as improve the traffic flow. At the same time, the section of the old railway network that has not been used lately should be rehabilitated and integrated with the local transport network, using the same tracks. According to the Timișoara Vision 2030, a document prepared in mid-2000s, the railway should be extended all the way to the airport. As the existing tram lines are getting very close to the airport, only a few kilometers of additional tracks would need to be built.

In order to stimulate traffic flow, the city government has in mind some measures, including the construction of a beltway, closing some of the existing ring roads, modernization of the key-radial streets, building

over- and underground passages. For example, the inner part of the first ring road located in the historical city center should be dedicated exclusively for pedestrian traffic. The city managers also plan to build three new bridges on the Bega Channel at Jiul, Ilsa, and Bobâlna streets.

Street Lighting Timing Program

This TRACE recommendation made to the city managers in Timișoara is centered on a street lighting timing program that would reduce the light intensity according to the specific needs of a particular area. It is an inexpensive method of diminishing electricity consumption for city streets, requiring an initial capital investment of USD 100,000 over a year that can prompt between 100,000 and 200,000 kWh in energy savings.

This program can be tailored to the specific needs for lighting in a particular area. The level of lighting can be adjusted through a monitoring system, according to varying weather and activity levels. Usually, light systems have astronomic timers with geographic designations, and allow for adjusting the light according to the season and time of day. More light is required during winters when days are shorter and it gets dark early, whereas less light is needed in the summers when days are brighter and sunnier. The attractive aspect of this program is that lighting and its intensity may vary based on demand at a particular time of day. For instance, at midnight, when only a few people and cars are out on the street, the light is reduced automatically from a command center. By dimming the lights gradually, eyes are able to adjust to lower lighting levels, and the dimming is barely noticeable.

Timișoara is implementing a lighting dimming system under a pilot project on Republicii Street in the downtown area. The project is aimed at reducing the light intensity by 30% from 1AM through 5AM. Although the purpose was to reduce the light intensity, in reality the system is not working properly. Instead of lowering the intensity, the light actually gets interrupted. Such shortcomings are expected to be resolved in the future, as the pilot is improved.

Under the Covenant of Mayors, the local public administration committed to reduce energy consumption by 20% by 2020. According to the Sustainable Energy Action Plan, over the next decade the local government wants to enhance the efficiency of the street lighting system



by replacing existing bulbs with new eco-framed ones with less consumption.

Several cities across the world have turned to street lighting timing programs. One of cities as such is Kirklees, UK, that chose to dim lights to varying levels throughout the day, instead of turning off the lights at certain times of the day. The municipality installed retrofit systems on each existing lighting pole and used wireless technology to monitor and dim the street lights. The retrofitting process simply requires adding a small antenna to the lamp heads, which gets plugged into the electronic ballast, with no need for additional wiring. The lights are switched on at 100% at 7PM, dimmed to 75% at 10PM, and then to 50% at midnight. If the lights are still on at 5 o'clock in the morning they are increased again to 100% lighting. Light dimming programs are very efficient because they save both energy and money, reduce the brightness of bulbs at times of low road or street usage, and fluctuate bulb brightness at varying times.

At the same time, city authorities in Timișoara are considering an automatic lighting system for certain city areas (e.g., areas with limited pedestrian traffic, such as parking lots). Using a motion-sensor, the light turns on only when someone is walking by, and it stays off when nobody is there. Such systems are implemented in some neighborhoods in Bucharest, along small alleys and paths around residential buildings.

Street lighting poles in Timișoara will control light intensity



Source: oradetimis.oradestiri.ro

In addition, the municipality should consider preparing a procurement guidebook for street lighting, when choosing the operator or replacing the bulbs. Some preliminary steps have been taken in 2005, when the City Hall asked for specifications for bulbs. The City Hall plans to introduce similar specifications for the next tender.

Municipal Buildings

Municipal Buildings Benchmarking Program

One of the main recommendations the TRACE team makes to most public administrations in Romania where the tool has been implemented is the need for a municipal buildings energy database, where all energy-related information can be tracked and monitored. The same recommendation has been made to Timișoara. An energy database in place is very useful to implement any energy efficiency program. City managers do not know if energy efficiency investments were indeed effective it is often not clear how much energy buildings consumed before and after the interventions. Most local authorities in cities where TRACE has been implemented do not keep a proper and reliable database on the buildings they administer (e.g., schools, kindergartens, hospitals, public administration offices, cultural centers, social assistance and sport facilities), on electricity and heat consumption, and on floor areas. Therefore, often times they do not know the actual consumption of heat per square meter nor the actual expenditure for the given floor area.

Timișoara has some issues regarding the municipal building database as the local public administration does not collect complete, basic indicators on the buildings managed by the City Hall. While some buildings in the city use natural gas, some are connected to district heating. After requests from the TRACE team, the city was able to produce the data pertaining to energy consumption and expenditure. However, this information can be improved.

This issue can be addressed through setting up a proper, clear, well-organized database that could be used to further prepare an efficient analysis of the energy saving potential of these buildings. The database should include 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. Local authorities in Timișoara that pay for electricity and thermal energy bills for municipal buildings should have a better picture about related energy consumption and expenditures and about how these expenses could be decreased.

It is important for city managers to understand that the data on energy consumption will be crucial for the local government when they will apply for funds under the 2014-2020 ROP, where energy efficiency will be one of the most important pillars of the program. The next ROP financial programming period will open ways for municipalities to apply for funds that could help improve the overall energy efficiency of their cities by lowering the electricity and heating bills, save money for the city budget, and thus, help the city become more efficient.

The municipal building benchmarking process should include a database comprising a series of specific information including type of construction, date of the construction and renovation or rehabilitation (if applicable), floor area, type of heating, information on electricity, heating, and water utility bills in recent years, as well as cooling, heating, and lighting system modes.

A small dedicated team within the City Hall and a few 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. The data should be published and updated on a regular basis to enable competition among building managers and open the path for productive exchange of information and cooperation. Such a 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. At the end of the day, the analysis should identify the most appropriate energy saving options. Also, 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 should look at when organizing the benchmarking process. For instance, an energy smart building labeling program is implemented in Singapore at the national level, under a project developed by the Energy Sustainability Unit of the National University of Singapore and the National Environment Agency.

The Louis Țurcanu Children's Hospital in Timișoara



Source: realitatea.net

Grigore Moisil High School in Timișoara





The project aims to promote energy efficiency and conservation in buildings by acknowledging those that are energy efficient. The assessment is done through an online benchmarking system used to evaluate the energy performance of office and hotel buildings. With the support of this tool, property owners can review the energy consumption patterns within their buildings and compare them against industry norms. Every year, the most efficient buildings receive an Energy Smart Building Label as part of an annual awards ceremony. The award recognizes the reduction in energy consumption and carbon emission, a high satisfaction level by building occupants, and energy savings due to active energy-related management.

The Ukrainian city of Lviv is another good example that an efficient benchmarking could achieve considerable energy savings. The city was able to reduce annual energy consumption in all its 530 public buildings by 10% and cut water consumption by 12% through a Monitoring and Targeting program to control energy and water use. As of 2010, the program achieved savings of USD 1.2 million with minimal costs. The program provided the city management with monthly consumption data for district heating, natural gas, electricity and water in all municipal buildings. This information was able to determine annual goals based on historical consumption and negotiations on an adjustment. The consumption was reviewed every month and all deviations and performances were communicated to the public through a public display campaign. Subsequently, the City Hall of Lviv established a new energy management unit and trained all personnel with responsibilities on building utility use in an administrative division, unit, or building.

Municipal Buildings Audit and Retrofit

Once the municipal building benchmarking is prepared, the next step the local public administration in Timișoara should consider is an audit and retrofit process to enable cost savings, and also reduce 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, purchase new equipment, and perform some building renovation. The retrofit program

can be executed in a cost-effective manner by involving Energy Service Companies (ESCOs), which would pay for the initial cost of the upgrades and then 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 25% of the initial consumption.

In recent years, the Timișoara City Hall has actively supported energy savings and encouraged both private and public buildings to be proactive and save energy in any of its forms. Some of the municipal buildings and several residential buildings have been renovated and thermally insulated. Rehabilitation work has been performed on a number of education facilities and administrative offices, including the building hosting the City Hall. Some of the rehabilitation work has been done with support from the 2007-2013 ROP. Nearly 4,000 apartments in residential buildings have been rehabilitated recently. In the near future, the local government plans to carry out rehabilitation and renovation of some municipal buildings, with support from EU structural funds. In the short run, the focus is on the rehabilitation of a couple of historical buildings hosting the Jean-Louis Calderon high-school and the C.D Lloga National College.

The C.D.Lloga National College will be rehabilitated



Source: panoramio.ro



At present, the municipal buildings pay utility bills (water, heat, electricity or natural gas) and then the money is reimbursed by the City Hall. But the problem is that the city government does not know what they are paying for, as the municipal buildings do not report the energy consumption. In order to address this, the Timișoara City Hall is thinking to pay the energy-related expenditures directly to the utility companies. In this way, the local public administration will have full control of the bills and will be able to maintain proper records on both consumption and expenditure.

In the near future, local authorities will continue the rehabilitation work on some of the residential buildings in the city. A number of 765 residential buildings in Timișoara asked for support from the city government for thermal insulation work. EUR 8 million have been allotted from EU structural funds for the year 2013. The city managers hope that similar projects will become eligible under the 2014-2020 ROP. Property owners must also contribute to the rehabilitation work, with maximum EUR 800 per apartment.

Germany provides a few successful examples in improving energy efficiency in municipal buildings and reducing related costs. The local government of Berlin, in partnership with the Berlin Energy Agency, managed the retrofit of public and private buildings by preparing tenders for work that would guarantee reductions in emissions. The public retrofit tenders require an average of 26% greenhouse gas emission reduction, so that winning Energy System Companies (ESCOs) must deliver sustainable energy solutions. Under this program, 1,400 buildings have been upgraded so far at no cost to owners, managing to have more than 60,400 tons per year in CO₂ reductions, and generating substantial savings.

In another successful case, the City of Frankfurt signed a contract with a private company to install and operate an energy-management system for three main municipal buildings to diminish the energy and water expenditures and decrease the greenhouse gas emissions. The company spent USD 680,000 on control equipment. The capital invested was recovered from energy savings (54%) over a period of eight years, while the remaining 46% was expected to reduce the operating costs for the buildings. Compared to the previous annual costs of USD 1.7 million, the potential cost reduction was estimated to be around USD 217,000 per year.

Last but not least, the city of Stuttgart is able to save 7,200 tons of CO₂ every year through an innovative form of internal contracting that makes use of a revolving fund to finance energy and water-saving measures. The city invests the savings directly into new activities, thus enabling a circle of environmental improvements and emissions reduction.



EUROPEAN UNION



GOVERNMENT OF ROMANIA



MINISTRY OF REGIONAL DEVELOPMENT
AND PUBLIC ADMINISTRATION



TIMIȘOARA



Instrumente Structurale
2007 - 2013

Annexes Improving Energy Efficiency in TIMIȘOARA 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



PROGRAMUL OPERAȚIONAL REGIONAL

Inițiativă locală. Dezvoltare regională.

Detailed Recommendations from TRACE

Improving Energy Efficiency in Timișoara, 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 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.

IMPLEMENTATION OPTIONS

Implementation Activity	Methodology
Feasibility Study	<p>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.</p> <p>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.</p>
Direct expenditures & procurement	<p>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.</p>

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



	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 summarizes 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: 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.

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.

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



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-motorized transport mode, modal shift, km of dedicated cycle/walking infrastructure, take-up of cycle promotion schemes by analyzing 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 accessible only 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 program, 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 3: 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 details.
Park & Ride facilities	The City Authority promotes multimodality by providing Park & Ride locations at key interchanges. By linking parking to public transport use, the 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

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



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 by 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 4: Traffic Restraint Measures

DESCRIPTION

Discouraging potential drivers from using their cars leads to fewer cars in circulation. This encourages people to use alternative modes, which in turn will increase their viability (increased public transport patronage for example). Removing vehicles from circulation reduces fuel use and reduces the need for road space.

IMPLEMENTATION OPTIONS

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

Attributes
Energy Savings Potential
 100,000-200,000 kWh/annum
First Cost
 US\$100,000-1,000,000
Speed of Implementation
 1-2 years
Co-Benefits
 Reduced carbon emissions
 Improved air quality
 Enhanced public health & safety

MONITORING

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



measurement activity (daily, weekly, monthly etc.), assignment of responsibilities for each aspect of the process, a means of auditing and reviewing performance and finally, establishment of reporting and review cycles.

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

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

CASE STUDIES

Vehicle bans: Motorcycle ban, Guangzhou, China

Institute for Transportation and Development Policy (2008). "Case study: motorcycles in Guangzhou", available online from <http://www.itdp.org/documents/Guangzhou%20Case%20Studies%20-%20Motorcycles%2015-Sep-08.pdf>

Motorcycles have been completely banned in the City of Guangzhou. The ban was implemented in phases, beginning with a moratorium on new licenses, extending to various roads and time periods. Gradual implementation has been crucial to allow time for the public to adapt, and efficient supply of additional infrastructure/services has supported the induced modal shift. Many motorbike riders have shifted to bicycles and buses, and cycle rickshaws have also emerged as a popular substitute. Road accidents have dropped by 40% since the initial implementation of the ban.

Rationing, Singapore, Singapore

Sustainable Urban Transport Project (2010). "The Vehicle Quota System in Singapore", available online from http://www.sutp.org/index2.php?option=com_content&do_pdf=1&id=1582

Singapore fixes the number of new vehicles allowed for registration. Potential buyers need to bid for a non-transferable license, which entitles them to own a vehicle for a fixed number of years. The scheme had to be modified soon after implementation to safeguard against speculative action. The licenses used to be transferable and within the first two months of the first round of release, 20% changed hands in "buy and sell" transactions with speculators making sizable profits of up to S\$5000. As the rationing system does not control annual mileage, the success of the rationed registration in limiting vehicle usage has been dependent on support from other traffic restraint measures, such as high road tolls, parking fees, and electronic road pricing.

No-driving days, One Day Rest, Puerto Princesa, Philippines

ICLEI (2001). "Vehicular Reduction Strategy for Air Pollution Prevention and Climate Change Mitigation; A Case of Puerto Princesa City, Philippines", available online from <http://www.iclei.org/index.php?id=1193>

Introduced as part of a zoning and rerouting, this program stipulates a one day rest for tricycle drivers in the central business district. Regulation of illegally operated tri-cycles is a major impediment, as enforcement irregularities pose questions of inequality between illegal and legal tri-cycle taxi drivers. Furthermore, the income potential of those who comply with the rest day is lost to the illegal operators.



TOOLS & GUIDANCE

Tools & Guidance

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



ANNEX 5: 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.

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.
Signaling	The City Authority invests in the necessary infrastructure for bus-priority signaling. Such systems are linked to buses via transponders which use GIS information, and favor 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

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



	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](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 totaled 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 *Eco² 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 high density 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: *Eco² 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: Eco² 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 the preparation in 2001 of 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/accessible_bus_stop_design_guidance.pdf



ANNEX 6: Traffic Flow Optimization

DESCRIPTION

Traffic can be positively managed to ensure the most efficient operation of the transport system. Management techniques will seek to minimize distance travelled between origin and destination, ensure the efficient flow of traffic and encourage multiple occupancy vehicle travel. Encourage the efficient use of vehicles and minimize journey lengths, reducing fuel use.

IMPLEMENTATION OPTIONS

Implementation Activity	Methodology
Flow optimization	The City Authority changes driving patterns either by technical optimization of traffic signaling, or by means of the provision of information. Real-time information can be provided by means of Variable Message Signing (VMS) or telecommunication where drivers are provided with route switching options, clear directional signing to destinations, and directions to nearest available car parks. This minimizes journey length and reduces congestion. Messaging systems have also been used to counter crime by providing information on e.g. kidnappings and terrorist attacks. See Portland and Milton Keynes case studies for further details.
Regulatory	The City Authority establishes high-occupancy vehicle lanes (HOV), producing an incentive for car sharing. The pairing of users can be left to civic initiatives, or driven by city authorities either separately or in combination with its other initiatives (in the latter case initiatives can be communicated to users using the same platform). Achieving a minimum number of users is crucial, as insufficient use results in reduced available road space and increased congestion. The implementation of an effective enforcement and penalties system are equally important, as the lane will otherwise attract an unacceptably high level of non-HOVs, which also reduces effectiveness. See Madrid 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

ATTRIBUTES

Energy Savings Potential

> 200,000 kWh/annum

First Cost

US\$100,000-1,000,000

Speed of Implementation

> 2 years

Co-Benefits

Reduced carbon emissions
Enhanced public health & safety



measurement activity (daily, weekly, monthly etc.), assignment of responsibilities for each aspect of the process, a means of auditing and reviewing performance and finally, establishment of reporting and review cycles.

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

- Perform traffic surveys of number of vehicles in circulation by using traffic counters.
- Determine mode share of people travelling in the area or city.

CASE STUDIES

Arterial 'green wave' traffic flow optimization, Portland, USA

C40 Cities (2010). "Portland, USA: Optimizing traffic signal timing significantly reduces the consumption of fuel", available online from http://www.c40cities.org/bestpractices/transport/portland_traffic.jsp

The City Authority optimized traffic signal timing at 135 intersections on 16 of some of Portland's most congested thoroughfares. 'Optimization' of traffic signals consists of re-timing the traffic signals to improve their synchronization across a road traffic network. The cost of an intersection synchronization varied USD 1,000-3,000. The resulting reductions in the frequency by which vehicles accelerate and decelerate, as well as the reductions in the time vehicles spend with idling engines, yielded annual fuel savings of 1,750,000 gallons of gas. This is the equivalent of removing 30,000 passenger vehicles from the road for an entire year. The city went a further step by measuring and eliminating CO₂ through the purchase of carbon credits.

Variable Message Signs, Milton Keynes, UK

Department for Transport (2010). "Case Study: Milton Keynes Integrated Traffic Management", available online from: <http://www.dft.gov.uk/itstoolkit/CaseStudies/milton-keynes-integrated-traffic-management.htm>

In order to achieve a more efficient usage of car parks and encourage shoppers into the central retail area of Milton Keynes, as well as reduce congestion caused by cars looking for parking, the city administration invested in Variable Message Signs which display the location and availability of parking spaces to road users. Installation costs were lowered by making use of existing ducted network in Milton Keynes used by the Police for CCTV. This created the added benefit of providing a large capacity network for future growth in data transmissions. The reduction in congestion and delays resulting from the system are estimated to save motorists and bus passengers in the central area more than GBP 3 million over a 10-year period.

High-Occupancy Vehicle lane, Madrid, Spain

Monzon, A. (1999) "Managing long term congestion in HOV lanes. Effect of 2+ vs 3+ limit on the Madrid N-VI corridor", paper presented at the European Transport Conference, Cambridge, Jan 1st 1999, available online from <http://www.etcproceedings.org/paper/download/2493>

High environmental standards, low housing density, and high motorization rates influenced the decision of implementing an HOV lane scheme on the median of the N-VI motorway into Madrid. The cut off limit for the lane is 2+ passengers and the facility is separated from the mix-flow lanes by a concrete barrier along the whole length of it. A successful design aspect is the reversible basis on which the system operates to match peak flows, serving the inbound trips during the morning peak, and the outbound trips during the evening peak. Rather than increase ridesharing, the lanes have attracted a growth in public transport mode share (40% in the period 0700-1000 in the year following implementation), resulting in increased frequencies of services.



TOOLS & GUIDANCE

Tools & Guidance

Colorado Department of Transportation (2005). "CDOT Guidelines on Variable Message Signs (VMS)", A guidance document for the design of Variable Message Sign (VMS) messages. Available online from <http://www.cotrip.org/its/whitepapers/VMSGUIDE-rev-2005.pdf>

Alabama Department of Transportation (2007). "Traffic Signal Design Guide & Timing Manual" A guidance document with detailed guidelines and recommendations for the designing and timing of traffic signals in the State of Alabama. Available online from <http://www.dot.state.al.us/dsweb/Traffic/pdf/AldotTrafficSignalManual122007.pdf>



ANNEX 7: Lighting Timing Program

DESCRIPTION

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

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

IMPLEMENTATION OPTIONS

Implementation Activity	Methodology
Study illumination timing alternatives	Prepare a study to estimate the types of streets and luminaires that have the opportunity to have reduced timing and dimming during late night hours.
Install timers and dimmers on existing street lights	Allocate funding to implement upgrades and retrofits for dimming and timing opportunities. Roll out upgrades over the course of multiple years to achieve 100% coverage of all city public lighting and street lighting installations. 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.

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



MONITORING

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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 Kirklees can save up to 30% of the electricity used annually. By replacing 1,200 lights, Kirklees 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 approximate 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 tele-management control was employed. Tele-management 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



ANNEX 8: 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: <ul style="list-style-type: none"> • lighting systems • 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, behavioral

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



	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

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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;
- kWht/m² - Benchmark annual heating energy consumption on a per-square-meter basis for all municipal office buildings;
- \$/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 tons 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 day-lighting 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 9: 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 meter).

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: <ul style="list-style-type: none"> • 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)

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



	<ul style="list-style-type: none"> • building heating, cooling, lighting system types
Set data collection strategy	<p>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).</p>
Begin collecting data	<p>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.</p>
Analyze and Interpret Data	<p>Conduct an analysis of collected data to ensure accuracy and begin to identify opportunities. Some examples of analysis include:</p> <ul style="list-style-type: none"> • 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 <p>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.)</p>
Formulate a Bespoke Benchmark	<p>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:</p> <ul style="list-style-type: none"> • types of tenants • occupancy density (persons/m2) • building energy management <p>This benchmarking is usually done for the purposes of building labeling. See Singapore case study for further details.</p>



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 fulfill these recommendations. The plan contains program 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 program of energy management to ensure their operating efficiency is maintained throughout their life span. The BEEMP consists of the following programs:

- 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 Labeling Programme, Singapore

<http://www.e2singapore.gov.sg/buildings/energysmart-building-label.html>

The Energy Smart Building Labeling 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, supported by MHME, NAER and European Association of 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.

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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

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



ANNEX 10: List of abbreviations for cities in the TRACE database

	City	Country	City Abbreviation		City	Country	City Abbreviation
1	Addis Ababa	Ethiopia	ADD	38	Karachi	Pakistan	KAR
2	Amman	Jordan	AMM	39	Kathmandu	Nepal	KAT
3	Baku	Azerbaijan	BAK	40	Kiev	Ukraine	KIE
4	Bangkok	Thailand	BAN	41	Kuala Lumpur	Malaysia	KUA
5	Belgrade	Serbia	BE1	42	Lima	Peru	LIM
6	Belo Horizonte	Brazil	BEL	43	Ljubljana	Slovenia	LJU
7	Bengaluru	India	BEN	44	Mexico City	Mexico	MEX
8	Bhopal	India	BHO	45	Mumbai	India	MUM
9	Bratislava	Slovakia	BRA	46	Mysore	India	MYS
10	Brasov	Romania	BR1/BRA	47	New York	USA	NEW
11	Bucharest	Romania	BUC	48	Odessa	Ukraine	ODE
12	Budapest	Hungary	BUD	49	Paris	France	PAR
13	Cairo	Egypt	CAI	50	Patna	India	PAT
14	Cape Town	South Africa	CAP	51	Phnom Penh	Cambodia	PHN
15	Casablanca	Morocco	CAS	52	Ploiesti	Romania	PLO
16	Cebu	Philippines	CEB	53	Pokhara	Nepal	POK
17	Cluj-Napoca	Romania	CLU	54	Porto	Portugal	POR
18	Colombo	Sri Lanka	COL	55	Pune	India	PUN
19	Constanta	Romania	CON	56	Quezon City	Philippines	QUE
20	Craiova	Romania	CRA	57	Rio de Janeiro	Brazil	RIO
21	Dakar	Senegal	DAK	58	Sangli	India	SAN
22	Danang	Vietnam	DAN	59	Sarajevo	Bosnia and Herzegovina	SAR
23	Dhaka	Bangladesh	DHA	60	Seoul	South Korea	SEO
24	Gaziantep	Turkey	GAZ	61	Shanghai	China	SHA
25	Guangzhou	China	GUA	62	Singapore	Singapore	SIN



26	Guntur	India	GUN	63	Sofia	Bulgaria	SOF
27	Hanoi	Vietnam	HAN	64	Surabaya	Indonesia	SUR
28	Helsinki	Finland	HEL	65	Sydney	Australia	SYD
29	Ho Chi Minh	Vietnam	HO	66	Tallinn	Estonia	TAL
30	Hong Kong	China	HON	67	Tbilisi	Georgia	TBI
31	Iasi	Romania	IAS	68	Tehran	Iran	TEH
32	Indore	India	IND	69	Timisoara	Romania	TIM
33	Jabalpur	India	JAB	70	Tokyo	Japan	TOK
34	Jakarta	Indonesia	JAK	71	Toronto	Canada	TOR
35	Jeddah	Saudi Arabia	JED	72	Urumqi	China	URU
36	Johannesburg	South Africa	JOH	73	Vijaywada	India	VIJ
37	Kanpur	India	KAN	74	Yerevan	Armenia	YER