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MASTER THESIS

EN310E Master of Science in Energy Management

ATTITUDES TOWARDS DOMESTIC ENERGY
EFFICIENCY AMONG RUSSIAN CONSUMERS:
FACTORS INFLUENCING BEHAVIOUR

Olga Koshman & Olga Ulyanova

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Sammendrag

For øyeblikket når menneskeheten reduserer eksponentielt naturressursene til Jorden øker rollen til energibevaringen og -effektiviteten over hele verden. Energieffektiviteten har blitt identifisert som et av nøkkelprioritetsområder ved de russiske myndigheter. Russland har et enormt potensial til energieffektivitet, og store innsatser ble nylig gjort innenfor utviklingen til energieffektivitetspolicy for å anvende dette potensialet.

Masteroppgaven fokuser seg om en av de største energiforbrukerne, boligsektoren, hvor de endelige forbrukerne til energiprodukter er husholdninger. Undersøkelsen er knyttet til the Sustainable Building for the High North Project (SBHN). Formålet til denne masteroppgaven er å etterforske husholdningens innstilling overfor energieffektivitet og identifisere faktorer som påvirker energieffektiv atferd til de endelige forbrukere. Studien som en del av et større prosjekt ble begrenset av rammene til to nordlige regioner av Russland: Murmansk og Arkhangelsk regioner.

Denne studien utnytter utforskende metode med elementene av den beskrivende utformingen. Halvstruktureerte intervjuer kombintert med en spørreundersøkelse ble valgt for denne forskningen. Innbyggere av Murmansk og Arkhangelsk har blitt intervjuert over temaet til energieffektiv innstilling og atferd. Som et resultat ble fire faktorer med en signifikant påvirkning på den energieffektive atferden identifisert og gransket: økonomisk, miljømessig, sosial og informasjonsmessig.

Abstract

At the moment when mankind is exponentially reducing earth's natural resources, the role of energy conservation and efficiency increases worldwide. Energy efficiency has been identified as one of the key priority areas by the Russian government. Russia has huge energy efficiency potential and great efforts have been made recently for the development of energy efficiency policy in order to implement this potential.

This Master Thesis focuses on one of the biggest energy consumers - residential sector, where the end-users of energy products are households. The research is connected to the Sustainable Building for the High North Project (SBHN). The aim of this Master Thesis is to investigate households' attitude towards energy efficiency and identify factors influencing energy efficient behavior of end-users. The study as a part of the big project was limited by frameworks of two North regions of Russia- Murmansk and Arkhangelsk regions.

This research uses explorative approach with elements of descriptive design. Semi-structured interviews in combination with survey were selected for this study. Residents of Murmansk and Arkhangelsk region have been interviewed on the subject of energy efficient attitude and behavior. As a result four factors with significant influence on energy efficient behavior have been identified and scrutinized: economic, environmental, social and informational.

Acknowledgments

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LIST OF ACRONYMS

Btu- British thermal units

EU- European Union

GDP- Gross Domestic Product

GW- gigawatt

kWh- kilowatt hour

Mtoe- million tonnes of oil equivalent

OPEC- The Organization of the Petroleum Exporting Countries

REA- Russian Energy Agency

sq.km- square kilometers

tce - tonnes of coal equivalent

toe - tonne of oil equivalent

US- United States

USSR- The Union of Soviet Socialist Republics

WCIOM- Russian Public Opinion Research Center

WWF- World Wildlife Fund

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1. Introduction

This part briefly presents the project, introduces the background of the research, research problem and formulates the research question. Finally the report structure is presented in order to guide a reader.

1.1. Background of the research

Energy contributes significantly to the formation of basic social and economic parameters of the country development, in particular income and budget. The Russian economy is dominated by the fuel energy complex which is mainly based on exports. State budget, investments, foreign trade all of these are highly dependent on the situation on the world energy markets. Energy export domination in the national economy not only makes it susceptible to global shocks, but also holds down the potential long-term economic growth.

Many countries have already faced energy shortages, and therefore the roles of energy conservation and efficiency have increased in the world. Moreover, today, this trend is becoming a major technology trend affecting the future of the global economy. In developed and developing countries which do not have significant reserves of energy, for a long time it has been the creation and application of energy-saving technologies, a variety of mechanisms ranging from the traditional energy saving and ending with the creation of alternative sources of energy. In Russia this topic for a long time has been neglected due to its vast reserves of natural resources. However, progress in energy conservation in other countries, including those who has resources, such as Norway; the high energy intensity of the Russian economy; as well as the inexorable fact of depletion of natural resources made governance of the country to pay most attention for energy efficiency.

Any country, being in a global market, objectively needs qualified approach to ensure its energy and environmental security. It is profitable for governments and people, and not only in economically term. Energy efficiency leads to the strengthening of energy security of the country. And it is the brand which largely generates country's image determining, ultimately, the success of its operations and competitiveness in the international arena.

Despite the improvement in Russian energy efficiency policy in recent years, the country is still among the world's most energy-inefficient economies. Thus, the energy intensity of GDP in Russia is several times higher than the global average level. Nevertheless, the World Bank (2008) concluded that Russia could save 45 percent of its total primary energy consumption

through energy-efficiency actions. The largest technical energy efficiency potential can be found in the residential, electricity generation, and manufacturing sectors. An energy saving potential in residential sector is up to 70%. This supposition makes this sector a very interesting topic to investigate in relation to energy efficiency and conservation.

A complex of measures for implementation of legal, organizational, scientific, industrial, technical and economic measures aimed at rational use and economical consumption of fuel and energy resources are understood as energy efficiency.

Despite the availability of research and development related to the evaluation of energy efficiency problems, it can hardly be said that the problems found their full resolution and accepted by consumers unanimously. Today every region, in fact, independently develops elements of energy efficiency policy, and usually the way it is understood by the head of the local governance. They, unfortunately, do not always have an adequate level of theoretical knowledge; do not have the methodological foundations and practical experience of creating and managing energy efficiency. The consequence of this is that energy efficient policy is unsystematic or even absent in most Russian regions.

Identifying an attitude towards domestic energy efficiency among Russian consumers and pointing out which factors influence on consumer's behavior we hope to understand what can be done in order to stimulate and develop energy efficiency in Russia. Deep understanding of the situation in all sectors of Russian economic and clear picture of the situation in Housing sector, where considerable part of energy saving depends on the residents, will provide policy makers with necessary information for making decisions. Overall energy efficiency in Russia will lead to significant economic benefits for Russia as well as environmental advantages. Thereby, the country's position on international arena will be strengthened and energy security will be reached.

1.2. Research problem/Question

In this Master paper we study residential buildings potential for energy efficiency. The aim of this study is to increase the general understanding of the energy efficiency concept in relation to residential sector. The main focus here is on the attitude towards energy efficiency among Russian consumers, because people are an integral part of the energy efficiency program's successful implementation. The research figures out which factors influence consumers' behavior and in which extent, what motivates and what prevents residents to implement energy efficient policy in their housing.

First of all the analysis of the existing literature is needed in order to determine the problem of energy efficiency and give definitions. The local aspect is also important for deeper understanding of the issue, and our research examines the situation in Russia.

Householders need to take energy actions from which stabilization and strengthening of energy efficiency depend on. And before investigation of factors influencing behavior the study examines steps people can do in order to reach energy efficiency.

So there are three issues of particular relevance to discuss in this project in order to understand what can be done for energy efficiency improvement:

1. *What is the general picture of Energy situation in Russia? Which is legal basis for improvements?*
2. *What is Energy Efficiency and how it can be attained by energy consumers?*
3. *What is attitude towards Energy efficiency among Russian consumers?*

The first two issues will be investigated through secondary data sources. And the third one issue will be based on primary data collected from end energy consumers in project focus regions.

According to the information described above the research question of this Master Thesis is:

<i>What are the factors influencing energy efficient behavior of end-users in the residential sector?</i>

1.3. The structure of the thesis

Here the structure of the report is presented. This paragraph serves as a reading guide. The report is organized as follows:

Chapter 1: Introduction

The introduction is a presentation of the entire project, and introduces the background for the project and formulates the research question.

Chapter 2: The Energy Situation in Russia

This chapter gives an overview of the current energy situation in Russia. The chapter starts with a little historical background, recalling the situation back to the time when Russia was a part of the Soviet Union, and explains the reasons for Russian attitude towards energy. Next the Chapter

gives an overview of the legal framework for the implementation of energy efficiency policy in the country. Finally, the chapter gives a brief description of the regional aspect.

Chapter 3: *Energy efficiency and how it can be attained*

This chapter presents energy efficiency definitions. Next goes the review of Russian energy situation and energy market. And finally, the chapter distinguishes five directions where energy efficiency can be implemented.

Chapter 4: *Theoretical Framework*

The theory chapter provides an overview of existing literature in the field of energy efficient behavior of end-users. In the end of the chapter a schematic model for the research, which is derived from combining various models from previous studies is presented.

Chapter 5: *Methodology*

The methodology chapter presents an overview of research methods, types of research design, time dimension of the research, research approaches, sampling design, data collection, data analysis and limitations of this particular project.

Chapter 6: *Analyses and Discussion*

This chapter presents results, analyses and discussion from primary data gathered during our investigation. The chapter consists of two stages. The first stage represents the analysis of data gathered with the help of questionnaire, and the second stage represents the analysis of data gathered during in-depth interviews.

Chapter 7: *Conclusions and implications*

This last chapter reviews the main issues and research question and summarizes the answers, following by possible implications, recommendations and further research proposals.

2. The Energy situation in Russia

It is very important to have read enough literature about the issue to understand the overall situation and to know what to look for when collecting data. This chapter gives an overview of the current energy situation in Russia and serves as a background for the understanding of energy efficiency issue in relation to the situation in the Russian Federation. The chapter starts with a little historical background, recalling the situation back to the time when Russia was a part of the Soviet Union, and explains the reasons for Russian attitude towards energy. Then it gives an overview of the legal framework for the implementation of energy efficiency policy in the country. Russia has huge energy efficiency potential, and in this chapter, we are talking about implementing this potential in the residential sector. Finally, a brief description of the regional aspect is given, since our investigation is focused only on two regions, rather than on the country in general.

2.1. Russian attitude towards energy and energy saving

For understanding of challenges and opportunities Russia faces on its way to energy efficiency, it is important to understand Russian attitude towards energy. Following the crisis after 1973-1974 OPEC oil embargo many countries lacked energy and began to think about energy efficiency. In most capitalist countries, the 1973 energy crisis forced to reconsider the policy of energy conservation. The story with the USSR was just the opposite. If you recall the situation that was before the crisis, back in the 60s, we can see that the USSR did not play a significant role on the international liquid fuel market. The 1973 energy crisis forced the country's leaders to seek new oil fields inside the country. In addition, such fields have been found in Western Siberia. This fact greatly increased export opportunities for the Soviet Union, and after a while, oil has become the most important and most profitable exported product in the country. Thereby Soviet Union citizens did not experience shortages of energy resources and they did not have to worry about conserving energy.

In Soviet times energy efficiency of residential buildings was not considered as a priority issue, it was not even mentioned anywhere. At the first place, there were such issues as saving building materials and reducing construction time. By reducing capital expenditures, the government increased operating costs in several times, relying on cheap fuel. As a result, at least one third of all energy produced in the USSR was spent on heating needs, and in dwelling houses, it was always so warm that several generations of Soviet people have grown up believing that the

normal room temperature in the wintertime - that's around 24 degrees above zero. While in most European houses the temperature is not higher than 18-20 degrees above zero during the winter.

After the collapse of the Soviet Union Russia inherited rich fossil fuel energy resources. Nowadays Russia is the second-largest producer of dry natural gas, the third-largest liquid fuels producer and the sixth largest coal producer in the world. According to the Oil and Gas Journal Russia's proven oil reserves were 80 billion barrels as of January 2013. Russia's reserves of natural gas account for about a quarter of the world's proven reserves and natural gas associated with oil production is often flared. Russia alone accounted for about 27% of the total volume of gas flared globally in 2011. At the same time Russia is the third-largest generator of nuclear power with an installed nuclear capacity of 23.6 GW, distributed across 33 operational nuclear reactors at 10 locations (US Energy Information Administration, 2013).

At the same time despite the abundance of energy resources, most Russians are trying to save energy. About 80% of Russians recognize the importance of energy efficiency problem for the economy of the country. Many people switch off the lights while exit the room, make maximum use of daylight and do other every day efforts. This is proved by the results of Russian Public Opinion Research Center's (WCIOM) survey.¹ WCIOM is the oldest and the leading marketing and opinion research company in the post-Soviet space. According to this survey the most common ways to save energy among Russians are turn off the lights before leaving the room (57% do it usually and 29% - sometimes), maximum use of daylight (54 and 30%, respectively), pull chargers out of the socket when they are not used (52 and 27% respectively).

Almost the half of the respondents turn off the electrical appliances that they do not use, such as computer or TV (48% - all the time, 31% - sometimes), and responsible way to use a washing machine - carefully selected wash program, run only full washing machine, etc. (47 and 28%, respectively). With the help of such measures, more than a half of Russians, around 56%, are able to save on electricity costs. In contrast, 32% of people complained that, despite the measures taken, the effect of saving is negligible. Those who take any measures to save energy, explain their actions by the desire to save electric energy (56%). The second common argument is a habit to behave like this (31%). Only 9% reported that thus seek to save the planet's resources. The WCIOM survey was conducted in forty-two different regions of Russia. Within the framework of this master paper, we will carry out a similar survey in our focus regions, viz.

¹The survey was conducted on 16-17 March 2013 interviewed 1,600 people in 130 towns in 42 regions of Russia

Arkhangelsk and Murmansk in Russia. The results and discussion will be presented in the practical part of the study.

2.2. Legal Basis

The basis for the development of any state is its energy security. According to this, energy efficiency, implementation of activities in the field of energy conservation is one of the guarantees that security and, consequently, the most important resource to accelerate economic growth. Efficient use of energy resources, reducing heat loss during operation of building infrastructure, solution of energy saving in the residential sector are global issues today and most states pay a lot of attention on this issue. Russia is not an exception to such tendency.

Energy efficiency has been identified as one of the key priority areas for the Russian government. A series of Federal Laws provides a systematic framework for improvement of the economy's energy efficiency. Legal regulation of energy supply and energy efficiency is provided by the number of Federal Laws, including the Civil Code, the Tax Code, the Forestry Code, the Customs Code, the Urban Development Code, etc. Additionally, a number of Federal Laws adopted in the country contribute to improvement of energy efficiency of the Russian economy (Energy Charter, 2007).

Basic documents regulating energy efficiency and energy conservation policy in Russia are:

- ✓ The Federal Law of the Russian Federation dated 23.11.2009 №267-FZ “On Energy Saving and Energy Efficiency Increase and Amending Certain Legislative Acts of the Russian Federation”
- ✓ Energy strategy of Russia for the period up to 2030 (Approved by Decree №1715-r Government of the Russian Federation dated 13.11.2009)
- ✓ State Program of the Russian Federation "Energy conservation and energy efficiency for the period up to 2020" (Approved by Decree №2446-r Government of the Russian Federation dated 27.12.2010)

Since 1996, a specific law called “Russia Federal Law on Energy Saving” has been in force (28-FZ dated 3 April 1996). However, this Federal Law had a declarative nature and absence of real measures allowing real development of energy saving technologies in Russia. New State policy on energy efficiency began to develop during Dmitry Medvedev's presidency from 2008 to 2012. In 2009 at the State Council's Presidium on “Improving the Energy Efficiency of the Russian Economy” in Arkhangelsk President Medvedev pressed the assembled governors to

focus more on wasting less energy (Millhone, 2010). Medvedev told the governors he was asking the State Duma to approve a law “On Energy Saving and Energy Efficiency Increase and Amending Certain Legislative Acts of the Russian Federation” (N261-FZ; hereinafter referred to as the “Law”). The Law was approved by the State Duma and came into force on November 27, 2009.

President Medvedev’s legislation includes layer after layer of major energy-saving measures and it is a central act embracing general principles of Russian policy in the sphere of energy efficiency. The purpose of this Federal Law is a creation of legal, economic and organizational basis of inducing of energy saving and raise of energy efficiency. The main goal of this Law is very ambitious- minimum 40% reduction in the energy intensity of the Russian economy (per unit of GDP) by 2020 compared to 2007. The decree also identified several target areas, such as the introduction of measures for technical regulation in the power generation, construction, residential and transportation sectors in 2008–2009, and called for the finalizing of the drafts of the laws and regulations, federal targeted programs, and other relevant legislative acts in the field of energy efficiency and ecological improvement (Rossiyskaya Gazeta, 2009).

The Law applies to all energy users across all sectors throughout the Russian Federation and sets the following five key principles:

- Effective and efficient use of energy resources;
- Support and encourage energy saving and increase in energy efficiency;
- Systematic and integrated character of energy saving and energy efficiency programs;
- Planning and integration of activities increasing energy saving and energy efficiency programs;
- Use of energy assets based on resource, technological, ecological and social conditions (CMS Newsletter, 2009).

The Law is comprised of ten chapters and fifty articles, including the following regulations and provisions:

- General government regulations in the area of energy conservation and energy efficiency;
- Requirements for energy efficiency labeling of goods and commercial inventory of energy resources;
- Energy efficiency of buildings and installations in the residential and commercial sectors;

- Requirements for mandatory energy efficiency audit, inspection, and monitoring (including requirements for data collections and analysis of the energy passports)
- Requirements for information dissemination (including the establishment of the federal integrated information system) and campaigns for awareness raising;
- Requirements for energy conservation and energy efficiency in the budget/governmental sector;
- Government support and stimulation of energy conservation and energy efficiency;
- Enforcement of compliance with energy conservation and energy efficiency requirements.

The Law “On Energy Saving and Energy Efficiency Increase and Amending Certain Legislative Acts of the Russian Federation” is a core of a legal framework for the use of energy resources for electrical and heat energy generation. The Law helps to provide governmental support for the companies investing in energy efficiency technologies and solutions. At the same time, the Law will help to increase the development of renewable energy and alternative types of fuel (Asia Pacific Research Centre, 2010).

In addition, one of the important steps towards energy efficiency was the establishment of the Russian Energy Agency (REA) in 2009. REA is a Federal state institution under the Russian Ministry of Energy. The Agency's goal is to promote the efficiency of public policy in the field of energy efficiency and conservation, creating a unified platform for interaction between all participants in the market, promoting the investment attractiveness of the electricity. REA ensures the implementation of the Federal Law and, in addition, it is a center for the exchange of information, monitoring, training, coordination and incentives for energy efficiency projects, renewable energy and innovation in the energy sector. REA is coordinating all stakeholders on the way to improve energy efficiency. The Agency is actively working with the Presidential Administration, the Government of the Russian Federation, the Federal authorities, regional authorities, budgetary organizations and state-owned enterprises, as well as with the population, housing and business communities by information and consulting, scientific and methodological support for energy efficiency. REA has a wide network of branches, which are located in 72 regions of Russia, including Arkhangelsk- Arkhangelsk Centre for Scientific and Technical Information, and Murmansk- Murmansk Centre for Scientific and Technical Information. Big role in improving energy efficiency is given to regional authorities of the Russian Federation, which are already endowed with corresponding powers. Every region and every municipality have its own energy efficiency program with clear, understandable targets and evaluation

system. At the regional level, budgetary institutions to support the energy efficiency policy are established as well. In case with Murmansk, it is Murmansk Oblast Energy Efficiency Agency and the Arkhangelsk Oblast Energy Efficiency Centre in Arkhangelsk.

2.3. Energy efficiency potential in relation to residential buildings

Russia is one of the most energy-intensive economies. Russia's energy intensity based on purchasing power parity significantly exceeds that in the U.S., Japan and the countries of the European Union. As for 2005, Russia consumed 1.39 tce of primary energy for every 1000 euro of GDP, 65% higher than Canada (Figure 2.1). In 2011 Russia consumed 32.77 quadrillion Btu of energy, mainly in the form of natural gas. According to the State information system on energy conservation and energy efficiency, total energy consumption in Russia in 2007 amounted to about 990 million toe. When bringing the introduction of energy-saving and energy-efficient equipment to the level of EU member's countries energy consumption would be reduced to a value of 650 million toe. In other words, about 35 % of energy lost. Despite the improvement in Russian energy efficiency policy in recent years, the country is still among the world's most energy-inefficient economies.

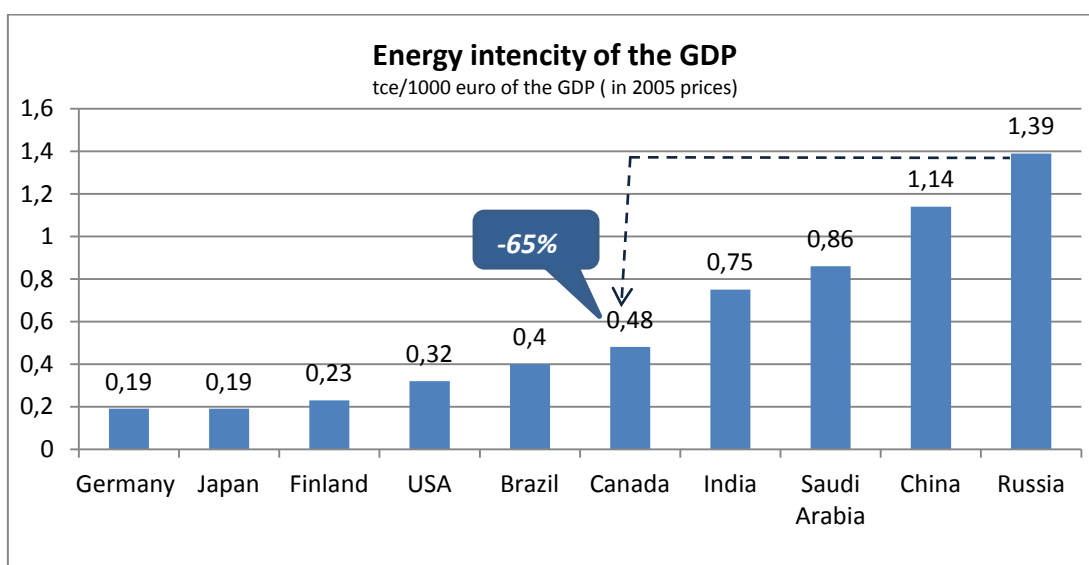


Figure 2.1. Energy intensity of Russia compared to other countries (McKinsey & Company, 2009)

The World Bank Working Paper by Sargsyan and Gorbatenko (2008) concluded that Russia could save 45 percent of its total primary energy consumption through energy-efficiency actions, which means that the resources are used inefficiently. Russia's current energy inefficiency is equal to the annual primary energy consumption of an average European country, like France for

instance. Such a high-energy intensity of the Russian economy could be partly explained by harsh climatic conditions in the most regions of Russia, the country's vast territory and intrinsic economic factors.

The energy-saving measures would cost \$320 billion and result in cost savings to investors and end-users of \$80 billion a year for a four-year payback period. The benefits could be higher—\$120 billion to \$150 billion a year—if the potential annual earnings from increased natural gas exports were included (Sargsyan and Gorbatenko, 2008). More clearly, energy efficiency potential of the Russian economy can be shown on the diagram on the Figure 2.2 below.

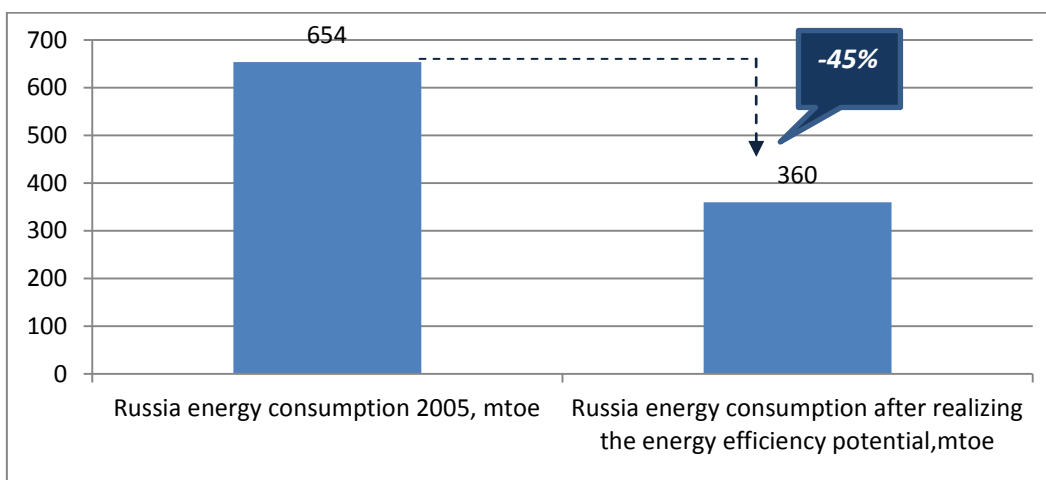


Figure 2.2. Russia energy efficiency potential (Sargsyan and Gorbatenko, 2008)

According to information of the WWF, housing and communal services sector accounts for almost 64% of the energy saving potential in final energy consumption. This could be explained by the extremely inefficient technologies and large losses in the heating system. For example, usually the heating system in Russia is centralized and most buildings lack thermostat. As a result, householders regulate the temperature by opening their windows if it is too hot, or use electric heaters in addition to central heating to raise the temperature when it is too cold. The power consumption in this system can be reduced by 52%. For example, the best examples of modern buildings in Russia consume almost 3 times less energy for heating per unit area compared with the average heating costs in the country. Energy saving potential in the residential sector is estimated at 67-77 Mtoe or 26-27% of the total fuel and energy consumption in Russia (Energy Charter, 2007).

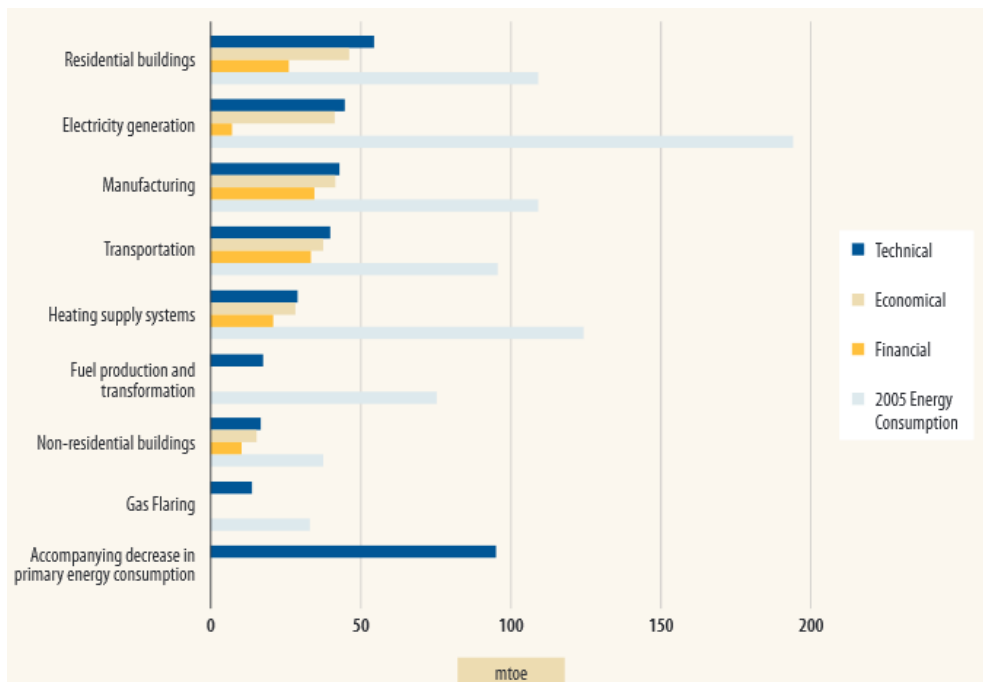


Figure 2.3. Russian energy efficiency potential by Sectors (Sargsyan and Gorbatenko, 2008)

As we can see from the Figure 2.3 the largest technical energy efficiency potential can be found in the residential, electricity generation, and manufacturing sectors. Whereas this paper is focused on the investigation of energy efficiency in the residential sector, we will focus on the consumption trends and potential for energy saving in this particular sector in more details.

During the period 1990-2005, primary energy consumption rose by 8.9% (from 180 to 196 Mtoe). The period before 1995 was an exception when, because of a general economic crisis in the country, the energy consumption in the sector dropped by 3.1% (to 174 Mtoe). During the same period, despite the overall drop of the energy consumption in the country, the share of residential consumption rose from 20.4% in 1990 to 29% in 2005. Electricity consumption in the residential sector increased in 2005 as compared with 1990 by 18% (from 182 to 215 billion kWh) and accounted for 22.9% of the country's total electricity consumption (Energy Charter, 2007).

According to the information of Government of the Russian Federation about 90% of power stations, 83 % of residential buildings, 70 % of electric grids and 66% of heating network were built more than 25 years ago and were not reconstructed. The most significant barriers to energy efficiency in residential housing relate to aging of buildings, building standards, public behavior, and difficulties in organizing and financing energy efficiency improvements in common areas.

Due to inappropriate construction and design of buildings as well as harsh climate conditions in the country, energy consumption is very intensive. Russian residential buildings consume twice as much energy for heating of one square meter of space as Canadian buildings (IEA, 2011). Taking into consideration similar weather and climate conditions of these countries, we can see deficient energy system of Russian Federation which demands attention of authorities and government. On the one hand, we cannot ignore the fact that a higher level of energy intensity of the Russian economy can be explained by objective factors such as significantly high proportion of energy-intensive industries in manufacturing, harsh climatic conditions, the enormity of the country and some others. On the other hand, we can say that there is very inefficient, wasteful consumption of energy resources.

The great potential for energy saving activity is in residential buildings of the country. An energy saving potential is up to 70% for housing building according to World Bank report. This branch is the foundation for social services and it provides the most basic needs for the population. The main consuming activities in this area are space heating and water heating which consume around 58% and 25% of energy respectively (Figure 2.4). Appliances, lightening and energy for cooking hold not so considerable part of energy consumption, but still demand attention in order to saving and carefully attitude to the energy use (Sargsyan and Gorbatenko, 2008). The activity which consumes a lot also has a big potential for saving. On the Figure 2.4 the residential buildings energy consumption in percentage for each activity is represented.

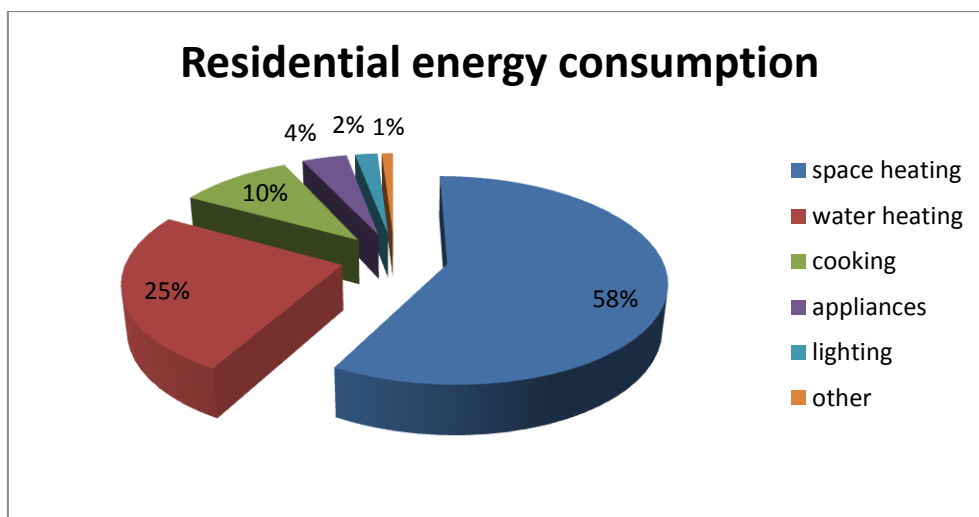


Figure 2.4. Energy consumption in residential buildings (Sargsyan and Gorbatenko, 2008)

Of course there exist some barriers to save energy in the residential sector. In relation to Russia the most significant barriers are as follows:

- Low tariffs faced by household customers;
- Lack of enforcement of existing federal standards for new construction;
- Lack of awareness or appreciation for energy efficiency among apartment owners, which ultimately drives their behavior;
- Lack of incentive to invest in energy efficiency among apartment owners;
- Lack of incentive to improve energy efficiency among developers and their contractors.

2.4. Overview of the Master Thesis focus regions

Within the framework of this paper, we consider the situation in two regions of the Northwestern Federal District of the Russian Federation- Murmansk and Arkhangelsk. This paragraph is concentrated on the brief overview of these two regions, with an emphasis on the level of energy consumption and potential for energy savings.

2.4.1. Murmansk region

Murmansk is situated in the North-West of European Russia and is obviously one of the strategic areas of the country in the North-Western Federal District. The Region borders with Finland and Norway in the west and north-west. Murmansk is the biggest non-freezing Russian port situated to the north of the Arctic Circle. As of early 2012, the Region includes 12 urban districts (Murmansk is the regional capital), 5 municipal districts and 23 settlements, 13 of them urban and 10 of them rural. As of 1 January 2012, there were 787.9 thousand people, including 92.7% urban and 7.3% rural population. The population in the city of Murmansk is 305 thousand people. Thus, it is the world's largest city located above the Arctic Circle. Murmansk has harsh climate, because it is situated in the permafrost zone and for this reason consumes a lot of energy. In addition, the energy conservation issue is particularly relevant.

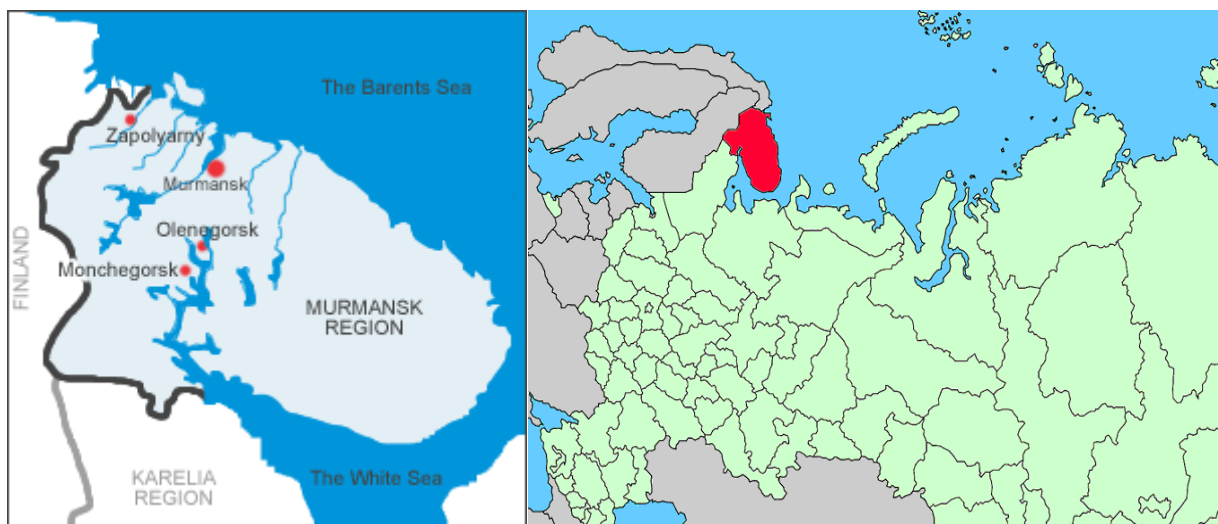


Figure 2.5. Map of Murmansk region- on the left. Murmansk region on the map of Russia- on the right.

Currently, the economy and public sector of Murmansk is characterized by high energy consumption. Particular attention should be paid to the problem of heat, as it is now spent up to 45% of all energy expended. The construction of new buildings was in very small quantities: in the Murmansk region from 2002 to 2007, total areas of 61 thousand square meters of residential buildings were put in operation. The majority of buildings were built during the period 1960-1980 and according to the low standards of energy efficiency and with the application of inefficient building materials (World Bank Vol. 4, 2008).

According to World Bank Murmansk region's energy consumption in residential buildings in 2007 was 1011.28 thousand toe. The share of heating was 61,2%, which is 619,00 thousand toe of the total energy consumption in residential buildings. 98% of the buildings in the Murmansk region are connected to the centralized heating system. Hot water accounts for 27.4% of the total energy consumption in residential buildings, which is 277, 22 thousand toe.

As we can see from the Figure 2.6 heating is on the top place in energy consumption in the Murmansk region. Heat loss due to energy-inefficient design of buildings is also increased by the prolonged heating period: Russia ranks second in the world by the number of degree-days of heating season per capita. For example in 2007, the duration of the heating period in Murmansk region was 299 days or 6177 heating degree-days period. Overall potential for increased efficiency in residential buildings in the region is about 34.8% or 351.95 thousands toe.

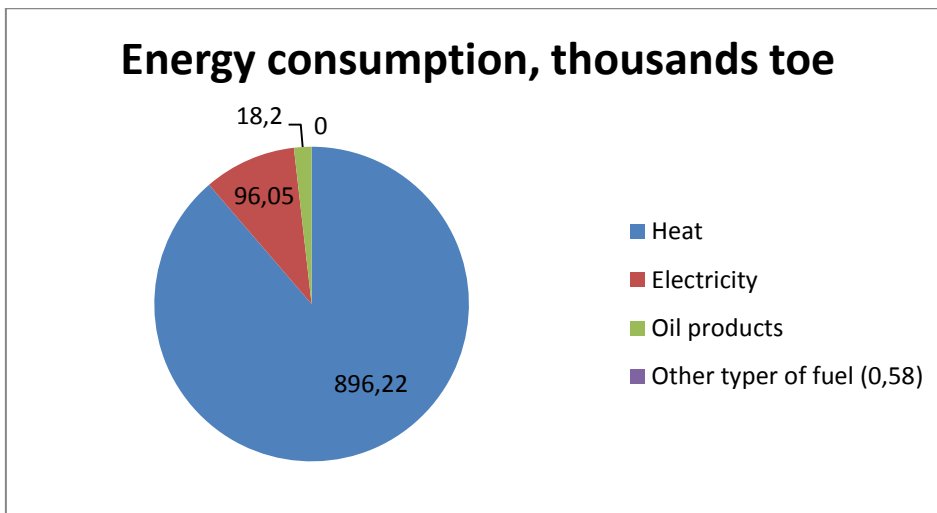


Figure 2.6. Murmansk region: total energy consumption in the residential buildings (World Bank Vol. 4, 2008).

The Federal Law provides for measures to promote energy efficiency in all regions of the Russian Federation, including budget organizations and through the development of regional energy efficiency programs. Regions of Russia have their own programs to improve energy efficiency. For instance, in Murmansk it is called “the long-term target program «Energy conservation and energy efficiency in the Murmansk municipality» till 2020”.

Officials pay much attention to energy efficiency issue in the region. According to the Murmansk Regional Government it is planned to implement 25 projects aimed at increasing of the energy efficiency in the Murmansk region in 2014. Murmansk Oblast takes part in different international conferences on energy efficiency issue, in order to learn from the experience of neighbors- Norway and Finland.

2.4.2. Arkhangelsk region

Arkhangelsk region is situated in the north of the European part of Russia. It includes the Arctic archipelagos of Franz Josef Land and Novaya Zemlya, as well as the Solovetsky Islands in the White Sea and the Nenets Autonomous Okrug. Territory area of Arkhangelsk region is 589,913 sq.km. Since the beginning of the XVII century and until today the city is one of the largest seaports in the north of Russia. Its coasts are washed by the cold waters of three Arctic seas: the White Sea, Barents Sea and Kara Sea. Closeness of the seas has a significant impact on the climate of the region, which is transitional between maritime and continental. Winter is usually long (up to 250 days) and cold, with low temperatures and strong winds, while summers are

usually short and chilly. According to the Government of Arkhangelsk Region the population was 1 185 thousand people in 2010.

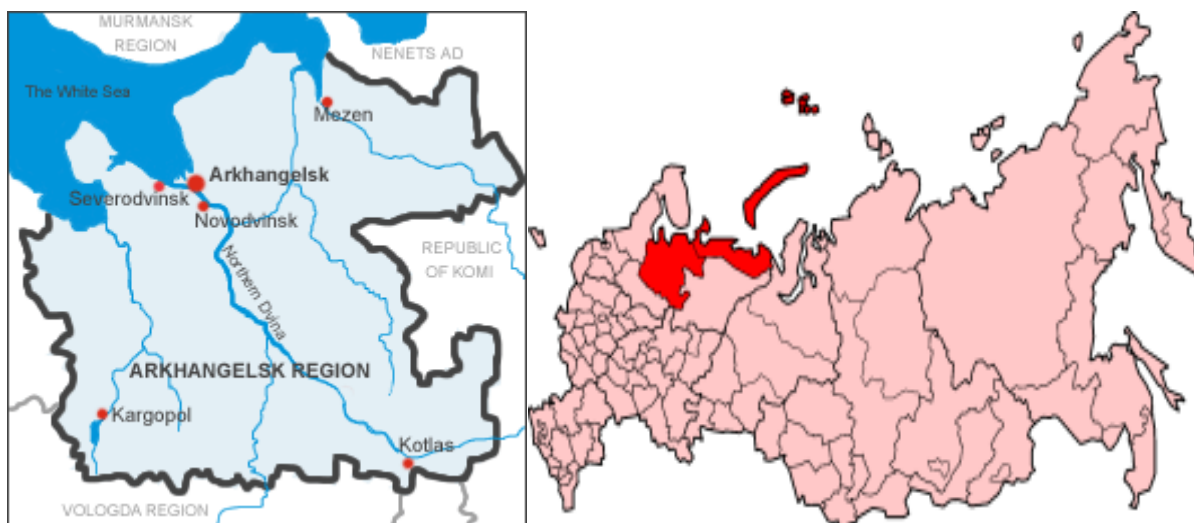


Figure 2.7. Map of Arkhangelsk region- on the left. Arkhangelsk region on the map of Russia- on the right.

Currently, the economy of the Arkhangelsk region is characterized by high-energy intensity compared to the average for Russia. Electricity is generated at 970 power plants with a total installed capacity of more than 2 GW, the annual supply of electricity to consumers is more than 8 billion kWh. The total housing area is 30.3 million square meters, and totally 587,422 units of flats. Housing sector is the third largest energy consumer in the Arkhangelsk region after and transportation and industry.

Renovation of residential sector in recent years has not changed much since the new construction was carried out in small volumes. More than 50% of buildings in the Arkhangelsk Region were put into operation in the period of construction in 1960-1980. Residential buildings were built according to the low standards of energy efficiency and with the application of inefficient building materials. A small proportion of buildings were constructed after 2002 in accordance with the new standards of thermal protection. These buildings meet modern requirements for thermal insulation and heating efficiency. However, most of the existing buildings have much lower heating efficiency parameters. The same as for heating, hot water energy consumption depends on the age of the building: the older the building is, the higher its inefficiency is.

In the Arkhangelsk region energy consumption in residential buildings in 2007 was 1010.75 thousand toe. The share of heating was 56.2%, which is 568.23 thousand toe of the total energy consumption in residential buildings. More than 60% of the buildings in the Arkhangelsk region

are connected to the centralized heating system. Hot water accounts for 21.3% of the total energy consumption in residential buildings, which is 215.71 thousand toe.

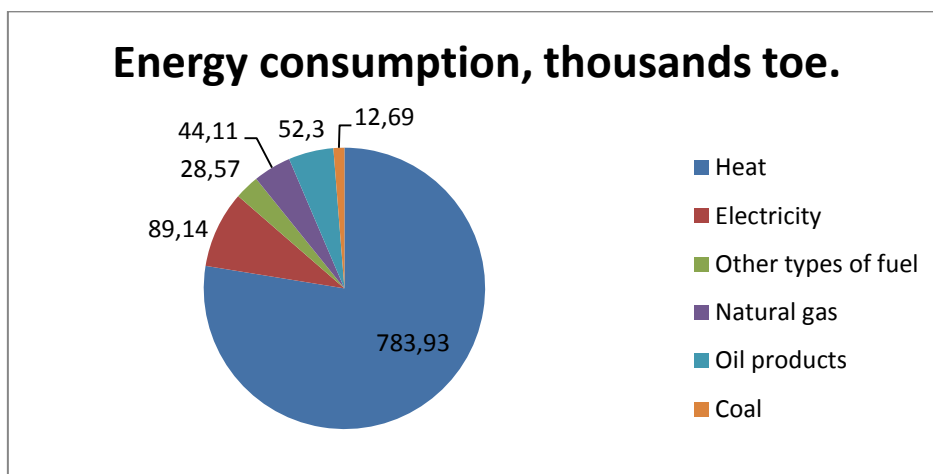


Figure 2. 8. Arkhangelsk region: total energy consumption in the residential buildings (World Bank Vol. 1, 2008).

Heat loss due to energy-inefficient design of buildings is also increased by the prolonged heating period: Russia ranks second in the world by the number of degree-days of heating season per capita. For example in 2007, the duration of the heating period in the Arkhangelsk region was 221 days or 5154 heating degree-days period.

Regional Centre for Energy Conservation has developed a long-term target plan of the Arkhangelsk region, which is called "Energy conservation and energy efficiency in the Arkhangelsk region for 2010-2020". As a result of the implementation of this program, it is planned to reduce the energy intensity of gross regional product of the Arkhangelsk region by 43% by 2020. Such a reduction in energy consumption can largely increase the investment attractiveness of the Arkhangelsk region, the competitiveness of products and improve the ecological situation.

In addition, the implementation of this program will reduce the dependence of the Arkhangelsk region from using imported fuel and increase the share of energy produced from renewable sources, as well as secondary energy sources in total energy consumption up to 30 per cent. The program has already given its first results. Total savings of energy resources during the implementation of the program for state and municipal institutions in the Arkhangelsk region compared to 2009 was 220 million rubles. With such savings on energy types as thermal energy - 135 million rubles, electric energy - 66 million rubles, water - 19 million rubles.

In the Arkhangelsk region there is a significant potential for energy savings in buildings, schools, hospitals, kindergartens, administrative buildings and in the residential sector. According to the Government of Arkhangelsk Region, the energy saving potential of the Arkhangelsk region is 3241.7 thousand toe per year. The largest part of the potential energy savings in the Arkhangelsk region can be achieved as an outcome of energy efficiency measures in heating and hot water supply system of residential sector. The share of energy consumption in these systems in the total regional consumption accounts for 77,6%.

Summary

The aim of this chapter was to study the first issue, which was introduced in the beginning of this report in the Introduction chapter:

What is the general picture of Energy situation in Russia? Which is legal basis for improvements?

The report starts with the situation in Russia, because our study was made in this particular country. Russia is a country with rich fossil fuel energy resources, and at the same time it is the third-largest generator of nuclear power. We can say that Russia has never faced the energy shortages, in contrast with some other countries. And according to the “tradition” prevailing in the Soviet Union, the economy of this country is energy intensive. In addition the use of energy resources in Russia considered inefficient. However such a high energy intensity of the Russian economy could be explained by harsh climatic conditions, the country's vast territory as well as intrinsic economic factors.

In 2008 the World Bank investigated Russian energy efficiency potential and concluded that the country could save 45 percent of its total primary energy consumption by implementing energy-efficiency actions. The energy-saving measures would cost billions dollars, but benefits are expected to be much higher, including the earnings from export of saved resources. It is interesting to note that one of the largest technical energy efficiency potential can be found in the residential sector, with around 70 per cent of the energy saving potential in final energy consumption. The most significant barriers to energy efficiency in residential sector relate to aging of buildings, building standards, public behavior, and difficulties in organizing and financing energy efficiency improvements.

Russian State policy on energy efficiency began to develop from 2009 under Dmitry Medvedev's presidency. The purpose of this policy is a creation of legal, economic and organizational basis for increasing energy efficiency. A core of a legal framework for the use of energy resources for electrical and heat energy generation is the Law "On Energy Saving and Energy Efficiency Increase and Amending Certain Legislative Acts of the Russian Federation". This legislation provides governmental support for the companies investing in energy efficiency technologies and solutions. Thus, the legal framework for increasing energy efficiency of Russia is already developed. But how well it works is another question and further we will touch upon this issue.

3. Energy efficiency and how it can be attained

In this chapter, we present energy efficiency and what can be done to reach it. The overview of Russian energy situation and energy market are presented below. In addition, we distinguish five directions where energy efficiency can be implemented. The key goal of this chapter is to provide information about methods through which energy efficiency can be reached in residential buildings. Later we will apply this information analyzing factors influencing end users behavior to buy and install these technologies in their housings.

3.1.Introduction

Energy saving and responsible use of resources are among the greatest challenge that mankind faces in the 21st century. All necessary potential such as natural resources as well as human resources are fully available for Russia. Moreover, the country is able to meet energy problems successfully. Objectively Russia is a resource base for European and Asian countries exporting oil, petroleum products and natural gas in the volumes of strategic importance for these countries. However, the abundance of natural resources in the Russian territory should not imply energy wasting. The most important factor for the competitiveness of Russian goods and services in an opened market is a responsible and energy-efficient consumption of households.

Energy saving has to be assigned to the strategic objectives of the state, being both the main method of ensuring energy security, and the only real way to maintain high revenues from hydrocarbon exports.

The energy required for Russia's own development can be obtained directly by energy saving in the centers of consumption, both in large and small settlements, instead of extracting non-conventional petroleum in remote areas, such as the Arctic region. The strategic goal of energy saving is the only one and it is increasing an energy efficiency in all sectors and in all settlements of Russia Federation. The aim of energy saving coincides with other public objectives, such as the improvement of the ecological situation in the country as well as in the world in general.

Energy production in most cases uses non-renewable resources such as gas, coal and oil. The world community and experts have been saying for a long time about the imminent shortage of these conventional resources. Environmentalists have been trying to inform people about the

upcoming global warming, and that energy wastage leads to considerable release of CO₂ emission into the atmosphere and, consequently, natural disasters happen more frequently.

The only thing we can do is to realize what is energy efficiency and energy saving and what can we apply for influence on all negative processes related to usage and wastage of energy. Further, in this chapter we present the conception of energy efficiency.

3.2. Energy efficiency

Understanding and meaning of the term "energy efficiency" in each period of time correspond to our knowledge, our technical capabilities and the level of our responsibility to the future generations for the wasteful use of natural resources, and therefore the meaning of this term is constantly changing with the development of this problem. World Energy Conference, one of the most authoritative international non-governmental organization of energy profile (the Soviet Union was a member of this conference since its inception in 1924), in 1977 formulated the problem of energy saving "as a lack of knowledge among experts about the thermal behavior of buildings and the extremely weak usage of science and technology in heating and air conditioning of buildings". First, it should be mentioned that the work on energy saving, since 1974, after the energy crisis in the world conducted in a large scale and, as a rule, governmental agencies give a serious financial support for this program. An important indicator of progress is the fact that at one time formulated doctrine that the energy consumption for heating and conditioning of buildings should remain at current levels in the period when there is growth in construction, in the developed world was already implemented in the early 80th years of XX century.

What is energy efficiency? Penni McLean-Conner in his book (2009) "Energy Efficiency: Principles and Practices" says that energy efficiency is a direct investment in decreasing kWh to meet rising energy demand. Energy efficiency has a focus on energy waste reduction. Also according to McLean-Conner (2009) energy efficiency reduces greenhouse gas emission due to reducing of end consumption and peak demand, thereby avoiding capacity upgrades.

Currently, useful application of energy primarily associated with energy saving. The official definition established by GOST R 51387-99 introduced by Russian State Standard Resolution dated 30.11.1999 and number 485-st. (State Standard, Basic Concept, 2000). It represents energy conservation as a complex of measures for implementation of legal, organizational, scientific, industrial, technical and economic measures aimed at rational use and economical consumption

of fuel and energy resources, when there is useful effect of their consumption and also when there is usage of renewable energy (Russian Federation Law "On Energy Saving", 1996).

According to the same Federal Law, energy efficiency is the ratio of the useful effect or result, including total output obtained from the use of energy resources to the cost of the corresponding resources contributing to the getting of this result.

The essence of energy efficiency is enclosed in efficient and rational use of energy resources. Using quite less energy to provide the same level of energy supply of buildings and manufacturing processes is energy efficiency. Energy efficiency is known as the utilization of energy in the cost effective way. Moreover, when the waste of energy is reduced and the overall consumption of primary energy resources is decreased it is also energy efficiency.

Energy efficiency is not the same as energy conservation. Energy conservation is reducing or even going without a service in order to save energy. Efforts to switch off the light leaving a room are energy conservation. In addition, such actions as a replacement of incandescent lamps with compact fluorescent lamps, application of thermal insulating materials in buildings and hot water accounting installment can be named as actions leading to energy efficiency.

According to the opinion of experts and politicians, energy efficiency is in the top of strategic priorities for the development of technologies in Russia. Required energy for the internal development can be obtained not only by increasing the production of raw materials and the construction of new power but with lower costs via energy savings directly in the centers of consumption. The most relevant is domestic saving, where we are lagging behind from advanced countries in several times, as well as energy efficiency in housing, where our backlog from the same countries still substantial.

3.3.Ongoing efforts for achieving energy efficiency

Improving energy efficiency of economic facilities is achieved primarily through conducting organizational and technical measures, which always precedes the assessment and investigation of efficiency of a particular object of the economy. Initial implementation of the assessments to ensure the energy effective functioning of the object is made when buildings are designing by appropriate services at the stage of technical, economic, environmental and other types of examinations. Efficiency assessment of the object is carried out also on the stage of reconstruction of the object, its expansion and modernization.

Thus, the study of energy efficiency - this is not a one-time action, but continuous, dynamic process that requires constant attention from government, municipal council, service staff and residents of the object of the economy. Based on the assessments, particular measures are developed to improve energy efficiency and prepare building for other activity.

To study and assess of the potential energy efficiency of the object are needed:

- To analyze the scheme of object's operation indicating elements that affect the efficiency of its operation;
- To assess the reliability of management systems, equipment and processes related to the object.

Efficiency of the object are associated with the need to consider the dynamics of changes in the environment and changes in governmental activities related to both the external environment and with opportunities to manage energy resources of the country more effectively.

The need to improve energy efficiency is a priority task for governments of all countries. Political support of energy efficiency is based on solid foundation. Primarily, increasing efficiency of energy consumption is beneficial strategy, which gives immediate result. In the context of climate change, the introduction of energy efficient technologies enables governments to gain time to prepare their economies for the future with low carbon emissions. Secondly, without policy measures it would be difficult to provide significant energy saving.

Energy efficiency can be achieved through ongoing efforts. Continuous analysis of this sphere is not only important, it is crucial, as well as investment in research and development actions. But without complex implementation of specific policy measures it can fail achieving energy savings. For this reason, development and implementation of policies to improve energy efficiency occupy the first place in the program of political events. These political measures to support energy efficiency actions are represented below:

- Increasing investments in energy efficiency;

One of the many obstacles for a decision in favor of cost-effective investments in energy efficiency is a "financial barrier". It is associated with unwillingness of investors and financial institutions to invest in energy-efficient technologies. Unconventional format of investments in energy efficiency and difficulties to quantify benefits of energy efficient technologies make this investment uncertain and, as a consequence, they cannot be taken into account in the standard

cost-benefit analysis for the investors. Initial costs of energy-efficient technologies may be higher than the cost of the alternatives, despite the significant relatively lower operating costs, but still it is a barrier for investors.

Government facilitating in the participation of private sector to invest in energy efficiency through subsidies and programs of stimulation of investors gets additional points in its strategy towards energy efficient future. Informing of participants about benefits and creation more favorable conditions for private sector investments in energy efficiency will provide reliable base for these operations.

- Developing governmental strategies and objectives in the field of energy efficiency;

Public policies in the field of energy efficiency can accelerate introduction of energy efficient technologies in all sectors of the economy. Expediency of state energy efficiency policies is that their development, implementation and evaluation can contribute to a more complete vision of the benefits of energy efficient technologies, draw attention to important issues, identify gaps in current work programs, definition of the necessary tasks and resources, as well as shared responsibility for the implementation and control.

Set of goals and creation of action plans to improve energy efficiency in each sector of the economy are another important political measures to support this energy efficient condition. Optimal plan of action includes assessment of energy consumption by end users in all industries; determination of the economy's potential in the field of energy saving; definition of objectives and appropriate methods, allowing to assess the success of the plan. It is very crucial for institutions dealing with energy policy to have the appropriate information and resources in order to make right decisions.

- Control over compliance and evaluation of results;

Careless compliance may entail not only the energy loss and failure to planned reduction of greenhouse gas emissions. It is also able to promote a sense of impunity, illegal actions and, consequently, economic losses, creating obstacles to market development, as well as cause of distrust towards use of political tools for improving energy efficiency in general.

Appropriate monitoring, enforcement and evaluation of the results of both voluntary and mandatory policies in the field of energy efficiency ensure maximum compliance with the established requirements. Creating the legal and institutional infrastructure that would ensure

compliance with the requirements for energy efficiency, ensuring transparency and fairness in assessment procedures with responsible requirements, including specification methods the frequency and the extent of control checks. Providing regular reports on inspections and disclosure their results including cases of non-compliance and develop and implement comprehensive disciplinary measures according to a degree of violation of requirements and cost energy losses also can be beneficial measures to support energy efficiency.

- Development and maintenance of energy efficiency buildings;

Worldwide existing buildings represent a major source of energy saving potential (World Bank, 2008). Through an upgrade of the total energy consumption system of existing buildings it could be halved. Despite the technical and commercial feasibility to improve energy efficiency of existing buildings, many market barriers prevent its implementation. These limitations include the conflict of interests between owners and tenants, lack of interest for power consumption, lack of knowledge about energy efficient options and lack of expertise for installation and maintenance of energy efficient technologies. Improving energy efficiency is often the most feasible during reconstruction period.

Energy efficiency is often ignored when major construction-related decisions are made. This includes the design of new buildings, the problems of their construction or acquisition, also purchase and repair of existing buildings. The reason for the lack of attention to the issue of energy efficiency is often that decision maker in the construction sector have limited or show little interest in energy efficiency. Ironically, this situation occurs despite the fact that energy costs are, basically a large percentage of the costs associated with the maintenance of the building.

The main goal for politicians and energy organizations is improving public awareness on the issue of energy efficiency, and provide information about the main advantages of energy saving. Systematically collection of information regarding energy efficiency in existing buildings and barriers to energy efficiency would be a big step on a way to the energy efficiency.

Any attempts to reach energy efficiency potential meet many restrictions. Imperfection of the international regulatory framework for optimization of energy consumption; lack of uniform standards of energy management; imperfect pricing systems for energy services are that serious barriers for energy efficiency. Worldwide lack of awareness about energy efficiency among

organizations and individual consumers is the biggest obstacle to the implementation of energy conservation projects. Russia is not an exception in this sense.

Energy efficiency is the same trend of the current historical period as, for instance, innovation five years ago. Literally, all aspects of our lives are not enough energy efficient and can be improved by the implementation of new technologies and management decisions.

3.4.Overview of Energy Market

Energy plays the most significant role in society at currently time. Almost each aspect of our daily life is somehow connected with energy consumption. It provides fuel for transport and heating of our houses, power for domestic uses and undoubtedly affects every business in industry, services, manufacture and agriculture.

Table 3.1 presents energy balance of Russian Federation in 2011; this information is placed on official website of Russian Statistic Agency. It is clear that Russian energy production is primarily based on fossil fuel, because of great potential of proven reserves. In addition, export of energy resources takes considerable part of the total production. Observing information about end consumption we can see the main expenditures of energy accounted for industrial and manufacturing production as well as for needs of population such as residential buildings and public sector. Quite big part of energy supply is taken to produce electricity and heating for these branches of consumption chain.

Table 3.1 Energy balance for 2011, million tons of oil equivalent (Mtoe) (RusStat, 2013).

		Fossil fuel (total)	Fossil fuel			reprocess fuel	electricity	heat energy
			oil	gas	coal			
Production		1736,3	732,7	774,1	224,6	415,8	363,4	198,2
Export		646,3	349,6	215,9	80,7	193,4	8,1	0,0
Consumption(total)		1080,3	378,8	662,6	133,8	226,0	358,7	198,2
Loss at the consumption and transportation stages		14,6	6,9	7,7	0,0	0,0	36,2	14,2
End	agriculture	1,1	0,01	0,8	0,1	7,8	5,1	3,8
Consumption	industrial production	76,5	0,3	67,4	8,7	62,1	194,5	83,5
	manufacturing	57,0	0,1	52,3	4,5	54,6	111,0	66,9

construction	0,7	0,01	0,6	0,1	4,4	4,1	1,7
transport	50,5	0,01	49,9	0,2	31,3	31,1	3,8
population	67,1	0,0	62,2	3,1	42,6	45,1	73,3
other	7,2	0,03	3,9	2,0	18,0	41,2	17,9

Feature of the domestic power system is a centralized heating system, which is about 70 % from total power system. Along with the many advantages of such system, there are many problems. First, there are large heat losses, 10-20 % or even more, during transportation (Table 3.1). To avoid the losses it is required a lot of money on reparation of heat pipelines and replacing them with pipes that are more modern. It is quite difficult to maintain the hydraulic and thermal conditions for very complex branched pipeline network with a huge number of heterogeneous consumers. Particularly, acute problem occurs when we try to adjust the heat consumption of the end consumers, what it is especially necessary for solving the problems of energy saving.

In Russia, there is almost entirely absence of heat and hot water metering. Therefore, on the one hand, it is needed to improve the centralized energy supply system, and from the other - to create autonomous energy sources.

3.5. Categories of residential buildings

Nowadays, the term "energy efficiency" is connected with the concept of «sustainable building», i.e. with the construction of such buildings, which provide qualitative conditions for residents, the preservation of the natural environment, the optimal consumption of renewable energy and the ability to reuse building materials and water resources.

In this Master Thesis, we investigate factors influencing behavioral motives and barriers to save energy in households. For better understanding of the area, where energy-efficient actions can be applicable we represent the categories of residential buildings.

The housing sector is the second largest in terms of final energy consumption after manufacturing in Russia. In the housing sector, there is the greatest potential for improving energy efficiency (World Bank, 2008). Implementation costs of energy efficiency measures depend on whether it is an existing or new building. For the implementation of energy efficiency measures in buildings under construction requires no additional capital costs. However, if we are taking into consideration existing housing sector, a great modernization are needed to bring them into the line with international standards of energy efficiency.

Whether a residential block is an independent house or multistoried building, most of the cases it is influenced by the types of energy technologies to use there. The reason to choose particular type of technology is location, space and the ultimate goal of building utilization.

Conventionally, all residential buildings in Russia can be divided into three categories.

- ✚ Category I. New or reconstructed residential building designed and constructed in accordance with modern requirements for thermal protection of external walls and with modern engineering systems.

In such buildings the heat loss is almost 3 times lower compared with buildings which were built at eighties years of the last century.

Heating systems are equipped with integrated control system regulating the parameters of the coolant. Thermostatic controls equipment should be at each radiator. Heating, hot and cold water are equipped with devices of the individual account of each of the resources. The ventilation system is usually a natural extract from the unorganized inflow which is traditional for ordinary residential buildings. Buildings of the category I should be put into commission with a full range of energy efficiency measures prescribed in the regulations documents. The task of tenants and the management companies of the building is an acceptance from builders such buildings in the condition of the strict compliance with regulatory and project documentation and declared energy efficiency class. Then, during the operation, they are required to maintain all systems and components of a building in a state corresponding to the project.

- ✚ Category II. Building which were designed and constructed/reconstructed during the last 10-15 years, but before implementation of the Federal Law of November 23, 2009 № 261 FZ, mandating the use of individual resource accounting equipment.

These buildings, according to the regulatory requirements of this specified period, should have almost the same set of energy saving measures that the category I building. The only difference is that they do not carry instruments of individual accounting of consumed resources, except accounting for electricity metering.

Maintain of all building systems in operation state and charge for the resources consumed by their actual consumption will both reduce the total resource consumption of the building and reduce the individual payments for utilities.

- ✚ Category III. This group of buildings of existing housing stock includes both high-rise buildings of old construction and modern buildings, which were built or reconstructed for several reasons with violation of the requirements of modern construction standards for energy efficiency.

Typically, these buildings have low level of thermal protection of external walls. The cold and hot water mixing system is very old designed, with significant internal leaks and overflows and with absence of pressure reducing valves. Equipment of such systems should be metered simultaneously with the modernization of this system. Simplified design of heating system has no means of controlling and monitoring parameters of the coolant and the heat energy accounting (Granovski, 2014).

3.6.Directions where energy efficient technologies can be applied

Buildings consume energy to provide human well-being and comfort (IEA, 2011). According to International Energy Agency (2011) human comfort is in most cases influenced by many different factors such as behavioral and cultural, buildings and their equipment determine the acceptable level of comfort for indoor air temperature, radiant temperature, humidity and air speed.

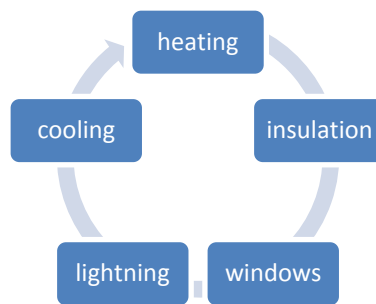
Isolated properly engineered building systems play an important role for people living spaces from the point of view of safety of life and health. Extremely important advantage of the insulation is the reduction of heat loss, and hence reducing power consumption. A significant proportion of energy used in the building can be saved if additionally invest relatively little money in energy saving technologies. Ventilation and cooling consumes about 30% of energy consumed in a new residential building. Installing modern, efficient heating, ventilation and air conditioning can significantly reduce energy consumption, regardless of the type of heating system installed. Investments in technical insulation provide direct cost savings over the lifetime of the building.

Almost all territory of Russian Federation is located in a harsh climatic zone. Moreover, it is obvious that demand for energy resources is essential for the country. Heating period can last up to 9 month in several regions of the country. Also on such huge territory of Russia, there are places with subtropical climate even, where there is need for using of air conditioning. They also consume quite a big part of electricity energy. That is why the problem of the efficient energy usage is a very hot topic nowadays in Russia.

It is not a secret for anyone that there is a tendency for the global climate change. Hotter summers are in the North of Russia in the regions where it is not common and colder winters in the South regions during recent years make a visible for humanity to pay careful attention on a climate changes. Along with changes in climate, with growth of population and income, with needs for more comfortable being, we demand more and more energy to provide this comfort life.

Conventionally, we can divide all energy efficient technologies in any residential buildings on five main areas aimed at reducing power consumption and supplying by comfortable living conditions for residents. In the figure 1.2 below the different zones for implementation of energy, efficiency technologies are represented.

Figure 3.1 Directions for implementation of energy efficient technologies in residential buildings



As we can see from the figure 3.1 all these areas are interconnected between each other. Improving one direction, for instance, installment of insulation system and not change the old windows can just turn all efforts as a useless. Energy efficient approach should consider all direction and reparations have to be complex.

➤ Heating

Heating system is an artificial space heating in the cold season to recover the heat losses and to maintain a predetermined temperature level corresponding to the conditions of thermal comfort and based on process requirements. Under heating, we also understand the system and devices to perform this function. Thermal comfort is most often determined by the temperature in the rooms. For example, in a residential area the most favorable temperature is considered to be 22-24 ° C. The uniformity of temperature distribution in a room in the horizontal and vertical directions is very important; it depends on the type of heating devices, and their arrangement as

well as properties of external thermal insulation barriers and the possibility of penetration the outdoor air into the room through them.

The capacity of the heating can be correspondently reduced for example in industrial buildings, factories and enterprises with constant heat generation from the equipment, where standard heat temperature would lead to overheating. Physiological processes of human being are also associated with the formation and release its heat to the environment. This heat is transferred to the air and to the objects involved in the creation of indoor microclimate. All components of heat loss in the buildings, as well as heat generation from the process equipment, people, electric lighting and solar radiation change continuously. Therefore, the quantity of heat, which is determined by the difference between the heat loss and heat supplied to the space by heating system, must be regulated. Automation of the heating system gives the greatest effect of controlling the supply of heat. It takes into account not only the generated heat and heat loss in the room, but the thermal inertia as well. Regulation is carried out by means of adjusting valves installed on a radiator.

There are central and local heating systems. In the central heating system, heat is generated outside the heated area, for example in boiler, and then heat is transported through pipelines in separate building. Central heating systems are classified by type of coolant. It can be water, air, steam and etc. In residential, public and some industrial buildings, the water heating system with different heating devices is the most widespread.

In low-rise buildings, local heating systems are commonly used. The feature of the system is the combination of the heat generator with a space heater. Very common form of local heating is a stove heating. However, it is gradually being replaced by more advanced and economical central heating, as well as other kinds of local heating: gas heating, electric heater and the so-called one flat heating. The latest system differs from the central heating in fact that the heat generator provides the heat to the one apartment only. It is placed, usually in the kitchen of the apartment. The heat generator is often performed as a single unit, combined with a stove for cooking.

For the Russian Federation, the heating is essential as the climate in most parts of its territory is characterized by low temperatures that determine the long heating period. The residential and civic buildings consume about 30% of all produced solid and gaseous fuels. The cost of the heating system installment is typically 4-6 % of the construction costs of the entire facility. Operating cost of heating is largely determined by the cost of fuel, which is used more efficiently in district heating of the cities and industrial areas.

➤ Cooling

The term air-conditioning usually refers to the automatic creation and maintenance of air parameters such as temperature, relative humidity, purity, composition, speed and air pressure, which is the most favorable for the well-being of people, conducting processes, actions of equipment and devices in buildings and in transport.

System of air-conditioning often performs the functions of ventilation. In the warm season, it cools and dries the air but in the cold season, it works to warm and moisturize the air. It can operate in conjunction with the heating system or perform their functions.

Air-conditioning system is the set of technical means serving to prepare, transport and distribute of air, as well as automatic adjustment of its parameters. There are central and local air-condition systems as well as heating system, which were described above. Central systems usually serve multiple buildings, whereas local ones can serve one room or a part of it only. Central systems are supplied from the outside heat (delivered by hot water, steam, gas or electricity), cold (cold water delivered from the refrigerating machines, artesian wells, mountain rivers or salt solutions) and electric energy to drive electric motors for pumps, fans and compressors. Required temperature and humidity in buildings are provided by air heaters and by devices for drying or humidification, respectively. During the warmer months, air-conditioning sometimes works together with radioactive cooling systems.

➤ Lightening

Lighting can be natural, artificial and mixed. Natural lightening is produced by natural light sources, changes in the widest range depending on the time of day and year, geographic latitude and atmospheric conditions. Side windows, overhead lights or both carry out natural lighting in buildings simultaneously. Improvement in natural lightening of buildings promotes by rational development of urban neighborhoods, the correct orientation of buildings and the light decoration of rooms. Natural lightening, as from a physiological point of view most favorable to the person cannot fully ensure its normal functioning, so people have the need for artificial lightening. For artificial lighting as the light sources incandescent and gas-discharge, light sources are used. Efficient and long-life discharge lamps with success but not entirely replacing incandescent bulbs. In addition, among them fluorescent lamps provide the best quality of light and can satisfactorily simulate the natural lightening.

➤ Insulation

Thermal insulation is a system to protect buildings from unwanted heat exchange with the environment. And also it is a set of tools that prevent such heat exchange. For insulation of buildings a basic requirement is to reduce heat loss in cold periods and ensuring relative stability at room temperature during fluctuations of outside air temperature. With industrial construction work of the building insulation, perform on the stage of manufacturing process of building structures such as panels and bars.

Thermal insulation materials can be organic and inorganic. Inorganic minerals include wool and its products, lightweight and cellular concrete, foam glass or fiberglass. Organic insulating materials are wood, fiberboard, reeds, straw, felt, porous plastics and some others.

➤ Windows

The main function of windows is to protect and guard buildings from temperature effects, wind, humidity, noise, radiation and etc. Windows are used to maintain a comfortable microclimate for the people and provide the required illumination indoors. Windows are usually the weakest link of the building. The heat loss in this case can be subdivided into ventilation and heat losses. Loss of the heat through the window is up to 6 times more than through the wall.

Energy-efficient glass is sprayed onto the surface of a transparent layer of metal oxides. Metal conducts heat less than glass, so the heat passing through the glass is delayed by the sprayed layer and reflected back into the space of the room.

3.7. Energy efficient methods in residential buildings

Energy saving activity in the scale of a residential building in order to reduce energy consumption, especially the heat, is possible and very profitable. This activity can be started with providing the ability to measure thermal energy consumption and monitoring of consumption. This is not a savings itself, but it allows evaluate the technologies and encourages the search for new saving methods.

Precondition for implementation of improvement measures is the availability of information about the actual distribution of heat flow through the house. Calculations require a lot of time and effort, but without them, it will not be possible to correctly identify the necessary steps for building renovation.

We identify the following methods for energy saving activity:

- i. First step can be determined as need to make an inventory of resource consumption.

Installation of heat meters and hot/cold water meters in a residential building can help to realize actual consumption and the payment costs of the actual resource consumption can be reduced by 50% approximately. The payment for average but not the real consumption is an ordinary practice in Russia nowadays. From the one side uncontrolled consumption and fixed payment are preferable for big families as it allows using as much water and heating as they need, but from the other side for families who would like to control consumption and costs of the installment of meters is the one possible way to reach the goal of saving.

- ii. The next important point of saving is building insulation.

Significant heat loss occurs through the old windows, uninsulated walls, cracks in welds, unclosed entrances, cold attics and basements of buildings and etc. Different solutions to reduce heat loss can be applied, both expensive as modern isolation material and cheap as any other available materials. In addition to saving energy and thus reduce the cost of heating of non-residential parts of the buildings, which provide greater comfort in the apartments and delay the natural destruction of building's structures. Replacing of old windows in common areas and optimization of ventilation allow reducing infiltration of heated air out of the house and reducing heat transfer of internal walls as well.

- iii. Modernization of heating system is the third method toward efficient consumption.

Heat supply system modernization leads to significant cost savings for heating and hot water at residential buildings. Replacement of defective valves and old sections of pipelines removes leakage of the cold and hot water. Installation of insulation materials on the heat pipes of the heating system reduces heat transfer from the heating system piping and reduces heat losses.

Installation of thermostatic valves, i.e. replacement of heaters connecting elements with regulated elements allows balancing the heating system for aligning parameters of the coolant. Installation of thermostatic valves not only allows to optimize and reduce the heat consumption in residential buildings, but also to balance the temperature of the indoor air what makes staying at house to be more comfortable.

- iv. Electricity saving is the last big step of energy saving activity.

Electricity saving can be implemented through installing of modern light bulbs. Energy saving lamps are more expensive than incandescent, but they serve much longer. With rational energy consumption and without any damage and additional cost, 20-25% of energy saving can be achieved. Paying attention on the power consumption while buying new appliances and choosing the less energy-intensive option is a real method towards energy efficiency.

Summary

The aim of this chapter was to study the second issue, which was introduced in the beginning of this report in the Introduction chapter:

What is Energy Efficiency and how it can be attained by energy consumers?

This part of the Master Thesis presented the main concept of energy efficiency and the ways it can be attained by energy consumers in residential buildings.

After the energy crisis in 1974, the work on energy saving is conducted in a large scale in the world. The essence of energy efficiency is enclosed in efficient and rational use of energy resources. The study of energy efficiency is a long-term dynamic process that requires constant attention from government, municipal council and residents.

Energy efficiency can be achieved through ongoing efforts only. And without complex implementation of specific policy measures energy efficient actions can fail. For this reason, as it was mentioned above, development and implementation of policies to improve energy efficiency occupied the first place in the program of political events. Collaboration and involvement of all participants of the energy producing and energy consumption chains can bring significant effect.

Imperfection of the regulatory framework for optimization of energy consumption; lack of uniform standards of energy management; imperfect pricing systems for energy services are that serious barriers for energy efficiency. And in general lack of awareness about energy efficiency among organizations and individual consumers is the biggest obstacle to the implementation of energy efficiency projects.

In the chapter 3 we defined several political measures to support energy efficiency actions. There are: increasing investments in energy efficiency; developing governmental strategies and objectives in the field of energy efficiency; control over compliance and evaluation of the results

and, finally, development and maintenance of energy efficiency buildings. All these measures together allow developing energy efficiency from the top level of governance. And the next step is to figure out how it is implemented and followed by end-users.

In this Master Thesis we investigate factors influencing energy efficient behavior of ordinary consumers. To understand the area where energy-efficient actions can be applied we defined three categories of residential buildings: new residential building, where all necessary appliances and technologies are already installed according to Federal program of energy efficiency, recently constructed building with violations of energy efficiency, and old buildings, where there are no any hints for energy efficiency at all. And most of the buildings belong to the third category in Russia. It means residents either never heard about energy efficiency or have to make effort to find relevant information and available appliances for their building category. Exactly for this category we identified five main directions for energy efficient technologies implementation in residential buildings. These are cooling, heating, lightening, insulation and windows. Complex improvement of all these directions allows reaching energy efficiency in the third category buildings.

Later we will use this information in our investigation of consumer's behavior towards energy efficient actions. Asking questions among the target group about the different efficient technologies and applicable directions will help us to figure out the level of awareness of end consumers about ways of being more energy saving.

4. Theoretical framework

Theoretical framework helps readers to understand the logic and perspective of a researcher. As for the researchers; developing the theoretical framework might be a serious challenge. A good theory shows that the investigation is not based on the researcher's personal opinion and guesses. It rather shows that the research is based on previous established theories and facts.

This chapter of the Master Thesis serves as a theoretical framework and the foundation for the data analysis. The theory chapter provides an overview of existing literature in the field of energy efficient behavior of end-users. The aim of this chapter is to understand what consumers of energy do, and why they do so. In the end of the chapter, we will come up with a schematic model for our research, which is derived from combining various models from previous studies.

4.1. Householder actions that reduce energy use

People are an integral part of the energy picture but many energy saving programs focuses only on technologies and appliances. Sometimes households do not have enough information or just are not enough motivated to use energy efficiency technologies. In these cases, people may use energy efficiency appliances 'incorrectly'. Technologies and energy actions that are developed to save energy in residential buildings save no energy until householders adopt them as planned. Some technologies and energy actions will appeal to householders but others will not. In other words, in such a situation the technologies will not be energy efficient in practice, even though they are energy efficient in theory (Shipworth, 2000).

To reduce the amount of energy used in residential buildings, it is not enough to develop and implement energy efficiency technologies. Householders need to take energy actions. By "energy actions", two types of actions are meant here:

- ✚ *Day-to-day energy actions* – like taking shorter showers or turning off lights in unused rooms.
- ✚ *One-off energy actions* – like installing insulation or buying an energy-efficient electrical appliance.

Such simple things like turning off appliances when they are not in use will help to save energy. This type of householder's behavior is called day-to-day energy actions. People can make energy conservation part of their daily existence. Many everyday energy actions (e.g. taking a hot shower) are habitual. They are not under the conscious 'control' of householders – so it is

difficult for householders to change how they act. However, 'energy-conscious' people are more likely to undertake energy-related actions (Lutzenhiser, 1993). Consequently, once householders have taken some energy actions and have become more energy-conscious, they are in a better position to change their habitual energy actions (Shipworth, 2000).

It can be easier to sustain energy savings from 'one-off energy actions', since they do not require ongoing energy saving activity (Kempton et al. 1992). For instance, once a heater thermostat is lowered, it does not require effort or attention for continued lower energy use. Likewise, once a new energy efficient refrigerator replaces an inefficient one, lower energy use will be as a result. (Shipworth, 2000).

Buying and installing energy efficiency equipment in the residential buildings is an excellent example of the one-off energy action. Once set, such equipment can save energy without additional efforts. However, energy efficient equipment is very often much more expensive than the ordinary one. The purchase of such equipment is not a routine purchase like buying a loaf of bread in a supermarket. Before making such a purchase you need to weigh the pros and cons and compare all the alternatives. Day-to-day energy actions may be much easier to follow. In our Master Thesis, we will investigate what energy actions people do in our focus regions.

4.2.Motives and barriers to save energy

Creating energy efficiency technologies is the first necessary step towards energy conservation, but household residents do not necessarily use them in energy-efficient way. The second step towards sustainable living is to understand people and change their energy consumption behavior. This section provides a short overview of the main factors influencing consumer behavior, a brief overview of motivation theories, and is focused on what does and does not motivate sustainable energy action. First, we will start with the motivation to energy actions and then consider the barriers to save energy based on the existing studies in the field of motivation in the context of energy efficiency actions, more sustainable and environmentally friendly energy use and green electricity. The following information serves as a basis for drawing up interview questions. Nevertheless, we have not limited the analysis to this particular theoretical material but rather allowed new issues to emerge from the analyses of our own data. By motives, in our content, we mean the force that drives a person to act in an energy efficient way. In addition, by barriers, we mean the force that prevents a person to act in such a way.

Reviewing the existing studies and other literature on this issue, we have identified several motives and barriers to save energy in residential buildings in relation to end-users of services. We will start with the *motives* to save energy:

1. *Cost savings*

According to Ek and Soderholm (2009) it is reasonable to assume that the consumer calculates and weighs the costs and benefits of a certain energy action to make a decision to save energy.² From the perspective of traditional neoclassical economic theory the decision whether to increase efforts to save energy or not is determined by its outcome in terms of net utility (U in the formula below). Thus, methodologically the net utility for consumer *i* at time *t* can be written as U_{it}^* , and the consumer is assumed to undertake a certain energy saving activity if and only if

$$U_{it}^* > 0. \quad ^3$$

The cost of undertaking energy saving measures can be both in the form of transaction costs (e.g., the perceived effort in terms of time or other inconveniences) and of a direct monetary nature (e.g., the purchase of energy-efficient light bulbs). The associated perceived benefits here are the expected reductions in energy costs.

2. *Environmental attitudes*

In the energy saving field, pro-environmental behavior is of particular interest. In the case of energy conservation, individuals must believe that electricity saving measures at the household level give rise to important environmental benefits. The individual must also feel a personal responsibility to undertake these measures. Bamberg (2003) argues, in his study of how environmental concern influenced specific environmentally related behaviors, that highly environmentally orientated consumers were strongly influenced by the belief that there could be control over a situation. There is a growing body of research indicating that household attitudes and beliefs related to the environment do have effects on the propensity to save energy. With stronger and more clearly expressed environmental concern comes a more marked propensity to save energy in the household (Martinsson et al., 2011).

² Ek & Soderholm were investigating electricity saving behavior. We assume that their findings are also valid for other energy (sources) saving behavior, i.e. heat, hot water or gas.

³ Since the actual net utility, u_{it} , cannot be meaningfully observed (a latent variable), a binary variable S_{it} can be defined so that $S_{it}=1$ if $u_{it} > 0$ and 0 otherwise.

3. *Social interactions*

Social norms, i.e., interactions with and/or perceived expectations from friends, neighbors, family or other households in general, can also help highlight the potential importance of energy savings behavior. Social interaction can trigger individuals to rethink their current situation and thus actively investigate the consequences of a changed behavior. In addition, if an individual is uncertain about the future cost savings or environmental effects associated with increased electricity saving efforts, beliefs about others' behavior and/or opinions may be used as a compass and thus play an important role in the decision-making process. Taken together, it should be reasonable to expect that individuals' stated willingness to increase their efforts to save electricity will be positively related to their concern for environmental issues as well as to their beliefs about other peoples' behavior, opinions and/or expectations (Ek and Soderholm, 2009).

Elizabeth Shove (2003) in her work entitled "Converging Conventions of Comfort, Cleanliness and Convenience" argues that there is evidence that routine consumption is controlled, to large extent, by the social norms, and is profoundly shaped by cultural and economic factors. As she views the problem, habits are changing in a way that often leads to a standardization of consumption patterns. It contributes to an escalation of resource consumption and environmental degradation. Shove (2003) argues that adoption of more sustainable ways of life depends on the diffusion of 'green' beliefs and actions through society.

After the identification and explanation of the main motives that lies behind the energy effective and sustainable behavior, we will continue with the possible *barriers*:

1. *Lack of information and knowledge*

The lack of knowledge can be mentioned as a barrier, but this is referred to practical questions more than to general information about the issue. This corresponds with the study by Hines who has differentiated the concepts of knowledge about issues and knowledge about action strategies. The first concept refers to the background information about environmental issues, while the second- how to act in an environmentally friendly way (Hines at al. 1986/87).

Householders may claim to be acting in an 'economically rational' fashion even when they do not have the necessary information to act in such a way (Lutzenhiser, 1993). It is very important to provide the consumer with the information about how many kWh they use and for which

purposes it was used. Usually people do not even imagine how much energy they use per day. People will say that they use energy in a sustainable way even when they do not know the real answer. Just because some tells you that they take a hot shower for only five minutes it does not mean that, they actually spend five minutes in the shower. Sometimes they do not even have any idea of how long they actually spend in the bathroom. Or another example, the household may invest in insulation at the start of a very cold winter, use more energy than usual due to the cold winter, and again view their insulation as a wasted investment. (Shipworth, 2000). Lack of awareness about the opportunities for energy efficiency and potential energy savings also creates uncertainty regarding the ability to capture benefits from investments in energy efficiency. People tend to think that more visible energy appliances, such as light bulbs consume more energy than less visible appliances, such as central heating. It is much easier to motivate people to save energy when they have information about their energy use and cost saving.

2. *Time, effort, routines*

The costs (i.e. spent time and effort) of environmentally responsible behavior vary in different situations. We can also say that environmentally conscious behavior is more costly. Extra effort is needed if one has decided to change to more effective energy use. Here we return to the question of *one-off energy actions*. Because of the lack of knowledge and information about energy saving, and no previous experience of buying energy efficiency technologies, some consumers think that changing their behavior might be a complicated task and require a lot of time and effort.

Another issue is routine. Quite often old behavior patterns prevent people from adopting new habits of energy action, because it is just easier to stick to the old routines. Despite the fact that switching suppliers would actually be quite easy and quick energy action to do, still old habits might be a barrier to accomplishing it. While in Europe the habit to save energy formed over the years since 1970th, Russia has always enjoyed an abundance of resources. As a result Russians are accustomed to perceive communal services (electricity, central heating, hot water, gas) as a public good.

3. *Lack of appreciation*

According to Bashmakov (2009), motivation for saving energy is diminished by limited competition, cross-subsidization, and the lack of ways to keep track of and regulate energy consumption. The lack of financial support for measures to improve energy efficiency diminishes the motivation for saving energy. Energy efficiency receives little appreciation in

Russia and people would need motivation and leadership to change their values and daily habits. For most consumers their energy consumption is visible only in their utility bills and they associate their energy consumption with its relevant costs on daily basis (World Bank,2008). Bashmakov (2009) argues that if consumers would be able to respond to an increase in their energy expenses by improving the energy efficiency, it would create motivation for energy savings. Thus, consumers would see the benefits of energy saving concretely in a form of a smaller energy bills (Mäkinen, 2010). One more barrier that we could mention here lies in the fact that individuals tend to follow the behavior of surrounding people. However, in Russia there has not yet developed a critical majority of people who appreciates the values and benefits of energy efficiency (Sargsyan and Gorbatenko, 2008).

4.3.Summary of the theory

In the previous section, we considered the energy actions, as well as various factors influencing and hindering these actions. For greater visibility, we summarize all factors, discussed above and represent them as a schema on the Figure 4.1.

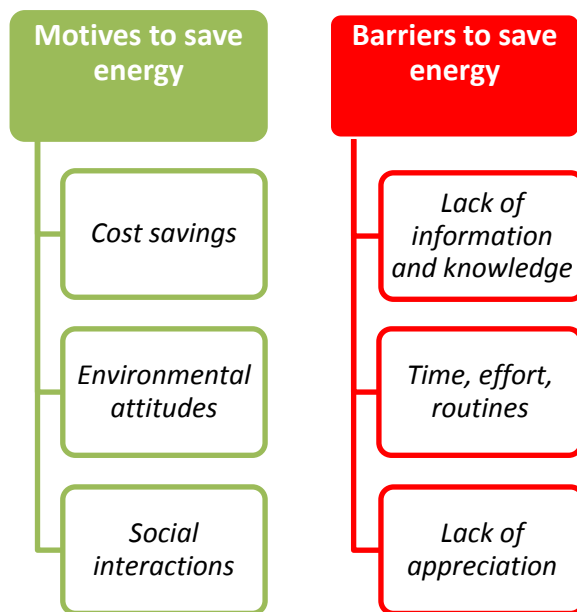


Figure 4.1. Summary of motives and barriers influencing energy efficient behavior

We would like to note that despite the abundance of literature on the energy efficiency theme; there are not so many investigations on the issue of people’s behavior. According to existing studies, we identified such motives to save energy as cost savings, environmental attitudes and social interactions. In addition, previous studies identified such barriers to save energy as lack of information and knowledge; time, efforts and routines; and lack of appreciation.

The question of motives and barriers can also be viewed from the other side. For example, if the cost savings of the energy actions were not satisfactory, a person would not do these actions anymore. Alternatively, if a person is surrounded with people of pro-environmental behavior, careful attitude to energy might be his/her habit, which is just a norm in his/her family. That is how the motive could turn into a barrier to save energy and vice versa. The availability of sufficient information on the issue could motivate a person to behave in energy efficient way at home.

As it was already mentioned we have not limited the analysis to the theoretical material presented in this paragraph, but rather allowed new issues to emerge from the analyses of our own data. According to surveys and interviews and, because of our investigation, we will try to check how factors specified in this chapter influence people's behavior and identify new factors, which are typical for our focus regions.

4.4. Developing a Research Model

Based on past studies we construct a theoretical model by using first literature review form, followed by summary scheme and identification of dependent and independent variables.

A dependent variable is a variable we think is affected by an independent variable, while independent variable can affect the dependent variable (Figure 4.2). The research typically examines the effect of an independent variable on a dependent variable. In other words, the independent variable is a cause and the dependent variable is an effect (Babbie, 2008). All the variables must be defined before the data collection and analyses actually begin.

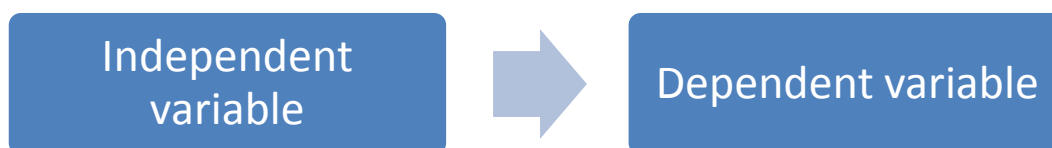


Figure 4.2 - Independent variable affects the dependent variable

In this particular research energy, action that people do serves as dependent variable. When an individual do a certain energy action, no matter day-to-day energy action or one-off energy action, he is saving energy and behaves in more sustainable way. For the purpose of our research, we will call “energy actions” dependent variable as “energy efficient behavior”.

Various factors, which influence energy efficient behavior, were presented in theory. Both motives and barriers to save energy influence the behavior of end-users in a certain way. To

simplify our research model we do not divide factors into motives and barriers. In addition we have already explain how barriers could become motives and vice versa. Furthermore, we combine all factors into four big groups: economic, environmental, informational and social. These four factors are independent variables, which influence energy efficient behavior. Thus we have four independent variables in our model. The research model of this study is presented on the Figure 4.3 and the brief explanation of it goes below.

The circle in the center of the research model is our dependent variable- energy efficient behavior. Four rectangles around the circle represent independent variables, and arrows symbolize effects of four factors on the dependent variable. A brief description of factors is given below the Figure 4.3.

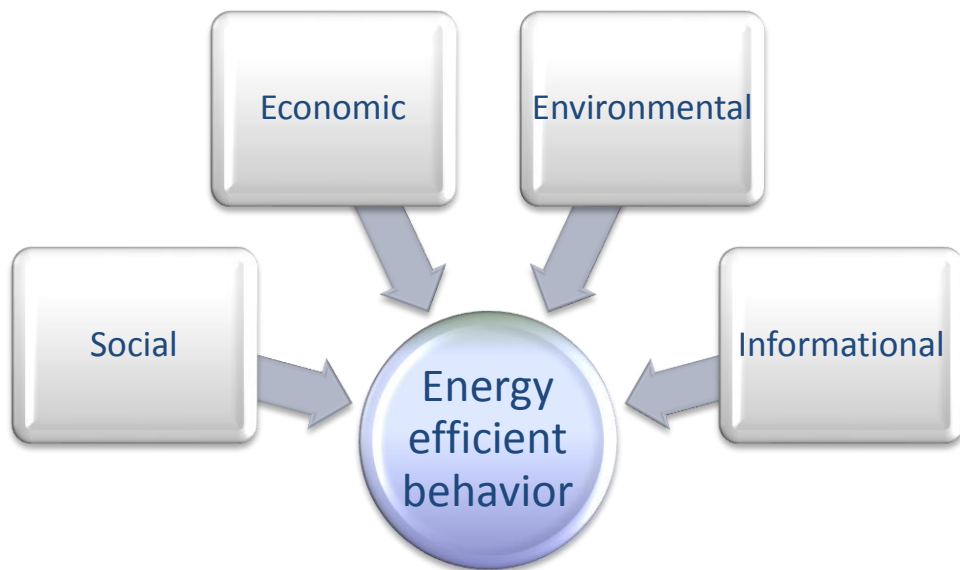


Figure 4.3. The research Model

1) *Economic factor.* The consumer calculates and weights the costs and benefits before making a decision to save energy. Costs here can be in a form of direct monetary costs (money) and transaction cost (time, effort). The associated perceived benefits are the expected reductions in electricity costs. It is assumed here that an individual behave in energy efficient way when his benefits are higher than costs.

2) *Environmental factor.* In the case of energy conservation, individuals may believe that energy saving measures at the household level give rise to important environmental benefits. The

individual may also feel a personal responsibility to undertake these measures. In such a situation individual tends to follow energy efficient behavior.

3) *Informational factor*. Usually people do not even imagine how much energy they use per day. It is very important to provide the consumer with the information about how many kWh they use and for which purposes it was used. In addition, the consumers are not always aware of current energy efficiency policy and available energy efficient technologies. The lack of knowledge about the issue can become a barrier to save energy.

4) *Social factor*. Individuals tend to follow the behavior of surrounding people. Social norms, i.e., interactions with and/or perceived expectations from friends, neighbors, family or other households in general, can trigger individuals to rethink their current energy saving behavior. If energy efficient behavior is appreciated in the society an individual is most likely to follow the example of surrounding people.

Thus the theoretical model for our study was developed step by step based on existing studies. We would like to note that despite the abundance of literature on the energy efficiency theme, too little attention is paid to people's behavior. Our investigation will expand the research in this field.

5. Methodology

The methodology part of the Master Thesis presents the scientific base of the research study. In order to select a specific research method, it is necessary to clearly define what we want to explore. The goal of empirical research should be fully correlated with the topic of the study.

The methodology is a guideline on how to collect and analyze data. It will help us to follow all necessary steps of the scientific research. Based on philosophical positioning we create a research design of our study to be able to collect appropriate data and answer the research question. Correctly chosen methodology will lead us for the achievement of the goal of this Master project.

The methodology chapter presents an overview of research methods, types of research design, time dimension of the research, research approaches, sampling design, data collection, analysis and limitations of this project.

5.1.Introduction

“Methodology” refers to the philosophical framework, view of being human, epistemological perspective and assumptions that are associated with a specific research method; it is the theory underlying a method (Van Manen, 1997). Methodology is described as a system of scientific research principles. Exactly methodology determines the extent to which collected facts serve as a real and reliable basis of objective knowledge. According to the positivist orientation, methodology is not associated with essence of knowledge about the real world, but rather has to do with the operations at through knowledge is constructed. Therefore, the term "methodology" is usually denoted as a set of research procedures, techniques and methods, including methods of data collection and processing. Research methods and procedures are a system of more or less formalized rules for the collection, processing and data analysis. However, here methodological premises are essential, especially in the choice of certain techniques for the study of the problem.

The choice of methodology to use in your research is important in order to create a valuable link between the problem statement, literature, analysis and conclusion (Hellevik, 1999). This chapter describes the methodology of gathering data, which will be analyzed afterwards.

The research question (and the aims of the research) shows which methods and techniques are better to apply. The research question of this study is:

-What are the factors influencing energy efficient behavior of end-users in the residential sector?

We have identified three issues of particular relevance to discuss in this project:

- 1. What is the general picture of Energy situation in Russia? Which is legal basis for improvements?*
- 2. What is Energy Efficiency and how it can be attained by energy consumers?*
- 3. What is attitude towards Energy efficiency among Russian consumers?*

According to the above questions, this research has an explorative design, where quantitative and qualitative methods for gathering and analyzing data are applied. The main components that characterize the methodology of our research are presented in this chapter, i.e. research question, the time dimension, philosophical positioning, research design, data collection and analysis, validity and reliability of data, limitations of the research. The research question has been already discussed in this paper, further we will discuss the other components.

5.2. The time dimension of the research

There are two options when you make an observation: to make it more or less in one time or to make it over a long period. Time also affects the generalizability of research findings. Researchers have two principal options for dealing with the issue of time in the design of their research: cross-sectional and longitudinal studies. A cross-sectional study involves observations of a sample, or a cross-section, of a population or phenomenon that are made in one point in time. In contrast, a longitudinal study is designed to permit observations of the same phenomenon over an extended period. They can be more difficult, but they are the best way to study changes over time (Babbie, 2008). For this particular paper, we chose the cross-sectional study.

Our investigation is explorative in purpose and is designed to look at how is the situation now, without looking at whether there is a trend at work. Data was collected within a short-time frame (the timelines will be discussed here later on). The disadvantage of such kind of research could be conclusions, based on observation, which was made only one time. However, as it is final work of our Master program, and we have limited time and capital, cross-sectional research is more suitable in our situation.

A clear plan and the timeframe are very important for the researcher to complete the work on time and fulfill all the university requirements. Writing a MOPP for master students in Energy

Management usually covers a five month period from the beginning of January till the end of May. All the stages and periods for each stage are presented in the Appendix 1.

5.3.Philosophical positioning

It has vital importance to clarify philosophical position of the researcher in order to understand his or her idea of the reality. There are two contrasting philosophical positions:

1. Positivism, and
2. Social constructionism.

The key idea of positivism is that the social world exists externally, and that its properties should be measured through objective methods, rather than being inferred subjectively through sensation, reflection or intuition. The main idea of social constructionism focuses on the ways that people make sense of the world especially through sharing their experiences with others via the medium of language (Easterby-Smith et al., 2012).

Social constructionism is a new paradigm developed by philosophers during the last half-century. This philosophical position stems from the view that “reality” is not objective and exterior, but socially constructed and given meaning by people. The focus here is on what people, individually or collectively, are thinking and feeling. Attention should be paid to the ways they communicate with each other. The researcher tries to understand and appreciate the different experiences that people have, rather than search for external causes. (Easterby-Smith et al, 2012).

The philosophical position that was chosen for this particular paper is social construction of reality, because ‘behavior’ is a phenomenon, which cannot be measured directly. We rather study the behavior of people through understanding the way people feel and think about it.

5.4.Research design

In this Master project, "research design" means the process of designing and planning of the study and the result of this process. When designing the study, the researchers relies on their knowledge about approaches of the study of social reality, theories and concepts to describe and explain social phenomena, processes and their relationships, as well as known and mastered method of data collection and analysis. Research design is a process, which reflects the level of

professionalism of the researcher. It is also knowledge of the researcher about the theories, methods and skills to apply this knowledge to solve a specific research problem.

Once we have established the research question, we start to plan a research design, by which we will get answer to our research question. Research design is a tool to establish a link and bring together the collected data and findings derived from the initial question of the study (Yin, 1984). A research paper may involve the use of one or more of three broad types of research design:

1. Exploratory,
2. Descriptive, and
3. Causal.

According to Kothari (2004), the research problem having been formulated in clear-cut terms, the researcher will be required to prepare a research design, i.e. he or she will have to state the conceptual structure within which research would be conducted. The preparation of such a design facilitates research to be as efficient as possible yielding maximum information. In other words, the function of research design is to provide for the collection of relevant evidence with minimum expenditure of effort, time and money. The preparation of the research design, appropriate for the particular research problem, involves usually the consideration of the following factors:

- i. the means of obtaining information;
- ii. the availability and skills of a researcher;
- iii. the time available for the research;
- iv. financing available for the research (Kothari, 2004).

Catherine Hakim (2000) believes that there is no any type of research, which would be essentially lower or higher than the other. Each type of research is doing a separate operation, and must be chosen according to the nature of problems or issue addressed by the researcher; the level of existing knowledge and previous research; available resources and time; and the presence of a researcher experience befitting to implement this design into the life.

Our Master Thesis is based on a broad base of literature both in printed and electronic forms, as well as primary data that we have collected during the study period. As we are only master students we have very poor research experience yet; this Master Paper allows getting experience and skills. We also have limited time and financing available for the research. Taking into

consideration all the above-mentioned factors and other circumstances, we chose our research to be of an exploratory nature, with elements of descriptive design.

Exploratory type of research used when researcher tries to develop a series of principles in order to provide a basic for understanding and predicting the behaviors and decisions. Exploratory is a proper method when there are not explicit set of hypotheses with large amount of available data regard to different views and values and looking to find a pattern in the data (Easterby-Smith et al., 2002). This type of research design is characterized by the flexibility allowed to researcher in the exploration of relevant issue. Research at this stage may include such techniques as literature review, focus groups, in-depth interviews and case studies (Wren et al., 2002).

We are studying the idea that lies behind the energy efficient behavior. In order to succeed we need a better understanding of the issue. In this paper, we intend to identify not only the motives to save energy, but also barriers to efficient usage of energy. Usually exploratory researches involve only a relatively small population. To identify this small group of people, which we will interview, we need to apply descriptive type of research as well.

The main goal of descriptive research is to describe characteristics of objects. In general, descriptive research design aims to paint a more or less specific picture of a certain context. The descriptive type of research is specifically designed to deal with complex social issues. It aims to move beyond the “just getting the facts” by trying to make sense of the human, political, social, cultural and contextual elements involved (Walliman, 2011). Descriptive research is conducted when there is a need to measure the frequency with which a sampled population behaves, thinks or is likely to act (Wren et al., 2002).

According to Robert K. Yin (2009) the most important condition for differentiating among the many available research methods is to clarify the type of research question being asked. In our case the main question is “What are the factors influencing energy efficient behavior of end-users in the residential sector?”. The question ‘what’ refers on exploratory research type.

In our case it is very difficult to stick to a pure exploratory or descriptive type of research. This research paper involves the use of these two types of research design.

5.5. Research approach

In accordance with the logic of the scientific research, the development of a methodology is carried out as a next step after the problem statement and preliminary literature review.

Methodology is a set of theoretical and empirical methods, the combination of which gives us the opportunity to explore sophisticated multifunctional facilities in the most appropriate way. Application of a variety of methods allows comprehensively investigate the problem and all its aspects and parameters.

Two different approaches of conducting a research are used in writing a research paper:

1. Qualitative;
2. Quantitative research.

Qualitative research is designed to explore the human elements of a given topic, while specific qualitative methods examine how individuals see and experience the world. Qualitative approaches are typically used to explore new phenomena and to capture individuals' thoughts, feelings, or interpretations of meaning and process (Given, 2008). According to Harwell (2011) Qualitative research methods focus on discovering and understanding the experiences, perspectives, and thoughts of participants—that is, qualitative research explores meaning, purpose, or reality. This research is characterized by the presence of multiple “truths” that are socially constructed. Qualitative research is usually described as allowing a detailed exploration of a topic of interest in which a researcher, through case studies, ethnographic work, interviews, collects information and so on.

The main advantage of the qualitative research is that it allows us to see the world through the eyes of an interviewee and to understand reasons of consumer's behavior. With the help of qualitative research, we can look at the essence of the problem in a very tight schedule and see varied nonstandard problem's resolution and can understand what the interviewee really expects. Qualitative research is a mirror, which reflects the ever-changing demands of trends, emotions thoughts and relationships forming consumer's attitudes.

Quantitative research is the systematic empirical investigation of social phenomena via statistical, mathematical or numerical data or computational techniques (Given, 2008). Quantitative research methods attempt to maximize objectivity, reliability and generalizability of findings, and are typically interested in prediction. Integral to this approach is the expectation that a researcher will set aside his or her experiences, perceptions, and biases to ensure objectivity in the conduct of the study and the conclusions that are drawn. Key features of many quantitative studies are the use of instruments such as tests or surveys to collect data, and reliance on probability theory to test statistical hypotheses that correspond to research questions

of interest. Quantitative methods are also frequently characterized as assuming that there is a single “truth” that exists, independent of human perception (Harwell, 2011).

Quantitative study is primarily based on the precise execution of the statistical procedures. The main advantages of this research are a wide coverage of the respondents, data processing with the help of modern software products and the possibility of global generalizations that is ensured by representativeness of the sample.

The choice between these two research methods depends on the purpose of research and the questions a researcher wants to answer. The method’s choice consists of series of stages showing the main steps, which have to be taken into account while making decision towards one or another method. These stages explain the logic under the method’s choice and provide helpful procedural aspects of the research. According to Musicant (2008) the following figure presents the choice of research method. It matches the logic of this Master Thesis; therefore, it is used in a current study.

Table 5.1. The choice of research method (Source: Adopted from V.K. Musicant, 2008 “Marketing communication management”, p 429.)

Stage	Qualitative research	Quantitative research
Target selection	to obtain a qualitative understanding	to provide a quantitative estimation
Method	focus group, interview	Survey
Sample	8-12 persons	a representative sample
Data collection	Unstructured	Structured
Data analysis	non-statistical	Statistical
Results	contribute to the proper interpretation	give facts and regularities

Analyzing the Table 5.1 presented above we decided to use the mixed method approach, thereby the strengths of quantitative and qualitative research approaches are maximized and the weaknesses are minimized.

The positions taken by an individual researcher may vary, from those who think that two methods are based on alternative views of reality and they must be separated and, to those who think that they should mixed within one research project. According to Bryman (1988) argued for a 'best of both worlds' approach and suggested that qualitative and quantitative approaches should be combined. As researchers, we agree with Bryman's position and use both qualitative and quantitative research approaches in our paper. Such a combination allows gaining an in-depth understanding of the studied issue.

The quantitative method helps us to make a quantitative estimation of our target group of end energy consumers and select representatives of the group for the further step such as deep interview for better understanding of the issued topic. The aim of the qualitative part of the study is to examine the attitude towards the energy efficient behavior in a relatively small sample of end energy consumers. Thus, the combination of these two methods of the research is the most preferable way of investigation of the formulated research question in this Master Thesis.

5.6. Sampling

Sampling is a process of population elements selection to study (Patrick Dattalo, 2008). According to Dattalo (2008) sample design addresses two main issues: how elements of the population will be selected and how many elements will be selected.

In most cases, the researcher uses different selection methods to choose a certain set of elements from a large population in such way that descriptions of these elements will properly characterize the population from which they were taken. Researcher hopes that this sample can identify properties of the research object in general. Type and sampling methods are directly dependent on the research objectives, hypotheses and research questions. The strictest requirements are applied to samples of descriptive and analytical experimental studies. In a descriptive study, scientists advise to apply representative sample. Requirements of the sample representativeness mean that selected parameters and criteria of surveyed participants must be close to relevant criteria in the whole population. To get more or less reliable information about factors influencing on consumer's behavior towards energy saving activity, it is necessary to ensure a proper numerical representation of each category of citizens in the sample.

The task of the study is to perform a descriptive survey of great public importance, as a result, conclusions about the factors influencing the behavior of the population in general should be made, of course, it is virtual, as accurate as possible, to implement all requirements of a

representative sampling procedure. Representative sampling is based on a quite big distribution of surveyed population and demands representatives from each category of the group. In our case, it is rather difficult to meet this requirement due to limited time and finance conditions.

In this master paper, we want to study particular circumstances and lifestyles of certain population groups such as end energy consumers in residential buildings. In this case a representative sample might be replaced by the target sample, in which the size of each chosen group will be sufficient for a solid analysis. We investigate our sampling through questionnaire first. Then from this sampling we select representatives for in-depth interview.

In our research, we use technique of “availability sampling”. It means that participants of the study were selected because of their accessibility. This technique is also known as convenience sampling. According to Frederick Gravette and Lori-Ann Forzano (2012) convenience sampling is the most commonly used method in behavioral science research. It is the type of research we create in our study. People are selected on the basis of their willingness to respond (Gravette and Forzano, 2012).

Usually convenience sampling method faces a lot of critiques because the researcher makes no efforts to expand sampling and goes on the way of the least resistance choosing available respondents only. In addition, it is suspicious as a respondent might not be representative of overall population (Dalatto, 2008). In this research study, we use convenience sampling, but we are rather sure about our respondents that we explore the factors influencing behavioral motives of the population in general. We refer on this type of sampling only because we indeed choose available respondents based on our own knowledge and experience.

The sample size depends on the homogeneity or heterogeneity of the studied objects. The more they are homogeneous, the smaller size can provide statistically reliable conclusions. We didn't define a size of sampling for qualitative study before it started. The plan is to investigate and make interviews until we are able to get necessary information to conclude about factors influencing energy efficient behavior.

5.7.Sources of data collection

Data collection is implemented in the form of two major research procedures. It is the formation of sampling which we discussed above as well as receiving and recording information. Here we present the way of gathering information.

Doing our research, we used two types of data sources:

1. Secondary data;
2. Primary data.

Secondary data information is often found in outside sources and it was already collected for another purposes. Before you start a research project, before you look at primary data, it is important to investigate secondary sources first. The use of secondary sources of information has many benefits. These benefits will be listed below (Smith, 2012):

- ✓ If enough information is available, you may solve the problem and avoid doing primary research.
- ✓ Compared to primary research, an in-depth search of secondary sources takes a fraction of the time and budget. Numerous research publications and databases can be accessed online for free.
- ✓ Before starting to collect primary data secondary sources help to define the problem, plan the collection of data, define the population and select the sample.

Primary data is collected by the researcher. Respondents are asked questions while the researcher collects the responses. These can be verbal or written. Responses can also be observed via the respondent's behavior. Collecting primary data is vital in finding solutions to research problems (Smith, 2012). Primary data also have many benefits; we identified some of them during our work:

- ✓ It is first-hand information, therefore it is unbiased.
- ✓ Researcher has control over the process of collecting data; it is collected for the purposes of particular study.
- ✓ Data presents the current situation, how things are now.

This Master Paper used the benefits of both types of data sources. On the stage of picking up the topic for our research and formulated the research problem, secondary data was a major source of information. It also helped in creating a background and understanding of what energy efficiency is and how it can be attained.

And primary data was then used to make analyses and conclusions. Secondary data was used in the forms of academic books, articles, web pages, legislation acts, etc. The primary data was used in the forms of surveys and interviews.

Our first step towards gathering primary information was to create a questionnaire. We distribute questions among the target group through the online portal for the convenience of our respondents. It was mentioned above our sampling was chosen based on convenience (available) technique. It helps to make research possible. We sent request to 85 persons and got back 62 responses. If respondents wish to discuss the current topic in more details, we put information in the end of the questionnaire about possibility to make interview with them.

The next step was in-depth interview with residents. Some respondents were from the group who completed our questionnaire. Interviews were gathering via face-to face meeting with representatives of studied regions and also phone interviews were conducted. On average interviews lasted for about one hour and we managed to make 11 interviews.

We used semi-structured interview with predetermined questions but with the possibility to modify them based upon the respondent's perception of what seems most appropriate in the particular situation. Question might be changed with necessary explanations. Some questions, which seemed inappropriate with a particular respondent, can be excluded and additional ones can be included in order to get information that is more relevant. Yet the conversation with each respondent didn't go beyond our topic and predetermined questions. Interview guide is presented in Appendix 3.

5.8. Validity and Reliability

Interpretation of the results is closely related to the procedures of their verification. Interpretation is good only if collected data are valid and reliable. Thus, the validity of the study is the most important stage of the investigation.

The principles of validity and reliability identify the value of the research. Validity is a question of how far we can be certain that a test or instrument measures the attribute that it is supposed to measure (Easterby-Smith et al. 2002). According to Silverman (2010) validity is another word for truth. The validity of information is its relevance and appropriateness to the particular research question and the directness and strength of its association with the concepts under scrutiny (Pierce, 2008). In simple words, validity shows us whether the findings in the research are about what they were supposed to be about.

In this particular research work, we tried to ensure validity of data through the analyses of literature and previous studies on the issues of energy efficiency behavior and energy conservation. It is very important to take into consideration the reputation of the source. For our research we used such sources of literature as legislation acts of Russian Federation on energy efficiency and energy conservation; scientific articles written by experienced and respected researchers, which are available in electronic form on Science Direct⁴ and Google Scholar⁵; previous studies on energy efficiency in Russia conducted by World Bank and CENEF; data from IEA, WCIOM and other official web pages.

Reliability is primary a matter of stability (Easterby-Smith et al. 2002). Reliability is, literally, the extent to which we can rely on the source of the data and, therefore, the data itself (Pierce, 2008). Reliability of the study characterizes the reproducibility of the results. This means the relative constancy and stability results under the primary and repeated research on the same respondents. Thus, we can say that the reliability of methods - is a criterion that indicates the accuracy of the measurements, i.e. gives an indication of how robust are the results obtained.

Collecting primary data, we as researchers chose a position of complete observer and did not influence the information received from respondents. Moreover, each interview was recorded and then transcribed word for word and then the result was shown to respondents. All the respondents live in residential buildings in one of our focus regions and are the end users of energy. Thus the results based on the data acquisition are reliable.

5.9.Data analysis

When we identified and gathered our facts and we are ready to analyze them. This analysis includes thinking of words that characterize the various aspects of our problem, organizing obtained facts.

Data analysis consists of two stages. The first stage was the survey data analyses. This was a preliminary and necessary step in order to achieve greater understanding of the issue for further investigation. The survey also helped to select a sample for interviews, because at the end of the survey we put an additional section. In this additional section those people who were interested in the topic of our research and were ready to participate in the second stage of primary data

⁴ <http://www.sciencedirect.com/>

⁵ <http://scholar.google.ru/>

collection could write their contact (e-mail or mobile number). Further this people were included to the sample for interviews.

The results of the questionnaire were analyzed through the exploratory data analysis, which means to look at the data and get the idea of what is there. We choose the visual representation of data for our analyses in order to simplify complexity. Data is presented in forms of pie charts and tables with explanations and discussion. In our case the first stage leads to additional data collection in the form of in-depth interviews.

The second stage of the analyses gives deeper understanding of the public opinion on the energy efficiency issue and practice on energy conservation. It is the main stage of the research. Analyses of interview transcripts and field notes are based on an inductive approach, which allows the research findings to emerge from the raw data. Inductive approach is intended to aid an understanding of meaning in complex data through the development of summary themes or categories from the collected data. The outcome from an inductive analysis is the development of categories into a model or framework that summarizes the raw data and conveys key themes and processes. Usually inductive studies report between three and eight categories in the findings (Thomas, 2003).

5.10. *Limitations of the research*

Writing a Master Thesis it is hard to avoid some limitations of the research. Before presenting the results of our investigation, some limitations should be mentioned in this chapter. Due to limited time and capital there was no possibility to reach large number of participants. Furthermore, not all potential respondents were able to participate in the relatively long and time consuming, one hour interview. Thus for the study were selected a small sample from our population. And the small sample of respondents must be kept in mind, because they do not represent the whole population of Arkhangelsk and Murmansk regions. Thus, the results cannot be generalized to all residents of the two focus regions, but they bring to light the factors which motivate and prevent end consumers to save energy. This limitation also will be carefully treated in the Analyses and Discussion Chapter.

Summary

This chapter presented main features of the research designing. We began from the selection of the philosophical positioning which is a core of any research study. The philosophical position that was chosen for this particular paper is social construction of reality. The ultimate goal of our research is to explore factors that influence energy efficient behavior and social constructionism was taken as a basis of the research because ‘behavior’ is a phenomenon which cannot be measured directly. We also noted the time dimension of the research and limitations of the resources such as time and finance for this particular study as a final project work for Master students.

We next introduced how the research was designed and how we collected the data using chosen methodology approach. Considering all three types of research design we chose our research to be of an exploratory nature, with elements of descriptive design. Based on existing approaches of data collection we decided to use mixed method of gathering data which includes the combination both qualitative and quantitative methods. This mixed approach matches strong sides of each method and reduces weaknesses.

Two types of data’s source were used in the project. Secondary data was used in the forms of academic books, articles, web pages, legislation acts, etc. The primary data was used in the forms of surveys and interviews. Finally, the process of data analysis and limitation of the research were described..

6. Analysis and discussion

Primary research involved collecting data about our subject directly from the real world. The aim of this chapter is to present results, analyses and discussion from primary data gathered during our investigation. It should be mentioned here that the public opinion presented as results in this chapter is based on the opinions of the participants of the study. Data analysis is presented here in two stages. The first stage represents the analysis of data gathered with the help of questionnaire, and the second stage represents the analysis of data gathered during in-depth interviews.

6.1. Survey data analysis

The aim of the survey is to gather general information from Murmansk and Arkhangelsk residents about:

- the attitude towards energy efficiency issue;
- the level of awareness about the energy efficiency and energy conservation policy;
- the measures of energy saving which people are aware of and the measures they actually use in order to save energy.

Making a survey was chosen as a first step of the data collection for several reasons. The first reason is limited time for data collection. The questionnaire was sent to 85 people via internet and we got 62 responses. Conducting interview with 62 people is very time consuming and complicated task, while the survey gave us the possibility to get answers to our questions within 10 days. The other reason is data analyses. Responses were received in electronic forms and there was no need to transcribe it. And finally the survey helped to select respondents for further analyses and prepare the questions for in-depth interview, as well as arrange several interviews. Further this paragraph encompasses the empirical data collected through questionnaire and the results are presented in the visual forms with explanations and discussion.

❖ *The attitude towards energy efficiency issue*

In order to investigate the general attitude towards energy efficiency in the residential sector the block of 3 questions was created. The results are presented in this section below.

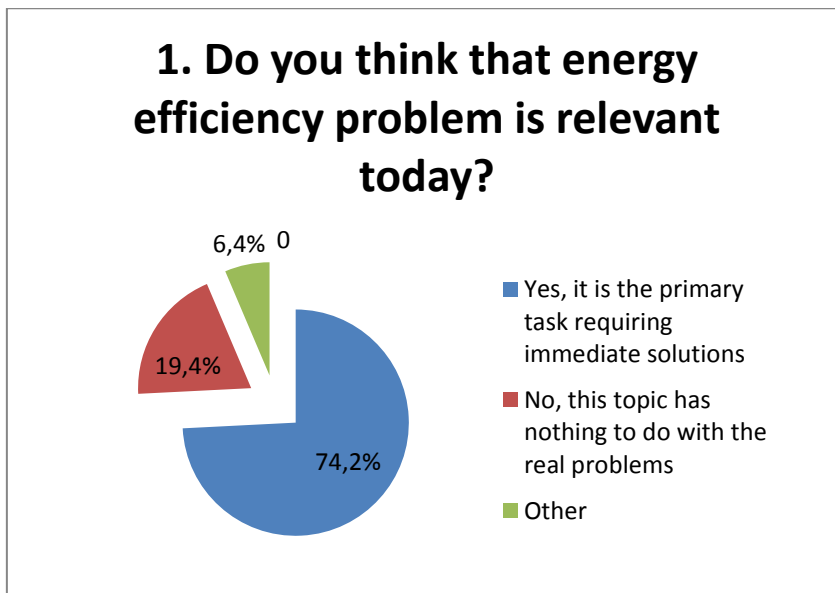


Figure 6.1. Residents’ attitudes towards energy efficiency issue

The pie chart gives a visual representation of the residents’ attitudes towards energy efficiency in general. 74.2 % of the respondents think that energy efficiency problem is relevant today and it is very important. In contrast 19.4 % of respondents consider energy efficiency problem irrelevant and say that this topic has nothing to do with the real problems. Almost every question in the survey contains the “Other” open answer, which allowed people to write what they think if they did not find the right answer in the list we suggested. In this question “Other” answers have very common meaning. For example, here are two quotes of respondents on this particular issue: “No, today it's not so crucial, it's the problem of future generations” (from the Questionnaire #3, hereinafter #3); “This problem is important and relevant, but not today, I prefer to think about today!”(#46). We can merge them into a single category and say that 6.4 % of respondent think that energy efficiency is the problem of the future. Now, when it is evident that most people think that the problem of energy efficiency is important and relevant, we need to find out if people try to conserve energy. The next step is to ask if residents try to make any efforts in order to save energy in their apartments.

66.7 % of the respondents try to save energy. It is a good trend; people think about energy conservation and try to conserve energy in their households. At the same time we still have 33.3%, which is a quite high proportion of people who are wasteful and do not even try to save energy. In this paper we are interested in identifying the factors which cause such behavior. Interesting to note that even if a person say that he/she tries to save energy in his/her daily energy consumption, it is not what he/she really does. Some people could say that they take a shorter hot shower, for instance, 5 minutes. But is a person takes a stopwatch to measure the

actual time spent in the shower, it could be much more than 5 minutes. People just do not always think about it. In our in-depth interview we will ask questions about the concrete actions people do to reduce daily energy consumption.

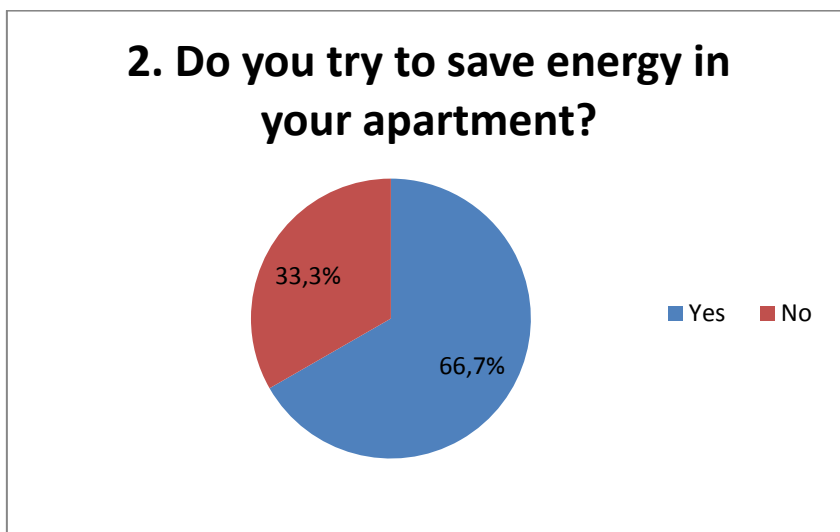


Figure 6.2. Energy saving actions

In general we can conclude that respondents consider energy conservation issue as important. According to the question 3, only 2.8 % of respondents say that the issue is not important. The “overwhelming majority” (almost 80%) of Arkhangelsk and Murmansk residents conserve energy in order to pay less for utility services and save money. 6.7% of people think that it is important to save energy in order to reduce the negative impact of CO₂ emissions. And only 12.3% reported that thus seek to save the planet's resources; this percentage is very close to WCIOM's 9%, which we have discussed in the second Chapter. Nobody marked the “Other” alternative in this particular question. We can say that economic reason to conserve energy prevails among other motives, and the second stage of the analyses will examine the impact of this factor on energy efficient behavior of householders.

Analyzing and summarizing the first three questions about attitude towards energy efficiency issue we can make a small conclusion. Most participants of the survey consider the energy efficiency problem important and relevant. Also we can say that the majority try to save energy in their domestic energy consumption. The main reason why energy conservation is considered to be important is saving money on utility bills.

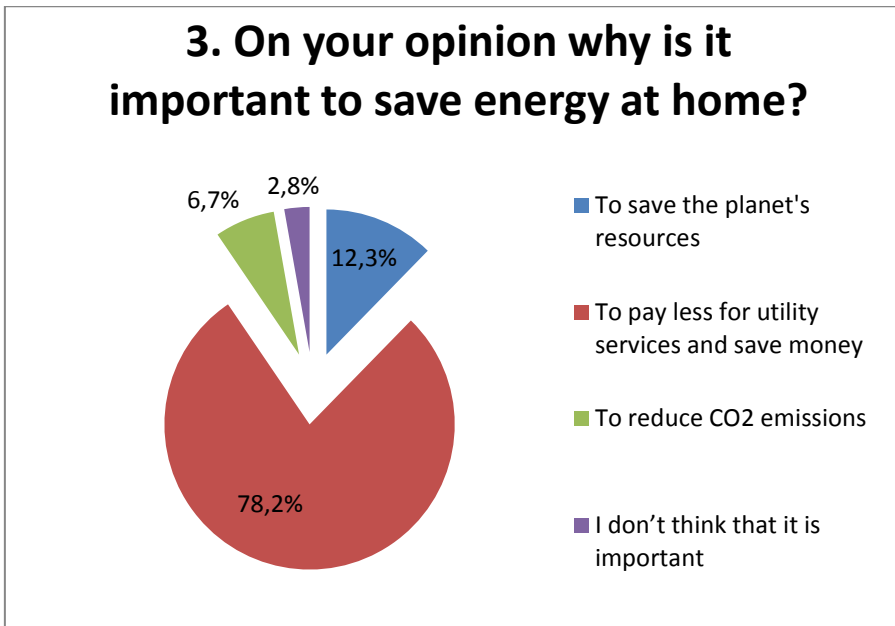


Figure 6.3 Reasons to save energy

❖ *The level of awareness about the energy efficiency and energy conservation policy*

Energy Efficiency policy in Russia is implemented in 90th of last century. We asked ordinary residents if they have ever heard about this policy.

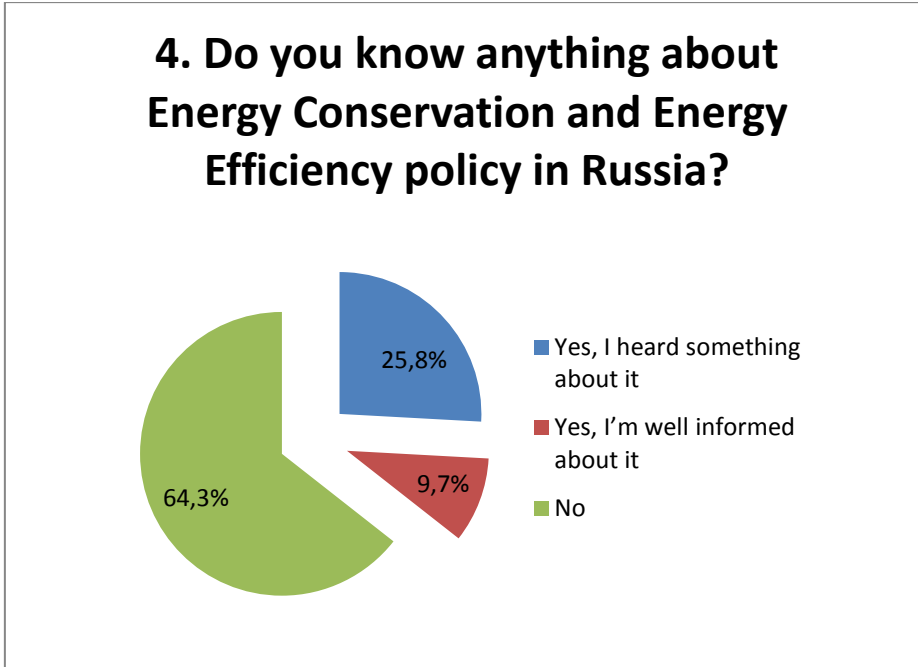


Figure 6.4. Residents' awareness about Energy Efficiency and Energy Conservation policy

More than a half of respondents (or more precisely 64.3%) are absolutely unaware of Russian policy in the field of energy conservation and energy efficiency. 25.8% heard something about

energy efficiency and energy conservation policy, but are not sure they are quite well informed about it. And only 9.7% of respondents have enough information and feel that they are aware of the policy. The second chapter of this Master Thesis is stated that “Energy efficiency has been identified as one of the key priority areas for the Russian government”, but as we can see from the results of the survey in our focus regions respondents are unaware of Russia’s efforts to achieve energy efficiency. Series of laws and regulations were adopted; different budgetary institutions are established to support the energy efficiency policy; Russian government put a lot of effort to realize county’s energy efficiency potential, but without informing people about the issue it is very difficult to succeed. In our in-depth interview we discuss the impact of the informational factor on domestic energy efficient behavior in more details, based on what people think and feel about it.

❖ *The measures people know and use in order to save energy*

Question 5 suggested different methods of energy saving. Respondents were required to indicate the measures which they know about. Then in Question 6 respondents were required to choose only those measures that they actually use in the real life in order to save energy from the same list. The results from two questions are summarized in a table and compared.

Table 6.1. Residents’ awareness and implementation of energy efficient measures

<i>What measures of saving energy...</i>	<i>do you know?</i>	<i>do you use?</i>
Different Measures	Percentage	
Install counters for heat, electricity, gas and hot water	46,7%	40,0%
Install an individual heating system in the apartments	20,0%	6,7%
Replacing incandescent light bulbs with energy saving light bulbs	40,0%	33,3%
Turning off the lights when leaving the room	60,0%	36,7%
Turning off appliances while not in use	40,0%	26,7%
Buying energy-efficient electrical appliances	26,7%	20,0%
Installing insulation of the apartments	6,7%	6,7%
All of the above	56,7%	6,7%
None of the above	0,0%	10,0%

The first column of the table suggests various methods of domestic energy savings. This is not a complete list of all possible measures, but a sample of the most common ones. The second green column represents methods which people know about in percents for each method, and the third blue column represents the percentage of methods which people use in real life. In general people have certain level of awareness about various methods of energy saving, because we have no respondents who chose the “None of the above” answer. 56.7% of respondents who know all the above mentioned methods is also relatively high. At the same time if you look on the results from the column 3 the statistics shows that the “leader” among methods is “installation of counters” (40%), but this not even a half of respondents use this method. The most interesting finding from this table is that 56.7% of the respondents are aware of all methods of energy saving from the list, but only 6.7% of the respondents actually use all the above mentioned methods. We can conclude that the availability of information about different methods of energy saving does not influence on their actual usage.

To sum up the data gathered from survey we can say that most participants consider the energy efficiency problem important and relevant. Also we can say that the majority try to save energy in their domestic energy consumption. The main reason why energy conservation is considered to be important is saving money on utility bills. The level of awareness about policy is low; more than a half of the participants of this survey know nothing about the Russian policy on the energy efficiency and energy conservation. At the same time the level of awareness about different possible measures of energy saving is relatively high. But in real life many of these methods are rarely used by consumers. Later in this chapter the results of interviews will be presented with more in-depth and detailed investigation and analyses of factors influencing domestic energy efficient behavior.

6.2. Interview data analyses

This part is based on the theoretical model which was developed in chapter 4. According to this theoretical model an interview guide with questions was developed. Analysis is based on 11 interviews with residents of Arkhangelsk and Murmansk, who represent ordinary end consumers of energy in residential buildings. All interviews were taped and then transcribed. In order to increase validity and reliability of our research, the results were verified by showing the transcribed text to interviewees and asking them if we have recorded accurately what they said. All the interviewees preferred to stay anonymous. For this reason, in the analyses and discussion real names are not used for citation, the ordinal number of interview was used instead.

❖ *Energy efficiency definition*

Before analyzing factors influencing energy efficient behavior, we will start with the meaning which our respondents give to the concept. All the respondents were asked to define what they mean by energy efficiency in relation to domestic energy consumption. And they have shown different understanding. Answers of the respondents in the form of direct quotations are shown in the table below.

Table 6.2. Respondents define energy efficiency

Respondent	Definition given by respondent
#1	When the householder <i>use as much energy as he needs</i> , exactly. Or when you do maximum housework with the minimum use of energy. I mean you <i>don't waste energy</i> . Then, it is <i>effective use</i> .
#2	It is <i>about saving energy</i> - insulation of your flat; the <i>light which automatically turns on and off</i> ; maximum use of alternative energy, wind for instance, which may be used to generate energy for a dwelling house.
#3	Unfortunately I'm not familiar with energy efficiency term. But I think this can be a special <i>bulbs or automatic switches to turn the lights on/off</i> , which will help <i>to save energy</i> . In Europe everyone use these, it could be very useful for Russia also.
#4	I think it is connected with <i>rational use of energy</i> , which is to use counters in your apartments to control how much energy you used per month.
#5	I think people should organize their domestic energy consumption in such a way when you <i>don't waste energy</i> .
#6	<i>Effective use of resources</i> to benefit all the residents of the building. For

	example, in the staircase of the building where I live, the light is always switched on. It is cold there and even no windows. I think <i>that it's a waste of energy</i> .
#7	It is just an <i>effective energy use</i> at home, you consume as much as you need. And not more. You <i>do not waste energy</i> without a reason.
#8	It means <i>to conserve energy</i> . And the rules of energy conservation is our skills, we need to be thrifty, and teach these skills in our children and thereby improve the environment.
#9	Energy efficiency means <i>careful and rational use of energy resources</i> . And in my opinion <i>saving resources</i> should become an integral part of our mentality.
#10	Energy efficiency means the <i>efficient use of resources</i> . Efficient use of resources <i>associated with the consumption</i> : if you <i>consume as much energy as really needed</i> , then your household is efficient.
#11	To tell the truth I have never think about it. But maybe it is some <i>energy saving efforts</i> , or something connected with the modernization of your flat. When everything is new and modern you <i>consume less</i> .

As we can see from the Table 5.2 in most cases energy efficiency concept is associated with *effective* (# 1, 6, 7, 10) and *rational use of energy resources* (# 4, 9) and *energy saving*(# 2, 3, 8, 11) Respondents also associate energy efficiency as such consumption when *energy is not wasted* (# 1,5, 6, 7).

Two respondents mentioned automatic lighting and one respondent also mentioned modernization of the flat. But again in all cases these measures were associated with saving energy: “*When everything is new and modern you consume less*” (#11); “... *special bulbs or automatic switches to turn the lights on/off, which will help to save energy*” (#3). Moreover, previously in chapter 3 we have discussed that such actions as a replacement of incandescent lamps with compact fluorescent lamps, application of thermal insulating materials in buildings and hot water accounting installment can be named as actions leading to energy efficiency.

According to the definitions from the Table 5.2 we can say that understanding of the energy efficiency concept presented by our respondents corresponds to the definition by McLean-Conner (2009), which was presented in the chapter 3. From all the above we can say, that energy efficiency is related to decreasing energy consumption and has a focus on energy waste reduction. The essence of energy efficiency is enclosed in efficient and rational use of energy resources.

❖ *The impact of Economic factor*

In the mind of an ordinary consumer benefits associated with efforts to make energy consumption more efficient are the expected reductions in energy bills. The data obtained from interviews confirmed the results we got from the survey. The economic factor can be named as one of the main factors influencing energy efficient behavior of the ordinary consumer of energy. After a small introduction to the topic of our investigation and discussion about the meaning which respondents give to energy efficiency in relation to their domestic energy consumption, respondents were asked to think about the drivers which could motivate them to save energy.

“You consume less- you pay less. The rule is very simple here. Money is the best driver! - as one of our respondents (#1) concluded. - I'd rather spend the saved money on something useful”.

Most participants of interviews share this opinion. The current tariffs for energy in Russia are considered relatively low, and from the point of view of our respondents the price increase could change the attitude towards energy. 8 out of 11 respondents claimed that a significant increase in energy prices could force them to reconsider their energy consumption and change their current behavior.

“Energy saving is important in the point of money saving. I think main drivers to change our current wasteful behavior are expenditures on energy. Energy is not very expensive in our country. And maybe poor and old people with low-income level try to save energy, but most people don't. Increase in prices could be a good reason for energy saving. I think that price hike would make me react and start conserving energy” (# 3).

Respondents also associate some costs with saving energy. Costs connected to purchase of household appliances with high energy efficiency classes; switching to energy saving light bulbs; installation of plastic windows and insulation were named by participants. It is interesting to note that most participants believe that benefits from more efficient use of energy will exceed the previously mentioned cost in terms of money.

“I always pay attention to characteristics of the appliance before buying it. Before purchasing, I usually spend some time searching for information on the Internet about energy efficiency class and Energy star standard. I prefer products with class A or B. So I'm trying to make more efficient energy consumption in my flat. I am convinced that my efforts will pay back in the medium-run” (#8).

“We recently made several improvements in our apartment. We changed old wooden windows to modern plastic; also we changed radiators and switched to energy saving light bulbs in all rooms. And we installed a counter for hot water as well. I believe that next winter I will see a significant difference in the bills in comparison to this winter. It was quite chilly and we used electric heater in addition to our central heating system, it was quite expensive” (#11).

Economic factor undoubtedly affects energy efficient behavior of an individual consumer of energy in residential sector. Taking certain energy saving measures and implementing energy efficient technologies consumer is expecting benefits in the form of reduction in utility bills. Until a person finds tariffs for energy cheap or do not see the opportunity to save money there is no incentive to make a change in consumption level.

❖ The impact of Environmental factor

Some individuals believe that energy saving measures at the household level give rise to important environmental benefits. Respect for the environment influence the behavior. In our case, first of all it was revealed that none of our respondents could confidently say which production sources energy they use at home is from. The most common versions included coal, gas, fuel oil, hydro and nuclear energy. Nevertheless, all the respondents associate energy generation from listed sources with certain environmental problems. For example, in the case with nuclear energy a lot of people still remember the Chernobyl disaster in 1986, and also two respondents mentioned the catastrophe at the Fukushima Nuclear Power Plant in 2011.

“When you asked about environmental impacts the first thing which somehow came to my mind was Fukushima Nuclear Power Plant in Japan. It was really a disaster. Or the situation happened in Ukraine in Soviet times, at the Chernobyl Power Plant. The place is still closed because it is really dangerous even to be there, despite the fact that it was nearly 30 years ago” (#4).

Not only is the generation of nuclear energy associated with certain environmental danger, but also other seemingly safe ways to generate energy. It should be noted that 3 respondents consider hydropower potentially dangerous for ecology.

“Hydroelectric power stations adversely affect our nature. Flooding of territory may occur and trees and other plants die as a result. Or even worse, it could leak oil as at the Sayano–

Shushenskaya Dam. In such cases negative environmental impact does not last for one day it rather last for months and years” (#7).

The question about environmental problems caused by energy production was asked with a purpose: to make our respondents think about possible harm of energy generation. This was the introduction prior to ask about how to avoid these harmful consequences and who is responsible for it. All 11 respondents claimed that the government and energy generation companies share the responsibility to reduce the environmental impact of energy production.

“The government of a country should implement certain norms and rules for safe energy generation and energy generation companies must follow these rules and bear full responsibility for their failures. It is unacceptable to spare money for the execution of safety rules and timely modernization of power plants. Energy producers, of course, must be more conscious” (#9).

On the question of whether the efficient use of energy by an individual consumer have an impact on environmental issues respondents had contradictory opinions. As we have already discussed in the previous chapters altogether the residential sector consumes a lot of energy. Compared to the total energy consumption one household consumes insignificant part. 7 respondents claimed that an individual consumption can not affect the general environmental impact of energy generation:

✚ *“If I save several kWh of energy I don’t think it will impact the environment in positive way. We have a lot of industry in our country, I cannot even imagine how much energy they consume a day! I think that environmental question is not how much we consume, but rather about the safe way of energy generation. Here the issue is within the competence of a generation side”(#1)*

✚ *“There will be a significant effect only if all people would think about these environmental problems, and start actions. Unfortunately no one cares about this including me. One person cannot change anything in so global problem”(#3)*

Another 4 respondents believe that even one person is able to change the general picture and by reducing his/her energy consumption thus reduce the negative impact of energy generation as a whole:

✚ *“Individual is able to change a “big picture”. If we consume less energy, producers will generate less. And less will be the negative impact on environment” (#7).*

✚ *“Cities and population are growing, we need more and more energy to satisfy our needs, thus yes, by reducing individual consumption can bring advantages for the whole*

process. We as a consumer can reduce our consumption and save energy. Then we will need less and energy companies will need less production” (#5).

From all the above we can see that if the individual consumer believe that energy saving measures at the household level give rise to important environmental benefits, this could be as a motive to achieve energy efficient behavior. Thereby environmental factor influences energy efficient behavior.

❖ ***The impact of Informational factor***

As we discussed earlier in the theory part information is the one of the main factor for making decisions. It is very important to provide the consumer with the information about energy policy and about possible ways to reduce energy consumption. Information is that invisible source which allows acting in a more appropriate way. But one question arises: where ordinary householder can gather necessary information for right actions. The easiest available way to reach audience is to do it through media. These regions are quite far away from the capital and the announcement of Federal Laws and Programs and compliance there can be limited due to historically organized manner of life on the periphery. We asked our respondents if they get enough information about energy efficient policy in the focus regions

- ✚ Respondent #1 – *“I have no information at all about this policy; I don’t even know how much money my family pays for energy.”*
- ✚ Respondent #2 – *“I can surely declare that it is not enough information about energy policy and energy efficiency in general. There is no advertisement at all. I have heard about the Resolution of President to stop using an incandescent lamps and replace them with energy efficiency ones. This is the only one mention of energy efficiency which I know ”*
- ✚ Respondent #3 – *“I absolutely don’t have any information about energy saving, except the fact that we have to use energy efficient bulbs instead of incandescent.”*
- ✚ Respondent #4 – *“Unfortunately, no. I own no information related to this issue. Never heard anything about policy of our government towards energy efficiency”*

Respondents #5, 6, 7, 8, 9, 10, 11 also presented the same answers as it is mentioned above. They didn’t see any commercial on TV or in newspapers about the implemented Federal Law.

The next question according to our interview guide was: “In your opinion, how is the energy efficiency policy in Russia works?” And of course based on our previous answers that no one knows about energy efficiency policy in Russia we didn’t ask the question about how it works. It

is obvious from mentioned above that ordinary Russians never heard and not involved in this Federal program.

Another important question was: what is that things about energy efficiency which ordinary householder would like to know more. It can be anything from the way simply to reduce energy consumption at home to the information about energy efficient equipment such as building insulation, modernization of heating system, installation of modern light bulbs as we discussed in the Chapter 3.

Considerable part of our respondents expressed a desire to know what can be done in order to be more energy efficient at their houses (#2, 3, 7, 9, 10, and 11). Respondents would like to see the whole picture of the situation in this sphere; they would like to understand an energy production process and the way they consume it.

Respondent #2: *“What about me, I want to know more, I am really interested. I would like to grasp this process from the extraction of oil, gas or coal to that moment when the light appears in my house. Of course, I understand that if I am so curious I can search information and to understands this process. But we know that people now are getting lazy and searching information about such question as energy efficiency is not a priority task for them. If it is really energy policy invented by government; and if this topic is really important for them, then why not to try to spread an information among the population. We know very well about powerful marketing activity. If any company wants to promote its service or goods they launch advertisement campaign. I would suggest institutions that are responsible for implementation of energy policy to follow that activity of profit organizations. Then I, you and everyone around will know it and for sure someone will try to be energy efficient.”*

Respondents #9: *“Definitely, I would like to know more about energy efficiency. I want to know more about the way to save energy, the way to be energy efficient. I want to know more about technologies which we can apply to reach the main goal. Just recently I knew about valves on the heating system form my daughter. So if we have more information we could act in appropriate way.”*

Respondent #10: *“We need more propaganda from the government and mass media; we have no information enough to understand what we do right or wrong. Most of people do not even know how we can save energy, what technologies exist for that purpose, where to buy it and how to utilize it.”*

In our opinion this answer (#10) in the best way described current situation in the region. People need information and they are ready to accept it. They are getting more conscious and starting to think about future. For the most of them, as it was discussed above, the main reason is economic factor, for other it is combination of economic and environmental factors. The point is that there is a strong desire in knowledge and information about this issue.

Information has the main impact on all of us. Owning by necessary and relevant information means to act in a right way. If we are talking about such important question as energy security of the country, here any right step towards energy efficiency will bring positive affect. We can conclude that there is a strong desire among the population to know more about energy efficiency. And considerable part wants to know production process. Ordinary social advertisement can have a great influence on the consumer. After getting the whole picture of energy production, consumer can realize that this complicated process which involves so many risks and has such a great impact on the environment can be taken under control by simply energy actions of each of them. We can conclude that the lack of information about energy policy can be the main barrier to the way of energy efficient consumption of ordinary households.

❖ *The impact of Social factor*

Cultural and social factors have the largest and deepest influence on consumer's behavior. Consumers are surrounded by family and society, and somehow want they or not the opinion of other people has influence on their decision making process. Child since birth learns basic set of values, preferences, mannerisms and actions specific to his family and the basic institutions of society. If consumer's behavior is determined by social factors, such as reference groups, family, friends, social roles and status, we defined Social factor as the one of the key for decision in favor or against energy efficiency behavior.

Influence of Social factors on behavior described by respondents reflects several aspects of Russian residents' features. Among them are: careless attitude towards energy consumption, unlimited consumption, behavior which is similar to the behavior of people around and lack of attention to the energy consumption in general because all people around don't pay enough attention to this issue.

Respondent #3 mentioned: *"In my opinion, society doesn't think about energy in global, just in local. They put counters in order to save money only. I think it should be some more reasons to start to think about energy consumption. There is no another motivation to save energy at home*

than money saving. I have never shared my point of view about energy consumption and energy efficiency with anyone surrounding me. Does it mean that we just don't discuss this problem between each other? We copy the behavior of our neighbor and act exactly as him. And excuse is why I should care and do some actions in order to change my behavior if my neighbor doesn't do anything about it. I think that I am powerless here and my actions will not change the global picture.”

This comment supports the fact that Social norms, i.e., interactions with and/or perceived expectations from friends, neighbors, family or other households in general plays significant role in a human behavior and in consumer behavior as well. It is reasonable to expect that individuals are willing to think and act in energy efficiency way if only they believe about other peoples' similar behavior.

We asked our respondents how they think: if the energy efficiency and energy conservation in Russia are perceived by the society, including their surrounding people. And the answers in most cases were related to the economic factor. Householders think about energy conservation if only they need to save money - as one of our respondents (#4) concluded. – *“And may be only poor and old people with low-income level try to save energy.”*

As it was discussed in the chapter 3, Russia has the greatest proven reserves potential and it is the biggest producer of oil, gas and coal in the world. Our respondents are quite confident that energy prices in Russia are not as high as in European countries. Respondent #1 commented: *“Energy is not very expensive.”* Rely on this fact that Russian householders don't pay a lot of money for the consumed energy we found out the question of energy efficient behavior is not so relevant for the population. Only several categories of citizenship pay significant attention to this issue. But it doesn't mean that attitude towards energy consumption should be careless and wasteful. Respondent #7 mentioned: *“I think this question is not very important for our society due to some reasons such as cheap available energy”*

From all presented above it can be said that social factor in energy efficient behavior plays significant role. In Russian peoples mind there is an opinion to act the same way as all people around. They are still sure that alone no one can change this situation and then no needs to do any actions from their own side.

7. Conclusions

This chapter presents a summary of current study. First, the main findings and the answer to the research question is presented. Secondly, possible practical implications of the research are considered, following by proposals for future research.

7.1. Conclusions

The essence of energy efficiency is enclosed in efficient, rational use of energy resources with the focus on energy waste reduction. Recently, the role of energy conservation and efficiency increases worldwide. Efficient use of energy resources, reducing heat loss during operation of building infrastructure, solution of energy saving in the residential sector are global issues today and most states pay a lot of attention on this issue, including Russia.

It is undeniable that individual consumer is an integral part of the successful implementation of energy efficiency policy in residential sector. This research project is concentrated on the behavior of end-user, which is individual consumer of energy. Moreover, the implementation of energy efficiency technologies is impossible if people are not enough motivated to use them.

Following the research question: “What are the factors influencing energy efficient behavior of end-users in the residential sector?” and the main issues of the study we have discussed energy efficient behavior within the suggested by previous studies theoretical framework.

Theoretical framework provides different factors, which motivate and prevent consumers to behave in more sustainable and energy efficient way. All identified factors were combined into four groups and based on this the Theoretical model for the study was developed. The factors are as follows: economic, environmental, social and informational. With the help of an empirical study in projects focus regions the influence of each factor on energy efficient behavior has been investigated. The research has obtained the following results.

The economic factor can be named as one of the main factors influencing energy efficient behavior of the ordinary consumer. This is evident by the data obtained from both interviews and survey. Taking certain energy saving measures and implementing energy efficient technologies consumer is expecting benefits in the form of reduction in utility bills. When an individual believes that expected benefits will exceed the costs it motivates energy efficient behavior. But when a person finds tariffs for energy cheap and do not see the opportunity to save money there

is no incentive to make a change in consumption level. Thereby in Murmansk and Arkhangelsk regions energy efficient behavior could be triggered by energy price increase.

Respect for the environment influences behavior as well. When an individual believes that rational energy consumption at the household level give rise to important environmental benefits, this fact motivates energy efficient behavior. Most participants of our study believe that an individual consumption can not affect the general environmental impact of energy generation. But there exist the minority of people who are convinced that even one person is able to change the general picture and by reducing his/her energy consumption thus reduce the negative impact of energy generation as a whole. For these people concern for the environment motivates energy efficient behavior.

Informational factor has direct influence on energy efficient behavior. For the implementation of energy saving events individual households should have access to information about how to identify and implement energy efficiency projects, as well as which professional market participants they may ask for the preparation and implementation of energy efficiency in their houses. Current study in the focus regions has shown that ordinary residents do not have necessary knowledge for energy efficiency implementation and they are not even involved in the process of Federal energy efficiency projects. Informational support to ensure the preparation and implementation of solutions for energy conservation and energy efficiency is weak. Lack of information was identified as a barrier to bring about behavioral change towards rational energy consumption in residential buildings.

And finally social factor, i.e. interactions with friends, neighbors, family or other households has the largest and deepest influence on consumer's behavior. It is reasonable to expect that individuals are willing to think and act in energy efficient way if only they believe about other peoples' similar behavior. Participants of the study showed careless attitude towards energy consumption; irresponsible unlimited consumption and following the behavior of surrounding people. Thus the study revealed little appreciation of energy efficient behavior among respondents, which is a serious barrier to implement energy efficiency at the household level.

7.2. Practical Implications

This Master Thesis presents a research conducted on the concept of energy efficiency in relation to residential buildings and investigated factors influencing energy efficient behavior of end consumers. The Master Thesis is developed in connection to Work Package 1 of the project

“Sustainable Buildings for the High North”. The Work Package 1 is focused on cross-border business development of energy efficient building technologies trade and distribution in the High North. Main focus regions of the project are Arkhangelsk and Murmansk regions. The Master Thesis may be implemented in order to complement Project Report developed by HHB/Nordområdesenteret.

This research reflects the attitudes towards energy and factors influencing the behavior of end consumers in the two focus regions and thus may be applied by producers of energy efficiency technologies and solutions from Russia, as well as from Scandinavia (Norway, Finland and Sweden).

Moreover, this study examined the degree of awareness about energy efficiency policy among population. It might be interesting for Russian authorities and can help to reveal problems of implementation of energy efficiency and energy conservation policy.

This particular study may be implemented by other Master students as a basis for future research. And finally, it might be useful for end consumers of energy to get additional information about the current policy, as well as measures/actions to gain energy efficiency in domestic energy consumption.

7.3. Recommendations and Further Research Proposals

Information dissemination about importance and benefits of energy efficiency can raise general awareness and understanding of this issue in society. Providing facts about negative environmental impacts of energy wasting and possible ways to optimize individual energy costs can be a stimulus for households to realize importance of the problem.

We recommend information campaigns in various forms, but to be effective, they must be precisely aimed at specific target group of consumers. Such campaigns may include: advertising campaigns on energy conservation, energy efficiency labeling of household appliances and equipment, advice on equipment and behavioral practice, education schools and interactive consultation of experts in the energy audits. Information should be widespread and available for each category of consumers. Fast moving consumer goods are strong promoted by the production organizations. The same practice would be very beneficial for energy efficiency campaign. It is important to organize a clear interaction with the business community, as well as to involve the human factor, providing information and educational support measures for energy

conservation and efficiency use of energy resources at the international, federal, regional and municipal levels.

Finally we want to suggest further research in the area of energy efficient behavior. We propose a longitudinal study on the question of household behavioral change under the influence of factors identified in this study. Furthermore, we propose a large-scale study of energy efficient behavior in other regions of Russia. In addition it might be relevant to conduct a more extensive study on the motivation to implement energy efficiency technologies, since our research identified the high level of awareness about technologies, but low level of their actual usage by consumers.

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Appendixes

Appendix 1

MOPP Timeframes

<i>Time period</i>	<i>Actions</i>
08.01.2014-25.01.14	Clarifying the research problem and creating a preliminary plan. Literature search.
28.01.14	Presentation number 1
29.01.14-27.03.14	Developing research questions. Literature review; creating of a theoretical framework and background for the study. Choosing the appropriate methodology. Writing up theoretical part and methodology chapter. Identifying the sample.
28.03.14	Presentation number 2
29.03.14-19.04.14	Preparing Questionnaire for the survey. Preliminary work on interview guide. Conducting a survey. Analyzing the results.
20.04.14-30.04.14	Revising the research model. Changes in interview questions.
01.05.14-20.05.14	Conducting interviews. Transcribing and analyzing interviews.
21.05.14-01.06.14	Writing up analyses, discussion and conclusion.
02.06.14-07.06.14	Editing and writing up the final version of the MOPP.
10.06.2014	Delivering the MOPP

Appendix 2

Questionnaire

1. Do you think that energy efficiency problem is relevant today?
 - Yes, it is the primary task requiring immediate solutions
 - No, this topic has nothing to do with the real problems
 - Other _____

2. Do you try to save energy in your apartment?
 - Yes
 - No

3. On your opinion why is it important to save energy at home?
 - To save the planet's resources
 - To pay less for utility services and save money
 - To reduce CO2 emissions
 - I don't think that it is important
 - Other _____

4. Do you know anything about Energy Conservation and Energy Efficiency policy in Russia?
 - Yes, I heard something about it
 - Yes, I'm well informed about it
 - No

5. What methods of energy saving do you know?
 - Install counters for heat, electricity, gas and hot water
 - Install an individual heating system in the apartments
 - Replacing incandescent light bulbs with energy saving light bulbs
 - Turning off the lights when leaving the room
 - Turning off appliances while not in use
 - Buying energy-efficient electrical appliances
 - Installing insulation of the apartments
 - All of the above
 - None of the above
 - Another _____

6. What methods of energy saving do you use in real life?
 - Install counters for heat, electricity, gas and hot water
 - Install an individual heating system in the apartments
 - Replacing incandescent light bulbs with energy saving light bulbs
 - Turning off the lights when leaving the room
 - Turning off appliances while not in use

- Buying energy-efficient electrical appliances
- Installing insulation of the apartments
- All of the above
- None of the above
- Another _____

Thank you!



This survey was the first step of our investigation. The second step will be conducting interviews on the same topic.

If you are willing to participate in interview, please write your e-mail and we will contact you.

Appendix 3

Interview guide

Before the interview:

Thank an interviewee for participation; introduce ourselves (name, university, our field of study); briefly describe the topic of our investigation; define the conditions of the interview (confidentiality and audio recording); and asking if the interviewee has any questions before we start.

1. *(Main research question)*

Is there anything you would like to change about how your household uses energy? If yes, what? And why? And how would your household go about making the change? What are the drivers? If not, why? Would you feel guilty to use too much energy at home? And what are the barriers to make a change?

Is energy saving important for you? Why? If yes: do you try to conserve energy? What exactly do you do? Explain the most successful ways you have found to save energy. If not: Why does saving energy in your apartments feel difficult for you?

What is the most important thing in order to change energy consumption at home? What could motivate you to save energy?

What do you mean by energy efficiency in relation to residential buildings? What are some simple steps people can take every day to conserve energy

2. *(The impact of Social factor)*

How do you think the energy efficiency and energy conservation in Russia are perceived by the society, including your surrounding people? What about politicians/officials?

3. *(The impact of Environmental factor)*

Which production sources do you think that the energy you use at home is from? Which environmental problems caused by energy production come to your mind? Who do you think has the responsibility to reduce the environmental impact of energy production? If you had the chance to decide, how would you try to reduce the environmental problems caused by energy

production? In your opinion, could the efficient use of energy be an effective way for an individual to have an impact on environmental issues?

4. *(The impact of Economic factor)*

In your opinion what are the potential benefits of the efficient energy use for an individual consumer? Do you feel that saving energy would benefit you/ your household in any way? Which costs do you associate with saving energy in your apartments? Do you think that benefits from more efficient use of energy will exceed the cost? Why?

5. *(The impact of Informational factor)*

Do you feel that you have enough information for a possible decision whether to conserve energy or not? Which things would you like to know more about? Do you have any information about the amount of energy you use per day and for which purposes it was used? In your opinion, will the availability of such information influence your energy consumption? Why/How? In your opinion, how is the energy efficiency policy in Russia works? Is it successfully implemented in your region? What are the potential obstacles?

6. *(Information about an interviewee)*

Can you tell me a bit about yourself? What city do you live in? Do you live in a flat/cottage? What is the approximate age of the building?

7. *(Additional information, the end of the interview)*

Is there something you would like to say about this subject that I did not ask about? Thank you for all that valuable information, is there anything else you'd like to add before we end? May I contact you, if further questions should arise? Would you like to receive a copy of our research findings? Thank you for your cooperation.