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## **ABSTRACT**

of a dissertation for the award of the scientific  
D. degree (in Economics) in Finance, Money Circulation, Credit and  
Insurance (Finance) on:

**"Financial and economic assessment of investments  
in the production of energy efficient building  
materials"**

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## **I. General Characteristics of the Dissertation**

### ***1. Relevance of the topic***

The relevance of the topic lies in the fact that, unlike other industrial sectors, climate neutrality and tightening climate targets in the real estate construction sector can be achieved by increasing energy efficiency (insulation) to a level where buildings can be heated with renewable energy sources. Evaluating investment in the production of energy efficient building materials is essential to reduce the impact of global warming by reducing the harmful effects of climate change and related problems. The introduction of stricter building energy efficiency regulations and the need to reduce carbon emissions , leads to the increased importance of examining the financial implications of retrofit investments is necessary to assess viable pathways to short and long-term sustainability goals in the building sector.

The financial and economic evaluation of investments is an important part of the process of making strategically important investment decisions. From a research perspective, the incorporation of financial-economic evaluation into analytical processes is applied to explore the benefits derived from practice.

### ***2. Object and subject of the study***

**The object** of study in this dissertation is the insulating building materials providing energy efficiency.

**The subject of** research in the dissertation is consumer demand for energy efficiency insulation building materials, which forms a positive financial and economic assessment of investment in their production.

### ***3. Research thesis***

The leading **thesis of** the dissertation is formulated as follows: the development of technologies for the production of insulation building materials forms a supply that provides customer demand for financially and economically sound solutions for investment in energy efficiency projects in the building stock in an environment of high EU green deal targets and energy price dynamics for end users.

### ***4. Objective of the dissertation***

**The aim of the thesis** is to justify the demand for investment in the production of insulating building materials for the purpose of improving energy efficiency, by studying the theoretical and technological aspects of this process and the financial and economic impact of these investments on consumers.

### ***5. Research objectives and methodology***

In order to achieve the so formulated research objective the following **tasks** are set for implementation:

**First.** To derive the theoretical framework of energy efficiency investments.

**Second.** To justify the methodological framework and management context in the process of implementation of energy efficiency projects.

**Third.** Conduct a survey of end-user attitudes towards scalable energy efficiency investments, manufacturing innovations in insulation materials, and growing demand for complex energy efficiency solutions with increased quality and cost.

**The methodology on the basis of** which this work is carried out is based on: literature review, historical research, analysis and synthesis, systematic analysis, retrospective data analysis, inductive-deductive method, verbal-

graphical modeling, written survey (questionnaire). The survey results were processed using IBM SPSS Statistics with the application of descriptive statistics modules.

**The sources of data** used to reach the main scientific and applied achievements are: the NSI, Eurostat, a field survey of the type of survey among individuals and companies.

### ***6. Scope of the study***

The temporal scope of this paper covers the last five-year period from 2019 to 2023, with a clear consideration of the force majeure impact of the pandemic crisis and the war in Ukraine on the pricing parameters of energy efficiency investments.

Outside the scope of this work remain national energy efficiency programs targeting multi-story, multi-owner structures.

Due to the lack and high degree of confidentiality of specific financial and economic data to make an up-to-date assessment of investments in the production of energy efficient building materials, this study focuses on the derivation of data based on the completion of an author's survey.

### ***7. Structure of the study***

The dissertation has a total length of 266 standard pages, structured in three chapters, an introduction and a conclusion as follows:

SCIENTIFIC METRICS OF THE DISSERTATION

INTRODUCTION

CHAPTER ONE. THEORETICAL FOUNDATIONS OF INVESTMENT  
AND ENERGY EFFICIENCY

1. Theoretical and practical dimensions of energy efficiency investment and deployment

1.1. Literature review on energy efficiency investment and deployment

1.2. Design and construction of an integrated plant for the production of energy efficient building materials - theoretical and practical-applied dimensions

2. Nature and characteristics of energy efficiency and energy performance in buildings

2.1. Benefits of energy efficiency investments in buildings

3. European and national instruments for short- and long-term efficiency of buildings

3.1. European instruments for energy efficiency investments

3.2. Energy efficiency of buildings in the focus of the National Recovery and Sustainability Plan

Conclusions and results from the exposition of chapter one

**CHAPTER TWO. METHODOLOGICAL FRAMEWORK AND MANAGEMENT CONTEXT IN THE IMPLEMENTATION OF ENERGY EFFICIENCY PROJECTS**

1. Methodological framework for the study and evaluation of energy efficiency investments

1.1. Methodological framework for structuring a questionnaire to assess energy efficiency investments

1.2. Methods and approaches for financial and economic evaluation of energy efficiency investments

2. Financial controlling in the crisis

2.1. Financial controlling and financial information system aspects of indicators

2.2 The role of financial controlling as an anti-crisis tool

### 3. Analysis of the situation and trends of the sector F "Construction" in Bulgaria

Conclusions and results from the exposition of chapter two

## CHAPTER THREE. A STUDY ON INVESTMENT ATTITUDES TOWARDS THE PRODUCTION AND CONSUMPTION OF ENERGY EFFICIENT BUILDING MATERIALS

1. Description of respondents, motivations for energy efficiency investments and budgeting energy needs

1.1. General description of respondents

1.2. Rationale for energy efficiency investments

1.3. Energy budget

2. Environmental aspects, insulation technology and energy efficiency budget

2.1. Environmental aspects

2.2. Insulation technology

2.3. Energy efficiency budget

3. Grant programs and technology efficiency, impact of the COVID-19 pandemic and social attitudes towards energy efficiency

3.1. Communication - grant programmes and technology efficiency

3.2. Impact of the COVID-19 pandemic on energy efficiency investments

3.3. Social attitudes towards energy efficiency

4. Financial assessment of public investments to support energy efficiency in Bulgaria

Conclusions and results from the exposition of chapter three

## CONCLUSION

Applications

Annex 1. Descriptive measures of the data obtained from the survey

Annex 2. Graphical results with the distribution of respondents' answers to the survey

Annex 3. Financial assessment of public investments to support the improvement of energy efficiency of housing in Bulgaria - regionally derived data

List of author's publications related to the topic of the dissertation

Reference for Compliance with the National Requirements under the Regulations for the Implementation of the Academic Staff Development Act in the Republic of Bulgaria

Declaration of originality and authenticity of the thesis

Bibliography

### ***8. Applicability of the study results***

The work provides a direct up-to-date assessment of the opportunities for implementing a sustainable transition to energy efficiency in the construction sector, which can be perceived as a kind of business niche in the construction sector. Based on the retrospective analysis of the dynamics and trends in the construction sector in Bulgaria, it is shown that there is a need to strengthen the integration of energy efficiency in the Bulgarian construction sector. A possible option for this is the construction of an integrated plant for the production of high quality energy efficient building materials, which would achieve accessibility on the Bulgarian market to this type of building materials, as well as a high degree of sustainability and adaptability to European energy standards. The study can be the basis for deriving an objective assessment arguing for the establishment of an association of national stakeholders to define national targets and strategies towards a sustainable building capacity and a lower carbon construction sector, the need to create mandatory energy codes for building potential and to define the pathway to achieve energy efficient standards, supply chains that promote energy efficient projects, low carbon and sustainable construction

## **II. Main content of the dissertation**

### ***Chapter One. Theoretical foundations of investment and energy efficiency***

Chapter 1 covers a theoretical review of the literature on energy efficiency investments. The main focus is on:

**First.** Theoretical and practical dimensions of energy efficiency investment and deployment.

**Second.** Nature and characteristics of energy efficiency and energy efficiency in buildings.

**Third.** European and national instruments for short and long term building performance.

The research variations of investments in the construction sector provide a starting point to build on the literature by applying financial and economic approaches to assess and analyse the circumstances leading to the process of implementing energy efficient solutions and making subjective assessments based on statistical and econometric methods. In line with this, an author's presentation of the theoretical and practical dimensions of the possibility of designing and constructing an integrated plant for the production of energy efficient building materials is carried out, presenting the possibilities for innovation in the industry. The literature review in the field of energy efficiency investment and deployment aims to explore the available research in the field, examining it in detail and synthesising the main conclusions reached. On the basis of the work carried out, the research methods applied and the thematic orientations developed in theoretical and practical-applied aspects could be brought out in concrete terms. This kind of synthesis of the sources studied presents information on the gaps and free scientific niches on which the research can focus, enrich the available literature and build upon within their empirical investigation.

In the scope of chapter one, the possibility of creating and integrating a waste incineration plant with a combustion device for steam production, with a generator for electricity generation and waste product production is presented in a theoretical and descriptive way. The advantage of the plant is that, in addition to the energy content, it does not require any fossil fuels for power generation. Thus, the presented process for the construction of an integrated plant for the production of energy efficient building materials would have a high added value in the production-functional process. The high theoretical contribution, would have a significant production effect, which would have significant effects on the financial and economic evaluation of investments in the production of energy efficient building materials.

The third section focuses on providing a theoretical overview of the nature and characteristics of energy efficiency and energy performance in buildings. Energy efficiency itself is a complex concept related to energy savings, energy consumption, energy sufficiency and energy transition in all sectors worldwide. Referring to the broad theoretical overview of the concept of energy efficiency, an author's definition is derived as follows: energy efficiency is a key tool to guide an ambitious, cost-effective and socially equitable transition towards a climate-neutral economy, aiming at its implementation as an integral part of sustainable growth and innovation. It is also one of the fastest ways to meet global energy security, environmental and economic challenge goals, through money saving and low political and technological risk. A qualitative approach based on researching, systematizing and analyzing the benefits of investing in energy efficiency and the disincentives to taking action to improve energy efficiency brings out the significant impact of considering and adhering to taking action to improve energy efficiency. The main benefits that can be derived are related to: increasing the comfort and standard of living for citizens, creating sustainable jobs, maintaining better health, reducing pollution levels, alleviating fuel poverty, improving long-term competitiveness, enabling long-term energy and cost savings. All this,

combined with the additional impacts in the areas of environment, economy, utility system, risk management, production, operation and maintenance, working environment, etc., minimise to some extent the impact of the factors preventing action to improve energy efficiency, both at national and European level.

European instruments and the National Recovery and Sustainability Plan and their focus on energy efficiency are analysed. As a consequence, the need to adequately take into account the need for significant building renovation in the country and the lack of a substantial amount of resources to provide it, which for the purpose of achieving an effect related to energy efficiency could be supported by the creation of new financial mechanisms to further secure the process, is highlighted.

### ***Chapter Two. Methodological framework and managerial context in the implementation of energy efficiency projects***

The scope of Chapter 2 is to derive the methodological framework for conducting a user study based on the evaluation of energy efficiency investments. In addition, for the purpose of optimal investment appraisal, a review of the possibilities of applying methods and approaches for financial and economic appraisal of energy efficiency investments is carried out. Structurally, the chapter focuses on:

**First.** Methodological framework for the study and evaluation of energy efficiency investments.

**Second.** Financial controlling in the context of crisis.

**Third.** Analysis of the situation and trends of the sector F "Construction" in Bulgaria

For the purpose of conducting a relevant scientific study, a questionnaire on "Investments in Energy Efficiency" was prepared. The questionnaire is structured in nine sections and includes 70 questions. Nearly half of the questions asked are subjective assessments using the Likert scale method. Each of the

sections is logically structured for the purpose of conducting a relevant survey with energy efficiency as the main subject. The sections are named as follows: Section One: General Description - covers 14 questions looking at more detailed information about the respondents - legal status, type of economic activity, locality, number of employees, size of assets, size of liabilities, size of net income, amount of taxes paid, consumer assessment. Section 2: Rationale for energy efficiency investments - 14 questions containing information on average monthly electricity bills in different seasons, provision of district heating, options for hot water provision. Section Three: Energy Budget - 13 questions, includes questions relating to options for investment in home renovation, the need to install energy efficient materials and the priorities being placed on property investment. Section Four: Environmental - 3 questions on priorities for energy efficiency investment in the building stock. Section Five: Insulation Technology - 3 questions relating to investment in external insulation for housing. Sixth section: Energy Efficiency Budget - 7 questions based on cause and effect relationships on the need for investment in insulation products. Section Seven: Communication - 3 questions related to information on the popularity of grant programs and the effectiveness of technologies. Section Eight: COVID-19 - 9 questions related to the impact of the pandemic on energy efficiency and the need to invest in energy efficiency to secure remote jobs. Section Nine: Social Attitudes about Energy Efficiency - 6 questions covering attitudes about energy efficiency investments, sufficiency of grant funds for energy efficiency investments.

In addition to the survey, a comprehensive theoretical review of the financial and economic valuation options for investments was conducted. On the basis of the models built, the results are derived on the basis of which the most appropriate investment scheme and financing options can be selected to match the wishes of investors.

Each of these methods has its advantages and disadvantages. For the purpose of optimal investment appraisal, more than one of these methods is

usually used or supplemented with more advanced and descriptive ones. Undertaking such analysis in combination with carrying out a qualitative assessment is equally important for a large project as for a smaller one. As an investment may not have the desired returns, but its development can be pursued nonetheless due to its significant impact on the long-term plan of the business and the realization of its operations. It is important to note that analysis with the above models is possible provided that up-to-date financial and economic data is available. In the present case, the data is insufficient or highly confidential. In this respect, the possibilities for applying the methods are very limited, but the results of the envisaged survey would be a starting point for the approbation of some of the investment appraisal methods or their adaptation to an author's version of the appraisal of investments in the production of energy efficient building materials. At the same time, the possibility of applying effective financial controlling as a part of the financial management system to achieve financial sustainability of firms in the medium and long term under the conditions of pandemic and more frequent local and global crises in the economy is also highlighted.

A detailed study of the main statistical indicators of sector F "Construction" has been carried out, which helps to derive more substantial information on the state of the construction sector in Bulgaria, the need to build new options for improving the quality of construction in the country and the opportunities for investment in the production of energy efficient building materials, which will improve the future state of the building stock in the country for the purpose of efficient and comfortable stay of consumers. The significant susceptibility of the sector to external influences, which positions it among vulnerable economic sectors, is highlighted. A retrospective analysis of the dynamics and trends in the construction sector shows the need to strengthen the integration of energy efficiency in the Bulgarian construction sector. A possible option for this is the construction of an integrated plant for the production of high quality energy efficient building materials, which would achieve accessibility on the Bulgarian

market to this type of building materials, as well as a high degree of sustainability and adaptability to European energy standards. In this way, the transformation of the sector into a highly efficient, energy friendly and carbon neutral one could be achieved.

### ***Chapter Three. Investigating attitudes towards investment in the production and consumption of energy efficient building materials***

Chapter 3 mainly presents the results of the large-scale survey, and applies the information obtained from the survey in a practical way to the financial assessment of public investments to support energy efficiency in Bulgaria. Structurally, Chapter Three contains:

**First.** Description of respondents, motivations for energy efficiency investments and budgeting for energy needs.

**Second.** Environmental aspects, insulation technology and energy efficiency budget.

**Third.** Grant programs and technology efficiency, impact of the COVID-19 pandemic, and social attitudes toward energy efficiency.

**Fourth.** Financial assessment of public investments to support energy efficiency in Bulgaria.

The analysis of the results obtained from the survey and the presented option of building an integrated installation for the production of energy efficient building materials leads to the following major conclusions and results. To 30 thousand people (33.8%), the majority of respondents are part of an SOE or a household with up to 5 people - over 50%, the net sales revenue according to the Profit and Loss Account for 2021 is mostly up to 50 thousand BGN. - 72.0% of respondents. 29.4% of respondents live in a low-rise condominium apartment. During the winter season, respondents pay electricity bills ranging from £151 to £200 (23.24%). During the spring season, 32.2% of respondents' average monthly

electricity bills range from £101 to £150. 40.6% pay electricity bills from £51 to £100. The average monthly electricity bill in the autumn for 30.1% of respondents was between £101 and £150. Providing domestic hot water via an electric boiler was the most common method, used by over 40% of respondents. In total, over 23% agreed with the statement that household dwellings should be renovated at the expense of programmes and public funds. Over 17% of respondents believe that the investment in rehabilitating their home should be made through a combination of personal involvement up to 20%. 40% occupy homes without available interior insulation, while 42% of respondents have no exterior insulation. 65.7% of respondents say they have energy efficient windows fully installed. For 30% of respondents, investment in external insulation for the home they live in is a priority in the future. Over 40% of respondents believe that investment in energy efficiency of the building stock should be a priority due to reduced fine particulate matter emissions, climate change and energy saving opportunities. 33.8% of respondents strongly agreed that investment in external insulation of a dwelling using stone wool should be supported, all other things being equal, up to 60% and at a cost of £96/m<sup>2</sup>. About 33% of respondents strongly agreed that electricity prices are a significant justification for putting external insulation on a dwelling. Over 20% of respondents considered rising petrol and diesel prices to be a justification for investing in external insulation to the household's dwelling. Information on the effectiveness of non-combustible stone wool insulation technology is not well enough publicised and further promotion of the high efficiency of non-combustible stone wool and its use for external insulation of residential and non-residential properties is needed. Data related to energy efficiency investments during the COVID-19 pandemic shows that an extremely small proportion of respondents (nearly 20%) invested additional resources to ensure energy efficient remote working conditions. Over 30% of respondents felt that the Recovery and Development Plan and operational programs should fund grant programs for energy efficiency in the housing stock.

Over 50% of respondents believe that public grant funds for energy efficiency investments in the housing stock are insufficient in size and do not meet public needs. Cumulatively, 23% of respondents disagreed on the positive impact of the country's accession to the Schengen area, while 26% disagreed on the potential benefits of the country's accession to the Eurozone. The thorough review of the theoretical underpinnings of energy efficiency investments and the large-scale survey of a significant number of respondents clearly present the high level of national importance of prioritising energy efficiency actions. Analysing the results provides an opportunity to focus on specific opportunities for improving energy efficiency in the country's housing stock. Table 1-1 presents the three possible options and the results of the survey based on the opportunities to prioritise finance due to the following factors: energy savings, climate change, fine particulate matter and sulphur dioxide emission reductions.

Table 1-1. Relative share of survey responses

<b>Result of the survey</b>	<b>Relative share of survey responses</b>	<b>Potential opportunity for prioritisation and future funding</b>
Percentage of respondents who "Strongly agree" that energy efficiency of the building stock should be a priority because of <b>energy savings</b>	41,50%	Ability to prioritise towards energy efficiency programmes
Percentage of respondents who "Strongly agree" that energy efficiency of the building stock should be a priority because of <b>climate change</b>	40,60%	Ability to prioritise towards climate change and environmental programmes
Percentage of respondents who "Strongly Agree" that energy efficiency of the building stock due to <b>reduced emissions of fine</b>		

<b>particulate matter and sulphur dioxide</b>		
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In order to adequately calculate and effectively present the results, the average values of the size of the living area of the external walls in some of the most widespread dwellings in the country were taken into account.

Table 1-2. Average cost of making different types of dwellings energy efficient

	Square metres of living area of external walls									Average price
	25	45	65	85	100	125	150	175	200	
	Small dwelling		Medium housing			Large dwelling		Very large dwelling		
<b>Option 1 (up to 60% and price from 96 BGN/m<sup>2</sup>)</b>	1 440,00 BGN	2 592,00 BGN	3 744,00 BGN	4 896,00 BGN	5 760,00 BGN	BGN 7 200,00	BGN 8 640,00	10 080,00 BGN	11 520,00 BGN	<b>6 208,00 BGN</b>
<b>Option 2 (up to 30% and price from 62 BGN/m<sup>2</sup>)</b>	465,00 BGN	837,00 BGN	1 209,00 BGN	1 581,00 BGN	1 860,00 BGN	2 325,00 BGN	2 790,00 BGN	3 255,00 BGN	3 720,00 BGN	<b>2 004,67 BGN</b>
<b>Option 3 (up to 45% and price from 73 BGN/m<sup>2</sup>)</b>	BGN 821,25	1 478,25 BGN	BGN 2 135,25	2 792,25 BGN	3 285,00 BGN	4 106,25 BGN	4 927,50 BGN	BGN 5 748,75	6 570,00 BGN	<b>3 540,50 BGN</b>

Source.

Financial assessment of public investments to support the improvement of energy efficiency of housing in Bulgaria - regionally derived data. As a result, under Option 1 (up to 60% and a cost of 96 BGN/m<sup>2</sup> ) the average cost of state support for renovation of a dwelling amounts to 6 208 BGN. Cumulatively for the country, the funds required amount to between BGN 10 086 512 799.10 and BGN

10 310 105 447.36, with the highest amount required for North and South East Bulgaria, South West and Sofia. In option 2 (up to 30% and a cost of 62 BGN / m<sup>2</sup> ) the average cost of state aid for renovation of an average dwelling amounts to 2 004 BGN, with the total cost amounting to between 3 257 103 091,38 BGN and 3 329 304 884,04 BGN. For Option 3 (up to 45% and a cost of £73/m<sup>2</sup> ) the cost amounts to £3 540,50 and the necessary state aid varies between £5 752 464 330,74 and £5 879 982 012,95.

As a result of the calculations performed, it is evident that to achieve an optimal amount of energy efficiency in Bulgaria, adequate measures need to be taken based on optimal values of the percentage of renovation and the cost of insulation materials of up to 45% and a cost of 73 BGN / m<sup>2</sup> .

### ***Conclusion***

The focus of this dissertation is on a topical issue related to energy efficiency investments, which is directly influenced by geopolitical changes, innovations and focus on key priorities and policies related to the construction sector. It is clear from this analysis that there is a real chance to make a sustainable transition to energy efficiency in the construction sector, which can be seen as a niche business in the construction sector. The construction sector, infrastructure and the building stock as a whole are significantly involved in the green transition. Their adequate valuation through the lens of their financial and economic performance is considered a good indicator for sustainable environmental development. The literature review and the authors investigating investments in the building sector and energy efficient solutions present a starting point for building on the literature by applying financial and economic approaches to assess and analyse the circumstances leading to the process of implementing energy efficient solutions and making subjective assessments based on statistical methods . Based on the presented analysis and evaluation of the design and

construction of an integrated plant for the production of energy-efficient building materials presents the possibility of simultaneously using and processing the heat of wood from the process of production of stone wool in the waste incineration plant, which in turn would have a high added value in the production-functional process and a good financial-economic evaluation of the investment in the production of energy-efficient building materials. The analysis of the European instruments and the National Recovery and Sustainability Plan and their focus on energy efficiency is necessary to adequately take into account the need for significant building renovation in the country and the lack of a substantial amount of resources to provide it, which for the purpose of achieving an effect related to energy efficiency could be supported by the creation of new financial mechanisms to further secure the process. The methodological framework developed for the survey, the results of which are considered as a starting point for deriving consumer attitudes and making a financial and economic assessment of investments in the production of energy efficient building materials. Summarising the findings of the focus group and survey is linked to monitoring whether investments in the production of energy efficient building materials are actually of interest among consumers and whether they provide the expected benefits to the practice. The methods and approaches presented theoretically for the financial and economic appraisal of energy efficiency investments have their advantages and disadvantages, and undertaking an analysis based on the methods and approaches considered in combination with undertaking a qualitative assessment is equally important for a large project as it is for a smaller one. Based on the study of the role of financial controlling as an anti-crisis tool, it is clear that it is possible to apply effective financial controlling as part of the financial management system to achieve financial sustainability of firms in the medium and long term under the conditions of pandemic and more frequent local and global crises in the economy. As a consequence of the retrospective analysis of the dynamics and trends in the construction sector in Bulgaria, the need to strengthen

the integration of energy efficiency in the Bulgarian construction sector is shown. A possible option for this is the construction of an integrated plant for the production of high quality energy efficient building materials, which would achieve accessibility on the Bulgarian market to this type of building materials, as well as a high degree of sustainability and adaptability to European energy standards.

Within the survey, over 70% of the respondents are individuals, with the majority of respondents being part of a municipal (unincorporated) city with a population of 15 thousand to 30 thousand (33.8%), the majority of respondents are part of a sole proprietorship or a household of up to 5 people - over 50%, net sales revenue as per the 2021 Income and Expenditure Account is mostly up to BGN 50 thousand. - 72.0% of respondents. 29.4% of respondents live in a low-rise condominium apartment. During the winter season, respondents pay electricity bills ranging from £151 to £200 (23.24%). During the spring season, 32.2% of respondents' average monthly electricity bills range from £101 to £150. 40.6% pay electricity bills from £51 to £100. The average monthly electricity bill in the autumn for 30.1% of respondents was between £101 and £150. Providing domestic hot water via an electric boiler was the most common method, used by over 40% of respondents. Over 17% of respondents felt that investment in the renovation of their home should be made through a combination of personal involvement up to 20%. 40% occupied homes with no internal insulation available, while 42% of respondents had no external insulation. 65.7% of respondents said that they had fully energy efficient windows. For 30% of respondents, investment in external insulation for the home they live in is a priority in the future. Over 40% of respondents believe that investment in energy efficiency of the building stock should be a priority due to reduced fine particulate matter emissions, climate change and energy saving opportunities. 33.8% of respondents strongly agree that investment in external insulation of a dwelling through stone wool should be supported, all other things being equal, up to 60%

and a cost of £96/m<sup>2</sup> . 33% of respondents strongly agree that electricity prices are a significant justification for installing external insulation to a dwelling. Over 20% of respondents considered the rise in petrol and diesel prices to be a justification for investing in external insulation to a household's dwelling. Information on the effectiveness of non-combustible stone wool insulation technology is not well enough publicised and further promotion of the high efficiency of non-combustible stone wool and its use for external insulation of residential and non-residential properties is needed. Data related to energy efficiency investments during the COVID-19 pandemic shows that an extremely small proportion of respondents (nearly 20%) invested additional resources to ensure energy efficient remote working conditions. Over 30% of respondents felt that the Recovery and Development Plan and operational programmes should fund grant programmes for energy efficiency in the housing stock. Over 50% of respondents believe that public grant funds for energy efficiency investments in the housing stock are insufficient in size and do not meet public needs. A cumulative disagreement on the positive impact of the country's accession to the Schengen area is shown by 23% of respondents, while 26% disagree with the possible benefits of the country's accession to the Eurozone. to achieve an optimal amount of energy efficiency in Bulgaria, adequate measures need to be taken based on optimal values of the percentage of renovation through Styrofoam of up to 30% and a cost of 62 BGN/m<sup>2</sup>. This leads to a total amount of energy aid needed in the country of between BGN 3 257 103 091,38 and BGN 3 329 304 884,04.

### **III. Guidelines for future research on the dissertation topic**

The above research directions, which the author has focused on in the dissertation, related to the financial and economic evaluation of investments in the production of energy *efficient* building materials is not exhausted. The topic will continue to be relevant given the introduction of stricter building energy efficiency regulations and the need to reduce carbon emissions. In this respect, the following directions for future research on the topic can be identified:

**First.** Analyse the development of national targets and strategies towards a sustainable and lower carbon building sector.

**Second.** Undertaking a study of governmental and non-governmental actions to increase investment in energy efficiency and promote a shift to a "circular material economy" for a more environmentally and carbon neutral status of real estate in Bulgaria.

#### **IV. Reference to the scientific and applied contributions in the dissertation work**

**First.** The author's interpretation of the term "energy efficiency" is put forward as follows: energy efficiency is a key tool to guide an ambitious, cost-effective and socially equitable transition towards a climate-neutral economy, aiming at its implementation as an integral part of sustainable growth and innovation.

**Second.** An innovative option for the construction of an integrated installation for the production of high quality energy efficient building materials is presented, which will achieve accessibility on the Bulgarian market to similar types of building materials, as well as a high degree of sustainability and adaptability to European energy standards.

**Third.** A precise user study has been carried out in the field with a focus on financial and economic evaluation of investments in the production of energy efficient building materials.

**Fourth.** By summarizing the results obtained from the survey of attitudes towards investment in the production and consumption of energy efficient building materials to achieve an optimal amount of energy efficiency in Bulgaria, the need to take adequate measures based on optimal values of the percentage of renovation by Styrofoam of up to 30% and a price of 62 BGN/m<sup>2</sup> is derived.

**Fifth.** A new vision for the expert financial assessment of public investments to support energy efficiency in Bulgaria has been proposed .

## **V. List of publications of the PhD student**

### **Articles (3 pcs.):**

1. Alexandrov, E., (2020) Financial Controlling in the Conditions of Crisis, Annual Almanac "Doctoral Research", Volume XIII, Book 16, Pages 615-623, Link: <https://t.ly/VtBL>
2. Aleksandrov, E., (2023) Analysis of the situation and trends in the Bulgarian construction sector, Scientific atlas, No 7, ISSN 2738-7518, pp. 22-35, Link: [https://t.ly/bS\\_0](https://t.ly/bS_0)
3. Prodanov, S., Zarkova, S., Aleksandrov, E., (2023) Financial evaluation of state investments to support the increase of energy efficiency in Bulgaria , 100th International Scientific Conference on Economic and Social Development - "Economics, Management, Entrepreneurship and Innovations" - Svishtov, 4-6 October, 2023, p.163-172

### **Scientific reports (1 pc):**

1. Aleksandrov, E., (2023) Benefits of energy efficiency investments in the construction sector, Management strategies and policies in modern economy", International Scientific Conference (8th edition), 24-25 March 2023, Kishineu, Moldova, Poligrafic Publishing Complex of Academy of Economic Studies, with indexation at ISBN 978-9975-147-65-1 (PDF) Ministry of Education and Research.

## **VI. Reference for compliance with the national requirements under the Regulations for the Implementation of the Law for the Development of Academic Staff in the Republic of Bulgaria**

National requirement in number of points: **30,00**

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Number of **studies** published in non-refereed peer-reviewed journals or  
published in edited collective volumes: 0 pcs.

Number of points for the author:

Number of **articles** published in non-refereed peer-reviewed journals or  
published in edited collective volumes: 3 pcs.

Number of points for the author: 23,3 points

Number of **papers** published in non-refereed peer-reviewed journals or  
published in edited collective volumes: 1 pc.

Number of points for the author: 10

**Total points: 33,3 > 30,00**

## VII. Declaration of originality of the thesis

The dissertation in the volume of 266 pages under the title "*Financial and economic evaluation of investments in the production of energy efficient building materials*" and the abstract to it are authentic and represent the author's own scientific production. They make use of the author's ideas, texts and visualization through graphs, charts, tables and formulas, and comply with all the requirements of the Copyright and Related Rights Act by properly citing and referencing other authors' thought and data, including:

1. The results achieved and contributions made in this dissertation are original and have not been borrowed from studies and publications in which the author has not participated.
2. The information presented by the author in the form of copies of documents and publications, personally compiled reports, etc. corresponds to the objective truth.
3. Scientific results that have been obtained, described and/or published by other authors are duly and extensively cited in the bibliography.

**Date:** 01.11.2023.

**Doc:** .....

/Emile Alexandrov/