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Construction

GREEN BUILDING CERTIFICATION: BASIC ASSUMPTIONS AND SELECTED APPLICATION RESULTS

Ujma A.[1),3)], Iremashvili I.[2)], Kamalbekova V.[3)], Mskhiladze N.[4)], Morgoshia D.[4)]
[1)] University of Applied Sciences in Nysa, Poland
[2)] Tsotne Mirtskhulava Water Management Institute
of Georgian Technical University
Tbilisi, Georgia
[3)] Czestochowa University of Technology
Czestochowa, Poland
[4)] Georgian Technical University
Tbilisi, Georgia
E-mail: adam.ujma@pans.nysa.pl, ingairema@yahoo.com,
wkamalbekowa12@wp.pl

Annotation. Human activity, since the industrial revolution, has contributed to very adverse changes in the natural environment. This is especially true in urban areas. and industry. Aware of the threats to our civilization, scientists, universities and institutions point to the need to introduce sustainable development. Successively, also in the European Union, regulations are being introduced to contribute to the gradual improvement of the natural environment. These activities also assume the creation of more and more friendly living and working conditions for people. In the area of construction, the principles of creating green buildings and green infrastructure with a minimized impact on the natural environment are being introduced. This is related, m.in other things, to the fact that the construction industry is responsible for about 39% of global CO_2 emissions (28% from operating emissions, energy needed for heating, cooling and powering them, and the remaining 11% from materials and structures). Construction consumes 50% of the world's natural resources.

Sustainable development of civilization will be possible with an increase in energy demand in construction. At the same time, this must be accompanied by a gradual reduction in the rate of CO_2 and other air pollutant emissions, improvement of the comfort of building use and ensuring environmental safety. It is necessary to reduce and rationally use water, collect and use rainwater, increase the area covered with vegetation around and on buildings, take care of reducing the amount of waste and its proper processing.

One of the ways to promote and implement sustainable development in construction is to carry out assessments of buildings and various technical infrastructure accompanying buildings, according to the principles of green building certification. Such building rating systems have been developed in several countries and are used in many countries. These are not systems required to be used obligatorily, but only at the request of the investor or building manager. However, they often form the basis for the creation of selected legal regulations.

In Poland, regulations are being developed to stimulate the processes of implementing sustainable, green buildings. The article presents selected certification principles and the results of their application. Georgia, like other countries, is also making efforts to implement energy-efficient, ecological, green buildings with biologically active areas in the building structure.

Keywords*:* green buildings; sustainable buildings; sustainable development; green certification

INTRODUCTION TO GREEN BUILDING CERTIFICATION

Green building certification, combined with such terms as: Green Construction, Green Building, Sustainable Building, is designed to promote architectural, structural, installation, technological and organizational solutions that are friendly to people and the natural environment. It is made voluntarily, at the request of the property owner or his manager, in order to check whether the design assumptions have been achieved or at what level they have been achieved. Often, the assessment of a building must take into account the full technical life cycle of the building. Starting with the materials used for construction, as far as possible, ecological, and ending with the demolition of the building after the end of its assumed service life and possible reuse or disposal of materials from demolition.

This action, if taken on a large scale, together with other pro-ecological activities, should contribute to reducing the negative impact of construction on the environment. Of course, a positive effect from such facilities can be achieved if their users maintain appropriate rules for the organization and operation of these facilities. To a large extent, maintaining the appropriate parameters of energy efficiency, ecology, comfort and others, originally assumed in the project, depends on the awareness and responsibility of people using such buildings.

Selected guidelines and components of sustainable construction:

- minimization of energy consumption, zero emission, close to zero emission of CO_2 and other gaseous pollutants;
- efficient use of renewable energy, water and other raw materials in the construction and operation of buildings;
- minimization of waste generation and pollutants discharged into the environment, minimum burden on the natural environment;
- avoidance of environmentally harmful materials;
- ensuring the health of buildings, or rather creating conditions conducive to the health and proper physical and mental condition of their users, i.e. minimizing the potential of harmful factors for the health of users;
- protecting the health of users and improving the work efficiency of employees, teaching school and university students, etc.
- location of buildings integrated into the surroundings, not disturbing the landscape.

Figure 1 presents the most popular green certification system for buildings, with their assignment to the country in which the system was created.

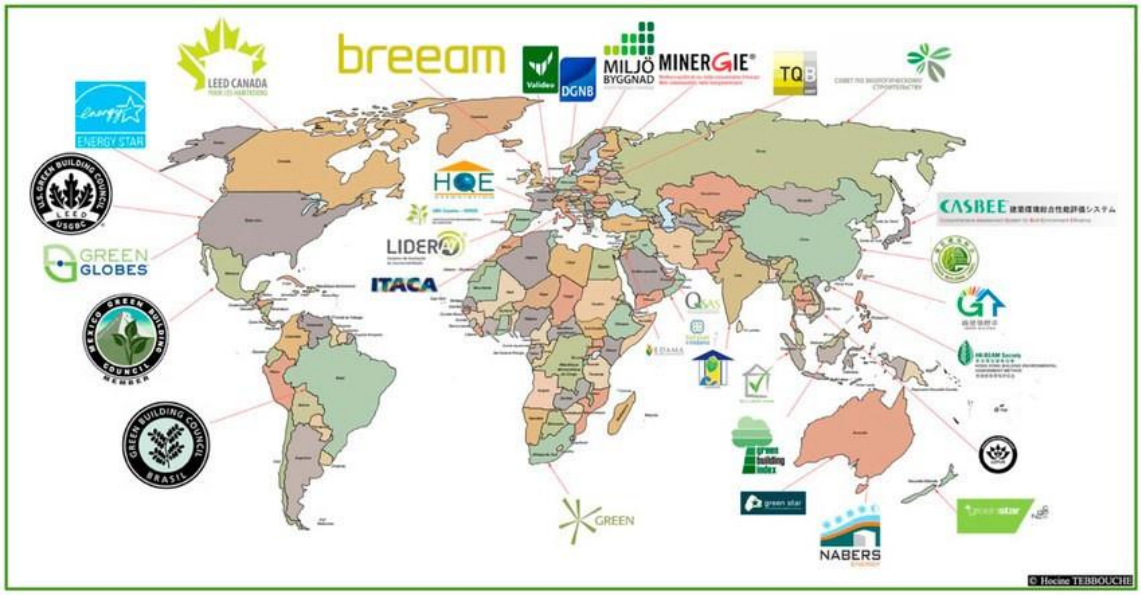

Fig. 1. Green certification schemes indicating the countries in which they have been established [1]

As Green building certification schemes typically take into account partial assessments such as energy efficiency, water savings, acoustic comfort, indoor lighting and air quality, and the use of vegetation. Certification schemes often have different rules and requirements, so it is difficult to compare them with each other.

Table 1 lists the world's best-known green building certification schemes, along with the date they were established and the country(s) in which they were developed. The most popular ones are marked in bold.

Table 1

Names of the main green certification system for buildings, including the date of their establishment and the country/s where they were introduced

Name of the green building certification system	Year of creation of the system	Country of creation of the system
BREEM	**1900**	**Great Britain**
HQE	**1995**	**France**
LEED	**1998**	**USA**
ESCALE	1998	France
ECO QUANTUM	1998	Netherlands
ECO EFFECT	1998	Sweden
ECO PROFIL	1998	Norway
Minergie	1998	Switzerland
NABERS	1999	Australia
CASBEE	2001	Japan
Green Star	2003	Australia
Green Globes	2004	USA
Nordic Swan	2005	Nordic coutries
LBC	2006	USA
DGND	**2007**	**Germany**
WELL	**2014**	**USA**
Active House	2017	Denmark

Table 2 lists the Polish green building certification schemes, with the date of their establishment. Polish ecological certification systems for buildings are not as popular as others, but their creation is a testimony to the fact that there is a lot of interest in this problem and a desire to create their own certification systems.

Table 2

Names of the Polish green certification system for buildings, including the date of their establishment

Name of the green building certification system	Year of creation of the system
E-Audyt	2002
ECO-ITB	2009
GBS - Green Building Standard	2017
Zielony Dom (Green House)	2021

The Intergovernmental Panel on Climate Change believes that the human impact on the Earth's climate is obvious, and that recent anthropogenic greenhouse gas emissions are the highest in its history. Climate change will significantly increase the current threats to both the environment and humans. The scale of the damage caused by climate change will depend on the extent and quality of the international community's response to the process. Climate change mitigation action is urgent and necessary to contain climate change as much as possible and reduce existing environmental and social risks.

The latest report by the World Meteorological Organization indicates that we are halfway through the implementation of the 2030 Agenda for Sustainable Development. Only 15% of the Sustainable Development Goals (SDGs) have been achieved and the global climate goals are still far from being achieved. The 2022 SDG report highlights the increasing impacts of climate change and extreme weather events, as well as other interrelated global challenges that hamper development benefits and jeopardise the full achievement of the SDGs by 2030 [1]

Unfortunately, the realistic assessment of progress in achieving the Sustainable Development Goals in the 2023 report shows significant problems. Of the approximately 140 targets that can be assessed, half of them show moderate or severe deviations from the desired trajectory. Moreover, more than 30% of these targets have made no progress or, worse still, have regressed below the 2015 baseline. This assessment highlights the urgent need to step up efforts to ensure the implementation of the SDGs and progress towards a sustainable future for all [2].

Sustainable development efforts need to be stepped up worldwide, including in Georgia. Significant climate changes have been observed in its area, which have led to many negative effects. In the years 1986-2015, compared to the years 1956-1985, the average annual air temperatures increased almost throughout the country by about 1°C [3].

The average area air temperature in 2023 in Poland was 10°C and was as much as 1.3 degrees higher than the annual long-term average (climatological normal period 1991-2020). The year 2023 should be classified as an extremely warm year, taking into account the average for Poland. Analysis of historical series shows that since 1851, air temperature in selected large cities in Poland has increased by 1.5°C to 2.3°C. It should be emphasized that over the last 40 years, the rate of temperature increase in large urban agglomerations has increased significantly. The average total precipitation in 2023 in Poland was 656.2 mm, which was nearly 107.3% of the norm determined on the basis of measurements in the years 1991-2020. In 2023, precipitation was characterized by strong spatial differentiation. Average area annual totals ranged from over 330 mm to over 1900 mm. In relation to the multi-year norm (1991-2020), precipitation in 2023 ranged between 80% and 130% of the norm [4].

The World Green Building Council points out that cities must first strive to reduce global carbon emissions. This is because half of the world's population lives in cities, accounting for more than 70% of CO_2 emissions. Buildings are the biggest contributors to urban emissions, accounting for 50-70% of urban emissions and 38% of global emissions. About 75% of building emissions are operational emissions generated by building systems (e.g. heating, ventilation and air conditioning, lighting and others). The remaining 25% are embodied emissions, i.e. carbon dioxide generated during the production of building materials, construction and interior design of buildings [5].

Areas and surface overgrown with vegetation on buildings, as well as collection sites and systems using rainwater will play a special role for the proper, sustainable development of urban areas.

In urban areas, it is recommended that CO_2 flows in green infrastructure systems, including buildings with vegetation (green roofs, living facades and living interior walls), should be considered throughout the technical life cycle of buildings [6]. This approach is also used in many green building certification schemes.

Assessing carbon emissions and CO_2 reduction opportunities in green building analyses should be done throughout their life cycle. A very effective way to balance CO_2 emissions and reduce their emissions is to use green, biologically active structures. According to some authors, the full reduction of carbon dioxide emissions for some facilities is achieved even in a very short period of about three years. At the same time,

there is a positive impact of these building solutions on human health and well-being, as well as the increase in biodiversity and others [7].

BENEFITS OF A GREEN BUILDING CERTIFICATE

An important benefit of obtaining a green building certificate is the possibility of obtaining a higher sale or rental price of the property or premises, compared to standard facilities.

Owners of such green buildings can obtain certificates. They ennoble one person as a very responsible person who is subject to influence on people and the natural environment. These objects are patterns for use and disclosures where they are alternatives in traditional construction.

A significant marketing effect from the designer, through the printing house, owner, investor, developers, to the end user. Lower costs for energy, water and other utilities compared to standard building solutions. Increased comfort of using rooms.

In ecological certification, special attention is paid to the quality of the internal environment of buildings. An appropriate, optimal ventilation system, adequate natural and artificial lighting, and the elimination of toxic chemicals should be used. Certified buildings create healthier and more comfortable conditions for their occupants. This ensures good health, well-being and higher productivity and quality of work and rest for other users.

These buildings are prepared to implement new technical solutions as new proposals emerge resulting from technical progress in the area of sustainable construction. These solutions should bring further benefits to the owners and users of such buildings.

Main factors taken into account in the design of sustainable buildings

- takes a smart approach to energy
- safeguards water resources
- minimizes waste production, maximizes reuse
- improves the well-being and health of users
- makes it easy for users to get in touch
- adapts to changing conditions
- covers the entire life cycle of a building
- boosts biodiversity

CONSTRUCTION WITH ELEMENTS OF SUSTAINABLE DEVELOPMENT

Activities conducive to sustainable development in construction include the implementation of the principles of energy-efficient construction, buildings with high energy efficiency, structures with green living vegetation, etc.

The latest version of the EU Energy Performance of Buildings Directive (recast) [8] highlights the need for green infrastructure, i.e. living roofs and walls, for urban planning and architectural design. Such actions allow for better adaptation to climate change and mitigation of the harmful effects of climate change in urban areas. It also indicates the necessary actions in the field of energy consumption. Buildings in the European Union must meet zero-emission CO_2 standards:

- from 1 January 2026 – newly designed buildings occupied, operated or owned by public authorities;
- from 1 January 2028 – all newly designed buildings;
- from 2050, all buildings (both new and existing) [9].

On energy efficiency, Georgia is aligned with the Directives on energy labelling and the energy performance in buildings. Fifteen energy efficiency bylaws were adopted in 2022 and 2023. The remainder of implementing legislation is still to be adopted. On energy labelling, the adoption of eleven product

regulations is pending, in addition to three that are already adopted. An advanced draft of the long-term building renovation strategy has already been developed [10].

In Georgia, in 2019, significant changes were made to the construction law concerning planning, architectural and construction activities. They define the zones (subzones) of land development and/or the specificity of individual planning units, architectural and planning features as well as spatial and cubature features of buildings, the location of buildings and their parameters. Specific greening coefficients are assigned to each of the zones and the corresponding subzones [11].

There are studies and various publications aimed at architects, builders, developers and other interested parties. Description and analysis of the world's most commonly used green building assessment systems, which aim to assess the quality of the environmental impact of buildings during construction, operation and after their operation [12].

In the case of Kazakhstan, the host of the EXPO2017 Energy of the Future exhibition, the integration of sustainable development principles in various spheres of the economy, including the construction sector, was initiated. The construction industry began to implement m.in environmental certification systems, such as Leadership in Energy & Environmental Design (LEED) and the Building Research Establishment Environmental Assessment Method (BREEAM). Especially in cities such as Astana and Almaty (Fig. Fig. 2, 3). The article [14] examines the factors affecting use, the characteristics of certified buildings, and the potential to promote certification schemes on a wider scale.

Fig. 2. Talan Towers, a social and business complex, Astana, the first completed project in the Kazakhstan to receive LEED Achieved gold certification [13]

Fig. 3. Q-2 Building, Nur-Sultan, Obtained a BREEAM certificate [13]

In Kazakhstan, attempts to implement green building have been made for about 10 years. However, as the analysis of this type of projects shows, there is a noticeable lack of qualified and experienced staff who could design and implement this type of facilities. In the case of Kazakhstan, water efficiency and energy efficiency of buildings were assessed as the most influential factors that should encourage the implementation of green building. The use of technical solutions for high water and energy efficiency in green buildings would reduce life cycle costs by about 40% [15].

EXAMPLES OF GREEN BUILDINGS IN GEORGIA

An interesting example of a building in Tbilisi classified as a green building is the Head Office of ProCredit Bank Georgia (Fig. 4). It is the first building in Georgia to be included in the list of green buildings, whose resource efficiency has been confirmed by the international EDGE Advanced certificate in 2020 [16]. The bank's headquarters is a modern architectural project with high energy, water and material efficiency, which is in line with the pro-ecological philosophy adopted for all buildings of the ProCredit group. The building features a glazed façade and atrium to provide daylight along with the building's energy-efficient partitions. LED lighting with presence and lighting control sensors. High-performance, energy-efficient units for space heating and cooling. ProCredit Bank Georgia has installed Georgia's first rainwater retention system. A system of photovoltaic panels producing electricity for the needs of the building and charging the batteries of the bank's electric cars. ProCredit Bank Georgia plans to gradually complete the next stages of EDGE certification for its headquarters, including reaching the zero-carbon emissions stage, making ProCredit Bank Georgia 100% CO_2 neutral [17].

Fig. 4. ProCredit Bank Georgia's head office in Tbilisi, an EDGE Advance certified building [18]

Another example is the Solar Energy Apartments (SEA) project (Fig. 5), which was presented at the Greenbuild EXPO. The design of the building has been certified in the BREEAM system and entered into the Green Book. Solar Energy Apartments (SEA) is an eight-storey building with 72 apartments. It is an interesting, environmentally friendly and energy-efficient building, using modern materials, technologies and renewable energy [19].

Fig. 5. Solar Energy Apartments (SEA) project implementation stage [19]

CERTIFICATION OF GREEN BUILDINGS IN POLAND

In Poland, the first buildings received LEED and BREEAM certificates in 2010. Since then, a gradual increase in the number of certified buildings has been observed in the following years, as shown by the annual reports of the Polish Green Building Council (Fig. 6). This applies primarily to newly constructed buildings.

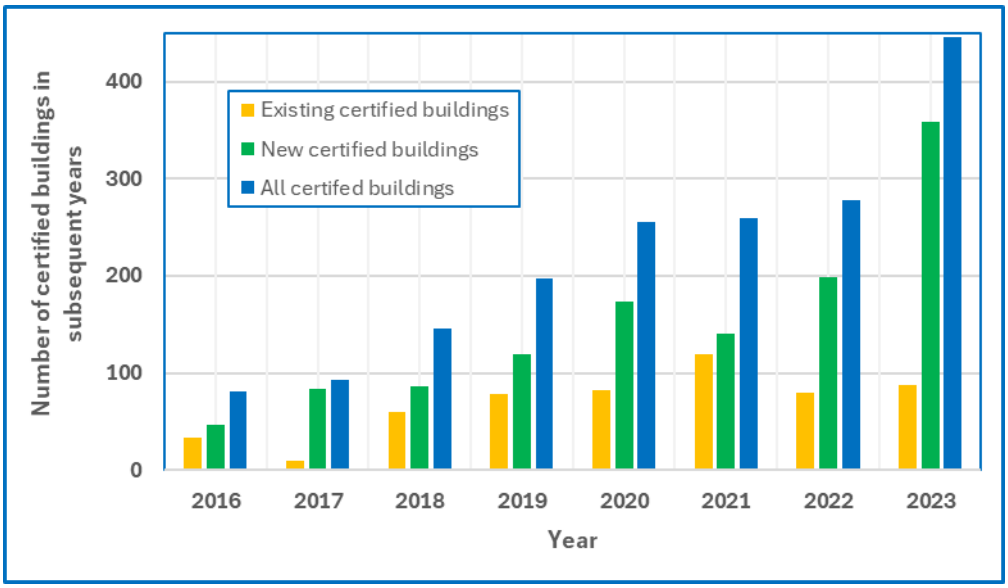

Fig. 6. Number of certified new and existing buildings in Poland in subsequent years

According to data from the 2023 report of the Polish Green Building Council, by 2023 office, warehouse and production buildings received the most certificates, i.e. over 45% (Fig. 7).

According to the PLGBC 2023 report, Poland is the leader in terms of the number of certified buildings in Central and Eastern Europe. Out of 3545 certificates issued, 1637 (46%) concern buildings located in Poland (Fig. 8).

Despite the increase in the number of certified buildings, the usable area of these buildings, especially in 2023, was smaller than in previous years (Fig. 9).

The percentage increase in the usable area of certified buildings in subsequent years in Poland is presented in the graphic list (Fig. 10). This is confirmed by a fairly significant decline in building certification in 2023.

This was influenced by several factors, including the COVID pandemic, the economic crisis, and the geopolitical situation in Polish's environment.

The average usable area of certified buildings in subsequent years is shown in the chart (Fig. 11).

Fig. 7. Industry division of certified buildings in Poland [20]

Fig. 8. The number of certified buildings in Poland compared to other buildings in Central and Eastern Europe [20]

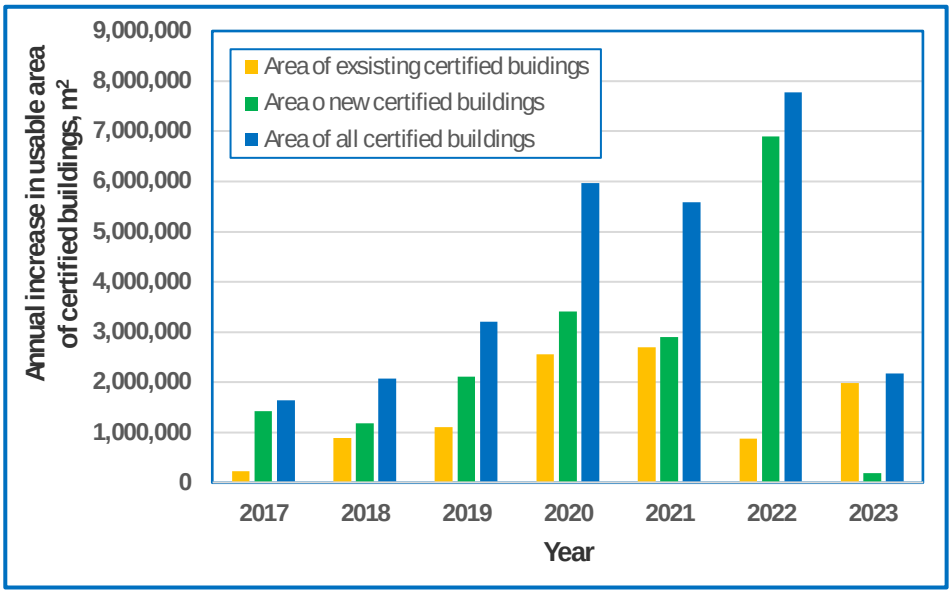

Fig. 9. Annual increase in usable floor area of certified new and existing buildings in Poland

Fig. 10. Percentage increase in the usable area of certified buildings in subsequent years, compared to data from the previous year

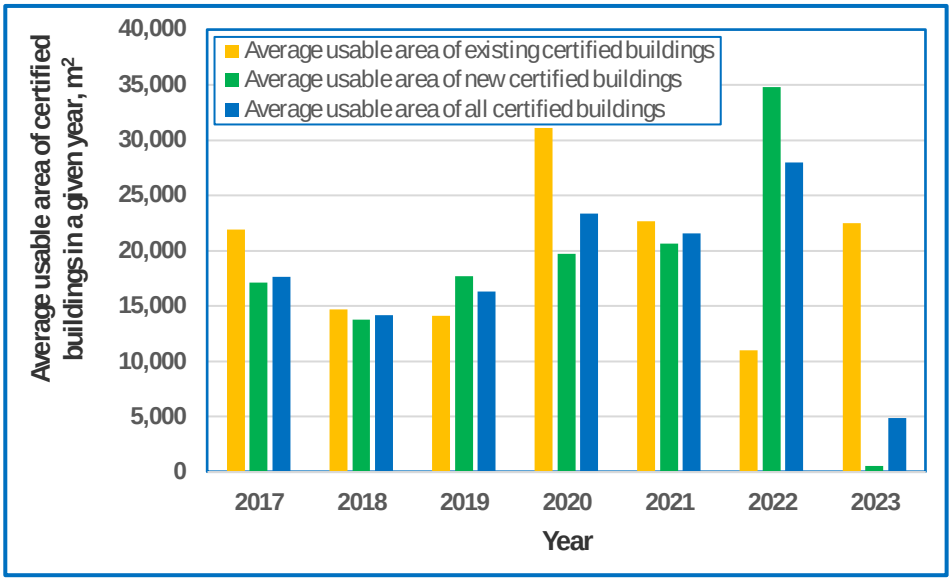

Fig. 11. Average usable floor area of one certified existing, new and total building in subsequent years

An interesting piece of information is the determination of the share of the area of newly constructed certified buildings in the total area of all buildings completed in a given year (Fig. 12). In 2022, it reached this value of 18%, unfortunately, in 2023, due to crisis phenomena, fell to a value of about 05%.

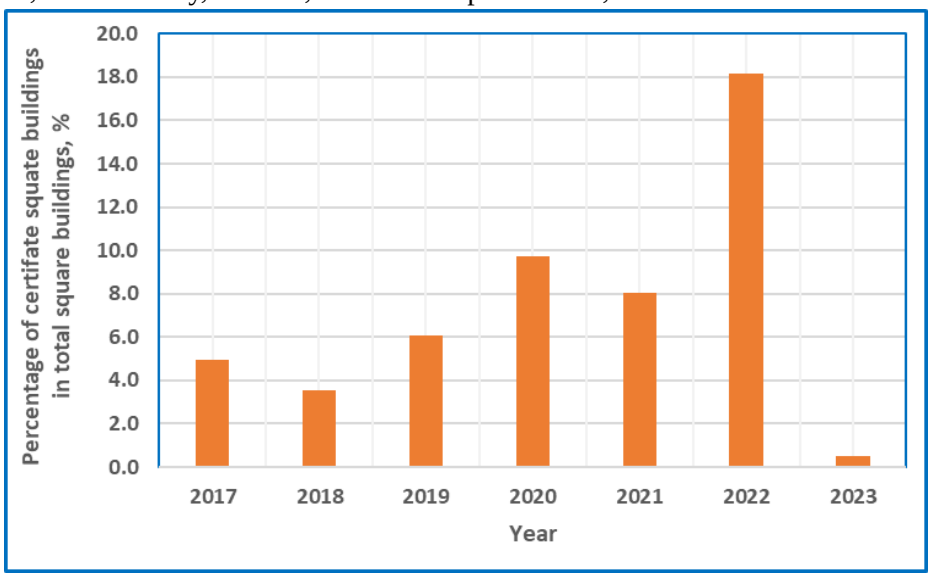

Fig. 12. Percentage share of the usable area of certified buildings in the total area of all buildings completed in Poland in subsequent years

CONCLUSION

Green building certification is an essential step towards creating more sustainable construction and architecture. It indicates models for creating construction that is more friendly to people and the environment.

It is required to improve design and construction guidelines in the construction industry, in the area of creating green buildings.

Such models should be disseminated to make the entire construction industry sustainable.

A valuable fact is that the need for sustainable construction is recognized in various countries. At the same time, it is necessary to intensify the training of building designers and builders in the creation of green buildings.

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C O N T E N T S

გამომცემლობა „უნივერსალი"
თბილისი, 0186, ა. პოლიტკოვსკაიას №4. ☎: 5(99) 17 22 30; 5(99) 33 52 02 E-mail: universal505@ymail.com; gamomcemlobauniversali@gmail.com