Socio-economic effects of house renovation in Lithuania

The case in Kaunas

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Abstract:

Lithuania and Kaunas are very dependent on the natural gas imported from Russia. More than 90% of the thermal power needed for the city of Kaunas is generated at one power plant only, where Russian natural gas is used.
Since there is a binding contract for the thermal power purchase till 2018, there is a potential to implement the house renovation scenario in order to decrease thermal energy and gas consumption and contribute to socio-economic situation on Kaunas and national level.
This project investigates the potential of the house renovation scenario in the city of Kaunas whilst considering the socio-economic benefits.
The situation of the thermal energy sector in Kaunas and organizational and technical problems linked to the old, not renovated dwelling-houses in Lithuania are described. Furthermore, the information regarding the socio-economic situation, thermal energy consumption trends and current renovation program is provided.
A case study of house renovation in Kaunas is presented.
A socio-economic analysis is conducted and technological, institutional and political barriers to the implementation of the house renovation scenario are discussed.
Concluding recommendations and perspectives on conclusions are provided.

Preface

The Master's thesis entitled "Socio-economic effects of house renovation in Lithuania. The case in Kaunas" was written by a student on the MSc Sustainable Energy Planning and Management at the Department of Development and Planning at Aalborg University, Denmark.

The project was conducted during the period of 11th of March to 11th of July 2011.

Literature references are marked with the author name and the date of publication in brackets according to Chicago style. The appendices containing supplementary materials are assigned with capital letters and referenced in the document. Tables and figures are numbered in format x.y, where x is the chapter number and y is the number of the item.

I want to express special thanks to the supervisor Frede Hvelplund for his support and ideas provided during the project work.

A special thank is also given to my main contact in Lithuania, Gediminas Zukauskas who provided the necessary literature and information related to the project. Also I would like to thank to those who participated in the interviews.

The project is conducted by:

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Justina Zvirblyte

List of abbreviations

AAUs	Assigned Amount Units
BAU	Business as usual
CO	Carbon monoxide
CO_2	Carbon dioxide
cu mtr	Cubic meter
EU	The European Union
EIB	The European Investment Bank
EUR	Euro
GWh	Gigawatt hour
Jessica	Joint European Support for Sustainable Investment in City Areas
k	Thousand
KHPP	The Kaunas Heat and Power Plant
kW	Kilowatt
kWh	Kilowatt hour
m^2	Square meter
MW	Megawatt
MWh	Megawatt hour
NH_3	Ammonia
NO_x	Nitrogen oxides
RES	Renewable energy sources
SO_2	Sulfur dioxide
toe	Tonne of oil equivalent
TWh	Terawatt hour
UN	The United Nations
UNFCCC	The United Nations Framework Convention on Climate Change
US	The United States
USA	The United States of America
VOC	Volatile organic compounds

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1. Introduction

However, Lithuania as a whole country regained its independence from the Soviet Union in the year of 1990, it is cannot be stated that it was completely independent, since its energy infrastructure and supply sector was strongly linked to Russia. It is a challenge for the country relying highly on the imported primary energy, and nowadays probably it cannot be considered that the country is independent, as its economy is highly influenced by energy import costs. However, Lithuania has joined European Union in 2004, and has complying to the certain directives, just like as well other EU countries, by increasing the country's self-sufficiency in the primary energy supply sector. Yet, Lithuania still remains highly dependent on the imported natural gas from Russia and this demonstrates the risk and uncertainty for the future energy supply sector and costs.

Kaunas is the second biggest city after the capital of Lithuania, situated on the confluence of the two largest rivers – Nemunas and Neris. It is used to be the leading centre of the Lithuanian economic, academic and cultural development (Wikipedia, 2011). Nevertheless, currently this city faces a big issue in the energy sector – it is entirely dependent on thermal power, generated using natural gas purchased from only one supplier – "Gazprom"– the largest extractor and company of natural gas in Russia.

This situation was legally enforced in 2003, when AB "Kauno energija" (energy supplier), owned by the Kaunas Municipality, has sold the Kaunas Heat and Power Plant (KHPP) to a consortium which main member was "Gazprom" holding 99.5% of shares. Besides a few other insignificant power plants, it is the main thermal power generator in the city of Kaunas, responsible for approximately 95% of resources (lrytas.lt, 2011).

Furthermore, besides the purchase contract of KHPP, there was another engagement regarding the thermal power purchase for the city of Kaunas. According to it, AB "Kauno energija" is engaged buying up at least 80% of needed thermal power for the city for the next 15 years from the date of contract signing, i.e., till 2018. Since the fuel used in KHPP is the natural gas supplied from Russia, Kaunas remained in a very parlous situation – completely dependent on only one energy source (which is imported) and at the risk of facing unpredictable energy supply, as well as the high costs for it. However, there is no single generator that could substitute or even compete with KHPP in the area of thermal power generation in the city up to now, and the contract shall bind Kaunas purchasing the thermal power till 2018 (ATN.lt, 2010).

At the moment, the citizens of Kaunas are paying the highest price for the thermal power compared to all other major cities – just in 5 other municipalities the thermal power is more expensive (Investar, 2010). Furthermore, in 2016 the EU Directive 2001/80/EC will come into force, it is intended for the main power plants in Lithuania, setting out the limits for the discharged emissions. Therefore, KHPP will need big investments, in order to meet these specifications. Thus, the prices for energy are likely increasing.

It is worth noting the fact that the average size apartment of 44.5 m^2 in the old, not renovated dwelling-house is consuming around 1,122 kWh of thermal energy in cold month during the heating season, and the expenditures are amounting 85 EUR per month (Thermal energy bill, 2010). Since the average monthly gross salary in the Kaunas region in 2010 was 585 EUR, which corresponds to 456 EUR of the net salary (Lietuvos Statistikos Departamentas, 2011), the expenditures for the thermal energy represent 19% of the resident's monthly net income. This is quite a big part of an income spent covering the costs for thermal energy consumption only. Besides, many residents are paid even less than 456 EUR per month net salary.

The previous mayor was concerned about the present situation and named such contract (KHPP and the thermal power purchase contract) as a faulty decision of the previous local government. Therefore, there was a willingness to establish a competitive market in this sector and reduce the natural gas consumption, in order to be able controlling and placing the ceiling for rising prices to the citizens (mediena.net). However, a new mayor was elected into the Kaunas Municipality in April 2011, and his attitude towards the present situation is still not obvious. Of course, there are different interested parties involved in this situation, some of them attempt making Kaunas staying in business as usual (BAU), while others try finding the solutions to reduce the dependence on the imported natural gas and thermal energy consumption. However, the prices for natural gas just keep on rising and citizens spend large share of their income paying the energy bills – this is a real evidence that the immediate actions are necessary.

One of the solutions for reducing the thermal energy consumption and natural gas import is the house renovation scenario. In Kaunas city by renovating more than 1,500 of old, big dwelling-houses, the annual consumption of thermal power could be significantly reduced: cutting the substantial amounts of natural gas import from Russia. Since the binding heat purchase contract shall be valid till 2018, the house renovation scenario could be seen as the first step in reducing costs for the thermal power supply and dependence on imported natural gas.

Additionally, Lithuania was hit by the big crisis – that is easily seen from its unemployment rate (which was almost 18% in 2010) (Lietuvos Statistikos Departamentas, 2011). There are issues linked to the public finances, analysing the deficit of the national budget and negative trade balance. Therefore, the house renovation scenario could positively contribute to the national welfare, first of all by increasing the local employment rate and by positively contributing to the public finances. The investments to the house renovation would decrease the energy import, raising the country's self-sufficiency of the energy supply and making the positive impact on its trade balance. By developing the advanced renovation measures locally, it could become the export product in the future and would contribute even more to country's trade balance.

Even though, Kaunas has a great potential subject to the dwelling-house renovation scenario, however, in order to succeed, not only the positive public will is needed, but the certain technological, institutional and political premises as well.

All this information leads to project's topic which is based on the following problem and research question formulation:

The strong dependence on the natural gas imported from Russia for the thermal power generation in the city of Kaunas – to which extent this problem can be solved using the house renovation scenario in this city and what needs to be done to make it practicable and feasible.

In order to understand the problem and the research question, the following sub-questions will be answered as well:

- What is the present situation in the heat sector and the tendency of thermal power supply in Kaunas? What is the thermal power consumption tendency in the dwelling-houses?
- What is the potential for reducing the thermal energy consumption in the dwelling-houses after renovation?
- Which types of actors, able to influence the present situation and house renovation scenario, are involved? What types of legal acts and funds supporting the investments are available in this scenario?
- What is the present socio-economic situation in Lithuania and Kaunas?
- How much could the house renovation scenario influence the socio-economic situation?
- Which are the barriers to the implementation of the house renovation scenario?
- Policy proposals: which conditions are needed in order to push forward the house renovation scenario process?

It is worth noting that this project concerns and analyses the house renovation scenario only in the scope of Kaunas, and includes only around 30% of total number of houses – it represents those bigger dwelling-houses with 5 and more floors that could be renovated in this city. However, this analysis could be taken as an example for whole country, considering the fact what influence to the socio-economic situation and the thermal energy conservation it would have on the national level if this scenario is implemented in the bigger extent – encompassing more dwelling-houses in other cities of Lithuania. Consequently, all socio-economic and energy conservation analysis on national level are performed assuming that this scenario is implemented by 10 times bigger extent, since there is enough potential for its realization. 10 times bigger expansion is considered being appropriate because there are around 34,000 dwelling-houses in Lithuania that may be renovated (Sirvintu krastas, 2009). As not all of them are of the same size (with 5 or more floors), like the example in this project, – even smaller – it has been assumed that around 15,050 (10 times more compared to the number of 1,505) of the dwelling-houses are characterized by the similar characteristics, therefore the similar investment and thermal energy savings can be required. However, it should be bore in mind that there might be an underestimation of the real

potential in Lithuania which could be not 10 times but even up to 30 times bigger and therefore, the contribution to all socio-economic aspects and thermal energy savings could be increased even more accordingly.

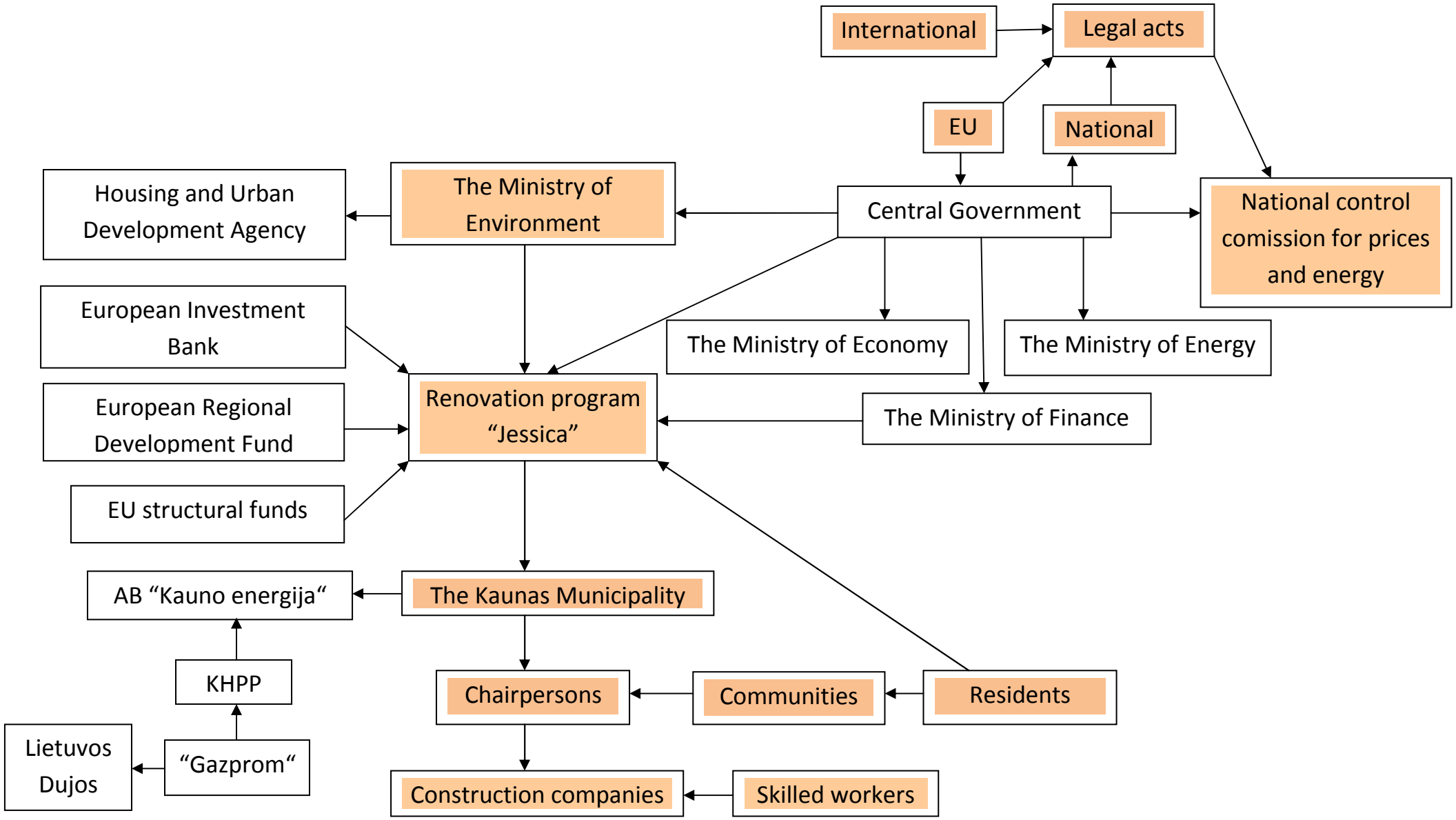
2. Theoretical approach and methodology

While developing this project, a theoretical approach and methodology as shown below have been used. The theoretical approach applied has been used in order to establish the project's boundaries and chose the appropriate methodology for data collection.

2.1 Global structure

The project's methodology is guided by the theoretical map – a global structure, which outlines a framework of project's range. This range shall encompass the main actors that in any way directly or indirectly are linked to the project's problem formulation and make influence on the present situation in the thermal energy sector and implementation of the house renovation scenario in Kaunas. Therefore, the literature review, interviews and data collection were performed according to this global structure approach.

Figure 2.1 Global structure



It should be noted that the actors are interlinked and the interlinks are represented by the arrows in the global structure. The direction of arrows marks the source of influence, i.e., which actor is auxiliary and which is the responsible one. If the arrow points to the actor analysed, it means that this actor is influenced in some way by the actor positioned at the starting point of an arrow. By establishing these links, the most important actors are coloured in red, determining the party having the biggest influence in the decision making process and when taking actions.

As mentioned above, some actors are marked in colour; this means that a bigger attention is paid to them, since they are considered having the biggest influence on considered problem formulation during this project. All these most important actors constitute a macro structure, where the most influential interests and responsibilities are involved only. Other actors not included to the macro structure are also in any way linked to the topic of the project, however, they are considered as having less or very little influence. For example, "Gazprom" is the Russian gas concern, which extracts and supplies the natural gas to the Middle and East Europe, and is the biggest supplier in the world. "Gazprom" is the main owner of KHPP, which has 99.5% of shares (Kauno termofikacijos elektrine). Although Kaunas is entirely dependent on its thermal energy supply and the energy sector of this city can be influenced by this concern by the large part, it is considered that the house renovation scenario can be hardly influenced by this actor, because it does not have enough of power to affect the government and residents regarding house renovation activity. Therefore, it is included in the global structure, but not between the actors in the macro structure. In addition, KHPP is excluded as it is considered to be accountable to "Gazprom" and is little influential subject to the chosen project's scenario.

Furthermore, AB "Kauno Energija" is also excluded, even though it is the only energy supplier in the city of Kaunas. First of all, since it is owned entirely by the Kaunas Municipality, it is considered that all main decisions and actions are made by this actor and therefore the Municipality is considered to be significant only. Secondly, even though AB "Kauno Energija" could influence the Municipality regarding decisions linked to the thermal power sector in Kaunas, but it cannot impede or support the house renovation scenario since it does not have the power for that.

Moreover, since the main responsibilities in the house renovation program implementation belong to the Ministry of Environment and the "Housing and Urban Development Agency" accountable to it administrates the house renovation program only, therefore, this agency is not included to the macro structure as it is not able influencing the main premises and conditions for the house renovation projects. Besides, it is considered that this agency cannot influence the activity and responsibilities of the Ministry of Environment.

Other Ministries, like the Ministry of Economy, are included to the global structure as for example they are responsible for the renovation of public buildings only, whereas the

Ministry of Environment is responsible for the dwelling-houses. Therefore, the Ministry of Economy is not considered to be the main actor in this case, since this project concerns the renovation of dwelling-houses only. Furthermore, the Ministry of Energy has a defined purpose reducing the dependence on only one supplier of external energy by uniting the Lithuanian energy systems with the EU ones, and integrating into the EU internal energy market. It also strives increasing the efficiency of energy use and the share of renewable energy in the primary energy supply sector (Lietuvos Respublikos energetikos ministerija, 2009). It is an important actor since it is responsible for the policy of infrastructure development in thermal power sector, as well as in the general energy sector. However, it is considered having little influence on the house renovation scenario.

Finally, the organization behind the house renovation program "Jessica", due to its available financial support, is one of the most important actors in this project. Nevertheless, even though there are several different sources of funding coming to this program, only the program "Jessica" is marked as the macro structure actor.

Moreover, The financial resources for house renovation projects in the house renovation program are allocated from the Supervisory fund, which was established by the Ministry of Finance and the Ministry of Environment and the European Investment Bank (EIB) (Atnaujink busta). However, the Ministry of Finance and the EIB were left outside the macro structure due to the lack of information on their influence and responsibilities towards house renovation program.

The actors in the macro structure are defining whether the house renovation scenario is possible implementing and what are the conditions for it. Therefore, later all actors of the defined macro structure are explained in detail, pointing out their role, responsibilities, influence or interests, and this frames out the project's micro structure. However, it could be done only after investigating the technological, institutional and political possibilities, therefore the micro structure is included in the chapter "Possibilities and barriers to the implementation of the house renovation scenario" at the end of project.

2.2 Data collection methods

The most important data collection method used in this project is the literature and documents' review. Using this method the global structure has been defined and the main actors have been identified. The literature reviewed consisted of the corresponding articles and books related to the present situation in the thermal energy sector, consumption trends, and the situation in the sphere of the dwelling-houses, to the house renovation process and opportunities, as well as to the present socio-economic situation. Moreover, the interviews as another data collection methods were also used implementing this project. They were an important material helping to get familiar with the information not noticed

during the literature review and they were focused on the house renovation possibilities and experience in Kaunas.

2.3 Types of data

In this project both, the qualitative, and the quantitative data was collected and used. The qualitative data was important in order to generate the general understanding of the present situation in the thermal energy sector in Kaunas, the present situation of dwelling-houses and their renovation possibilities, as well as the present socio-economic situation in Kaunas and Lithuania. The qualitative data was used showing which and how the actors are important, to this end using the means for designing the global, macro structures and through the analysis of the micro structure understanding the dynamic details.

The quantitative data is everything that it is needed to be shown in numbers. It includes the consumption trends of thermal energy and natural gas, its import costs, all numerical data related to the house renovation possibilities (investment, possible thermal energy savings, etc.), as well as all numbers characterising the present socio-economic situation.

2.4 Data limitations and assumptions

Some data limitations were faced while developing this project. This was due to the lack of needed information and therefore certain assumptions had to be applied.

In the 6th "Case study" chapter:

1. Since it was not possible to know what thermal energy consumption and cost of Apolonija's house were before renovation- the needed numbers were taken from another not renovated house of the same type.

In the 7th "House renovation scenario consequences on the socio-economic situation and thermal energy consumption" chapter:

1. Assumption on the number of dwelling-houses that need to be renovated in Kaunas- 1,024 of 5 floors and 481 of 6 and more floors. Later on, this number was increased by 10 times to analyze the consequences on national level.
2. Investment cost of 486,100 EUR was assumed to be the same for all dwelling-houses.
3. Heating area of 4,418 m^2 was assumed to be the same in all dwelling-houses.
4. By average 75 houses can be renovated annually in the city of Kaunas.
5. In the investment cost- 80% as domestic labor cost and 20% as import share were assumed.
6. All employed people by the house renovation scenario would get 600 EUR monthly gross salary.

7. Assumptions on the unemployment insurance benefit- people that get employed in the scenario have less than 25 years of work experience and were getting a monthly gross salary of 600 EUR for the last 36 months.
8. Applied 20% of energy losses at the power plant and that all thermal energy saved is generated in water-boilers only, neglecting a co-generation mode.
9. Income from the sold CO_2 allowances contributes to the national budget instead of trade balance.
10. Assumptions on the total thermal energy savings after the implementation of the house renovation scenario- all houses of 5 floors have equal savings, as well as houses of 6 and more floors.
11. Price for the natural gas does not change in the next 20 years- it stays 226 EUR for 1,000 cubic meters.
12. It was assumed that 10 EUR/m^2 is used for the preparation of renovation project, technical supervision of construction works and for the administrative expenses for the implementations of renovation project.

Furthermore, the excluded actors from the global structure, or those included in the global structure but excluded from the main actors in the micro structure could be considered as another data limitation. The global structure was defined after the literature and documents review, but there might be important actors that were left out due to the lack of information. The micro structure with the most important players considered for this project was also defined by using the same data collection method. However, not all possible literature sources have been investigated and therefore this could lead to different results.

3. Historical and present situation in thermal energy sector in Kaunas

This chapter explains the present situation in the thermal energy sector in Kaunas, including the problems linked to the thermal power generation, monopolistic situation and the contentions between the different interested parties. This chapter is important showing that the house renovation scenario could be used as the first step for Kaunas when decreasing the natural gas consumption and reducing the expenditures for the thermal energy bills for the residents.

3.1 Thermal power generation in Kaunas

Besides KHPP there are other 4 sources of the thermal power supplying the heat energy to the city of Kaunas: Petrasiunu power plant, Pergales, Silko and Inkaro regional boiler-houses. The following figure illustrates the share of heat supply of each unit.

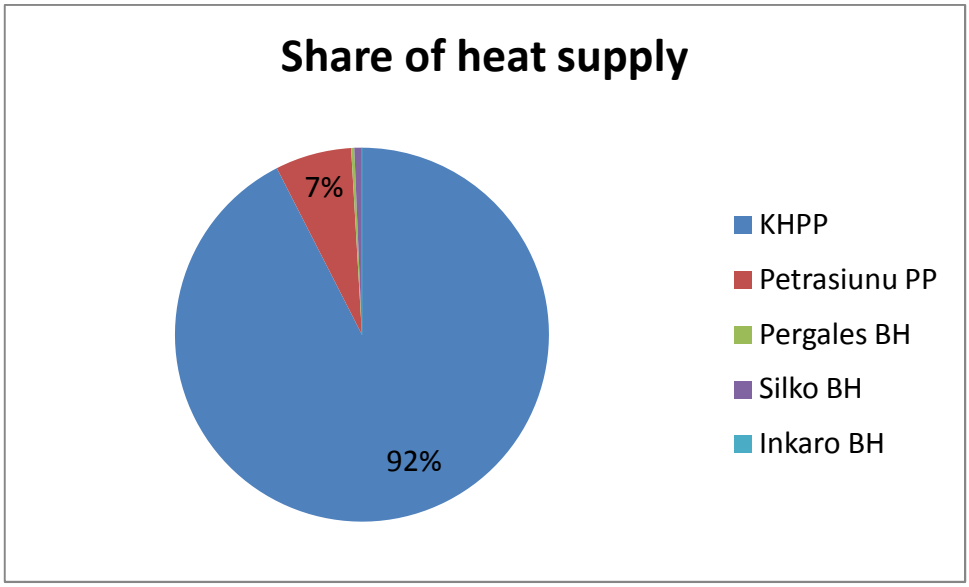


Figure 3.1 Share of heat supply of each unit in Kaunas (Kauno Elektrine, 2009)

KHPP is the main heat and power plant in Kaunas which supplies around 95% of the needed thermal power to the city, however, its facilities are 36 years old already, whereas the critical exploitation limit is considered being 30 years. There are two Russian type turbines still working pretty well but they are very inefficient and the price for natural gas is high, moreover, the installed thermal capacity is 1,500 MW when only 600 MW is needed – this raises the operation and maintenance costs. Furthermore, Pergales boiler-house is 32 years old and Petrasiunu power plant, Silko and Inkaro boiler-houses have reached 48, 50 and 44 years, respectively. There were no investments in these thermal power sources for the last years, therefore the immediate decisions and development are needed, in order to ensure the security of supply system and the appropriate heat price for the city (Kauno Elektrine, 2009).

3.2 Contract, investments and contentions

In 2003, KHPP that belonged to AB "Kauno energija" (which is owned by the Kaunas Municipality) at that time, has been sold to the consortium and now it is owned by "Gazprom", the Russian gas concern holding 99.5% of shares, whereas the rest 0.5% belongs to "Dujotekana" and the USA company "Clement Power Venture" (Veidas.lt, 2010). Besides the purchase contract of KHPP, there was another engagement regarding the thermal power purchase for the city of Kaunas. According to it, AB "Kauno energija" is engaged buying up at least 80% of needed thermal power for the city for the next 15 years from the date of contract signing (ATN.lt, 2010).

The contract signed in 2003 stated that the new owners are pledged investing 114.29 million EUR to KHPP till 2018. However, in a few years after the signature of the contract the conflict between the Kaunas Municipality and KHPP has raised. Till January 2009 there had to be

46.29 million EUR invested to KHPP and only around 14.29 million EUR were actually invested. The Kaunas Municipality has been considering terminating the contract between "Gazprom" and AB "Kauno energija", due to the nonconformity to the contract conditions. It was related to the fact that the Finish energy consortium "Fortum" offered a similar amount of money during the sale contest in 2003, but didn't win, as their investment amount reached 12.86 million EUR only (Veidas.lt, 2010). However, a new mayor has been elected into the Kaunas Municipality recently and this brings the new doubts and hopes about the future situation in the thermal energy sector in Kaunas. Since the previous mayor demonstrated a strong will decreasing the dependence on the Russian natural gas, now it might prove that there are little or no interest in the new investments and changes in the thermal energy sector.

Anyhow, now "Gazprom" promotes its plans building the new power plant in Kaunas, which would be based on co-generation. According to the Deputy Chairman of the Management Committee of "Gazprom" Valery Golubev, it has been decided building the new power plant instead of investing in the old one and it has been estimated having around 285.71 million EUR of investments (AB Kauno energija). This project includes the co-generation units of 320-360 MW installed capacity, being powered by the natural gas supplied by the same "Gazprom" according to the binding contract for 20 years (Kauno Elektrine, 2009). This means, if this project is really implemented, the reliance on the energy supply in Kaunas would become even stronger and for a longer period, and the investment cost most probably would be covered raising the tariffs to the citizens.

Notwithstanding this fact, since December 2009, when the project was presented, the construction of the new co-generation power plant has not been even started, even though it was planned that the plant will start running already in 2013.

There are assumptions that "Gazprom" is considering selling KHPP, but there is too less information on the legal proposals or serious intentions buying it. Nevertheless, there were a few interested parties planning to buy all or at least some shares of KHPP, for instance, the Finnish corporation "Fortum" and the Lithuanian company "Senukai" (Diena.lt, 2011). Yet, there are no guarantees if "Gazprom" is up to selling it, as well as how serious are the intentions of other investors buying it.

For the time being, the situation is like this: Kaunas is still entirely dependent on the thermal power generated by the Russian natural gas in KHPP. The Commercial Arbitrage Court of Vilnius has already enacted that KHPP must paying 1.55 million EUR to AB "Kauno energija" for the noncompliance to the contractual conditions (vz.lt, 2011). Later, KHPP came up with reproach to the Lithuanian government, when it has started applying the special price setting method for the thermal power in 2008. "Gazprom" had a commitment not changing the thermal power (generated in KHPP) price for the period of 2003-2008, and from 2008 calculating it according to the special formula linked to the oil prices trend in the European

market. According to “Gazprom”, they were complying their commitment, though in 2008 the Lithuanian government introduced the new price estimation formula, which led “Gazprom” experiencing the loss of 97.78 million EUR 2003-2008. “Gazprom” pursues getting around 138 million EUR as the compensation from the Lithuanian government (Kauno termofikacijos elektrine, 2010).

Nevertheless, assumptions on the “Gazprom” losses due to the newly applied estimation method for the thermal power price are considered to be faulty, since the previous price for the thermal power applied for the first 5 years (till 2008) was set out in the purchase contract as one of KHPP purchasing conditions. Furthermore, if the new method wasn’t applied, the residents of Kaunas would be paying over 0.09 EUR/kWh now, whereas the set price is around 0.076 EUR/kWh.

3.3 Conclusions

- KHPP is the main heat and power plant in Kaunas, powered by the Russian natural gas. It supplies around 95% of the needed thermal power to the city of Kaunas.
- AB “Kauno energija” is engaged buying up 80% of needed thermal power for the city from KHPP till 2018.
- The present situation in thermal energy sector in Kaunas seems to be problematic. “Gazprom” wishes holding its monopoly in this sector, whereas the previous Kaunas mayor showed an interest in resolving this and becoming more self-sufficient in thermal energy supply sector.
- Recently, the new mayor has been elected into the Kaunas Municipality and this brings an uncertainty for the future changes and development.
- If “Gazprom” plans on the new co-generation power plant are going to be really realized, Kaunas will be strongly linked to the Russian natural gas supply for longer period, and the investment costs would lie on the end-users’ shoulders.

Since it is not clear how the situation in the Kaunas thermal energy sector, which is entirely dependent on the Kaunas Municipality will and the present thermal power generator and supplier, is going to change, there is a potential implementing the demand side management. Particularly, the house renovation scenario could cut and control the expenditures for the energy bills for the citizens, and this could be seen as the first solution towards decreasing the costs and natural gas consumption, even under monopoly circumstances. Most residents are paying the monomial price for heating (a tariff for the thermal energy paid during reporting cycle only, not including the fixed rate for one kW of installed capacity) and that means that they are paying for the consumption during the heating season only. This ensures the independence for the implementation of house renovation scenario in such a way that residents will be able cutting off the expenditures for the thermal energy bills, accordingly to reduced consumption.

4. Present situation of dwelling-houses and renovation program

The information regarding the organizational problems in the sphere of the dwelling-houses, possible tariffs for the thermal energy and service methods in the supply chain, heat losses in the not renovated dwelling-house and available house renovation financial support are discussed in this chapter. This chapter provides the overview of the organizational and technical problems linked to the old, not renovated dwelling-houses, and describes the present renovation program and its process.

4.1 Organization in the dwelling-houses

It is common that there is a low organizational level among the residents of dwelling-houses in Lithuania, although the management of dwelling-houses by the communities is supported by the democratic principles (voting, elections). Nevertheless, the communities that manage property effectively are covering only a small percentage of the existing dwelling-houses. The decisions on the rest dwelling-houses are taken and activities are organized by the administrators which are allocated by the municipalities. However, their work is poorly regulated and there is no direct interest in the building's quality, therefore, there is a lack of active organization (Lukosevicius, 2011).

Yet, according to the present Lithuanian law, the residents of dwelling-houses have a right to:

- Choose or change the building heating or hot water system supervisor by the residents' majority votes, and agree the price;
- Choose the type of thermal energy supply by the residents' majority votes – it is possible buying it at the "entrance" of building and organising the internal thermal power distribution, payments' collection and etc. by themselves. In such a way, the residents would avoid the extra fees for these services, otherwise paid to thermal energy supplier;
- Choose or establish their own thermal power distribution method within their building by the residents' majority votes;
- Set the beginning and ending dates of the heating season, and the heating mode by voting;
- Choose the price tariff for thermal power – monomial or binomial to each resident individually;
- Be informed about the thermal energy consumption and be able getting advises on solving the problems of the heating system from the administrator.

Furthermore, the residents should be informed on the house renovation possibilities, effectiveness, and available financial support methods, as well as to be able taking the needed corporate decisions. In order to take decisions on the matters described above, the

appropriate information, consultation and active residents' involvement are needed. If the care for building is taken by the administrator appointed by the municipality, he should organize the residents' meetings, render the needed information and organize voting regarding the building exploitation and renovation issues. Unfortunately, most of the possibilities and options for the residents described above are not only forgotten to be discussed in residents' meetings, but it seems that the residents know very little about those options. It could be considered that it is a fault of administrator of the administrated building, however, in order to change the administrator, the decision of residents' majority is needed. However, voting among residents regarding this matter has to be organized by the same administrator, therefore, nothing is moving forward (Lukosevicius, 2011).

4.2 Tariffs for the thermal energy

There is a possibility choosing whether to pay a monomial or binomial price for thermal power for the citizens in Lithuania. The binomial price is comprised from the fixed price for one kW of installed capacity, covering the thermal energy system operation and maintenance costs, whereas the variable price covers the expenses for the generation of energy of one kWh. The binomial price system is good if the citizens want avoiding big expenditures on the energy bills during the cold season, because the total annual costs for thermal power would be the same as in case of the monomial price, but the costs would be dispensed more evenly. Also, the binomial price system is an advantage for the suppliers, since they would be getting the constant income and wouldn't need taking loans, in order to ensure their activity – therefore, the end-users wouldn't need covering the suppliers' deposits (Lukosevicius, 2011).

However, most of the citizens choose paying the monomial price for the consumed heat and therefore, the energy bills are taking the big part of citizens' incomes during the cold season. Even though, the thermal power suppliers have improved in the last few decades and upgraded their technical and economical level, the main problems in thermal energy sector still occur in the area of the consumption in the dwelling-houses. The aforementioned houses haven't improved much since 1990 and most of them frayed even more (Lukosevicius, 2011). For example, in Denmark or Finland the thermal power needed warming up the heated spaces is by average 110 kWh/m^2 annually, whereas in Lithuania this index is around 200 kWh/m^2 (Gatautis, 2011).

4.3 Service methods

The thermal energy suppliers are engaged supplying the heat energy to every single apartment in Lithuania, whereas in many other countries the thermal power is usually supplied to the "entrance" of the building only. In the western countries, the owner/chairperson of the house (individual, municipality) buys the thermal power from the supplier to entire building. The incoming thermal power is measured by the anticipatory

thermometer and its usage in the building is organized by the owner or according to the hygiene norms (Lukosevicius, 2011).

Till 1993, the centralized thermal energy supply was delivered till “entrance” of building only, and there was a household administrator or other similar subject responsible for the distribution inside. However, when the economical reforms have been started, the citizens’ living standards have dropped and the problems with payments for these services arose. The attendant companies couldn’t collect money from the residents and couldn’t manage to the payments to the energy suppliers. The economical conditions and potential supplying the heat energy became critical, even though the thermal energy for domestic users was subsidized from the payments of industrial users. However, it was the reason why many of industrial users have disconnected themselves from the system, increasing the thermal energy supply costs to the remained users in such a way. Therefore, the Ministry of Energy has decided that the suppliers should supply the thermal energy “till the end-user” at that time – to every apartment of the domestic user, by monopolizing whole thermal energy system in such a way. Since then, the thermal energy suppliers render the energy bills and notifications to every single apartment, collect money and take care of all other activities related to the thermal power market (Lukosevicius, 2011).

In order to guarantee the heat supply to every apartment, it is important to guarantee the efficiency of building’s internal system, which is a property of building residents. Therefore, such work should be carried out by the new subject, so called the “heating and hot water systems’ supervisor”. This service might be rendered by various subjects having the appropriate competence, but if residents do not make the decision on the following, such obligation falls to the thermal energy supplier. Later, a definition of the “hot water supplier” emerged in the Lithuanian law. Although, the household administration hasn’t disappeared – it became the administration for the commonly used property. Furthermore, the cold water is supplied to a single apartment by the cold water supplier, which owns and takes care for the separate counter in the apartment. Thereby, when there is no effective and appropriately functional property community, the services are provided by many different subjects to the dwelling-houses in Lithuania, various payments are collected, and the residents do not understand who is responsible for what very often, they do not know what services their fixed payments cover and what partition is paid as a variable cost. It seems that the exploitation and supply of utilities to all administrated houses (there are more than 80% of total) became very complicated and insufficient when implementing the reforms – there are no real building owners. For this reason, the care for most of dwelling-houses is taken very badly, they are not being renovated: no one really cares about the trend of thermal power consumption. It is clear that the costs for utilities are raising and the domestic users are becoming more and more unsatisfied (Lukosevicius, 2011).

4.4 Real situation and recommendations

The experience shows that the apartments' privatization and their management democratization do not solve the problems for the dwelling-house exploitation and renovation. The present situation shows that nothing is really happening in the renovation sector without the active government and maybe private business involvement, and the situation is more likely will be getting even worse, because of these reasons:

- The buildings are getting older and the renovation activity is hardly moving forward;
- The annual thermal energy consumption by average is 200 kWh/m^2 (which is almost double than it is in Denmark at present) due to the lack of renovation activities;
- The global prices for fossil fuel are expected to increase due to the constantly increasing demand, their depletion and climate change problems. This situation induces the increase of expenditures for the heating bills to the unacceptable level seen in relation to the incomes of people living in the flats;
- The economic condition of most Lithuanian residents is improving too slowly, so the confusion due to the proportion of their income allocated for the payment of thermal energy bills arises.

The country should pay attention to the fact how the taxes are being collected from the citizens and how they are being used, since the end-users of the centralized thermal energy are being supported from the budget by applying the exemptions on value added tax, paying allowances to the welfare recipients, subsidizing the investment programs, etc. Certainly, there are many energy related difficulties in Lithuania, however, the inefficient management of the dwelling-houses is one of the main problems in the sector of the centralized thermal power supply. It's not wondered that there is no real and responsible landlord, meaning that there is no proper order; the residents get lost between the various service providers and cannot find the appropriate justice. After all, if the country has decided solving all problems related with the thermal energy, firstly, it should be important appointing one appropriate chairperson representing all interests of the residents in each dwelling-house. This could be the first step to start solving the enormous thermal energy consumption and renovation problems instead of trying to find the guilty ones for the high energy bills after every colder month. The biggest improvement possibilities in thermal energy sector should be seen from the experience of Lithuania and other countries, and qualified decisions should be taken accordingly (Lukosevicius, 2011).

4.5 Heat losses

In order to have an idea on energy losses in the old dwelling-house, the following images are provided. These pictures are taken in February 2011; all data on temperatures are provided in the table below the images.

Figure 4.1 Old not renovated dwelling-house

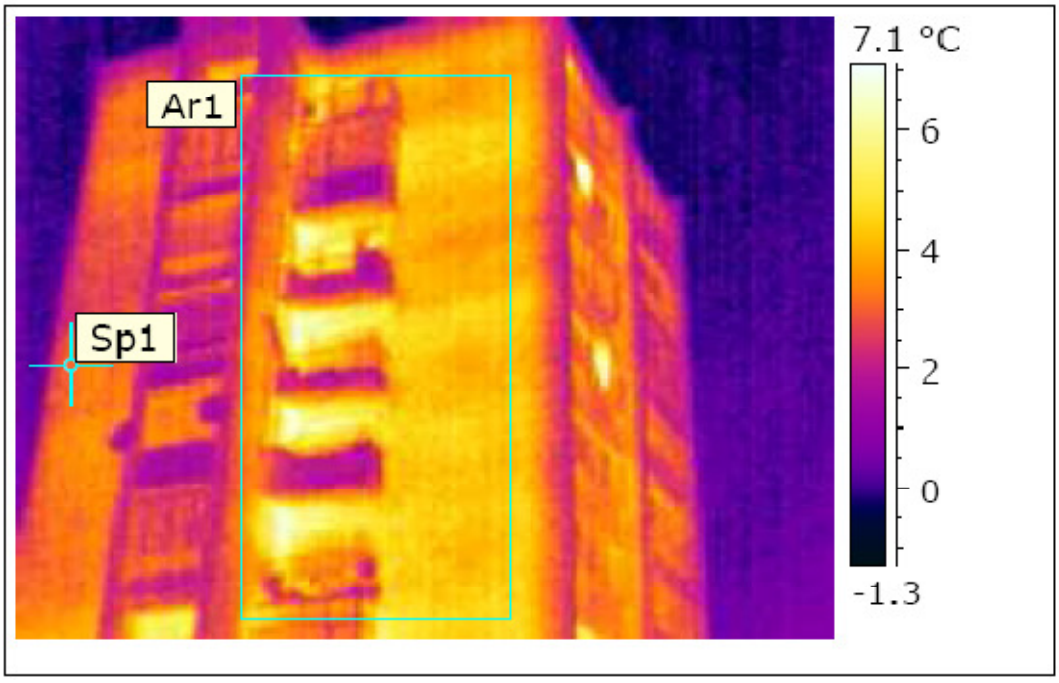


Figure 4.2 Old not renovated dwelling-house pictured by infrared thermal imaging camera

Table 4.1 Information of the pictures

Date of pictures taken	7th February 2011
Time of pictures taken	20:30
Outside temperature	1.2 C
Ar1, the highest temperature	7.5 C
Ar1, the lowest temperature	1.0 C
Sp1 temperature	3.1 C

(Unknown, 2011)

The picture taken by the infrared thermal imaging camera exposes the surface temperature in colours, demonstrating where the biggest heat losses appear in the building in such a way. According to this example, the heat energy is lost not only through the windows, but also through the old walls by big part. The darker colour, the more efficient house is. However, analysing the images above, such house is very inefficient, therefore the heat losses are enormous.

4.6 Renovation program

At the moment, the renovation of dwelling-houses is supported by the Joint European Support for the Sustainable Investment in the City Areas ("Jessica"). This initiative was implemented by the EIB with the European Commission. According to this initiative, the state members are able using the support from the EU structural funds, in order to compensate the investments in the projects of the sustainable cities. After investigating the possibilities of implementing this initiative in Lithuania, it has been decided applying for the demand side management, precisely, for the renovation of dwelling-houses (Atnaujink busta).

Lithuania, like many other former Soviet Union countries, is built-up by the old, energy insufficient dwelling-houses. It is estimated that there are more than 34,000 of houses of different sizes built before 1993, and that equals to 96% of total dwelling-houses in Lithuania. It is planned that till 2020 around 70% (which equals to approximately 24,000 houses) will be renovated, and around 0.86 billion EUR will be allocated for this activity; besides the government's and residents' financial resources, 57 million will come from the EU structural funds, 143 million from the European Regional Development Fund, and 86 million EUR from the European Investment Bank. According to the specialists, the retaining structures of these Soviet buildings are in a quite good shape, but the real damage occurs in their roofs, walls, entrances, water-supply and draining systems, electrical inlets, etc (Sirvintu krastas, 2009).

The financial resources for house renovation projects are allocated from the Supervisory fund, which was established by the Ministry of Finance and the Ministry of Environment and the EIB, the latter was chosen to be the superintendent of the fund. The EIB has framed the

competition conditions by which the financial stakeholders for the Supervisory fund were selected. The Supervisory fund supervised by the EIB provides long term loans through the financial stakeholders to the residents that want to renovate their house. This money invested into house renovation projects will come back to the fund and will be available for the further investments later on (Atnaujink busta).

At the moment, the valid provisions are that the following: till 31st December, 2013, the country government shall compensate 100% of the expenses used for the preparation of renovation project and for the technical supervision of construction, also it compensates 100% of the administrative expenses for renovation project implementation. But as of the 1st January, 2014, the expenses mentioned above will be financed only by 50%. However, the government is engaged financing 15% of total renovation cost to the citizens, however, previously this percentage amounted 50% (Atnaujink busta). Nevertheless, the citizens decided realizing their house renovation can receive the long term preferential loans (for up to 20 years) with the fixed interest rate of 3%. Besides that, if the renovated house reaches the certain energy efficiency level, it is possible getting the extra financial support of 15%. Even though, the support on expenses for the house renovation is reduced, the cost for renovation is estimated nowadays to be around 40-50% lower than a few years ago before the crisis hit. Therefore, the total cost for renovation can be much smaller than a few years ago, and the citizens need taking the smaller loans (Sirvintu krastas, 2009).

The new model for financing the house renovation process shall allow spending less of income to the residents for the heating and preferential loan, compared to those who pay for heating only in the not renovated building. Furthermore, all expenses on the project implementation are compensated for the families with special needs and for citizens that live alone, i. e., their bank deposits are 100% covered as well, since there is a will involving all residents into this program – even those whose incomes are low (Atnaujink busta).

It seems that there are ambitions and fair conditions for this activity to happen, unfortunately the implementation of renovation program is happening quite slow (Sirvintu krastas, 2009).

4.7 Conclusions

- The biggest issue in the area of centralized thermal power supply in Lithuania seems to be the inefficient management of dwelling-houses. Since there are no appropriately established functional communities with the assigned one responsible chairperson, this leads to the lack of organization. The administrators assigned by the municipalities are not the residents of the houses, therefore, they show no interest in the house renovation opportunities.
- When there is no community established and the chairperson assigned, that would well represent the interests of all residents- the services are provided by many

different subjects, various payments are collected in dwelling-houses, and the residents very often do not understand what they are paying for and who is responsible for what.

- Even though, the thermal power suppliers have improved during the last few decades and upgraded their technical and economical level, the real problem is the enormous consumption trend in the dwelling-houses.
- The existing initiative for the house renovation makes the favourable financial conditions implementing the renovation projects and allows spending less for the heating and taken loan (with fixed interest rate) to the residents, compared to those who pay for heating only in the not renovated building. Such savings are possible, as most residents pay the monomial price for heating – only for the consumption during the heating season. Besides, the renovation costs are estimated being around 40-50% lower than a few years ago.

Therefore, the first step for start solving the problem of the enormous thermal energy consumption in the dwelling-houses and being able to reclaim the existing financial support is to establish the well functioning community with one appropriate chairperson that would represent the interests of all residents and would be interested in the renovation possibilities.

5. Present socio-economic situation and thermal energy consumption and natural gas import statistics

In order for the house renovation scenario to be considered practicable and feasible certain preconditions in the current situation must apply. This chapter includes the evaluation on socio-economic, thermal energy and natural gas consumption situation in Kaunas and Lithuania. Thus, the present situation analysis is used to show that there are areas that could benefit from the house renovation scenario and in exchange these areas would make this scenario implementation realizable and feasible.

5.1 Unemployment and migration

Lithuania experienced a considerable unmeployment rate in 2010. Having a total population of about 3 million at the time, which keeps decreasing due to a considerable emigration, the number of people unemployed in 2010 was 291,100 from the 1,634,800 possible labour force. During the economic recession period the unemployment rate increased more than four times, which can be explained as every fifth person willing and able to work cannot find a job at the moment. The growing number of long-term unemployed people damage the growth of Lithuanian economy, which as a consequence harms the social situation. The following table summerizes the statistics of labour force including data under each gender.

Table 5.1 Labour force statistics in Lithuania 2010

	Labour force	Unemployed	Unemployment rate
Men	812,600	172,400	21.2%
Women	822,200	118,800	14.4%
Total	**1,634,800**	**291,100**	**17.8%**

(Lietuvos Statistikos Departamentas, 2011)

Lithuania experienced the economic growth from 2001 till 2007, creating a “golden age” specially for the construction sector, which accordingly generated a considerable employment. However, the economic recession lead to a serious depression which has decreased employment significantly. During its “golden age” people migrated to the construction sector, therefore when the stagnation hit this sector in 2008- it caused a huge rate of unemployment, which stopped not only the migration of employees from different sectors, but left lots of skilled construction workers without their jobs, also. The construction sector is one of the main areas of increased unemployment rate, and knowing that around 90% in it are the male employees- it had dramatically changed the employment trend between this gender (Nordea, 2011).

Moreover, just in the Kaunas region there are 55,900 people unemployed, which represent the ratio of 13% of the registered unemployed people with the possible labor force in this city (Lietuvos Statistikos Departamentas, 2011).

Besides, this economic recession led to a huge emigration between Lithuanian citizens'- 83,157 people left Lithuania in 2010, when only 5,213 immigrants came to the country- amounting to -77,944 net migration (Lietuvos Statistikos Departamentas, 2011). According to the statistics of 2010, 228 people by average per day emigrated from Lithuania, when only 14 per day immigrated to the country (Lietuvos Statistikos Departamentas, 2011).

5.2 Employee's salary and tax

According to Lietuvos Statistikos Departamentas, the average monthly gross salary in the Kaunas region in 2010 was 585 EUR, which corresponds to the net salary of 456 EUR (Lietuvos Statistikos Departamentas, 2011). Employees from the construction sector in the Kaunas region got an average monthly gross salary of 500 EUR in 2010 (Lietuvos Statistikos Departamentas, 2011).

At the moment there is a 15% set income tax. However, there is a formula applied to calculate a non-taxable income, if the income exceeds 2,743 EUR per year, otherwise the non-taxable income is 1,611 EUR deducted from the yearly gross salary.

$$\text{Non-taxable income} = 1{,}611 \text{ EUR} - 0.2 \times (\text{yearly income} - 2{,}743 \text{ EUR})$$

Furthermore, before applying the 15% tax, from the taxable income the following can be deducted: fees of life insurance and pension fund, interest rate of one loan taken before 1st of January 2009 to buy or build a house, fees for vocational training and certain studies. The overall deducted sum shouldn't exceed 25% of the total taxable income, to which 15% tax is applied (Lietuvos Respublikos Finansu Ministerija, 2011).

5.3 Unemployment insurance benefit

In Lithuania, this payment consists of fixed and variable parts, where the fixed part is 81.4 EUR/month at the moment. However, the variable part represents 40% of the former salary, that employee was getting for the last 36 months till he became unemployed. Furthermore, the period of unemployment insurance benefit depends on the total years of person's work experience: if it is less than 25 years- the period of unemployment insurance benefit is 6 months, if it's from 25 to 30 years- 7 months, 30-35 years- 8 months and 9 months if it's over 35 years. For the first 3 months unemployed person gets 100% of his defined unemployment insurance benefit, but it gets reduced for the remaining months- fixed part together with the half of variable part. However, in all cases the maximum uneployment insurance benefit shouldn't exceed 282.8 EUR/month (15 min.lt, 2009).

5.4 National budget and deficit

The Lithuanian national budget amounted to 6,971,114,286 EUR together with the EU and other international financial support in 2010. However, the expenditure was 8,379,657,143 EUR comprising the deficit of 1,408,542,857 EUR (Lietuvos Respublikos Finansu Ministerija, 2009).

5.5 Trade balance

The external trade of Lithuania amounted to 33.37 billion EUR in 2010, which increased by 34% compared to the previous year. In 2009, the trade balance was at its lowest since 2004- 1.33 billion EUR, due to the bigger increase of exports compared to imports in the country. In 2010, the trade deficit increased again to 1.93 billion EUR, but it is still much less than the trade deficit in 2007, which was 5.3 billion EUR.

Table 5.2 Lithuania's external trade in 2010

Export	Import	Trade balance
15,716,030,000 EUR	17,650,230,000 EUR	-1,934,200,000 EUR

(Balticexport.com)

Table 5.3 Main partner countries for exports

Country	Share
Russia	15.6%
Germany	9.8%
Latvia	9.6%
Poland	7.7%
Netherlands	5.5%
Byelorussia	5.2%
Estonia	5%

(Balticexport.com)

Table 5.4 Main partner countries for imports

Country	Share
Russia	32.6%
Germany	10.9%
Poland	8.8%

(Balticexport.com)

As it can be seen from the tables provided above, the main export and import partners in 2010 were firstly Russia and countries from the European Union.

5.6 Thermal energy consumption trend in Lithuania and Kaunas

Table 5.5 Thermal energy consumption trend in Lithuania and Kaunas in 2010

Total thermal energy	Lithuania	AB "Kauno energija"
Supplied	9,803,500 MWh	1,696,700 MWh
Consumed	8,173,900 MWh	1,381,900 MWh

(Lietuvos Silumos Tiekeju Asociacija, 2011)

The losses in the centralized thermal energy supply in Lithuania amounted to 15.7% and in AB "Kauno energija"- the thermal energy supplier in Kaunas- 18% in 2010.

87.5% of the AB "Kauno energija" supplied thermal energy was bought from KHPP, which was 1,485,200 MWh in 2010. As mentioned in the previous chapter, the only fuel used in KHPP is the natural gas supplied by the Russian gas concern- "Gazprom".

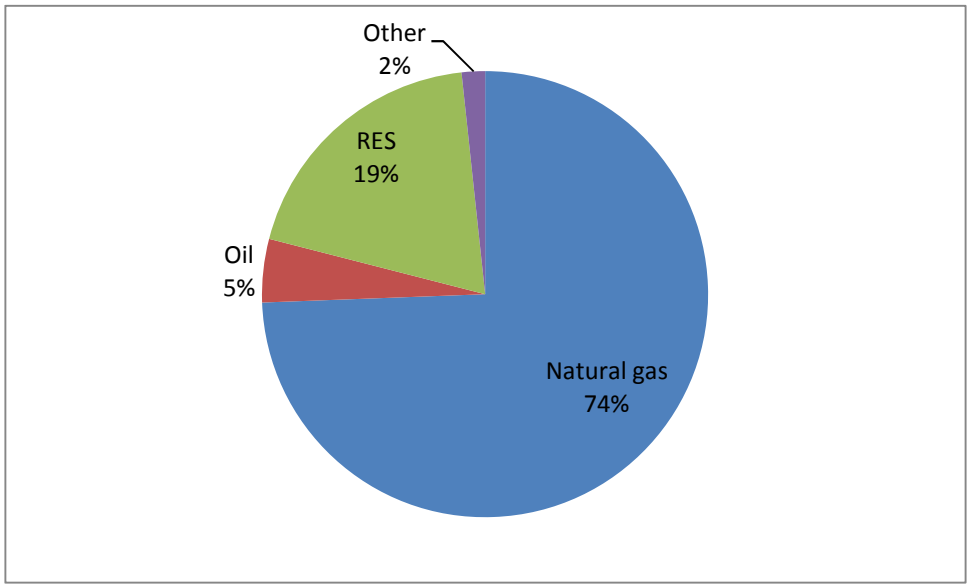


Figure 5.1 Fuels consumption trend in the Lithuanian thermal energy supply in 2010
(Lietuvos Silumos Tiekeju Asociacija, 2011)

5.7 Natural gas import and cost

The total gross natural gas consumption in Lithuania in 2009 was 2,727,000,000 cubic meters, where the final consumption amounted to 650,600,000 cubic meters (Lietuvos Statistikos Departamentas, 2010).

The natural gas supplied by the Russian gas concern "Gazprom" is approximately one third more expensive at the Lithuanian border than that at the German border. According to the data of September 2010, Lithuania was paying 226 EUR (320 US dollars) for 1,000 cubic meters of natural gas, whereas Germany paid only 155 EUR (220 US dollars) (Diena.lt, 2010).

Knowing the total gross natural gas consumption in 2009 and assuming that the price and consumption trend in 2009 and 2010 stay the same, the total amount paid for the imports of natural gas is 616,302,000 EUR each year.

5.8 Conclusions

- There is a large employment potentiality and there are enough of unemployed skilled workers from the construction sector. Hence, the encouragement of investment and activity in the construction sector like the renovation of dwelling-houses could lead to a bigger employment and probably would decrease the emigration.
- Lithuania possesses the deficit in national budget and its trade balance is negative- this could be improved by implementing the house renovation scenario, also.
- Natural gas is the main fuel used to generate heat power in the country and the price for it is high since the Russian gas concern “Gazprom” holds a complete monopoly. Therefore, house renovation projects could be seen as very advantageous in becoming less dependent on the natural gas supplied from Russia.

Consequently, because of all these specific national problems, linked to the socio-economic situation and thermal energy and natural gas consumption, the house renovation scenario becomes more viable and therefore it is important to include these areas into feasibility studies analysis.

6. Case study

The case study was performed in order to show the possibilities and barriers that residents are facing while decided to renovate their dwelling-house. It is to investigate if residents really achieve the promised financial support and what difficulties they meet during the implementation of their house renovation project. Consequently, in such a way the possible limitations and gaps in renovation process are being demonstrated thus they could be considered for the improvements in the future. However, this house renovation chosen for a case study was realized with a different financial support than the one that is available for the time being.

6.1 House renovation process of Apolonija‘s community

Apolonija Laukeviciniene was the chairperson of her community since 1999. There are 121 apartments in her dwelling-house and it has the total area of 5,778 m^2.

Even though Apolonija became a chairperson in 1999, she became interested in the house renovation opportunities before, especially when she was sick and had lots of free time. She was inviting the representatives from the agency, that was consulting and preparing renovaton projects, to the community meetings where this agency was giving the information and consulting regarding their house renovation possibilities.

Her house was renovated in 3 stages, the following tabe summerizes each of them.

Table 6.1 Renovation stages and their characteristics

	Start year	Total cost	National support	Works done
1st stage	2000	23,714 EUR	30%	• All pipes were changed; • Thermal station was renovated, with installation of two record devices- one for heating and one for hot water.
2nd stage	2002	42,286 EUR	30%	• Roof was renovated; • All outside doors were changed.
3d stage	2008	542,857 EUR	50%	• Electrical system was changed; • Outside walls were renovated; • All windows were changed; • Pedestal was renovated; • Drain system was renovated; • Foundations were renovated.

(Laukeviciene, 2011)

Before the first stage, the house residents were unsatisfied with the hot water supply- all pipes were in a bad condition, they didn‘t know how much of thermal energy they consume for heating and how much for preparing hot water. Therefore, firstly they decided to change the pipes, renovate the thermal station and install two record devices- one recording the thermal energy consumption used for heating, another- used for prepraring the hot water and since then, the hot water is being produced in the building.

The first renovation was implemented under the “Energy savings“ program which was supported by the World Bank. The financial support at that time amounted to 30% of the total renovation costs, though the audit and technical project were financed by 100%. The interest rate was set by the World Bank at that time, which was 11%. According to Apolonija, the costs for thermal energy dropped after the first renovation already and the expenses of the first stage were covered in two seasons.

The second stage of renovation was implemented according to the same program, therefore the support and interest rate were the same. During this renovation which took place in 2002- the roof and all outside doors were changed.

After the second stage, the thermal energy consumption has dropped even more. Even though, some residents were claiming that they pay the same as before, but Apolonija states that the price for thermal energy has increased since then, therefore the residents would have paid even more if this renovation hadn‘t happened.

Considering the compensation, Apolonija says there was no problem in getting the promised financial support. When the time was to pay for the works done, the contractor was writing one bill to the community amounting to 70% of the total costs, whereas the rest 30% were written to the government stragith. Therefore, the community never had difficulties in receiving this promised support. The same was with the loan- the bank was dividing bill into two parts 70% for the residents and 30% for the government- and the same situation was for the first and second stages.

The third stage started in 2008 and finished in February 2010. It was financially supported by the new program, when 50% of the expenses were covered. Apolonija mentioned, that this 50% support lasted very shortly, and her community had troubles in getting it even though their project was already confirmed and the works had already started. When their project was suspended for this support, Apolonija by herself went to the Ministry of Finance to demand the promised compensation. Nevertheless, she succeded to get this 50% support, even though for the new projects it was lowered to 30% at that time. However, the house residents had to cover the audit and technical project- there wasn‘t any remuneration on that.

At the third stage the residents decided to install a new electrical system, to change the windows in stairwells, apartments and balconies, to renovate the outside walls, pedestal, drain system and foundations. Apolonija demanded to insulate the foundations down to 60 cm, and to use plate instead of daub for the walls insulation, since it is much easier to change a plate if it gets unglued than to change daub when it starts to crumble from the walls.

In general, the third stage took much more effort and was more difficult than the previous two in financial and technical respects. First of all, this stage took place during the so called “golden age” in the construction sector, therefore the prices were enormous- just the cost for the technical project was 9,140 EUR. Yet, during this program the technical supervision of the construction was included under this 50% support, whereas in the previous stages the residents had to pay for it separately. Second, the community had problems in getting the loan, even though the project started in 2008 and finished in 2010, the residents succeeded in getting it only in March 2011. According to Apolonija, the community was paying the deposits of previous loans responsibly, but this didn’t help in getting the third loan without troubles- during this renovation program there was one bank that won the governmental contest to have a right to participate, however the contract has expired and the bank has suspended this activity. The worst was that the bank kept promising the people that they

will receive it and kept people waiting and expecting when the renovation works had already started and they had to cover the expenses by themselves. Out of patience, her community applied to another bank, which promised to administer around 286,000 EUR, but then the crisis hit and it hasn't kept its promise, either. Finally, only the 4th bank they turned to gave them the needed loan with the interest rate that is re-counted every 3 months and it's 4.5% at the moment. Furthermore, Apolonija says that they had serious problems with one contractor and the technical supervision.

As before, after each work that was done during the 3d stage one invoice representing 50% of the total costs was written to the community, another- to the government.

Figure 6.1 The front side of the renovated dwelling-house

Figure 6.2 The front side of the not renovated dwelling-house

Figure 6.3 The back side of the renovated dwelling-house

Figure 6.4 The back side of the not renovated dwelling-house

Before the renovation, the last 5th floor suffered from the water leakage during rainy days and too high temperatures in summer and too low in winter time. Just after the second stage of renovation when the roof was changed- the temperature has increased around 5 degrees on the 5th floor in winter and it‘s not too hot anymore in summer time.

For the first two stages the community didn’t have to take big loans since many residents afforded to pay straight- the biggest apartment for the first stage had to pay around 200 EUR in total, though the costs for the second stage almost doubled. However, the third stage was the most expensive and the loan of 62,857 EUR was needed, even though 86 apartments managed to pay straight. Besides, the present chairperson has decided to take the third loan in Euro, which might increase the interest rate in the upcoming months. The loans were taken for 10 years period and they are completely compensated for the welfare families for all three stages- there are 26 apartments with the registered welfare residents in Apolonija’s house.

Considering the number of agreed residents for every renovation stage- the first stage had more than 50%, the second added around 30% to the previous number even more and at the third stage 102 apartments from the total 121 had agreed. Therefore, Apolonija didn’t have to convince the people, since all the rest had to surrender because more than 50% had signed for the renovation. However, if all or at least more of the residents sign for

renovation from the beginning- the conditions on getting the loan from banks are much better. The more people sign for the renovation the more credibly a community is evaluated by banks- the interest rate gets more favorable. Therefore it facilitates the implementation of whole project when more people agree from the beginning since at the end they have to agree anyway if there is more than 50% of the total number of residents that had already signed for it.

Nevertheless, it took some effort in persuading the house residents for the first renovation stage- Apolonija has invited different agencies and one chairperson that had already implemented the renovation to talk about its benefits and to show the real facts and numbers. Other stages were easier in taking the decisions in the community, since people have already noticed the improvements and achievements after the first renovation stage. Later on, after the renovation in her house- Apolonija went to agitate in few other communities by herself, talked about the purpose and achieved advantages since her house renovation was done by meeting high standards.

It is very important to implement the house renovation properly, with the best quality of works, materials and technical supervision possible, therefore the lowest investment cost shouldn‘t be the most important. Many contractors try to offer the lowest price in order to win the contest and to get the job, however the quality of works suffer at the end, since the lowest price cannot guarantee the best performance. Apolonija was really concerned to have the best quality, therefore was trying to engage the best contractors- was researching and asking the Ministry which companies are the best and trusted ones in order to have the renovation without any problems and defects afterwards. According to Apolonija, a renovation costs a lot of money, hence the quality of life has to be improved and the energy bills lowered considerably. There were some examples, when some communities have renovated their houses, but the works were done not properly- some significant defects appeared later on and the community couldn‘t solve this without paing extra money, even though the guarantee term hasn‘t expired yet, but the company that had done all those works got bankrupted.

Furthermore, it is even better if a chairperson has a competence by himself about the renovation activity- so he can check and evaluate by himself if the works, materials and technical supervision are performed accordingly. The Investments are high and none community wants to risk in paying this for the not qualitative renovation.

The voting took place and the signatures were collected only once and at the beginning of every renovation stage- deciding on the audit and investment project. As soon as the investment project is confirmed- the technical project is being prepared.

Moreover, Apolonija’s community is paying a monomial price for thermal energy- paying every month during the heating season just for what is consumed. According to her, this is

the only way to know how much of thermal energy is really used and what needs to be paid. However, separate record devices- one for hot water and another for heating are necessary; in such a way the community shall know where the energy is consumed most and will be able to take certain actions in order to improve the demand side management.

So far, Apolonija as well as the whole community are satisfied with the renovation- haven't noticed any defects and the energy bills are not as high as in not renovated houses. She lives on the 4th floor in the 44.5 m^2 size apartment and has an average temperature of 21 degrees all year long, though there are no thermostats on the heaters- it was not included in the renovation project then. However, the quality of life is obviously improved, as well as the apartment price is significantly raised.

6.2 Thermal energy consumption and cost comparison in the renovated and not renovated house

The followong table shows the thermal energy consumption and price per m^2 in the same type not renovated dwelling-house as Apolonija's and in her house in December 2010.

Table 6.2 Thermal energy consumption and price per m^2 in the renovated and not renovated house in December 2010

	Not renovated house	Renovated house
Cost	1.91 EUR/m^2	0.73 EUR/m^2
Consumption	25.21 kWh/m^2	10.06 kWh/m^2

(Laukeviciene, 2011), (Thermal energy bill, 2010)

These two buildings were built around the same year, but one of them was completely renovated and another- not, therefore the thermal power consumption in them differs by 60%. Knowing this data, it can be easily compared how much of heat Apolonija's house would consume and what her community would pay if their house was not renovated. The following table provides the results on this analysis considering that the total area of her house is 5,778 m^2.

Table 6.3 Total thermal energy consumption and cost in the renovated and not renovated house

	Total consumption	Total cost
Not renovated house	145,663 kWh	11,036 EUR
Renovated house	58,127 kWh	4,218 EUR
Difference	**87,536 kWh**	**6,818 EUR**

As this case study shows, the thermal energy savings in renovated house can be enormous, in such a way reducing energy bills for the residents significantly. Thus, Apolonija‘s community and their house renovation could be a good example and motivation for other communities to consider the opportunities of renovation, especially now when the construtions costs have dropped considerably and even though the support is 15%- the fixed interest rate of 3% is considered to be very favorable.

Figure 6.5 The comparison of the renovated dwelling-house in a prospect of the not renovated one

6.3 Conclusions

After the implementation of house renovation:

- The thermal energy consumption and costs are significantly reduced. This can be clearly seen from the comparison of the thermal energy consumption in renovated and not renovated the same type dwelling-houses.
- The quality of life is significantly improved.
- The condition and appearance of the house are significantly improved- the apartment’s cost is raised, accordingly.

It seems that there are no problems achieving the promised financial support, since the residents are responsible for covering the invoice representing only their share of total cost. However, it is worth highlighting that the lowest investment cost shouldn't be the most important, but the highest quality of works and materials should be guaranteed. Besides, it is very advantageous and even important if a chairperson has the competence by himself on the renovation works and process- so he could assess if everything is done appropriately. A renovation costs a lot of money- therefore all possible measures should be applied in order to guarantee the maximum improvements.

7. House renovation scenario consequences on the socio-economic situation and thermal energy consumption

This project concerns and analyses the house renovation scenario in the scope of Kaunas when including around 1/3 of the dwelling-houses that could be renovated in this city. There are around 5,500 dwelling-houses in Kaunas that are built before 1993 and could be possibly renovated (BUPA, 2011), but they are of different sizes and only around 1,500 houses have 5 and more floors (like the ones used in this project's case). Hence, it was estimated that the investments and thermal energy savings of the house renovation scenario in the scope of Kaunas represent around 40-50% only of the total potential in this city. Furthermore, the analysis of this scenario is performed on national level later on by applying it in the 10 times bigger extent. There are around 34,000 dwelling-houses in Lithuania that could be renovated (Sirvintu krastas, 2009), but just like in the case of Kaunas- their size and heating area can vary significantly. Therefore, it was estimated that there are 10 times more of the same type of dwelling-houses (of 5 and more floors) that have similar characteristics of the investment of renovation, heating area and possible thermal energy savings in Lithuania. However, the analysis on national level might represent around 50% only of the real potential of the total investments and thermal energy savings in Lithuania.

At first, the influence on Kaunas level is found- the generated employment and thermal energy consumption reduction. Later on, all socio-economic and energy conservation analysis on national level are performed assuming that this scenario is implemented in a 10 times bigger extent, since there is enough of potential for its realization. The performed socio-economic analysis includes evaluation on generated employment, contribution to national budget, reduction of deficit and influence on trade balance. The calculation tables are provided in the Appendix B.

The following table summarizes the total number of dwelling-houses with 5 and more floors in Kaunas, which are connected to the centralized heating system.

Table 7.1 Total number of dwelling-houses and their thermal energy consumption

Type of dwelling-house	5 floors	6 and more floors
Total number	1032	489
Annual thermal energy consumption before renovation	381.38 MWh/year	747.83 MWh/year
Annual thermal energy consumption per m^2 before renovation	171.02 kWh/m^2	156.7 kWh/m^2
Annual thermal energy consumption after renovation	193.53 MWh/year	444.65 MWh/year
Thermal energy saved after renovation	49.3%	40.6%

(Zinevicius, 2011)

The data provided in the table above is of 2005 and was obtained from "Kaunas Regional Energy Agency". According to this agency, 10 dwelling-houses were already completely renovated, 6 had some small works done and more 6 had started to be renovated in 2008. Therefore, in this analysis it was assumed, that in 2011 there are 16 dwelling-houses that are already completely renovated- 8 with 5 floors and other 8 with 6 and more floors. Therefore, in total there are 1,024 of 5 floors and 481 of 6 and more floors houses that can be renovated in Kaunas.

Even though, to the support of "Jessica" program can pretend smaller dwelling-houses than those of 5 floors- in this analysis only of 5 floors and bigger ones are considered, because thermal energy savings are greater in them.

The investment cost for the renovation is taken from (UAB "Miesto renovacija", 2010), where the case of the renovation of a dwelling-house of 5 floors in Kaunas was chosen. The house was renovated in 2009 and all main renovation measures were implemented- the windows in stairwells, apartments, balconies and basements were changed, the walls and roof were insulated, the thermal station and its system were reconstructed, the outside doors were changed. This case is considered to be the most appropriate, since all main house renovation measures were implemented and the construction costs in 2009 are closer to those in 2011. The following table summarizes the data on this house.

Table 7.2 Dwelling-house's characteristics

Name	Value
Total heating area	4,418 m^2
Number of apartments	100
Construction year	1974
Number of floors	5
Total investment*	486,100 EUR

(UAB "Miesto renovacija", 2010)

*Including the energy audit, preparation of investment and technical projects, technical supervision and organization.

Even though, dwelling-houses can have the same number of floors- the total heating area can vary substantially, and conversely- a house of 5 floors can have the same or similar heating area as of 9 floors house. For the same reason, the investment cost for renovation can also differ widely, therefore, for the sake of simplicity- in this analysis it was assumed that all dwelling-houses have the same investment cost of 486,100 EUR per house.

7.1 Analysis on Kaunas level

7.1.1 Generated employment

To estimate how much of employment can be generated in Kaunas- the total investment cost was needed. Knowing how much it costs to renovate one house and the total number of not renovated houses, the following formula was applied:

Total investment cost = (1,024 + 481) x 486,100 EUR = 731,580,500 EUR

According to the councilor (see Appendix A), the real potential for renovation projects varies from 50 to 100 houses annually, and knowing that there are 1,505 not renovated houses at present in Kaunas- this gives the time frame of 20 years to renovate all of them. The assumption was made that around 75 houses will be completely renovated in one year.

Further assumptions were made on the import share and domestic labor cost, where accordingly 20 and 80% were applied. 80% for the domestic cost is considered to be appropriate, since there are a lot of skilled workers in the construction sector that lost their jobs in the recent years due to the crisis. However, 20% for the import share is used to compensate some needed construction materials and maybe some project's preparation or supervision works. The following table summarizes the results.

Table 7.3 Investment costs for the house renovation scenario in Kaunas

Name	Value
Total investment	731,580,500 EUR
Domestic labor cost (80% of total)	585,264,400 EUR
Import share (20% of total)	146,316,100 EUR

To calculate the number of people employed, the data from the following table was used.

Table 7.4 Data on employee's salary and tax

Name	Value
Monthly gross salary*	500 EUR
Yearly gross salary	6,000 EUR
Income tax	15%
Non-taxable income**	959.6 EUR
Taxable income	5040.4 EUR

(Lietuvos Statistikos Departamentas, 2011), (Lietuvos Respublikos Finansu Ministerija, 2011)
*Average monthly gross salary in the construction sector in Kaunas region in 2010
**Non-taxable income = 1,611 EUR – 0.2 x (6,000 EUR – 2,743 EUR) = 959.6 EUR

Using the yearly gross salary, domestic labor cost and chosen time frame, the total number of 4,877 people employed per year in 20 years was found.

7.1.2 Thermal energy savings

By renovating 1,505 houses it would be possible to save 338,188 MWh of thermal energy annually at the consumption side. This number was obtained knowing that the dwelling-house of 5 floors consumes 381.38 MWh/year before and 193.53 MWh/year after renovation, and the dwelling-house of 6 and more floors consumes 747.83 MWh/year and 444.65 MWh/year, respectively. These savings, considering the total number of not renovated houses of 5 floors and of 6 and more floors, were applied to find the total thermal energy savings, which is 338,188 MWh/year.

7.2 Analysis on national level

7.2.1 Generated employment and the contribution to national budget

This analysis was performed assuming that the house renovation scenario is implemented in a 10 times bigger extent, encompassing more dwelling-houses in the other cities of Lithuania. Therefore, the calculations were done by multiplying the number of dwelling-houses by 10 which gives the total number of 15,050, or 1.5 million of flats.

The following table summarizes the results on investment costs.

Table 7.5 Investment costs for the house renovation scenario in Lithuania

Name	Value
Total investment	7,315,805,000 EUR
Domestic labor cost (80% of total)	5,852,644,000 EUR
Import share (20% of total)	1,463,161,000 EUR

Using the yearly gross salary, domestic labor cost and chosen time frame, the total number of 48,772 people employed each year was found. Knowing taxable income and a tax applied, the total contribution to national budget from the employees' taxes was found.

Moreover, since there is a considerable number of unemployed people in Lithuania and they get unemployment insurance benefits- the studied scenario would reduce these budget expenditures paid for the unemployed people, as well. For the sake of simplicity, in this analysis it was assumed that people that get employed by this scenario have less than 25 years of work experience and were getting a monthly gross salary of 500 EUR for the last 36 months. Therefore, the unemployment insurance benefit period is 6 months and payment for the first 3 months would be 281.4 EUR and 181.4 EUR for the remaining 3 months. By applying these assumptions and numbers, additionally, the total amount of 67,715,091 EUR can be saved in national budget by employing 48,772 people in the house renovation scenario in Lithuania.

Furthermore, by reducing the thermal energy consumption through the demand side management in Lithuania it is known that the natural gas consumption is reduced significantly. Since Lithuania has adopted the Directive 2003/87/EC that establishes the scheme for greenhouse gas emission allowance trading within the Community- Lithuania can trade its given but not used emission allowances. Since 1 kWh of natural gas emits around 205 gr. of CO_2 equivalent and assuming that the price for 1 ton of CO_2 equivalent is 20 EUR, the additional contribution to national budget could be 21,136,751 EUR/year. Worth noting, that here a total consumption reduction at the power plant was used, which is 3,381,880 MWh/annually together with the 18% losses in the supply system and possible 20% losses at the power plant. Although, this extra income from the CO_2 allowances that could be sold could be also added to benefit the trade balance instead of national budget, however, in this case it was assumed that a certain condition apply- the projects that get the subsidies from the state also gives their saved CO_2 allowances to the state, in such a way giving their contribution to naitonal budget.

The following table summarizes the results of the contribution to national budget.

Table 7.6 Results of the contribution to national budget

Name	Value
Contribution from employees' taxes	36,874,584 EUR/year
Contribution from reducing unemployment insurance benefits	67,715,091 EUR/year
Contribution from reduced CO_2 emissions	21,136,751 EUR/year
Total contribution to national budget	125,726,425 EUR/year

It is worth noting that by employing 48,772 people and increasing their income- it increases the national consumption, respectively. People are able to buy and pay more for the goods and services. Consequently, by increasing the consumption- the national economy is also improved and this would additionally contribute to the national budget. However, this was not included into this analysis, but is certainly worth to be taken into consideration.

Besides, the skilled workers employed again in the renovation projects would not forget their skills and competences.

7.2.2 Thermal energy savings and the contribution to trade balance

The Lithuanian energy sector is very dependent on the imported natural gas from Russia. The imports of natural gas in Lithuania in 2009 were 2,727,000,000 cubic meters and the price was 0.266 EUR/cubic meter for it. By renovating all 15,050 houses it would be possible to save 3,381,880 MWh of thermal energy annually. Cosnidering that there are some losses at the power plant and in the thermal energy supply system, the thermal energy savings can be up to 5,155,305 MWh/year. This number was obtained by applying 18% of losses in the AB "Kauno energija" supply system and assumed losses of 20% at the KHPP. Even though, the KHPP produces thermal energy in water-boilers, as well as in a co-generation mode- in this analysis those losses in water-boilers are considered only, since they have 670 MW of installed capacity, whereas a co-generation mode has only 320 MW. Therefore, for the sake of simplicity, the installed capacity in a co-generation mode is neglected assuming that all 20% of appeared losses will be in water-boilers only (Kauno Elektrine, 2009).

These 5,155,305 MWh were converted into cubic meters, by applying this equation:

$$1 \text{ cubic meter} = 11{,}06 \text{ kWh}$$

Therefore, by renovating 15,050 dwelling-houses 466,121,609 cubic meters of natural gas can be saved annually. The following table summarizes the results on the total savings of thermal energy, natural gas and cost.

Table 7.7 Results on the total savings of thermal energy, natural gas and cost

Name	Value
Total savings of thermal energy	5,155,305 MWh/year
Total savings of natural gas	466,121,609 cubic meters/year
Total saved cot	105,343,484 EUR/year

However, the assumption was made that the price for natural gas does not change in the next 20 years- it stays 226 EUR for 1,000 cubic meters. However, since the fossil fuels are becoming very expensive due to the increase of their scarcity- the reduction of natural gas consumption would contribute to trade balance even more in the next years if evaluating this aspect.

Also, by developing the renovation projects of high quality and improving people's skills further- the developed measures and gained experience could be transferred to the neighboring countries as export products. Therefore, in the future this could add more advantages to the side of trade balance, as well.

7.3 Results' analysis

7.3.1 On Kaunas level

7.3.1.1 Generated employment

The following table provides the data on unemployment level in Kaunas.

Table 7.8 Present unemployment situation in Kaunas

	Kaunas
Unemployed	55,900
Unemployment rate	13%

(Lietuvos Statistikos Departamentas, 2011)

By renovating 1,505 dwelling-houses in Kaunas in the 20 years time period- it can generate the employment for 4,877 people and this can reduce the level of Kaunas unemployment by 8.7%.

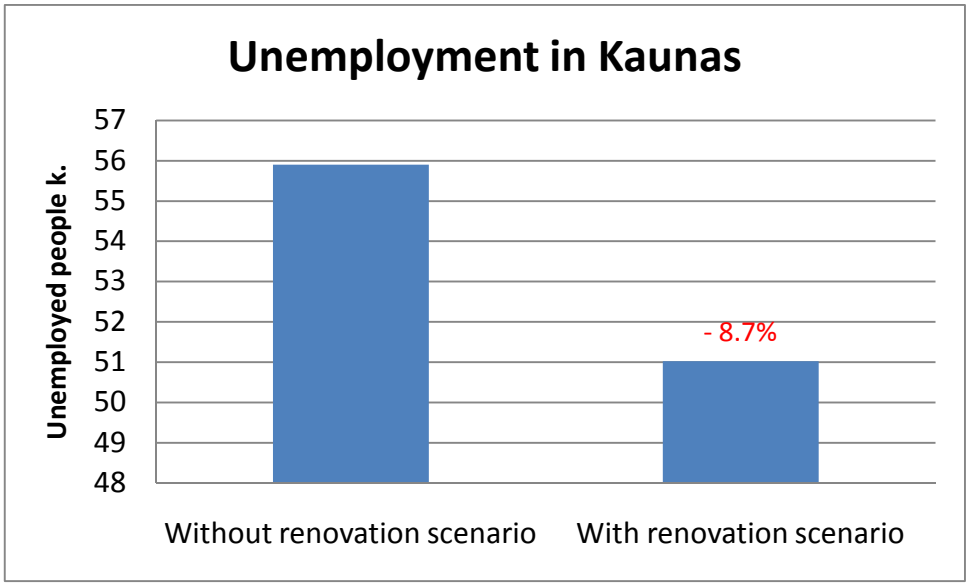


Figure 7.1 Unemployment in Kaunas with and without the implementation of the house renovation scenario

Therefore, by actualizing the renovation scenario in Kaunas and only of those bigger dwelling-houses of 5 and more floors- a significant number of employment positions can be generated. Since there are quite a lot of skilled people unemployed, especially from the construction sector- the house renovation scenario could be very advantageous if evaluating this aspect. It is worth noting, that it might be possible to realize this house renovation scenario in a shorter period- in 10 years, in such a way it would double the employment per year. It would be very beneficial since this employment would come in the period of present massive unemployment.

7.3.1.2 Thermal energy savings

Furthermore, by implementing the house renovation scenario in Kaunas- the thermal energy consumption could be decreased by 24.5% in this city.

Table 7.9 Present thermal energy consumption in Kaunas

Name	Value
Thermal energy consumption	1,381,900 MWh

(Lietuvos Silumos Tiekeju Asociacija, 2011)

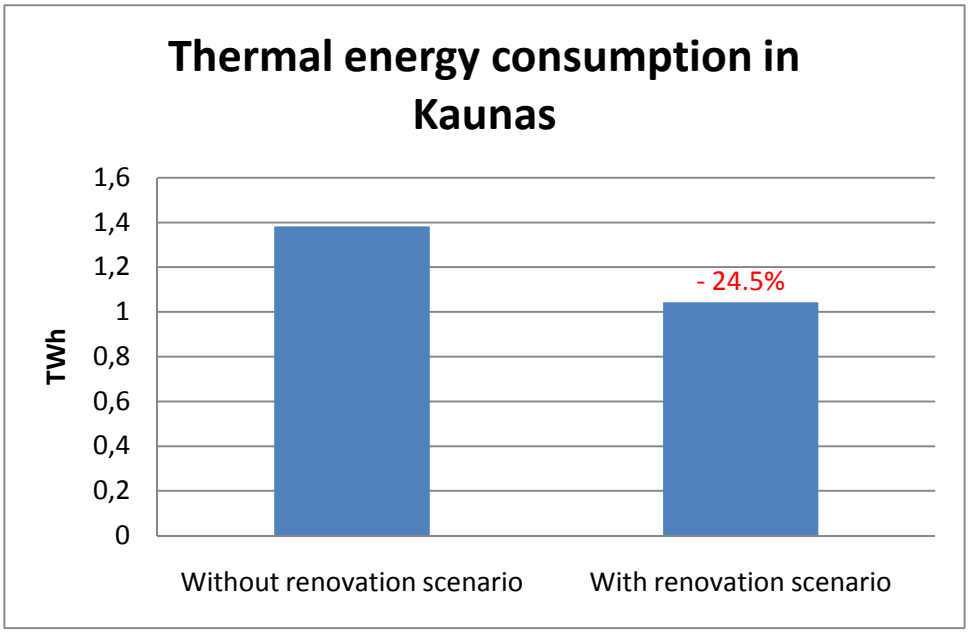


Figure 7.2 Thermal energy consumption in Kaunas with and without the implementation of the house renovation scenario

Worth noting, that the reduction in Kaunas thermal energy consumption in this graph is showed by renovating 1,505 dwelling-houses of the possible 5,500 only. This represents around 1/3 of the total number of houses that could be renovated and around 40-50% of the possible thermal energy savings in this city.

Therefore, this scenario gives a good effect for Kaunas in decreasing the dependence on the thermal energy generated in KHPP, where only "Gazprom" natural gas is used.

7.3.2 On national level

Once more, this analysis is based on the assumption that the house renovation scenario is implemented in 10 times bigger extent in whole Lithuania. However, there might be an underestimation of the real potential of the investments and thermal energy savings due to the possible bigger number of dwelling-houses of 5 and more floors or the possible bigger thermal energy savings than chosen for this case. Besides, if both potentials- the number of houses of 5 and more floors and thermal energy savings are underestimated- the extent might be even 30 times bigger instead of 10.

7.3.2.1 Employment

By renovating 15,050 dwelling-houses in Lithuania possibly 48,772 people can be employed and this would reduce the unemployment by 16.8% in the country.

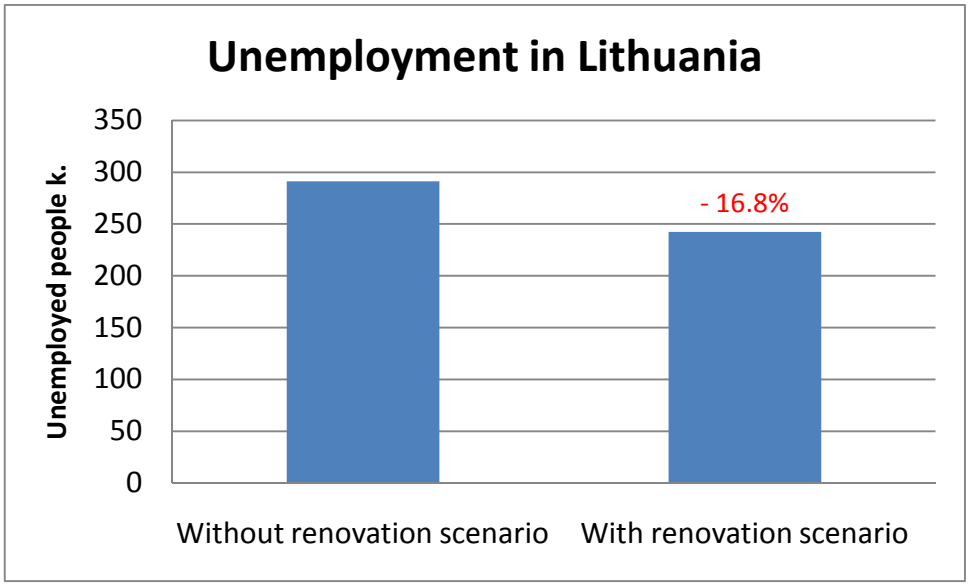


Figure 7.3 Unemployment in Lithuania with and without the implementation of the house renovation scenario

7.3.2.2 Public finances

The following table summarizes the situation on the public finances in Lithuania.

Table 7.10 Present situation on the public finances in Lithuania

Name	Value
National budget	6,971,114,286 EUR
Budget deficit	1,408,542,857 EUR
Trade balance	- 1,934,200,000 EUR

By implementing the house renovation scenario- almost 126 million EUR could be added to the national budget from employees' taxes, by reducing unemployment insurance benefits and by reducing CO_2 - this could increase the national budget by 1.8%. Furthermore, there is a considerable amount of deficit in the national budget and by renovating 15,050 dwelling-houses in the country it could be reduced by 8.9%.

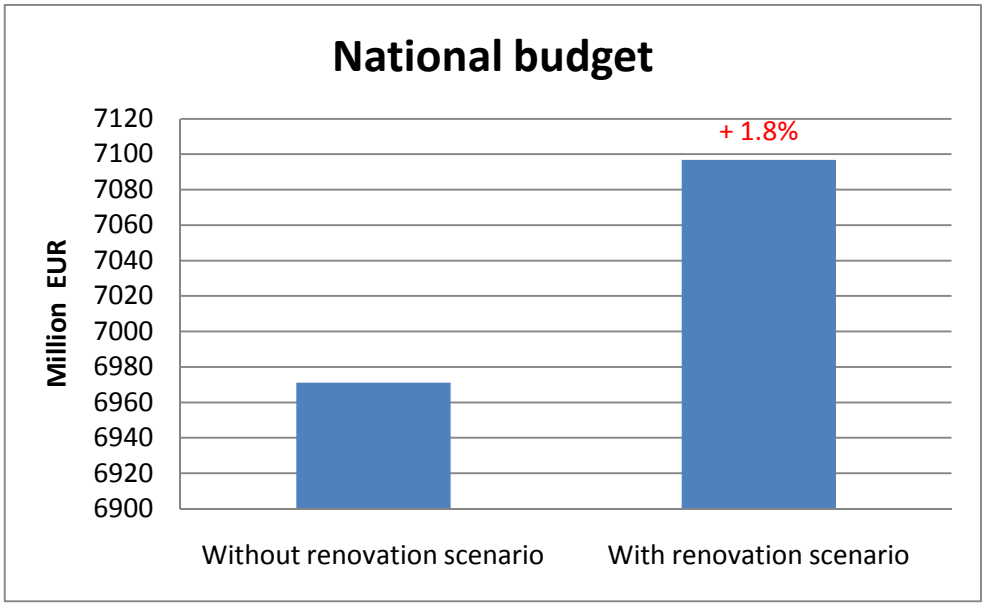


Figure 7.4 National budget with and without the implementation of the house renovation scenario

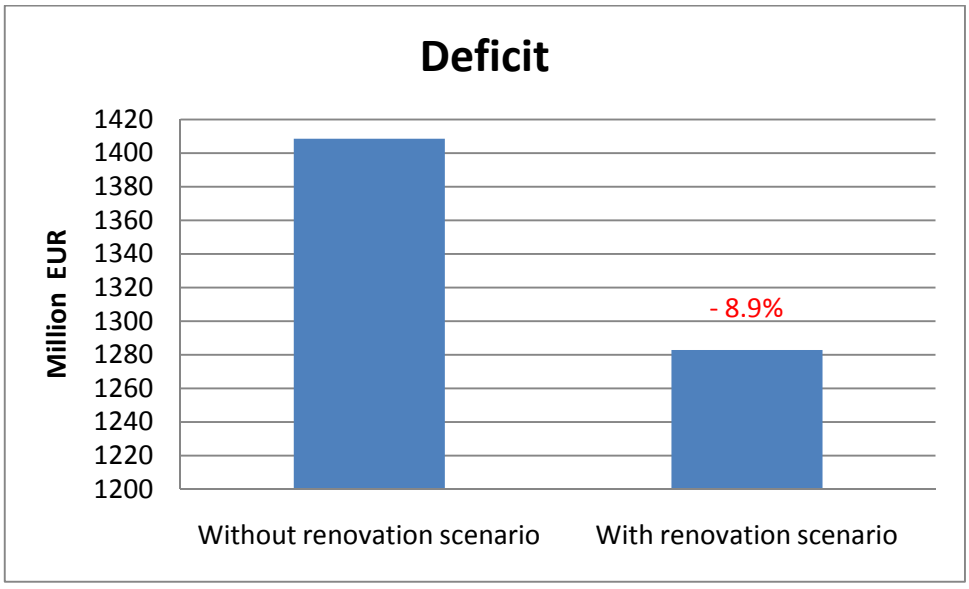


Figure 7.5 Deficit in the national budget with and without the implementation of the house renovation scenario

Another national problem that Lithuania is facing is a negative trade balance, which was -1,934 million EUR in 2010. Consequently, by implementing the house renovation scenario in a 10 times bigger extent it could be reduced by 5.4%.

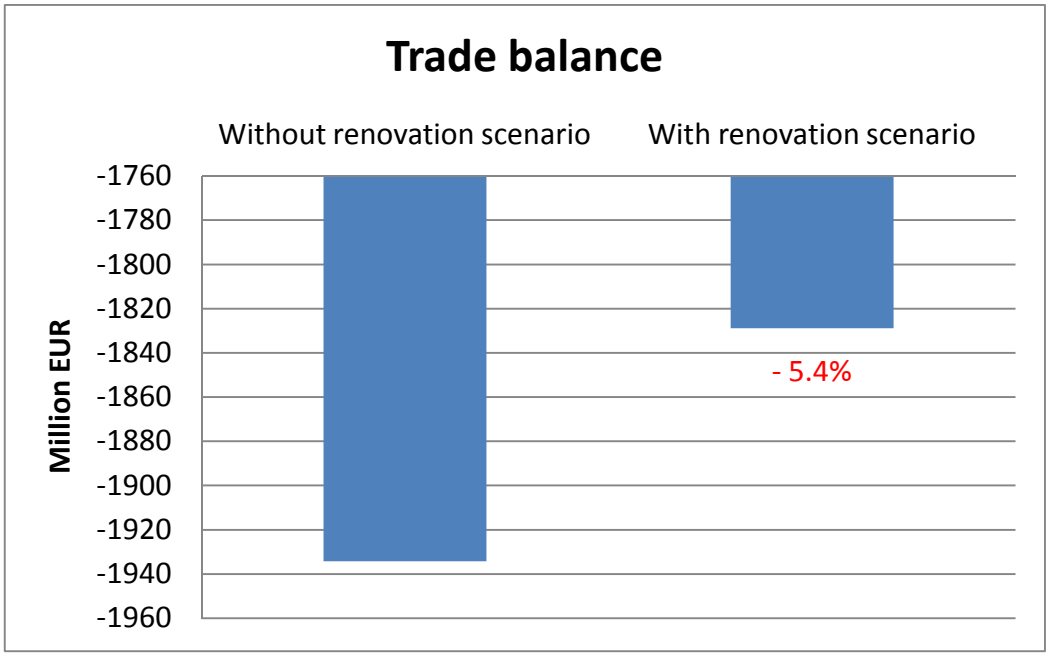


Figure 7.6 Trade balance with and without the implementation of the house renovation scenario

7.3.2.3 Thermal energy savings

Table 7.11 Present thermal energy consumption in Lithuania

Name	Value
Thermal energy consumption	8,173,900 MWh

By implementing the house renovation scenario in Lithuania, the thermal energy consumption could be decreased even by 41.4%.

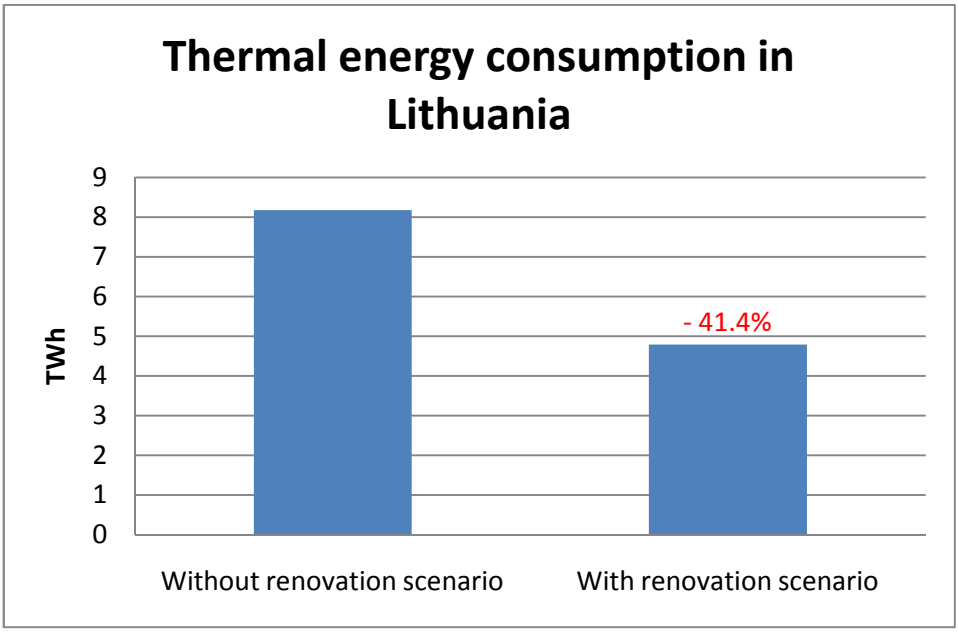


Figure 7.7 Thermal energy consumption in Lithuania with and without the implementation of the house renovation scenario

Therefore, this scenario gives a good effect for Lithuania in becoming more self-sufficient in primary energy supply since Lithuania is very dependent on the imported natural gas from Russia and the imports for it amount around 616,302,000 EUR every year. The applied house renovation scenario in the country could decrease these imports by 17%.

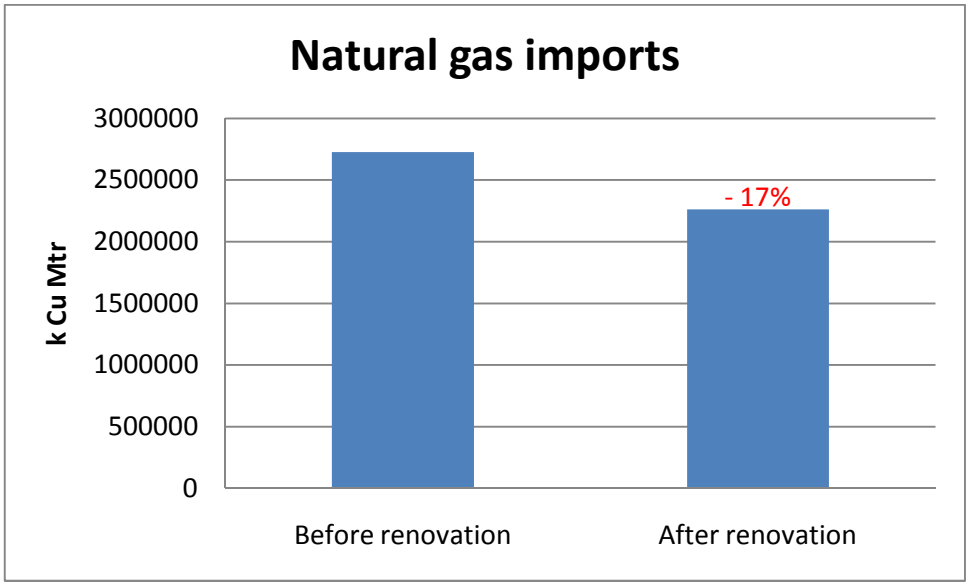


Figure 7.8 Natural gas imports with and without the implementation of the house renovation scenario

Worth noting again, that a factor of 30 instead of 10 might be more appropriate to apply for the house renovation scenario in the case of Lithuania. If it is the real potential, then the possible reduction of natural gas imports might be around 50%.

7.4 Investment analysis

7.4.1 In national respect

Considering the case chosen for this analysis of a dwelling-house of 5 floors with a total heating area of 4,418 m^2 and total investment cost of 486,100 EUR, this gives a cost of 110 EUR/m^2. Since the thermal energy consumption in a dwelling-house of 5 floors is 171.02 kWh/m^2 and the savings after renovation are up to 49.3% which gives 84.3 kWh/m^2, whereas a dwelling-house of 6 and more floors gives the savings of 63.6 kWh/m^2, accordingly. Knowing that the natural gas price for 1 cubic meter is 0.226 EUR and 1 cubic meter equals to 11.06 kWh, this gives the savings of 1.7 EUR/m^2 for a dwelling-house of 5 floors and 1.3 EUR/m^2 for a house of 6 and more floors. These savings seem to be quite low compared to the total investment cost and it could be argued that the renovation does not pay off comparing 110 EUR to 1.7 and 1.3 EUR. However, since the unemployment rate is high in Kaunas and Lithuania and the house renovation projects would provide lots of extra work positions for the local people- this investment could be considered much more beneficial. Furthermore, since only 20% is considered to be as an import share and the rest 80% as domestic labor costs- this would give only 22 EUR of investment as an import share per 1 m^2, since the rest 80% as domestic labor costs would generate a considerable quantity of employment positions. Consequently, 22 EUR/m^2 is a fair investment considering 1.7 EUR/m^2 and 1.3 EUR/m^2 as annual savings, which could be paid off in 13-17 years. Yet, this argument should be supported by the fact that the import share amounts to only 20% and the domestic labor cost is very advantageous for the generation of local employment.

Worth noting that only a short term price for natural gas is considered here- what is the price at the moment not considering its increase in the future. Besides, the price at the border is taken only- the distribution and CO_2 costs are not applied here, either. If all these extra costs were included- the investment cost would become even more favorable.

Furthermore, by reducing the thermal energy consumption in dwelling-houses it is clear that the thermal energy production at a power plant is reduced accordingly. Since there is a considerable consumption reduction- a lower temperature is needed in a district heating system and smaller pipes can be installed in a long term scenario. Therefore, by applying the house renovation scenario a smaller investment cost in a supply system in a long term is needed.

7.4.2 In residents' respect

As the previous analysis showed, the investment does pay off on national level sooner than in 20 years if considering the import share only. Also, it is very important if it does pay off for the residents, since the biggest share of investment they pay by themselves. It is known that the total cost of investment is 110 EUR/m^2 and that 15% of it is financed by the renovation program. However, this 110 EUR/m^2 of investment includes not just the construction cost but the energy audit, preparation of investment and technical projects, technical supervision and organization, as well. Since the renovation program compensates 100% of the preparation of renovation project, technical supervision of construction works and administrative expenses for renovation project's implementation- it was assumed that all of this amount to 10 EUR/m^2. Therefore, the total investment that is paid by the residents is:

$$\text{Investment paid by the residents} = 110\ \text{EUR}/m^2 - 10\ \text{EUR}/m^2 - 15\% = 85\ \text{EUR}/m^2$$

Since the thermal energy consumption in a dwelling-house of 5 floors is 171.02 kWh/m^2 and the savings after renovation are up to 49.3% which gives 84.3 kWh/m^2, whereas a dwelling-house of 6 and more floors gives the savings of 63.6 kWh/m^2, accordingly. Knowing that the thermal energy price for 1 kWh is 0.076 EUR- this gives the savings of 6.4 EUR/m^2 for a dwelling-house of 5 floors and 4.8 EUR/m^2 for a house of 6 and more floors.

Furthermore, the loan for house renovation has a fixed interest rate of 3% and is considered to be for 20 years, so this gives a present value of 96 EUR/m^2 for a house of 5 floors and 72 EUR/m^2 for a house of 6 and more floors. It is clear that the renovation investment in a house of 5 floors does pay off in 20 years, however it is not the same for a dwelling-house with more floors. Nonetheless, some assumptions were applied, that could influence the present value calculation considerably- not all dwelling-houses have the same heating area, as well as the investment cost can vary significantly. Also, the thermal energy savings per m^2 after renovation can be very different and all of this could give different results on the present value.

Anyhow, the house renovation scenario could be argued in a respect of the improvement of life quality, also. Since such measures as changing windows in stairwells, apartments, balconies and basements, insulating walls and roof, reconstructing thermal station and its system, changing outside doors are implemented- this improves the conditions of life considerably. Some things in human life like holidays, purchased car are materialized without considering the pay off time and house renovation could be seen with the same attitude- it is needed for the comfortable and joyful living. Besides, by implementing all the measures of house renovation mentioned above it raises the realty value- the apartment price is increased, accordingly.

7.5 Conclusions

The house renovation scenario is very beneficial for the city of Kaunas in reducing thermal energy consumption and generating employment, as well as on national level by implementing it in a 10 times bigger extent- such indexes as the employment level, deficit in national budget, trade balance are improved and the self-sufficiency in primary energy supply is increased. The following table sums up the results on the analyzed socio-economic aspects, as well as on the savings of thermal energy and natural gas.

Table 7.12 Analysis' results

Name	Value	
Unemployment	Kaunas (1,505 houses)	Lithuania (15,050 houses)
	-8.7%	-16.8%
National budget	+1.8%	
Deficit	-8.9%	
Negative trade balance	-5.4%	
Thermal energy consumption	Kaunas (1,505 houses)	Lithuania (15,050 houses)
	-24.5%	-41.%
Natural gas imports	-17%	

Note that, the minus indicates a reduction, whereas the plus shows that there is an increase of a value compared to the present situation. Besides, the results given for Kaunas are based on the house renovation scenario only in Kaunas by renovating 1,505 dwelling-houses, whereas the results for Lithuania are based on the house renovation scenario in a 10 times bigger extent- renovating 15,050 houses.

All values on national level wouldn't be that outstanding in the case of the house renovation scenario in the city of Kaunas, because this scenario is dealing only with 6% of the total dwelling-houses that could be renovated in Lithuania and around 40-50% of the real potential of investments and thermal energy savings in Kaunas. Therefore, this number was increased by 10 times encompassing more houses in more cities- in such a way representing the benefits on national level if this scenario was implemented in the whole country, since there is a potentiality for it. However, due to the applied assumptions, the real potential might be not 10 but even 30 times bigger in Lithuania and this would contribute to the values on national level much more.

However, the generated employment is beneficial on Kaunas and national level if there is unemployment only. Therefore, these conclusions should be seen in the condition of massive present unemployment- if the unemployment is reduced within 3-5 years- these conclusions won't be advantageous if considering this aspect. Hence, if the unemployment is reduced significantly in the future- it should be up to the politicians and residents to

consider the implementation and possibilities of house renovation, since it won't be supported by the fact of generated employment.

Taking 20% as the import share in investment cost and considering only the short term price for natural gas at the Lithuanian border, the house renovation scenario could pay off in 13-17 years on the national level when evaluating the reduction of natural gas consumption. Furthermore, if considering a dwelling-house of 5 floors- the renovation could pay off for the residents in less than 20 years, but it wouldn't be the case for the residents living in a dwelling-house of 6 and more floors. Even though, house renovation in the residents' respect could be challenged on the needed total investment, available public financial support and total thermal energy savings afterwards, it could also be seen as a method to raise the apartment's price and improve the quality of life, which are also strong arguments on this scenario side.

8. Possibilities and barriers to the implementation of the house renovation scenario

In the 2nd "Theoretical approach and methodology" chapter identified main actors in the global structure. Here they are explained in more in detail (micro structure) in order to analyse their influence on the possibilities of implementing the house renovation scenario. The possibilities lie in these actors responsibilities and interests and therefore their influence is important for the house renovation scenario. Later on, the technological, institutional and political barriers are identified according to the present situation and the results of project's analysis.

8.1 Micro structure

The micro structure can be described as the identification of possibilities for implementation of the house renovation scenario in Kaunas. In this structure each important actor that is included in the global boundary and corresponds to the macro structure are explained in brief, pointing out its role, resposibilities, influence or interests. Therefore, the micro structure represents the available conditions and possibilities for this scenario to become practicable.

8.1.1 The Ministry of Environment

This Ministry together with the Ministry of Economy are responsible for the house renovation projects. However, in this project only the Ministry of Environment is included in the global and macro structures as a relevant actor, since the Ministry of Economy is responsible for the renovation of public buildings only, whereas the Ministry of Environment together with its accountable agency are reponsible for the dwelling-houses. Therefore, the

Ministry of Economy is not considered to be an actor in this case, since this project concerns the renovation of dwelling-houses only (IQ.lt).

8.1.2 The Kaunas Municipality

The Kaunas Municipality owns AB "Kauno energija", which is the energy supplier in the city of Kaunas. Kaunas Heat and Power Plant (KHPP), which is the main thermal power generator in the city before was owned by AB "Kauno energija" and it was sold to the consortium in 2003. However, the Kaunas Municipality was not satisfied with the fulfillment of the contract, since there wasn't done promised investment in KHPP by the new owners and therefore it was even considered to terminate this contract. Nevertheless, the attitude towards the dependence on the thermal power generated in KHPP, where mainly the natural gas from Russia is used- is strongly linked to the politicians that are elected into the Municipality and to the city mayor. Even though, the previous mayor KHPP sale was calling as a faulty decision of the previous local government and there was a strong will to be less dependent on the imported natural gas (mediena.net), now there is a new mayor in the Kaunas Municipality from April 2011 and his interests and intentions on this issue are not clear yet. Anyhow, since the future situation in the thermal energy sector in Kaunas is vague- the local government could be responsible for promoting and initiating the establishment of communities and coordinating house renovation projects.

8.1.3 National control comission for prices and energy

This comission approves heat pricing methodologies and determines basic heat prices for the heat supplier selling at least 10GWh/year. It is also responsible for the validity of investments and operating costs, investigation of the complaints linked to the activity and failures of energy companies. Therefore, it is a very important actor concerning the thermal power sector and can influence the process in the house renovation scenario development by implementing corresponding prices for thermal power (National Control Commission for Prices and Energy, 2010).

8.1.4 Construction companies and skilled workers

Even though, these actors cannot influence a lot the implementation of the house renovation scenario in insitutional and political respect, but it is very important in a technological respect. It is very important to implement the best quality renovation, since bad practice can be easily spread around and scare off other communities not to renovate their houses. The construction workers should be motivated to perform their work in the best way, as well as the construction materials and technologies used should be of the best quality. In such a way, the house renovation would be the best promoted and the residents wouldn't see and hear about bad renovation cases. Therefore, these actors are very important for keeping the status of house renovation on the highest level.

8.1.5 Renovation program „Jessica“

At the present, according to the available renovation initiative “Jessica“, the communities that have decided to start their house renovation can expect this support:

- 100% compensation on the preparation of renovation project;
- 100% compensation on the technical supervision of construction works;
- 100% compensation on the administrative expenses for renovation project implementation;
- 15% compensation on the total costs of construction works;
- Preferential loan with the fixed interest rate of 3% for up to 20 years.

Furthermore, welfare residents and families are 100% financed on all the expenses linked to house renovation. Besides, the construction costs have droped by 40-50% comparing to those costs that were few years ago, therefore people don‘t need to invest that much or take big loans (Atnaujink busta).

The financial resources for house renovation projects are allocated from the Supervisory fund, which was established by the Ministry of Finance and the Ministry of Environment and the European Investment Bank, which was chosen to be the superintendent of the fund (Atnaujink busta). However, the main responsibilities in the house renovation program implementation belong to the Ministry of Environment.

It is the only renovation initiative and main financial support for house renovation projects. Most of the renovation projects of dwelling-houses wouldn‘t be even considered if this program was not available. Therefore, the organization behind this program is one of the main actors in the house renovation scenario that has a strong influence in its implementation process.

8.1.6 Residents, communities and chairpersons

Residents are very important in the issue of house renovation. These are the main players to initiate the renovation of their own buildings in order to minimize their thermal energy consumption and in such a way reducing thermal energy costs for themselves and for the city. However, the renovation activity has to be organized including all residents, but it is exremely difficult when there are a lot of apartments with many different owners in one building. Therefore, a proper and effectively managing community has to be established and this has to be done by the same residents. Furthermore, for the community to be able to take corresponding decisions and actions- a responsible chairperson has to be assigned. All these three actors are strongly interlinked- a community cannot be established without the will of all residents and a chairperson cannot be assigned without the established community.

8.1.7 Legal acts

There are startegies, laws, conventions and directives which Lithuania has adopted in the last years or about to adopt soon that would strongly influence the energy sector. However, in this case only those legal acts are considered to be as the main actors which can influence or are focused on the thermal power sector and can impact the house renovation scenario.

8.1.7.1 EU

Since Lithuania is in the European Union since 2004, it had to adopt certain directives. These directives that promote the reductions of emissions or pollution in the thermal power sector could be divided into 3 groups:

1. Directives that limit the discharged pollution into the atmosphere;
2. Directives that promote energy efficiency and energy generation from the renewable sources;
3. Directives that implement the instruments of economical environmental protection.

Directives that limit the discharged pollution into the atmosphere

- ***Directive 2001/80/EC on limitation of emissions of certain pollutants into the air from large combustion plants***
  It limits the amounts of discharged SO_2, NO_x, CO and other rigid particles from the plants that have 50 MW or more of installed capacity. However, Lithuania managed to negotiate on the transitional period till 31 December 2015, when the marginal values of sulphur oxide and nitrogen oxide are not applied to Vilnius, Kaunas and Mazeikiai power plants. Yet, there are total allowed limits set for these power plants:
  2010- 30,500 tons of SO_2 and 10,500 tons of NO_x per year;
  2012- 29,000 tons of SO_2 and 10,800 tons of NO_x per year
  (Lietuvos energetikos institutas, 2008).
- ***Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants***
  This Directive sets the limits for such pollutants as SO_2, NO_x, volatile organic compounds (VOC) and NH_3 till 2010, which match the values set by UN Gothenburg Protocol. The limits in Lithuania were set like this: 2010- 145,000 tons of SO_2, 110,000 tons of NO_x, 92,000 tons of VOC, 84,000 tons of NH_3 (Lietuvos energetikos institutas, 2008).
- ***Directive 96/61/EC concerning integrated pollution prevention and control***
  It sets the measures to prevent discharged pollutants into the air, water and ground, and it includes waste management, as well. If it is not possible to prevent the pollution completely- it has to be minimized in order to obtain the maximum level of environmental protection (Lietuvos energetikos institutas, 2008).

Directives that promote energy efficiency and energy generation from the renewable sources

- ***Directive 2002/91/EC on the energy performance of buildings***

  It promotes the effeciency in energy use in buildings and sets the requirements for the general methodology application for the calculation of energy use in buidlings, for the minimum requirements of energy input in buildings, for the regular checks of boilers and air conditioning systems, as well as heating system (Lietuvos energetikos institutas, 2008).
- ***Directive 2006/32/EC on energy end-use efficiency and energy services***

  The purpose is to increase energy efficiency for the end-users by setting the necessary orientation indexes, mechanisms, stimulating measures, as well as the institutional, financial and legal base. This base has to eliminate the obstacles and defects in the present market that are impeding the effective energy end-use, also stimulate and create the conditions for the market development of energy services and other installations of measures to increase energy efficiency in the consumption of end-users.

  The action plan on the energy efficiency in cunsumption was approved in 2007 in Lithuania. This plan defines the national energy savings of 325 toe for the period of 2008-2016, and the official national saving index is 9% of the total energy consumed in 2005 (400 toe) (Lietuvos energetikos institutas, 2008).

Directives that implement the instruments of economical environmenal protection

- ***Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community***

  It obliges the countries that have national emission allowance plans certified by the committee to start trading from 1st January 2005. The included sectors are: energy transformation and oil refinery, black metals manufacturing, mineral substances processing and cellulose and paper industry companies. They were given free emission allowances for the period of 2005-2007 according to the emission allowance plan. In the energy sector, companies that are included in the CO_2 trading have a nominal installed capacity of at least 20 MW. A general emission allowance amount for Lithuania was set to be 36,769,184 tons of CO_2 equivalent: 40% were dispensed in 2005, 30% in 2006 and the rest 30% in 2007.

  Furthermore, a general emission allowance amount of 44,256,520 tons of CO_2 equivalent was certified for the period of 2008-2012 (Lietuvos energetikos institutas, 2008).
- ***Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity***

  It had a purpose to equalize the excise for energy carriers from 1st January 2004. It sets the minimum excise levels for the motor fuel, including reduced tariffs in different sectors (agriculture, forestry, construction, public transport, etc.), for the

fuel used to generate energy, as well as including minimal excise for the electricity in order to form equal competition conditions in all EU countries. It is worth noting, that the excise is not applied for the natural gas and for the power products used to generate electricity (Lietuvos energetikos institutas, 2008).

8.1.7.2 International

- ***Convention on Long-range Transboundary Air Pollution***
  Countries that have signed this Convention agreed on the air pollution (considering SO_2, NOx, NH_3, VOC) control and pollution reduction by equal percentage (or to keep a present pollution level). Different Protocols of this Convention consider different objectives of pollution reduction. According to the Oslo and Gothenburg Protocols, Lithuania is commited to reduce the disharged SO_2 by 35%, NOx by 30%, NH_3 by 0% and VOC by 11% compared to the level of 1990 (Lietuvos energetikos institutas, 2008).
- ***United Nations Framework Convention on Climate Change***
  According to this Convention countries are commited to reduce the discharged levels of greenhouse gases. Same countries that have signed the UNFCCC in 1992 have signed the Kyoto Protocol, as well. Lithuania has signed it in 1998 and in the period of 2008-2012 is commited to reduce the disharged greenhouse gases by 8% compared to the base year of 1990 (Lietuvos energetikos institutas, 2008).

8.1.7.3 National

- ***National Energy Strategy (January 2007)***
  It is the highest document in hierarchical level, that plans the energy development and includes all of the energy sectors. The plans of energy sector development and implementation directions are set till 2025 and it is resumed not more often than every 5 years. The provisions include economy, energy security, environment protection and management aspects and they are fully combined with the rising national energy needs and international requirements. Futhermore, this startegy includes the ways and measures to ensure strategical energy supply, specially to neutralize or minimize the negative influnece of dominated energy supplier.
  The purposes in the thermal power sector include striving for the smallest prices possible, the secure and qualitative supply to end-users, stimulation of competetiveness between the different types of fuell, as well as different technologies. It is also very important to raise the efficiency in heat production, supply and consumption and to use more of the local sources, such as biomass and other renewable resources.
  The necesesary actions include development of co-generation, use of waste heat from the industrial sector, promotion of the thermal power generated from local energy sources, as well as from waste incineration. It is also important to improve the

infrastructure of thermal power supply together with the replacement of old pipelines by 75%. Also, the government has to take the responsibility for the formation and administration of needed funds and to frame the economical and legal conditions for house renovation (Lietuvos energetikos institutas, 2008).

- ***Law on Heat Sector (May 2003)***

  This law regulates the national management in heat sector, activity of its subjects and their relations with end-users, as well as the inter-relations and responsibilities. By this law the competition, heat sector planning, heat and hot water supply, contracts with end-users and their rights' protection, heat supply and facilities disconnection from the supply infrastructure, price formation and other related provisions are legalized. Additionally, there was a resolution on a new thermal power price formation method in March 2008. According to it, for the suppliers that sell not less than 10 GWh of thermal power per year and independent generators that generate more than 50% in one thermal power system and sell not less than 10 GWh of thermal power- the basic prices for heat are set by the National control comission for prices and energy, otherwise- the prices are set by the board of municipalities. From now on, all the suppliers shall be divided into the groups according to their size, and their activity input will be compared. Also, this commission shall supervise where the suppliers spend their finance got from selling the assigned amount units (AAUs) and if it was invested in the reduction of environment pollution. If the suppliers didn't invest this finance into the measures of pollution reduction- the expenditure for the additional AAUs would not be considered as a necessary expenditure in the thermal power supply activity in the future (Lietuvos energetikos institutas, 2008).

- ***National tax system on environmental protection***

  The main environmental problem caused by the thermal power sector is atmospheric pollution, which is caused mainly by burning the fossil fuels. The tax system on pollution is being regulated by the Law on Pollution Tax, which has a main purpose of the stimulation of suppliers to reduce their pollutions and emissions, to implement their waste prevention and management, not to exceed the emission normative, as well as to accumulate the finance from these taxes and to implement the measures of environmental protection.

  The tariffs on taxes and their coefficients on different pollutants (SO_2, NO_x, vanadium pentoxide, solid particles) are set according to their noxiousness. The coefficients are applied when the pollution exceeds the fixed normative. However, this system is considered to be little motivating for the thermal power suppliers in investing in cleaner technologies or using less polluting fuel (Lietuvos energetikos institutas, 2008).

8.1.8 Summary of the influence of different actors

All the key actors mentioned above have similar or different interests and responsibilities and each of them in some way is linked to the thermal power sector

or implementation of the house renovation scenario in Kaunas. Every actor has its own attitude towards the present situation or house renovation scenario and can influence in direct or indirect way. The following table summarizes the responsibilities, influence or interests of all actors in brief.

Table 8.1 Summary of the key actors and their influence

Key actor	Influence
The Ministry of Environment	Responsible for the implementation of dwelling-house renovation program. This actor is very important in making the house renovation scenario feasible, since it prepares the legal acts and documents regarding this.
The Kaunas Municipality	It is strongly linked to the thermal power sector in Kaunas. Besides that it owns the energy supplier AB "Kauno energija", it also has a power to promote and initiate the house renovation process. Moreover, for the house renovation scenario to become practicable- the communities need to be established, and this can be done with the help of the municipality, also.
National control comission for prices and energy	It is responsible for setting the prices in the thermal power sector in the country. Certain prices can motivate the residents to consider the issue of house renovation more seriously. The higher prices get- the more feasible the house renovation scenario becomes.
Construction companies and skilled workers	If the construction companies and their workers had influential decisions- the process of house renovation would certainly move fast forward. However, since it is not in their power to accelerate this process they can try to implement the renovation projects meeting the highest quality possible, in such a way showing only the good examples to other communities.
Renovation program "Jessica"	It's the only available financial support for house renovation projects. It certainly has a strong influence in the house renovation scenario, since many residents wouldn't even consider renovating their buildings if this initiative was not available.
Residents, communities and chairpersons	Residents are the first players when it comes to the question of their house renovation- they are the first to take decisions and actions. However, this is very difficult if a proper community with an interested chairperson is not defined among them and this can be organized and done by the same residents only. Therefore, they are very important in initiating- giving the first step in the

	renovation process of their building.
EU Directives	By adapting the directives that limit the discharged pollution into the atmosphere- it increases the price for power generation, since the investments in cleaner technologies are needed or additional cost is added for the dischared pollutants. Rising the price for thermal energy is a good motivation for the residents to consider renovating their house. Furthermore, the directives that promote energy efficiency and energy generation from the renewable sources make Lithuania to look into the scenarios where the use of energy could be improved and reduced in buildings- this is a very strong legal act on the house renovation scenario side. Finally, the directives that implement the instruments of economical environmenal protection are important in order for Lithuania to be able to sell the emission allowances, which can be obtained through the decreased thermal energy consumption after implementing the house renovation scenario.
International Conventions	Controls and seeks to reduce the air pollution and discharged greenhouse gases. It is a good motivation for increasing energy efficiency and reducing thermal energy consumption. Therefore, it is a favorable actor for the demand side management.
National legal acts	Besides, promoting the efficient energy use, they also seek to neutralize the negative influnece of dominated energy supplier. Moreover, they define the responsibility for the government in formating and administrating of needed funds and framing the economical and legal conditions for house renovation. Furthermore, the National tax system on environmental protection tries to stimulate the suppliers of thermal power to invest in cleaner technologies or to use less polluting fuel, and these investments might lay on the shoulders of end-users. Therefore, the national legal acts could be considered as an important actor, since it can stimulate to use energy more efficiently and reduce consumption- in such a way promoting the investments in the house renovation scenario.

8.2 Barriers

Even though, seems there are quite fair conditions and potentiality for the house renovation scenario to happen- the renovation process in Kaunas and whole Lithuania teritorry is still moving quite slow, which is might be explained by the following identified technological, institutional and political barriers.

8.2.1 Technological barriers

Technological barriers include those regarding the availability of needed technology and materials, skilled labor force and qualitative performance on works.

From 2001 till 2007 the construction sector in Lithuania experienced its “golden age”- the costs and employment were very high within it then. However, when the crisis hit, many companies got bankrupted leaving skilled workers jobless. Therefore, there are no serious barriers regarding needed working force in the house renovation scenario, since there are enough of skilled people that could fill in the available positions. Furthermore, most of the renovation materials are also available locally making this scenario even more practicable.

However, here the real barrier might occur not in the lack of labor force or needed technology or materials, but in the rumors of implemented bad quality renovation, which can be spread very fast between other communities. If one house was renovated by concerning on saving the investment cost, there is a big probability that some defects might occur afterwards. This should be strongly avoided, since bad renovation can impede this activity in other communities. Even though, there are enough of good examples in the renovation sector and quite a few happy communities with their renovated houses, unfortunately the ripples of bad experience spread around much easier, faster and further than those of good ones. This should be avoided by implementing only the best measures possible in renovation projects and not trying to get just the lowest price.

However, another problem that might arise is chairperson’s competence. Since it is the first person responsible for this activity, he should understand the whole process and works that need to be done. As the case study shows, if Apolonija wasn’t aware of the required quality for renovation works- most probably her community would be facing some defects at the moment or in the near future. Since she was interested and concerned by herself to implement this renovation without considering the lowest price, but really trying to get the highest class of service and materials- now her community can be happy about renovated house with a highest quality.

8.2.2 Institutional barriers

Include those relating financing, conditions, management, research and education policies.

First of all, as the present value analysis showed that the investment cost for the residents living in a dwelling-house of 6 and more floors doesn‘t pay off in 20 years compared to the annual thermal energy savings. This barrier can be a strong holdout for the renovation scenario not to happen, since most people don‘t want to invest in something without seeing a benefit in it, even though the life conditions are improved and apartment price is raised. However, many people get a minimum or average income which is quite moderate compared to the needed investments, so it is natural that certain results on their savings are exepcted after renovation.

Secondly, a big barrier impeding renovation process is a lack of established communities. To organize all residents to take the decisions and actions regarding house renovation- a nominated chairperson is needed, who would be enthusiastic about it. Many apartments in one dwelling-house correspond to many owners, but at the same time there is no real one owner of the whole house. Therefore, when the decisions are needed regarding house renovation- someone needs to gather all residents in order to be able to take actions. This is especially difficult when there is no one in charge to do so, even though, there are administrators assigned by the municipality in many dwelling-houses to organize all the relevant activity. However, real practice shows that these administrators are not concerned enough about the renovation possibilities in order to reduce thermal energy consumption and energy bills‘ costs. Moreover, they are not residents of the same building, but just assigned statemen, therefore there is no big will coming from their side to change somehting. This deficit of established communities and assigned chairpersons leads to the lack of organization. Therefore, the best thing to do is to establish a proper community with an assigned chairperson that would be interested in improving living conditions and reducing energy consumption and costs.

Furthermore, the house renovation process can face difficulties in the community from the beginning when the majority of residents are needed to be present at the meeting to take decisions. Many times some or even the majority of residents do not show up at the meetings and this hinder the whole house renovation process since votes of all or at least of the majority residents’ are needed to take any decision and start any action. All house residents should be interested in the ongoing activities within their community- therefore they should care more of common issues and participate at all meetings.

It is clear that it is difficult to gather all residents and collect the signatures for needed renovation to happen when there is no established community in the house with the assigned one local person responsible for it or when there is a lack of residents‘ participation at the meetings. However, there are cases when this action is even more difficult with an established and well working community between the residents. Regarding the councilor (see Appendix A), since the community is not well defined, meaning it can vary from one dweling-house to such size as 37 houses included under the definition of community- this can lead to the specific troubles when it is needed to organize all residents to take decisions

and actions on one of the houses within the same community. Since 50%+ 1 of the residents' signatures are needed to start any works on any house- this becomes almost impossible when there are 37 houses, whith possible thousands of apartments and therefore numerous residents.

Another barrier that could be included under the institutional respect is the welfare people's unwillingness to do anything, since they get the compensation on thermal energy consumption. According to the councilor (see Appendix A), even though they get a full support on the monthly deposits after taking the loan and basically it doesn't cost anything for them to give their vote for renovation to happen, many times they still refuse to do so. Most probably they are scared to end up paying for the renovation from their own pockets since they cannot afford it and now they are satisfied with the compensated situation. For this not to happen, they should be well informed about their financial support and renovation advantages, since their thermal energy consumption bills are being compensated by the government. The government should care more of how its budget is being invested and spent- therefore, it should make all possible efforts to build the enthusiasm regarding renovation possibilities in these people's minds.

Finally, as the case study showed that Apolonija's community faced troubles in getting the loan- only the 4th bank they turned to finally provided the needed money. However, this happened under the previous conditions, when the interest rate was not fixed and was subject to be recounted every 3 months. According to the councilor (see Appendix A), the present renovation program provides loans with the fixed interest rate of 3%, which is only a service fee of banks, and the loan comes from the renovation program funds. Seems like there are no problems now in obtaining the needed loan, but the bad experience from other communities from the past, like Apolonija's, can be spread around and scare other residents. This should be strongly avoided by promising and advertising the available loans and interest rate.

8.2.3 Political barriers

Include the openess in public administration, dissemination of information to the public, so they are well informed and able to be active.

First of all, for the renovation of a dwelling-house to happen there need to be a responsible person taking care for gathering all residents, voting and collecting signatures. Therefore, a well defined community with an assigned chairperson are needed and this should be encouraged by the municipality. Besides advertising the house renovation program- the community engagement should be advertised, as well. People should join into communities as a first step towards the renovation activity. Bad practices as those of fighiting communities should be avoided in order not to show bad examples to other residents, as

well as appropriate law on the community‘s responsibilites should be finally settled, so the residents are aware of its purposes and advantages.

Secondly, according to the councillor (see Appendix A), it is very missleading when different politicians talk about the renovation support mistakenly. For example, when on the news or press such announcements appear that soon the financial support will be increased to 30% or more, when there are no financial conditions or any real plan to do so. This should be avoided as much as possible, since it stops the will of other residents to take action now since they expect the situation on financial support will get even better in the near future.

However, this could be seen as a misleading information spread on purpose in some cases. First of all, it can happen before some elections, in order to gain people‘s votes, therefore promising better conditions, financial support and, in general, promising to provide a “better future”. Second, since there is a strong monopoly in the natural gas market, and the only supplier is Russia- there are always people interested in keeping this monopoly as long as possible. They are also concerned in making the biggest profit from the natural gas or thermal energy sales- hence, there might always be certain misleading talks regarding the increase of support or if the investments in house renovation is really worth compared to the saved thermal energy consumption.

Another political barrier could be a lack of dissemination of the information regarding possible thermal energy and costs savings after renovation. Seems there are quite good conditions in receiving the promised financial support and loan with the fixed interest rate of 3%, and it is widely discussed on the news and in the press- unfortunately, it is not enough of motivation for the residents to start doing something. The practice shows that it works the best when the chairperson from a neighbooring renovated house comes to the meeting to talk about his house savings. When people see the real differences between the energy consumption before and after renovation- then they start considering it seriously. Therefore, together with the announcements of the support program more attention should be paid to the possible savings in both- thermal energy and energy bills‘ costs.

9. Concluding recommendations

The recommendations for the house renovation scenario to become more attractive and feasible in national, Kaunas and residents‘ respect are provided here as the final results of the project. Certain barriers were identified in the previous chapter and therefore the recommendations on their solutions are given first, followed by the general recommendations which expose the possible areas of improvement of the avalable house renovation program and process.

9.1 Recommendations for the identified barriers

The following recommendations are provided considering the identified barriers in the previous chapter. The following table gives an overview of them together with the suggested recommendations.

Table 9.1 Recommendations for the barriers of the house renovation scenario

Barriers	Recommendations
Technological	
Bad house renovation quality	Only the best service and materials should be used. Even though, the contractors are chosen by the contest- certain criteria should be set by the government, so the same quality on works apply to all contractors. Or all the suppliers and contractors participating in the contest should be checked according to the same criteria- minimum required criteria for all works should be identified.
Lack of chairperson's competence	This could be improved by providing trainings for chairpersons. These trainings should cover financial management, renovation reasons, possibilities, advantages and results. Also, it should give a background to renovation matters- process, quality, criteria, technology and materials. These trainings could be financed from the municipality's fund- since there is not much of money and therefore it is not enough to implement any proper renovation. So, it would be wise to invest it in up scaling chairpersons' knowledge, so they can understand and manage all the necessary works by themselves.
Institutional	
Investment cost for the residents living in a dwelling house of 6 and more floors does not pay off in 20 years	This can be solved by the increased financial support- covering more than 15% of the expenses needed for renovation. Besides, the house renovation activity can be encouraged and advertised by the improved quality of life and raised price of property.
Lack of established communities	It should be encouraged and advertised together with the available financial support for renovation. The same municipality's fund could be used to promote and establish

	communities.
Lack of organization	The lack of organization could be solved together with the establishment of communities. Also, the trainings provided to chairpersons could lead to the improved organization within community.
Problems in big communities	This problem should be identified and solved in the enacted law on community. If there are many houses belonging to one community- each house could have one or few representatives who would represent the opinions and decisions of their house residents. These representatives could organize their own meetings only with their house residents in order to discuss the issues relevant to all community.
Welfare people unwillingness to renovate their house	This should be considered by the government seriously, since the compensation on their energy bills comes from all other citizens' taxes. Since they get a full support on their monthly deposits and they don't need to afford any renovation investments- they should be well informed about renovation advantages, costs and support. There could be another extreme solution for this- to reduce their compensations if they refuse to participate in renovation, but this could be done if these residents still do not put their signature after knowing all the possible conditions and available full support. To encourage them- a sort of guarantee that their thermal energy bill will not increase after renovation could be additionally developed.
Residents' absence at the voting meetings	It could also be settled in the law on community- what should be done if the residents are not present at the meeting. A good practice could be taken from Estonia and Finland, where the decisions are taken by those participants that are present at the meeting only. In such a way other residents instead of being pococurante would be more interested in the community's life since important decisions could be taken without considering them.

Banks unwillingness to provide loans to the residents	As the case study showed- there were troubles in achieving the promised loan from banks. It is not clear if this barrier is still present under the current renovation program, though. However, the information on other communities' failure in getting loan should be strongly avoided by advertising good examples only and all available present conditions for achieving needed loan. All well organized communities should be equally eligible to the promised financial support and loan possibilities.
Political	
Lack of encouragement to join into communities	This should be done by the government and municipality. People could be educated on that through the news and press. This should be emphasized as a first step and one of the main criteria to achieve a proper organization and to take the decisions and actions on house renovation issues.
Misleading announcements on increased financial support	Politicians should be careful with such announcements and speak about it only if it's proved and going to be really available for the upcoming projects. Or if there are really serious considerations regarding increased support in the near future- the new renovation projects that would be started soon should be allowed to get this support, also. In such a way, it wouldn't stop the people to start renovating their houses as soon as possible.
Announcements stating that the house renovation is not worth the savings	This can hardly be avoided since there are politicians and entrepreneurs interested in keeping Lithuania and Kaunas dependent on natural gas as much as possible. However, the examples of good renovation practice and other chairpersons' announcements regarding possible savings could fight this misleading information back. A proper information and education on renovation possibilities on everyday news and press would offset wrong statements.

Lack of dissemination of the information regarding real savings of thermal energy and costs.	The practice shows that people believe better in a common person who is a chairperson of a community from renovated house than in bankers or politicians. Therefore, some chairpersons from renovated houses with a high quality could participate at the meetings in other communities in order to persuade them in taking the right decisions. They could show the real numbers of their house's thermal energy consumption and costs before and after renovation- this should work very well in convincing the other residents to invest in renovation. Besides, the improvement of life and increased price of apartment should be advertised, as well.

9.2 General recommendations

- Since the house renovation scenario can reduce CO_2 emissions, income from selling those saved CO_2 allowances could be added to the national budget instead of contributing to the trade balance. In such a way it would be possible to use this income as subsidies for the further house renovation projects or depending on the revenue extent- add an extra financial support for residents. Besides, this money could be used to support the establishment of communities and chairpersons' training- which are very important for the house renovation matter.
- To increase the efficiency in renovation process all dwelling-houses could be divided into certain standard groups, according to their age, location, size, thermal consumption trend, etc. By doing this- the necessary works and needed materials would be assigned accordingly and the communities wouldn't get lost between offered different services. This would help establishing the minimum criteria and needed quality for works and materials, as well as defining an average investment cost and would lead to a higher level of renovation projects and reduction of risk of facing the defects afterwards.
- Another possibility to increase the efficiency of house renovation process is to renovate them by groups- in the divided blocks encompassing more than one house. According to the councilor (see Appendix A), Kaunas was already divided into 77 blocks and each block could be renovated at once including the replacement of all pipes and renovation of local roads and surroundings. The renovation by blocks would facilitate all works since they would be planned in order and all certain works could be done at once for all houses in the same block. This could be coordinated and planned by local municipality.
- Some residents are scared of the long reliance on monthly deposits for the bank after receiving needed loan. It is no surprise if some people do not want to have an extra expenditure for up to 20 years, especially pensioners or those that do not plan to live in the same building for many years. However, this could be solved by binding the loan not to each resident individually, but to each apartment in the house- in such a way the monthly deposits would be paid only by those residents that own the apartments in that dwelling-house.
- There were some talks by politicians that the house renovation projects should be done under compulsion without considering if the house residents want it or not. This might be an extreme solution, since there will always be some citizens that are not positive about renovation opportunities. Even though, it might look too drastic from the residents' side, it could be seen as a good solution for the country to become more self-sufficient in energy supply and less dependent on imported natural gas.
- A less drastic but very promising solution to make residents consider house renovation seriously is to set certain tariffs for thermal energy. For those dwelling-

houses that are still not renovated until the defined deadline and consume enormous amounts of thermal energy- a higher tariff could be applied. Since Lithuania has to look into alternatives to reduce the dependence on Russian natural gas- it could be a good way involving all citizens into this duty. Besides, higher tariffs for thermal power for not renovated buildings would make the investment cost of renovation very favorable and this would lead to the shorter pay off time for residents.

10. Perspectives on conclusions

It is worth noting, that this project and its analysis, conclusions and recommendations were developed according to the chapter 2 mentioned and discussed theoretical approach, data collection methods and applied assumptions. However, other perspectives could lead to different outcome and therefore it is important to understand what influence the chosen delimitations might have on final results. Therefore, this final chapter gives an overview of the project's delimitations together with their possible influence, and the recommendations for further work in order to improve the analysis and achieve more precise results.

10.1 Delimitations

While developing this project certain limitations were met since it was impossible to investigate all available data or some of it was not existent at all. Consequently, these constraints lead to the current conclusions of project's analysis and adequate recommendations.

1. Theoretical approach- selection of global, macro and micro structures

First of all, the global structure was defined through literature and documents' review- collection of qualitative data. Finally, the macro structure with most important actors was identified, which were described in the micro structure later on. Clearly, not all available data was investigated and therefore it is important to underline that this have influence on the defined project's boundary- global, macro and micro structures. The identification of different actors could lead to different data collection methods from different sources, later on- this would lead to the collection and investigation of different data and application of different assumptions. Hence, this would have obvious influence on final results.

For example, including such actors as the Ministry of Economy and Ministry of Finance into the micro structure would have given interesting results on the way how these actors evaluate the house renovation scenario in the respect of generated employment and public finances. Furthermore, AB "Kauno energija" would show its own attitude towards thermal energy conservation, since it is the only thermal energy supplier in Kaunas. Similarly, the Ministry of Energy would give different understanding about the

energy conservation consequences induced by the house renovation scenario on national level. Therefore, it is important to realize that differently designed global, macro and micro structures might take to different data collection methods, analysis, conclusions and final recommendations.

2. Used sources and data collection

The data collection methods used in this project were literature and documents' reviews and interviews. The data sources chosen for data collection were dependent on the defined theoretical approach and their selection was guided by it. However, not all available sources were investigated and available data collected, which consequently might lead to different project's conclusions.

More interviews of different actors could have led to different information and maybe other conclusions. For example, since residents were included in the macro and micro structures- it could have been a good idea to interview more of them, who live in renovated and not renovated dwelling-houses and to find out their opinion and expectations towards the house renovation process and results. These people could be from different groups- from those getting social benefits, pensioners, flat renters and owners, etc. It is no doubt that different opinions and possibilities would be found between different residents' groups. Moreover, the interviews with such actors as the Ministry of Environment could have given interesting results, showing the different opinion and vision on the house renovation scenario on national level.

3. Lack of data and assumptions

The lack of data led to applied assumptions, which had a significant influence on the final project's outcome, respectively. Besides, assumptions can also vary and can be applied differently since some of the essential data needed in the analysis was not available.

Once again, here are the assumptions that were applied in this project:

In the 6th "Case study" chapter:

2. Since it was not possible to know what thermal energy consumption and cost of Apolonija's house were before renovation- the needed numbers were taken from another not renovated house of the same type.

In the 7th "House renovation scenario consequences on the socio-economic situation and thermal energy consumption" chapter:

13. Assumption on the number of dwelling-houses that need to be renovated in Kaunas- 1,024 of 5 floors and 481 of 6 and more floors. Later on, this number was increased by 10 times to analyze the consequences on national level.
14. Investment cost of 486,100 EUR was assumed to be the same for all dwelling-houses.
15. Heating area of 4,418 m^2 was assumed to be the same in all dwelling-houses.
16. By average 75 houses can be renovated annually in the city of Kaunas.
17. In the investment cost- 80% as domestic labor cost and 20% as import share were assumed.
18. All employed people by the house renovation scenario would get 600 EUR monthly gross salary.
19. Assumptions on the unemployment insurance benefit- people that get employed in the scenario have less than 25 years of work experience and were getting a monthly gross salary of 600 EUR for the last 36 months.
20. Applied 20% of energy losses at the power plant and that all thermal energy saved is generated in water-boilers only, neglecting a co-generation mode.
21. Income from the sold CO_2 allowances contributes to the national budget instead of trade balance.
22. Assumptions on the total thermal energy savings after the implementation of the house renovation scenario- all houses of 5 floors have equal savings, as well as houses of 6 and more floors.
23. Price for the natural gas does not change in the next 20 years- it stays 226 EUR for 1,000 cubic meters.
24. It was assumed that 10 EUR/m^2 is used for the preparation of renovation project, technical supervision of construction works and for the administrative expenses for the implementations of renovation project.

Naturally, the real numbers instead of the assumptions described above would lead to more precise results, or numbers assumed differently could lead to the deviation of the current outcome.

Besides, the applied 10 times bigger extent for the analysis on national level is considered as an assumption, as well. First of all, the house renovation scenario deals only with 1,505 dwelling-houses that could be renovated in Kaunas and this might be around 40-50% of the total investments and thermal energy savings that are possible in this city. Secondly, the number of 15,050 used for the analysis on national level might present just around 50% of the real potential in Lithuania. Therefore, it is very important to underline that this project's analysis does not include the entire potentiality on Kaunas and national level. Consequently, real potential would give greater results on the contribution to socio-economic situation and thermal energy savings.

10.2 Recommendations for further work

- This project could be used as a pilot project for other cities and could be applied in different extents. However, there is enough of area how this project could be improved by investigating and collecting the needed data where assumptions were applied. For example, precise number of not renovated dwelling-houses in Kaunas and Lithuania could be found, including smaller buildings and not just those with 5 floors and more. It is possible to use the same investment cost per m^2, but it is necessary to know the heating area in each house, which can vary significantly. Possible thermal energy savings should be measured in each building also, considering its conditions and renovation possibilities.
- Instead of reducing thermal energy consumption by 40-50%, more ambitious savings of up to 70% after renovation could be defined. According to the councilor (see Appendix A), these savings are realistic if the recuparators are installed. Besides, an example from Denmark could be taken, where a national goal of thermal energy savings in dwelling-houses are up to 70% by 2050 (Jesper Kragh, 2010).
- It could be interesting to investigate what consequences on socio-economic situation the house renovation projects by blocks would have, since it would encompass more works, higher investments would be needed and, therefore, even more people could be employed. Clearly, this would contribute to all socio-economic aspects even more.
- More actors could be included in the global, macro and micro structures. Besides, more actors could be interviewed to find out different opinions, visions and possibilities.
- Any further work related to this project could include investigation and collection of data instead of all applied assumptions- this would lead to more explicit results.

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Appendix A: Interview with the councilor

The real problem in house renovation issue turns out to be not the lack of financial support- the conditions for financing are quite good and should be motivating enough- it lies in the management system of dwelling-houses. After privatization period when Lithuania got its independence, for example in a dwelling-house of 60 apartments - there are 60 different owners, but at the same time the house belongs to nobody. This is a real problem, since all the owners cannot manage to organize and take common decisions on renovation issues. According to the Lithuanian law, the only reasonable management form of a dwelling-house is so called "a community", although, the law on this community's responsibilities is incomplete- it has been tried to be settled in the last 5 years, but unsuccessfully. However, since the houses need to be taken care for- the municipalities were obliged to assign temporary administrators for those dwelling-houses which are still without the established community. Unfortunately, this system of "a temporary administrator" lasts for 15 years already. Here, the real problem occurs in the service costs- since there is no established community that would be responsible for all the activities realized in dwelling-house, the assigned administrator- who is simply a statesman- charge much more for those services provided. Even though, the real tariffs for administration services are not as high, administrators find their way to charge the residents more for their works done. For example, the administrator changes the stairwell's door, which costs not more than 250 EUR, but the residents are charged for 1500 EUR- in such a way the administrator adds more money for himself and it's unfair to the residents. However, there were intentions to change this situation, but it is not easy since the lobbyism on this is still very strong. This is a very important issue- till the administration system is not well defined or proper communities are not established- the process of dwelling-house renovation won't be moving much forward.

Before, the state was financing up to 50% of total renovation cost (but now it is lowered to 15%), and some of the residents excuse themselves that they would consider the renovation if the same 50% of financial support was still available. But the truth is that, even then- with 50% of support the renovation was slowly moving, because of the same house management issue. On the other hand, this 50% of support rose the complaints, since not all tax payers were happy that their money were being invested in the renovation of these houses- they saw it as unfair matter. Anyhow, there is no room to finance 50% of house renovation costs for the government right now.

Another thing that could be seen as a holdout for renovation projects, are the announcements of other politicians about raising the financial support, for example from 15% to 30% and more, when there are no real conditions to do so. It is troubling, since some residents that have already decided to invest in their house renovation, decide to hold the renovation activity after hearing these announcements, expecting that this percentage of support will increase in the near future. Recently, it was announced that those houses, which succeed in the reduction of thermal energy consumption by 40% after renovation, will be supported by 15% extra, meaning that in total the support would equal to 30%. These extra 15% are planned to be allocated from the sold emission

allowances, which should compound around 29 million EUR. Unfortunately, these can be considered as empty promises, since these emission quotas haven't been sold yet, as well as their purchasers are undetermined. These announcements about the unreal financial support should be avoided, unless they are really planned, established and are available for all residents.

It is possible to cut 50% of thermal power consumption by renovating an old dwelling-house, however, it is important to understand where the heat loses appear- where are the weak spots in the house. It is estimated that 40% is being lost through the walls, 20%- through the windows and more 20%- through the ventilation with warm air. Worth noting that, even when the house decreases its losses through walls and windows after renovation significantly, the heat loss through ventilation doubles. Nevertheless, if a recuparator or heat pumps are installed, the house can save up to 70% of thermal power after renovation, but sadly, there are no real examples of their installments and it is not clear how well they would function.

180- 200 kWh/m^2- this is an average amount of the thermal power that a typical dwelling-house built before 1993 consume during heating season. However, according to the present construction technical requirements- new buildings have to comply with the limit of 96 kWh/m^2.

Furthermore, a controversy rises when considering "a community" definition- how big one community can be, how many houses or blocks it can incorporate. The size of community can bring other problems in taking house renovation decisions. For example, if the community is a block with 10 or more (there is a community with 37 houses in Kaunas) included houses, and if there is a will to renovate one of the houses- all the residents from the community need to take a decision on this. This might be too complicated, since the residents of other houses (even from the same community) might not be motivated enough to participate in the renovation process of neighbors' house. Even though, there was a will to organize a meeting of all residents in order to take the decisions on renovation issues- there must be an appropriate place that was big enough to gather all of those residents at once. This raises conflicts particularly, since sometimes a chairperson decides not to include all the residents into ongoing activity, thinking that not all are important or need to know, and therefore many residents get unsatisfied and even angry with the situation. It is very important to solve this issue, since the government promotes the coupling into communities in order to facilitate house renovation process, and when the residents see these examples of fighting communities- they show no will do to so. This should be solved by implementing an appropriate law on community, but, unfortunately, this hasn't happened yet.

Moreover, this JESSICA program can be used for the renovation projects of those dwelling-houses that are built before 1993, because in 1993 the new technical requirements for construction were adopted, which set different limits for the thermal resistance. A building that was built after 1993 had to meet these requirements, which are few times stricter than those before 1993. However, the number of dwelling-houses built after the implementation of these new requirements presents not more than 4% of the total number and, therefore, the houses that can purport to this JESSICA support make the majority. Furthermore, the biggest potentiality in energy savings is

represented by 83% of the total number of dwelling-houses, which are very inefficient in thermal energy use. Even though, under the definition of "a dwelling-house" can be considered a house with only two or three apartments, however, this program supports only those dwelling-houses with tens of apartments, since the potential and effects in them after renovation are much greater.

This condition of not letting the residents from small private houses use the benefits from renovation program can be evaluated negatively, since they are equal country's citizens that are paying taxes where certain part of them goes to this JESSICA program, also. However, it is to avoid a complete and fast program budget squander, since it is considered that the residents from small private houses are more aware about the benefits of renovation and are easier in taking actions, since they don't need to organize the whole community on taking the necessary decisions.

However, another great challenge for the community in taking the decisions on house renovation is the unwillingness of those welfare recipients and pensioners to do anything. Even though, they get full compensations in covering the bank's deposits, the lack of will between these people to put down a signature on their house renovation project still remains. Maybe it is so, because the primary sum needed for the whole house renovation is around 300,000 EUR, and the residents get scared of this number and think that they cannot afford this with their incomes. However, this could be solved by a professional consultation and residents' education, since dividing this cost of 300,000 EUR by the number of apartments in the building the average deposit for a typical two room apartment would amount to approximately 20 EUR per month. This is likely affordable to all residents, especially when the welfare families are financed by 100% on this.

In most cases, the monthly deposit paid to the bank together with the cost of thermal energy bill after renovation equal to the cost of thermal energy bill before the renovation was implemented. Of course, this vary from case to case, and some very old and inefficient houses after renovation might need to pay more than before on the monthly basis, however- the quality of life is increased significantly, and this should be one of the main reasons to motivate the residents.

There are big ambitious between some politicians to renovate many dwelling-houses annually, however, the real potential varies between 50 to 100 houses per year, and when the program gets its highest acceleration only. Yet, the problem occurs in the same unwillingness of welfare recipients to renovate their house- they get a complete compensation for their thermal power consumption, and they don't see a need in improving their house efficiency.

Therefore, it is advisable to let a chairperson from a neighboring renovated house to speak about the house renovation possibilities and advantages to the residents from a not renovated one in order to pursue them on taking action instead of letting politicians or bankers to do so. The practice shows, that people believe better in their neighbor telling the benefits of house renovation and seeing a real example of renovated house in their neighborhood. Specifically, when this chairperson brings his thermal energy bills and shows the real differences between

those bills when the house was not renovated and after the renovation- then the residents can really see the real situation and that none of the politicians or bankers are trying to trick them by saying false arguments. This works very well in persuading the residents to renovate their house.

Furthermore, according to the construction law- 50% + 1 residents' signatures are needed to start the renovation process. However, it is advisable to have not less than 60% of residents agreed, since the voting is needed 3 times- for investment project, to confirm that project and for taking the loan. These three steps have to be decided between all residents, and therefore if only the minimum of 50% +1 votes are collected at the first step and then at the second step (confirming the investment project) one or more of the residents decide not to confirm it or simply some of them are not present at the voting- the project cannot be implemented. Therefore, this is also advisable by the banks to have at least 60% of residents' compliance from the beginning, because some of them might decide to change their mind in the following steps. The most important is to have 50% +1 still at the final step of agreement.

Moreover, some residents that do not want or do not see a need to renovate their house might complain that their rights are being violated in making them taking then loan and participating in the house renovation process against their will. None the less, in the aspect of those residents that want to renovate their house this situation can be seen in the same way- their rights are being violated since there is a clear statement in the Lithuanian civil code: the co-owners of a dwelling-house must take care of their common property appropriately, to renovate it and to fulfill all the technical requirements for construction. However, in order to force all house residents to take a better care of their building these technical requirements should be complemented by an additional statement- what would happen if these requirements are not met.

As mentioned before, a problem occurs when the voting is taking place, and if there are not enough of votes (less than 50%)- the house renovation cannot be started. This is a real issue when organizing all residents to take action, especially when a dwelling-house has lots of apartments and therefore, many different owners. It is a great challenge for a chairperson to convince all residents to participate at the community meetings, since all votes are needed to be counted in, even of those ones that are not participating. However, a good practice could be taken from Estonia and Finland, where the decisions are taken only by those residents that are present at the meeting, even if there are only few residents participating.

Considering the loan- it is taken by the entire house, but it is given back by every apartment separately. There is a fixed interest rate of 3%, which is applied to everyone, and it cannot be changed, since the loan is not given by the banks but allocated from the fund for renovation projects and these 3% is charged as the banks' service fee only. There was a different situation before- loans were taken and given back by the entire house, but it turned to be complicated since some residents were not paying back the deposits and this problem was falling on the "shoulders" of other residents. Since the situation was changed when the loan is paid back by a separate

apartment- banks became the responsible ones to take care of those who are not paying properly, in such a way facilitating the situation for other residents.

To conclude, there are quite good conditions and support scheme for the implementation of dwelling-house renovation, but the real problem is inefficient house administration. In order to assimilate the available financial support- the house administration has to be done by trained and professional people and not by amateurs. Besides, roughly one year passes from the moment when the first idea of house renovation appears till the real action starts - this is not a fast movement.

Appendix B: House renovation scenario consequences on the socio-economic situation and thermal energy consumption. Calculation tables

On Kaunas level	Value	Units	Comments
Total number of houses of 5 floors	1,024		
Total number of houses of 6 and more floors	481		
Total number of houses	1,505		
Investment per one house	486,100	EUR	
Total cost to renovate all houses	731,580,500	EUR	
Thermal energy price	76	EUR/MWh	
Annual heat consumption of house of 5 floors (before renovation)	381.38	MWh/year	
Annual heat consumption of house of 6 and more floors (before renovation)	747.83	MWh/year	
Annual heat consumption of house of 5 floors (after renovation)	193.53	MWh/year	49,3% saved
Annual heat consumption of house of 6 and more floors (after renovation)	444.65	MWh/year	40,6% saved
Annual cost for heating per house of 5 floors (before renovation)	28,985	EUR	
Annual cost for heating per house of 6 and more floors (before renovation)	56,835	EUR	
Total annual cost for heating for all houses (before renovation)	57,018,191	EUR	
Annual cost for heating per house of 5 floors (after renovation)	14,708	EUR	
Annual cost for heating per house of 6 and more floors (after renovation)	33,793	EUR	
Total annual cost for heating for all houses (after renovation)	31,315,904	EUR	
Time frame for the house renovation scenario	20	years	
Average monthly gross salary	500	EUR	
Average yearly gross salary	6,000	EUR	
Taxable income	5,040.4	EUR	
Import share (20% of total investment)	146,316,100	EUR	
Domestic labor cost (80% of total investment)	585,264,400	EUR	

Number of annual salaries for the whole investment period	97,544		
Number of people employed each year in 20 years	4,877		Generated employment
Annual heat consumption of all houses (before renovation)	750,239	MWh/year	
Annual heat consumption of all houses (after renovation)	412,051	MWh/year	
Total heat saved in all houses (after renovation)	338,188	MWh/year	Thermal energy savings

On national level (10 times bigger extent)	Value	Units	Comments
Total number of houses of 5 floors	10,240		
Total number of houses of 6 and more floors	4,810		
Total number of houses	15,050		
Investment per one house	486,100	EUR	
Total cost to renovate all houses	7,315,805,000	EUR	
Thermal energy price	76	EUR/MWh	
Time frame for the house renovation scenario	20	years	
Average monthly gross salary	500	EUR	
Average yearly gross salary	6,000	EUR	
Taxable income	5,040.4	EUR	
Import share (20% of total investment)	1,463,161,000	EUR	
Domestic labor cost (80% of total investment)	5,852,644,000	EUR	
Number of annual salaries for the whole investment period	975,441		
Number of people employed each year in 20 years	48,772		Generated employment
Total payment per year	292,632,200	EUR	
Taxable payment	245,830,557	EUR	
Tax	15	%	
Contribution to national budget from employees' taxes	36,874,584	EUR/yeae	
Contribution to national budget from reducing unemployment payments	67,715,091	EUR/year	
Contribution to national budget from CO2 reductions	21,136,751	EUR/year	
Total contribution to national budget	125,726,425	EUR/year	
Annual thermal energy consumption of all houses (before renovation)	7,502,394	MWh/year	
Annual thermal energy consumption of all houses (after renovation)	4,120,514	MWh/year	
Total thermal energy saved in all houses (after renovation)	3,381,880	MWh/year	
Natural gas used in KHPP boilers	100	%	
Natural gas saved in KHPP boilers	3,381,880	MWh/year	
Natural gas input in KHPP boilers	5,155,305	MWh/year	Losses: 18% in supply, 20% in the power plant

Natural gas input in KHPP boilers	5,155,305,000	kWh/year	
Natural gas imports (total in Lithuania)	2,727,000,000	cubic meters	
Natural gas price	0.226	EUR/cubic meter	
Natural gas saved in KHPP	466,121,609	cubic meters/year	
Total cost saved every year	105,343,484	EUR/year	Contribution to trade balance
CO2 eq price	20	EUR/ton	
Natural gas emissions	205	gr/kWh	
Total thermal energy saved	5,155,305,000	kWh/year	
Total emissions saved	1,056,837,525,000	gr/year	
Total emissions saved	1,056,838	tons/year	
Cost saved from emission reductions	21,136,751	EUR/year	Contribution to national budget
Total people employed	48,772		
Employee's salary	500	EUR	
Fixed part of unemployment income	81.4	EUR	
Variable part of unemployment income	200	EUR	40% of 500 EUR
Unemployment insurance benefit for the first 3 months	281.4	EUR	81.4+200
Unemployment insurance benefit for the next 3 months	181.4	EUR	81.4+(0.5*200)
Total payment per person per year	13,88.4	EUR/year	
Total payment for all people (48,772) per year	67,715,091	EUR/year	Contribution to national budget