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LATVIAN JOURNAL OF PHYSICS
AND TECHNICAL SCIENCES
2022, N 6

DOI: 10.2478/lpts-2022-0045

# ENERGY PERFORMANCE ASPECTS OF NON-RESIDENTIAL BUILDINGS IN LATVIA

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Increase of energy efficiency is Latvia's national priority and policy instrument that allows reducing consumption of energy and costs, increasing the safety level of energy supply and reducing dependence on import. One of the trends for reducing energy consumption is to increase energy performance of buildings. In compliance with the EU and Latvian political statements, it is required to promote renovation of residential and non-residential buildings.

Studies regarding energy performance aspects in the sector of non-residential buildings in Latvia are comparatively rare; however, non-residential buildings form a considerable part of the building stock, and the increase of their energy performance can bring a significant contribution in achieving the national targets.

The research analyses the sector of non-residential buildings, their characteristic statistical data, energy consumption and requirements of energy performance standards. To characterise this sector more comprehensively, information on energy performance certificates of buildings issued during the period from 2016 to 2021 has been evaluated, allowing to make general conclusions on the energy performance level of different non-residential buildings and provide proposals for trends to increase their energy efficiency.

***Keywords:*** *Building energy performance class and index, energy efficiency, energy performance certificate, non-residential buildings.*

## 1. INTRODUCTION

Latvian policy planning documents set the increase of energy efficiency as a national priority. The Strategy of Latvia for the Achievement of Climate Neutrality by 2050 stipulates that one of the potential solutions for ensuring low carbon development is comprehensive energy efficiency – Increasing of energy efficiency and implementation of the horizontal principle "energy efficiency first" is one of the main factors of sustainable energy sector in Latvia as it reduces the demand for energy generation in different sectors of national economy, as well as in households [1].

In accordance with the EU Directive on the energy performance of buildings [2], [3] and the Regulation (EU) on the Governance of the Energy Union and Climate Action [4], Latvia, as the EU Member State, has to promote renovation of residential and non-residential building stock (both public and private) in order to become highly energy efficient and decarbonised by 2050, promoting the cost-effective transformation of the current buildings into almost zero-energy buildings [5].

The Latvian Energy Policy stipulates that energy efficiency is one of the main tools of the Policy that allows reducing costs and, with reduction of energy consumption, increases the safety level of energy supply and reduces dependence on import. These aspects have become especially topical during the past year. Latvian laws and regulations include the requirements to ensure rational usage and management of energy resources to achieve sustainable national economy. Latvian mandatory national target in the field of energy efficiency for the period of 2021–2030 is a cumulative end-use energy savings of 73.72 PJ (20472 GWh or 1.76 Mtoe) [6]. To reach the set savings target at households, as well as in commercial and public [7] sectors, about a half of the planned savings of energy consumption is planned to be achieved by increasing energy performance of buildings (residential, public, including state administration, and commercial sector buildings).

Studies regarding energy performance aspects in the sector of non-residential buildings in Latvia are comparatively rare, as the attention is mostly focused on residential buildings. However, it has to be noted that non-residential buildings form a considerable part of the building stock and the increase of their energy performance can bring a significant contribution in achieving the national targets.

## 2. CURRENT SITUATION AND PROBLEMS

Structure usage types are prescribed by Cabinet Regulation No 326 "Structure Classification Regulations" [8]. All structures are divided into two parts – buildings and engineering structures. Buildings are divided into residential and non-residential.

The main groups of non-residential buildings, in accordance with Regulation No 326, are as follows:

- Hotels and similar usage buildings (code 121);
- Office buildings (code 122);
- Wholesale and retail trade buildings (code 123);
- Transport and communication buildings (code 124);

- Industrial buildings and warehouses (code 125);
- Public entertainment, education, hospital or institutional care buildings (code 126);
- Other non-residential buildings (code 127).

In accordance with the State Land Service data [9], 1373642 buildings were registered in Latvia as of 1 January 2022, of which 368038 (26.8 %) were residential and 1005604 (73.2 %) non-residential. All buildings occupy the area of 206.6 million $m^2$; residential buildings occupy 91.1 million $m^2$ (44.1 %) and non-residential 115.5 million $m^2$ (55.9%). Division of non-residential buildings by groups according to their number and area is provided in Fig. 1.

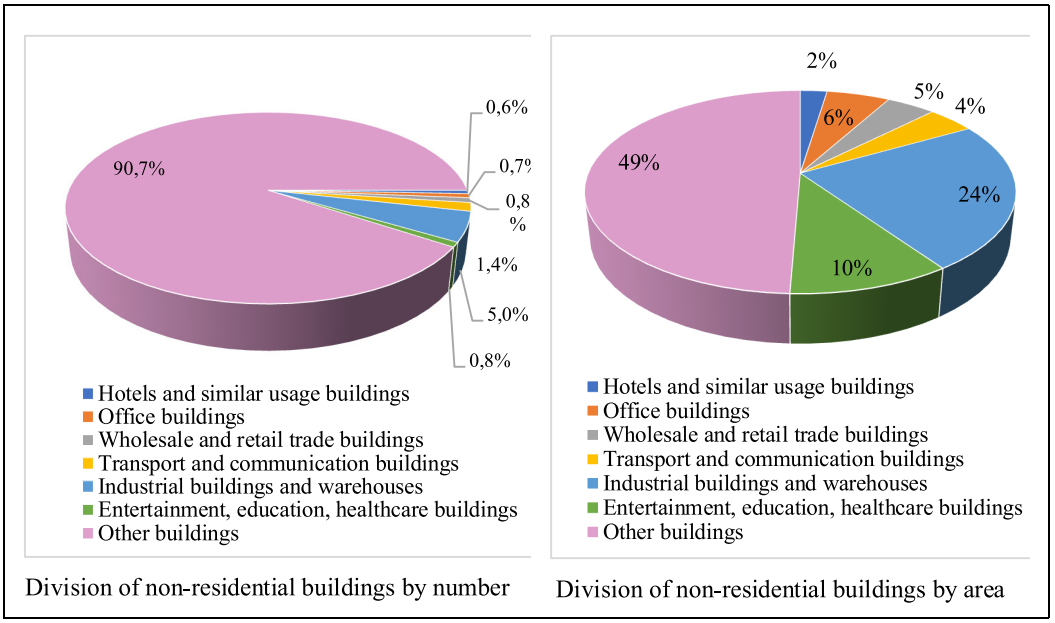



*Fig. 1.* Proportion of non-residential buildings by number and area [9].

The bulk of non-residential buildings – 913.1 thousand or 90.7 % – are other non-residential buildings, which are buildings of penal institutions, prisons, defence forces, border guards, police and fire fighting services, water closets, outbuildings of households, individual garages, individual baths, cellars, summer kitchens, greenhouses, security guards, gatehouses, individual garden houses, outhouses not otherwise classified, etc. The next biggest group is represented by industrial buildings and warehouses (50.4 thousand or 5.0 %) and transport and communication buildings (14.5 thousand or 1.4 %). The number of buildings in other groups (hotels, offices, educational, healthcare, wholesale and retail trade and sport buildings) fluctuates from 5 to 8 thousand.

When analysing the division by area, other non-residential buildings form about a half (57.0 million $m^2$ or 49.4 %), industrial buildings and warehouses – about 27.3 million $m^2$ or 23.6 %, entertainment, education and healthcare buildings together – about 11.9 million $m^2$ or 10.3 %. Other groups of buildings occupy the area of 2–6 million $m^2$.

**Table 1.** New and Reconstructed Non-residential Buildings (2010–2021), thsd. $m^2$ [10]

| Groups of buildings | Total non-residential buildings | New | | Reconstructed | |
|---|---|---|---|---|---|
| Hotels and similar usage buildings | 2770 | 255.0 | 9.2 % | 245.0 | 8.8 % |
| Office buildings | 6530 | 260.5 | 4.0 % | 601.6 | 9.2 % |
| Wholesale and retail trade buildings | 5080 | 526.8 | 10.4 % | 809.0 | 15.9 % |
| Transport and communication buildings | 4950 | 200.6 | 4.1 % | 88.1 | 1.8 % |
| Industrial buildings and warehouses | 27280 | 2380.4 | 8.7 % | 2001.8 | 7.3 % |
| Entertainment, education and healthcare buildings | 11870 | 488.3 | 4.1 % | 2727.7 | 23.0 % |
| Other buildings | 57010 | 1908.7 | 3.3 % | 972.6 | 1.7 % |
| **Total** | **115490.0** | **2380.4** | **2.1 %** | **11085.7** | **9.6 %** |

When looking at statistical data [10] about new and reconstructed non-residential buildings during the period from 2010 to 2021 (Table 1), only 2.1 % new buildings were built and 9.6 % were reconstructed from the total area of non-residential buildings. Public entertainment, educational, healthcare and wholesale and retail trade buildings prevail among new and reconstructed ones.

During the period from 2008 to 2020, commercial and public sectors, which include hotels and restaurants, offices, wholesale and retail trade, educational, healthcare and sport buildings, on average consumed about 24.8 PJ of energy a year and households – 53.3 PJ.

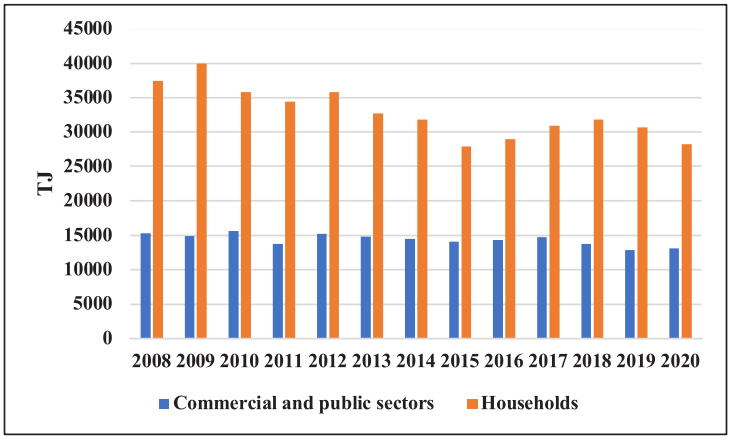



*Fig. 2.* Final energy consumption for space heating, TJ [12].

When taking into account final consumption of electric energy (electric energy consumption for ensuring heating is not taken into account), which is mostly used for lighting and operation of different devices, then commercial and public sectors on average consumed 15.1 PJ of energy a year and households – 46.9 PJ. It can be counted that this energy was consumed for heating of premises and preparing hot water. The consumption of commercial and public sectors forms about 44 % of that of households.

The calculations took into account that a certain amount of energy was consumed for preparing hot water, which did not influ-

ence the building heating indicators. It was assumed that on average 25–30 % of energy resources were consumed for preparing hot water at households [11] and on average 5 % – in commercial and public sectors. The final energy consumption of commercial and public sectors in comparison with households is provided in Fig. 2.

In the context of energy performance of buildings, attention should be paid to non-residential buildings which are heated. The Long-term Strategy for Building Renovation mentions that out of all non-residential buildings only about 7.5 % or 75 thousand are provided with heating [5]. The area of these buildings is about 27 million $m^2$.

Groups of non-residential buildings, which are heated:

- Hotels and restaurants;
- Office buildings;
- Wholesale and retail trade buildings;
- Buildings of educational institutions;
- Buildings of healthcare institutions;
- Sport buildings;
- Other type of buildings where energy is consumed.

The number and area of the aforementioned groups of buildings are provided in Table 2.

**Table 2.** Number and Area of Non-Residential Buildings in the Group of Heated Buildings [9], [5]

| **Groups of buildings** | **Number** | | **Area, mln.$m^2$** | |
|---|---|---|---|---|
| Hotels and restaurants | 2928 | 11.2 % | 2.35 | 9.1 % |
| Office buildings | 7124 | 27.3 % | 6.53 | 25.3 % |
| Wholesale and retail trade buildings | 8089 | 31.0 % | 5.08 | 19.7 % |
| Educational buildings | 3791 | 14.5 % | 6.93 | 26.8 % |
| Healthcare buildings | 1340 | 5.1 % | 2.02 | 7.8 % |
| Sport buildings | 1048 | 4.0 % | 1.24 | 4.8 % |
| Other buildings | 50700 | 67.6 % | 2.95 | 10.9 % |
| | **75020** | **100.0 %** | **27.10** | **100.0 %** |

Other type of non-residential buildings presents the biggest number of heated non-residential buildings; however, their area in general is not large – only about 11 %. The biggest proportion according to the area is for educational, office and wholesale and retail trade buildings.

As of 1 January 2020, the Latvian Construction Standard LBN 002-19 "Thermotechnics of uilding Envelopes", approved by the Cabinet Regulation No 280 adopted on 25 June 2019, took effect. From 1 January 2021, all new buildings must comply with the requirements of the almost zero-energy building (Table 3).

**Table 3.** Minimum Allowed Energy Efficiency Level for New Buildings, Renovation and Reconstruction of Buildings [13]

| Documentation acceptance period of a building construction project | For residential buildings | | For non-residential buildings | |
|---|---|---|---|---|
| | Multi-dwelling houses | One- or two-dwelling houses | Buildings owned by the state or local governments | Other non-residential buildings |
| **Minimum allowed energy efficiency level for new buildings** | | | | |
| From 1 January 2021 | almost zero-energy building | almost zero-energy building | almost zero-energy building | almost zero-energy building |
| **Minimum allowed energy efficiency level for renovation and reconstruction of buildings, kWh/$m^2$ a year** | | | | |
| From 1 January 2021 | ≤ 80 | ≤ 90 | ≤ 90 | ≤ 100 |

The requirements for the almost zero energy building are set by Cabinet Regulation No 222 "Building Energy Performance Calculation Methods and Building Energy Certification Regulations" [14]. With regards to energy consumption for heating, the consumption of such building may not exceed the level for the A class building. Also, the consumption of the primary non-renewable energy of the building may not exceed the values for the A class building. Devices consuming energy of engineering systems installed in the building must comply with the eco-design requirements and their energy marking – of at least A class. Moreover, compliance of the microclimate of premises with the construction regulatory enactments and requirements in the field of hygiene and occupational safety must be ensured in the building (Table 4).

**Table 4.** Minimum Allowed Heating Consumption Level of the Building Energy Performance, kWh/m$^2$ a Year [14]

| Building energy performance class | Residential and non-residential buildings | | Residential buildings | Non-residential buildings | |
|---|---|---|---|---|---|
| | Heated area, m$^2$ | | | | |
| | 50–120 | 120–250 | Over 250 | | |
| | | | Residential houses | Offices, educational institutions, hotels, restaurants, sport and commercial buildings | Hospitals |
| A | ≤60 | ≤50 | ≤40 | ≤45 | ≤50 |
| B | ≤75 | ≤65 | ≤60 | ≤65 | ≤70 |
| C | ≤95 | ≤90 | ≤80 | ≤90 | ≤100 |
| D | ≤150 | ≤130 | ≤100 | ≤110 | ≤120 |
| E | ≤180 | ≤150 | ≤125 | ≤150 | ≤160 |
| F | >180 | >150 | >125 | >150 | >160 |

Until 2021, to determine the energy performance class, buildings were divided into 'residential' and 'non-residential' and all residential houses of A class were set the requirement not to exceed 40 kWh/m$^2$ a year and all non-residential buildings – 45 kWh/m$^2$ a year. Starting from 2021, the heated area of the building has been also taken into account. For buildings with the area of 50–120 m$^2$, the minimum allowed heating consumption level for the A class building is 60 kWh/m$^2$, for buildings with the area of 120–250 m$^2$, it may not exceed 50 kWh/m$^2$ and for larger buildings – 40 kWh/m$^2$. For non-residential buildings, except for hospitals, the heating consumption level for the A class building may not exceed 45 kWh/m$^2$ and for hospitals – 50 kWh/m$^2$ a year.

## 3. DISCUSSION AND RESULTS

Energy certification of buildings in Latvia was started in 2010. Cabinet Regulation No 504 (8 June 2010) "Regulations on Energy Certification of Buildings" was issued that year. In 2013, the Regulation was replaced by Regulation No 383 (9 July 2013) "Regulations on Energy Certification of Buildings", and Cabinet Regulation No 222 (8 April 2021) "Building Energy Efficiency Calculation Methods and Building Energy Certification Regulations" took effect in 2021.

Until 2016, energy certificates were issued in paper form, and there are no data

available regarding how many and what type certificates were issued during that period. Since 2016, independent experts have been registering energy performance certificates of buildings in the Building Information System (BIS) [15]. Thus, these energy performance certificates and basic data included there are publicly accessible. As of 1 August 2022, BIS had 332 such historical energy performance certificates of buildings registered, of which 281 are in force. However, the content of these certificates is not available and they cannot be used in the research.

In accordance with the Law on the Energy Performance of Buildings [16], energy certification is performed for the following buildings:

- for a building to be designed, rebuilt, or renewed in order to accept it for service or sell it;
- for an existing building in order to sell, rent, or lease it;
- in cases where a building owner has taken a decision on certification of the energy performance of the building;
- for a public building the area of inside premises of which exceeds 250 $m^2$ and which is used by a state or local government institution.

The research uses the list of building energy performance certificates of the State Construction Control Bureau of Latvia published on the Latvian Open Data Portal [17] and the Building Information System [15].

The statistics of building energy performance certificates, in general, for the period of 2016–2020 was researched in the project "Analysis of Actual Energy Consumption of Almost Zero Energy Buildings and Development of the Required Energy Efficiency Increase Solutions" No 1.1.1.2/VIAA/3/19/505. It was noted in the publication [18] that documents with the expired validity were erroneously included in the list of valid temporary energy performance certificates. It also has to be noted that there is a lot of erroneous information regarding 2021: (1) when searching for energy performance certificates in BIS, a list appears with a big number of temporary energy performance certificates; (2) in the Open Data Portal, data on 2021 are entered incompletely.

As of the start of 2022, 4241 energy performance certificates were registered in the BIS energy performance certificate register (this number does not include building temporary energy performance certificates), of which 1789 (42.2 %) are for residential buildings and 2452 (57.8 %) for non-residential buildings (Fig. 3).

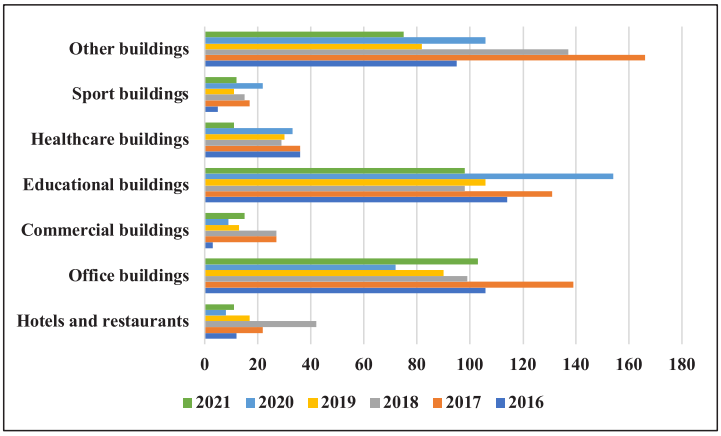



*Fig. 3.* Division of energy performance certificates of non-residential buildings by year and type of buildings.

Energy performance of non-residential buildings has been evaluated based on the data of energy performance certificates. The total amount of the considered data forms a comparatively small part (see Fig. 4) of the total number of buildings; however, it is sufficiently large to characterise the situation with non-residential buildings in general and to make general conclusions.

Figure 4 demonstrates the proportion of energy performance certificates registered in BIS in each group of non-residential buildings. The biggest number of energy-certified buildings is between educational institutions (18.8 %) and healthcare institutions (13.3 %), as well as office buildings (8.7 %) and sport buildings (7.7 %).

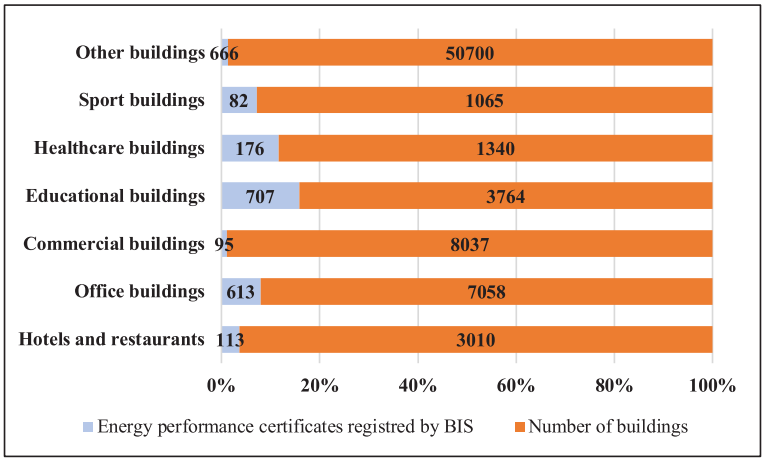



*Fig. 4.* Proportion of energy-certified buildings.

Figure 5 demonstrates the number of energy performance certificates registered in BIS in each group of non-residential buildings. In the sector of non-residential buildings, the biggest number of energy performance certificates during the period of 2016–2022 is registered for educational institutions (28.8 %) and office buildings (25.0 %). The largest proportion is formed by the group of other buildings (27.2 %), which are not included in any of the aforementioned categories.

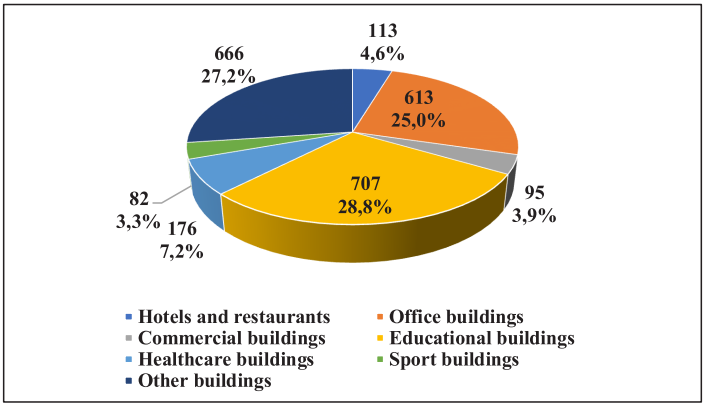



*Fig. 5.* Division of the number of building energy performance certificates by the type of non-residential buildings.

In accordance with the Structure Classification Regulations, office buildings are the ones used for transactions and different administrative purposes, including banks, post offices, publishing houses, local government institutions, state administration institutions, buildings of companies, institutions and other organisations, as well as conference and congress centres, court and parliament buildings. The biggest number of energy performance certificates for office buildings can be explained by the fact that this group includes state and local-government buildings for which energy certification is compulsory. Similarly, a big part of educational and healthcare institution buildings belongs to the state or local governments.

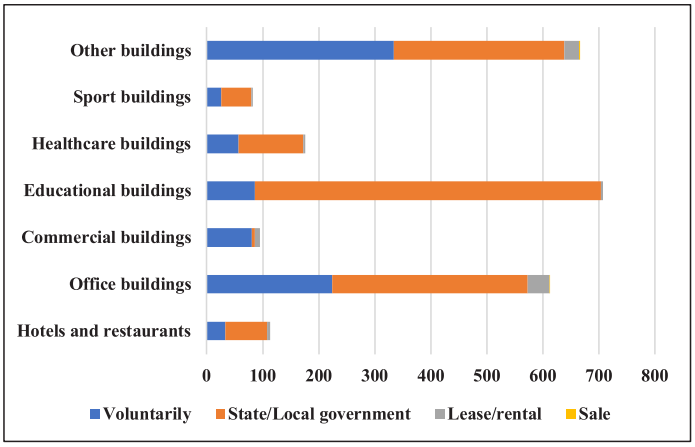



*Fig. 6.* Purpose of building energy performance certification.

Figure 6 confirms the aforementioned fact on compulsory energy performance certification of state or local government buildings. Besides, the fact should also be mentioned that an energy performance certificate is a compulsory requirement to submit an application for receiving co-financing from the EU funds.

For the biggest part (61.9 %) of non-residential buildings, the purpose of energy performance certification is that the building belongs to the state or a local government or a state or local government institution is located there. The purpose of issuing 34.3 % of energy performance certificates is voluntary energy performance certification and only in 3.7 % of cases an energy performance certificate was required to sell or lease a building. Voluntary energy performance certification also includes cases when co-financing from the EU funds is planned to be attracted for a building.

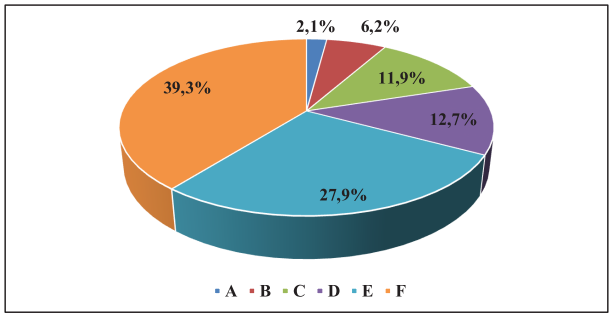



*Fig. 7.* Division of energy performance classes of non-residential buildings.

Figure 7 demonstrates a summary on energy performance classes of non-residential buildings. The biggest proportion (39.3 %) is for buildings of the lowest F class. A similarly big number (27.9 %) of buildings have the E class. 11.9 % and 12.7 % of non-residential buildings have respectively C and D classes. Whereas 6.2 % of buildings correspond to the B class, and only 2.1 % of buildings – to the A class.

Figure 8 summarises information on energy performance heating consumption classes of non-residential buildings by the group of buildings.

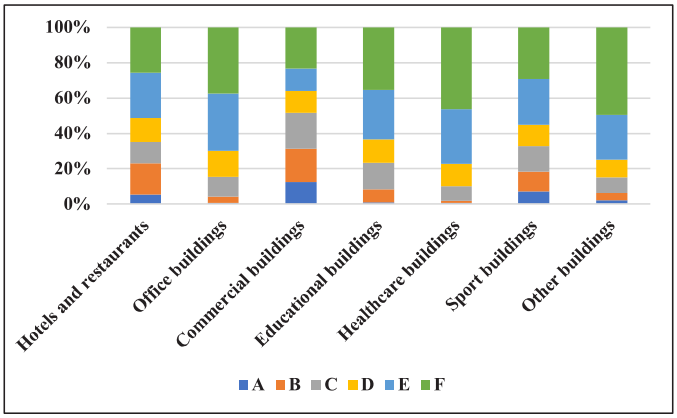



*Fig. 8.* Energy performance levels of non-residential buildings by the group of buildings.

When analysing the energy performance classes by the group of buildings, one can conclude that the highest energy performance class is at wholesale and retail trade buildings, as well as hotels and restaurants. They are followed by sport and educational buildings, and the lowest class is at office, healthcare and other buildings. As there is no information available regarding what are these other buildings, it is not possible to analyse this group of buildings more comprehensively.

**Table 5.** Average Energy Performance Levels and Classes of Non-residential Buildings

| Group of buildings | Energy consumption for heating, kWh/m$^2$ | Energy performance class |
|---|---|---|
| Hotels and restaurants | 116 | E |
| Office buildings | 142 | E |
| Wholesale and retail trade buildings | 104 | C |
| Educational buildings | 137 | E |
| Healthcare buildings | 158 | E |
| Sport buildings | 128 | E |
| Other buildings | 173 | F |
| Non-residential buildings | 137 | E |

In all groups of non-residential buildings, except for wholesale and retail trade buildings and other buildings, the energy performance class is E. At wholesale and retail trade buildings, it corresponds to the C class and at other buildings to the F class. The average energy performance class of non-residential buildings is E (Table 5).

## CONCLUSIONS

One of the trends for reducing energy consumption is to increase energy performance of buildings. In compliance with the EU and Latvian political statements, it is required to promote renovation of residential and non-residential buildings.

Studies regarding energy performance aspects in the sector of non-residential buildings in Latvia are comparatively rare; however, final consumption of energy at heated non-residential buildings forms about 44 % of that of residential buildings. Therefore, the increase of their energy performance can bring a significant contribution in achieving the national targets.

Having researched 2452 energy performance certificates of non-residential buildings for the period of 2016–2021, one can conclude that the biggest number of energy-certified buildings of the total number of non-residential buildings is between educational institutions (18.8 %) and healthcare institutions (13.3 %), as well as office buildings (8.7 %) and sport buildings (7.7 %).

In the sector of non-residential buildings, the biggest number of energy performance certificates during the period of 2016–2022 was registered for educational institutions (707 or 28.8 %) and office buildings (613 or 25.0 %).

The purpose of energy performance certification for the biggest part (61.9 %) of non-residential buildings is that the building belongs to the state or local government, or a state or local government institution is located there (energy performance certification for such buildings is compulsory). The purpose of issuing 34.3 % of energy performance certificates is voluntary energy performance certification (voluntary energy performance certification also includes cases, when co-financing from the EU funds is planned to be attracted for a building renovation) and only in 3.7 % of cases an energy performance certificate was required to sell or lease the building.

With regards to energy performance classes, the biggest proportion (39.3 %) is for buildings of the lowest F class. A similarly large number (27.9 %) of buildings have the E class. 11.9 % and 12.7 % of non-residential buildings have respectively C and D classes. 6. 2% of buildings correspond to the B class, and only 2.1 % of buildings – to the A class.

The highest energy performance class is at wholesale and retail trade buildings, as well as hotels and restaurants. They are followed by sport and educational buildings, and the lowest class is at office, healthcare and other buildings.

In all groups of non-residential buildings, except for wholesale and retail trade and other buildings, the energy performance class is E. At wholesale and retail trade buildings, it corresponds to the C class and at other buildings to the F class. The average energy performance class of non-residential buildings is E.

Up to now, co-financing from the EU funds and other financial support instruments to increase energy performance of non-residential buildings has been mostly provided to the public sector – state and local government buildings. In the future, it would be required to anticipate support also for the commercial sector buildings regardless of their trend of business activity and the industry (hotels, restaurants, offices, as well as educational, healthcare and sport buildings, etc., which are not state and local government buildings), with account of the fact that they form a big part of the segment of non-residential buildings [5].

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