

Benchmarking of Heat Energy Consumption in Public Buildings in the City of Kragujevac

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Abstract

Final energy consumption in buildings has the highest share in final energy consumption on a global level. Heat has the highest share in final energy consumption in European buildings. Also, public buildings consume more final energy than residential buildings in general. Specific heat consumption is an important parameter that indicates the state of energy efficiency of the building sector. In this research, specific heat consumption of public buildings in the city of Kragujevac is analyzed. Part of the data collected for the Energy Efficiency Program for the City of Kragujevac is presented and compared with similar results from other countries and cities. Authors conclude that specific heat consumption in municipal buildings of Kragujevac is relatively high compared to other countries and that its values also vary depending on building purpose and building built year.

Introduction

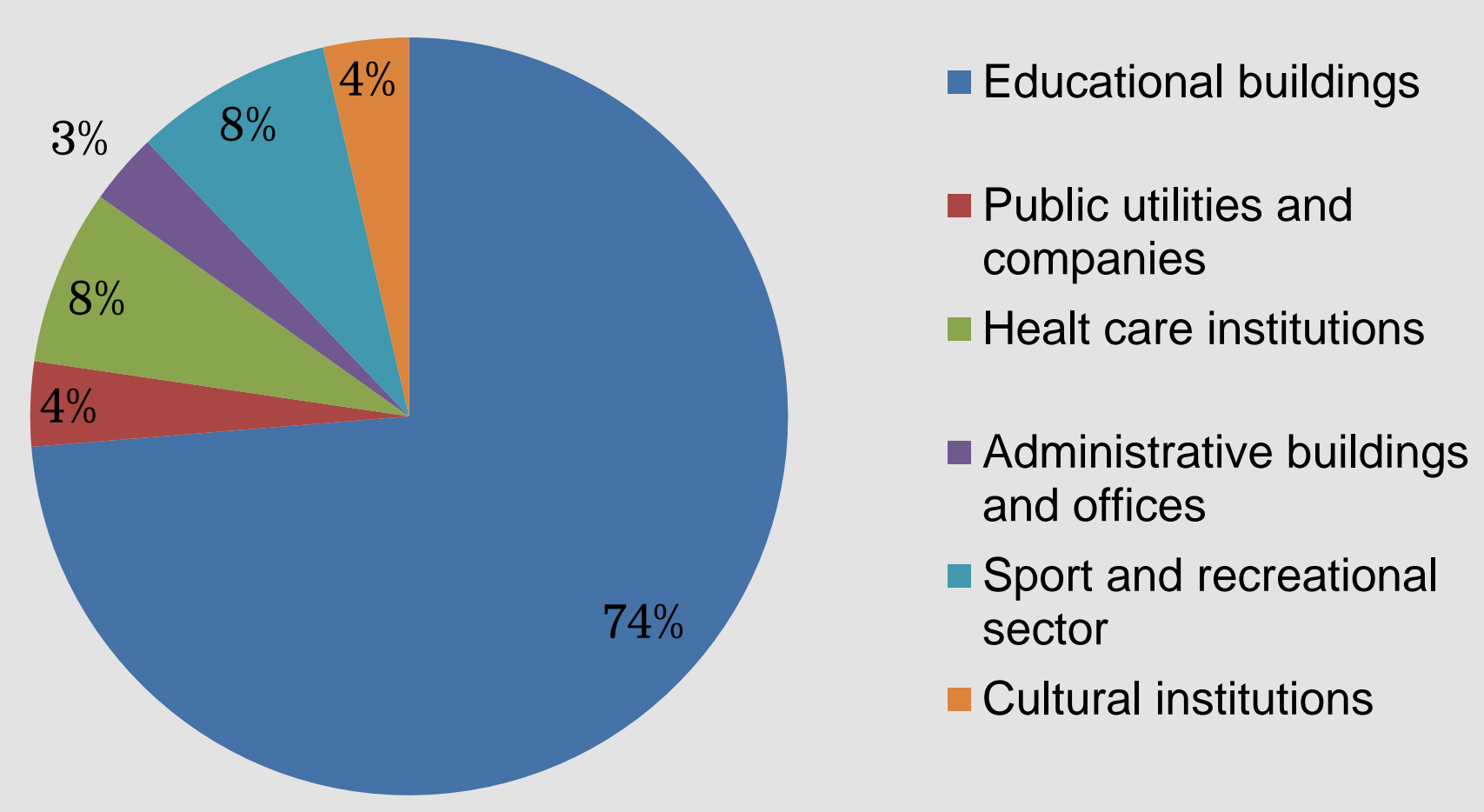
In Serbia, 57.6% of heat energy consumption went on buildings. Although consumption of heat, as well as final energy in general in public buildings, is lower than the consumption in residential buildings its share is not insignificant, 20.8% of total share of heat consumption in the EU and 11.5% of total share in heat consumption in Serbia. It is important to mention that specific heat consumption in public buildings in Serbia is for a half a value higher than in residential buildings. According to all above mentioned it can be concluded that:

- Final energy consumption in buildings has the highest share in final energy consumption in total,
- Public buildings consume more final energy than residential buildings,
- Public buildings record constant growth in its energy demands and
- Heating energy has the highest share in final energy consumption in buildings.

Public buildings in the city of Kragujevac

Public building in Kragujevac, according to its purpose, can be classified in 6 categories:

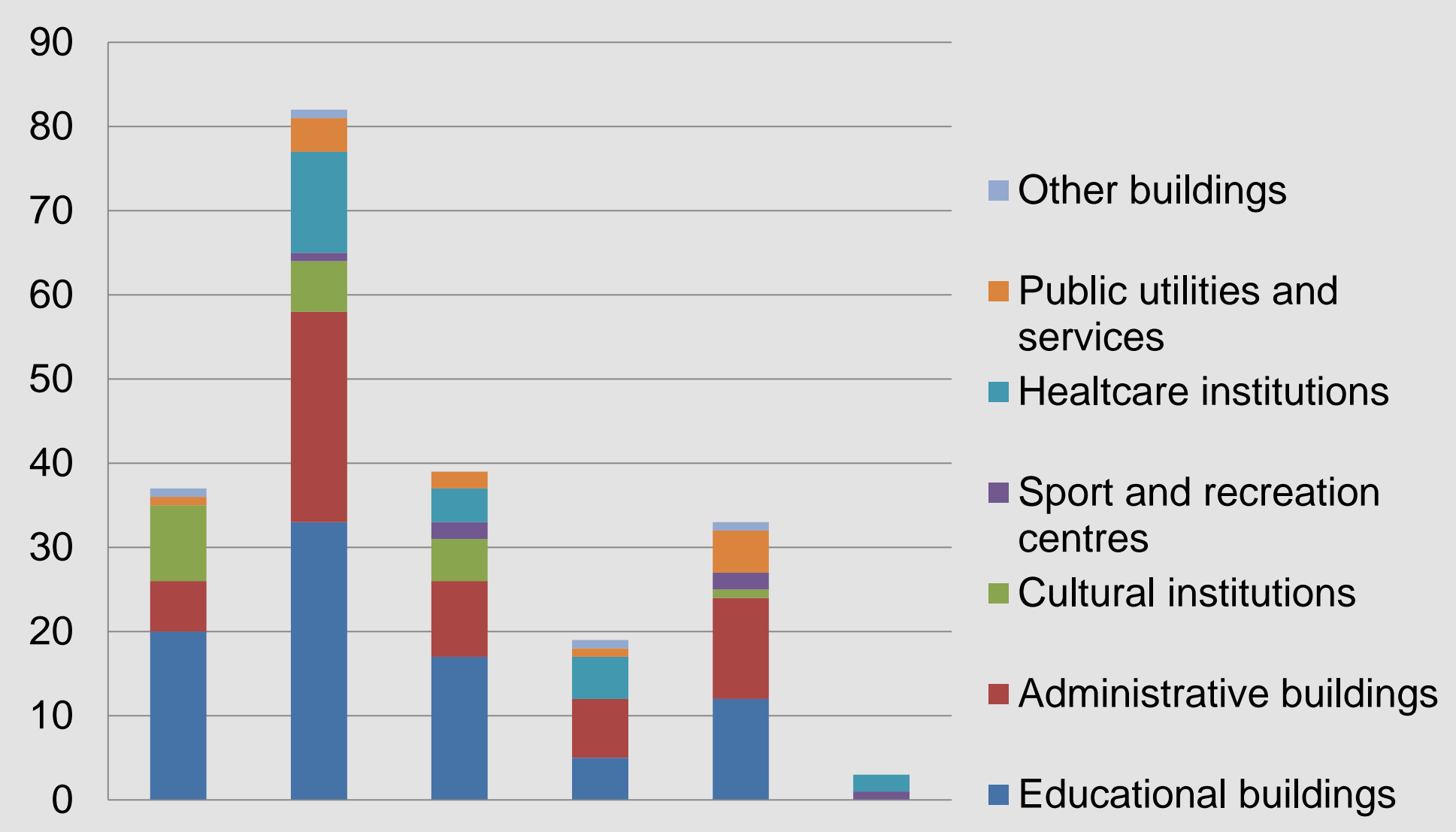
- Educational buildings – preschools and kindergartens (15 buildings), elementary and high schools (75),
- Buildings of cultural institutions – museums (2), libraries (6+), houses of culture (2+), theatres (2) and other (3)
- Administrative buildings (93)
- Community health centers' buildings (26),
- Sport and recreation buildings (3).
- Buildings of public utility services and companies (7)



Heat consumption of different categories of public buildings

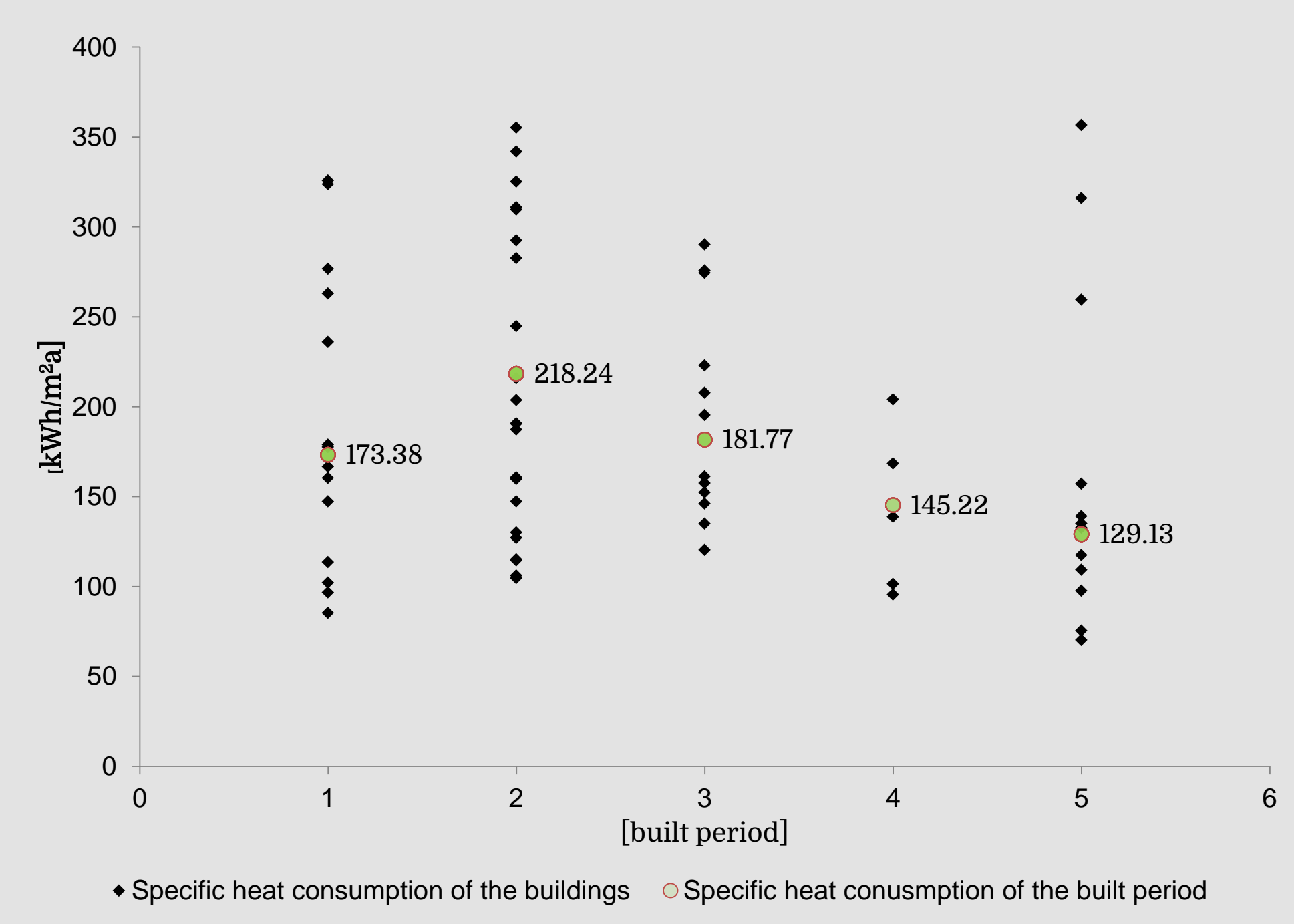
According to a year of built, type of building construction and different legislation periods, public buildings in the city of Kragujevac can be classified into 6 categories:

- Buildings built before 1945,
- Buildings built between 1946 and 1970,
- Buildings built between 1971 and 1980,
- Buildings built between 1981 and 1987,
- Buildings built between 1988 and 2011,
- Buildings built after 2012.



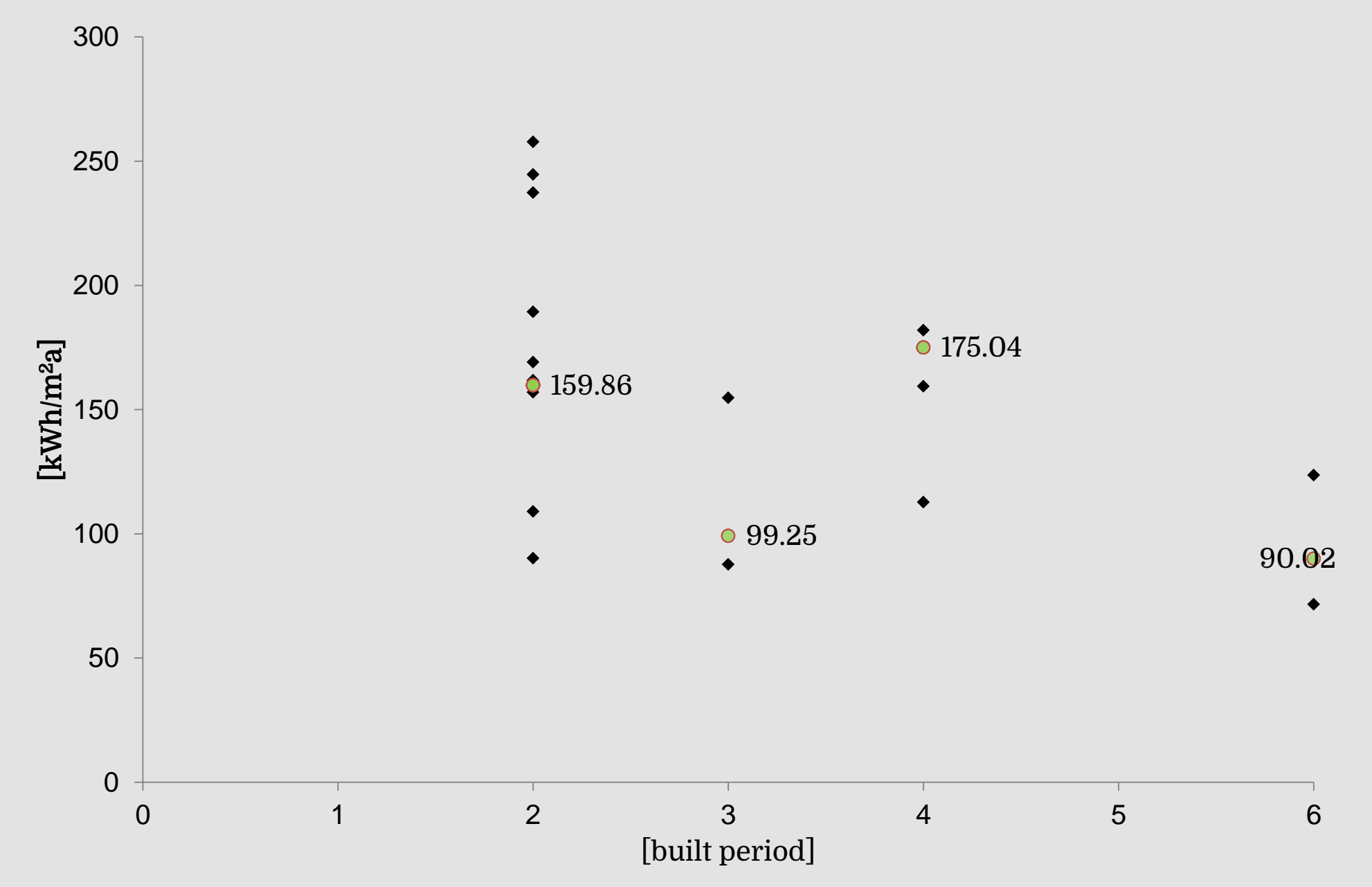
Overview of public buildings according to built year

Specific heat consumption in public buildings in Kragujevac, according to built period



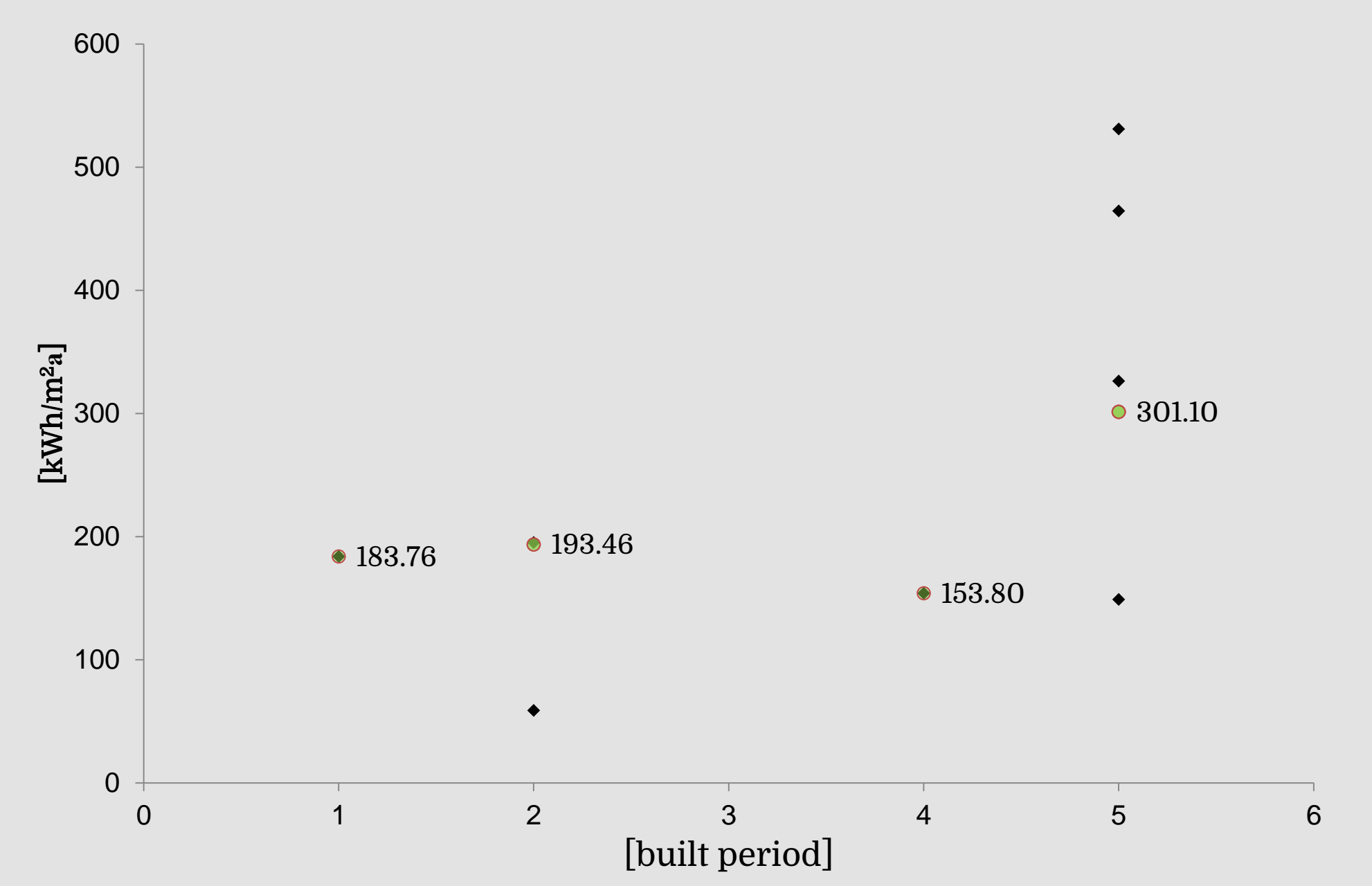
Specific heat consumption in educational buildings

Average specific heat consumption of analyzed educational buildings in the city of Kragujevac is 175.6 kWh/m²a. This value can be considered as relatively high having in mind that specific heat consumption in educational buildings in Austria is 117 kWh/m²a, in Poland 123 kWh/m²a, Hungary 110 kWh/m²a, Slovakia 85 – 112 kWh/m²a.



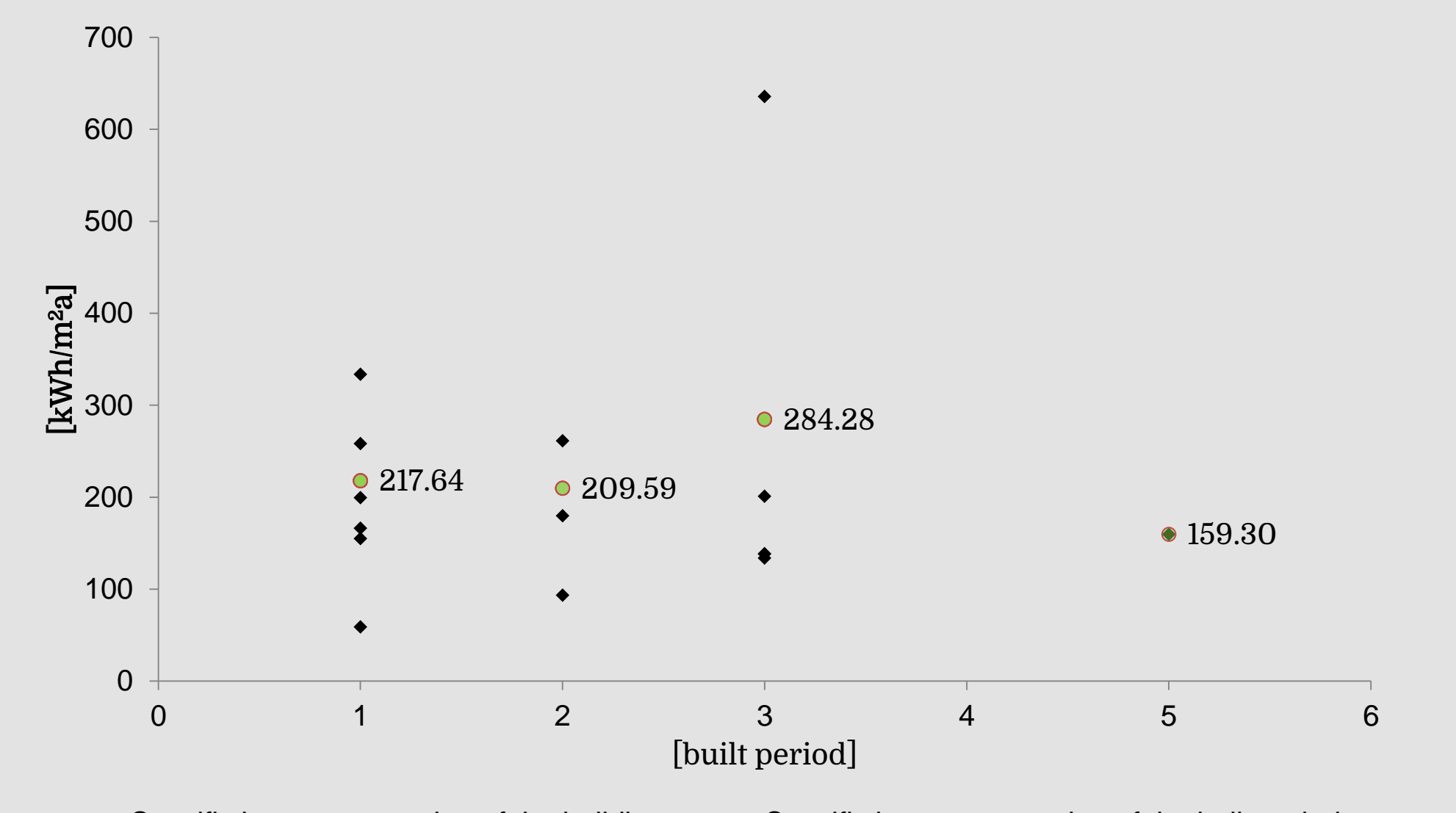
Specific heat consumption in health care institutions

Average specific heat consumption of analyzed healthcare institutions is 149 kWh/m²a, However, according to research dealing with final energy consumption in health care centers in the city of Kragujevac, almost all analyzed healthcare buildings have been reheated by some sort of individually installed electric heaters. Estimated share of electricity used for heating in total heating demand ranges from 6 – 60%, so average specific heat consumption in health care institutions calculated taking this into account is 195 kWh/m²a. For comparison, specific heating consumption in health centers in Vojvodina (Northern Serbia) is 244 kWh/m²a.



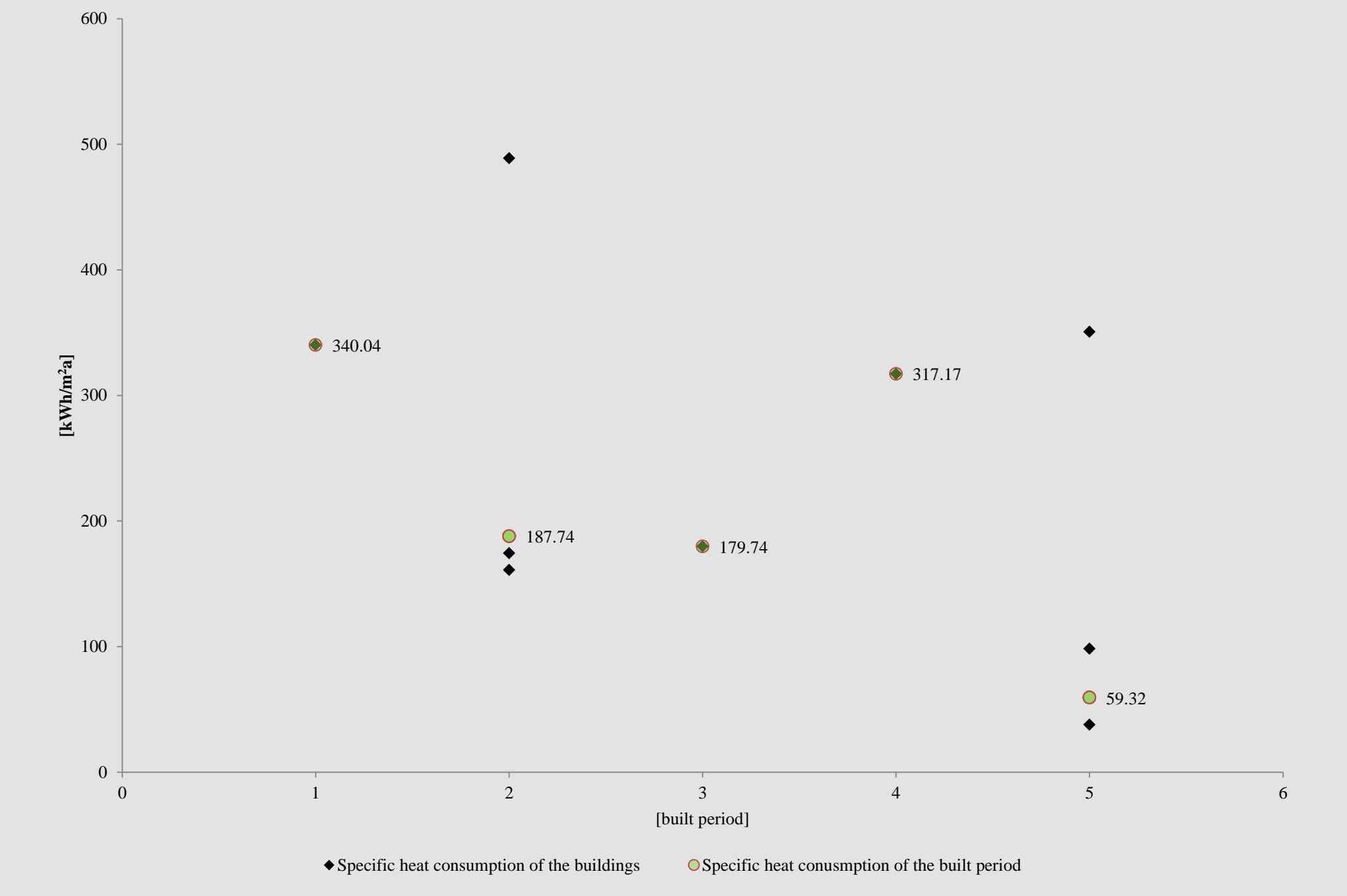
Specific heat consumption in administrative buildings

Average specific heat consumption of analyzed administrative buildings in Kragujevac is 200 kWh/m²a. Specific heat consumption in the buildings of the same type in AP Vojvodina is 254 kWh/m²a, in Austria 251 kWh/m²a, in the Czech Republic 294 kWh/m²a, in Bulgaria 130 kWh/m²a.



Specific heat consumption in cultural buildings

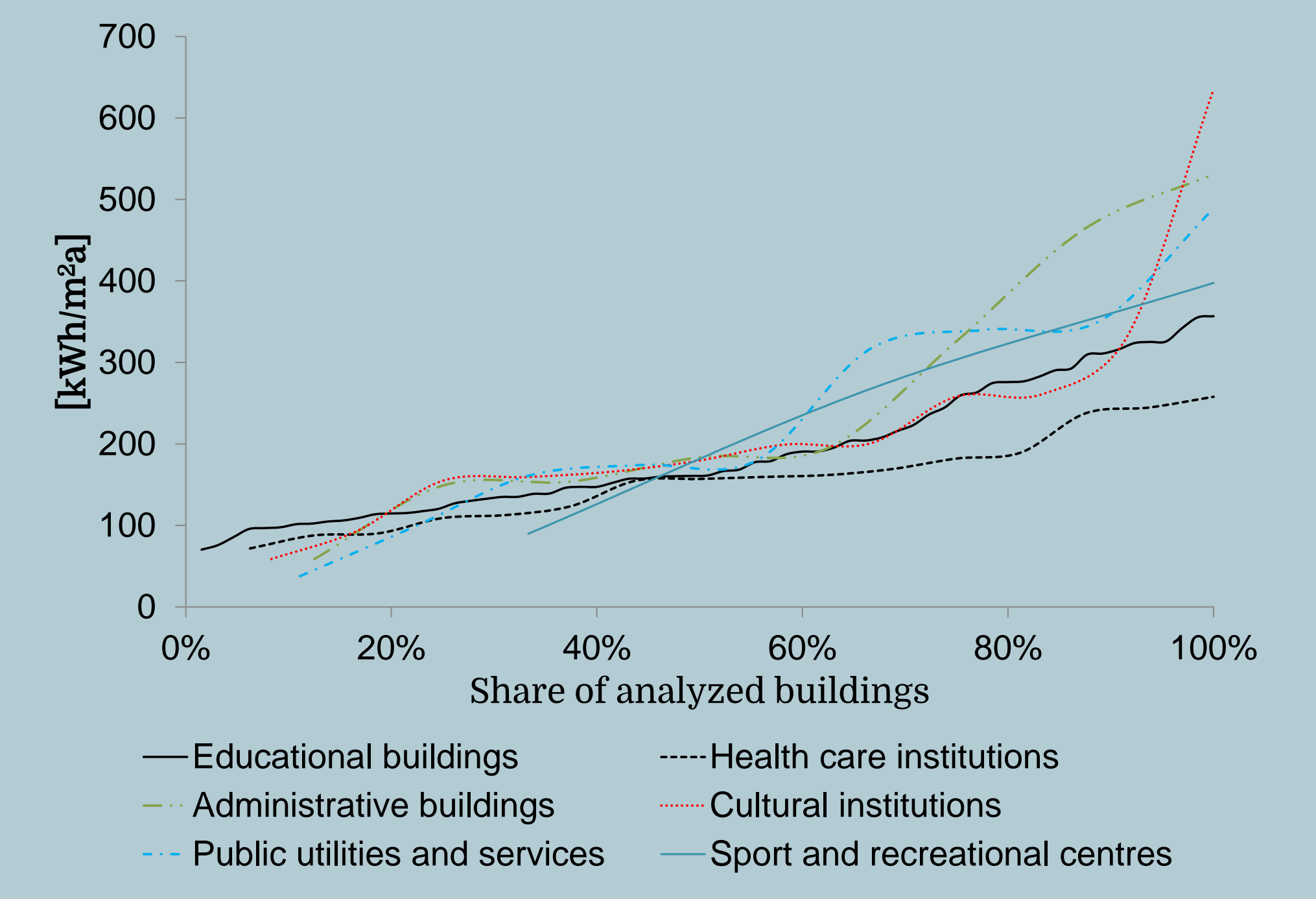
Majority of the analyzed buildings have the status of cultural monuments and they are under direct jurisdiction and protection of the Ministry of Culture and Information of the Republic of Serbia. Preservation of cultural heritage is the primary goal to be achieved with these buildings; therefore their energy efficiency is not considered as a priority.



Specific heat consumption of the public services and companies

Average specific heat consumption in analyzed buildings is 130 kWh/m²a, which is the lowest value of all types of public buildings in Kragujevac. City market halls have great influence on relatively low average specific heat consumption as they have useful space of 4828 m² and 1490 m² and consume in average 37.6 kWh/m²a and 98.1 kWh/m²a, respectively. Other buildings consume in average 227 kWh/m²a of specific heat.

Conclusion



Share of the building of the same sector inside total heat energy consumption of the sector

7,8 % of analyzed public buildings in the city of Kragujevac have heat consumption that corresponds to "C" energy class, 19,1% to "E", 33 % to "F" and 40 % to "G" energy class.

Acknowledgement

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