

The European Union's programme Covenant of Mayors Going East –  
Supporting the Participation of Eastern Partnership and Central Asian Cities in the Covenant of Mayors

# WHAT MUST A CITY DO TO BECOME A SUCCESSFUL PARTICIPANT OF THE COVENANT OF MAYORS



## CASE STUDIES from Ukraine and Georgia



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the Association "Energy Efficient Cities of Ukraine"



# **WHAT MUST A CITY DO TO BECOME A SUCCESSFUL PARTICIPANT OF THE COVENANT OF MAYORS**

**CASE STUDIES FROM UKRAINE AND GEORGIA**

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# FOREWORD

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In 1991, Ukraine inherited an extremely energy-intensive economy from the USSR. The origin of this situation was the availability and very low cost of basic energy resources, especially oil and natural gas; the physical and moral depreciation of fixed assets, and an inadequate rate of fixed asset modernization over time. As a result, today's energy intensity of gross domestic product of Ukraine is 16.7 kWh per unit product at a cost of \$1, while in developed countries the same product requires (consumes) 2.4 kWh of energy.

Following 30 post-war years<sup>1</sup>, of "planned" plundering of Ukraine's richest oilfields and deposits of natural gas (when most of Ukraine's production was exported to Russia, Belarus, Lithuania, Latvia, Austria, Poland, Czechoslovakia, East Germany, Hungary, Moldova, Bulgaria and Italy), Ukraine turned from an exporter of these strategic energy sources into their importer. Today, based on its domestic production, the country provides for 35% of its demand for natural gas, and only 12-15% of its demand for oil (based on 2010 data). The remainder is imported, primarily (70%) from the Russian Federation. At the same time, natural gas holds the largest primary energy consumption share (41%).

Due to low (much lower than in EU countries) prices for Russian energy sources, the status of Ukraine's energy supply remained relatively stable until 2005. Prior to the presidential election in 2004, Russia, attempted to keep Ukraine in the orbit of its political influence, agreeing to reduce the price of gas from US \$80 per thousand cubic meters to \$50 per thousand cubic meters (See Annex 4 of the contract for the supply of natural gas between "Naftogaz of Ukraine" and "Gazprom"), whereas, according to World Bank estimates, European parity price of gas at that time was US \$235 per thousand cubic meters. Accordingly, succeeding post-Soviet governments in Ukraine did not care highly about the strategic need to diversify energy supplies or the need to increase energy saving and energy efficiency of the economy, and while exercising a populist rhetoric about "brotherly friendship", they failed to provide "brotherly friendship" by neglecting the warnings of experts. Recently, the gas war (declared by Russia against the "orange" (and then "blue-white") government of Ukraine) and the subsequent new round of the global energy crisis revealed the imbecility of the previous line of policy. As a result, within the last 5 years, the price of natural gas in Ukraine increased by 550%, the price of the electricity increased by 300%, and the price of the centrally supplied heat energy – by more than 400%

The housing and communal economy (which consumes over 40% of the energy produced in Ukraine) appeared to be especially vulnerable to the rampant price escalation, primarily through its technical inadequacies and lack of routine maintenance. The specific costs for heating residential buildings constructed during the Soviet period (70% of housing stock was built before 1970) range from 400 to 700 kWh/m<sup>2</sup> per year, while the European standard is 80-150 kWh/m<sup>2</sup> per year (depending on the climate zone). Overall depreciation of fixed assets exceeds 60%. At the beginning of the 1990s, an average of 30-40 accidents occurred per 100 kilometres of public utilities in Ukraine, while over the past years, this figure has reached 180 accidents per 100 kilometres of water supply networks and 10-20 - per 100 kilometres of heat supply networks.

However, the outcome is that that today the residential sector has the greatest potential for easing the burden of national energy expenditures. A well-planned and vigorous restructuring, aimed at a dramatic increase in the energy consumption indicators to a level of modern international standards, will provide a real chance to break the vicious circle of Ukraine's energy dependence.

The case studies that follow represent real life success stories from three Ukrainian cities (metropolis - Lviv, medium-sized city - Kamyanets-Podilsky, and small town - Dolyna), which accepted the highly political challenge and decided on their own to restore order in their "cold house," beginning with energy consumption management in public buildings.

This collection includes also case study of Tbilisi – the first city in Georgia which joined the Covenant of Mayors, the mainstream movement of European cities combating global climate change. The case study of Tbilisi was prepared by Energy Efficient Centre Georgia.

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<sup>1</sup> In the 70's last century, based on its total production of oil and gas, Ukraine was a part of the top ten oil & gas producing countries, being the leader in Europe. The maximum oil recovery (14.4 million tons) occurred in 1972, and the maximum natural gas production (68.35 billion m<sup>3</sup>) – in 1976. The reserves of only two major, depleted then, gas fields - Shebelynske and Khrestyshchenske - were 712 and 313 billion m<sup>3</sup>, respectively. In total, in 1944-1995 about 1.6 trillion m<sup>3</sup> of natural gas was produced in Ukraine. For comparison, in 2010 Ukraine consumed 57.6 billion cubic meters of gas.

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## BRIEFLY ABOUT LVIV

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Lviv is the largest city in Lviv oblast. It is a cultural, educational, scientific and business center, an important industrial center, and one of the country's primary transportation hubs. The city was founded by King Danylo Romanovych and the first written mention of the City dates back to 1256. It is considered the unofficial capital of Halychyna (Galicia) and western Ukraine. Lviv was awarded the "Cultural Capital of Ukraine" status, ranks first in Ukraine with the largest number of architectural monuments, and its historic centre is inscribed on the UNESCO World Heritage List. Lviv was one of the four Ukrainian cities hosting the 2012 UEFA European Football Championship.

As of February 1, 2012, the population of Lviv was 757,795 people (making it the seventh most populous city in Ukraine). According to the latest census in Ukraine (2001), 88.1% of the city residents are Ukrainians. The area of the city is about 180 km<sup>2</sup>.

The main European watershed ridge, which divides the rivers of the Baltic Sea and the Black Sea basins, passes through the city of Lviv. The local climate is moderately continental and characterized by rapid changes in atmospheric pressure, temperature and humidity. Lviv is characterized by the highest rainfall and the lowest summer temperatures among all regional centres of Ukraine. The average annual rainfall is 760 mm, with its lowest temperature in January and highest temperatures in July. On average, there are about 174 days of precipitation a year. The average humidity is 79%. Winters are mild and frosts below -20°C are observed very rarely. Persistent snow cover is not established each winter. Spring is cool and rainy, frost and snow possible by early May. Summer is warm: within +20-25°C and heat above +30°C is rare. Thunderstorms with heavy rains and hurricane winds are frequent in summer. Autumn, by contrast, is moderately warm and dry.

Within the city of Lviv there are 513 public sector buildings with total area of 1157.5 thousand m<sup>2</sup>; 270 of these buildings are educational institutions, 69 are health care institutions; 86 are cultural institutions, 81 are sports and leisure facilities, and 7 hold the City Administration. In total, they consume an average of 245.2 kWh/m<sup>2</sup>/year.

In turn, the housing stock consists of 19,713 residential buildings with total area of 13,498.2 thousand m<sup>2</sup>, 43% of which is owned by the local community of Lviv. Their average consumption of energy is 321.8 kWh/m<sup>2</sup>/year.

The basic energy sources used by the public sector buildings are heat (62%) and natural gas (23%), with in addition to electricity and hot water. The situation is quite opposite in the residential sector: with natural gas at 59%, and heat at 31%.

The public joint-stock company «Lvivoblenergo» provides the city with electricity, public JSC «Lvivgas» – with gas. Heat is provided by two major municipal public utility companies «Lvivteploenergo» and «Zaliznychneteploenergo» (they also provide hot water service) as well as by 129 small subordinate boiler facilities (their total contribution is 10%). Cold water is provided by the municipal communal enterprise «Lvivvodokanal».

Lviv city budget expenditures for the purchase of energy consistently rank second after wages, and more than 90% of these expenditures are related to maintenance of the public sector buildings.

# A SUCCESS STORY

## THE BASELINE

Lviv entered the new millennium with a typical (for Ukrainian cities of that time) range of energy problems caused, on one hand, by an unprecedented increase in energy prices, and on the other hand, by mass impoverishment and, consequently, low bill-paying capacity of the population. Because of the large indebtedness of consumers and underrated tariffs that did not cover the cost of housing and public utility services, municipal energy companies were on the verge of bankruptcy. The system of subsidies for housing and communal services for certain categories of people, which was introduced by the state, did not solve the problem. Thus, in May 2001 (because of the debt of «Lvivvodokanal» to «Lvivoblenergo» (42.5 million UAH)), the electricity at a few urban pumping stations was cut off. As a result, most residents of the city, who had already been accustomed to receiving water only for two hours in the morning and the evening, found themselves without any water for three days. Losses from the financial and economic activity of JSC «Lvivgas» in 2006 reached 35.3 million. Among 54 facilities of «Lvivteploenergo» that operated at that time, 35 operated at a loss. The lack of funds for maintenance repairs, preventive measures, modernization and retooling contributed to the rapid aging of fixed assets and the increase of energy loss. A paradoxical situation happened when bills for utility services were growing, while the quality of these services was falling steadily. For example, according to the residents, during the winter of 2006-2007, the Heating Electrical Plant HEP-1, which provides heat to Sykhiv – the largest “sleeping” district in Lviv, worked only in order to avoid the freezing of pipes.

## THE FIRST ATTEMPT TO MAKE A DIFFERENCE

The first innovative international experience in the area of municipal energy was put into practice in Lviv in 1997: within the framework of the international Municipal Network for Energy Efficiency (MUNEE). The City, along with the US Alliance to Save Energy (ASE), executed a pilot project at Lviv boarding school No. 1 for children with cardiovascular diseases. After repairing windows and doors, sealing windows with special rubber strips and installing an automatic control system of heat transfer to the building, the heat consumption decreased from 168 to 35 kWh per week. At the same time, the thermal comfort was improved significantly and, consequently, the frequency of disease among children dropped by 20% during the cold season. Generally, over the next three years

savings on energy in the boarding school amounted to 45,522.75 UAH. Later, the successful experience was extended to four more schools in Lviv and to the cities of Ivano-Frankivsk, Lutsk, Slavutych, Ternopil, Kharkiv and Khmelnytsky.

At the same time, Yuriy Havrylyuk from the ASE office in Lviv developed two PC software packages (ASE 2.3 and BEEP) for the City Department of Education. These software packages were developed to calculate, monitor and analyse energy consumption in school buildings and related expenditures. In particular, the database created by ASE 2.3 allowed buildings to be ranked in terms of energy consumption, identifying the ones that were most energy intensive. It has greatly facilitated the informed decision-making regarding investments for improving energy performance.

As part of another joint pilot project (funded by the United States Agency for International Development (USAID)) with ASE, two apartment houses in Lviv were equipped with utility meters for heat and hot water to analyse the impact of these technical measures on public subsidies for housing and utilities. And a few months after meters were installed, the bills for heat and hot water decreased by 30-38%. Even after raising tariffs rates for housing and communal services in 2000, the total savings for 313 apartments in two buildings were 3,800 USD. It was possible to reduce the subsidies, paid by the city to its residents, by 57%.

In 2006, a two-part tariff for heat energy was introduced for all users in Lviv, which made it possible to reduce the level of debt to the heat supply enterprises, and enabled businesses to plan and perform better routine maintenance of the heat distribution networks in summer.

However, together with the first lessons learned on how, by combining efforts of stakeholders, we can effectively prevent the waste of energy and money at the level of the end-user of services (user of the building), it was also clear that it is not enough to have demonstration projects in order to change the situation in the city for the better: the problem needs to be addressed comprehensively.

The turning point towards implementation of a full-scale energy management system in Lviv was a project conducted in cooperation with the Association of

European Municipalities "Energy Cities". The project was funded by the European Commission and aimed towards creating a similar national association of cities in Ukraine. In 2004-2005, Ukrainian participants of the project, including the representatives of executive authorities of Lviv, through participation in major international conferences and workshops, were able to get acquainted with the theoretical foundations of municipal energy management and relevant practical experience of advanced European cities, including Montpellier and Besançon (France), Stuttgart and Freiburg (Germany), Martigny (Switzerland). The participants were also able to establish strong business contacts with European partners, especially with Energy Cities.

### A NEW STAGE

A truly systemic and systematic approach aimed at solving energy problems of the city began when, following the results of the elections in March 2006, Andriy Sadovyi, 37, became Mayor of Lviv. The starting point was a meeting between Oleh Bereziuk, Director of the Department of City Mayor Administration of Lviv City Council, Taras Burhan, Head of the Division of Foreign-Economic Relations and Investments of Lviv City Council, and Anatoliy Kopets, Project Manager of the Alliance to Save Energy in Ukraine and representative of Energie-Cities in Ukraine, who was invited to consult on how to develop a strategy to overcome local energy problems. During the meeting the parties agreed to join their efforts using as a basis suggestion of A. Kopets to begin development of a municipal energy management system with public sector buildings which were best prepared for this task (at the end of 2006, the majority of the public buildings in Lviv were already equipped with water, gas, electricity and heat meters). The initiative group was formed, which included Victoria Dovzhyk, Head of Unit of Utilities of Economic Division of Department of Economic Policy of Lviv City Council, Oleh Syniutka, newly appointed Director of Department of Economic Policy, who had worked as a Deputy Mayor of Ivano-Frankivsk (the city where, for the first time in Ukraine, a unit in energy efficiency affairs was organized in the framework of the municipal executive committee) and A. Kopets. Soon the initiative group prepared its first core document (Concept). The draft Concept for introduction of the Energy Management System in Lviv, amongst other things, provided for the creation of a separate special Subdivision of Energy Management within the system of city administration, the formation of an electronic database of energy consumption by urban facilities, and launched the structure for control and reporting of energy use. On December 1, 2006,

the draft Concept was approved by the Executive Committee of Lviv City Council, and on 14 December the Concept was adopted by the session of the City Council. One week later, on 21 December, the Mayor's instruction appeared; it was the first in a series of instructions aimed at ensuring implementation of the resolution, which were further developed and specified by relevant resolutions of the Executive Committee of the City Council. Under the instructions of the City Mayor, heads of Divisions of Education, Health, Culture, and of Utilities Management Unit of the City Council, as well as the heads of subordinate agencies and institutions became responsible for implementation of measures aimed to create the energy management system in the public sector. In early 2007, within the Unit of Utilities, a Sector of Energy Saving was carved out that included two employees, and on 24 March 2007, a separate Subdivision of Energy Management was formed in the Economic Division (today it has five employees, and it consists of two sectors – Energy Saving and Energy Supervision). The work began with the formation of an organizational and functional structure of the Energy Management System in the public sector and with training of its staff.

In each of the aforementioned branch divisions, persons responsible for the collection and timely submission to the Sector of Energy Saving (later – to the Unit of Energy Management) of the information on energy consumption in the subordinate institutions and agencies, were appointed by relevant orders from among the employees (later it would be the position of an energy manager in branch divisions). The new functions were included in the official duties of each appointee and each was provided a computerized workstation with access to email.

Similarly, all agencies and institutions subordinate to these branch divisions assigned employees (by internal orders) to be responsible for the collection and timely submission of information on energy consumption in their buildings. The official duties of those employees were also expanded as new functions were identified and their work was computerized to the extent possible (from 70-80%).

As a result, a coherent system of energy management was arranged with a hierarchical organizational and functional structure (Fig. 1). It was personally led by the first Deputy Mayor Syniutka, who at that time was Director of Department of Economic Policy and Head of the initiative group, which once again proved the utmost importance which was placed on this area of work by the city authorities.

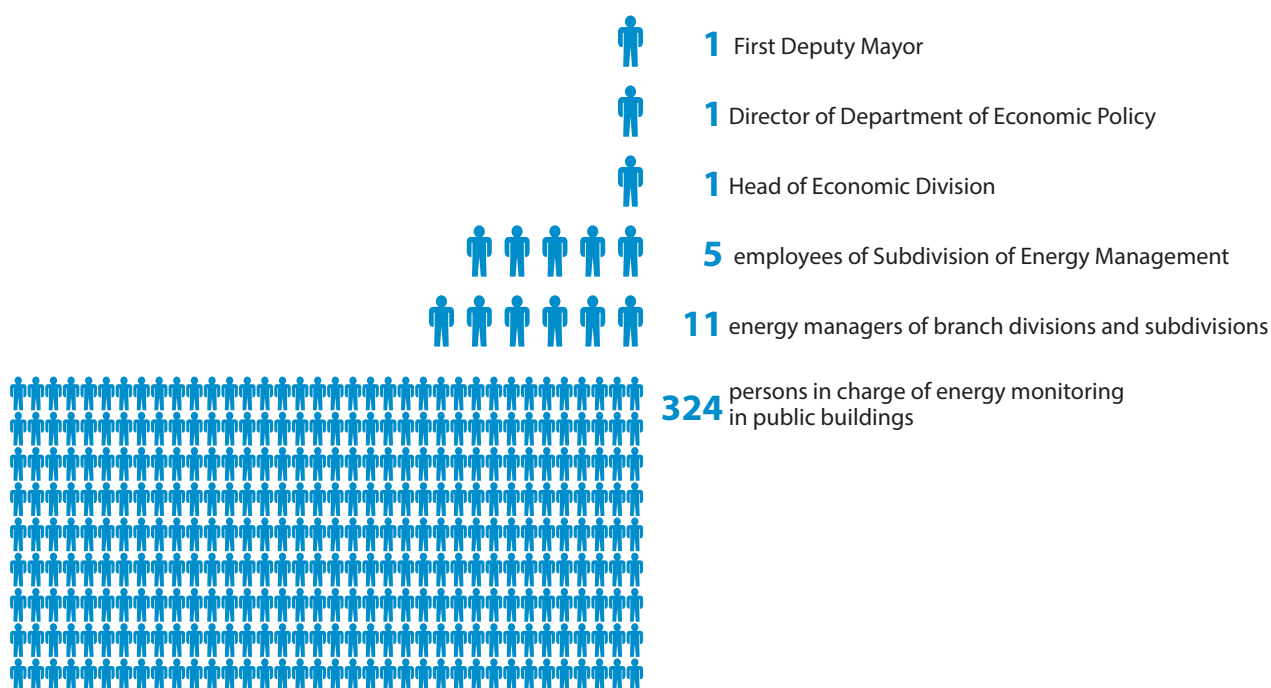


Figure 1. Structure of the Energy Management System in the public sector buildings of Lviv

Soon the energy management system was extended to include the urban housing and communal services. For that purpose the appropriate modifications in the organizational and functional structure were made (Fig. 2).

Lviv municipal services were restructured. The old scheme «producer – consumer» was replaced by a new one «producer – agent – consumer.» Utility companies acted as agents (responsible parties), where, for the first time in Ukraine, the special energy manager position was introduced. In particular, the public utilities were delegated a control function (collecting

information related to the consumption of gas, heat and electricity from suppliers and reading data from water meters, and ensuring collection of payments for consumed water), which previously belonged to the agent, and for which they received deductions from payments collected. They began posting monthly information on energy and water consumption, per 1 m<sup>2</sup>, in apartment buildings.

The software became a bottleneck for future of the energy management system, as the previously mentioned PC software ASE 2.3 had a number of significant limitations and did not meet the new require-

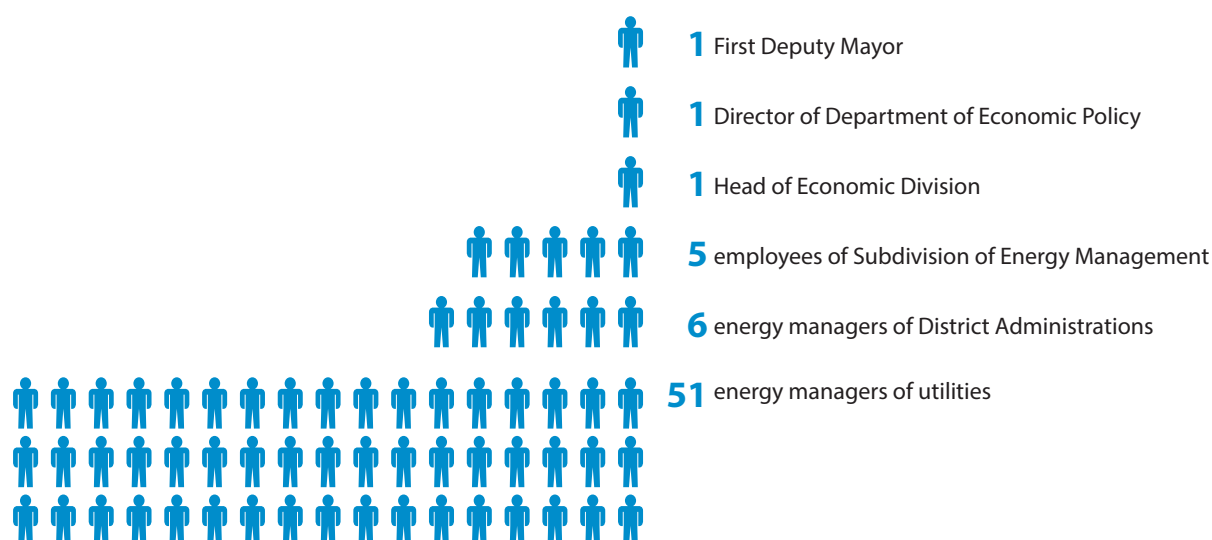


Fig.2. Structure of the Energy Management System in the housing and communal sector buildings of Lviv



ments. Fortunately, Taras Kopets, Director of «IT Management» company, had the idea to create software for recording and analysis of energy consumption in the city. Having analysed the popular English-language commercial applications, he developed original Ukrainian-language software called «Energoplan», which he gave to the city for free in late 2006. During the first half of 2007, with the joint efforts of T. Kopets and Maryana Bokhonko (main specialist of Sector of Energy Saving, and who was later to head the newly formed Unit of Energy Management) and under the direction of Dovzhyk, the software was debugged and used in a test run mode for the public sector buildings. The changes affected about 30% of the software, and related primarily to the features of input analysis. The internal temperature indicator for the buildings also was added. As a result, Lviv received a modern tool for creating the first computerized database of energy consumption in public buildings and for processing the database.

In order to establish the collection and receipt of the raw data (readings from meters and bills for the consumed gas, electricity, heat, and hot and cold water) and to enter information into the computerized database, the Sector of Energy Saving of the City Council together with «IT Management» company organized training for the responsible staff. The training consisted of more than 20 one-day trainings (each with 15-20 people at each time). A. Kopets made a presentation on global, national and local aspects of energy security and modern ways of providing it in the cities amid the crisis. T. Kopets then acquainted the participants with «Energoplan» and taught the participants how to use it in practice. The audience consisted of engineers from the city branch divisions and subdivisions, building and technical maintenance staff, secretaries of the agencies and institutions, school teachers of computer science, and others.

It is important to emphasize that the active implementation of innovations in the energy sector would never have been crowned a success if it were not for the constant monitoring and full support from the senior management of the city. In particular, at a meeting with the Mayor Sadovyi (held on 19 March 2007), Syniutka reported on «Creating a system for monitoring energy consumption in educational, health, cultural and administrative buildings of the City Council». A month later, on April 18, a working session was held, dedicated to the creation of a system of energy consumption management for public buildings in Lviv in which the Mayor, Directors of Departments and Heads of District Administrations participated and new tasks were set. On May 25, the Executive Committee of the

City Council adopted the resolution «On the results of computer monitoring of energy consumption by on-budget buildings in Lviv in 2006 and in the 1st quarter of 2007.” In this resolution, among other things, temporary tasks of the employees involved in the energy management system were assigned to their regular duties, and the corresponding executive divisions were tasked with providing explanations as to the reasons why certain buildings, during the first quarter of 2007, exceeded the energy consumption of the corresponding period in 2006. Finally, the resolution of the City Executive Committee of 12 October 2007 («On the results of conducted computer monitoring of energy use by the buildings of budget-funded institutions in Lviv, in January-August 2007») required procedures for determining the limits of monthly consumption of specific energy sources for each public sector building and (based on those limits) calculation of the city budget expenditures on energy sources for the budget-funded institutions for the next year. In order to provide for continuity in process (despite changes in staff) it was extremely important to support each organizational step with corresponding regulation.

As it may happen in any innovative process, introduction of the Energy Management System in the beginning encountered frustration of some of the staff involved who were overloaded with new work. Meanwhile, the influence of such factors as personal desire, interest, understanding, skills, and responsibility became crucial to the success of the venture. Some honest errors occurred while entering metering data into the computerized database, but there were also some sporadic deliberate attempts to falsify data in order to hide an unreasonably high level of energy consumption in a certain building. So, before the grass-roots level of the energy management system started to work correctly, the employees of the Sector of Energy Saving of City Council, in addition to trainings and consultations, regularly conducted random on-site verification of database entries. This data was compared to internal accounting logs and with raw meter readings data. In return, the initiative group members – Syniutka, Dovzhyk and A. Kopets – provided quarterly reports to the members of the City Council. In addition, Bokhonko prepared and sent out relevant monthly information sheets to parliamentary commissions and departments of the Municipality, contributing significantly to a constructive discussion of the issues related to energy management in the assembly hall. Dovzhyk and Bokhonko also held regular briefings for journalists, presented for TRC «Lux», stories in newscast on UTB channel, and developed publications in the journal «Energy Efficiency» and in the «Express» and «High Castle» newspapers.

The young professionals who joined the Unit of Energy Management (Halyna Luchechko, main specialist of Sector of Energy Saving, and Ihor Vyshyvanyi, main specialist of Sector of Energy Supervision) brought the process a fresh strong impetus to the new goals, throwing themselves into the work, which was new to them and so important for the city.

As a result of consistent, persistent and well-coordinated activities, the operation algorithm of the energy management system was optimized, and it finally moved into its finished form (Fig. 3).

According to this algorithm, on the last day of the month those responsible for gathering information in the involved institutions collect readings of the meters, record them in the internal log books and enter them into the “Energoplan” database. The next day this segment is exported by e-mail to branch unit energy managers (in the event that there is no technical ability to do this electronically, they deliver it in electronic (CD) or paper form, and the branch energy managers personally enter it into the database). They then send the collected meter readings to the suppliers in order to form utility bills, and they have a week to analyse and summarize the data received, if necessary to clarify it, and, in conjunction with staff responsible for energy management in buildings, to correct any identified errors. The generalized results are communicated to the branch management and

sent to the Unit of Energy Management of Economic Division of Lviv City Council. The City Council then prepares (on the basis of the information provided by the branch divisions), the final monthly report on energy and water consumption in the public sector. The report also includes an explanation of the reasons of any overuse. After the tenth of the month, the report is analysed during monthly meetings chaired by the First Deputy Mayor. Energy managers of the Unit of Energy Management, all branch divisions and subdivisions participate in these monthly meetings. In the event that there are high levels of energy consumption without any justifiable reasons, methods of organizational and administrative influence may be applied to violators who exceed the limits. Following the results of the meeting, instructions are given to examine the most energy intensive buildings and to prepare proposals to remedy deficiencies.

Creation of the «Energoplan» database covering 511 public sector buildings began with an electronic inventory and energy certification. An optimal structure was formed for the further accumulation of energy consumption information in buildings during 2007 (based on the readings of meters and bills). Later available information for the previous year (2006) was entered in the database. This made it possible to compare data for the relevant two year periods, and it launched monthly planning of sound operating rules of use (so-called monthly limits) for each build-

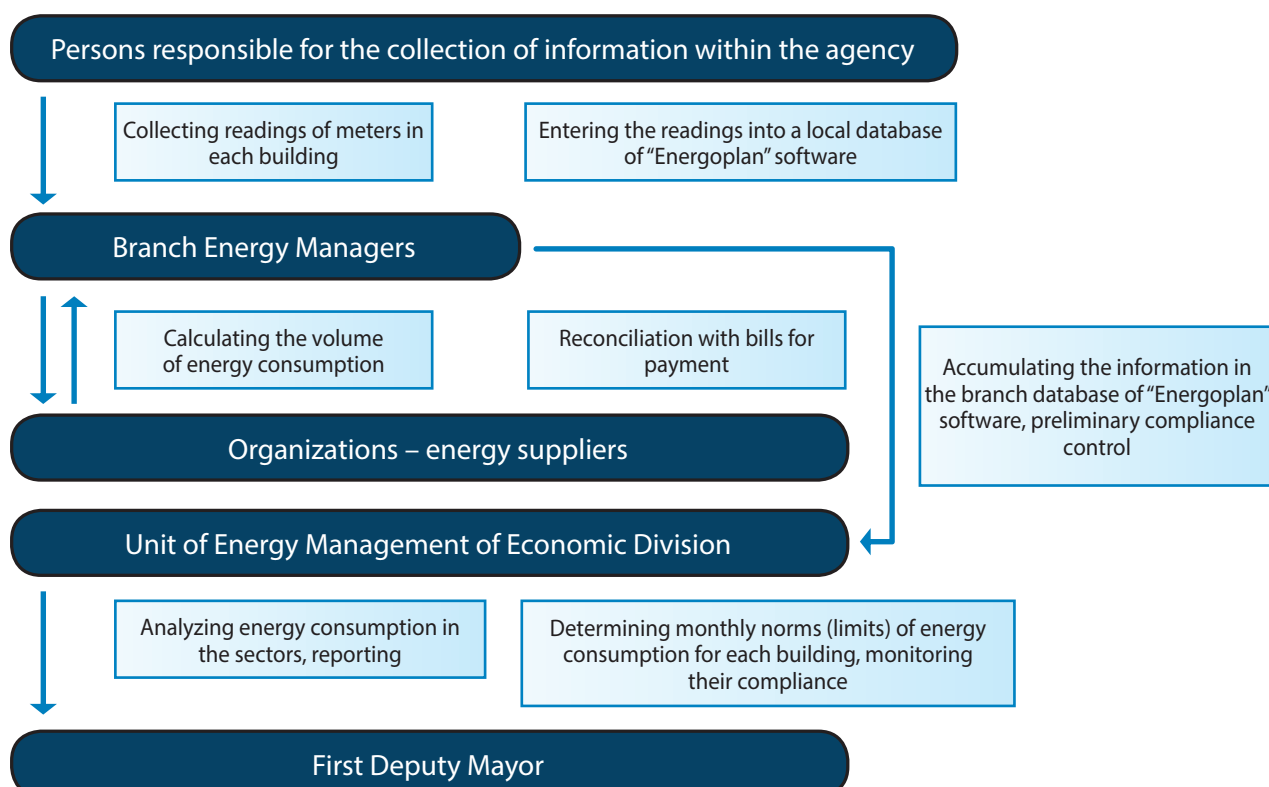


Figure 3. The operation algorithm of the Energy Management System in the public sector of Lviv

ing and for each type of energy carrier. The following indicators were selected for the operational analysis of energy consumption:

- total charges of energy consumed
- per unit charges of energy consumed (in terms of  $\text{m}^2$  of heated space)
- amount of each type of energy consumed

The analysis allowed the formulation of a list of the 40 most energy-intensive public sector buildings. This list was approved by a resolution of the City Executive Committee and allows for energy surveys and primary energy upgrades to be conducted.

The Association «Energy Efficient Cities of Ukraine» (EECU), founded by Lviv, Berdyansk, Kamyanets-Podilskyi and Slavutych in June 2007, had a huge positive impact on the development of the municipal energy management system in the City of Lviv with EECU providing the program new ideas, techniques, tools and funds. A. Kopets was EECU's ideologist and engine of its creation, later on he became the first Executive Director of EECU. Today, the organization brings together 31 cities and is an influential member of the municipal energy reform process in Ukraine. In 2008, EECU became a member of the Association of European Municipalities "Energy Cities", and in 2011, Lviv acquired the status of individual membership in this Association.

In March 2008, with the support of EECU, the city of Lviv joined the European campaign of voluntary energy and environmental performance certification of public buildings – Display®. This certification sys-

tem provides a powerful means of visualization and communication impact on the citizens aimed to form their energy efficient behaviour. Using a special tool for automatic calculation, which can be found on the web-site of the campaign, the public sector buildings in the city, previously placed in one of 16 categories depending on their purpose, have been rated from A to G in terms of the level of energy and water consumption and  $\text{CO}_2$  emissions. Energy certificates in the form of colour posters (Fig. 4) were publically displayed in the buildings. The certificates are updated annually, making it possible to monitor the changes in the energy and environmental performance of the buildings over time. Moreover the certificates serve as a starting point for regular mass campaigns aimed at raising awareness of the general public of the state of certain buildings, in order to use public opinion to stimulate institutional administration of the buildings and city authorities to ensure steady improvement of energy use indicators.

Lviv became the second (after Ivano-Frankivsk) Ukrainian city to take part in the Display® campaign. Later on, with the support of EECU, 15 more Ukrainian cities have joined it.

Today, the Display® campaign in Lviv has reached out to all of its most visited public sector buildings (educational institutions, including preschools, medical and cultural institutions, sports and leisure facilities, administrative authorities; today they include 396 buildings) and the certificates starting from 2006 can be viewed. In 2010, in the framework of a pilot study based on five typical apartment buildings, the energy certification was launched in the residential sector as well. The energy certificates have become a mandatory element during classes in the corresponding dis-

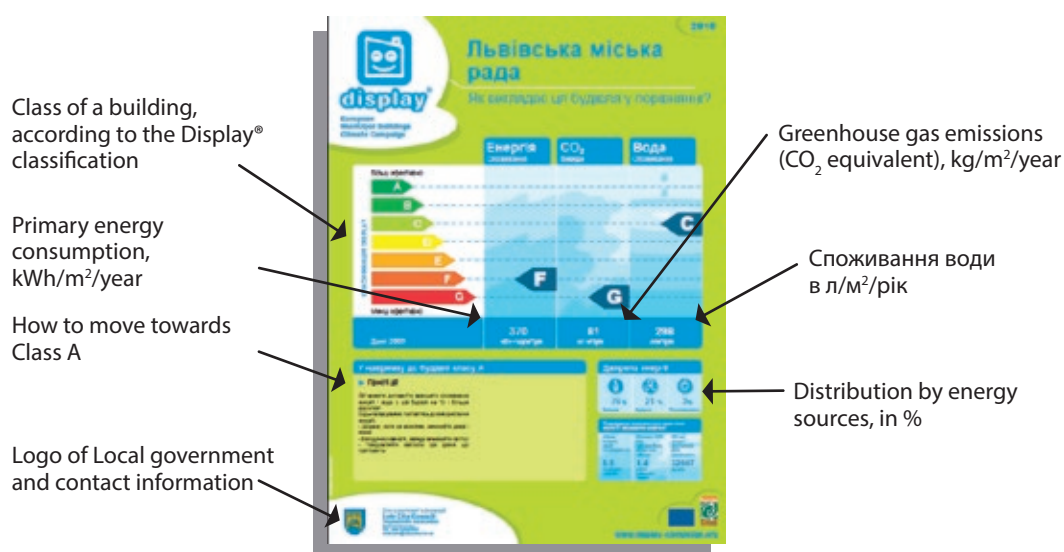


Figure. 4. General view of the Display® Certificate

ciplines in Lviv schools and during the annual municipal Sustainable Energy Days.

At the end of the first year energy savings figures were obtained. As Ukrainian legislation does not provide for transferring savings into the next fiscal year a natural question arose: How can these savings be used? The solution was found: Beginning in 2008, all decrees of Lviv City Council on the city budget for the future year included the following paragraph:

«To allow the Division of Finance of the Department of Financial Policy, during the implementation of the city budget of Lviv, in certain cases, upon justified submission of the key spending units of the city budget of Lviv, to redistribute the expenditures by economic classification within the scope of its budget allocations in consultation with the respective profile Standing Committee of the Council and the Standing Committee of Finance and Budget Planning.»

In applying this statement to energy expenditures: if, based on the results of a preliminary analysis of their use the key spending units have received savings within 11 months, they are allowed to request that this money be spent by the end of the year on any

important needs of their subordinate agencies and institutions.

## ACHIEVEMENTS

Since the energy management system for public sector buildings was introduced in Lviv, a steady annual decrease in actual consumption of primary energy sources has begun, while retaining comfortable internal temperature conditions. In 2007-2011, the total gas consumption decreased by 28.47%, heat consumption – by 11.88%, electricity – by 7.57%, cold water – by 39.66% (Fig. 5). These decreases occurred despite the fact that a number of new facilities were put into operation and old facilities were expanded (kindergartens, school pools, new equipment, etc.).

Improved energy efficiency, in conjunction with annual planning, has placed more and more severe restrictions on consumption, becoming more aligned with actual need (Fig. 6). Thus, during the period 2007 – 2011, the limit of heat energy consumption was reduced by 8.45% and cold water – by 24.11%. Gas consumption was also stabilized. The electricity consumption limit, which increased by 10.2% in 2008, also began to gradually decrease in the following years.

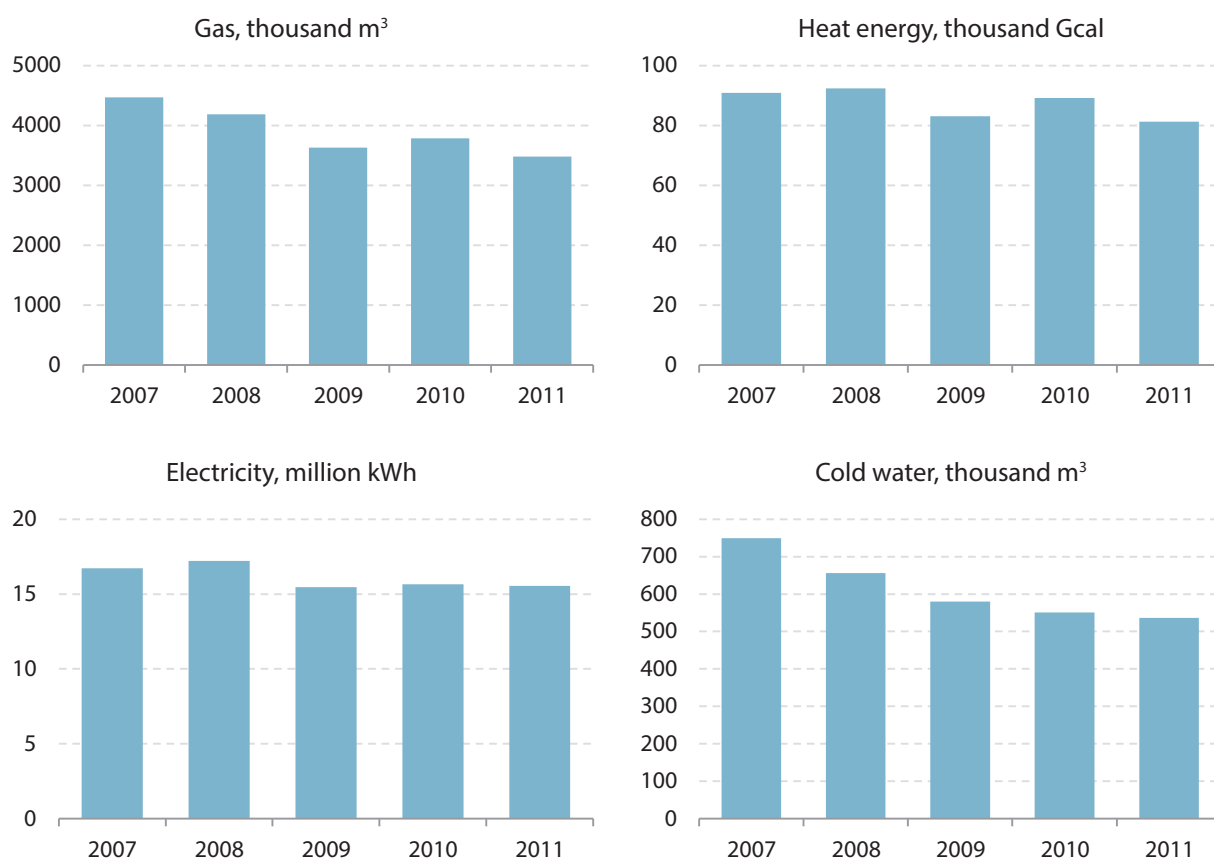


Figure 5. Energy consumption in the public sector in Lviv, over the period of 2007-2010 (the sudden change in heat consumption in 2010 was caused by the severe winter in 2009-2010)



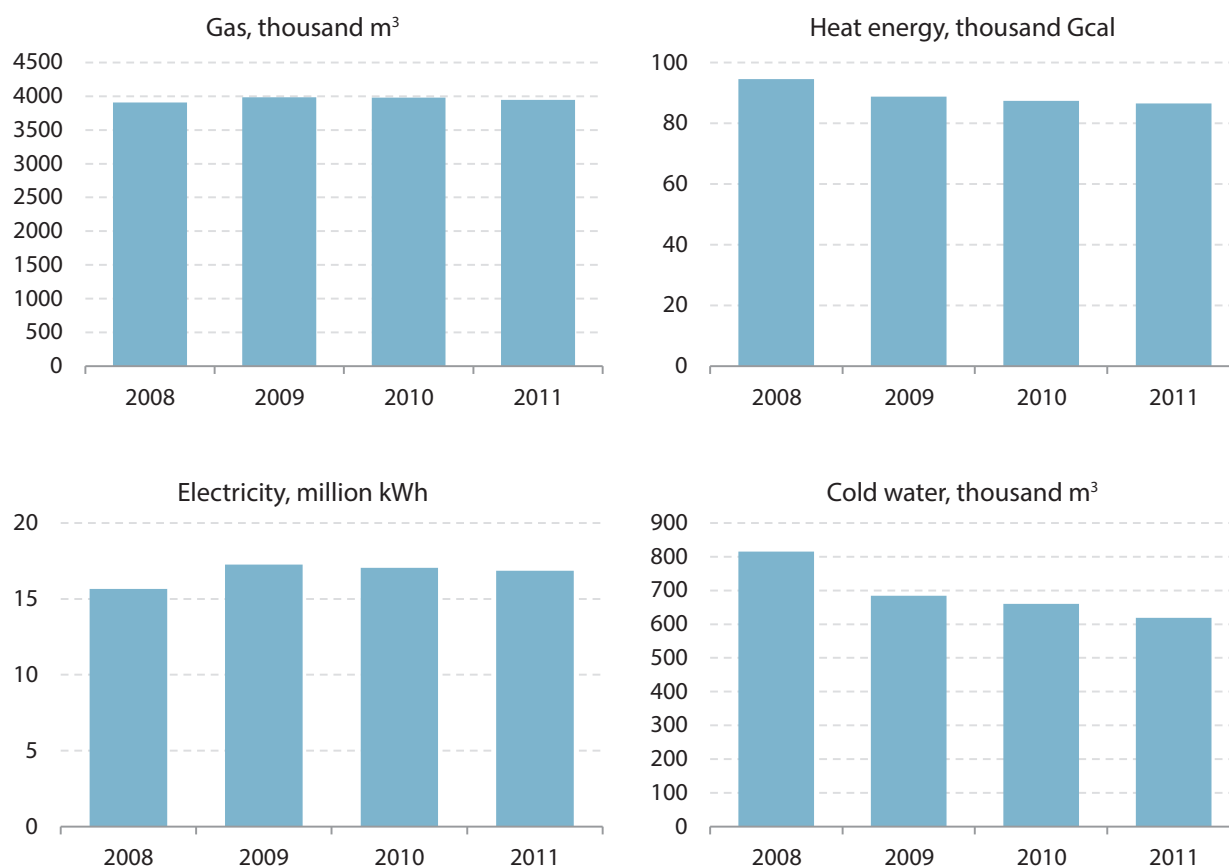


Figure 6. Annual limits on energy consumption in public sector buildings in Lviv, in 2007-2011

As a result of more efficient use of energy from 2006 to 2011, the proportion of the highest energy intensive buildings (classes F and G according to the Display® classification) with the original 12% for each class of buildings dropped to 6 and 4% respectively, while the proportion of buildings with low specific consumption (Class B) increased from 7% to 28%, and Class C – from 24% to 28% (Fig. 7a). Overall, the mean specific energy consumption in public sector buildings decreased by 8.36%, from 2006 to 2011 (from 267.6 to 245.22 kWh/m²/year). With the help the Dis-

play® Certificates, similar improvements were also recorded in public sector buildings in terms of emissions of CO<sub>2</sub> (Fig. 7b) and water consumption (Fig. 7c).

In 2009, according to the results of the international competition «Towards Class A», which annually identifies the three most active participants of the campaign, the achievements (in conducting the Display® campaign) of the city of Lviv were marked very high. The Lviv City Council was ranked third (Fig.8), after Highland (Scotland) and Pamplona (Spain).

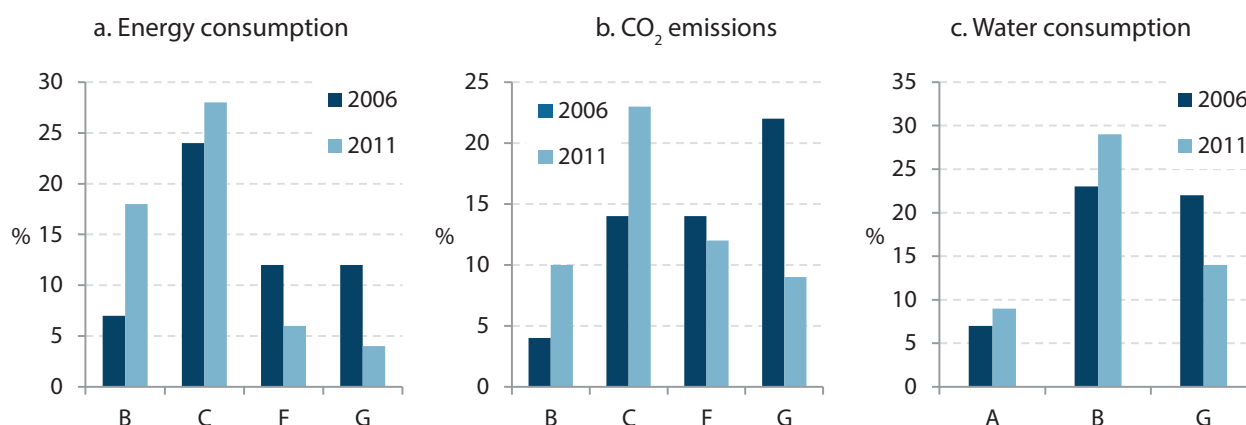


Figure 7. Redistribution of the public sector buildings in Lviv between classes, according to the Display classification, for the period of 2006-2011.



Figure 8. The Award Certificate presented to Lviv City Council in 2009 for the third place in the competition «Towards Class A» within the framework of the Display® Campaign

It is quite indicative that the actual energy consumption oscillates around the planned limits within the range from 2 to 20% (Fig. 9). In most cases this deviates towards savings rather than overuse of energy sources. In other words, the system of limits has become not only an effective planning tool, but it has also launched a new management culture of savings relative to energy consumption in the public sector buildings.

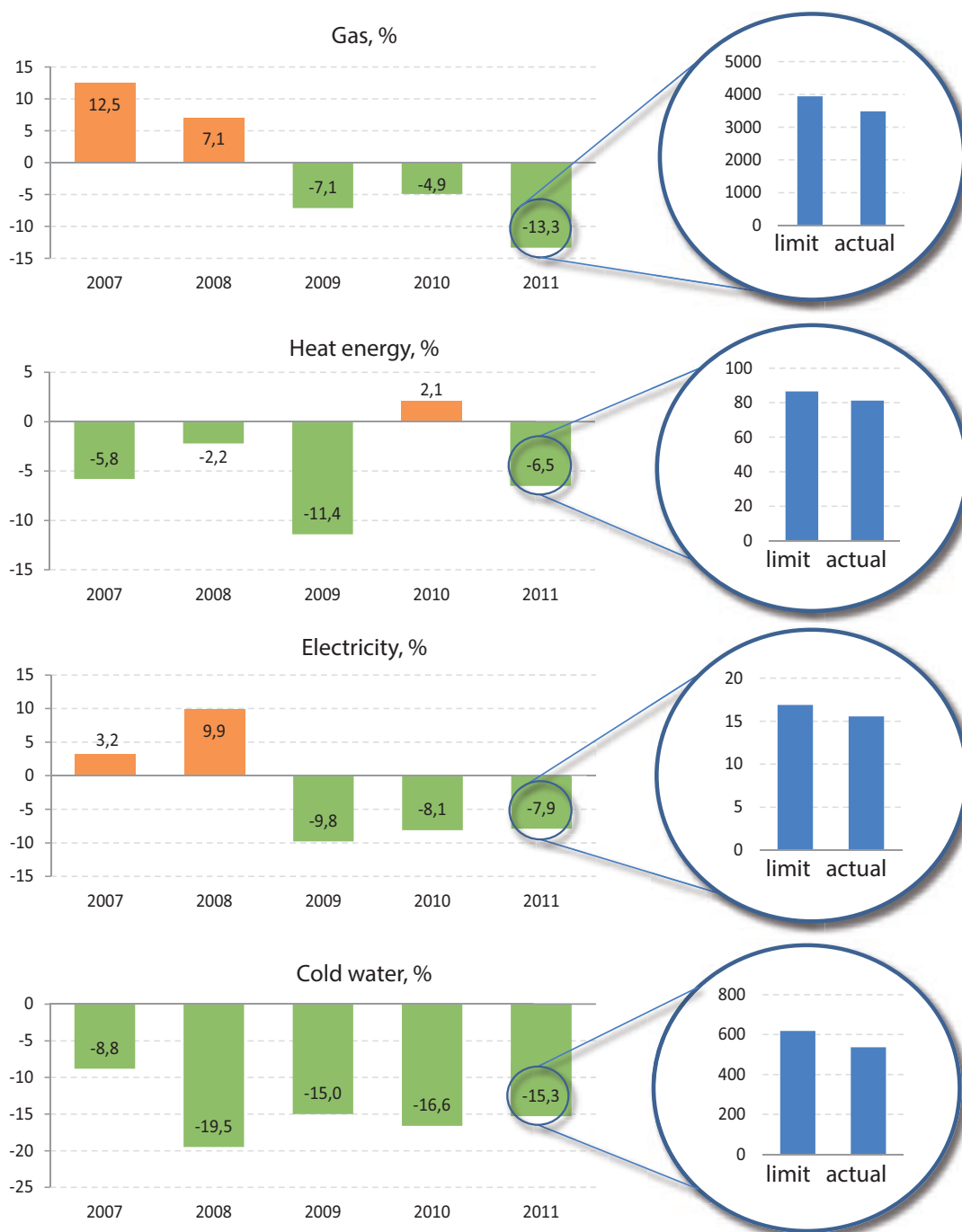


Figure 9. Deviation of real annual energy consumption from the planned limits in the public sector of Lviv, in 2007-2011

a. Without regard to the growth of energy tariffs	
2007	2 million 406 thousand UAH
2008	2 million 583 thousand UAH
2009	4 million UAH
2010	2 million 663 thousand UAH
2011	6 million 400 thousand UAH
Total:	18 million 52 thousand UAH

b. With regard to the growth of energy tariffs	
2010 p.	1 million 145 thousand UAH
2011 p.	7 million 100 thousand UAH

Figure 10. Savings in energy in the public sector in Lviv, in 2007-2011.

Due to this fact, beginning in 2007, the City has maintained a stable economy of budgetary funds allocated for the energy purchase (Fig. 10a). However, the rampant increase of energy tariffs due to global price increases (Fig. 11) has regularly absorbed a portion of the on-going savings achieved during the budget year (Fig. 10b). In 2011, it «swallowed» the savings entirely. That is, the costs that were avoided serve along the way as a sort of a “buffer”, which first takes the fall of tariff shocks and suppresses or significantly weakens them.

To sum up, despite the steady decrease of the total volume of energy consumption by public sector buildings in the city, energy spending on these buildings from the city budget has been increasing steadily

ly (Fig. 12). In addition, the city of Lviv was not able to avoid the threatening trend of the recent years, which is to varying degree typical of almost all Ukrainian cities, namely, the rapid reduction of funds for capital expenditures in their budgets.

Increasing energy costs and reduction of funds for capital expenditures put at risk not only the modernization of obsolete assets, but also their normal support in working condition due to operational maintenance. That is why, after the energy management system was introduced in the city, the next priority for local authorities was to attract additional investment in reforms and technical upgrading of the municipal energy economy, including energy upgrades of the most energy intensive buildings.

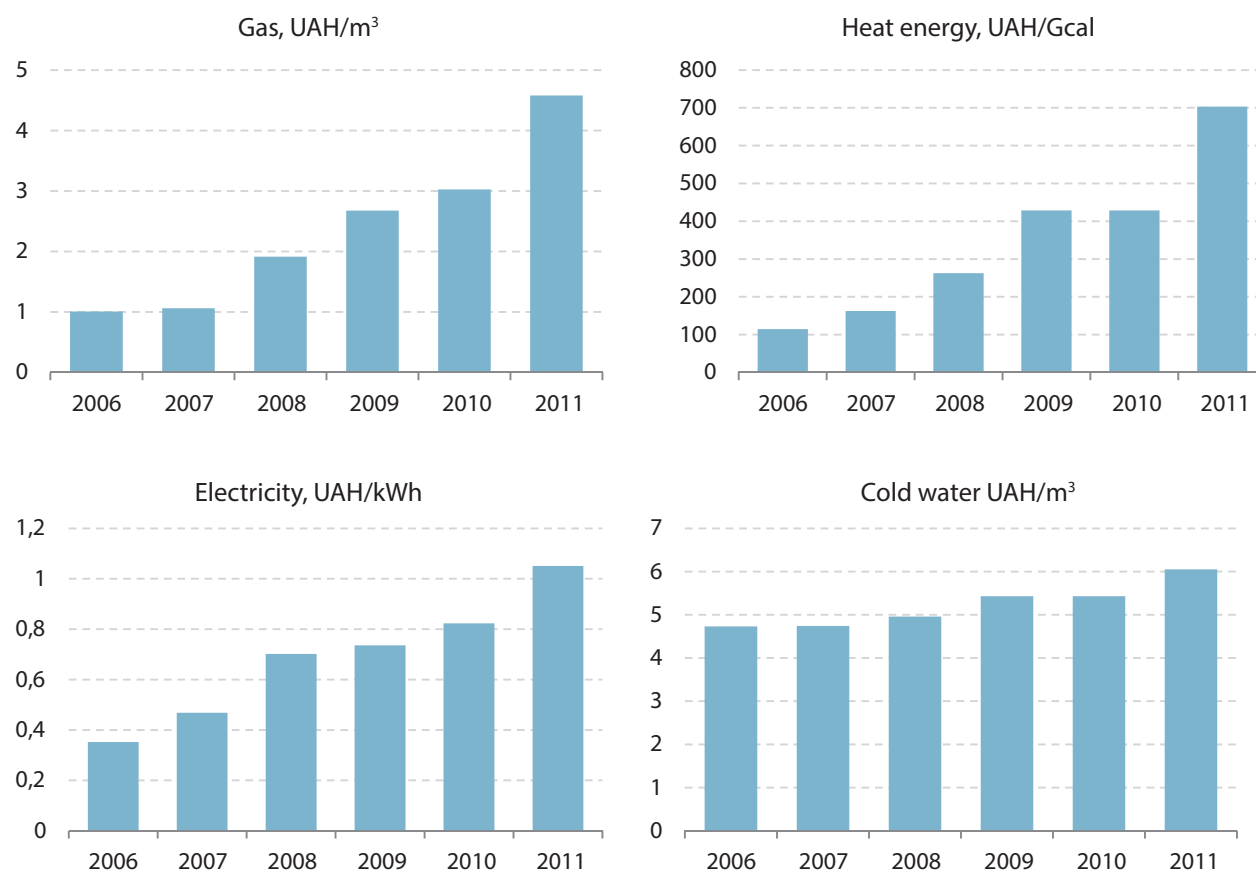


Figure 11. Energy tariffs in the public sector in Lviv, in 2006-2011.

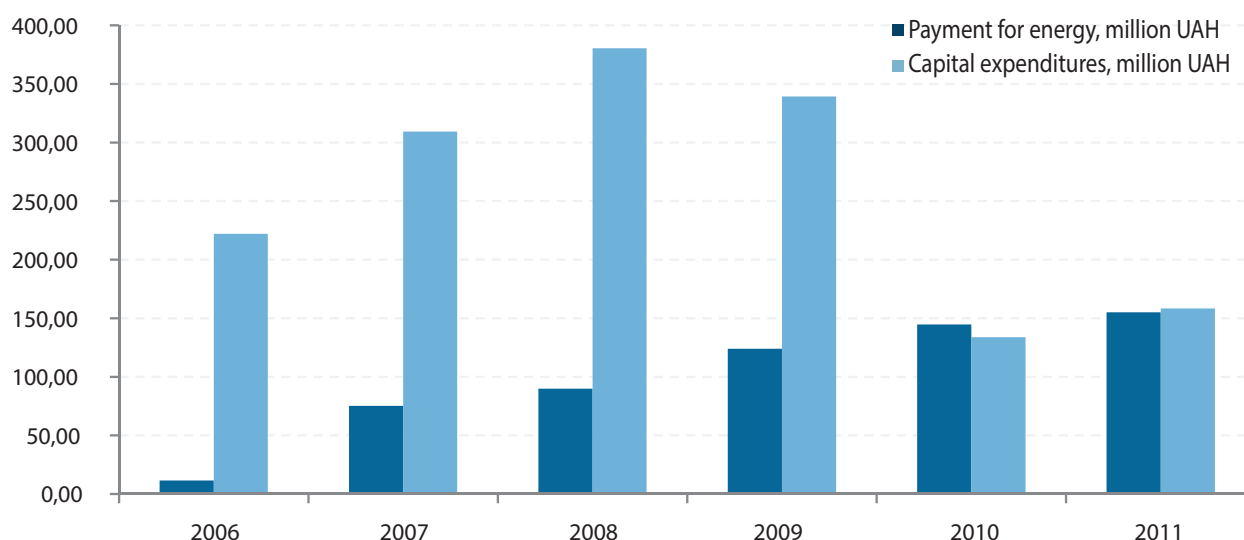


Figure 12. Expenditures (payment) for energy and capital expenditures in the budget of Lviv, in 2006-2011.

### TOWARDS NEW CHALLENGES

Year after year, Lviv has continued to increase the amount of financing of energy saving measures in the public sector from the city budget (Fig. 13).

In addition to this money, with the assistance of EECU, the city has been able to attract funds of international institutions and programs by participating in a number of important projects, including:

- **Municipal Heating Reform in Ukraine:** This project began implementation in 2009 by the International Resources Group. The project is funded by the US Agency for International Development (USAID). In the framework of this project, Lviv energy managers were trained to develop and finance energy efficiency projects in the heating sector. The energy audit experts, were also trained to use the Energy Auditing of Building (EAB) software for energy surveys of buildings (the software was developed and adapted to Ukrainian conditions by the Norwegian consulting company ENSI). In addition, specialists have been trained to develop medium-term municipal energy plans according to the methodology of Bulgarian Centre for Energy Efficiency EnEffect. Based on the results of energy auditing, heat meters and systems of automatic weather-based control of heating were installed at the expense of the project in the buildings of two educational institutions (preschool «School-Kindergarten 1, 2, 3» and secondary school No. 77), and in three condominium associations exterior walls of the buildings were selectively winterized, automatic weather-based control systems and lighting control systems for staircases were installed, and water pipes were partially replaced at the cost of the project, residents, and Lviv City Council. The National Forestry University of Ukraine in Lviv took part in the program «Energy Efficient University Campuses», and four municipal school (secondary schools No.3 and 30, school-lyceum «Oriyana» and Lviv specialized school «Nadiya» with advanced study of subjects of Eco-Law profile) took part in the training program «Energy Efficient Schools»;
- **Preferential Loans for Energy Saving:** Project of the Nordic Environment Finance Corporation (NEFCO), launched in 2009, provides concessional

Amount of financing, thousand UAH	2006	2007	2008	2009	2010	2011	Total, thousand UAH
Department of Education	4 462,9	9 600,4	20 835,2	22 500,4	32 569,1	12 876,3	102 844,3
Department of Culture	504,8	808,2	2 291,9	163,7	45,7	966,1	4 780,3
Public Health Department	1 457,4	2 199,2	5 670,2	1 309,8	1 958,4	1 496,8	14 091,6
Total	6 425,1	12 607,8	28 797,2	23 973,9	34 573,1	15 339,2	121 716,2

Figure 13. Investments in energy saving measures in the public sector in Lviv, 2006-2011



loans for thermo-modernization of public sector buildings at 3% per annum. In the framework of the Project, NEFCO, together with the Norwegian company Reinertsen AS, conducted trainings on energy audits, business planning and municipal energy planning and management for local officials, energy managers and managers of budgetary institutions and establishments. After that, training participants optionally conducted energy audits of their own buildings and, based on the results, developed business plans for energy efficient modernization, which formed the basis of applications for debt financing by NEFCO. In 2011, a Memorandum of Understanding was signed between the NEFCO Corporation, «Municipal Heating Reform in Ukraine» Project and Lviv City Council on co-financing of energy efficient modernization of six public sector buildings selected after considering the results of proximate energy auditing (the 5th Municipal Clinical Outpatient Hospital, 2 buildings of Communal 4th Municipal Polyclinic, preschools No. 129 and 169 and secondary school No. 84). The Memorandum took effect after it was adopted by the resolution of the Lviv City Council session in May 2012;

- **Management of Domains related to Energy in Local authorities (MODEL):** This international project started in April 2010, with participation of Ukraine (cities: Kamyanyets-Podilsky, Lutsk and Lviv), Georgia (Tbilisi), Armenia (Spitak) and Moldova (Drochia). Lviv is the leader of the MODEL project (Vasylyna Horban', Head of Subdivision of Energy Management of Lviv City Council, is Project Director), the Association of European Municipalities "Energy Cities" coordinates the Project (Coordinator is Christophe Frering, Project Manager). The objective of the MODEL Project, funded under the European program CIUDAD, is to implement energy management in local authorities and to perform a selective power-efficient thermo-modernization of the most energy-intensive public sector buildings. A number of awareness-raising and training workshops have been conducted for the project participants; by the resolution of Lviv City Council, the building of the educational complex «Grammar School «Sykhyvska» was selected as an object of future thermo-modernization, and project estimates have already been developed to complete repairs of its heating system. The energy efficient thermo-modernization of the school building will also include: winterizing exterior walls, replacing windows, installing screen behind the heating radiator under windows, replacing the internal heat supply systems.

In 2010, the Advisory Committee on Sustainable Energy Development of Lviv was established as a permanent body to the Executive Committee of the City Council. This committee aims to provide the City necessary assistance in the implementation of the City's energy policy. It is made up of officials and local city councillors, academics and energy efficiency experts as well as representatives of companies which produce and transport heat energy and electricity.

With its rich experience in organizing the municipal energy management system and in participating in projects, Lviv is eager to share its experience with colleagues from other cities. Over the past few years, the Unit of Energy Management of Lviv City Council hosted delegations from Artemivsk, Berdyansk, Donetsk, Kamyanyets-Podilskyi, Kovel, Kryvyi Rih, Mohyliv-Podilskyi, Novovolynsk, Kherson, Chervonohrad, Cherkasy, and from foreign partner-cities – Tbilisi (Georgia) and Sztum (Poland). Lviv achievements have been regularly presented at conferences, seminars, workshops and other professional meetings both in Ukraine and abroad; and the achievements are promoted among the residents and visitors of the city during the annual municipal Sustainable Energy Days.

On February 10, 2009 at a ceremony conducted in the assembly hall of the European Council in Brussels, Iryna Kulynych, Director of Department of Economic Policy of Lviv City Council, signed the Charter of Covenant of Mayors, thus certifying the adhesion of Lviv to this ambitious initiative of the European Commission with the goal of supporting and strengthening actions on the Climate Action and Energy Package, approved earlier by the European Council. More than 300 delegations from European countries, including those from 11 Ukrainian cities, took part in the first signing of the Charter. Today, the initiative brings together 4,087 participants concerned about the global climate change, including 27 Ukrainian cities.

**The decision of Lviv leaders to participate in the Covenant of Mayors was a logical step which emanated from previous efforts and was based on the City's own practical experience. It was, therefore, a deliberate step towards the ultimate goal – sustainable energy development of the city.**

Signatories of the Covenant of Mayors have undertaken a voluntary commitment to reduce emissions of CO<sub>2</sub> in their territory by more than 20% by 2020 as it is required by the Climate Action and Energy Package, by reducing their energy consumption while increasing their share of renewable energy sources.

The first measure to implement these commitments in Lviv was the creation of a register of CO<sub>2</sub> emissions for determining the emissions baseline (Baseline Emission Inventory). As a result of the Baseline Emission Inventory, the starting point has been defined and the largest sources of air pollution have been determined in the city. The task was accomplished by EECU experts, using the experience of the European Association "Climate Alliance" on applying a special computerized tool ECORegion developed by the Swiss company "Ecospeed".

Following the development of the Baseline Emission Inventory, a working group consisting of Maryana Balashch, Head of Economic Division of Lviv City Council, Vasylyna Horban', Head of Unit of Energy Management of Lviv City Council, Vyshyvanyi, main specialist of Sector of Energy Supervision of Subdivision of Energy Management, Andriy Muzychak and Oksana Kobyliukh, experts of Lviv Polytechnic National University, Volodymyr Karpyna, engineer technologist of «Lvivteploenergo», and Petro Mavko, expert of Western Ukrainian Regional Training Centre, developed a Programme of Sustainable Energy Development of Lviv through 2020 (adopted on 14 July 2011 by the resolution of the Session of Lviv City Council). The medium-term municipal energy plan developed earlier within the «Municipal Heating Reform in Ukraine» project was integrated into this program.

The program examines public sector buildings (including buildings of regional (oblast) communal and state ownership), residential buildings, enterprises of housing and utility sector, industry and business and public transport (including transit).

The average annual energy consumption between 2007 and 2009 was used as a starting point. Several prediction scenarios of energy consumption for 2020 have been created, with the assumption that nothing will interfere in this process (business as usual). According to the pessimistic scenario, total energy consumption will grow by 28%. according to the optimistic scenario, total energy consumption will grow by 11%, and according to the most realistic scenario, total energy consumption will grow by 20%. In the latter case, taking into account the current growth trends in the world prices for major energy sources, the city expects to have 5-fold increase in the corresponding expenditures. This means that it is very likely that if there is no active interference, collapse can soon occur in the operation of major systems that ensure its vital activities. After having analysed the potential energy saving in the aforementioned sectors of municipal economy, the city's program offers a realistic action plan that forecasts, by 2020, a reduction of energy consumption by 22.4% and a reduction of greenhouse gas emissions by 20.8%. It also forecasts that the City will achieving a 11.0% share of renewables in the total energy consumption balance. The City only has to insure that the program is put into effect in a diligent manner.

**Thus, professional management of municipal energy economy is the factor which appears capable of stabilizing the economic sphere and community of the city and significantly improving the ecological situation in it while at the same time making a vital contribution to mitigating the global climate change.**



# **IMPLEMENTATION OF THE ENERGY MANAGEMENT SYSTEM IN KAMYANETS- PODILSKYI AS A MEANS OF EFFECTIVELY MEETING ITS ENERGY NEEDS**







## BRIEFLY ABOUT KAMYANETS-PODILSKYI

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Kamyanets-Podilskyi is a city and province center in South-West Ukraine; it is the center of Kamyanets-Podilskyi District of Khmelnytskyi Province, a significant national economic, educational, cultural and tourist center. The first reliable written mention of the city dates back to 1374, when the city was granted with Magdeburg rights. In terms of the number of historical and architectural monuments, Kamyanets-Podilskyi is in second place (after Lviv). Its Old City has the status of National Historical and Architectural Reserve and is considered to be one of the Seven Wonders of Ukraine. The Smotrych River Canyon, which forms a loop around the Old City, belongs to one of the 7 Natural Wonders of Ukraine.

As of February 1, 2012, the population of Kamyanets-Podilskyi was 102,986 people. Its area is 27.84 km<sup>2</sup>.

The topography of the city is formed by hills stretching from the southeast to the northwest. The local climate is temperate continental, with mild winters and rather warm summers, and it is influenced by the Tovtry ridge and canyons of the Dnister River and its tributaries. The average annual period of time without frost is 176 days. Within the region, the lowest duration (75-80 days) and thickness of the snow cover is within the city. On average, Kamyanets-Podilskyi has less than 600 mm of rainfall a year in. The average annual temperature in the city is +9,2°C, while the highest recorded temperature has been +39°C, and the lowest -33°C.

Machine manufacturing, food processing, and light industry enterprises operate in the city and construction materials are also produced. There are 10 higher educational institutions, including two universities - Kamyanets-Podilskyi National University (named after Ivan Ohiyenko) and the Podilskyi State Agricultural and Technical University.

Kamyanets-Podilskyi City Council owns 96 public sector buildings with a total area of 181.97 thousand m<sup>2</sup>, 43 of which are occupied by educational institutions, 26 – by health care institutions, 11 – by sports and leisure, and 16 – by cultural establishments. They consume an average of 190 kWh/m<sup>2</sup> per year.

The housing stock, consists of 7,230 residential buildings with a total area of 2 169 thousand m<sup>2</sup>, 6 546 of which are individual houses, 518 – municipal housing, 36 – cooperative housing, 108 – condominiums, and 22 – departmental housing. Their average annual consumption of energy is 244.3 kWh/m<sup>2</sup>.

The energy resources consumed by public sector buildings include: heat (79%), natural gas (12%), and small amounts of electricity and hot water.

The city is provided with electricity by Kamyanets-Podilskyi urban district of electrical networks public joint-stock company “Khmelnytskoblenerho”, with gas – by the Kamyanets-Podilskyi branch of the public joint-stock company “Khmelnytskogas”, with heat, hot and cold water provided by the public utility enterprise “Miskteplovodenerhiya.”

# A SUCCESS STORY

## THE BASELINE AND THE FIRST ATTEMPTS TO MAKE A DIFFERENCE

Reformation of the urban energy sector in Kamyanets-Podilskyi began in the late 1990's, when Oleksandr Mazurchak was first elected mayor. At that time the city faced a pressing need to improve heating service quality and reduce heating costs. Forty percent of the city's heat was supplied by the cogeneration plant (which was under the jurisdiction of the Ministry of Fuels and Energy of Ukraine), and its main responsibility was to produce electricity. Correspondingly, in autumn, when the cogeneration plant was supplying steam to the local sugar refinery, the city experienced a lack of heat, and after the sugar refining period was over, the cogeneration plant unilaterally exceeded the quota of heat energy supply by 20-30% inflicting damage to another heat provider to the city – public utility enterprise "Teplocomunenerho."

Persistent requests by city authorities to transfer ownership of the cogeneration plant to the city, addressed to Kyiv, finally succeeded. In September, 1999, following a Decree of the Cabinet of Ministers of Ukraine, the cogeneration plant was transferred to city ownership, and was placed on the balance sheet of "Teplocomunenerho." This transfer made it possible to shut down 3 of the city's boiler houses and a need to upgrade another one fell away. Tariffs for heating went down, since 20% of profitability, which the cogeneration plant had included before in the tariff while selling heat to "Teplocomunenerho" had disappeared. In addition, the cogeneration plant began fully covering the electricity needs of all boiler houses in the city, and at the same time ensuring continuity of boiler operation in the event of an interruption of electricity supply from the power grid.

At the same time these events were occurring, the city began a large scale project to upgrade the city's depreciated central heating network, using modern technology of pre-insulated pipes, significantly reducing counterproductive losses of thermal energy during transportation. Over the period of 1998-2001, 5050 m of pipes were laid in Kamyanets-Podilskyi (90% of the total volume of such works in the whole Khmelnytskyi province). In order to optimize the municipal heating system, a new pumping station and a number of bypass connections were built.

Automated water metering devices were installed in seven central heat supply stations of "Teplocomunenerho", and data was then transferred to the control unit of the public utility enterprise, enabling rapid response to work deviations of the above-mentioned stations.

Approval of the "Energy Saving Program in Kamyanets-Podilskyi for 2001-2010" by the City Council session in 2001 became an important event that demonstrated the seriousness of the local authorities' intentions to put the municipal energy sector in order. The program, which was developed by the Department of Economy of the City Executive Committee, contained detailed annual plans of the relevant measures for all industrial and public utility enterprises, educational, cultural and health care institutions along with the cost of the planned works and expected energy and cost savings. In fact, the city for the first time received a strategic document dealing with its energy consumption.

At that time a threat to the proper functioning of the municipal water supply system in Kamyanets-Podilskyi arose. Established in 2001, public utility enterprise "Vodokanal" faced a plethora of problems: excessive electricity consumption, significant water losses in the networks due to leakages, poor water quality, and a low collection of payments for the services provided (and subsequent rise of internal debt, and, in particular, for electricity), high accident rate, and poor quality of waste-water treatment. Technical measures, such as installation of a multi-rate meter in the first stage pumping station that allowed filling urban tanks with water at a lower night tariff, reconstruction of another tank in addition to the two existing, replacement of defective stop valves and inefficient pumping units in the second stage pumping stations, didn't make a significant difference: "Vodokanal" was steadily heading for bankruptcy. In August, 2002, the City Council session (with the consent of the State Committee of Ukraine on Housing and Municipal Economy) approved a decision that committed "Teplocomunenerho" to providing water supply services. For this purpose human resources, production capacities, facilities and property of "Vodokanal" were transferred to "Teplocomunenerho".<sup>1</sup>

<sup>1</sup> It was decided to leave at the "Vodokanal" a minimum staff to complete work on collecting receivables and refunding payables. In October 2004 per curiam this public utility enterprise was declared a bankrupt and ceased to exist.

In early 2002, at the cogeneration plant where two back pressure turbines were operating, an additional condensing turbine was launched and, as a result, heat and electricity production grew. «Teplocomunenerho» became able to provide municipal waste-water treatment facilities and pumping stations with its own-produced electricity. Moreover, the enterprise began to sell surplus electricity to other public utility enterprises (even in Khmelnytskyi), and in this way to improve its difficult financial situation caused primarily by household debts for the consumed heat. At the same time, in order not to create conflict with «Oblenerho», the electricity was sold only to those enterprises that were not its debtors.

However, «Oblenergo» interpreted the measures on improvement and strengthening of «Teplocomunenerho» as a threat to its sole dominance in the local electricity market. People willing to privatize the successful cogeneration plant (and not only it) appeared suddenly. Behind-the-scene games involving influential players started. In order to retain the whole property complex of «Teplocomunenerho» in the municipal ownership, the city decided to create a closed joint stock company, which would allow the entire complex to be leased out to (according to the initial plan, 49% of shares had to be owned by the employees of the enterprise, and 51% – by «Khmelnytskhas» shareholders). In 2004, a lease contract for 10 years was signed between Kamyanets-Podilskyi City Council and the newly-created CJSC «Teplovo-doenerhiya».

Meanwhile, local enterprises began to produce of electricity meters (JSC «Kamyanets-Podilskyi Electro-mechanical Plant»), and heat and water meters (JSC «Kamyanets-Podilskyi Electron Plant»). Buildings (first of all, public sector buildings) were, step by step, equipped with meters.

Street lighting improved significantly in Kamyanets-Podilskyi. From 2001-2005, 2,000 new luminaires equipped with energy efficient high pressure sodium vapour lamps were installed in the city and they were transitioned to multi-rate electricity meters. This made it possible to resume street lighting throughout the night (previously, lights were switched off from 2 a.m. to 5 a.m.).

The modernization of the energy sector in Kamyanets-Podilskyi was carried out in line with the traditional extensive understanding of development inherited from the Soviet times. The main emphasis was put on increased production and supply of heat and electricity, and on reducing counterproductive

energy losses at those initial stages of the energy cycle. Unfortunately, end-user management work in the city was confined to preparatory installation of energy meters.

In September, 2006, the City Council session approved the updated «Energy Saving Program in Kamyanets-Podilskyi for 2006-2010», which (although it contained a small separate section «Energy Efficiency Management») did not offer any specific effective management mechanism to address the identified issues.

### NEW STAGE

The event, which launched a new stage in reforming the energy sector in Kamyanets-Podilskyi, was the International Workshop «Rational use of energy resources and introduction of energy saving technologies in the public utilities sector in Ukraine» organized by the city authorities in February 2007. The participants became especially interested in a series of presentations of Anatoliy Kopets, representative of the European Association of local authorities «Energie-Cités» in Ukraine, who spoke about the European approaches to solving energy problems in urban areas, relevance and applicability of the European experience in Ukraine, as well as about the first achievements in creating a municipal energy management system in Lviv. O. Mazurchak, the mayor of Kamyanets-Podilskyi, immediately appreciated the importance of these innovations and the benefits that his city might get from their implementation.

Acquaintance and further fruitful cooperation between O. Mazurchak and A. Kopets caused significant events also at the national level. At the same time A. Kopets together with Valeriy Baranov, the Mayor of Berdyansk, head of the Coordinating Council of the Sustainable Development Unit of the Association of Ukrainian Cities and Communities, (with the support of Gérard Magnin, Executive Director of «Energie-Cités»), were developing the idea of creating a similar national association in Ukraine. O. Mazurchak without any hesitation joined the work of the initiative group and quickly became its main driving force. Soon after that on April 23, 2007 Mayors of Berdyansk, Kamyanets-Podilskyi, Lviv and Slavutych signed the corresponding declaration. After sessions of these cities' councils approved the decision about their participation in the future association, a meeting of founders was held in Kyiv on June 14, 2007, where mayors of the cities-founders announced the creation of a new voluntary association of local governments – the Association «Energy Efficient Cities of Ukraine» (hereinafter – EECU). The board and the president of the organization were elected and

Oleksandr Mazurchak, the mayor of Kamyanets-Podilskyi, became the president.

Intensive preparation for creating municipal energy management system started in Kamyanets-Podilskyi. The city's authorities decided to apply the same approach as in Lviv – at first to confine to the public sector buildings. In September 2007, the city council approved Statute of the Department for Housing & Municipal Economy and Energy Conservation of Kamyanets-Podilskyi City Council (Department of Energy Saving). Borys Kyrychenko became the first head of the Department.

With consulting support of A. Kopets, a concept of implementing the energy management system in Kamyanets-Podilskyi was developed. In December, 2007, the concept was adopted by the City Executive Committee. In January 2008, under the mayor's decree, a permanent working group was established for elaborating the program of implementation of the energy management system in the public sector of the city, based on this concept. The working group included representatives of the City Executive Committee, City Council, and A. Kopets. The group was led by Viktor Dybash, Deputy Mayor.

Meanwhile, O. Mazurchak resigned from the Kamyanets-Podilskyi mayor's position after being appointed a Deputy Minister of Housing and Municipal Economy of Ukraine (one year later he also resigned from the position of the EECU president). However, the process of reforming the management of the municipal energy sector had been launched, and it became irreversible, despite the tumultuous events of the next two years related to the elections of a new leader of the city.

The work of the working group resulted in the program "Improving efficiency of the energy use in the buildings of the budget-funded institutions in the city (energy management in public institutions)". With the concurrence of the City Executive Committee, on February 27, 2008 the Program was approved by the City Council session, and the working group proceeded to its practical implementation. In order to accelerate the establishment of the urban energy management system, regular weekly meetings in the office of the Deputy Mayor V. Dybash were set up, where reports on the work performed during the previous week were considered, and tasks for the next week were assigned.

In accordance with the relevant orders, branch energy managers were appointed to the Department of Edu-

cation and Science, Department of Health Care and Department of Culture and were made responsible for collecting information about energy consumption in the subordinate institutions and entering it into an integrated (single) computerized database. The institutions then appointed persons responsible for collecting meters' readings and energy bills, for recording this information in special internal journals, and for passing information to their branch energy managers. As a result, the organizational structure of the energy management system, similar to that one in Lviv, was formed in the budget sphere (Fig. 1).

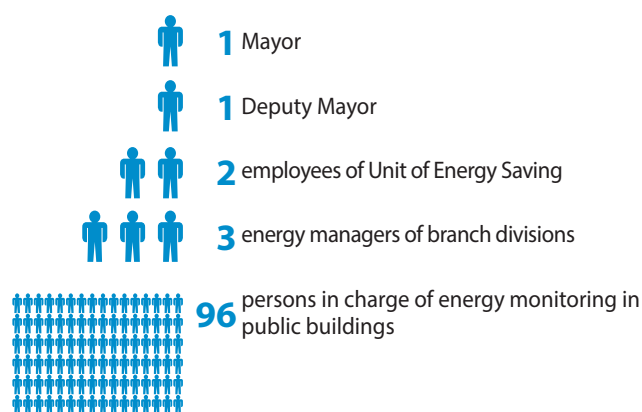


Figure 1. Structure of the energy management system in the public sector buildings of Kamyanets-Podilskyi (as of 2012)

Office equipment was purchased for the Department of Energy Saving, and computers were allocated for the purpose of the energy management system in the branch departments of the City Executive Committee and in the budget-funded institutions of the city. Company "IT Management" provided Kamyanets-Podilskyi with the software "Enerhoplan" (free of charge). Taras Kopets, Director of "IT Management", developed basic electronic inventory of the objects and subjects covered by the future energy management system, and later on, in April and May, he held two training sessions for the future users of "Enerhoplan". Following this training, the computer program, along with the inventory data, was installed on the computers of the Department of Energy Saving, branch departments of the City Executive Committee and involved budget-funded institutions. Afterwards, the company "IT Management" provided the necessary maintenance of its software.

At first the energy documentation involved 87 buildings of 53 budget-funded institutions in the city. The data on energy consumption in the subordinate institutions were passed to the branch energy managers by phone and Internet, but soon this process was organized via Internet only. Communication between



the Department of Energy Saving and the branch energy managers was set up via the Internet from the beginning of the undertaking. In order to avoid possible errors and counterfeiting of input data the employees of this department from time to time inspect the work of the authorized persons in the field.

In June, a detailed electronic database was developed for involved buildings. This database included monthly consumption of gas, heat, electricity, hot and cold water for the period beginning January, 2006. In September, 2008, following Yuriy Liahutko appointment as Head of the Department of Energy Saving, weekly monitoring of energy consumption was launched and, from October – daily monitoring was conducted. A detailed analysis of the whole array of data collected was performed and the first monthly limits for energy consumption based on it were defined (for the fourth quarter of 2008).

Since then, at the beginning of each year employees of the Department the Energy Saving (in March, 2009 an additional employee joined the Department) prepare monthly energy consumption limits for the public buildings, and following mayorial approval, the limits are used to control regulatory compliance. At that time, the Department of Energy Saving began conducting daily analyses of the results of energy consumption in each building for the previous day, and if any incomprehensible deviations arise, the corresponding branch energy manager (who has the responsibility to identify the reason and to take immediate action to eliminate the problem in the event of breakdown) is informed by the Department. The Department of Energy Saving regularly sends the results of the current analysis of energy consumption (in physical units) for the previous week comparing these to the same period of the previous year (if needed – along with the explanations) to the financial managers and delivers this information to the attention of the Mayor.

The daily energy monitoring (based on the results of the prior day) has turned out to be an extremely effective management tool, enabling the prevention of waste of energy resources (and the corresponding expenses from the city budget) caused by breakdowns and deliberate abuses. For example, thanks to early detection of the peak consumption of heat energy in one of city schools and in a kindergarten, it was possible to avoid flooding of the basement due to a pipe break in a remote basement room before there were any visible signs of the accident. Relatively high electricity consumption was found in another school. On-site inspection detected shunt running of the me-

ter – after control disconnection of the whole building from the grid, it continued “metering.” Immediate replacement of the meter stopped the non-existent electricity consumption. Also, thanks to daily energy monitoring the widespread practice of renting school gyms and canteens during off hours without taking into account utility charges was stopped. Today, the city no longer pays for the energy consumed by a tenant; now the tenant pays for it himself quite transparently on the basis of meter readings.

In 2008 Kamyanets-Podilskyi joined Display® – the European campaign of voluntary certification of energy performance of buildings, which made it possible to demonstrate the general public the results of activities aimed at more efficient use of energy in buildings (and inaction as well). The corresponding posters-certificates for two previous years were produced and placed in 47 buildings of the public sector. In 2008 the total number of posters rose to 70; in particular, 20 apartment buildings were added. In 2010 there were already 39 certified apartment buildings. Today the Display® campaign covers 89 buildings in the city.

On February 10, 2009 Kamyanets-Podilskyi represented by the Deputy Mayor V. Dybash, along with 10 other Ukrainian cities, became one of the first signatories of the European Covenant of Mayors.

In April, 2009, a new version of the program “Improving efficiency of the energy use in the buildings of the budget-funded institutions in the city” developed by the staff of the Department of Energy Saving was approved by the City Council session.

## ACHIEVEMENTS

Since the municipal energy management system began operating in Kamyanets-Podilskyi in 2008, there has been a gradual reduction of energy consumption in public sector buildings (Fig. 2), despite the fact that the number of buildings covered by the system has increased, and the technical equipment within institutions located there has improved (new boilers, computers, computerized axial tomography scanner, X-ray apparatus, the “artificial kidney” apparatus, etc.). In particular, the use of cold water has been reduced noticeably (between 2007 and 2011 cold water use has decreased by almost 31%). However, in 2010 gas and heat consumption jumped up, but only due to the fact that winter that year was much colder compared to the same period in 2009, and therefore the heating season started two weeks earlier. That difference was caused also by a significant energy savings that was obtained in 2009 due to a school quarantine in the city.



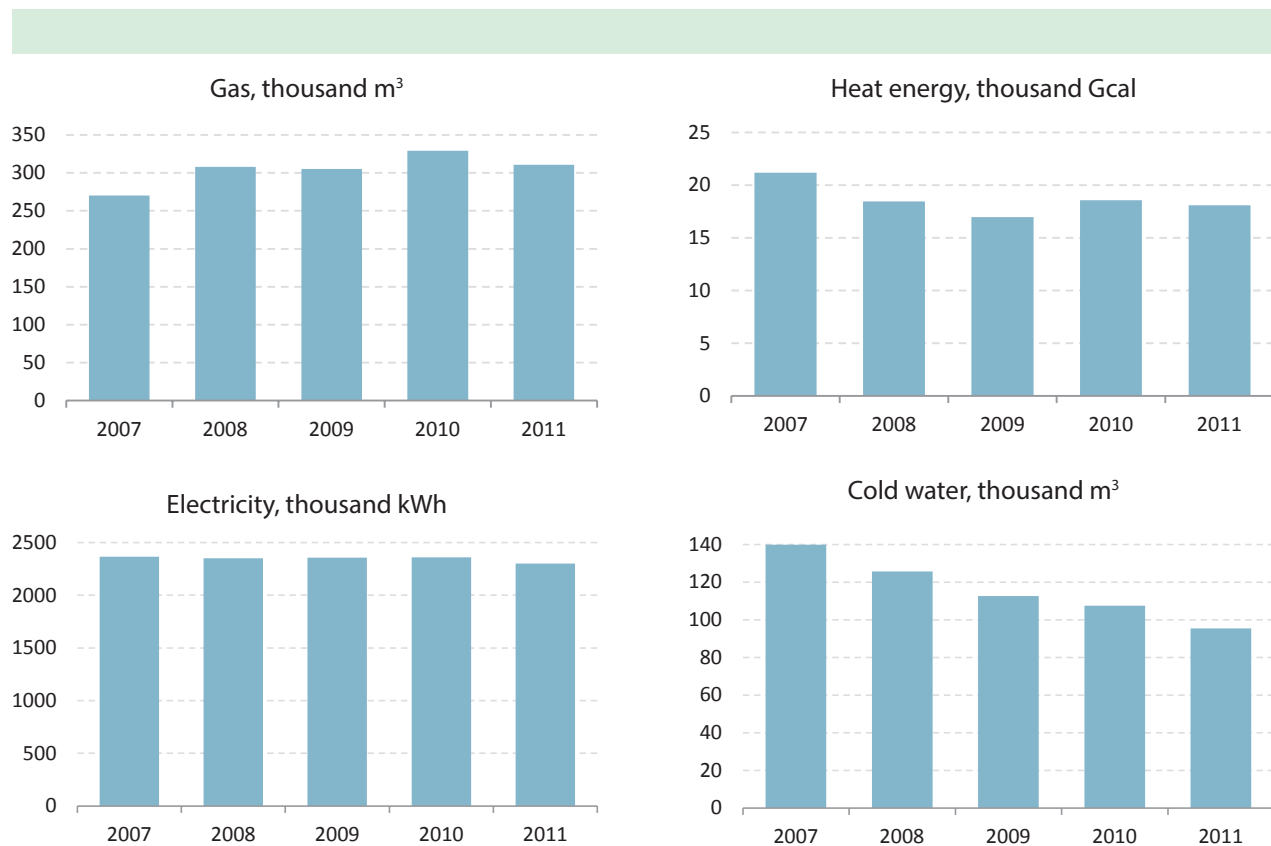


Figure 2. Energy consumption in public sector buildings in Kamyanyets-Podilskyi, 2007-2011

In view of the above-mentioned processes, energy consumption limits between 2009 and 2011 (for the

year) remained at approximately the same level (Fig. 3). Only in case of cold water did they decline slowly.

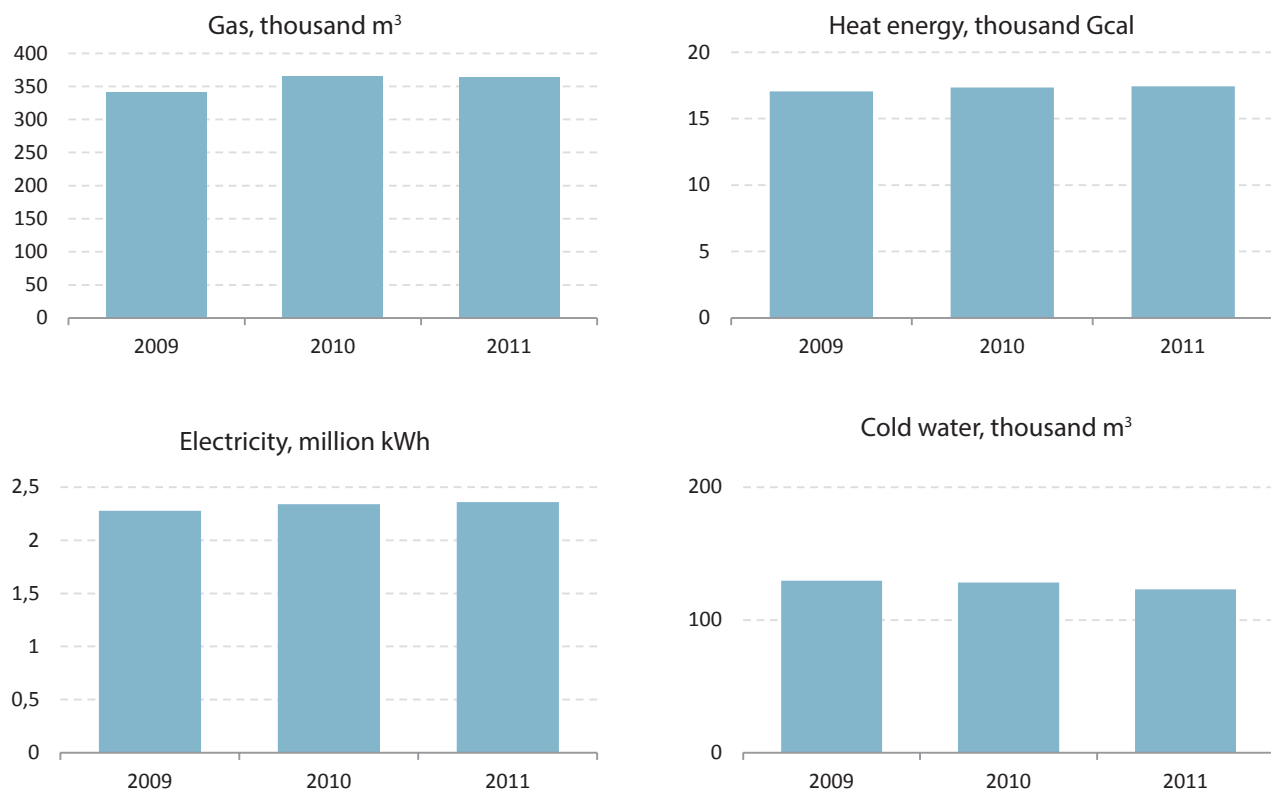


Figure 3. Annual limits on energy consumption in public sector buildings in Kamyanyets-Podilskyi, 2009-2011

However, overall the real energy consumption was less than the planned limits, which, in particular,

indicated the effectiveness of daily energy monitoring.



Figure 4. Deviation of actual annual energy consumption from the planned limits in the public sector of Kamyanets-Podilskyi, 2009-2011

As a result of the annual reduction of energy consumption (compared with the corresponding data for the previous year), there have been savings in energy costs in the public sector of Kamyanyets-Podilskyi (Fig. 5a) every year. The only exception was mentioned 2010. However, unconstrained increase of energy tariffs (Fig. 6) takes a “bite” of a bigger and bigger (ever-growing) piece of these savings (Fig. 5b).

	a. Without taking into account the increase in energy tariffs (thousand UAH)	b. Taking into account the increase in energy tariffs (thousand UAH)
2008	1786,6	1441,778
2009	1424,087	1318,175
2010	-1067,033	-1073,625
2011	732,368	546,768
Total:	2876,022	2233,096

Figure 5. Savings in energy in public sector buildings in Kamyanyets-Podilskyi, 2008-2011

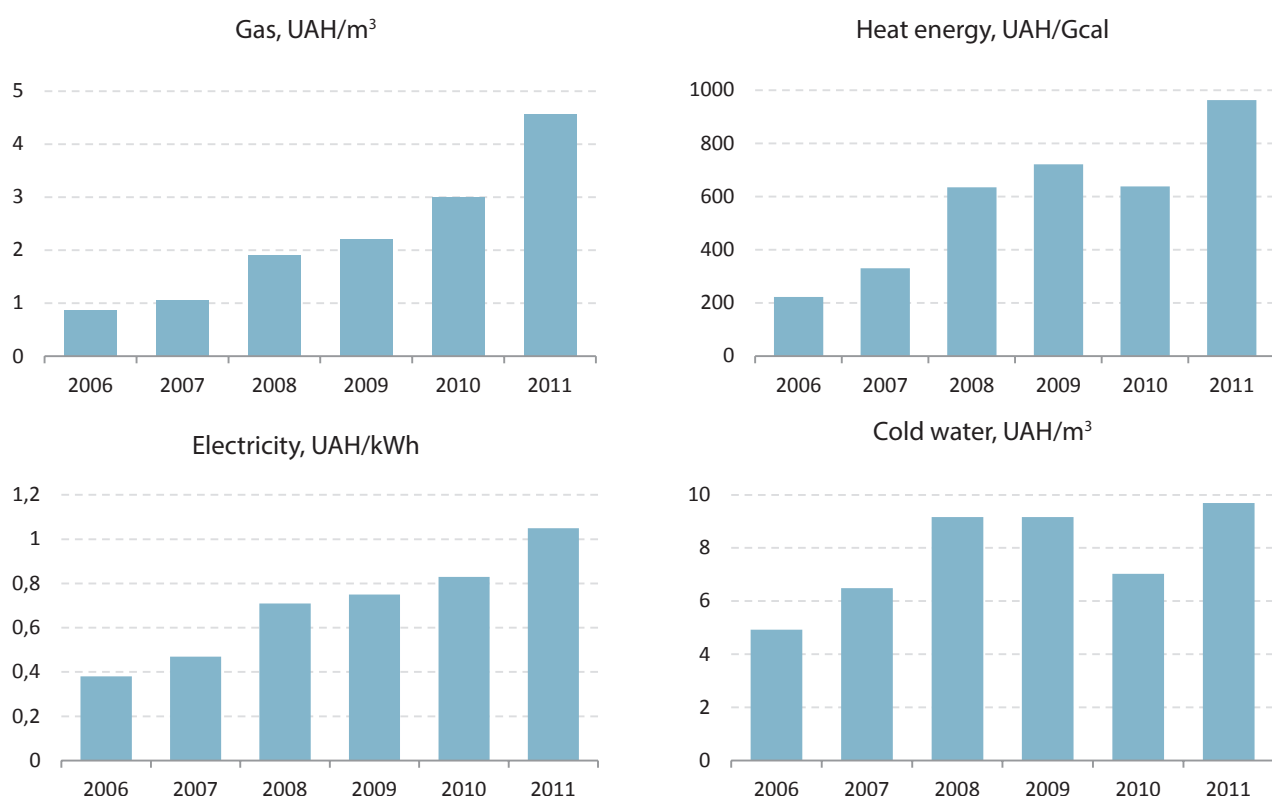


Figure 6. Energy tariffs in public sector buildings in Kamyanyets-Podilskyi, 2006-2011

Sharp reduction of funds for capital expenditures in the city budget, which started in 2009 (Fig. 7) has been another disturbing (and unfortunately, typical for most Ukrainian cities) trend that threatens the normal functioning of public sector buildings in Kamyanyets-Podilskyi. Thus, it has become more and more difficult to maintain the buildings, corresponding energy equipment and internal networks in proper working condition.

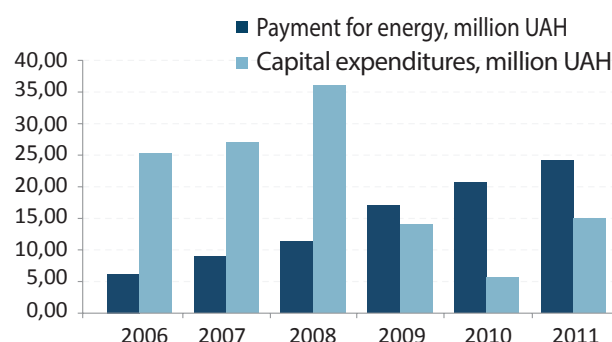


Figure 7. Payment for energy and capital expenditures in the budget of Kamyanyets-Podilskyi, 2006-2011

## TOWARDS NEW CHALLENGES

An independent active search and use of new opportunities related to special-purpose national and international programs is a real way out of the difficult situation of persistent underfunding from the state budget, in which many Ukrainian towns and cities find themselves today. The total funding of the projects and activities on sustainable energy development of Kamyanets-Podilskyi, implemented by the Department of Energy Saving, has been maintained at approximately the same level (Fig. 8) due to external funding. There was an exception in 2010, when the city received substantial funds from the Stabilization Fund of the State Budget of Ukraine.

	2008	2009	2010	2011
Financing from the city or state budget (thousand UAH)	450,4	378,4	3953,8	288
Attracted external funding (thousand UAH)	19,2	172,6	32,4	181,8
<b>TOTAL:</b>	<b>469,6</b>	<b>551</b>	<b>3986,2</b>	<b>469,8</b>

Figure 8. Investments in energy saving measures performed by the Department of Energy Saving in the public sector buildings of Kamyanets-Podilskyi, 2008-2011

Achievements of the Department of Energy Saving include the following projects and programs:

- Kamyanets-Podilskyi, along with 37 other Ukrainian cities, was selected as a pilot city for the Municipal Heating Reform Project implemented in Ukraine by the International Resources Group and financed by USAID. With the funds from the Project, from 2009-2010:
  - two-part heat tariffs established in the city,
  - energy audits of 10 residential buildings, 5 public sector buildings and the municipal district heating system were conducted,
  - in accordance with the Mayor's order, in December 2010 an Advisory Committee on improving energy efficiency in the public utilities of the city was established in the City Executive Committee,
  - the Department of Energy Saving together with the Advisory Committee developed a Concept of energy saving and energy efficiency for Kamyanets-Podilskyi (approved by the City Council session in February 2011),
  - on the basis of the Concept a short-term Municipal Energy Plan until 2015 was developed (approved by the City Council session in February 2012),
  - the Department of Energy Saving developed a concept of Condominium Support Centre, which was later used to create such a centre in the city,
  - with active participation of the Department of Energy Saving a Catalogue of investment projects for Kamyanets-Podilskyi, covering recommended projects for thermo-modernization of buildings and modernization of the municipal district heating system, potential creditors and major risks, was produced;
- In 2010, Kamyanets-Podilskyi became one of three Ukrainian pilot cities in the international project MODEL-CIUDAD with participation of Ukraine, Georgia, Armenia and Moldova, funded by the European Commission. The European Association of local authorities "Energy Cities" is a Project Manager and the EECU – the coordinator from the Ukrainian side. The Project participants took part in a series of trainings on energy efficiency of buildings. The Project also provides a practical component: in particular, in Kamyanets-Podilskyi it incorporates a comprehensive thermo-modernization of the most problematic public sector building in the city – the building of Educational Complex No. 16 (the walls of which are 28 cm thick). Using the Project funds, an individual heating system will be installed for automatic regulation of the heating medium supply based upon weather conditions, and the ventilation system will be reconstructed. The Project cost is 976 thousand UAH (90 thousand EUR), of which 72 thousand EUR is a grant from the European Commission, and 200 thousand UAH are funds from the city budget. Besides, an agreement has been reached with the companies "Knauf Insulation Ukraine", "Phillips Ukraine" and "Danfoss Ukraine" concerning provision of technical assistance in deep thermo-modernization of this building. Execution of works is planned for 2013;
- Within the project "Government 2 Government" (2010-11) an inventory of CO<sub>2</sub> emissions in the city was developed together with the experts from the Dutch NL Agency and EECU, using the Swiss software "EcoRegion" in conjunction with the financial support from the Ministry of Economic Affairs, Agriculture and Innovation of the Kingdom of the Netherlands. Proceeding from the inventory data,

a long-term (till 2020) Sustainable Energy Action Plan (SEAP) for Kamyanets-Podilskyi, required by the Covenant of Mayors, was developed in collaborations with the experts of the NL Agency and Western Ukrainian Regional Training Centre. The Plan was based on the above-mentioned Concept of energy saving and energy efficiency of Kamyanets-Podilskyi. In April 2011, the Plan was approved by the City Council session and sent to the Covenant of Mayors Office in Brussels for final approval;

- In 2011, the project proposal prepared by the Department of Energy Saving won a competition for funding of the feasibility study for energy efficiency projects, organized by the Netherlands-Ukrainian Sustainable Energy Platform NUSEP. The NL Agency experts with the assistance of the Department have elaborated the feasibility study of a waste disposal plant for Kamyanets-Podilskyi. Negotiations with the potential investors are ongoing;
- Within the framework of the International school educational project on rational use of resources and energy SPARE (School Project for Application of Resources and Energy), carried out in Ukraine with the support of the Ministry of Education and Science of Ukraine, the National Agency of Ukraine on Ensuring of Efficient Use of Energy Resources and the Embassy of the Kingdom of Norway in Ukraine, the Department of Energy Saving organized a training workshop for local school teachers called "Education as a way to engage children in energy saving activities." During the training in May, 2010, representatives of the environmental club "Eremurus", SPARE National Coordinator in Ukraine, introduced teachers to the new training course "Energy Saving and Climate Change Mitigation" (for students of 8th and 9th grades), approved by the Ministry of Education and Science of Ukraine, its syllabus and the textbook of the same name, as well as donated 300 copies of the textbook to the municipal Department of Education for conducting extracurricular activities at schools. Extracurricular classes on energy saving were launched in the local schools. SPARE Project partners from Denmark inspected the illumination intensity of the students' workplaces in classrooms of Kamyanets-Podilskyi schools and prepared recommendations on how to bring lighting in schools in line with the workplace lighting standards. In September 2012, a team of the secondary school No. 1 occupied the second place in a competition of teachers' and students' projects on energy audit

of their school buildings at the 14th All-Ukrainian Student Conference of the UNESCO Associated Schools;

- In October 2010 and March 2011, Sustainable Energy Days were held in Kamyanets-Podilskyi. The primary focus was upon children and young audiences. Drawing competitions and puppet shows dedicated to energy saving at home were conducted in kindergartens, and competitions of slogans, chants, pictures and wall newspapers, special lessons and extracurricular discussions – at schools. Students of universities and colleges attended the corresponding lectures; viewing of movies "Inconvenient Truth" and "Home" was organized at schools. In addition, the issue-related posters and billboards were exposed, and meetings on economical use of energy resources were held in the public utility enterprises and public institutions. During this event, local mass media widely covered the issues related to energy and global climate change, depletion of traditional energy sources and renewable energy, energy efficiency and energy security of Ukraine;
- In March, 2012, as part of the international project "Covenant of Mayors Capacity Building Model for Ukraine and Georgia" (European Commission program "Covenant of Mayors going East: Supporting the participation of Eastern Partnership and Central Asian cities in the Covenant of Mayors"), experts of Envidatec Ost Ltd (Russia) and EECU conducted an internal audit of the energy management system in Kamyanets-Podilskyi under ISO 50001:2011 "Energy Management System," a new voluntary international standard developed by the International Organization for Standardization. The team prepared recommendations toward adjusting the municipal energy management system in accordance with the new standard;
- In 2008, the Department of Energy Saving developed and implemented the Program "Safe Housing". Within the Program, lighting in 327 hallways of residential buildings was reconstructed, 2653 luminaires were equipped with energy efficient bulbs, and 100 old and worn front doors were replaced with insulated metal doors with combination locks;
- In early 2011, staff of the Department of Energy Saving developed the program "Warm House" (which was, in February, 2011, approved by a decision of the City Council session). The goal of this program is to help co-owners of condominiums



organize and finance major repairs of their buildings. In total, over the period of 2011-2012, under the terms of co-financing (50/50), 22 walls in 17 apartment buildings were insulated for the total amount of 981.6 thousand UAH;

- In June 2012, staff of the Department of Energy Saving developed the Program "Energy saving in local budgetary institutions in 2012-2015", which was then approved by the City Council session. As of now in the framework of the Program, 45% of windows and doors in the budgetary institutions have been replaced with energy-saving ones (10785 sq. m), and 66% of incandescent bulbs – with energy-efficient ones (10619 pieces). A solar collector has been installed in the kindergarten No. 23, and it provides the kitchen with hot water.

The Department of Energy Saving of the City Council in Kamyanets-Podilskyi willingly shares its experience with the colleagues from other cities. Representatives of the cities of Alchevsk, Artemivsk, Doly-na, Zhmerynka, Novovolynsk, Ternopil, Cherkasy and Chernivtsi (Ukraine), Gori and Rustavi (Georgia), Beltsy (Moldova), Bishkek (Kyrgyzstan), Dushanbe (Tajikistan) have had an opportunity to get acquainted with local practices during their personal visits to Kamyanets-Podilskyi and/or during special events held in Ukraine and abroad. Yuriy Lyahutko, Head of the Department, often acts as an expert on trainings conducted within various projects by the EECU and office of the European Commission project "Covenant of Mayors – East".

It should be noted that, along with the Department of Energy Saving, two local active players in reforming energy sector in Kamyanets-Podilskyi include:

- The public utility enterprise "Miskteplovodenerhiya". This enterprise was created because CJSC "Teplovodenerhiya" (mentioned above) had neglected maintenance of the leased property complex, as it was stipulated by the lease contract (see section "The baseline and the first attempts to make a difference"). Therefore, the court nullified the lease contract, and all property was returned to municipal ownership. Since February, 2010, the newly established public utility enterprise has been providing heat and water supply and waste water disposal services to the residents, institutions and businesses in Kamyanets-Podilskyi.

At the same time, the enterprise started extensive energy-efficient modernization and technical upgrading of the entire technologic complex. In par-

ticular, four cogeneration units were installed and launched in two municipal boiler-houses. The process of changing over of all the municipal boiler-houses to the automatic mode is ongoing. The first automated control unit began its operation and now controls all water and wastewater pumping stations. Gradual replacement of worn networks (heat, hot and cold water supply pipelines) with the new ones, using pre-insulated and polypropylene pipes, is ongoing. Apartment houses are being equipped with individual heating systems.

In February, 2010, "Miskteplovodenerhiya" received a loan of 40 million UAH for 17 years at 0.5% annual interest for the modernization of water supply and wastewater systems from the World Bank.

In January 2012, the City Council approved the Complex scheme of optimization of water supply and wastewater systems in Kamyanets-Podilskyi, which includes 4 work stages:

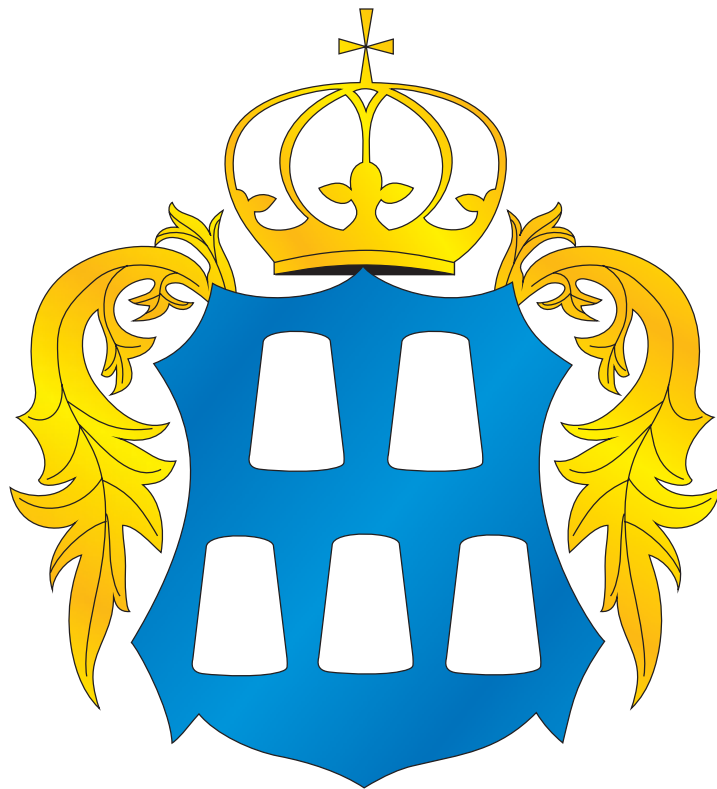
- replacement of energy-intensive equipment,
- creation of an electronic scheme of networks,
- replacement of worn networks,
- dispatching and automation of water supply and sanitation facilities.

Due to its strategic importance for the city, "Miskteplovodenerhiya" has been subordinated directly to the mayor of Kamyanets-Podilskyi, Mykhaylo Simashkevych, who personally supervises the operation and development of the enterprise.

- The public utility enterprise "Miskliftsvitlo": From 2008-2011, 1,976 street lanterns (new and old ones – instead of incandescent bulbs) were equipped with high pressure sodium bulbs, 17.8 km of the streetlight grid was repaired, and 9 zone meters were installed. Today, a half of all traffic lights in the city are LED. LED illuminators are widely used for the lighting of facades of architectural landmarks during darkness hours.

**The processes launched in 2008 by creation of the municipal energy management system in Kamyanets-Podilskyi and enhanced by technical measures on improving energy efficiency in the utility sector, have made it possible today for the city to confidently overcome barriers on the way towards sustainable energy development of the local community.**

**A SYSTEMIC APPROACH TO  
SUSTAINABLE ENERGY DEVELOPMENT  
IN THE TOWN OF DOLYNA: A SUCCESS  
STORY FOR SMALL TOWNS**





## BRIEFLY ABOUT DOLYNA

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Dolyna is a town and district center in the foothills of the Carpathian Mountains in Boykivshchyna (Boyko region), the administrative centre of the district of the same name of Ivano-Frankivsk province. It is an important cultural, educational and industrial centre of the region with well-developed oil & gas and wood industries, and considerable tourism potential. Dolyna lies at the crossroads of important transport corridors – roads of National Significance Stryi - Ivano-Frankivsk - Chernivtsi - Mamalyga (to Chisinau) and Dolyna - Khust and the Lviv railway branch runs through the town.

Dolyna is one of the oldest towns located on the east side of the base of the Carpathian Mountain Range. Although the first written mention of it dates back to 1443, it is considered to have been founded in 979, when salt springs were discovered in the area. Prior to the industrial production of oil in 1950, salt making had been the main and oldest branch of local economy.

The population of Dolyna is approximately 20,500 residents and the area of the town is 20.5 sq.km.

The real eye appeal of Dolyna is a lake with a total area of 25 hectares. Small rivers, Turianka, Sadzhava and Sivka, also flow through the town.

The local climate is temperate continental with elements of high level (mountain) climate, wet and cool in summer and mild in winter. The amount of precipitation in area around Dolyna ranges from 600 to 1800 mm / year, depending on the altitude. About 73% of the annual precipitation occurs in the warm season. The months with the highest amount of rain are during the summer (44% of annual precipitation), especially June. Throughout the year, there are 28-29 days with thunderstorms. Snow is consistent throughout December, followed by snow cover melt in March. In summer, the average daily temperature for half of the days is within 15-20 °C. The hottest month is July: on average, when the 13 days with temperatures of 20-25 °C. With the onset of winter, there is a slow decrease in temperature from 0 to -5 °C, which lasts for 40-45 days. There is a gradual increase in temperature from -5 to 0 °C in late winter which lasts for about 35 days and ends in March.

There are 29 public sector buildings in the town, with the total area 64.1 sq m. Five of them are pre-schools, 7 schools, 4 cultural institutions, 4 medical institutions, 2 sports and leisure facilities and 7 local governments and public authorities. Only 5 pre-schools and the museum “Boykivshchyna” are on the Dolyna City Council’s balance sheet, while other buildings in municipal ownership have been transferred to the permanent use of Dolyna District Council and District State Administration. Average energy consumption in the public buildings in Dolyna is 202.4 kW • h/m<sup>2</sup>/year.

The housing stock of the town (its total area is 292.4 thousand sq. m) consists primarily of apartment buildings (62%), the rest is individual housing. In total, there are 168 apartment buildings in Dolyna, 108 of which have 2 or more floors. All apartment buildings are on the balance of the public utility company “HOA”, however, only 89 of them are serviced by it. Instead, there are 28 condominiums in the town. Average energy consumption in the residential sector is 187.4 kW • h/m<sup>2</sup>/year.

Basic energy resources used in the urban buildings in Dolyna include natural gas, electricity and water. The town does not have a centralized heating system. Every public building, individual house or apartment is heated with its own boiler, mostly gas, which is supplied to 92% of the buildings.

Dolyna is provided with electricity by the public joint-stock company “Prykarpattiaoblenergo”, with natural gas – by the public joint stock company “Ivano-Frankivskgas”, and with cold water – by the district public utility company “Dolyna production administration of water and waste water services”.

# A SUCCESS STORY

## THE BASELINE AND THE FIRST ATTEMPTS TO MAKE A DIFFERENCE

After World War II, due to the discovery of new thick deposits of oil and natural gas in its surroundings, Dolyna turned into one of the flagships of the oil and gas industry of the then-USSR. In 1963, the maximum gas production (1.2 billion m<sup>3</sup>) was achieved, and in 1966 - the maximum oil production of 2 million tons was achieved. Overall, from 1950 to 2008, over 52 million tons of oil and 19.5 billion m<sup>3</sup> of gas were recovered here.

Naturally, the town of oilfield workers, which was growing quickly, did not experience any lack of energy, and several generations of Dolyna residents grew up in the full conviction that energy is a readily available, unlimited, cheap resource. Sometime after the collapse of the Soviet Union and the restoration of Ukrainian statehood, crisis phenomena that began to accumulate rapidly in the economic and social spheres of Ukraine, blew over Dolyna – the oil and gas sector continued working steadily, providing residents with jobs and quite decent earnings. However, it did not continue for long.

Sharp depreciation due to hyperinflation of wages and other income of the population and a concurrent relentless growth of utility tariffs severely affected the ability of people to make full and timely payments to the providers of these services. Debts began to accumulate. As a result, the historically breakeven public utility company “Dolynateplokumunenerho”, which had steadily supplied heat in residential and public buildings of the town, was suddenly confronted with the problem of timely payment of gas bills and appropriate taxes.

In search of a way out, the town (in addition to payment for the heat consumed by public-sector buildings), also covered the household debts from the town budget for some time. However the town lacked money to maintain boilers and heating mains in good technical condition, resulting in frequent accidents, which in turn then led to a noticeable deterioration in the quality of services provided. There were mass withdrawals of Dolyna residents from central heating as they switched, without authorization, to cheaper and more efficient heating with individual boilers. As a result, in 2000, by Resolution of the Commercial Court, the company “Dolynateplokumunenerho” was declared bankrupt and, after completion of the liquidation process in 2002, it ceased to exist.

Working to address this situation, Dolyna City Council, led by Mayor Vasyl Romanyuk, made a radical decision to transfer heating of the entire town to individual heat supplies, and at the same time, organized a single monetary support using the city budget and oil & gas companies' funds for the most vulnerable population groups. As a result, by the end of 2007, each public sector building (with the exception of two dormitories which had been transferred to electric heating) received separate large scale boilers, and residents equipped their apartments and individual houses with individual boilers. As a result, gas consumption dropped to 50 % of use in comparison with the period when the central heating system functioned.

## NEW STAGE

In May 2006, following the results of March elections, Volodymyr Harazd (40 years old), became mayor of Dolyna. He had extensive experience in senior positions in public, private and social structures, and started his work with conducting a detailed analysis of the current state of the town, its previous development strategy, and its projections for the future based on local and global trends (in particular, in the energy sector).

The conclusions drawn awakened anxiety. Although energy crises had been experienced in the past, these had occurred due to political issues. Now, for the first time, a global energy crisis was caused by the passing of an “oil peak” which signalled the beginning of an era of physical shortage of ‘black gold’ on the planet. As the Dolyna oil field (the largest in the Western region) was exhausted, Dolyna's volume of oil and gas production began to decrease. At the same time, the volume of exploration and drilling of new wells reduced significantly (due of the complexity and high cost of developing commercial reserves of fossil fuels at a deep depth). The global energy crisis became obvious in Dolyna. The powerful JSC “Ukrnafta”, which had been the primary sponsor of the socio-economic development of the town, began an organizational restructuring, leading to the dismissal of some of the employees due to the reduction of regular staff. Idle times in the work of drilling crews and forced leaves became commonplace.

Despite the fact that tariffs for the major energy sources in Dolyna were still relatively low, especially for the population, it became clear that a surge in these tar-



iffs was not far off, with negative consequences and the town was not ready to meet new severe realities.

The town lacked detailed and accurate information about the local energy consumption. The executive committee of the City Council did not have a competent unit to monitor the energy situation in the town and that could quickly respond to new challenges. The municipal energy infrastructure was unbalanced and entirely dependent on traditional energy sources, with meagre use of renewable energy sources (such as firewood in the private sector). At the same time the level of residents' awareness about the imminent problems related to energy along with possible solutions to those problems, was extremely unsatisfactory. Dolyna was in desperate need of broad and open dialogue between the authorities and the local community on issues related to the future energy supply of life-sustaining activities of the town. There were no NGOs able to champion the energy and environmental interests of the community.

Given that the access to energy provides for the stable operation of a city, there was no doubt that in order to ensure sustainable development of Dolyna, it was necessary to take care of its energy aspect as soon as possible. But the question arose as to how to do this. The situation required a systemic rather than a situational solution. And the opportunity to get professional answer to this fundamental question was not long in coming.

In February 2007, the mayor of Dolyna attended a regular meeting of the All-Ukrainian public association "Mayors' Club" in Kiev. One of the speakers at that meeting was Anatoliy Kopets, executive director of the newly established Association "Energy Efficient Cities of Ukraine" (EECU). Kopets spoke about the activities of the Association and, in particular, about the success of the City of Lviv in creating a municipal energy management system. Actually, the acquaintance of Harazd and Kopets at the "Mayors' Club" laid the foundation for the fruitful cooperation between Dolyna and EECU, which was the decisive factor that influenced further reformation of the energy sector of the town.

Mayor Harazd, who had a constructive relationship with the deputies of Dolyna City Council, began to actively promote, amongst them, the ideas of sustainable energy development, by convincing the deputies of the feasibility of this path of development. The Mayor invited Kopets to speak to the deputies several times, and as a result, in November 2007 Dolyna City Council made the decision to join the Association "En-

ergy Efficient Cities of Ukraine". Thus, Dolyna provided political support to future innovations, and soon the town became one of the most active members of the Association. In December 2007, at a general meeting of the Association, V. Harazd was unanimously elected Vice-President of EECU and a member of its Board.

In April 2008, V. Harazd (as a member of the Ukrainian delegation) attended the 13th annual conference of the Association of European local authorities «Energie-Cités» in the Irish city of Cork. The central point of that representative gathering was to discuss the future of EU energy policy (at that time the Climate Action and Energy Package was in the process of developing) and the bottom-up initiative later called the "Covenant of Mayors. In addition, during the conference, 13 member-cities of «Energie-Cités» shared their own experiences of reforming the municipal energy sector. Everything that Harazd saw and heard in conversations and discussions with European colleagues once again confirmed the correctness of the chosen path of development for Dolyna and inspired the mayor to further activities in this direction.

Deputy Mayor Maksym Novoselskyi was given the responsibility to lead the introduction of management innovations, and he, in turn, reported regularly on the progress to V. Harazd. The working group also included Nadiya Popovych, Head of the Financial Department of the City Council, and Oleksandr Kizyma, Director of the Association "Entrepreneurs of Dolyna district". Based on the experience of the City of Lviv, the decision was made to start creating an energy management system in Dolyna with the inventory of energy resource consumption from previous years in the public-sector buildings, namely: five pre-schools. At the request of the town, "Entrepreneurs of Dolyna district" began to develop and fill in with content the primary database in terms of consumption of natural gas, electricity and water in these institutions. Given the small number of buildings, the City decided to use the simpler Microsoft Excel, instead of the program "Energyplan" that had worked well in practice in Lviv. However, in creating energy passports of 5 pre-school buildings, the town used the section "General information about the building" from "Energyplan". Since that time, energy passports have been updated annually.

According to the order of the Mayor, principals of pre-schools were asked to provide the necessary assistance during the process of developing the inventory and to assign persons responsible for the collection and submission of information on current energy consumption in these buildings. The responsible persons (stewards) received the task to read meters daily



and to register this data in the logbook, and after collecting a week's results, to fill out a separate sheet and to send it to the Association "Entrepreneurs of Dolyna district" (where the data was transferred to the general computer database). In order to establish executive discipline and to prevent any possible conscious counterfeit of data, the logbooks were checked from time to time during 2008, until that additional workload became a routine task for the stewards.

In August, Volodymyr Smoliy, graduate of the Department of regional and sectoral economic development management, Ivano-Frankivsk State Technical University of Oil and Gas, voluntarily joined the working group. Prior to this, Smoliy had successfully defended his master's thesis on the strategic planning of socio-economic development of the local community of the Town of Dolyna. Based on the data already collected in the past three years, he developed approximate limits of monthly energy consumption in the pre-schools, which were used as benchmark figures, making it possible to compare current consumption with the benchmarks. With the limits on hand, the pre-schools were able to control their energy needs for the first time. At the end of each month, V. Smoliy prepared analytical reports, which were then discussed at monthly Mayor Meetings together with the of pre-school principles. If there were deviations from the limits, the group investigated possible causes of their occurrence.

Thus, at the end of 2008, the system of limits was finally adjusted in a test mode. In January 2009, the executive committee of the City Council approved the Regulation on the limits on consumption of fuel and energy resources by public sector institutions in Dolyna, whereupon the municipal energy management system started working in a full-fledged operating mode. If the limit was exceeded during the month within a public sector institution, the head of the institution was required to provide a reasonable explanation for the overage (in the form of a memorandum addressed to the Mayor), and to take immediate action towards the elimination of this overspending. If the need to increase consumption was considered reasonable (and was not temporary), consideration was given towards its increase.

Simultaneously with the Regulation on the limits (in order to encourage initiatives and responsibility in the field), the Mayor's office also approved a Regulation on financial incentives for managers and employees of public-sector institutions. This regulation was financed from Dolyna's budget to promote the saving of fuel and energy resources. According to this document, if there is actual saving of energy con-

sumption in a public-sector institution at the end of a quarter, the director and steward of the public-sector institution, in addition to their salary, would receive a bonus equal to 10% of the amount saved. The rest of the budget element would be spent on the increase of energy efficiency in this institution.

In late 2008, through the efforts of V. Smoliy, Dolyna became a member of the European campaign of voluntary certification of energy performance of buildings - Display®. Today the campaign covers 19 public buildings in the town; and annually, based on the results of the past year, a new poster-certificate Display® is posted in a conspicuous place. Thus, visitors can observe whether the institution's building users care about lean and efficient use of energy, and how well they manage to do it.

Another important milestone event in 2008 (for the first time in Ukraine and two months before the first signing of the European Covenant of Mayors with its mandatory Sustainable Energy Action Plan till 2020!) was the elaboration by V. Smoliy of a Sustainable Development Strategy in the area of energy consumption in Dolyna for 2009-2020. In December 2008, the Dolyna City Council adopted the strategy as a basis, and in January 2009, without waiting for its final approval (which followed in May), the Program for implementation of the Sustainable Development Strategy in the area of energy consumption in Dolyna and of environmental protection for 2009 was submitted for consideration and approved by the session of the City Council. After that time, the Dolyna City Council has routinely approved the annual program of the Sustainable Development Strategy in the area of energy consumption each new calendar year and appropriate funds are allocated in the town budget (taking into consideration the prior period implementation report).

On February 10, 2009, in Brussels Dolyna (along with ten other Ukrainian cities), joined a large international group of the first signatories of the Covenant of Mayors; Volodymyr Harazd, Mayor of Dolyna, witnessed this event by his signature during a ceremony in the session hall of the European Parliament.

In order to complete the creation of the municipal energy management system in Dolyna, the town had to introduce the position of a municipality energy manager in the framework of the Mayor's office. V. Smoliy was offered an internship with the City Council (for possible future employment). During the one-month internship, Smoliy took a course at the Energy Management Training Centre at the Institute for Energy Saving and Energy

Management within the National Technical University of Ukraine “Kyiv Polytechnic Institute”, and visited Lviv where he became closely acquainted with the activities of Energy Management Department at the Lviv City Council. After a successful internship (and based on the results of the competitive selection) V. Smoliy was appointed a Specialist first class responsible for energy management in the town within the Economic Development Department, Dolyna City Council.

By that time, the primary structure of the energy management system in the public sector of Dolyna had been formed. Soon after, in January 2011, it was slightly modified when, due to the emergence of new challenges and expansion of the scope of energy management, Dolyna City Council decided to establish a separate Department of energy efficiency, investment and municipal development consisting of 3 people. This new department was led by V. Smoliy. The municipal energy management system then acquired its modern look (Fig. 1).

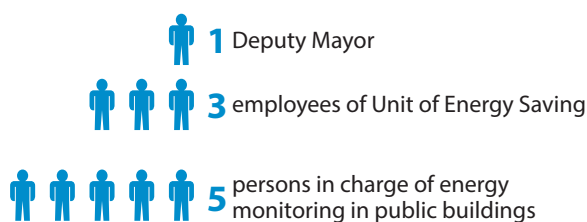


Figure 1. Structure of the energy management system in the public sector buildings of Dolyna

Meanwhile, in June 2009, following a decision of the general meeting of the Association “Energy Efficient Cities of Ukraine”, Volodymyr Harazd took the lead of EECU and superseded Oleksandr Mazurchak, the first President of EECU, Mayor of Kamyanets-Podilskyi. Earlier Mazurchak had been appointed the Deputy Minister for Housing and Communal Services of Ukraine and had stepped down from the Kamyanets-Podilskyi Mayor’s office.

In October 2009, according to the Mayor’s order, the “Council on energy efficiency” under the Mayor was established in Dolyna. Its main task was to prepare the local energy policy framework and to develop corresponding recommendations to local authorities and all economic entities within the town (regardless of their ownership or jurisdiction). In addition to senior management of the town, the Board included representatives of the Department of Education of Dolyna District Administration, local businesses and residents. The Council continues to meet 2-3 times a year, depending on need.

## ACHIEVEMENTS

2009, when the energy management system began operating in public sector buildings in Dolyna, was a turning point in the consumption of energy resources as the gradual reduction of consumption took the place of its growth (Fig. 2), due primarily to detection and elimination of unproductive losses.

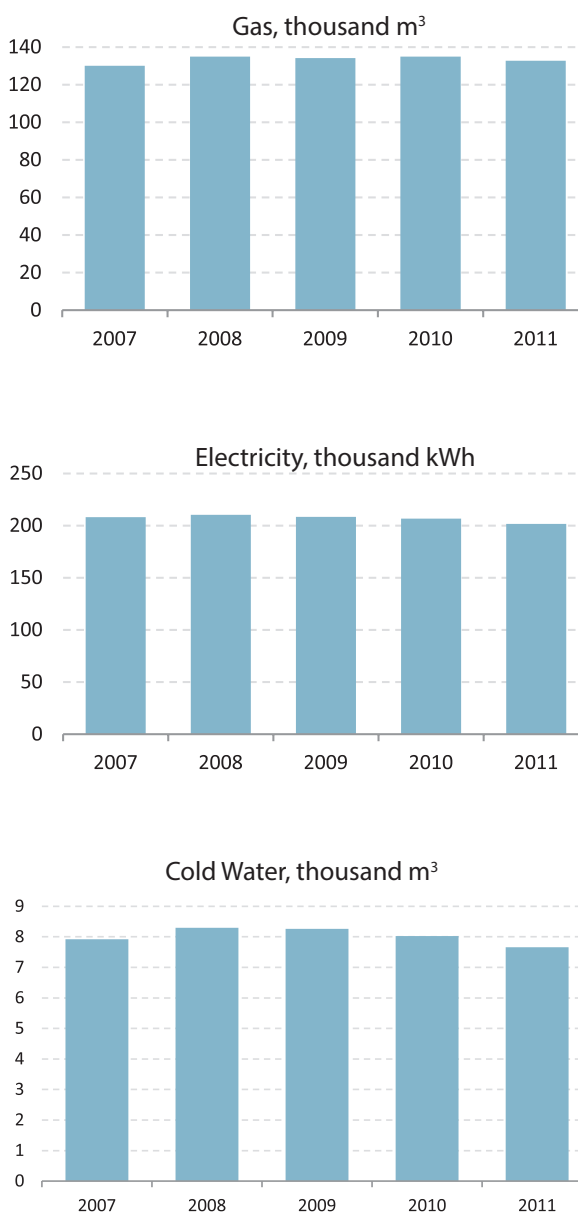


Figure 2. Energy consumption in the public sector of Dolyna, 2007-2011

This allowed proceeding to the planned and smooth reduction of consumption limits for natural gas, electricity and water (Fig. 3), while observing the required thermal comfort in buildings.

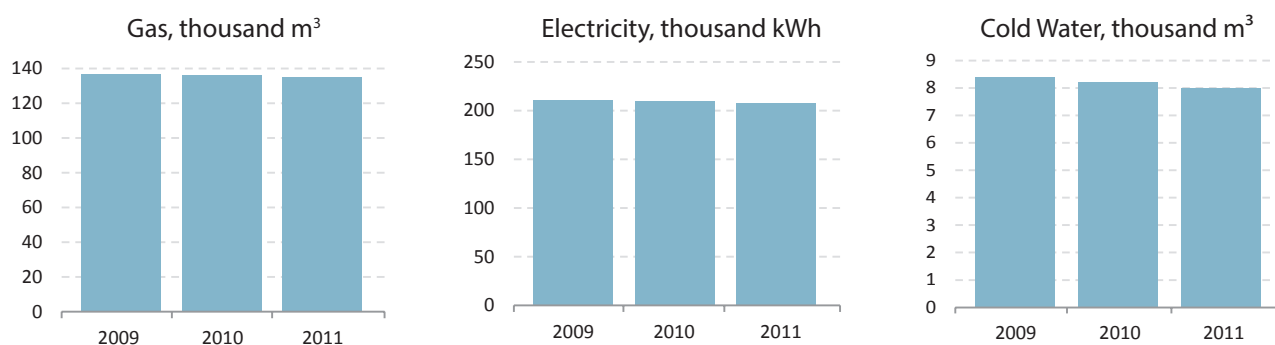


Figure 3. Annual limits on energy consumption in public sector buildings in Dolyna, 2009-2011

It should be noted, that after Dolyna introduced energy management, actual consumption of energy resources in public sector buildings ( based on annual figures), consistently appeared to be slightly below

the planned limits (Fig. 4). This was possible because, as in Lviv, the building users, for their part, got actively involved in the process of energy consumption management.

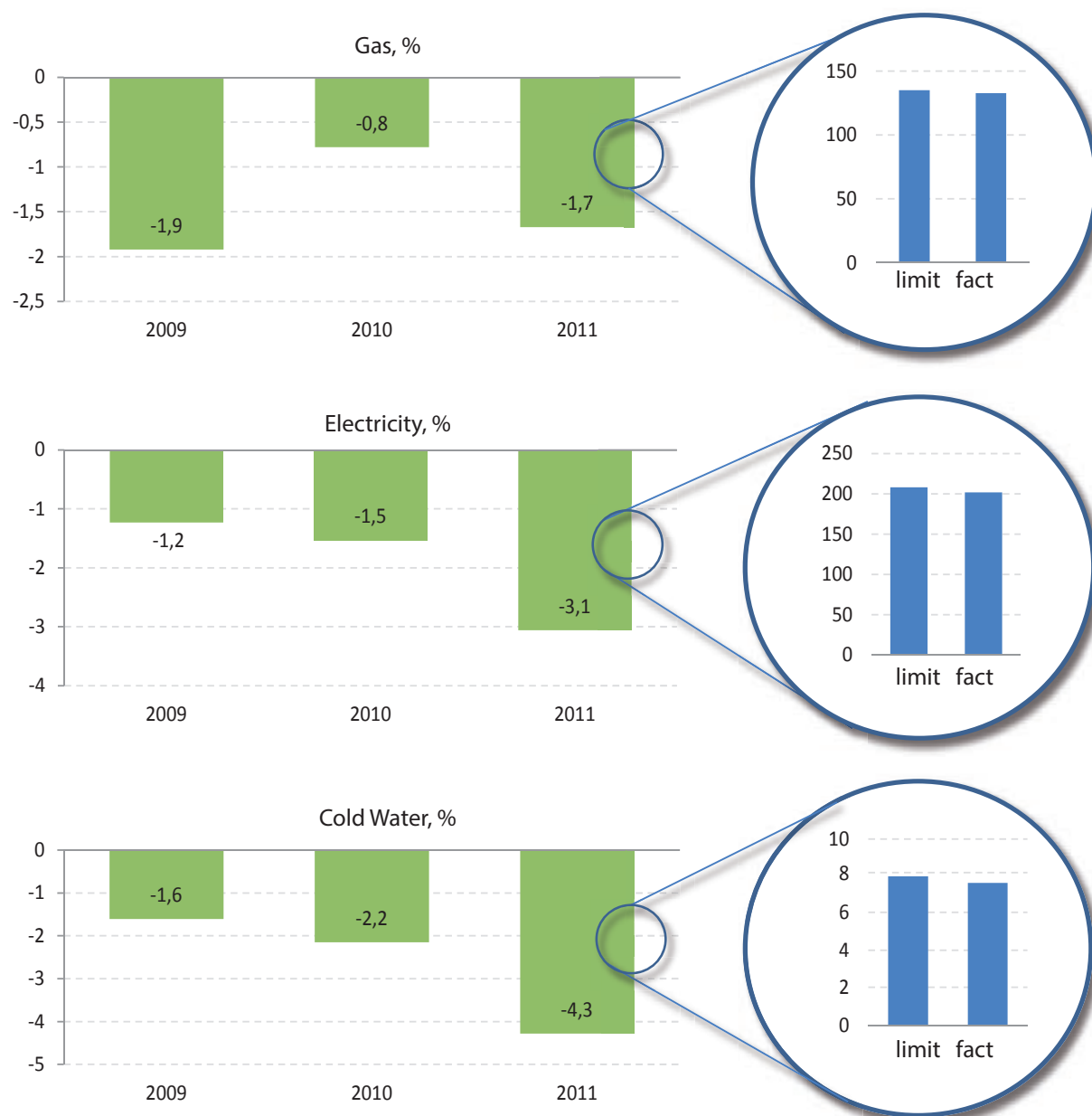


Figure 4. Deviation of real annual energy consumption from the planned limits in the public sector of Dolyna, 2009-2011

As a result, the town small savings of budget funds began to appear (Fig. 5a). However, these savings were soon completely negated by soaring energy tariffs (Fig. 5b).

	a. Excluding the increase in energy tariffs (thousand UAH)	b. Taking into account the increase in energy tariffs (thousand UAH)
2009 p.	10,5	3,7
2010 p.	8,0	-3,7
2011 p.	15,0	-13,2
Total:	33,5	-13,2

Figure 5. Savings in energy in the public sector in Dolyna, 2009-2011

Unfortunately, the predictions of the future bulk growth of tariffs for major energy resources, made back in 2006, came true (Fig. 6). However, due to the obtained savings, strikes delivered to the city budget were softened.

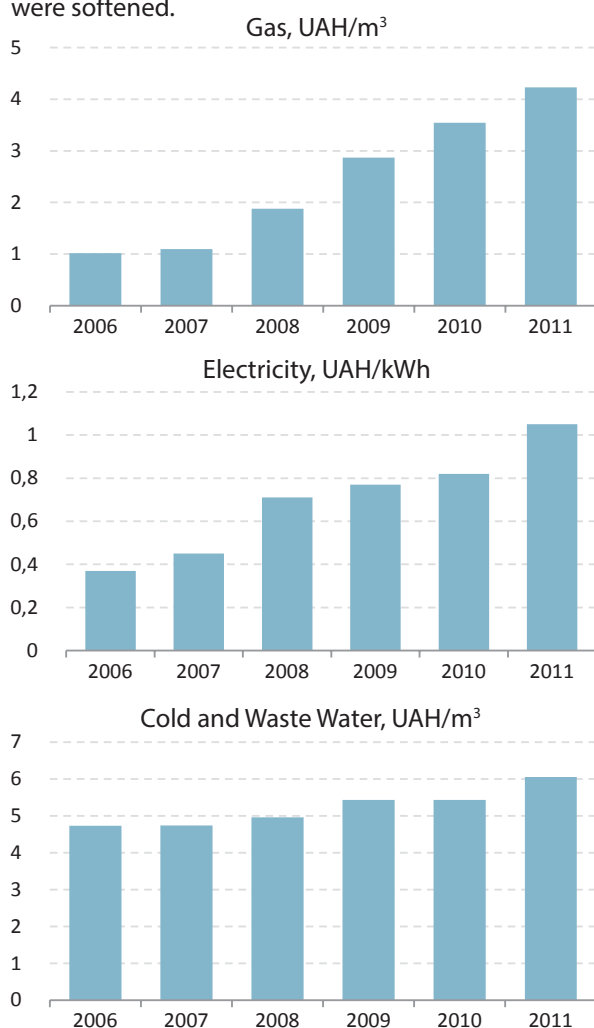


Figure 6. Energy tariffs in the public sector in Dolyna, 2006-2011

Although the total volumes of energy consumption by public buildings owned by the town have been reduced, the town has to pay more and more for them (Fig. 7). In 2011, expenditures for purchasing energy resources for the public sector buildings reached 833 thousand UAH, accounting for 2.87% of all costs from the municipal budget. However, unlike many Ukrainian cities, that was not a result of a reduction of funds set aside for capital expenditures. Therefore, Dolyna is able not only to maintain its capital assets, but is also consistent in conducting upgrades.

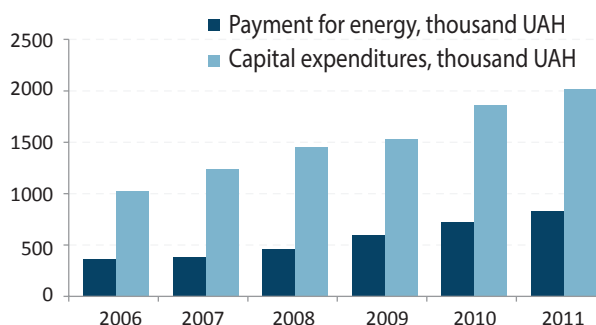


Figure 7. Payment for energy and capital expenditures in the budget of Dolyna, 2006-2011

## TOWARDS NEW CHALLENGES

Creation of the municipal energy management system in Dolyna and ambitious commitments assumed by the town when it joined the Covenant of Mayors were almost simultaneous. Without taking a long breath after achieving the first important milestone towards sustainable energy development of the town, Dolyna got down to a new, much more complicated task of reducing emissions of CO<sub>2</sub> in the town by more than 20% by 2020. The effective energy use management only in public sector buildings was not enough; reaching these reductions required a comprehensive solution involving the housing, transport and local industry sectors. It also required lots of money, which the town budget was short of. The town faced a thorny problem of extra-budgetary fundraising in order to continue energy modernization of the town. Under those circumstances, the only effective way out was to gain proficiency in project activities as quickly as possible, to be able to benefit from the assistance of various international and national programs and funds.

The first successful project developed and submitted by the City Council in 2009 was implemented the same year. It dealt with insulation of an apartment building, where residents formed a condominium. Due to reduction of heat loss, gas consumption for heating of the house decreased by 20-30%. The project was implemented with financial support of the Municipal Governance and Sustainable Development Program implemented in Ukraine by the United Nations Development Programme (UNDP/MGSDP). This effort was innovated

in that 10% of the necessary funds (the total project cost was 200 thousand UAH) was provided by the residents themselves. Other condominiums in the town became interested in this innovative experience.

The next year, three projects were implemented. This was possible, not least of all, due to the active and mutually beneficial cooperation between city authorities and local NGOs (which generally is typical for Dolyna). Specifically, in addition to the previously mentioned Association of Dolyna Entrepreneurs, the Centre for Reforms Support and Development, headed by Serhiy Harhat<sup>1</sup>, Charitable Community Fund of Dolyna, and Association of Dolyna cyclists "VeloKom" is notable and discussed below.

In 2010, the town's successful projects were:

- "Optimization of heat energy consumption in budget-funded entities of Dolyna through the establishment of automated heating control systems." In the framework of this project, partners of the City Council included the Centre for Reforms Support and Development and the Department of Education of Dolyna District State Administration (DSA). In four pre-schools and in one school, all radiators were equipped with thermostats, and boilers – with programmers that automatically regulate the operation mode of boilers depending on the temperature in the coldest room, thereby minimizing the impact of human factors. The total project cost was 168 thousand UAH, of which 123 thousand UAH came from the state budget under the All-Ukrainian competition of projects and programs of the local self-government development, conducted by Foundation for Local Self-Government under the President of Ukraine, and 43 thousand UAH from the city budget;
- "Energy Days - 2010. Replace the bulb." Partners of the City Council in this project (as in the previous one), included the Centre for Reforms Support and Development and the Department of Education of Dolyna DSA. A drawing and essay contest dedicated to energy efficiency was conducted in all seven schools of the town. Each school - participant received a set of 60 energy-saving bulbs to substitute for traditional light bulbs, and the most active and creative schools received multimedia equipment. The project implementation was supported by the Royal Norwegian Embassy in Ukraine (40 thousand UAH);
- Replacement of windows and doors with ones that provided more energy savings in the pre-school "The

Sun". The public board of trustees of the pre-school was a partner of the City Council. As a result, inefficient heat losses were reduced significantly, while comfort inside the kindergarten improved. The Project cost was 190 thousand UAH. It was funded by the Municipal Governance and Sustainable Development Programme of UNDP/Ukraine.

Further development of cooperation of a municipal energy manager with Dolyna district authorities on city buildings, which are in constant use by organizations of district subordination, also contributed to the fact that today all schools, medical and cultural institutions in Dolyna (total - 14 buildings) are covered by the campaign of voluntary certification of building energy performance Display®. At the same time, the corresponding posters-certificates are produced at the expense of the district budget. The Department of Education of Dolyna DSA has moved forward even further by introducing its own system of monthly limits for schools, similar to that operating in the pre-schools in Dolyna. Volodymyr Spodar, head of the department, personally exercises control over their observance.

Meanwhile, during a private visit to Holland, the Mayor of Dolyna noticed how popular bike riding is among urban residents as means of transportation in a country that is far from poor, and how well organized cycling is in cities. In The Hague he met with Robert van Gameren, planning officer of cycling and urban infrastructure. Soon after this event, at the invitation of V. Harazd and with support of the NGO PUM Netherlands Senior Experts, the Dutch expert came to Dolyna, where a working group was waiting for him. This meeting included V. Smoliy, S. Harhat and O. Slavko, Chief architect of the town. During a week of joint work, they analysed the transport network of the town and the local potential of cycling, and prepared a corresponding presentation along with conclusions and recommendations for local councillors and the public. The group received positive feedback and having enlisted support, the working group independently undertook the development of the urban cycling concept. Thus, municipal energy management in Dolyna, which was initially limited to buildings, was applied to transport as well, and a new line of work, sustainable mobility, was opened.

In 2011, after Dolyna's Department of Energy Saving, Investment, and Municipal Development began operating, the following four projects were launched:

- Overhaul of seven apartment buildings. The City Council, in partnership with the Centre for Reforms

<sup>1</sup> The Centre was established in 2007 (the City Council was one of its cofounders) so that the town could benefit also from international aid intended for the institutions of civil society in Ukraine. Today, the Centre for Reforms Support and Development is a Municipal Coordinator of projects of the United Nations Development Programme in Dolyna, and Dolyna is a city-partner of UNDP.



Support and Development, submitted project proposals for 13 buildings, some of which were rejected. It should be noted that five of the selected buildings have Condominiums. In three houses, major repairs to the roofs and the attics cold-proof heat insulation were made; in two buildings the elevators were overhauled and old equipment was replaced with more energy efficient; in one building, a leaky internal water supply network was replaced; and in another building, the basement and underground vault were insulated. The total project cost was approximately 1.3 million UAH. Project funding was based on the results of the competitive allocation of funds under the National Programme on Reforms and Development of Housing and Communal Utilities;

- “Creating a cluster model for heat supply to budget-funded institutions in Dolyna, based on local alternative energy resource - wood chips, in Dolyna rayon children’s hospital”. Within this project, the City Council acted as Dolyna District Council’s partner. The hospital building’s heating system was reconstructed, including the installation of a boiler (running on waste wood); while the production line of logging, grinding and stocking of wood chips was launched in the public utility company “Komunhosp”. This effort significantly reduced gas consumption for hospital heating. The total project cost was 780 thousand UAH, of which 440 thousand UAH were state budget funds allocated under the All-Ukrainian competition of projects and programs of the local government, and 340 thousand UAH were from the city budget;
- «Preparing and conducting Sustainable Energy Days in two selected towns” was a project of the Association “Energy Efficient Cities of Ukraine” in partnership with Dolyna and Artemivsk city councils, aimed at children’s audience. Teachers and students from 7 local schools, the Department of Education of Dolyna DSA, the Centre for Reforms Support and Development (actual headquarter of the ‘Days’), Association of Dolyna Entrepreneurs, a weekly paper of the City Council “Good Deeds”, and a private radio station “Wave of the Mountains” also got actively involved in the project implementation in Dolyna. In late April, in the framework of the Days, they held one-week thematic “energy” sports days, during which the schools competed with each other in the following categories: a model lesson, students’ energy audit of a school buildings, wallpaper, drawing, graffiti, sports all-round, and amateur performances. Local mass media informed Dolyna residents about the Spartakiad; also daily radio programs of children’s workshops “Scrabble” and “Educational program FAQ” regularly presented a menu of interesting facts about energy

saving, energy efficiency, global climate change and environmental protection. On the final day, a capsule with an appeal to future generations was solemnly laid at the foot of the monument to M. Hrushevsky, and then the first town-wide bike ride was set off along the streets, in support of an environmentally friendly vehicle, headed by the Mayor and his colleagues from the City Council. The Sustainable Energy Days concluded with an awards ceremony for winners and participants of the “energy” Spartakiad and gala concert of young talents of Dolyna. The ceremony and concert were held in the municipal House of Technology. The total project cost was 200 thousand UAH. Dolyna’s share of this cost was 63,400 UAH, of which 50,800 UAH was provided by a grant of the Finnish Fund for Local Cooperation (FLC), and 12,600 UAH was Dolyna’s own contribution;

- Replacement of windows and doors by energy-saving ones in the pre-school “Goldfish.” The pre-school “Goldfish”, implemented a scheme similar to that noted above for the pre-school “The Sun”: the local public board of trustees of the pre-school partnered with the City Council. The Project cost was 220 thousand UAH and was funded by the Municipal Governance and Sustainable Development Programme of UNDP/Ukraine.

In April 2011, the employees of the Department of Energy Saving, Investment, and Municipal Development, using the software ECORegion, created a CO<sub>2</sub> emission inventory in Dolyna, and a month later the Sustainable Energy Action Plan (SEAP) of Dolyna for 2011-2020 was developed. After its approval at the City Council session in May, the document was sent to the Brussels office of the Covenant of Mayors. Thus, Dolyna became the second Ukrainian city after Voznesensk, to fulfill the basic obligations of the Covenant signatory. Since then, fundraising has focused on the tasks identified in the SEAP.

The development of the CO<sub>2</sub> emission inventory allowed Dolyna, for the first time, to realistically assess the overall contribution of the town to the global climate change (86992 tons of CO<sub>2</sub> in 2010), and the contribution of individual sectors of the urban economy (Fig. 8). It was found that the largest local pollutant was public transport, not buildings (38% vs. 34%). Such excessive “enthusiasm” for motorization in the small town where the inhabitants, generally, have to travel quite short distances daily, indicated a lack of awareness around the level of their wastefulness, rather than efficiency. Therefore another strategic document that the City Council session approved simultaneously with the SEAP, namely, the Concept of promoting cycling in Dolyna for 2011-2020 appeared just in time.

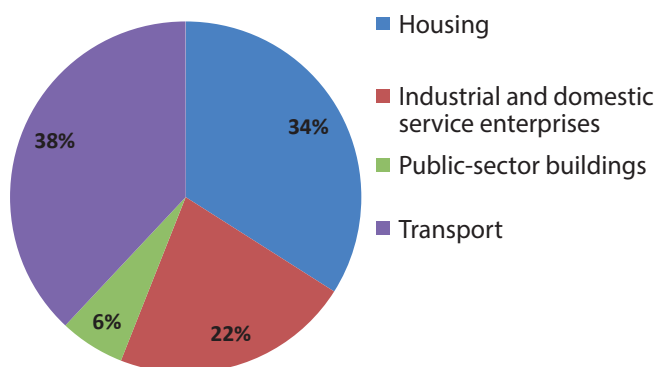


Figure 8. Contribution of certain municipal economy sectors in CO<sub>2</sub> emissions in Dolyna

After the first urban bicycle race during the Sustainable Energy Days, Dolyna amateurs of cycling also did not waste their time: they united and created the Association of Dolyna cyclists “VeloKom”, which soon became an active partner with local authorities in promoting the sustainable mobility policy and in creating the necessary infrastructure for convenient and safe movement of cyclists in the town.

On August 28, during the City Day in Dolyna, a cycling-quest competition was held for the first time, where together with the residents of Dolyna, cycling teams from Bolekhiv, Ivano-Frankivsk, Lviv and Stryi competed in an event of speed, intelligence and agility. In order to get to the destination point as quickly as possible, the participants had to fulfil a series of smartly encoded tasks in the form of puzzles, rebuses, and riddles. At the same time, they had to not only find and communicate with hidden agents, but to also sometimes involve bystanders. The awards ceremony took place on the stage of the Boykos’ Honey Fest. Following the awards ceremony, the Lviv team organized a spectacular demonstration – a performance of extreme cycling tests. The event was organized by the tourist information centre “Boykivshchyna” and the Dolyna City Council. The necessary funds (5 thousand UAH) were provided by private sponsors.

In the following year (2012), three mass cycle races were held in Dolyna:

- in July – for the protection of the Ukrainian language in Ukraine (178 participants),
- in August – dedicated to the 21th anniversary of the Independence – for a symbolic distance, 21 kilometers long,
- in September – dedicated to the City Day, in the framework of the event “A Day with a Bike.”

In autumn the Association of Dolyna cyclists “VeloKom” was created by the local community. The creation of this organization was a logical conclusion of the first organizational step towards recognition of cycling as an equal member of traffic in the town.

In 2012, Dolyna’s projects related to implementation of the policy for sustainable energy development included:

- World Water Day (March 22). The Department of Education of Dolyna DSA partnered with the City Council. During the week preceding the holiday, themed events and educational classes were held in Dolyna schools. All students received souvenirs – special rulers-reminders for water consumers. Drawing competitions were organized for the youngest Dolyna residents in pre-schools, and their participants received gifts. On the City Day, a kids costume parade took place under the slogan “Let’s Save Water for Life” to protect the water resources of the planet. The celebration culminated in a ceremony opening the reconstructed source of drinking water in the city park. Local media provided information in support of the holiday. The event was held as part of the project aimed at restoration and improvement of two urban sources, funded by the trademark “BonAqua” of “Coca-Cola Ukraine” (200 thousand UAH);
- Construction of a bicycle path. The project applicant – the Centre for Reforms Support and Development, a partner – the City Council. With the assistance of the State Automobile Inspectorate, the State Road Service of Ukraine and foreign experts, design estimates were developed, and necessary approvals were obtained. The first bicycle path, 3.35 km long, ran through busy streets of Hrushevsky and Shevchenko, connecting the central part of the town with the park area and the Railway station square. Along the entire route, the roadbed was marked as a bike path and traffic signs were installed, a section of the route in the city public garden was rebuilt and extended, 15 bicycle parking areas were equipped (in particular, near all schools), with the largest being located next to the city Railway Station. The Project cost was 406 thousand UAH, of which 256 thousand UAH came from the city budget, and 150 thousand UAH – from the Municipal Governance and Sustainable Development Programme of UNDP/Ukraine;
- «Energy Days 2012. Environmentally friendly Transport”(16-19 October). The project applicant – the Centre for Reforms Support and Development, partners – the City Council and the Department of Education of Dolyna RSA. Themed events were held in all schools of the town, in particular, the students participated in

competitions of radio advertising and posters in support of urban cycling as the most 'green'. The students met with Robert van Gameren who came from The Hague to Dolyna at the invitation of the Mayor. The culmination of the celebration was the opening ceremony of the newly equipped bicycle path and a mass festive bicycle-parade along the path, which ended with a win-win fun raffle for the participants. The first (in the region) monument of a Bicycle was unveiled. Ruslan Popadynets, a metal artist from Dolyna, hammered it and presented it to the town. The project was implemented with financial support from the Municipal Governance and Sustainable Development Programme of UNDP/Ukraine (12 thousand UAH);

- "Implementation of energy saving measures in budget-funded institutions in Dolyna". The project applicant - Charity Foundation of Dolyna Community; partners included the City and District Councils. The building of the town's museum of local lore "Boykivshchyna" (named after Tetiana and Omelian Antonovych), and a building where the aesthetic education school, art school and young technicians' station are located, were selected for a complex thermomodernization. In the museum, walls were insulated, windows and doors were replaced by ones that were more energy-saving, the heating system was replaced and two gas condensing boilers installed. The lighting system was fully repaired, and simultaneously, the building switched to LED lighting. A ceremony opening the renewed museum took place on October 31. In the second building windows and doors were replaced by ones that were more energy-saving. The total project cost was 1.65 million UAH, of which 1 million 190 thousand UAH (115 thousand Euros) came from a grant of the European Union within the program "Promoting energy efficiency in small cities of Ukraine", 230 thousand UAH - from the city budget, and 230 thousand UAH - from the rayon (district) budget;
- Energy efficient reorganization of the municipal buildings, using the scheme of targeted environmental investments. Projects approved by the State Environmental Investment Agency of Ukraine for 2012 were related to wall insulation and replacement of windows and doors in the buildings of 4 pre-schools, 1 school, a rayon dental clinics and the central rayon hospital (43% of the total area of all public sector buildings in Dolyna). It is expected that as a result of these activities, natural gas consumption in the public sector would decrease by 15%. Total projects cost is 10.5 million UAH from the state budget;
- In late November 2012, another piece of comforting news arrived: Nordic Environment Finance Corpora-

tion NEFCO approved the project concept of energy efficient modernization of pre-schools "Goldfish" and "The Sun", which involves the complete renunciation of gas by transferring heat to the wood waste and installing solar collectors. The project feasibility study, funded by NEFCO, was prepared by the Swedish company Pöyry SwedPower AB based on the results of the energy audit conducted by the specialists of Kyiv energy audit company "FIATU: Finance & Technology." This means that next year Dolyna will get a loan from NEFCO on very favourable terms - for a period of 5 years at 3 percent per annum.

Thus, the activities of the Department of Energy Efficiency, Investment and Municipal Development of Dolyna City Council each year are steadily gaining momentum. Today they encompass energy efficient modernization of the stock of buildings, development of cycling as the most eco friendly type of transport, and awareness of residents, particularly the youngest, with energy-related issues. The respective funding, which began with 35 thousand UAH allocated from the city budget in 2008, in 2012 reached 17 million 700 thousand UAH (Fig. 9). At the same time, public and international special-purpose programmes and grants as well as sponsorship and cash contributions of the residents have become the major source of funds. Receiving the 2012 grant from the European Union is a very prominent fact that reflects both the confidence of investors and the appropriate professional level of the applicant.

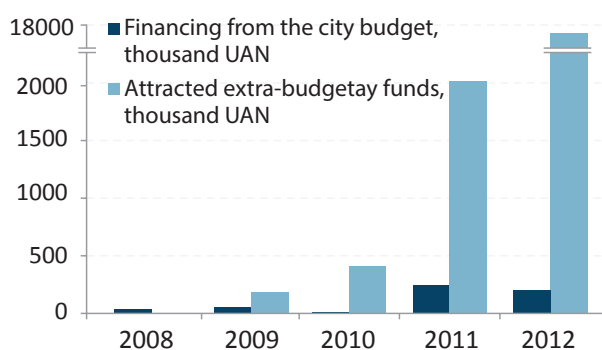


Figure 9. Investments in energy saving measures in the public sector in Dolyna, 2008-2012

**Today Dolyna ranks second in the oblast (region), after Ivano-Frankivsk, by the number of investments in the energy sector. Investors willingly come to Dolyna, as they are sure that their money will not be wasted. Instead, it will be used with the maximum benefit for the needs of local sustainable energy development. So, the prospect of a brighter energy future for the cohesive and hardworking community of this town, under the visionary leadership of its leaders, has every reason to become a reality.**

# **STEPS TOWARDS A SUSTAINABLE ENERGY MANAGEMENT SYSTEM AT TBILISI MUNICIPALITY**



## INTRODUCTION

By signing the Covenant of Mayors, Tbilisi City Hall joined an initiative under which Tbilisi should become a “low carbon city” by 2020 – a goal that will be reached through the support of the social and economic development of the city.

In order to achieve this goal, the Tbilisi City Hall analyzed the municipal energy consumption process and prepared the Sustainable Energy Action Plan for Tbilisi.

Due to high volumes of energy consumed at the Tbilisi municipal area, the most important energy consumer groups and thus energy and CO<sub>2</sub> savings potential have been identified as: transport, buildings, and infrastructure (municipal waste and waste water management treatment, street lighting, electricity and gas distribution networks, and green spaces). A SEAP has been developed to support the optimization of energy consumption in the municipal area. In order to achieve energy savings and reduction of CO<sub>2</sub> emissions, the document envisages implementation of various renewable energy (RE) and energy efficiency (EE) activities and measures in each target sector. Department of Economic Policy of Tbilisi Municipality is considered to be the main coordinator for the implementation of mentioned measures.

The process of development of the SEAP included:

- Development of an overall strategy for the reduction of energy consumption in the capital;
- Development of a Baseline Emissions Inventory (BEI) for Tbilisi
- Development of a sustainable energy action plan with selected energy efficiency measures through 2020
- Acknowledgement of the role of Tbilisi City Hall as the main administrative driving force in carrying out responsibilities addressing all activities related to energy consumption and use of renewable energy in transport, buildings and within municipal infrastructure sectors that cannot be implemented without municipal support;

- Raising public awareness by dissemination of information about the application of energy saving measures.

Realization of SEAP goals and related actions in Tbilisi will accomplish 25% CO<sub>2</sub> emissions reduction by 2020.

## BASIC INFORMATION ABOUT TBILISI

Tbilisi – the capital and the largest city of Georgia, lies on the banks of the Mtkvari River. The city covers an area of 726 km<sup>2</sup> (280 sq mi) with 1,480,000 inhabitants.<sup>1</sup> The growth rate of the population over the past ten years has been 1.1% each year. According to 2005 calculations, the population density in Tbilisi was 2,937 persons per square km. The densest region in the city is the Didube– Chugureti district with 7,855 persons per square km, and the lowest density in the city is in the Isani-Samgori district with 2,323 persons per square km<sup>2</sup>.

### Geography

The geography of Tbilisi is complex located in the South Caucasus at 41° 43' North Latitude and 44° 47' East Longitude. The city lies in Eastern Georgia on both banks of the Mtkvari River. The elevation of the city ranges from 380–770 meters above sea level (1246–1968 ft) and has the shape of an amphitheater surrounded by mountains on three sides. To the north, Tbilisi is bounded by the Saguramo Range, to the east and south-east by the Iori Plain, to the south and west by various endings (sub-ranges) of Trialeti Range<sup>3</sup>.

### Climate

The climate of Tbilisi can be classified as moderately humid subtropical. The city's climate is influenced both by dry (Central Asian/Siberian) air masses from the east and humid subtropical (Atlantic/Black Sea) air masses from the west. Tbilisi experiences relatively cold winters and hot summers. Because the city is bounded on most sides by mountain ranges, the close proximity to large bodies of water (Black and Caspian Seas) and the fact that the Greater Caucasus Mountain Range (further to the north) blocks the intrusion of cold air masses from Russia, Tbilisi has a relatively mild micro-climate compared to other cities that possess a similar continental climate along the same latitudes<sup>4</sup>.

<sup>1</sup> <http://en.wikipedia.org/wiki/Tbilisi>

<sup>2</sup> Sustainable Energy Action Plan City of Tbilisi For 2011- 2020

<sup>3</sup> GEO-Cities Tbilisi: an integrated environment assessment of state and trends for Georgia's capital city – prepared with project of UNEP and OSCE – page 3



### Electric power supply of Tbilisi

Following the breakup of the USSR, the energy sector in Georgia and its capital Tbilisi suffered a catastrophic collapse in the early 1990s. Power, oil and gas import and supply to industries and households dropped dramatically. The district heating system stopped operation and never was renewed. At that time, no customers in Tbilisi had an uninterrupted power supply. The

or near the city as well as from a thermal power station in Gardabani town located 39 km south-east of Tbilisi. Electricity in Tbilisi is distributed by the Joint-Stock Company Telasi. The major shareholder of Telasi is Inter RAOUES JSC of the Russian Federation. This is one of the largest distribution companies in the Georgian energy market. JSC Telasi distributes about 2 billion kilowatt-hours of energy to 416,500 individual, public

Climate data for Tbilisi													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<b>Average high °C (°F)</b>	5.9 (42.6)	7.1 (44.8)	12.2 (54.0)	19.3 (66.7)	23.1 (73.6)	27.5 (81.5)	31.0 (87.8)	30.2 (86.4)	26.1 (79.0)	19.4 (66.9)	12.7 (54.9)	7.8 (46.0)	18.6 (65.5)
<b>Daily mean °C (°F)</b>	1.5 (34.7)	2.4 (36.3)	6.8 (44.2)	13.0 (55.4)	17.0 (62.6)	21.1 (70.0)	24.5 (76.1)	23.7 (74.7)	19.8 (67.6)	13.6 (56.5)	7.8 (46.0)	3.4 (38.1)	12.9 (55.2)
<b>Average low °C (°F)</b>	−1.5 (29.3)	−0.8 (30.6)	3.0 (37.4)	8.1 (46.6)	12.1 (53.8)	16.0 (60.8)	19.4 (66.9)	18.6 (65.5)	15.0 (59.0)	9.4 (48.9)	4.5 (40.1)	0.5 (32.9)	8.7 (47.7)
<b>Precipitation mm (inches)</b>	20 (0.79)	29 (1.14)	31 (1.22)	51 (2.01)	84 (3.31)	84 (3.31)	41 (1.61)	43 (1.69)	35 (1.38)	41 (1.61)	35 (1.38)	23 (0.91)	517 (20.35)
<b>Avg. precipitation days (≥ 1 mm)</b>	4.0	4.6	5.9	7.6	9.7	8.7	5.7	5.7	5.0	5.6	4.4	4.0	70.9
<b>Mean monthly sunshine hours</b>	99.2	104.4	142.6	171.0	213.9	249.0	257.3	248.0	207.0	164.3	102.0	93.0	2,051.7

Table 1: Monthly average climate indices for the City of Tbilisi

(Sources: Pogoda.ru.net, Hong-Kong Observatory for data of average precipitation days and sunshine hours)

capital had scheduled power supply, with daily black-outs, and in winter periods some areas on the city had no power for a number of days. Power sector assets were dilapidated and theft of electricity and corruption were rampant. Due to a lack of financial discipline in the sector, only a fraction of fees paid by customers were collected, resulting in a massive debt accumulation by sector companies, making them unable to import needed power for the country from neighboring countries' systems, which in turn led to more power shortages. Following the 2003 (Rose Revolution), with support from the International Development Association (IDA) in the Electricity Market Support Project, the government transformed the power sector into a financially viable, modernized, and functioning sector. For the last few years, this sector has delivered 24-hour uninterrupted power supply to its customers including households, the public sector, industry, transport and commercial entities. Households are the major power consumers in Tbilisi. The Tbilisi subway is the largest single consumer of electricity. Tbilisi receives electricity from a number of hydropower stations, located in

and commercial customers per year. Even though the power distribution network has been improving in the last few years, it remains in a poor state after its deterioration in the 1990s. At present, technical and commercial losses in the distribution network of JSC Telasi amount to 17-20%.<sup>5</sup>

### Natural gas supply and heating of Tbilisi

Most of Tbilisi is supplied by natural gas. Natural gas has been used for heating and cooking in households, as well as for heating commercial and public buildings. It has also been used by industrial and commercial enterprises as a fuel. In Tbilisi natural gas is distributed by the Ltd "Kaztransgas Tbilisi".

Natural gas consumption in Tbilisi was more than 2.05 billion m<sup>3</sup> in 1989. Gas import and consumption dropped dramatically in the 1990s. The natural gas supply has improved in recent years. Currently annual consumption is about 500 million cubic meters. There is a trend of increasing gas consumption in the city. The major consumer is the household sec-

<sup>4</sup> <http://en.wikipedia.org/wiki/Tbilisi#Climate>

<sup>5</sup> GEO-Cities Tbilisi: an integrated environment assessment of state and trends for Georgia's capital city – prepared with project of UNEP and OSCE.

Economic Sectors	2006	2007	2008
Agriculture, forestry, fishery	1.4	1.0	1.0
Industry	734.8	741.6	757.2
Processing of products by households	43.3	65.5	65.6
Construction	635.9	784.2	643.3
Trade, repair of motor vehicles and household goods	1,498.2	1,636.2	2,204.4
Transport and Communication	1206.7	1333.8	1392.5
State management, defense and law enforcement	386.8	837.3	1,019.1
Education	157.0	151.7	167.9
Public health and social assistance	200.4	270.3	351.4
Other Services	789.5	1187.9	1311.2
TOTAL value added	5653.9	7009.5	7913.6

Table 2: Gross value added of Tbilisi (at current prices, mln. GEL)  
(Source: National Statistics Office of Georgia-<http://www.geostat.ge>)

tor. The central heating system in Tbilisi collapsed in the 1990s due to the shortage of fuel and lack of maintenance on the distribution network in the city. There is no central heating system in Tbilisi at present. Households usually use individual gas and electric heaters.<sup>6</sup>

### Water Supply of Tbilisi

The withdrawal, purification and transportation of drinking water to a customer, as well as treatment of waste- and storm waters in the capital region and surroundings is carried out by the 'Georgian Water and Power' (GWP), a private company and legal successor of the formerly state-owned company Tbilisi Water, also known in Soviet times as the 'Tbil-Tskal-Kanal'. Currently, GWP is a leading company in the water supply market of Georgia and provides high-quality service to the municipality of Tbilisi, as well as greater Tbilisi (neighboring districts), state institutions, and the industrial and commercial sectors. The company delivers 21m<sup>3</sup>/sec of high quality drinking water without significant interruptions 24 hours a day. It serves about 400,000 customers, from which around 2000 are public and state organizations, about 15,000 are commercial enterprises and the rest are in the residential sector.<sup>7</sup>

### Tbilisi as an industrial, social and cultural centre

Tbilisi is a significant industrial, social and cultural centre not only in Georgia, but in Eastern Europe and the Caucasus region. Situated along the route of the historical Silk Road, Tbilisi still holds a strategic location at the crossroads of Russia, Turkey, Armenia and Azerbaijan, Europe and Asia, and the Islamic and Christian worlds. Georgia is now emerging as one of the most important transit countries for the flow of global energy, information and trade.<sup>8</sup>

Tbilisi is governed by the Tbilisi Assembly (Sakrebulo) and the Tbilisi City Hall (Meria). The City Assembly is elected once every four years. The mayor is elected by the City Assembly.

The greatest share of economic development in Georgia is related to economic activities in Tbilisi. Tbilisi is the centre of economic, commercial, and financial activity in Georgia. About 50% of Georgian companies function in the capital city. Industry, construction, trade, transport and telecommunications are the economic foundation of Tbilisi. More than half of the value of products and services in Tbilisi are produced in these sectors.

<sup>6</sup> GEO-Cities Tbilisi: an integrated environment assessment of state and trends for Georgia's capital city – prepared with project of UNEP and OSCE

<sup>7</sup> GEO-Cities Tbilisi: an integrated environment assessment of state and trends for Georgia's capital city – prepared with project of UNEP and OSCE.

<sup>8</sup> GEO-Cities Tbilisi: an integrated environment assessment of state and trends for Georgia's capital city – prepared with project of UNEP and OSCE.

	2005	2006	2007	2008	2009
GDP at current prices, mln GEL	11620.9	13789.9	16993.8	19074.9	17986.0
GDP at constant 2003 prices, mln GEL	9935.6	10868.0	12208.8	12491.4	12019.7
GDP real growth, %	109.6	109.4	112.3	102.3	96.2
GDP deflator, %	107.9	108.5	109.7	109.7	98.0
GDP per capita (at current prices), GEL	2689.1	3133.1	3866.9	4352.9	4101.3
GDP per capita (at current prices), USD	1483.5	1763.5	2314.6	2921.1	2455.2
GDP at current prices, mil. USD	6411.0	7761.7	10171.9	12800.5	10767.1
USD/GEL (period average)		1.78	1.67	1.49	1.67

Table 3: GDP in Georgia (2005-09)

(Source: National Statistics Office of Georgia – <http://www.geostat.ge>)

As the economic sector developed, environmental challenges (increase of CO<sub>2</sub> emissions) emerged thus making environmental policy the issue of the day. For Tbilisi Municipality the main stimulation in actualizing environmental policy was the joining the Covenant Mayors in 2010, thus emphasizing the CO<sub>2</sub> reduction through the development of renewable energy and energy efficiency technologies, growing the green cover areas in Tbilisi, and improving performance of high energy consumption sectors as the main source of carbon emissions.

With the consideration of everything mentioned above, Tbilisi City is characterized as one of the greatest users of produced and imported energy. According to the Baseline Emission Inventory (BEI) prepared within the framework of 'Tbilisi SEAP' the three main energy sectors for which the carbon emissions' share is at the most high have been revealed. These sectors are: transport, buildings, and infrastructure (municipal waste and waste water management treatment, street lighting, electricity and gas distribution networks, and green spaces. The impact of the current environmental situation on the social-economic development of the municipality and citizen's health is not desirable.

### Transport Sector

According to the BEI of 2011, the major source of GHG emissions in Tbilisi is the local transport sector. Emissions

caused by auto transport depend on type, average age, technical fitness of transport, type and quality of fuel, mobility management, conditions of road network and natural ventilation (general micro-relief of town, characteristics of its development, meteorological parameters, and seasonality), working regime of engines and other factors.

According to 2010 data, there are an average of 325 000 operational automobiles in Tbilisi (all types); this constitutes 41% of the vehicle fleet existing in the country. The total length of roads and motorways of Tbilisi is 1200 km. The flow capacity of main and secondary roads of Tbilisi is 1500 cars per hour. It should be noted that the majority of automobiles in Tbilisi are old and poorly maintained, which increases transport-induced emissions.<sup>9</sup>

According to the Second National Communication of Georgia to UNFCCC, the CO<sub>2</sub> emissions from the transport subsector in 2000 amounted to 1,111.9 Gg, accounting for 35.0% of CO<sub>2</sub> emissions from the energy sector, 30% of total CO<sub>2</sub> emissions, and 10.1% of national GHG emissions. The major source of CO<sub>2</sub> emissions in this subsector was road transport, which emitted 1,052.9 Gg CO<sub>2</sub>, accounting for 94.7% of CO<sub>2</sub> emissions from the transport subsector in 2000.<sup>10</sup>

So, during the development of Tbilisi's SEAP, solutions of mentioned problems in the mid-term strategy

<sup>9</sup> GEO-Cities Tbilisi: an integrated environment assessment of state and trends for Georgia's capital city – prepared with project of UNEP and OSCE – pages 37-38;

<sup>10</sup> Sustainable Energy Action Plan City of Tbilisi For 2011- 2020 – page 9;

(2012-2018) were identified; they include an increase of the share of public transportation among a total passenger turnover. Special attention will be paid to the development of an electric transport network since the energy intensity of electric transport (such as tram and subway) per passenger/per kilometer is much lower than other modes of public transport. Also, it is envisaged that in the future the emission factor of electricity will significantly decrease due to a national government plan to increase hydropower generation share in the electricity generation sector. A long-term strategy (2018-2020) focusing on the transport sector aims to decrease the mobility of private cars and encourage low emission cars by means of various restrictions and incentives (it is implied, that this will happen by the time the public transport and street infrastructure is well developed and can meet society's need in terms of speed, convenience and accessibility).

### Building sector

In general the building sector of Tbilisi City in respect to energy efficiency and GHG emissions is very sensitive. It is result of number of factors: absence of the central heating in the buildings, the form of ownership of buildings, absence and/or incomplete construction industry legal framework/legislation.

The second largest emitter of carbon emissions according to the Tbilisi SEAP is the building sector. In considering the building sector in Tbilisi, it is essential to differentiate the types of buildings according to the constriction (before and after soviet period), functionality and ownership (municipality/state, co-operative and private).

During the soviet period, building construction was implemented under soviet building norms and standards at which time when, due to artificially low price on energy resources along with neglected environmental issues, energy efficiency was not considered. So, the buildings constructed in the soviet epoch are one of the highest emitters of GHG emissions. Following the soviet era, construction has been one of the most rapidly growing economic sectors of Tbilisi in last 10-15 years and the Tbilisi municipal authority promotes development of this sector. It has provided favorable investment conditions and streamlined construction permit issuing procedures<sup>11</sup>. Despite Tbilisi's 10-15 year growth trend, energy saving materials have not been utilized in construction processes.

This situation could be due to the absence of relevant building legislation.

Tbilisi is an old city with a huge central historical area designated as the "Old Tbilisi District". Buildings there are generally up to three stories high and made of brick. So, in term of energy efficiency and GHG emissions these buildings will be considered separately. The "Old Tbilisi District" consists primarily of pre-1917 buildings, which may account for about 10-12% of all the residential building stock of Tbilisi. An examination of the old city residential building stock from the standpoint of the buildings' compactness shows that they are usually well designed and do not have a high ratio of envelope surface area to its volume, thus from this perspective they aren't characterized by excessive heat losses. One of the way heat losses could be considered the single-glazed wooden framed windows.

According to the SEAP for Tbilisi the plan (within the short-term strategy (2011-2015) is to increase the efficiency of heating systems and the share of renewable energy in the heating (geothermal energy, biomass and solar energy) sub-sector within the municipal building stock (kindergartens, policlinics).

The mid-term strategy (2014-2017) is to apply the same measures to public buildings that are not under administration of the Tbilisi Municipality (schools, state agencies, etc.); while in the long-term strategy (2015-2020) energy efficiency will be increased, and the share of renewable energy in heating (mostly geothermal heating) will grow in the residential building stock. Other energy efficiency actions will be carried out as well.<sup>12</sup>

### Municipal sector

Municipal sectors (municipal waste and waste water management treatment, street lighting, electricity and gas distribution networks, and green spaces) are also considered one of the major source of GHG emissions (CH<sub>4</sub> emission). This has been predetermined by the absence of relevant waste management legislation. In general municipal waste was disposed of on the territories on which even the basic principles of landfill management were not practiced. At the same time some recent changes are being noticed in terms of waste management.

Since 2006-2007, the management of municipal waste in Tbilisi has improved considerably. In 2006,

<sup>11</sup> GEO-Cities Tbilisi: an integrated environment assessment of state and trends for Georgia's capital city – prepared with project of UNEP and OSCE – pages 26

<sup>12</sup> Sustainable Energy Action Plan City of Tbilisi For 2011- 2020 – page 7:

a Municipal Cleaning Department was created and the main functions of this Department have been defined as follows:

- Cleaning-up activities in the city;
- Waste generation avoidance and waste separation, recycling, and reuse;
- Waste collection, treatment process, and its disposal;
- Landfill management;
- Elaboration of rules for the regulation of waste management and cleaning;
- Control of the fulfillment of rules stated by the legislation in the field of waste management and cleaning.

It should be mentioned that there is no special law on waste management that would regulate the sector on a national level. The following main legal acts are referred to and applied for regulation: the Georgian Law on Environmental Protection (1997) and the Georgian Law on Healthcare (1997). On a local level, according to the Georgian Organic Law on Local Self Government (2006), the planning and implementation of collection and disposal of household wastes is the responsibility of local-government entities. However, legislation does not require municipalities to develop municipal waste management plans or clarify the legal status of these plans if they are developed<sup>13</sup>. In addition in 2010 was closed one of the landfill and opened new rather modern.

Ltd “Kaztransgas Tbilisi” is a supplier and distributor of natural gas throughout Tbilisi. The natural gas distribution network could be considered as one of source of GHG emissions as well. The total length of the distribution network is 2450 km., part of which is underground. Most of the underground pipes have been seriously degraded due to corrosion and poor maintenance. According to the data provided by the distribution company, the losses due to gas leakages are in the range of 20-25%. The Kaztransgaz Company has periodically been implementing a program of replacement of old metal pipes with new plastic pipes.

The company has been implementing a program of daily monitoring of leakages and their elimination<sup>14</sup> and in order to decrease CH<sub>4</sub> emissions “LTD Kaztransgaz Tbilisi” has developed a CDM project that is registered at UNFCCC <http://cdm.unfccc.int/Projects/DB/SGS-UKL1234786138.56/view>.

The general situation of green spaces is very problematic in the city especially when compared with the amount of green space found historically in the soviet period. The total area covered by parks, public gardens and greenery zones in Tbilisi is very small compared to the built up-area and population living in the city. According to normative acts<sup>15</sup> designed in Soviet times and still in effect, the required green area per inhabitant in a city with a population of more than 0.5 million should not be less than 15 sq. m. In case of Tbilisi, this number never has been greater than 13.0 m<sup>2</sup> (in 1983). Unfortunately, an updated figure for this indicator does not exist. However, according to the latest City Master Plan, in 2001 this number was closer to a much lower value of 5.6 m<sup>2</sup> per city dweller. Such a critical decrease could have been caused by the acute energy crisis in Georgia in the mid-1990s, when city authorities were unable to control massive tree cutting by local residents for heating and cooking. By the end of the 1990s and beginning of the 2000s, green areas again underwent extreme pressure of an unregulated and chaotic construction boom, turning parks and public gardens into building lots<sup>16</sup>.

## FIRST ATTEMPTS AND ACHIEVEMENTS

Of course, all of these problems had an effect on the energy sector in terms of energy efficiency and savings and/or security. Unfortunately significant and basic alterations have not occurred for many years, though in this regard some positive changes have taken place in Georgia, Tbilisi, in particular. In 2007 Tbilisi municipality council approved a concept of “Municipal Energy Efficiency Planning” (MEEP) covering energy efficiency aspects of municipal buildings developed by the union “Energy Efficiency Center Georgia” (EECG) and Energy Saving International (ENSI) – Norwegian energy efficiency and energy business development consulting company with financial support of the Norwegian Government. It should be mentioned that Tbilisi has not implemented the MEEP. Along with the development of MEEP

<sup>13</sup> Sustainable Energy Action Plan City of Tbilisi For 2011- 2020 – page 105

<sup>14</sup> GEO-Cities Tbilisi: an integrated environment assessment of state and trends for Georgia’s capital city – prepared with project of UNEP and OSCE – pages 37-38

<sup>15</sup> A normative act is a document issued by competent body for establishing, amending, or abolishing a rule of law.

<sup>16</sup> GEO-Cities Tbilisi: an integrated environment assessment of state and trends for Georgia’s capital city – prepared with project of UNEP and OSCE – pages 73



project, ENSI and EECG has provided trainings to key municipal key in overall energy management and has developed a municipal building database with the purpose of monitoring and reducing energy consumption in the municipally-owned buildings and towards planning future energy saving actions.

The initial excitement and interest around active and introduction and involvement in a common municipal energy policy began with the project: "Management of Domains Related to Energy in Local Authorities (MODEL)". The leader of MODEL project is the Lviv City Council (Ukraine) and the coordinator is the Association of European Municipalities "Energy Cities".

The project noted above began in 2010 with the financial support of the European program CIUDAD of which 6 pilot cities (include Lviv, Kamyanets-Podilskyi, Drochia, Spitalak) participate, as well as non-governmental organizations of various countries including Georgia. The primary aim of the project is to become models in energy management for their citizens and other municipalities in the region through appointment of municipal energy managers; organization of energy units within their administration; the development of local energy action plans and energy information systems; getting the financing for concrete investments; and improvement of their communication of energy issues with their citizens.

Tbilisi City Hall and NGO "Energy Efficiency Center Georgia" are involved in the project on the Georgia side. The project participants have been trained in Municipal Energy Planning and an Economic Policy Department has been created with an energy unit/team consisting of staff of 1-2 people that are combining energy manager's position. The result is that the energy unit/team is not an independent unit within the municipality.

Within project the unit/team periodically collects monthly energy data (electricity, natural gas and water consumption) from municipal buildings through ENSI Profitability Software program. The buildings that were identified as using over-norm amounts of energy have been analyzed and are implementing relevant energy efficient measures. At present, based on information collected there have been #155 kindergartens selected to carry out relevant energy efficient and renewable energy measures with assistance from foreign donor organizations (USAID, Winrock International).

Also, within the project MODEL, EECG with partnership of Tbilisi City Hall implemented the "Display" Campaign

for municipal buildings (10 kindergartens). About ten kindergartens have identified and managed their energy and water consumption and CO<sub>2</sub> emissions. The continuation of the Display campaign is planned for all kindergartens of Tbilisi within the project.

## IMPLEMENTATION & RESULTS

At the present time the existing municipal energy management system mechanism at Tbilisi Municipality doesn't meet a common contextual meaning (doesn't provide for the collection and creation of database, analysis and assessments of data base, methods of analysis and evaluation of the available information, determination of information sources and all other steps related to municipal energy management) that would allow the City to establish, develop and implement an integrated municipal energy management system useful for carrying out relevant energy efficiency measures. As of yet, an enhanced municipal energy management system at Tbilisi municipality has not yet (with the absence of central heating system and insufficient amount of municipal buildings (kindergartens, sport centers, some polyclinics)) become economically viable.

Although according to information provided by the Economic Policy Department of Tbilisi Municipality, the city is considering the establishment of a new more modernized department and/or agency of municipal energy management. Presumably the obligations identified in the CoM are the major stimulating factor of this the new effort.

At the same time that the Tbilisi Municipality signed the CoM, Tbilisi Economic Policy Department actively began the process of SEAP development and the energy unit/team (staff) created within MODEL-CIUDAD project took part in the development of the Covenant of Mayors Sustainable Energy Action Plan (SEAP). The team members met different experts to identify the major actions that will be included in the SEAP.

In the process of SEAP development working groups consisting of various stakeholders (representatives of international, governmental and non-governmental organizations, independent experts and educational/research institutions) played a very active role. The initiator and facilitator of SEAP development for Tbilisi City was the German International Cooperation Agency – GIZ.

The SEAP developed for Tbilisi City includes a Baseline CO<sub>2</sub> emission inventory and a CO<sub>2</sub> reduction target. The overall CO<sub>2</sub> reduction target of the CoM Signato-

ries is a 20% reduction by 2020 achieved through the implementation of the SEAP for those areas of activity relevant to the local authority's mandate.

When considering Tbilisi's SEAP, it is essential to note that the selected scenario of baseline emission inventory differs from that used in other SEAPs. For Tbilisi the so called "business as usual" (BAU) scenario was selected and anticipated changes in the consumption of energy were taken into account. The Reference Scenario identified possible development trends diverging with the initial state in case there is no energy program implemented.

The Baseline Emission Inventory (BEI) quantifies the amount of CO<sub>2</sub> emitted due to energy consumption in the territory of Tbilisi (Covenant Signatory) in the baseline period of 2000-2009. The Reference Scenario assesses the GHG trends for the period of 2010-2020 and allows for the quantification of the overall CO<sub>2</sub> reduction effort to be accomplished by signatories to meet their commitment under the Covenant of Mayors. The Reference Scenario and subsequent Monitoring Emissions Inventories (MEI) allow for the identification of the principal anthropogenic sources of CO<sub>2</sub> emissions and prioritization of the reduction measures accordingly.

Tbilisi Municipality requested USAID assistance in the development of the SEAP. USAID/NATEL program in cooperation with the NGO "Sustainable Development Center REMISIA" and the NGO "Sustainable Development and Policy Centre" (SDAP) and a SEAP for Tbilisi was developed. NGO REMISIA commenced work on the creation of a Baseline Emission Inventory for Tbilisi, including baseline and reference scenarios and the development of the SEAP.

It should be noted that a methodology has been prepared for SEAP implementation intended for cities not included in Annex 1 of the Kyoto Protocol (i.e. the countries that do not have obligation of CO<sub>2</sub> reduction). This provides a unique opportunity for Tbilisi to serve as a model city in the region.

Thus, if the actions proposed in the SEAP are implemented by 2020, the overall CO<sub>2</sub> emissions in Tbilisi can be potentially reduced by 24%. In addition, the number of natural sources of CO<sub>2</sub> emission absorption, such as forest areas surrounding the capital and parks within the city, will increase and be further developed. In conjunction with the Covenant of Mayors,

Tbilisi City Hall aspires to make Tbilisi the "Green Capital" of the South Caucasus<sup>17</sup>.

In 2011 the developed SEAP for Tbilisi was submitted to the Joint Research Centre (JRC) (the group within the European Commission responsible for providing technical and scientific support to the CoM initiative). The submitted SEAP was approved officially on 25 November 2011 by the European Commission and adopted as a guidance document for the city. The finalized SEAP includes the implementation of RE and EE measures in the period 2011-2020 which results in a CO<sub>2</sub> reduction by 25%. (Table 3: BAU and CO<sub>2</sub> emission reduction scenarios for Sustainable Development Action Plan of Tbilisi)<sup>18</sup>.



Table 4: BAU and CO<sub>2</sub> emission reduction scenarios for Sustainable Development Action Plan of Tbilisi

Tbilisi Municipality has already begun implementing activities envisaged in the Action Plan. So far, the Mayor's office has been focusing on the transport and municipal infrastructure sectors by developing road infrastructure, renovating public transport, and introducing modern cable lines, smart traffic lights, and energy-efficient outdoor lighting.

Energy saving and energy efficiency modifications in the building sector included replacement of incandescent bulbs with energy efficient bulbs and/or installation of touch lighting system in common places of buildings.

At present it is too early to speak about the results of the already implemented measures in terms of CO<sub>2</sub> reduction as the official assessment will be presented by Tbilisi the second year following SEAP submission. However some rough calculations have been developed in conjunction with implementation efforts and the ongoing measures and CO<sub>2</sub> reduction preliminary

<sup>17</sup> <http://winrock.ge/en/projects/previous/nateli/energy-efficiency>

<sup>18</sup> <http://economicforum.ge/history/2012/Day%202/Mr.%20Mamuka%20Salukvadze.pdf>

quantitative indexes appear as follows (and as identified in the chart below): Renovation of Municipal Fleet – 1 thousand t/year; Optimization of Bus' Fleet – 15 thousand t/year; Operation of Traffic Lights Control/Management System – 5 thousand t/year; Development of road infrastructure – 0.5 thousand t/year; installation of fluorescence bulbs in common spaces of residential buildings – 11.7 thousand t/year; Improvement of Public Transport Service – about 30 thousand t/year; Development of Electric Tram System– 30 thousand t/year. The two last measures presented in the chart need to be considered in conjunction with other measures, the results of which have not yet been obtained, but future prospects should be considered.<sup>19</sup>

Tbilisi Municipality was also a very active participant in the commemoration of Sustainable Energy Days, Sustainable Energy Week and Intelligent Energy Days initiated and organized by the union “Energy Efficiency Centre Georgia” (EECG) in Georgia.

In addition, CoM initiative combined with Tbilisi's experience in the CoM process has become an inspiration for other Georgian cities and municipalities. As a result, Georgian self-governing cities: Rustavi, Kutaisi Batumi and Gori very soon – has become signatory



Table 5. Implemented and ongoing measures by Tbilisi and quantitative indicator of CO<sub>2</sub> reduction

cities of CoM. Tbilisi City Hall is also involved in other international programs and projects such as Covenant of Mayors – Going to East which envisages various activities which also work towards the reduction of CO<sub>2</sub> emissions.



<sup>19</sup> <http://economicforum.ge/history/2012/Day%202/Mr.%20Mamuka%20Salukvadze.pdf>