THERMAL INSULATION IN URBAN HOUSING AND THEIR ECONOMIC BENEFITS

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ABSTRACT

Energy supply for the population is among the main and most serious problems in the current that runs our country, especially if we take into consideration the fact that half of total energy is consummated by familiars for household heating. It often cause in the peak time difficult situations in providing the energy, especially electricity. This is a problem that needs concrete solutions by facing the energy resources available to the population's energy requirements, and taking into consideration the comfort, health and cost-effectiveness. For heating residential, the population use electricity, firewood (stoves) or boilers. Therefore we need to increase the use of alternative materials for space heating and other heating ways of housing. Reduction of energy due to the thermal insulation of housing brings economic benefits due to the reduction of spending and electricity savings. This paper focuses only on the thermal insulation of housing, which is one of the key factors in achieving energy efficiency by achieving an analysis of the economic benefits that how much money can be saved over a year by applying thermal insulation in housing.

Keywords: Energy Efficiency, thermal insulation, heating of housing, economic benefits.

INTRODUCTION

Each flat before '90 used to heat individually by heating only one environment that was usually the kitchen, which was realized by the stoves, where firewood were used as fuel The efficiency of these devices does not exceed 50%. After 90 years, the structure of warming has remained almost the same in terms of heating facilities (only kitchen) and its manner (individual heating for each flat or per room). While, in terms of energy sources, which is carried out the warming, we can say that its structure has changed. Besides firewood, which are used more in rural areas, extensive use is electricity, where 50% of its use in the apartment goes for heating. This has made that in certain years have had consistently absence or interruption. Also, it is used liquefied petroleum gas, and oil for boilers. As above, we can say that this is one of the reasons that we have to find ways and methods to save energy, especially the electric one. WE have adopted in our country until now two DCM and a Law. In DCM no. 584, dated 02.11.2000 it is determined that all new buildings must have located central and individual heating installations. On 12 September 2002 it was adopted the Law no. 8937 "for conservation of heat in the building." The new buildings that were built after the adoption of this law should have had rates in terms of heat loss in them, the rate of normative coefficient Gv), which was approved by DCM. 38 dated 16.01.2003 (the Building Energy Code).

THEORETICAL AND HISTORICAL CONTEXT OF THERMAL INSULATION

The '90s brought major changes to economic and social situation, which affected the energy sector and in the heat sector in particular. It began the liberalization and privatization process of the buildings, which brought its own advantages in the free market in terms of housing, but

also problems in fuels coverage for heating. It started massive use of electricity (this also for non-payment, low enough price and comfort in its use) and increasing the area of housing, changing the architecture and structure of the building. In many residential buildings were installed central and individual heating plants and it was attempted the use of thermal insulation in surrounding structures of buildings. Reduce of energy consumption in buildings through thermal insulation is one of the priorities of Albania which are included in its National Strategy of Energy. Reduce energy consumption for cooling and heating should reduce the amount of imported energy. About 67% of energy and 30% of all energy sources is consumed by the residential sector, and most of it (29%) is used to provide heat into the apartment. Thermal insulation is the reduction of heat transfer between objects in thermal contact or in range of radioactive influence. Thermal insulation is one of the main methods of "Energy Efficiency", which means a percentage ratio of the power output to the incoming energy, in the same energy system, which in our case is the building. This is its theoretical definition. Most simply we can say that "energy-efficiency" would be when in an energetic process we achieve the same results using less energy. The excess energy in this case is the energy saved by taking measures to reduce the amount used in the process.

The benefits from an efficient construction are:
• Energy save and therefore money in our energy bills.
• More comfort and more quality of life.
• Long life building.
• Contribution to environmental protection and reduction of pollutant emissions in the environment.
• Increase the value of the building / apartment.

The goal of energy saving in buildings is to create conditions for systematic rehabilitation of existing buildings and improving the thermal protection required for new buildings. Old buildings consume on average per year Q = 131-325 kWh / m^2 energy used for heating, while isolated buildings in a standard way use less than Q = 120 kWh / m^2. Annual demand for heating Q (kWh / year), is the amount of energy estimated that heating system should provide for the building during the year to maintain the interior temperature of the design. Such expression of energy consumption on buildings in m^2 or m^3 provides basic data that enable the presentation of energy performance in buildings and to compare the "energy performance" in different buildings. This annual energy, calculated for heating, should not be higher than that required in the regulations established for this purpose. In this case it is important to note that in Albania there is a law and a regulation that sets up rules for conservation of heat in the building.

Taking into consideration that the largest losses of heat are caused by surrounding structures of building, its reduction measures are taken by placing into them thermal insulation layer. Some of the materials used in thermal insulation of buildings are styrofoam and panels with glass or mineral cotton. Thermal insulation material more useful in Albania is styrofoam, which is produced in Tirana, Elbasan, etc. Styrofoam produced by these factories is a good quality and it meets certain requirements and standards in this topic. Its production in the country has made the cost of its use in construction to be low. The cost for the thermal isolation of a new building is from 1.5% ÷ 2% of the total cost for construction.

BASIC LEGISLATION IN THE FIELD OF HEAT CONSERVATION IN BUILDINGS

The legal framework related to conservation and energy savings in buildings in Albania is provided as below:

- Decision Nr.584, dated 11.02.2000 "On energy saving and conservation of heat in buildings".
- Decision No. 38, dated 16.01.2003 "Rates, terms and conditions of design and construction, production and storage of heat in buildings.
- Law No. 10 113, dated 04.09.2009 "For indicators of energy consumption and other resources from devices for home use, by labelling and standard information of products"

The main goal of the Law "For the conservation of energy", is to establish the rules and regulations for the storage of heat in the apartment, public and private buildings as well as the control, recording and management of energy consumption in them. The purpose of this law is expressed in:

Article 3

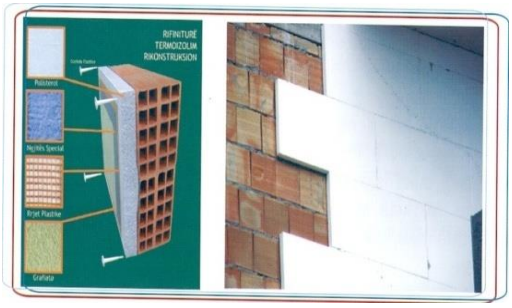
Design and construction of buildings should meet the technical parameters necessary for the preservation, conservation and the efficient use of energy. All buildings that will be built after the entry into force of this law, must respect the normative volume coefficient of thermal losses (Gv), and must predict the placement of the central heating installation. Thermal Coefficient Loss volume GV, which depends on climatic zones and building characteristics, is provided by the "norms, rules and conditions of design and construction, production and heat conservation in buildings", which we have renamed as Building Energy Code. The decision for the approval of the Energy Code for buildings in our country is going in the right direction associated with the European Directive 2002/91 / EC "On the Energy Performance of Buildings". The main objective of this Directive is to reduce energy consumption and to limit emissions from the residential sector, in order to allow the EU and representatives of the European states to fulfill all obligations of the Kyoto Protocol.

Energetic code of buildings

This code analyzes the heat demand of the whole building and the heat losses from it. In this code it is made a detailed analysis to determine the weather conditions (degree-days, external temperatures, periods of heat in cities of Albania etc.), as well as internal temperatures according to the intended use of the building. The coefficient values of the volumetric losses transmitted by the building (Gv) should not exceed normative values (Gvn), which are recommended regarding to the climatic zone and building characteristics: $Gv \leq Gvn$. Updated Energy Building Code by the National Agency of Natural Resources of Albania will be made due to changes that have occurred in the field of production of building materials, building structures and changes in the comfort of new buildings, adapting these also to the Directive 2002/91 / EC of the European Union on energy performance in buildings. *AKBN 2013*

Thermal insulations of buildings

One of the ways to meet the conditions set by law and energy Code is thermal insulation of buildings. To reduce the losses of heating outside the building it must be modified thermal properties of the building (especially the capacity and conductivity). Insulated walls and terraces, double glazed windows and air space between them will be the main design features of an efficient building. Insulating materials, which resist to heat transmission and atmospheric factors, should be incorporated into new building projects. Typical and indispensable functions of insulating system are:



- Uninterrupted insulation from the cold and the warmest.
- Use of the thermal flux.
- Protection of the facades from atmospheric agents.
- Provides significant savings in energy usage.
- Better conditions to moisture structure of buildings.
- Optimal comfort and hygienic conditions of services, residential spaces, etc.
- Reduction and minimizing of pollutant emissions into the atmosphere.

Fields of application

Thermal insulation is used in any kind of external or horizontal screens, manufactured to any destination such as civil, sanitary, technical, and industrial, etc. Thermal insulation system serves to isolate in a safely and continuously way screens which are composed of different materials. In the design of new structures, insulation has several advantages:

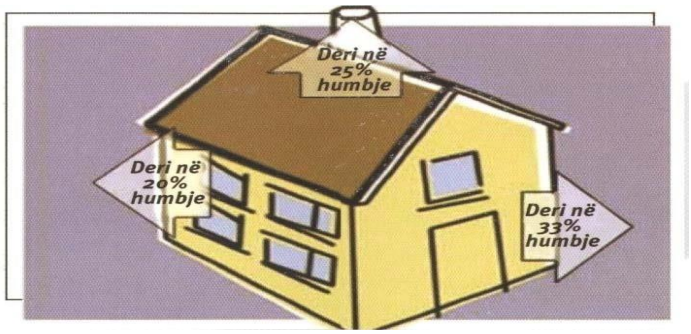
• Reduction of thickness of the perimeter walls, so it brings more residential space.
• Simplification in design, in particular to respond rationally and simply to descriptions on energy savings.
• Possibility to use traditional and economic materials for structures construction in a way to eliminate thermal bridges.

Advantages

After installing the thermal insulation system, the external walls of buildings, do not distribute the heat outside, but develop an important thermal function. Even in winter, the air exchange can be done without having to change the temperature of the heat, the heat absorbed by the walls regenerate rapidly and homogeneously comfortable conditions. Saving the fuel used for heating, lead also to minimization of CO_2 and SO_2 emissions into the atmosphere, contributing consistently on solving environmental problems and saving money in the same time. For all these effective characteristics thermal insulation system finds application in different types of use as below:

- Residential buildings,
- Commercial buildings
- Military buildings
- Manufacturing buildings
- Schools

- Hospitals.



Insulation of walls and roofs

Thermal losses along the walls can reach a value of 50% of total losses, while losses from the roof can reach up to 25%. Consequently, insulation of walls and roof of a house is an effective way to make the home more energy efficient. *AKBN 2013.*

Thermal insulation materials
Two materials are the most important for thermal insulation:

1. Styrofoam, which can be divided into:
    a) Simple Styrofoam;
    b) Styrofoam with great density.
2. Mineral fiber, which can be divided into:
    a) Rock wool;
    b) Glass wool;

Wall Insulation

To avoid problems associated with condensation, insulation can be better applied on the outer walls of the house. If isolation should be implemented within the home, it is very important to provide a protective layer on the inside of the entire building in order to avoid unwanted air movement. Moreover, mineral fibers, in particular rock wool, serve as additional protection against fire. You can choose different insulation width, although it is recommended a minimum of 5cm for the coast of Albania and 8cm for the north – east of Albania. Energy efficient windows and doors prevent the infiltration of air and reduce solar heat loss. The so-called U value measures the level of insulation of a window. The lower the value of U, the more isolated the window. *AKBN 2013*

ECONOMIC BENEFITS FROM THERMAL INSULATION

Energy efficiency (EE) improvements have the potential to produce benefits at all levels of the economy and society:

- at the individual level (individuals, households and enterprises);
- at the sectoral level (by economic sector such as transport, residential, industrial sectors);
- at the national level (including macro-economic benefits and benefits to national budgets);
- at the international level (reflecting the international public good of these benefits).

Economic Benefits from Energy Efficiency

There are significant economic benefits associated with achieving the 20% target on the reduction of primary energy use. Investment in EE can spur economic growth by creating wide-ranging business and employment opportunities such as by:

Creating jobs - The implementation of EE measures is usually a labour-intensive activity at the local level, which cannot be easily relocated or outsourced. The investments will create demand for a range of skills as well as developing expertise for the implementation of new technologies. This demand for EE work requires increased output from the construction sector, which in turn can generate demand for intermediate work across the economy, thus boosting labour demand.

Generating revenues - EE investments in general, and refurbishment investments in particular, can be expected to bring in public revenues through a number of channels in the short term (e.g. value added tax from goods, corporate taxes, The Benefits of Energy Efficiency property taxes, income taxes, social security contributions and avoided costs of unemployment), all of which should offset the reduced revenues from taxes on energy consumption in the medium to long term. Encouraging research and innovation - EE technology in many areas is still in its infancy. Therefore there are huge opportunities for further innovation. By promoting EE measures, public authorities can encourage the private sector to propose new methods and technologies which can then be utilised on future projects. Increasing competitiveness - By lowering energy costs and reducing the exposure to the risks stemming from volatile energy prices, companies can become profitable and operate their businesses more efficiently.

Other Benefits of Energy Efficiency

In addition to the financial and economic benefits related to EE outlined above, there are other benefits, which, while they might not be specifically attributable to EE improvements in buildings, are typically associated with or especially pronounced in EE measures targeted at Europe's housing stock, e.g.:

More efficient buildings - Energy consumption in residential and commercial buildings represents approximately 40% of total final energy use, and is responsible for 36% of the European Union's total CO2 emissions. Therefore, applying available EE technologies and methods to residential and commercial buildings would have a substantial impact on energy usage and carbon emissions in Europe. As a result, the Energy Performance of Buildings Directive (EPBD) requires Member States to establish minimum levels of energy performance for new buildings and buildings undergoing major renovation.

Adapting to climate change - EE measures contribute to the overall resilience to climate change as they play a safeguarding role against adverse/extreme weather events. Thus, EE improvements may be considered as part of a strategy to pursue and expand the scope of climate change adaptation measures.

Increased energy security - At a time of rising and volatile oil and natural gas prices, Europe is the largest importer of energy worldwide. The EU currently imports approximately 50% of its energy. This ratio may increase to 70% in 2030 if no further measures are taken. Energy savings, which reduce primary energy consumption and decrease the need for energy imports, are thus imperative in increasing the security of energy supply given the future scarcity of fossil fuels and in limiting the impact of energy price shocks. Alleviating energy poverty - Energy poverty is defined as the difficulty or inability to ensure adequate heating in the dwelling or to access other essential energy services at a reasonable price. Low-income households in Europe are likely to occupy less

efficient older buildings, which are expensive to heat (or cool) and which place pressure on limited household income. Energy poverty is a significant problem across Europe which will become more acute with rising energy prices and fuel bills. By reducing fuel bills, EE interventions in social housing can mitigate many of the issues associated with inequality and social exclusion.

Improving quality of the building stock and property values - EE improvements in existing buildings can have other positive effects which eventually increase property values, such as higher building quality, better noise and moisture insulation and lower maintenance costs.

Improved health and well-being - EE measures targeted at buildings can also improve indoor air quality, with corresponding health benefits, particularly in respect of problems such as asthma. A UK study on a social housing refurbishment project noted positive improvements to health and well-being, alongside EE gains. Apart from influencing residential well-being, from a public health point of view such measures also reduce public health expenditure. *European Union Directive 2006*

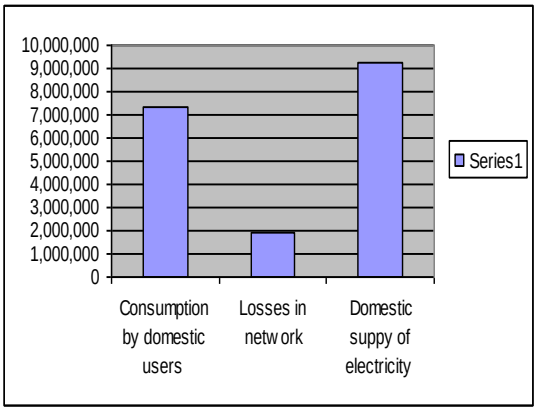
Assessing energy use in buildings

The energy consumption of a building can be calculated using simple hand calculation methods, based normally on statistical outdoor temperatures at a specific location, thermal insulation (U-value) and expected ventilation rate. Many dedicated energy software programmes exist, but not all will be applicable to all situations; for example some focus on residential buildings, others can be used only in particular countries or climatic regions. As thermal insulation directly affects the amount of energy consumed for heating, this paper is focused only on the heat sector of apartments and the assessment of the monetary benefits that come as a result of energy saving. Considered thermal isolation directly affects the energy amount used for heating this project is mainly focused on heating systems in the household sector, as well as calculating the monetary profit gained by saving energy.

The table 1 show the Domestic supply of electricity, consumption of domestic users and losses in network for the Year 2013.

Tab 1. Total electricity supply and consumption of electricity by domestic users in Year 2013*

Indicators	MWh	% of consume
Consumption by domestic users	**7,334,000**	**79**
Losses in network	1,948.000	21
Domestic supply of electricity	**9,282,000**	100



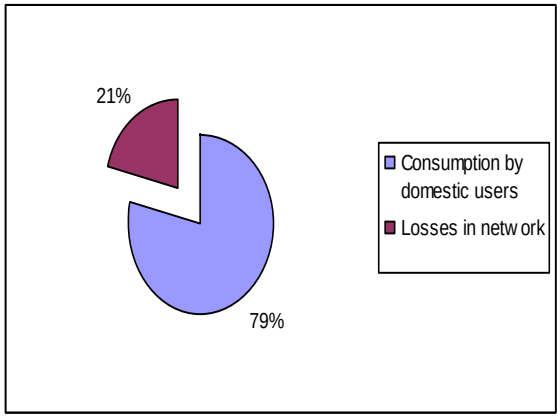
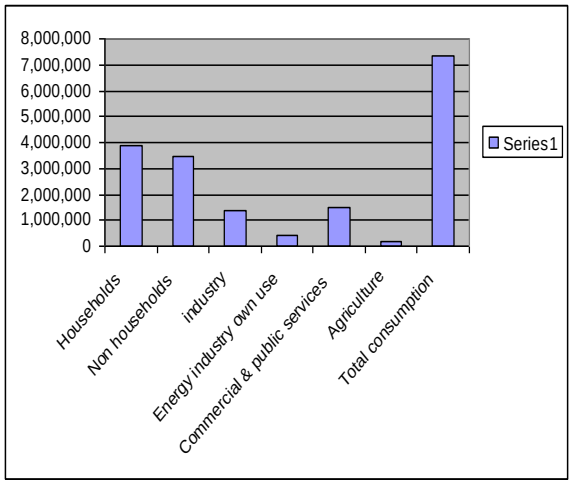


Table 2 shows the distribution of household and non household energy consumption. Family sector is predominant and consumes about 52.6% of the total energy.

Tab. 2. Consumption by sectors in Year 2013*

Sectors	MWh	% of consume
Households	**3,860,000**	**52.6%**
Non households	3,475,000	47.4%
industry	1,389,000	18.9%
Energy industry own use	441,000	6%
Commercial & public services	1,478,000	20.2%
Agriculture	167,000	2.3%
Total consumption	**7,334,000**	**100**

**http://www.iea.org/statistic*



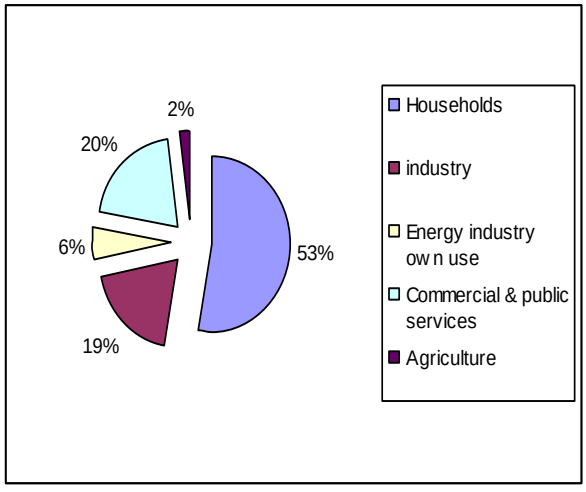


Table 3 shows the distribution of the energy consumption of the household sector for different indicators. As mentioned above, our major concern is the energy used for apartment heating, which is 1,134,840 MWh or 29.4% of the total energy consumed in an apartment.

Table 3. Household Consumption by indicators in year 2013*

Indicators	% consumption	Quantity of MWh
Total consumption	**100**	**3,860,000**
Lighting	7.20%	277,920
washing machine, tV	16.10%	621,460
Cooking	26.90%	103,8340
Sanitar water heating	20.40%	787,440
house heating	**29.40%**	**1,134,840**

Household Consumption by indicators in MWh in year 2013*

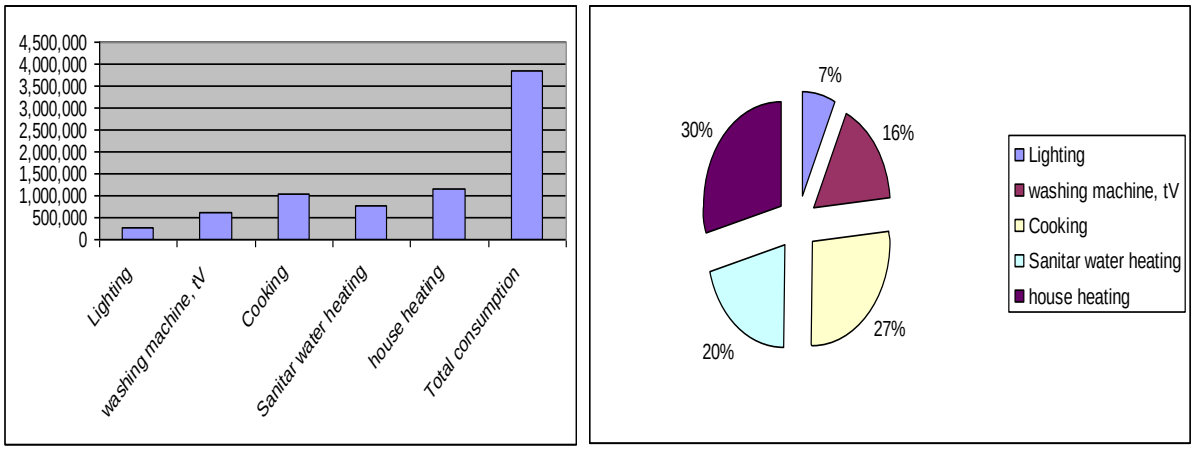


Table 4 shows the total amount of consumption for heating and the average price which is 11.5 L/kwh. (1 Mwh = 1000 kwh)

Tab. 4 **Household Consumption for heating in ALL in year 2013**

	Indicators	Mwh	Value / thousand AL Lek
1	**Household Consumption for heating**	**1,134,840**	13,050,660
2	Average price	L/kwh	11.5

The coefficient of energy waste is 20% because thermal insulation is not being used, in other words the use of thermal insulation will bring saving bills up to 20%. The cost of insulation installation is 2% of total energy consumption; in our case would be 2% of the 13,050,660 ALL. Total energy savings is 204.271 MHH or else in monetary value it is 2,349,116 ALL.

Tab. 5 Annual savings by thermal insulation in households in ALL

	Indicators	Mwh	Value in thousand AL Lek	%
1	**coefficient of loss energy**			**20***
2	Thermal insulation cost		261,013	2 % of consumption value
3	**Totali Neto i kursimeve vjetore**	**204,271**	**2,349,116**	**18**

** Source: IEA (2012c), World Energy Outlook 2012, OECD/IEA, Paris*

CONCLUSIONS

- Thermal insulation is one of the main methods of "Energy Efficiency", which means a percentage ratio of the power output to the incoming energy, in the same energy system, which in our case is the building.
- Thermal insulation is used in any kind of external or horizontal screens, manufactured to any destination such as civil, sanitary, technical, and industrial, etc
- Economic benefits from thermal insulation are as below:
  - *Creating jobs*
  - *Generating revenues*
- In addition to the financial and economic benefits related to EE outlined above, there are other social and environment benefits as below:
  - *More efficient buildings*
  - *Adapting to climate change*
  - *Improved health and well-being*
  - *Increased energy security*
  - *Improving quality of the building stock and property values.*
- The use of thermal insulation will bring savings bills by 20%.

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