

The use of Electricity for Heating

October 2015

The impact of
cogeneration on
energy consumption



ABBREVIATIONS

DH	→	District Heating
EC	→	European Commission
ET	→	Energy Treaty
ERO	→	Energy Regulatory Office
EU	→	European Union
KAS	→	Kosovo Agency of Statistics
KEDS	→	Kosovo Electricity Distribution and Supply Company
ktoe	→	Kilotonne of oil equivalent
KfW	→	KfW Development Bank
MW_{th}	→	Mega Wat Thermal Energy
WB	→	World Bank

Executive Summary

The Government of Kosovo and Municipality of Prishtina, assisted by international donors, at the end of 2014, managed to put into operation the cogeneration project – or the connection of “Kosova B” thermal power plant to the Termokos, Prishtina’s District Heating company.

This investment of 37 million Euros gave immediate positive results and is one of the most successful capital investments in the recent years.

Termokos has a network comprised of approximately 12 thousand customers. For many years, the district heating was not operational due to major problems in management, heavy fuel oil supply, damages to the network, and non-payment of bills by the customers. The use of the “Kosova B” steam to heat the residential spaces of customers of Termokos resulted in an immediate resolution of numerous problems of this enterprise.

GAP Institute has analyzed the impact of cogeneration on the electricity consumption in Prishtina. For this purpose, GAP conducted 350 surveys with customers of Termokos, comparing the two last winter seasons: the pre-cogeneration season (December 2013 – January 2014) and cogeneration season (December 2014 – January 2015). The findings of the study, among others, indicate that the electricity consumption has decreased by 34%, the collection increased by 176%, and the dissatisfaction of customers towards the Heat quality within a year decreased from 94% to 8%.

Considering these encouraging data related to the decrease of the electricity consumption, GAP Institute recommends bigger investments in the expansion of the Termokos network, putting into operation the existing heating plants in other cities of Kosovo, and finding opportunities for construction of new heating plants.

Such investments, despite having a direct impact on increasing the quality of the lives of the citizens, would also influence the decrease of the electricity demand.

1. Introduction

One of the major problems since the end of the war is the irregular electricity supply, both in the household and the industrial sector. The problems with the electricity originate from the insufficient generation of electricity and the low efficiency by the end customers.

According to the latest data of the Kosovo Agency of Statistics (KAS), in 2014, out of 402.09 ktoe of consumed energy, 58% was consumed by the household sector while the rest (27%) by the industry sector and services (15%)¹.

Due to the lack of an adequate public heating system, a large part of the electricity is used for heating the residential and business premises. The use of electricity for heating during the winter season causes the electricity consumption to double during the coldest months of winter compared to the summer months. In addition, the energy used for heating together with the winter electricity tariffs, influences the increase of the price of electricity bills.

Prishtina is the city with the highest level of electricity consumption in the country². Furthermore, due to the poor-quality insulation of residential premises, the largest part of this consumption is used for heating. Alternative heating options such as wood, coal, and natural gas are more limited in Prishtina than in other cities. As a result, regardless of the high price, electricity is still the main source of heating of residential and business premises.

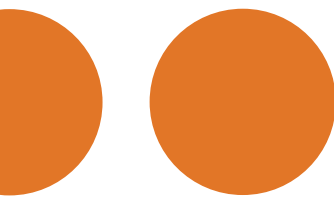
One way to lower the consumption of electricity for heating purposes in urban areas is to use a district heating systems which, because of the economies of scale, is able to deliver a quality heating source at a more affordable cost.

However, in Prishtina, the DH Termokos covers only 5% of the heating demand, or 12,000 customers with approximately 1.1 million m².³ Over the last years, the problems with heating supply have been very serious because this company operated with heavy fuel oil, the price of which

¹ Kosovo Agency of Statistics. Annual Energy Balance in the Republic of Kosovo 2014. pg.11.

² Energy Regulatory Office (ERO) - Annual Report 2014. pg. 47.
Source: <http://bit.ly/1CUGICA> (last opened on 22 July 2015).

³ "Termokos" District Heating Company- Information about the Cogeneration Project. Source <http://bit.ly/1HQMKRE> (last opened on 22 July 2015).



increased continuously and did not enable Termokos to provide heat throughout the entire winter season⁴. In order to fulfill the need for heating, the customers of Termokos used electricity, thus further increasing the total demand for electricity.

Moreover, the heating plant network was inefficient, thus contributing to great thermal losses. This damaged not only the socio-economic aspect of citizens but it was also contradictory to international agreements. Kosovo, as a signatory of the Energy Community Treaty (ECT) and an aspirant country for integration to the European Union (EU), is obliged to comply with the EU directives, namely the Directive 2004/8/EC on the proportion of cogeneration system and Directive 2006/32/EC on reaching energy end-use efficiency of 9% until 2016⁵.

Due to the aforementioned reasons, in 2010, the EU assisted Kosovo by initiating a feasibility study for the establishment of the cogeneration system, which uses the steam produced by “Kosova B” thermal power plant for the needs of Termokos⁶. This project was commissioned in October 2014.

In this study, GAP Institute analyzed the impact of cogeneration on the electricity consumption in Prishtina. For this purpose, GAP conducted a survey of 350 questionnaires with the customers of “Termokos”, comparing the two last winter seasons: the pre-cogeneration season (December 2013 – January 2014) and cogeneration season (December 2014 – January 2015).⁷

2. Functioning of the Central Heating Plants

In Kosovo, there are four district heating enterprises located in Prishtina, Gjakova, Mitrovica, and Zveçan, which have a total installed capacity of

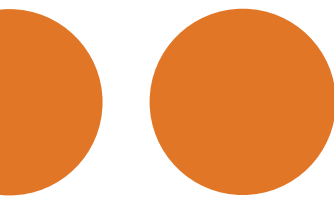
⁴ Energy Regulatory Office (ERO) - Annual Report 2014. Pg. 72.

Source: <http://bit.ly/1CUGICA> (last opened on 22 July 2015)

⁵ “Energy End-Use Efficiency and Energy Services - Directive 2006/32/EC of the European Parliament.” Source: <http://bit.ly/1efWFaZ> (last opened on 17 July 2015)

⁶ COWI & IPF Consortium, “Cogeneration Feasibility Study 2010-2011.”

⁷ This sample was distributed in Dardania, Ulpiana, Sunny Hill and buildings at the center of Prishtina, these being neighborhoods where Termokos operates. The study is also based on secondary sources, analysis of experts in the energy field, and managers of cogeneration project, interviews with relevant stakeholders, and the data for the energy consumption, provided by KEDS.



262 MW and cover approximately 5% of the demand.⁸ These enterprises were established mainly during 1970s and 1980s.

Nevertheless, low level of investment in these enterprises has significantly deteriorated their financial situation. Over time, such financial difficulties deepened even more due to the enterprises' dependence on import of heavy fuel oil, increasingly high levels of water losses during the heating supply, and low level of collection. These problems have continuously accompanied the district heating systems in Kosovo and have made it impossible for these enterprises to provide quality heating to citizens.

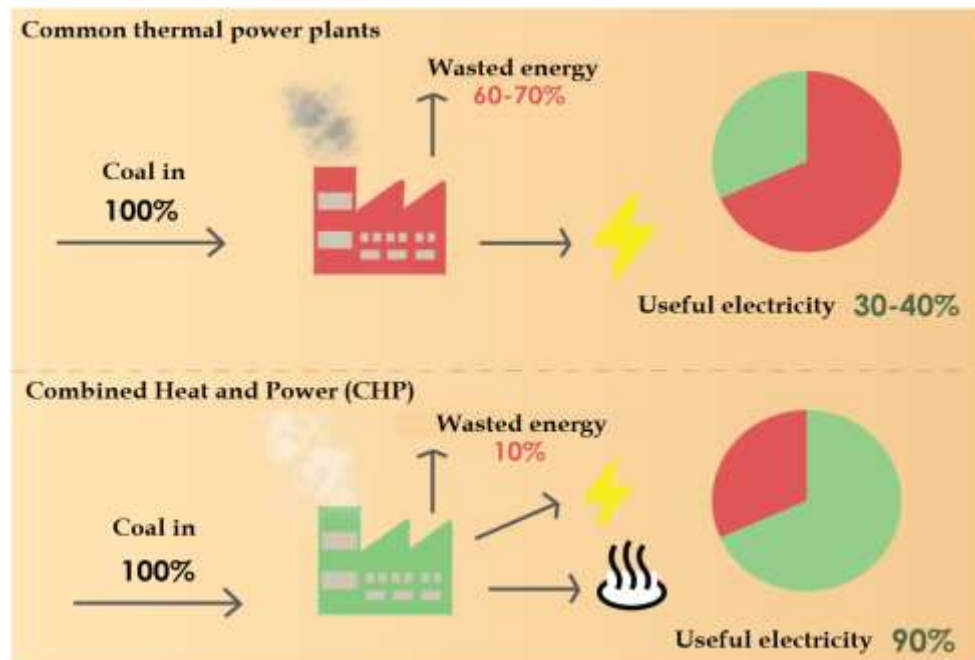
The use of electricity for heating has a very low efficiency and during the winter, it loads the energy system of Kosovo, thus causing frequent blackouts and resulting in the imports of electricity. Under these circumstances, putting district heating plants into operation is essentially important for achieving the energy efficiency targets. In addition, considering the low level of electricity generation and continuous increase of demand, the use of district heating system is the best option for meeting such demands and achieving the EU objectives pertaining to the reduction of the pollution and increasing efficiency.

An important step towards the development and modernization of the district heating plants was taken in 2014 in Prishtina, by constructing the cogeneration system.

As Figure 1 shows, before the construction of this system, in common thermal power plants, an average of 60-70% of thermal energy is lost; however, after the construction of the cogeneration system, only 10% of the energy is lost and the rest may be used for heating.

⁸ Energy Regulatory Office. Annual Report 2014. Pg. 69.
Source: <http://bit.ly/1CUGICA> (last opened on 22 July 2015).

Figure 1: Energy loss in thermal power plants



Source: <http://bit.ly/1CPsB1P>⁹

For constructing the cogeneration system, a total of 37 million and 325 thousand Euros were allocated¹⁰. These funds were provided by the European Commission (13.8 million Euros), Municipality of Prishtina (3.8 million Euros), German Development Bank – KfW (15 million Euros), Government of Kosovo (1.2 million Euros), Government of Sweden (2 million Euros), and Government of Luxembourg (1.5 million Euros). Out of these funds, 32 million and 325 thousand Euros are grants, whereas 5 million Euros are in the form of loan from KfW.

These funds have been used to modernize the depreciated pipelines, construct two pumps at “Kosova B” thermal power plant and one near “Kosova A” thermal power plant and plan for the overhaul of 50 substations. These improvements, in addition to having reduced the percentage of losses during heating, have increased the efficiency of the district heating plant, thus increasing the temperature of water circulating in pipelines from 70 °C to 120 °C during the peak time¹¹.

⁹ Combined heat and power – Cogeneration. Source: <http://bit.ly/1CPsB1P> (last opened on 22 July 2015).

¹⁰ Termokos Internal Report on Cogeneration Project.

¹¹ Quarterly Progress Report no. 12 – TERMOKOS District Heating JSC – KfW – Pg. 2. Source: <http://bit.ly/1CUGICA> (last opened on 22 July 2015).

We have presented below our findings on the impact of cogeneration on the electricity consumption and based on such data we have provided several scenarios of electricity saving by replacing the electric heating with district heating.

3. Effects of cogeneration on the Termokos customers

Termokos has a network of 11,281 customers. GAP Institute has conducted a survey with 350 customers. Based on the collected data, we have provided a series of conclusions related to the electricity consumption, heating sources, heating expenditures, citizens' satisfaction with the district heating services, and others.

Presentation of the findings follows the structure of the questionnaire and compares the non-cogeneration winter season, namely the December 2013 – January 2014 period, with the winter season, namely the December 2014 – January 2015 period when the cogeneration became operational. The data collected by the survey have been compared with the data provided by KEDS on the electricity consumption for these two comparable periods.

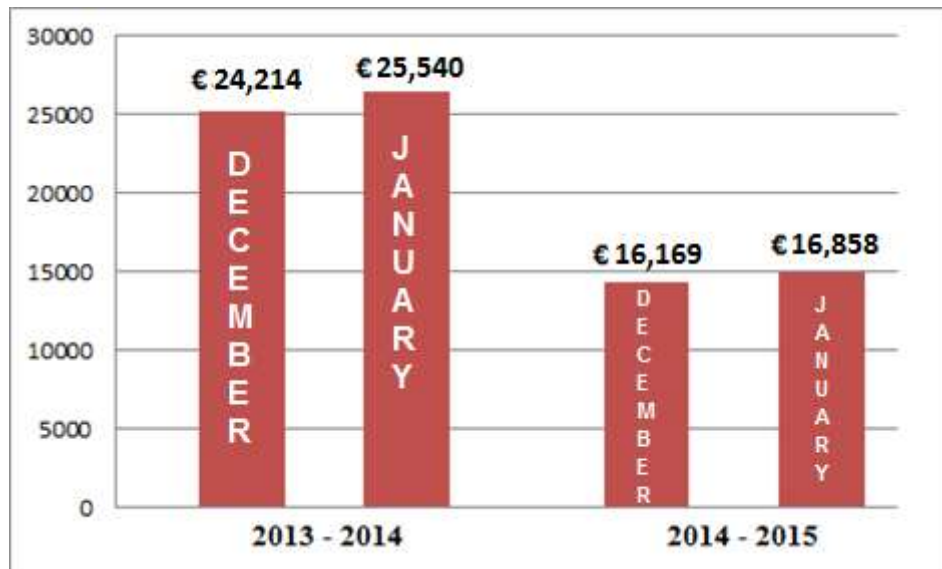
3.1 Electricity consumption

During the 2013-2014 winter season, the respondents used mainly the electric heating. As a result, in December 2013, a family paid on average 77 Euros per electricity bill, whereas in January 2014, it paid on average 82 Euros per electricity bill. After the cogeneration became operational, the average payment in December 2014 was 52 Euros, whereas in January 2015, it was 54 Euros per bill on average. These data show that following the improvement of the district heating, the electricity bills decreased by an average of 34%. Figure 2 shows the difference of consumption of 313 respondents who showed us their bills for the two winter seasons.

In the first season (2013-2014), the respondents paid on average 24,877 Euros, whereas during the second season (2014-2015), while keeping the other factors isolated such as the number of family members and financial

income unchanged, they paid a total of approximately 16,514 Euros, or 34% less¹².

Figure 2: The difference of electricity bills of the respondents (customers)



Based on the figure above we note that for two months, the total amount saved is approximately 16,727 Euros. If this number is applied to all Termokos customers, then it results that on average 602,867 Euros or, translated into kilowatt per hour, approximately 6,512,559 kWh have been saved for only two months¹³.

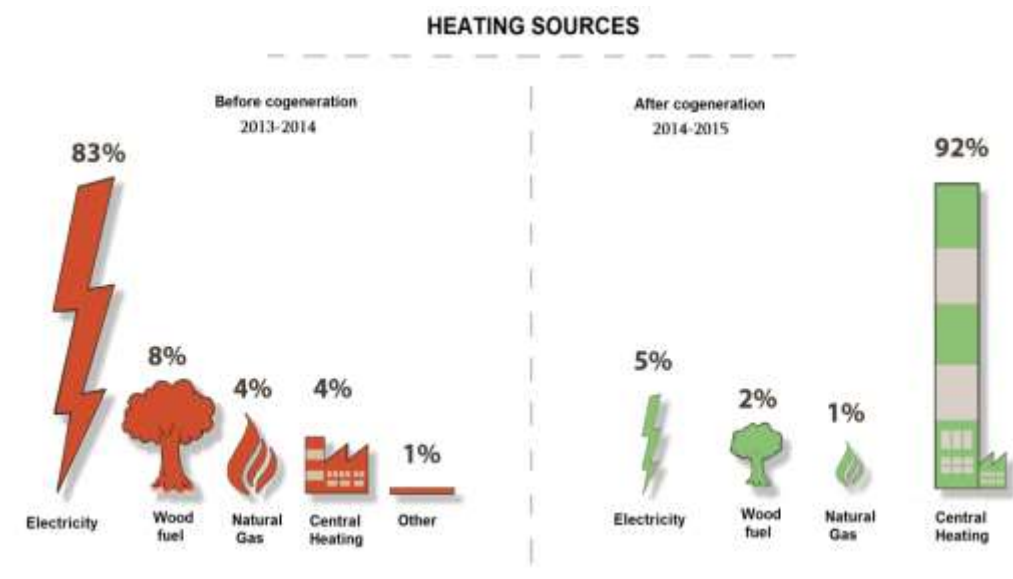
Although the saved amount is satisfactory, the heat quality has not been the same in every neighborhood. In some neighborhoods, the district heating has performed better while in some others more poorly. Differences of electricity consumption by neighborhoods are provided in annex no. 1.

3.2 Main heating source

During the 2013-2014 winter season, on average, 80% of the respondents have used electricity as their primary source of heating and only 4% of the them have used the district heating. Whereas after the cogeneration became functional, the electric heating as a primary source comprised 5% while the district heating increased to 92%.

¹² The saved electricity was calculated by removing the effect of the double increase of the electricity price during 2014.

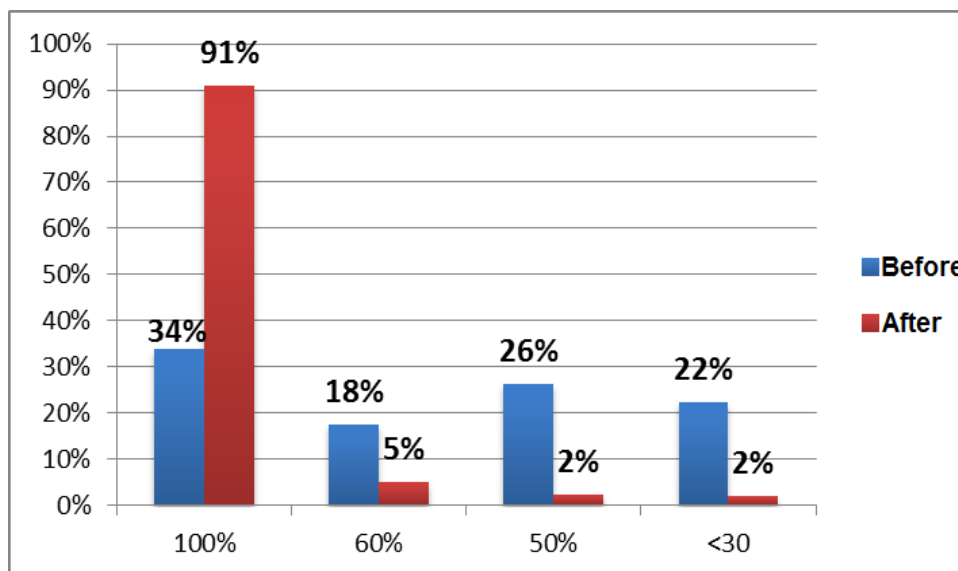
¹³ VAT was removed from the electricity bills when calculating the saved electricity in kWh.

Figure 3: Primary heating source before and after cogeneration

The switch from electric heating to district heating, in addition to reducing the expenses, has ensured heating stability and security, because the dependency on electric heating creates insecurity in cases when Kosovo faces shortages of electricity. Furthermore, the electricity saved during winter lowers the need of Kosovo to import expensive electricity from the countries in the region.

3.3 Heated residential spaces

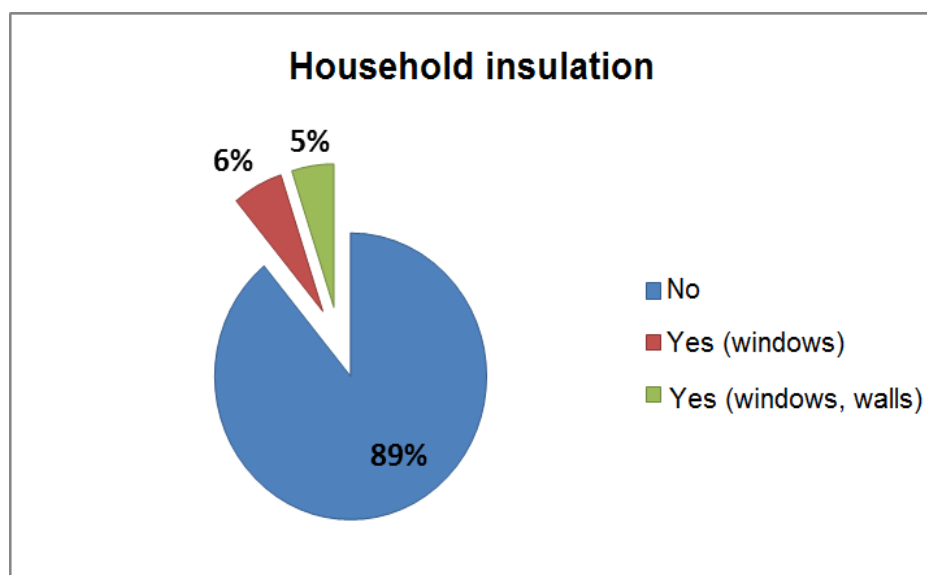
During the 2013-2014 winter season, on average 34% of Termokos customers have heated 100% of their residential space, while 26% of the later have heated only half of their residential space. This low percentage of the heated space was due to the non-functioning of Termokos and the high electricity cost for heating all the rooms. Whereas after the cogeneration became operational, 91% of customers have heated their entire residential space and only 2% of customers have heated half of their residential space. Figure 4 shows the difference in percentage of residential space heated during the two winter seasons.

Figure 4: The share of heated space before and after cogeneration

This switch from heating less than 30% of the residential space to heating 100% of the latter, in addition to having a lower cost, has increased the quality of the lives of the citizens connected to this district heating.

3.4 Insulation of residential premises after the winter season (2013-2014)

Another factor that might influence the change of the electricity consumption is the insulation of residential premises. Thus, if the premises are insulated, the consumption of electricity for heating is expected to be lower. In this case, the insulation after the 2013-2014 season might have had an impact on having a lower consumption of for heating. The data show however, that such insulation has occurred at a very low scale and its impact on the electricity consumption might not be essential. Figure 5 shows that only 11% of the respondents have undertaken insulation measures, whereas 89% of them have made no change with regards to insulation.

Figure 5: Insulation of residential premises

3.5 Respondents' attitude towards the heating quality

The improvement of heating system has influenced also the attitude of customers towards Termokos. During the first season, Table 1 shows that 94% of customers were dissatisfied with the heat quality, whereas in the second season only 8%. This improvement in perception has significantly influenced also the increase of the collection and the improvement of the financial situation of this company.

Table 1: Attitude of customers towards Termokos before and after the cogeneration

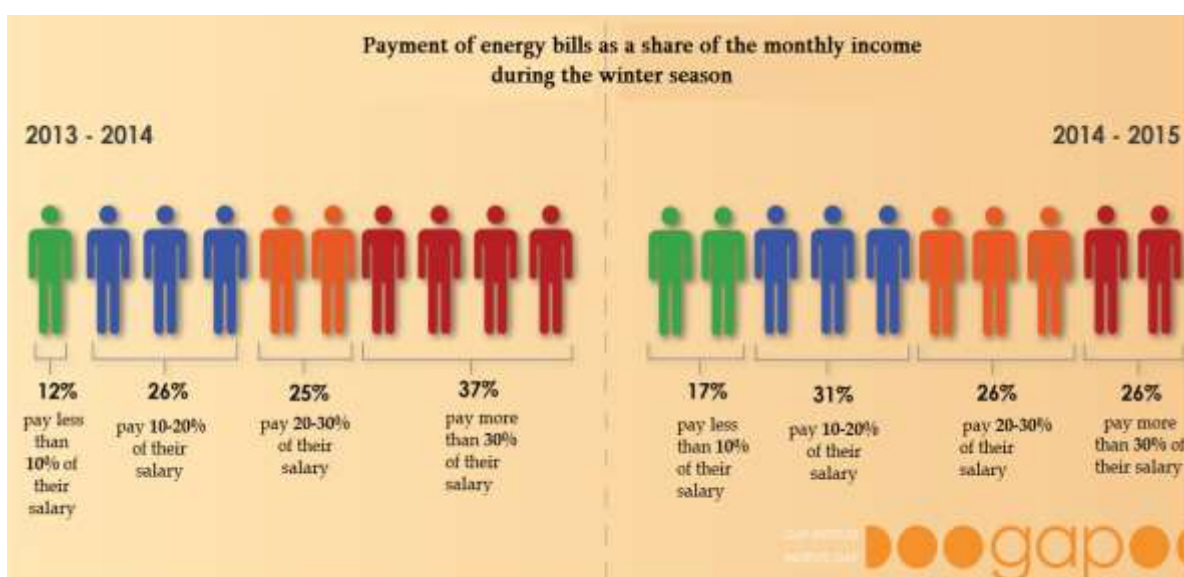
	2013-2014 winter season			2014-2015 winter season		
	Heating quality	Heating price	Service quality	Heating quality	Heating price	Service quality
Dissatisfied	94%	88%	53%	8%	35%	17%
Neutral	5%	9%	34%	7%	22%	42%
Satisfied	1%	3%	13%	86%	44%	40%

3.6 Income of households and energy poverty

One of the most disturbing findings of this research is the large number of citizens who live in energy poverty. Energy poverty occurs if household energy costs are above 10% of their disposable income¹⁴.

Our data suggest that before the cogeneration was operational, on average 88% of the households lived in energy poverty. After the improvement of the district heating, the expenditures for electricity decreased and, as a result, the energy poverty declined to 83%.

Figure 6: Payment of energy bills as share of the monthly income during the winter season¹⁵



Despite the fact that a significant number of people has managed to make it out of the energy poverty, the number of those remaining in such situation is alarming. The price of thermal energy is very high when considering that the operational expenditures of Termokos have declined by 10 million, and the collection has increased by more than 176% compared to the last year. This means that the heating price calculated per square meter (m²), which is the same as it was the last year, is very high and should be re-calculated based on the real costs of production which this year is much smaller.

¹⁴ ECOSOC - Overcoming the Energy Poverty in Underdeveloped Countries 2014. Pg. 4. Source: <http://bit.ly/1CPHTUc> (last opened on 16 July 2015)

¹⁵ The definition of energy poverty includes the payments of electricity and thermal energy of a family.

4. Some scenarios for expansion of the Termokos network

Based on the data shown above, it turns out that the decrease of electricity consumption by 34% is mainly attributed to the improvement of the district heating through the use of cogeneration. In addition to saving, the cogeneration has improved the quality of life, enabling the customers to heat all their living space.

By providing citizens with a more quality heating, Termokos has managed to increase the collection by 176% and lower the operational expenditures by more than 10 million Euros¹⁶. These improvements have a direct impact on the welfare of citizens connected to network of this company; however, their number is only 12,000, whereas by 2020, the growth forecast for the number of residential premises in Prishtina is approximately 200,000¹⁷.

Based on the findings of this study and the saving potentials by expanding the Termokos network, GAP Institute provides below several scenarios related to the options for saving electricity as well as its monetary value.

Table 2 shows the impact of Termokos expansion in several scenarios. In the first scenario, where the number of citizens does not change, the saving of electricity for a winter season is 16,281,396 kWh. Doubling the customers would increase the savings to 32,562,793 kWh, whereas tripling them would save more than 48,844,189 kWh.

Table 2: Forecast of saving of electricity based on the scenarios of Termokos network expansion

Network expansion	Number of Customers	Savings from electricity bills per winter season	Savings in kWh per winter season	Savings in MWh per winter season
0%	11,281	€ 1,507,167	16,281,396	16,281
100%	22,562	€ 3,014,334	32,562,793	32,563
200%	33,843	€ 4,521,501	48,844,189	48,844
300%	45,124	€ 6,028,668	65,125,585	65,126

¹⁶ Interviews with officials of DH Termokos

¹⁷ IBE – Kosovo Combined Heat and Power (CHP) feasibility study 2005. Pg. 9. Source: <http://bit.ly/1liBYHE> (last opened on 13 July 2015)

400%

56,405

€ 7,535,835

81,406,982

81,407

Based on this study, in neighborhoods where Termokos operates, during two months on average 602,867 Euros or 6,512,559 kWh¹⁸ have been saved. If this is applied to 5 months or one winter season (15 October – 15 April), it results that on average 1,507,167 Euros or 16,281,396 kWh have been saved. In the abovementioned scenarios, this saving trend has been applied proportionally with the increase of the customer network expansion.

Replacing electric heating with district heating in Prishtina would save electricity bills by more than 7.5 million Euros per year, while the entire cogeneration project has cost approximately 37 million Euros. In less than five years, the savings from district heating would pay for this investment and, at the same time, we would have a more quality and sustainable heating in Prishtina.

The advantages of saving from district heating are not limited to heating only. In the majority of the countries of the region and Europe, the district heating companies supply the residential premises also with hot water for washing and air conditioning in the summer, two of these services which consume immense quantities of electricity. The savings from the use of such options pave the way for even more monetary savings and a smaller need for electricity generation.

¹⁸ Price per kWh (0.11/kWh) was obtained from the data of KEDS as an average during the winter for the customers in the neighborhoods located at the center of Prishtina.

5. Conclusions and recommendations

Based on the findings of this analysis, GAP Institute considers that the investment of 37 million Euros in the construction of the cogeneration system has decreased the electricity consumption by an average of 34% in the areas of Prishtina which are connected to Termokos. The monetary value of such saving is approximately 602,867 Euros for only two months (December 2014-January 2015), while the electricity demand has decreased by approximately 6,512,559 kWh.

Besides saving the electricity, this system has significantly decreased the dissatisfaction that customers had earlier towards Termokos and, at the same time, it has doubled the collection level.

Considering the benefits from the functioning of Termokos and the opportunities of improving other district heating plants in Kosovo, GAP Institute recommends the following:

For Termokos:

- Improvements should be made in the distribution network of the neighborhoods in the center of Prishtina (Aktash, “Anton Qeta” street, and “UÇK” street) and Sunny Hill, which, based on the survey and data for each neighborhood, presented in annex no. 1, are the neighborhoods that have had the lowest level of electricity savings due to poorer functioning of the district heating;
- Normative tariffs should be replaced with metering tariffs and the thermal energy meters should be installed, as made obligatory under Article 32 of the Law on Central Heating;
- During the heating season, in the night hours, the room temperature should be kept at a maximum of 20°C rather than keeping the same temperatures as during the day. This would improve the comfort of customers and save thermal energy;
- Termokos itself should conduct a study on the number of customers who wish to be connected to this district heating system and, as a result, to develop a mid-term plan for requesting grants or additional loans for the purpose of connecting more customers.



For the Energy Regulatory Office:

- The tariffs of Termokos customers should be re-calculated because as of the last year (2013-2014), the operational expenditures have decreased by more than 10 million Euros and, at the same time, the collection has increased by 176%;
- It should insist that the district heating utilities, in the 2015-2016 winter season, install thermal energy meters, as made obligatory by law;
- It should design incentive tariffs to promote the construction of new district heating plants in Kosovo;

For municipalities:

- The municipalities having a high density of population should conduct a research of the market demand for district heating and consider whether the construction of a district heating plant is feasible;
- The Municipality of Gjakova, through a long-term loan, should financially assist DH “Gjakova” to rehabilitate and modernize the heating plant or to consider the option of privatizing this enterprise;
- The option of constructing a new district heating plant in Drenas, which would be connected to “Feronikel”, should be considered.

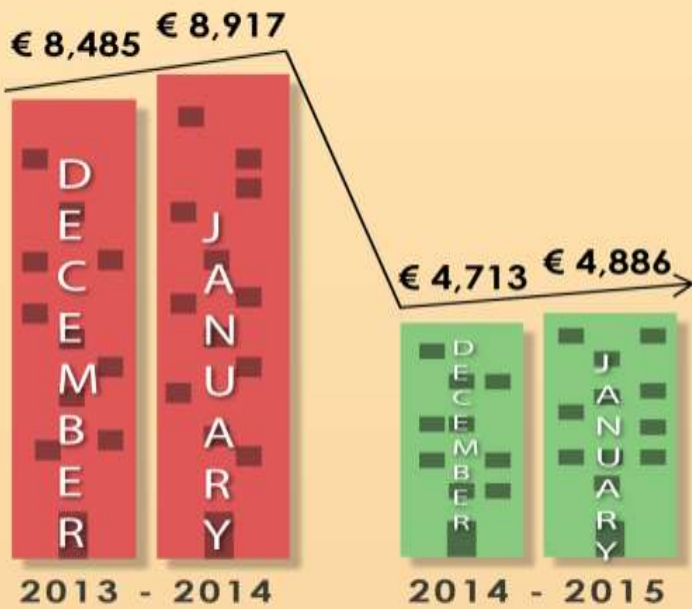
For the Government:

- The Government, in cooperation with ERO, should create more favorable conditions by means of fiscal and tariff incentives in order to increase the private investments in district heating plants;
- The Government should develop an institutional strategic plan on identifying the unused thermal energy and defining the targets of renewable sources-based generation.

Annex 1: Difference of electricity bills by neighborhoods

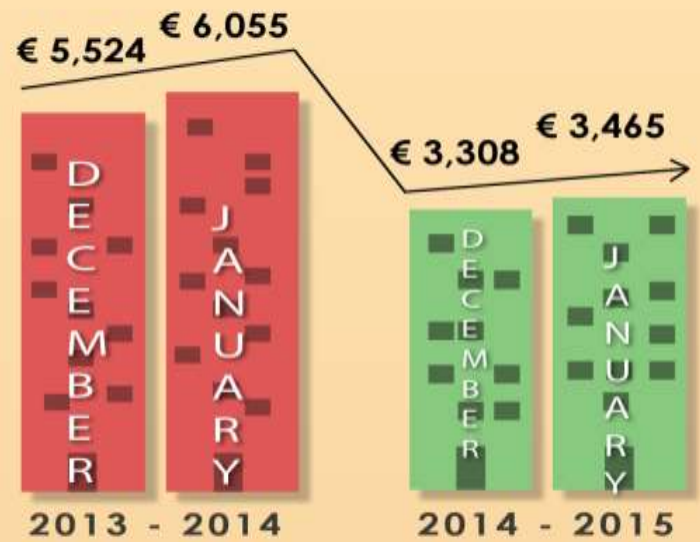
Dardania

Out of 112 respondents



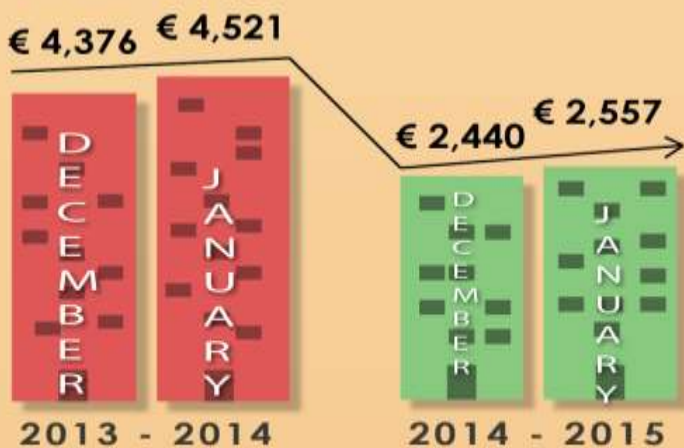
Ulpiana

Out of 77 respondents



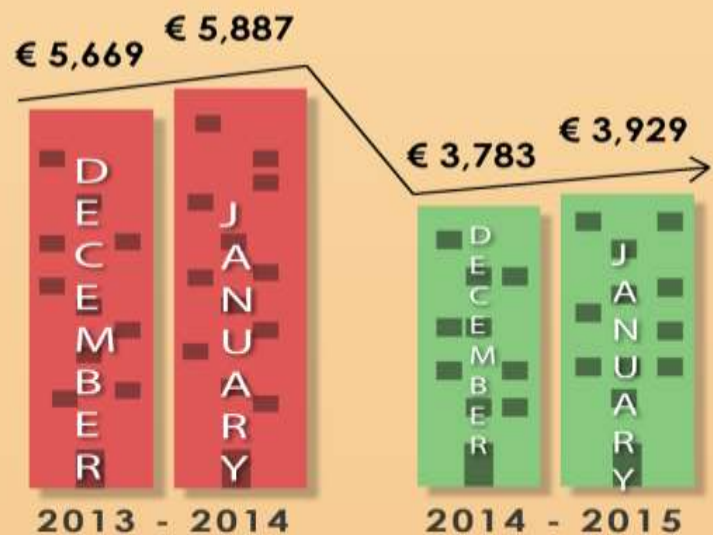
City Center

Out of 46 respondents



Sunny Hill

Out of 76 respondents





GAP Institute is a Think Tank established in October 2007 in Kosovo. Its main goal is to attract experts in creating a professional development and research environment, which may be found in other similar institutions in western countries. This also provides Kosovars with opportunities to research, develop, and implement projects aiming to advance the Kosovar society. This Institute's priority is to mobilize experts in addressing economic, political and social challenges in the country. GAP's main objectives are to bridge the gap between the Government and citizens and between problems and solutions.

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