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Scientific Conference  
of Riga Technical University

**Scientific Problems  
of Engineering Economics  
of Construction and Real  
Estate Management,  
Regional and Territorial  
Development ICEREE'2022**

Book of Abstracts

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and Real Estate Economics

29–30 September 2022, Riga, Latvia

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BOOK OF ABSTRACTS

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FOREWORD	7
TRAINING CURRICULA FOR HOUSING MANAGERS IN LATVIA WITH REGARD TO IMPROVING THE ENERGY PERFORMANCE LEVEL OF RESIDENTIAL BUILDINGS	8
LARGE-SCALE HYDROGEN UNDERGROUND STORAGES AND ASSOCIATED RISK FACTORS	9
GASEOUS FUEL DIVERSIFICATION IN RESIDENTIAL SECTOR: ANALYSIS OF POTENTIAL RISKS	11
EVALUATION OF URBAN SUSTAINABILITY IN UZBEKISTAN	13
CONFORMITY ASSESSMENT FOR BUILDING MATERIAL IN CONSTRUCTION PROJECT IN KINGDOME OF BAHRAIN	14
STRATEGIC PLANNING OPTIONS AND SOLUTIONS FOR CONSTRUCTION COMPANY DEVELOPMENT	15
PROBLEMS AND POSSIBLE SOLUTIONS OF POST-DISASTER HOUSING RECONSTRUCTION PROJECTS IN INDIA	16
DEVELOPMENT OF THE INSTITUTE OF ENGINEERING CONSULTANT IN LATVIA: IMPACT ON THE CONSTRUCTION INDUSTRY	17
DAMAGE TO ARCHAEOLOGICAL SITES: SUFFERED PARTIES AND PROTECTION OF THEIR SOCIO-ECONOMIC INTERESTS	18
THE GREAT EUROPEAN ENERGY CRISIS OF 2022	20
INNOVATIVE BUILDING CONCEPTS FOR SOCIAL HOUSING DEVELOPMENT	21
CHANGES IN CONSTRUCTION COST INDICES IN LATVIA	22
PECULIARITIES OF CONSTRUCTION PRODUCTS AND THEIR ASSESSMENT METHODS IN LATVIA AND UKRAINE	23
ASPECTS OF IMPLEMENTATION OF GREEN CONSTRUCTION IN THE PUBLIC BUILDING SECTOR	24
REAL ESTATE PRICES AND ACTUAL TENDENCIES IN REAL ESTATE MARKET OF INDIA	25
ACTUAL ISSUES OF THE DEVELOPMENT OF THE REAL ESTATE MARKET IN LATVIA	26
PROBLEMS AND SOLUTIONS FOR THE RENTAL OF RESIDENTIAL SPACES OWNED BY THE LOCAL GOVERNMENT	27
LEGAL, ECONOMIC AND ORGANIZATIONAL ASPECTS OF APARTMENT HOUSE MANAGEMENT	28
CHALLENGES FOR THE PARTICIPATION OF APARTMENT OWNERS IN ENERGY COMMUNITIES	29
PARTICIPATION IN ENSURING CLIMATE NEUTRALITY: RIGHT OR DUTY OF APARTMENT OWNERS?	30
DEVELOPMENT CONCEPT OF MULTI-APARTMENT RESIDENTIAL BUILDING FUND IN LATVIAN CITIES	31
NEW APPROACH OF IT COMMUNICATIONS IN THE PROCESS OF RESIDENTIAL HOUSE MANAGEMENT	32

OPPORTUNITIES FOR IMPROVEMENT OF THE REAL ESTATE MANAGEMENT PROCESS	34
POSSIBILITIES AND SOLUTIONS FOR MANAGING MULTI-APARTMENT RESIDENTIAL BUILDINGS IN THE LATGALE REGION	35
ASSESSMENT OF ENERGY EFFICIENCY IMPROVEMENT MEASURES OF STUDENT DORMITORIES	36
ACTIVITIES OF THE SOCIETY OF APARTMENT OWNERS IN LATVIA	37
OPPORTUNITIES OF APARTMENT HOUSE MANAGEMENT COMPANY EFFICIENCY INCREASING	38
USE OF LEAN APPROACH IN REAL ESTATE PROJECTS	39
IMPROVEMENT OF SUSTAINABLE URBAN PLANNING AND DESIGN IN LATVIA	40
	
FOREWORD	42
ERASMUS+ "WOOD IN CIRCLE" PROJECT: AIMS AND ACHIEVEMENTS	43
E-LEARNING COURSE "CIRCULAR ECONOMY IN WOODEN CONSTRUCTION"	44
E-LEARNING PLATFORM FOR THE COURSE "CIRCULAR ECONOMY IN WOODEN CONSTRUCTION"	45
FEEDBACK ABOUT ERASMUS+ "WOOD IN CIRCLE" INTENSIVE LEARNING COURSES	46
CO-CREATION OF A STUDENT-CENTERED METHODOLOGICAL FRAMEWORK IN TIMBER CONSTRUCTION	47
ENERGY AND ENVIRONMENTAL IMPACT OF A TIMBER HOUSE IN DIFFERENT CLIMATE CONDITIONS	48
THE ADDED VALUE OF PARTICIPATION IN EU ERASMUS+ INNOVATION PROJECTS	49
CIRCULAR ECONOMY AND SUSTAINABLE DEVELOPMENT: ARE THESE CONCEPTS HEADED IN THE SAME DIRECTION?	50
URBAN AND SOCIAL REGENERATION OF MAINIEMI MILL AREA	51
BENEFITS OF WOOD AS A SUSTAINABLE RESOURCE FOR CONSTRUCTION	52
LIFE CYCLE ASSESSMENT OF BUILDINGS: OVERVIEW OF THE METHODOLOGY AND DISCUSSION OF A CASE-STUDY	53
ENGINEERED WOODEN MATERIAL PRODUCTION ASPECTS	54
BUILDING MANAGEMENT ASPECTS OF HYBRID ENGINEERED TIMBER BUILDINGS	56
SUSTAINABLE FORESTRY FOR WOODEN MATERIAL PRODUCTION	57
SUPPORT OF THE EUROPEAN UNION FUNDS IN THE NON-RESIDENTIAL BUILDING SECTOR IN LATVIA	58



## FOREWORD

Within the framework of the annual 63rd International Scientific Conference of Riga Technical University (RTU), the Institute of Civil Engineering and Real Estate Economics (ICEREE) of RTU Faculty of Engineering Economics and Management organizes conference “Scientific Problems of Engineering Economics of Construction and Real Estate Management, Regional and Territorial Development”. Conference provides a discussion platform for researchers, where everyone can get to know the latest developments, research findings, ideas and their application in construction science and engineering economics, entrepreneurship and economics. The conference brings together scientists, researchers and PhD students from all over the world every year.

The goal of RTU 63rd International Scientific Conference Section “Scientific Problems of Engineering Economics of Construction, Real Estate Management, Regional and Territorial Development” is to promote scientific discussion on topical issues of construction management, real estate, regional and territorial development, as well as to publish the latest research results in the field.

Book of Abstracts is divided into 2 parts. First part contains 29 abstracts which are related to following thematic fields of the Conference: 1) Problems and tendencies of construction management and real estate engineering economics at the local and global level; and 2) Local and global development tendencies and scientific problems of regional and territorial development. Second part contains 15 abstracts which are related to sub-section “Circular Economy in Wooden Construction (WOOD in CIRCLE): ERASMUS+ project outputs for higher education”, which is organized within the framework of the EU Erasmus+ project “Circular Economy in Wooden Construction” (WOOD in CIRCLE). Project No: KA203-8443DA0D. Project code: 2020-1-LT01-KA203-077939.

Organizing Committee of ICEREE2022

# TRAINING CURRICULA FOR HOUSING MANAGERS IN LATVIA WITH REGARD TO IMPROVING THE ENERGY PERFORMANCE LEVEL OF RESIDENTIAL BUILDINGS

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**Abstract.** Main problems in the Latvian housing sector are depreciated buildings with low energy performance levels, insufficient education regarding the organization and management of energy efficiency measures, low public activity, lack of interest to improve the energy performance of buildings, and insufficient attraction of private investment. Current education of housing managers focuses more on technical servicing and management activities and less on energy efficiency measures. To improve the situation of managing the multi-apartment residential buildings and reduce their negative impact on climate change, within the European Climate Initiative (EUKI), project “CLI-MA – From Housing Manager to CLlimate MAnager” is being implemented in Latvia and Poland from October 2020 to March 2023. The main goal of the project is the promotion of the renovation process of residential buildings as a component of climate policy and the implementation of EU directives concerning strategies of building renovation. Specific goal of the project is development and implementation of training curricula for housing managers which will raise knowledge and skills in the fields of energy efficiency and climate. In the Latvian training curricula, there are 6 aspects included regarding energy efficiency and climate problems: climate policy and sustainable development, concept and indicators of energy efficiency, housing policy and legal framework, technical solutions and energy efficient materials, implementation and problems of energy efficiency projects, communication problems in the housing management. In the future, these aspects will be incorporated in the existing study programs for housing managers to improve their knowledge about energy efficiency and climate.

**Keywords:** *climate change, energy efficiency, housing manager, multi-apartment building*

**JEL Classification:** Q49, R39

**Acknowledgement.** *This work was supported by the European Climate Initiative (EUKI) project “From Housing Manager to CLlimate MAnager” (CLI-MA). Agreement number: 81263938. Project processing number: 17.9045.0-002.77.*



# LARGE-SCALE HYDROGEN UNDERGROUND STORAGE AND ASSOCIATED RISK FACTORS

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**Abstract.** Risks assessment for large-scale hydrogen underground storages (HUS) is one of the central issues in gaseous fuel diversification agenda of the European Union's (EU) energy transition, because hydrogen is regarded as a fuel and energy carrier, that will gradually replace natural gas in almost all segments of national economies of the EU Member States.

Hydrogen can be stored in the aboveground storage sites, mixed with the natural gas in the already existing gas network, with a help of power-to-gas technology, or underground in deep geological structures. HUS facilities can be distinguished from other types of energy storage primarily by the large volume of gas stored, the seasonal or long storage period, and large capital expenditures related to their construction and exploitation, as their economic viability is directly affected by the cost of electricity for water electrolysis and the construction costs.

For HUS different types of storages – namely, salt caverns, deep water aquifers and depleted oil and natural gas reservoirs have been proposed, which are currently under scientific scrutiny. Moreover, hydrogen is a specific gas, which needs to be compressed to occupy the smallest possible volume. In comparison with other gases, it has the lowest molecular weight (2.016 g/mol), a low density (0.08375 kg/m<sup>3</sup>), very low solubility in water and a low dynamic viscosity (0.88 at 200C, 10<sup>-5</sup> Pa S). Also, hydrogen has a high mass-energy density (120 MJ/kg) with a very low volumetric energy density (0.01079 MJ/L). These parameters affect underground storages differently, for example, low viscosity of hydrogen and the associated rate of gas movement carry a higher risk of leakage. It should also be highlighted, that HUS have specific environments, characterized by potentially high microbial abundance and activity. Subsurface microorganisms can use hydrogen in their metabolism and thus lead to a variety of undesired side effects or risks, such as hydrogen loss, methane and acid formation, as well as clogging and corrosion.

In contrast to aboveground storage systems, HUS have several strong advantages, too: they allow gas to be stored in large quantities thus reducing storage costs, ensure storage safety – underground storage is less vulnerable to fire or terrorist attack, optimize the land use – traditional aboveground storages may occupy

significant areas, which might be used for other purposes, and existing engineering and safety management experience in underground gas storage sector (regarding storage of the natural gas).

**Keywords:** *gaseous fuels, hydrogen, risk factors, underground storage*

**JEL Classification:** G28, K32, L91, L94, L95, L98

# GASEOUS FUEL DIVERSIFICATION IN RESIDENTIAL SECTOR: ANALYSIS OF POTENTIAL RISKS

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**Abstract.** Gaseous fuel diversification, which includes, but is not limited to wider renewable gas (RG) usage in energy generation and energy intensive industry throughout the European Union (EU), has strong national economy and climate related advantages. But, at the same time, gaseous fuel diversification, especially when carried out at a large scale, can be associated with numerous risk factors. These risks can vary from sector to sector, and apply not only to large-scale energy and industrial processes, but to a residential gas supply as well.

If the main avenues of gaseous fuel diversification in a residential sector correspond to blending of following RGs: biomethane and green hydrogen, into existing natural gas networks with subsequent delivery of blended resources to all consumers, including residential ones, – risks associated with it falls into two categories. The first category being methane rich fuel associated risks (the natural gas and biomethane) and the second – non-methane rich fuel associated risks (hydrogen). The first category includes the natural gas related risks, as chemically biomethane is a substance identical to it. These risks are: leaks, fire, explosion and suffocation, however the natural gas alone will not burn or explode.

The second category includes green hydrogen (or hydrogen of any origin), that could be blended with methane and biomethane in low proportions with minimal investments into the existing natural gas systems. The share of hydrogen in a blend may range up to 10 percent by energy, although this is subject to ongoing debate.

The main risk factors associated with usage of pure hydrogen or high concentration of hydrogen in hydrogen-methane blends are: propensity to leaks, as hydrogen can diffuse through many materials considered airtight or impermeable to other gases, buoyancy as hydrogen is the lightest known gas, that rises quickly under atmospheric conditions, flammability – when mixed with air, hydrogen can easily ignite or/and explode, metal embrittlement (hydrogen-induced cracking) as reduction in the ductility of a metal can occur due to absorbed hydrogen (in steels, iron, nickel, titanium, cobalt, and their alloys). Also risks of proper mechanical blending of hydrogen and methane may arise in certain situations, that might, among other, result in rising gaseous fuel usage risks in residential sector. Especially, when domestic appliances, that are not designed to run on a high mix of hydrogen (gas boilers, furnaces, cookstoves etc.) are concerned. To mitigate these

risks in a timely manner, at least part of them have to be replaced with hydrogen-compatible alternatives, which currently available to consumers in rather limited amounts.

**Keywords:** *diversification risks, gaseous fuels, management strategies, renewable gases*

**JEL Classification:** G28, K32, L91, L94, L95, L98

# EVALUATION OF URBAN SUSTAINABILITY IN UZBEKISTAN

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**Abstract.** The foundation of material production and human existence is provided by natural resources and environmental conditions. The quality of resource utilization, protection, and reproduction as well as the state of the environment heavily influence economic growth and production efficiency. It is increasingly important to take ecological and social concerns into account when making decisions about sustainable development at the current stage of society's development. It is increasingly important to take ecological and social concerns into account when making decisions about sustainable development at the current stage of society's development. In this research we attempted to evaluate the level of sustainable development in Uzbekistan, using surveys, interviews with experts, theoretical and statistical analysis. As a result of this research, we developed a formula for urban sustainability assessment in Uzbekistan. The analysis showed that although Uzbekistan is approaching sustainable goals more actions need to be undertaken to speed up that process. Among the most important country-specific factors affecting sustainability are sustainability awareness and gender equality.

**Keywords:** *awareness, gender equality, sustainability, sustainable development*

**JEL Classification:** Q01, Q56

# CONFORMITY ASSESSMENT FOR BUILDING MATERIAL IN CONSTRUCTION PROJECT IN KINGDOME OF BAHRAIN

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**Abstract.** Before a product can reach the market, it must generally be able to verify to a consumer or control board that it is safe and performs as claimed in terms of energy efficiency, consistency, sustainability, and a variety of other criteria. The action of confirming that a standard or technical specification was followed in the design, manufacturing, installation, maintenance, or repair of a device or system is known as conformity assessment. To achieve consistent and repeatable results, this activity must be carried out according to a set of well-defined criteria. In other words, conformity assessment must be conducted in a consistent manner. Nowadays all the project need approval in its processes so it can start working, including the construction projects. In construction projects the conformity starts for the design and end in the finishing work. Every country or region has its own standard and specification to ensure the stability of the construction project, where this standard suit the region conditions, uses and the availability of the used materials. In Kingdome of Bahrain, they set there standard for construction work. The new Standard Specifications for Construction Works aims to bring consistency to the construction sector by providing a crucial reference for developers to ensure that construction projects are developed to the highest possible standards. It serves as a guide for design professionals in terms of acceptable construction methods for Ministry of Works projects. In this research the conformity assessment for building materials in construction project in Kingdome of Bahrain will discussed. The research is aiming to discuss the conformity assessment definition and types, how the conformity system applied in construction project, the standard specifications for construction works in Kingdome of Bahrain, the standard of Earthworks, Concrete, Masonry, Glass & Glazing, Structural Steel & Coating, Painting & Decoration and Internal finishing including the thermal insulation Materials and how these materials tested to conform the standard.

**Keywords:** *conformity assessment, construction materials, materials testing, standard specification of construction work*

**JEL Classification:** R30

# STRATEGIC PLANNING OPTIONS AND SOLUTIONS FOR CONSTRUCTION COMPANY DEVELOPMENT

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**Abstract.** Modern entrepreneurs operate during the time of changes and in circumstances of uncertainty. The environment, where entrepreneurs operate, is not stable and constantly develops. Strategic planning is a tool, enabling to adapt to the contemporary variable environment, to set priorities and propose important tasks. Every entrepreneur, in particular, an owner of a small enterprise, asks a question to himself, how to achieve effectiveness with less expenses. An entrepreneur organizes, manages the company and makes risks every day. In turn, enterprises with a small number of employees quite often work more effectively and are able to respond faster to changes in the market than enterprises with a bigger number of employees. The world has become more dynamic therefore, it constantly changes. Nowadays, the ability to adapt is very important for the entrepreneur. The entrepreneur has to understand the movement of the external environment, in order to change in a timely manner, the internal environment of the company in accordance with the requirements of the customer.

When talking about strategic management, attention always is paid to big companies, but this issue is rarely being analysed from the sector of a small enterprise. In terms, small enterprises are bigger developers, therefore, these companies need well-arranged and organized strategic planning and management. In the countries with developed economy small enterprises are one of the most important parts in the market economy. Effective strategic planning is a prestige of a small enterprise. It is not sufficient only with a plan for effective operation of the company, the plan should not only be established, the plan should work and work effectively, in accordance with modern requirements, in order to achieve the preferred result and effect. Relations between the buyer and the seller are dynamic, they constantly develop, therefore, the sellers have a task to convince the buyer that you are better than competitors, considering legislation and changes in other external circumstances, determining the growth. Topicality of the research – as far as the biggest proportion of enterprises in Latvia consist of enterprises with a small number of employees, it is considered that it is useful to introduce strategic planning in companies with a small number of employees.

**Keywords:** *competitiveness, planning, risk analysis, small enterprises, strategic management, strategic planning, strategy, strategy analysis, tools*

**JEL Classification:** R30

# PROBLEMS AND POSSIBLE SOLUTIONS OF POST-DISASTER HOUSING RECONSTRUCTION PROJECTS IN INDIA

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**Abstract.** Natural disasters occurred often around the globe and resulted in significant loss of life and property. Over the last two decades, there has been a remarkable rise in extreme weather events that have the potential to wreak devastation on the planet. Frequently, disaster-affected regions are needed to enhance their capacity for rebuilding, requiring more experienced and competent personnel to oversee the projects. Post-disaster reconstruction (PDR) is a complicated and difficult procedure requiring a variety of distinct and well-coordinated actions. The purpose of this research is to examine the effect of disasters, analyse the problems associated with post-disaster housing reconstruction projects in India, and provide potential solutions. A standardised questionnaire is used to gather data from a purposeful sample as part of a quantitative methodology. The analysed data reveal that institutional procedures, rebuilding techniques, project execution, and stakeholder management all contribute to the effective implementation of post-disaster home reconstruction projects.

**Keywords:** *impact of disaster, Indian disasters, Post-disaster housing reconstruction*

**JEL Classification:** Q54, Q59, R11, R29



# DEVELOPMENT OF THE INSTITUTE OF ENGINEERING CONSULTANT IN LATVIA: IMPACT ON THE CONSTRUCTION INDUSTRY

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**Abstract.** The construction process is characterised by standards such as LVS EN 16310, LVS 1046, etc. However, the geopolitical situation has shown that the construction industry needs to be aware not only about the process itself, but also supply chains, materials and the fact that we are not disconnected from the international community.

Typical construction industry problems in Latvia are imprecise, ill-considered definition of the intent, lack of technical studies and lack of structure in the processes. These are all issues for the client. To some extent, they can be expressed in one word: *imprévision* (lack of foresight).

The role of the Institution of Engineering Consultant is to ensure the opposite: a well-managed construction process ensures the efficient use of the resources needed in it. Assuming that the involvement of an engineering consultant in the definition phase of a construction project will contribute to a significant reduction of errors in the subsequent construction process, the question is whether there is sufficient awareness of the institution of an engineering consultant in Latvia and what benefits can be expected from this institution in the next five years?

**Keywords:** *builder, construction initiator, construction process, customer, engineering consultant, EN 16310, FIDIC, standards*

**JEL Classification:** L74

# DAMAGE TO ARCHAEOLOGICAL SITES: SUFFERED PARTIES AND PROTECTION OF THEIR SOCIO-ECONOMIC INTERESTS

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**Abstract.** Socio-economic interests of various stakeholders – owners, local communities, researchers, visitors, businesses, heritage institutions, etc., as well as society as a whole and future generations suffer due to damage done to cultural heritage sites. Probably the most vulnerable sites are archaeological ones.

Damaging of archaeological sites and illegal acquisition of antiquities therefrom is more frequent offence in Latvia. The Latvian State is usually recognized as the only victim in these offences, but the question arises whether there are interests of other archaeological heritage stakeholders that should be identified and taken into account?

National approaches regarding identification of related socio-economic interests differ, however international community recognizes that offences against cultural heritage can impact different types of victims both directly and indirectly. Moreover, the socio-economic impact of such offences may have transnational character, leading to a global impact that is identifiable e.g., in criminal proceedings (e.g., International Criminal Court, Policy on Cultural Heritage).

The presentation, analyzing Latvian situation and making international comparisons, uses the integration of socio-economic and legal approaches to the impact of heritage offences, providing theoretical and practical insights into:

- identifying the stakeholders whose socio-economic interests are significantly affected,
- introducing socio-economic indicators to connect personal benefits with the opportunities provided by the heritage sites,
- determining the type and nature of damage caused,
- connecting stakeholders with suffered interests and possible reparations,
- identifying opportunities to protect suffered parties' socio-economic interests and identifying possible regulatory improvements.

The presentation uses the integration of socio-economic and legal approaches to the researched issue and is based on the research conducted by Andris Kairiss (PhD oec. cand., Mg. sc. soc., Bac. iur.) and Irina Olevska (PhD iur. cand., LL.M., Diploma in Art Law) in 2021–2022.

**Keywords:** *archaeological heritage, legal issues, socio-economic interests, socio-economic indicators, socio-economic justice, stakeholders*

**JEL Classification:** Z10, Z18, K11, K25, K14, K33, K42

# THE GREAT EUROPEAN ENERGY CRISIS OF 2022

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**Abstract.** Energy, particularly cheap energy, is the backbone of any economy. The more expensive the energy, the more expensive the output of goods in an industrial economy. For that reason, energy policy should be a priority for decision-makers everywhere. However, when it comes to the European countries, we witness an erratic decision-making process and priorities that are often based on wishful thinking, not hard facts. Such a process has led to the decommissioning of traditional, reliable and robust ways of providing energy, like coal and nuclear, in favor of more “green” alternatives, such as wind and solar. Although admirable in theory, these practices have led to increased reliance on natural gas as a way to ease the energy transition. Europe has traditionally had one main supplier, Russia, gas who has been interrupted due to the recent war in Ukraine and resulting economic and political sanctions. Faced with half-empty gas storage facilities and a looming winter, the European nations have scrambled to fill them by any means necessary, with varying results. As a result, Europeans are being introduced to the term “rolling blackout” for the first time since World War 2 and mandatory energy cuts by 10–15% across the European Union member states. This paper aims to explain how a once prosperous continent is heading towards energy poverty and the consequences of that going forward.

**Keywords:** *energy crisis, energy sources, Europe, European Union*

**JEL Classification:** Q42, Q43, Q47

# INNOVATIVE BUILDING CONCEPTS FOR SOCIAL HOUSING DEVELOPMENT

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**Abstract.** This research concentrates on innovative limited constructions made from natural or recycled materials in accordance with the idea of sustainable housing development. In the future, such inventive structures may serve as an alternative to sophisticated high-tech skyscrapers. A secondary data source is used to find creative buildings and to describe the primary kinds of structures that might be used in the creation of social housing. In addition, it addresses the application possibilities and limitations as well as the benefits and drawbacks of the implementation technology in the context of detached social housing difficulties.

**Keywords:** *innovative building structure, separate housing, social housing*

**JEL Classification:** R11, R14

# CHANGES IN CONSTRUCTION COST INDICES IN LATVIA

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**Abstract.** Over the past five years, there have been signs of rising costs for various construction projects. This shows that the reading of the construction cost index is also increasing. In order to be able to make a comparison of the index of construction costs in different countries of the European Union, it must be concluded that, for the most part, it cannot be implemented correctly. In different countries, the criteria forming the cost index differ in different groups of construction works – housing, civil engineering, etc. A large number of European Union member states publish construction price indices, which mostly differ from each other in terms of the type and purpose of the index, the coverage of construction activity and the items included in the creation of the index. The authors of the research conclude that when developing construction price indices, the European Union member states are recommended to use international or national classifications, noting that national classification systems must be compatible with international classifications.

**Keywords:** *classification systems, construction, construction cost, construction cost indices*

**JEL Classification:** L74

# PECULIARITIES OF CONSTRUCTION PRODUCTS AND THEIR ASSESSMENT METHODS IN LATVIA AND UKRAINE

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**Abstract.** Construction issues in Ukraine are regulated by several laws, subordinate national and local legislation, as well as various construction regulations, which are not legally binding but are widely used in practice. In Latvia, construction issues are regulated by the Construction Law and subordinate regulatory acts.

According to the classification of general economic activity in Latvia NACE 2nd edition, the economic type of activity "Construction" includes general and specialized construction of buildings and civil engineering structures. It includes new construction, repair works, reconstruction and renovation, assembly of prefabricated structures or structures on the construction site, as well as the construction of temporary structures.

Compared to the products produced in the industrial sector, it must be concluded that several peculiarities or differences can be found in the products produced in the construction sector, which can be conditionally divided into several large groups: peculiarities of a technical nature, peculiarities of a legal and management nature, peculiarities of an economic nature, peculiarities of a social nature, as well as peculiarities of the surrounding environment.

The authors of the research conclude that each group of construction product features contains sub-criteria for their evaluation. As a result of the research, groups of criteria will be developed, which will be applicable both in Latvia and Ukraine in the future.

**Keywords:** *classification groups, construction, construction product, construction product peculiarities*

**JEL Classification:** L74

# ASPECTS OF IMPLEMENTATION OF GREEN CONSTRUCTION IN THE PUBLIC BUILDING SECTOR

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**Abstract.** Clarifying the demand factors for green construction, as well as evaluating their advantages, is important in the construction process not only in the private sector, but also in the public and public buildings sector. An actual question is how to measure green building criteria, according to international sustainability systems, in relation to green public procurement criteria. The authors of the research note that it is important to determine mandatory criteria for green public procurement in construction in Latvia and the steps for their implementation.

The research finds out the demand factors for green construction and the advantages they provide, also analyses how green construction can be measured, what measurement systems are and explains the regulation and standards of green construction.

In order to obtain correct results, research was conducted on the application trends of green public procurement criteria and the 10 largest public building construction procurements in Latvia were evaluated.

The procurement criteria of the green public building Ogre Library and their compliance with green public procurement criteria have been assessed for credibility. Calculations of the life cycles of buildings have been carried out to justify the advantages of the construction, maintenance, management costs and environmental impact of the green building in relation to an alternative building, as well as the author of the work provides proposals to introduce mandatory green public procurement criteria in Latvia and will indicate the steps to be taken for their implementation.

Comparing the costs of building maintenance and management over a 20-year period, it was proven that green building is a more efficient solution in terms of costs and environmental impact, although the short-term total capital investment is higher than the cost of an alternative building.

**Keywords:** *calculations of the life cycles of buildings, costs of building maintenance and management, demand factors for green construction, green buildings*

**JEL Classification:** Q56, L69, L74



# REAL ESTATE PRICES AND ACTUAL TENDENCIES IN REAL ESTATE MARKET OF INDIA

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**Abstract.** Currently, India is the second most populated country in the world. Poverty, unemployment, and low incomes are some of the problems faced by some parts of the population. Owning or renting a house is a high priority for this category of people. The aim of the research is to investigate the actual tendencies within the real estate market of India. The literature, data analysis, logical access, and other methods have been used in the research. A variety of factors are influencing the development of the real estate market and real estate prices within it. Price is an important factor for buyers of real estate. Sometimes people buy plots in underdeveloped areas for lower costs from unauthorized landowners. The research investigates this question and provides some recommendations for minimizing the economic and other risks faced by market participants within the real estate market.

**Keywords:** *economic problems, economic risks, landowners, laws, real estate, real estate developer, real estate market, real estate prices*

**JEL Classification:** R21, R30, R31

# ACTUAL ISSUES OF THE DEVELOPMENT OF THE REAL ESTATE MARKET IN LATVIA

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**Abstract.** A variety of factors influence the development of the real estate market. The tendencies within the development of the real estate market could change during the time. The aim of the research is to investigate several actual issues of the development of the real estate market in Latvia in order to provide recommendations for entrepreneurs operating within the sector. The analysis, synthesis and logical access methods have been used in the research. In the analysis of the real estate market, entrepreneurs could include the analysis of macroeconomic indicators, a detailed analysis of aggregate supply and aggregate demand within different sectors of the real estate market and for different types of real estate, and the identification of actual risks that could affect the development of the market and particular purchases.

**Keywords:** *analysis, development, entrepreneurship, Latvia, macroeconomic development, real estate, real estate market, sectors, tendencies*

**JEL Classification:** R21, R30, R31

# PROBLEMS AND SOLUTIONS FOR THE RENTAL OF RESIDENTIAL SPACES OWNED BY THE LOCAL GOVERNMENT

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**Abstract.** The subject matter of the research is highlighted by both the new regulatory framework and the need for technical housing, and the need for clear conditions – how to calculate the rent so that it also covers the technical maintenance work of the dwelling, thereby ensuring that the residential space complies with the technical requirements. The aim of the research is to identify problems and gaps in the rental process of residential spaces owned by the local government and to provide proposals for solutions to related problems. Methods used in the development of the research: the method of collecting intelligence, analysis and empirical data (interview, observation, analysis of the situation). The theoretical, methodological and informative basis of the research is composed of theoretical and practical knowledge of Latvian science and economic scientists, and residential houses management and rental specialists, scientific publications, legislation of the Republic of Latvia, data of the Ministry of Economics, Riga City Council (including “Riga city builder”, Riga Municipality Housing and Environment Department) data, internet resources and other sources of information, including information published and unpublished by the company. The research examines the problems, including legal relations, the technical state of residential houses and the decision-making aspects that affect the rental process of residential spaces. Research examines the conditions of the rental contract for residential spaces, the processes of mandatory management activities, decision-making aspects, and the method of calculating rental for residential spaces. Within the framework research, the possibilities for the development of residential rental processes are examined, including methods for improving the method of calculating rental residential spaces, as well as a comparison of the laws on rental of residential spaces. As part of the study, the hypothesis is being confirmed: the lack of residential spaces or their unsatisfactory technical status, as well as low rents, affect the possibility for municipalities to fully implement their statutory functions by providing residents with living space.

**Keywords:** *municipal housing fund, rent, residential premises*

**JEL Classification:** R21, R31, O18

# LEGAL, ECONOMIC AND ORGANIZATIONAL ASPECTS OF APARTMENT HOUSE MANAGEMENT

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**Abstract.** The aim of the research is to evaluate the legal, economic and organizational aspects of apartment house management based on the analysis of the information gathered within the research process. The analytical part of the research deals with the historical aspects of apartment property privatization, the procedure of residential house privatization process, summarizes information about the situation in other countries and summarizes the most significant problems related to the management of apartment buildings. In the theoretical part, a comprehensive description of Latvian multi-apartment residential buildings has been provided and an analysis of the regulatory enactments regulating Latvian housing stock has been performed, paying special attention to management activities. In the practical part of the research, the processes related to the implementation of apartment privatization and management are analysed and compared, considering in whose possession is the building. In addition, an insight into management-related expenditures is provided and the factors influencing them are explored. Based on the collection and analysis of information, authors conclude that the main problems in the industry are related to the complex regulatory framework, bureaucratic processes, ignorance and disinterest of apartment owners, as well as insufficient qualifications of managers.

**Keywords:** *apartment house management, government policy*

**JEL Classification:** R28, R38, O18, K25, L85

# CHALLENGES FOR THE PARTICIPATION OF APARTMENT OWNERS IN ENERGY COMMUNITIES

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**Abstract.** Latvia as other European Union (hereinafter – EU) member states must become climate neutral by 2050. Energy communities are one of the key elements in achieving the EU's energy transition by 2050: half of Europe's population could produce up to half of EU's renewable energy.

In Latvia the energy consumed in the building sector (households) accounts for up to 30% of the entire energy sector, therefore the building sector includes significant potential in achieving the overall energy efficiency goals. Taking into account the fact that the area of apartment buildings in Latvia is almost one quartet of the area of all buildings and while most apartment buildings belong to several owners are divided into apartment properties, the successful involvement of apartment owners' associations in energy communities is essential for achieving energy goals.

At the EU level the regulation of energy communities is included in the Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU, as well as in the Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources. The requirements of the abovementioned directives were transposed in Latvia's regulation by amendments to the Electricity Market Law and to the Energy Law. However, it does not follow from the definition of the energy community included in the Energy Law providing that the community of apartment owners can itself be an energy community. In addition, the law does not provide that apartment owners associations can act as a member of a wider energy community. Therefore, it can be concluded that when making amendments to the Energy Law, the concept of community of apartment owners is not taken into account, so it creates significant risks for the involvement of multi-apartment residential buildings in energy communities.

**Keywords:** *energy communities, energy efficiency, EU Directive, renewable energy*

**JEL Classification:** K32, P28, P48, Q28, Q43, Q48

# PARTICIPATION IN ENSURING CLIMATE NEUTRALITY: RIGHT OR DUTY OF APARTMENT OWNERS?

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**Abstract.** In multi-apartment residential buildings apartment owners have a different and often conflicting vision of the necessary investments for their shared ownership. Therefore, both, from the point of view of all apartment owners and also from the public interest point of view, it is essential to find a fair balance between the interests of the interested parties. As a social reality and society's economic needs change, the concept and scope of real estate management has been constantly improved both in Europe and in Latvia. If historically property management has been understood as dealing with the property as a whole or its parts, as well as participation in joint expenses for its maintenance and preservation, then in the context of climate goals, the question of the place of energy efficiency issues in the management activities of residential houses is especially relevant not only in Latvia but also elsewhere in Europe.

Currently the Law on the Management of Residential Buildings generally provides that the provision of measures to improve the energy efficiency of a residential house is a mandatory management activity, however, *prima facie* it can be concluded that such regulation can be improved, as it does not provide answers to many important questions. For example, is an individual apartment owner obliged to participate in the installation of solar panels or the creation of a parking space for electric cars? What are house manager's responsibilities in informing apartment owners about climate goals (energy transition) and drawing up a management work plan related to these goals? Therefore, in order to successfully ensure the achievement of energy transition, in addition to the already known management activities, the scope of management activities established by the law should be expanded, also providing for the rights and obligations of those involved in the management of residential buildings – apartment owners, associations of apartment owners and house managers in relation to energy communities.

**Keywords:** *energy communities, energy efficiency, energy transition, residential house management*

**JEL Classification:** K25, L85, K32, P28, P48, Q28, Q38, Q43, Q48

# DEVELOPMENT CONCEPT OF MULTI-APARTMENT RESIDENTIAL BUILDING FUND IN LATVIAN CITIES

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**Abstract.** In 2022, the Latvian Municipal Union decided to initiate a new mission "Smart municipalities on the road to climate neutrinos by 2030". It is intended to follow the innovative model of the European Commission, where the management of the missions is intended to achieve concrete results in the European Union to reach the targets by 2030. According to the direction identified, each municipality should assess and develop action lines and directions to follow in the long-term, including development projects. The residential fund is significantly outdated in Latvia, which increases its maintenance costs and, without increasing household income, alters the prospects for its recovery.

According to data provided by the Ministry of Economics, Latvia is experiencing a very slow recovery of the multi-apartment residential fund, with only 0.2% of the total number of apartments in Latvia. New multi-apartment residential houses are being constructed in Riga and near the city of Riga, are being renovated, but the situation outside the Riga area is completely different.

To be able to develop a concept for the development of residential houses, research is being done: development of residential houses in Latvia and housing characteristics, demographic situation and employment in cities, requirements of town building regulations, possibilities of attracting financing from municipalities and Financial Institution Altum for real estate development and construction of new low-rent housing have been analysed, as well as an analysis of the urban SWOT analysis by identifying the lingering and contributing factors.

The development of residential buildings is influenced by various factors – the demographic situation, the solvency of the population, regulatory enactments, the capacity of management companies and their financial indicators, as well as state and local government support. Latvia mainly uses European Union funds for the renovation of buildings, as well as funds from the state and local government budgets, as the population has low solvency. State and local government support is needed for the renovation and energy efficiency measures, improvement of construction works, as well as for the development of rental housing construction to be able to develop multi-apartment residential buildings in Latvian cities.

**Keywords:** *development concept, financial support, housing characteristics, residential building*

**JEL Classification:** G11, G18, K11, K25, K32, O21, L88

# NEW APPROACH OF IT COMMUNICATIONS IN THE PROCESS OF RESIDENTIAL HOUSE MANAGEMENT

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**Abstract.** Multi-apartment building management are linked to a number of sectors interrelated in a single system: construction, real estate operations, financial and insurance activities, energy, gas supply, heating and air conditioning, water supply, sewerage, waste management and remediation activities, provision of information and communication services, technical services, operation of administrative and support service etc.

More and more companies in the field of multi-apartment building using management have been paying close attention to the type of communication, access to information exchange to make it more convenient, functional and a quality tool to educate the industry not only potential and existing customers, but also society as a whole.

Nowadays, it is necessary to pass on global information to the public, to educate it, and to interest everyone with personalized information, possibly supplementing existing or applying new, modern forms of communication and information exchange approaches that are intriguing to the people of Latvia.

In recent years, the type of communication has shifted strongly and fundamentally from verbal to digital communications. The face-to-face approach is increasingly being replaced by communication through technology and systems. Information exchange is carried out on social networks, media networks, including educational programmes, and listening to different programmes. The events that have occurred over time in the world, including the Covid-19 pandemic, have led society to change their habits, affecting everyday lives. People are more inclined to express themselves, to say their opinions aloud, to express their feelings and positions. Every day, it can be seen more and more that we each are different, which is also reflected in our actions and communication.

To ensure the availability of information and to monitor the work of managers, substantial amendments have been made to the "Housing Property Act", which makes it mandatory to seek a home case in the Construction Information System. The implementation and use of information technologies (IT) communications in the management of residential houses is a process that develops, implements, and controls the management service, achieves the objectives, strategies, increases work efficiency, expands the range of functions, and involves customers.



**Keywords:** *digital communication and information, information technologies, multi-apartment building*

**JEL Classification:** C8, G14, M15, O33

# OPPORTUNITIES FOR IMPROVEMENT OF THE REAL ESTATE MANAGEMENT PROCESS

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**Abstract.** By evaluating the process of managing and maintaining multi-apartment residential buildings, the aim of the research is to develop proposals for improving the manager's performance in any type or size of company, which work in the real estate management and maintenance industry.

The research has evaluated the concept of real estate and its nature, quantitatively evaluated multi-apartment residential buildings, as well as realized an analytical evaluation of the management and maintenance market of multi-apartment residential buildings.

In order to explain the nature of the management process, the research has evaluated the theoretical and legal aspects of the management process of multi-apartment residential buildings and analysed the regulation of real estate managers in Latvia and the world.

Based on the fact that the tasks are transferred to the managers in the research company with the help of various software, on the basis of keeping and updating the house and building file, proposals for improving the process of managing multi-apartment residential buildings have been developed.

Based on the collected conclusions, proposals are put forward for improving the process of managing and maintaining multi-apartment residential buildings.

**Keywords:** *multi-apartment residential buildings, real estate, real estate management and maintenance industry*

**JEL Classification:** R30, R31, R39

# POSSIBILITIES AND SOLUTIONS FOR MANAGING MULTI-APARTMENT RESIDENTIAL BUILDINGS IN THE LATGALE REGION

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**Abstract.** Apartment ownership is one of the most common types of real estate in the country. In Latvia, 66% of the population live in apartments, not in private houses, and this is the highest proportion of people living in apartments among the 14 European Union countries, for which data are collected by “Eurostat”.

The housing management and administration sector is one of the most important economic sectors, regardless of the economic situation in the national economy and the region of Latvia. Maintenance of apartment buildings in a condition suitable for living cannot be ensured without management. Different categories of residents live in Latvian apartment buildings – different in age, economic and social status. Ensuring and equalizing the comfort level of the shared property according to the financial capabilities and wishes of each apartment owner is a complex task, where the manager’s actions in educating and informing residents and choosing the most optimal management option are essential, with the aim of maintaining and organizing the residential building as best as possible.

In the research authors provide an idea of the concepts of joint ownership and separate ownership, the concept of the apartment owner, rights and obligations, and get acquainted with the most important laws of apartment building management. A survey was conducted among apartment owners in order to understand how well they are aware of their rights and obligations, to what extent they are informed about the aspects of property management and how much they want to participate in the management and management of the house. The research summarizes conclusions and makes proposals for solving management problems in the Latgale region.

**Keywords:** *apartment house management, apartment owner, apartment owner’s community, apartment ownership, managerial activities*

**JEL Classification:** R30, R31, R39

# ASSESSMENT OF ENERGY EFFICIENCY IMPROVEMENT MEASURES OF STUDENT DORMITORIES

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**Abstract.** A current topic in Latvia is the assessment of measures to increase the energy efficiency of student service hotels. The conducted research showed that issues related to the stages of creating a set of energy saving measures and the development of energy saving culture specifically in the service hotels of educational institutions, throughout Latvia, are still not sufficiently reflected in Latvia. Students have to live in not particularly favorable conditions, as many service hotels have not been renovated since Soviet times.

The aim of the research is to increase energy saving measures in the RTU service hotel building.

The author analyzed the state of energy saving and energy efficiency in Latvian universities, and also described the current state of energy efficiency of the RTU service building. The main stages of creating a complex of energy saving measures for the RTU service hotel building were determined. Based on the practical research, the technical support for the installation of the modern "Smart House" automation system in the RTU service hotel has been carried out.

**Keywords:** *energy efficiency, student dormitories*

**JEL Classification:** R30

# ACTIVITIES OF THE SOCIETY OF APARTMENT OWNERS IN LATVIA

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**Abstract.** House management is often entrusted to a management company, but managers' unjustified costs for house maintenance, invoices for undone work, force owners to look for other solutions for effective house management. Apartment owners do not have to suffer and live in peace with an irresponsible house manager. Latvian laws require apartment owners to change the house manager by mutual agreement.

The apartment owners' society is a voluntary association of apartment owners that takes care of the maintenance of their apartment buildings by signing a contract with the house manager and manager and paying a membership fee money in a savings fund, which is used when there is a need to do house repairs or any repairs, for example, sewer pipes are broken, etc.

As a result of the research, it is concluded that, in general, the owners of the house and the people living in it are satisfied with the work of the Union of Apartment Owners "X", but they want more participation, which is possible only from the owner himself, by participating in various meetings.

**Keywords:** apartment owners, apartment owners society, maintenance, management

**JEL Classification:** R21, R31

# OPPORTUNITIES OF APARTMENT HOUSE MANAGEMENT COMPANY EFFICIENCY INCREASING

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**Abstract.** The study examines various efficiency indicators affecting economic activity and efficiency assessment methods, the application of which can contribute to increasing the efficiency of economic activity. The research examines the field of management of real estate, especially multi-apartment residential buildings, its most important elements and the factors influencing it, describes the form of management of the apartment owners' cooperative society with its peculiarities, analyses the term efficiency, lists and describes the types of efficiency and related concepts – competitiveness and productivity, as well as the indicators affecting them, the methods of evaluating efficiency and the indicators affecting it are examined and analysed, the consequences of increasing efficiency in economic activity are identified, the risks of economic activity are examined.

In the study, an in-depth study of the researched organization from legal and practical aspects is carried out, the involved parties are analysed, a management plan is developed, risks in the researched organization's operation are identified, and the efficiency of the researched organization's operation is evaluated.

**Keywords:** *business efficiency, efficiency, efficiency evaluation methods, evaluation of efficiency, increasing efficiency, management of real estate, risks*

**JEL Classification:** R21, R31

# USE OF LEAN APPROACH IN REAL ESTATE PROJECTS

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**Abstract.** The purpose of the research is focused on the lean construction methods and concepts to deal with real estate market by showcasing the improvements in construction management and waste reduction. Lean thinking being more efficient as it enhances productivity and speed, reduce time, cost and losses. Lean construction tools selected for the study are either ready to-use with minor suggestions and improvements. Author makes a quantitative analysis of investigations through assessment of case studies by using structural analysis, use of Last Planner System metrics and value stream efficiency. The research examines the current condition of the process and future preparation through value-stream mapping which is actually a material and information-flow mapping which focuses on finding and eliminating waste. The study shows how LPS improves reliability, productivity and planning in the project. Lean manufacturing application streamlines and optimizes the manufacturing process also reducing waste concluding to project success. The study also identifies the challenges in lean construction management and how it could be hampered by improvement program that focuses on results. The research provides numerous measures and production of new metrics, and systematic LPS parameter evaluation with database-driven tools for future analysis of real-world initiatives.

**Keywords:** *construction management, data analysis, lean approach, real estate, value streaming map*

**JEL Classification:** R21, R31

# IMPROVEMENT OF SUSTAINABLE URBAN PLANNING AND DESIGN IN LATVIA

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**Abstract.** The purpose of the study is focused on the urban strategies present by Latvian government and development organizations by evaluating development possibilities with application of sustainable practices in the evolution of Latvian urban design. Study is focused on the development of urban spaces in Latvia to set policy guidelines for sustainable growth. Authors make a comparative analysis of the present urban growth and development of Latvia policies and urban planning. Expansion of development centre, seacoast spatial development and transit development by low-cost affordable housings to foster to build the economic growth and living environment. The concepts of sustainable development gleaned from the study is assessed for criteria through SWOT analysis and live case studies. From authors perspective sustainable urban planning is based on the triple-E concept of sustainability which focuses on viability of economy, socially equitable and environment friendly structure. The study is confined to understanding development concerns and potential remedies, focused solely on developing urban areas through evaluating sustainable methods. Hence revamping the current policies and schemes of local and central governing bodies of rural and urban Latvia.

**Keywords:** *policies, survey study, sustainable development, sustainable urban planning, transit orient development*

**JEL Classification:** R30





## FOREWORD

Following part contains results and related research studies of the EU Erasmus+ project “Circular Economy in Wooden Construction” (WOOD in CIRCLE). Project No: KA203-8443DA0D. Project code: 2020-1-LT01-KA203-077939.

Circular economy is a prominent action to tackle climate change and the need for sustainable development. As wood is the only significant renewable construction material, wood can also contribute to a more circular construction sector. Wood is renewable and it uses low energy processes and generates little waste that cannot be recycled or used as a source of renewable fuel. Circular construction is not only about resource recovery, re-use and recycling; it is a much broader concept. Circular economy principles must be applied across a building’s life cycle: starting from growth and extraction of materials, production, continuing with design, construction, building maintenance, and ending with building demolition and recycling of waste. There is a significant body of literature on the drivers and benefits of circular economy; however, little research or wide scale application has been undertaken within a wooden construction context. Challenges of circular economy in wooden construction require scientific research and well-educated graduates, who are able to think holistically and interdisciplinary, to research, assess and model sustainable construction solutions.

EU Erasmus+ project “Circular Economy in Wooden Construction” (WOOD in CIRCLE) is aimed at delivering innovative student-centred transdisciplinary education in circular economy-based wooden construction for postgraduate students across the European countries.

The project is being implemented by five higher education institutions across Europe:

- Vilnius Gediminas Technical University (Lithuania);
- University of Palermo (Italy);
- Laurea University of Applied Sciences (Finland);
- Häme University of Applied Sciences (Finland);
- Riga Technical University (Latvia).

Organizing Committee of ICEREE2022

# ERASMUS+ “WOOD IN CIRCLE” PROJECT: AIMS AND ACHIEVEMENTS

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**Abstract.** Erasmus+ project “Circular Economy in Wooden Construction” (WOOD in CIRCLE) aims at delivering innovative student-centered transdisciplinary education in circular economy-based wooden construction to postgraduate students across the European countries. The project is being implemented by five higher education institutions: Vilnius Gediminas Technical University (Lithuania), Riga Technical University (Latvia), Häme University of Applied Sciences (Finland), Laurea University of Applied Sciences (Finland), and University of Palermo (Italy). In frames of the project five intellectual outputs have been developed: methodological framework, e-learning course “Circular Economy in Wooden Construction” (12 ECTS), e-learning platform, case studies, joint academic publications. Methodological framework was presented in the intensive course for teachers, organized remotely by Laurea University of Applied Sciences. Furthermore, developed methodology and curriculum were practically tested in two intensive learning courses, hosted by Häme University of Applied Sciences and University of Palermo. The courses were attended by international groups of students and delivered by international group of teachers. Positive feedback from students and teachers revealed that international activities were successfully implemented, the methodology and the course can be further used in the education process.

**Keywords:** *aims, education, Erasmus+, outputs, WOOD in CIRCLE project*

**JEL Classification:** I21, L74, O13

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# E-LEARNING COURSE “CIRCULAR ECONOMY IN WOODEN CONSTRUCTION”

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**Abstract.** In frames of the Erasmus+ project “Circular Economy in Wooden Construction” (WOOD in CIRCLE) the e-learning course “Circular Economy in Wooden Construction” was developed. The course is dedicated to postgraduate – MSc students and contains 12 ECTS. Analysis of available study programmes and courses in participating countries and other EU countries revealed that such kind of course is not available. Moreover, innovative teaching methodology brings additional innovative character to this output. Preparation of the e-learning course is led by Häme University of Applied Sciences. Transdisciplinary content is being developed by Vilnius Gediminas Technical University (Lithuania), Riga Technical University (Latvia), Laurea University of Applied Sciences (Finland) and University of Palermo (Italy). Curriculum of the course covers topics on whole cycle of wooden construction: general information about sustainability and circular economy principles in construction, extraction of materials, production, continuing with design, construction, building use and maintenance phases, and ending with building demolition and recycling. The course was tested in two intensive international learning courses in Finland and Italy.

**Keywords:** *course, curriculum, education, e-learning, Erasmus+, WOOD in CIRCLE project*

**JEL Classification:** I21, L74, O13, Q51

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# E-LEARNING PLATFORM FOR THE COURSE “CIRCULAR ECONOMY IN WOODEN CONSTRUCTION”

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**Abstract.** In frames of the Erasmus+ project “Circular Economy in Wooden Construction” (WOOD in CIRCLE) an e-learning platform has been developed. Analysis of available e-learning platforms revealed that there are many platforms dedicated to education in sustainable construction, however, platforms on circular wooden construction do not exist. It was decided to use a Moodle platform as the base. The e-learning platform contains topics on wooden construction life cycle, intended learning outcomes, learning materials (texts, presentations, videos, etc.), cases, quizzes and other tools for assessment of students’ achievements, additional reading resources, e.g., books and academic publications. To increase attractiveness of the course, interactive content, created by using H5P open-source content collaboration framework based on JavaScript, was applied. The platform can be used for educational and research purposes. At the end of the project, it will be open to all students, teachers, researchers and other stakeholders who are interested in circular wooden construction. It is expected that the platform will attract attention to sustainable wooden construction and circular economy principles, will help to obtain new knowledge and foster research in this field.

**Keywords:** *contents, education, e-learning platform Erasmus+, tools, WOOD in CIRCLE project*

**JEL Classification:** I21, L74, O13, Q51, D83

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# FEEDBACK ABOUT ERASMUS+ “WOOD IN CIRCLE” INTENSIVE LEARNING COURSES

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**Abstract.** In frames of the Erasmus+ project “Circular Economy in Wooden Construction” (WOOD in CIRCLE) two intensive learning courses were organized. The first course in March 2022 was hosted by Häme University of Applied Sciences, it took place in Hämeenlinna, Finland. The course was attended by international groups of students and teachers from Lithuania, Latvia, Finland and Italy. The course was additionally supported by the associated partner – Municipality of Padasjoki. Groups of students were given a task to create a plan of reuse of the old Mainiemi sawmill area with a strong emphasis on circular economy principles. The second intensive course in June 2022 was hosted by University of Palermo, it took place in Palermo, Italy. The course complemented the first course and was attended by the same students and teachers. Students worked on life-cycle assessment tasks, they have also visited the company “Gli ingegneri del legno” and the site of low-impact wooden house. Feedback surveys revealed that students and teachers were satisfied/very satisfied with the courses. Students were excited working in the international groups, they gained new competences, awareness about carbon and ecological footprints, sustainable construction in timber, circular economy. All survey participants would recommend the “Wood in Circle” workshop to their fellow students. On the other hand, teachers learned from good practices abroad, improved their knowledge and pedagogical competences in application of innovative student-centered teaching/learning methods, experimented and developed new, innovative learning practices and teaching methods, enhanced their curriculum design skills, gained skills relevant for their current job and professional development, reinforced or extended their professional network and cooperation with partner institutions.

**Keywords:** *Erasmus+, feedback, intensive learning courses, international groups, students, teachers, WOOD in CIRCLE project*

**JEL Classification:** I21, L74, O13, Q51

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# CO-CREATION OF A STUDENT-CENTERED METHODOLOGICAL FRAMEWORK IN TIMBER CONSTRUCTION

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**Abstract.** Even if the pedagogy in higher education is gradually transforming from teacher-centered to student-centered approaches, the conventional teaching methods focusing on transmitting information from teachers to students are commonly used. The application of learner-centered approaches requires a pedagogical or methodological framework that guides the teacher in creating and facilitating a learning experience. Hence, a student-centered methodological framework was co-developed in the WOOD in CIRCLE project, which was implemented by five higher education institutions from Lithuania, Finland, Latvia, and Italy. The two-year project aimed at delivering innovative student-centered transdisciplinary education in circular economy-based wooden construction to postgraduate students across European countries.

This paper describes the development process of a methodological framework intended for student-centered, effective, and transdisciplinary learning in the education of circular economy timber construction. It identifies the theoretical basis of the framework, which includes phenomenon-based, research-based, and blended learning with the social leadership approach. It also illustrates the application strategies of the framework and outlines the main challenges discovered during the pilot course.

**Keywords:** *blended learning, methodological framework, pedagogical framework, phenomenon-based learning, research-based learning, social leadership, student-centred pedagogy*

**JEL Classification:** I21, L74, O13

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# ENERGY AND ENVIRONMENTAL IMPACT OF A TIMBER HOUSE IN DIFFERENT CLIMATE CONDITIONS

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**Abstract.** About 40% of European energy consumption and most of the environmental impacts are related to the construction sector. A key role in decarbonising the construction sector play the timber buildings. Wood is a sustainable resource and has excellent thermophysical characteristics compared to traditional building materials. Today building a timber house means creating energy-efficient buildings, with high levels of bioclimatic comfort, durable, safe and sustainable buildings. To achieve this, simultaneous energy and environmental assessment of a building is required. To date, the resolution of this complex problem is entrusted to numerous software and calculation algorithms that are often complex to use and that require the presence of expert users. In this work, a simplified procedure is proposed that allows to simultaneously evaluate the energy-environmental performance of timber houses as the climatic context varies. In particular, the performance of a building made with traditional construction will be compared with a simulated wooden building at different latitudes and climatic conditions. At the same time, a simplified assessment of the GWP index will be carried out, which will make it possible to assess the environmental impact of these buildings. For each model, thanks to a parametric analysis, the main thermophysical and geometric characteristics necessary to achieve the minimum environmental and energy comfort requirements will be identified. The results represent a starting point to guide new researchers and designers to research and model sustainable construction solutions responding to the objectives of the Erasmus+ project "Circular Economy in Wooden Construction" (WOOD in CIRCLE).

**Keywords:** *climatic context, comfort indoor, energy consumption, environmental impact, timber house*

**JEL Classification:** C61, C67, Q41, Q47

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# THE ADDED VALUE OF PARTICIPATION IN EU ERASMUS+ INNOVATION PROJECTS

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**Abstract.** During the 21<sup>st</sup> century when global issues related to all dimensions of sustainable development are becoming more overpowering, the role of education becomes more significant as it has been and still is a part of the answer to global issues. Students, teachers, researchers and other people that are linked to higher education institutions have a specific urge to find out new things and explore the uniqueness of this world and the ongoing processes. Aside from learning and teaching activities in higher education institutions of affiliation, great value lies in participation of Erasmus+ innovation projects. These projects connect people from different countries to work on different tasks but the outcome from that is exceptional – improved language, teamwork, leadership, presentation and communication skills, knowledge about ongoing processes and tendencies of industries in other places of Europe, new contacts and many more. Erasmus+ innovation projects are great platform for creating new and unique ideas because of the international students and teachers that participate in them. They truly combine cultural, scientific, environmental aspects and accelerate the creation and discovery of innovative solutions to proposed research problems. EU Erasmus+ project “Circular Economy in Wooden Construction” (WOOD in CIRCLE) is aimed at delivering innovative student-centred transdisciplinary education in circular economy-based wooden construction for postgraduate students across European countries. This project has given more holistic view for the students on circular economy and wooden construction as well as improved language and soft skills. Moreover, it has been a platform for networking, knowledge sharing, which has strengthened collaboration among partner universities, as well as the collaboration between academic and business sectors.

**Keywords:** Erasmus+, higher education, international, project, studies

**JEL Classification:** I23, I29

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# CIRCULAR ECONOMY AND SUSTAINABLE DEVELOPMENT: ARE THESE CONCEPTS HEADED IN THE SAME DIRECTION?

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**Abstract.** Global society consumes goods and services as if we had 1,75 planets Earth. Continuous heat records being set as the time goes by and more severe climate events are taking place more frequently. Landfills and the world ocean are filled with great amounts of waste continuously. These are just few consequences that are driven by linear 'take-make-use-dispose' model of consumption which is very opposite of what the term 'sustainability' stands for. However, the concept which might correlate with sustainability and sustainable development is circular economy. Many studies have shown potential benefits deriving from this concept. On the other hand, it requires great systemic transformations and creates a lot of challenges. The aim of the research is to evaluate where does the concept of circular economy stand within the dimensions of sustainable development. Literature review was used to evaluate the links between circular economy and sustainable development. Results show that the greatest emphasis within the concept of circular economy has been put on environmental dimension of sustainable development and such environmental benefits as conservation of resources, climate change mitigation etc. Economical dimension is also addressed by several studies emphasising efficient use of circular business models. However, there is a lack of good practices implementing circular business models and lack of measurable proof that they are profitable. Therefore, the strength of link between economic dimension of sustainable development and circular economy is still an open issue. The weakest link is between circular economy and the social dimension of sustainable development. However, it is stated that transition to circular economy can accelerate job creation contributing to social dimension of sustainable development. To sum up, circular economy is a view on the economy from the environmental protection point of view. Further research should be addressed at researching the measurability of circular economy in order to evaluate implementation progress in specific territory, region or country.

**Keywords:** *circular economy, dimension, sustainability, sustainable development*

**JEL Classification:** O13, Q01, Q56

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# URBAN AND SOCIAL REGENERATION OF MAINIEMI MILL AREA

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**Abstract.** Historical Mainiemi saw mill was founded in 1880 by the region's manor owners C. Schultz, E. Mether-Borgström, and G. Schildt. The saw mill area has not been at use for decades after its' bankruptcy in 1963. During recent years many operators have placed efforts on creating new activities for the area. Alongside of the creation of new social activities and services, evaluation of the technical possibilities in the area must be done realistically.

WOOD in CIRCLE Erasmus+ project offered a structural platform for combining creation of new services in the area with construction efforts to technically improve the Mill building. The multi-professional process with teachers and students created a policy, where both urban and social regeneration were developed simultaneously by both social work and engineering professionals.

The developing multi-professional model describes, how university students and teachers together with municipal authorities and citizens may create new activities to old real estate, which are socially, environmentally and ecologically sustainable.

**Keywords:** *civil society, Mainiemi Mill, social regeneration, socio-cultural animation, sustainability, urban regeneration*

**JEL Classification:** I21, L74, O13, Q51

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# BENEFITS OF WOOD AS A SUSTAINABLE RESOURCE FOR CONSTRUCTION

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**Abstract.** Sustainable development is particularly relevant in the construction sector, because the built environment has a significant impact on many sectors of the economy, on local jobs and quality of life. Many authors, organizations and companies worldwide recognize the possible environmental benefits of substituting the most common building materials with wood-based products. Use of wood reduces the environmental impact of a building for several reasons: (1) wood is the only renewable construction material that requires very little energy for its processing; (2) all timber products store carbon; (3) timber construction can reduce energy consumption and CO<sub>2</sub> emissions from the manufacture of construction products, as well as reduce the overall material use and thereby the amount of waste; (4) timber products are reusable and recyclable.

**Keywords:** *benefits, environment, resource, sustainable construction, wood*

**JEL Classification:** I21, L74, O13, Q23, Q51

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# LIFE CYCLE ASSESSMENT OF BUILDINGS: OVERVIEW OF THE METHODOLOGY AND DISCUSSION OF A CASE-STUDY

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**Abstract.** The decarbonisation of the building sector has been one of the main priorities of the European Commission in the past years and will only grow in importance as the EU political agendas in the next years will aim to achieve climate neutrality on a continental level by 2050. The built environment has a significant impact on the overall primary energy requirements of the EU reaching up to 40% and as such, cannot be overlooked when planning to achieve carbon neutrality. However, buildings do not have environmental impacts only during their use stage: the embodied environmental and energy impacts – regarding e.g., building construction, material extraction, end of life – can reach up to the 90% of the overall building life cycle impacts.

It is thus paramount to investigate all the life cycle stages of the building at the design stage, to make sure that no impact is moved from one life cycle stage to another or from one impact category to another. The Life Cycle Assessment methodology allows a proper interdisciplinary vision through the use of a wide set of indicators targeting all life cycle stages of the building.

The research presents an overview of the Life Cycle Assessment methodology applied to buildings and some specific case studies to investigate the role of the Life Cycle Assessment methodology in the achievement of real green buildings.

The results are in line with the objectives of the Erasmus+ project of the EU “Circular economy in wooden construction” (WOOD in CIRCLE) and represent a starting point for researchers and practitioners to orient the design and retrofiting of buildings towards sustainability and carbon neutrality.

**Keywords:** *environmental impact, life cycle, Life Cycle Assessment, timber house*

**JEL Classification:** C61, C67, Q41, Q47

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# ENGINEERED WOODEN MATERIAL PRODUCTION ASPECTS

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**Abstract.** Construction industry is looking for more sustainable materials to reduce pressure on such materials as steel and concrete. One of the sustainable and organic materials is wood. Construction requires certain technical materials, therefore engineered timber products are researched. Wooden construction elements are used together with steel and concrete to ensure the required parameters in high-rise buildings. Wooden material for hybrid construction needs to be extracted according to the principles of sustainable forestry to ensure minimal impact on forests and contribute to sustainability and circular economy. Current research targets engineered wooden materials and primary technical properties. Methods: literature review, technical solution analysis, case study analysis.

Research results indicate critical factors to understand wood as the material for designing and using in hybrid buildings. Wooden microstructure and growth characterise initial (non-engineered) material. Traditionally wooden material is considered a trunk, but engineering enables the use of other parts, previously considered as waste or by-products. Designing engineered timber products, the anisotropic structure of the material to be considered in 3 dimensions: 1) longitudinal strongest and with least shrinkage; 2) radial; 3) tangential. Different tree species have different technical characteristics and together with uneven structure and defects have to be reduced in engineered materials either by better input or by checking of material during production or construction process steps. The general approach in construction considers isotropic material, thus engineered products with anisotropy require an understanding of the material for proper designing and engineering for buildings.

Conclusions reveal that sustainable construction requires the use of organic materials for buildings to ensure required technical properties, and engineered timber is providing required parameters.

**Keywords:** *construction, engineered timber materials, hybrid engineered timber buildings, sustainable forestry*

**JEL Classification:** L73, L74

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# BUILDING MANAGEMENT ASPECTS OF HYBRID ENGINEERED TIMBER BUILDINGS

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**Abstract.** Wooden materials are regaining popularity in building construction, and therefore maintaining buildings with wooden elements is increasing significance. A sustainable approach expects prolonged use of already constructed buildings to reduce the demand for building materials. Maintenance periods are calculated for up to 50 years and more. Therefore, material aspects are needed to be identified and considered for the planning of renovations and repairs.

Current research aims to evaluate building management aspects of hybrid timber buildings. Research methods applied to this study are literature review, technical solution analysis and case study analysis.

Results show that primary concerns for wooden construction maintenance is moisture protection as prolonged exposition to moisture are deteriorating timber construction elements. Increased moisture levels also provide an environment for mold or other "illnesses" of timber elements, especially in connection points, where timber elements are used together with steel or concrete.

Conclusions reveal that maintenance of hybrid engineered timber buildings should be performed within the framework of regular maintenance processes considering the specifics of timber elements.

**Keywords:** *construction, engineered timber materials, hybrid engineered timber buildings, maintenance, timber, wooden materials*

**JEL Classification:** L73, L74

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# SUSTAINABLE FORESTRY FOR WOODEN MATERIAL PRODUCTION

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**Abstract.** Due to emerging global environmental issues and efforts to operate in a more sustainable way, wooden material demand is increasing. Therefore, acquisition methods of sustainable materials are of great importance. Wooden materials are products of the forest and they are used in the construction industry as building materials. Sustainable forestry methods seek to reduce the negative impact on the environment.

Current research is aimed at evaluating sustainable forestry aspects in the context of wooden material production. Research methods applied to this study are literature review and case study analysis.

Research results show that awareness of sustainable forestry methods is increasing and becoming an industry-expected approach. Cultivated forests are both technically more efficient and impose less impact on the environment compared to harvesting natural forests. Traditionally wooden material is considered as trunk, but the development of engineered timber material enables use of lower quality timber material while ensuring required technical parameters of an engineered product. Parts of the tree that previously were considered waste or by-products can be turned into engineered timber products, thus increasing wooden material yield from forest.

Conclusions reveal that sustainable forestry principles are the basis for future development in construction industry to supply the growing demand for wood as a material.

**Keywords:** *sustainable forestry, sustainable growth, wooden materials*

**JEL Classification:** L73, L74, Q23

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# SUPPORT OF THE EUROPEAN UNION FUNDS IN THE NON-RESIDENTIAL BUILDING SECTOR IN LATVIA

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**Abstract.** Climate change is one of the greatest challenges that the world is facing nowadays, and the concept of circular economy has a potential to be a part of the solution to this threatening global challenge. In the energy sector circular economy focuses on development of renewable energy sources and implementation of energy efficiency measures in residential and non-residential buildings. Non-residential buildings form the biggest part of the total Latvian housing stock – 73% according to the number of buildings and 56% according to their area. According to data provided by the State Land Service, the aggregate depreciation of non-residential buildings is 41%, and their energy performance level is low. Most of the heated non-residential buildings are related to the public and commercial sector. The final energy consumption of this sector on average is 25 PJ a year, of which about 60% (15 PJ) is used for heating.

During the 2014–2020 programming period for EU funds, following support measures were introduced in the field of improvement of the energy efficiency of non-residential buildings in Latvia: measure 4.2.1.2 “Promotion of energy efficiency in public buildings” and specific support objective 4.2.2 “Promotion of an increase in energy efficiency in local authority buildings and the use of renewable energy sources therein, pursuant to the integrated development programmes of local authorities”.

According to the Cohesion Policy Funds Management Information System, by 1<sup>st</sup> January 2022, within the framework of measure 4.2.1.2 134 projects were approved and the implementation gave a reduction of annual primary energy consumption of 48496 MWh (0.175 PJ). Within the framework of specific support objective 4.2.2 147 projects were approved and a reduction of annual primary energy consumption of 23862 MWh (0.086 PJ) was achieved. The total annual primary energy savings are 72358 MWh (0.26 PJ).

Latvia's National Energy and Climate Plan for 2021-2030 determines the reduction target of primary energy consumption – 165–170 PJ by 2030. In 2020, primary energy consumption was 180.4 PJ, which means that a reduction of 10–15 PJ is required over a 10-year period. Measures supported by EU funds in non-residential buildings contribute in the amount of 2.6% of national targets.

**Keywords:** *energy performance level, non-residential building, primary energy consumption*

**JEL Classification:** Q49, R39

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