

# ANALYSIS OF CO<sub>2</sub> EMISSIONS IN THE PUBLIC SECTOR - THE EXAMPLE OF THE CITY OF KRAGUJEVAC

Ana Radojević<sup>1</sup>, Danijela Nikolić<sup>2</sup>, Jasmina Skerlić<sup>3</sup>, Vanja Popović<sup>4</sup>

<sup>1</sup>Kragujevac City Administration, Nikole Pašića 6, Kragujevac, Serbia; E-mail: [aradojevic@kg.org.rs](mailto:aradojevic@kg.org.rs)

<sup>2</sup> Faculty of Engineering, Sestre Janjić 6, Kragujevac, Serbia; E-mail: [danijelan@kg.ac.rs](mailto:danijelan@kg.ac.rs)

<sup>3</sup>University of Priština temporarily settled in Kosovska Mitrovica, Faculty of Technical Sciences, Kosovska Mitrovica, Serbia, E-mail: [j.skerlic@pr.ac.rs](mailto:j.skerlic@pr.ac.rs)

<sup>4</sup>Kragujevac City Administration, Nikole Pašića 6, Kragujevac, Serbia; E-mail: [valee996@gmail.com](mailto:valee996@gmail.com)

## ABSTRACT

Local governments play an important role in fighting the climate changes, as much in reducing emissions as in raising the awareness of citizens in the fight against climate changes. By analyzing CO<sub>2</sub> emissions - from which sectors the largest emissions originate - it is possible to propose adequate measures that will contribute to the target values of CO<sub>2</sub> emission reduction.

The paper analyzes the energy consumption and CO<sub>2</sub> emission of the public sector of the City of Kragujevac. For the public sector, emissions from the district heating system, public transport and public lighting were observed.

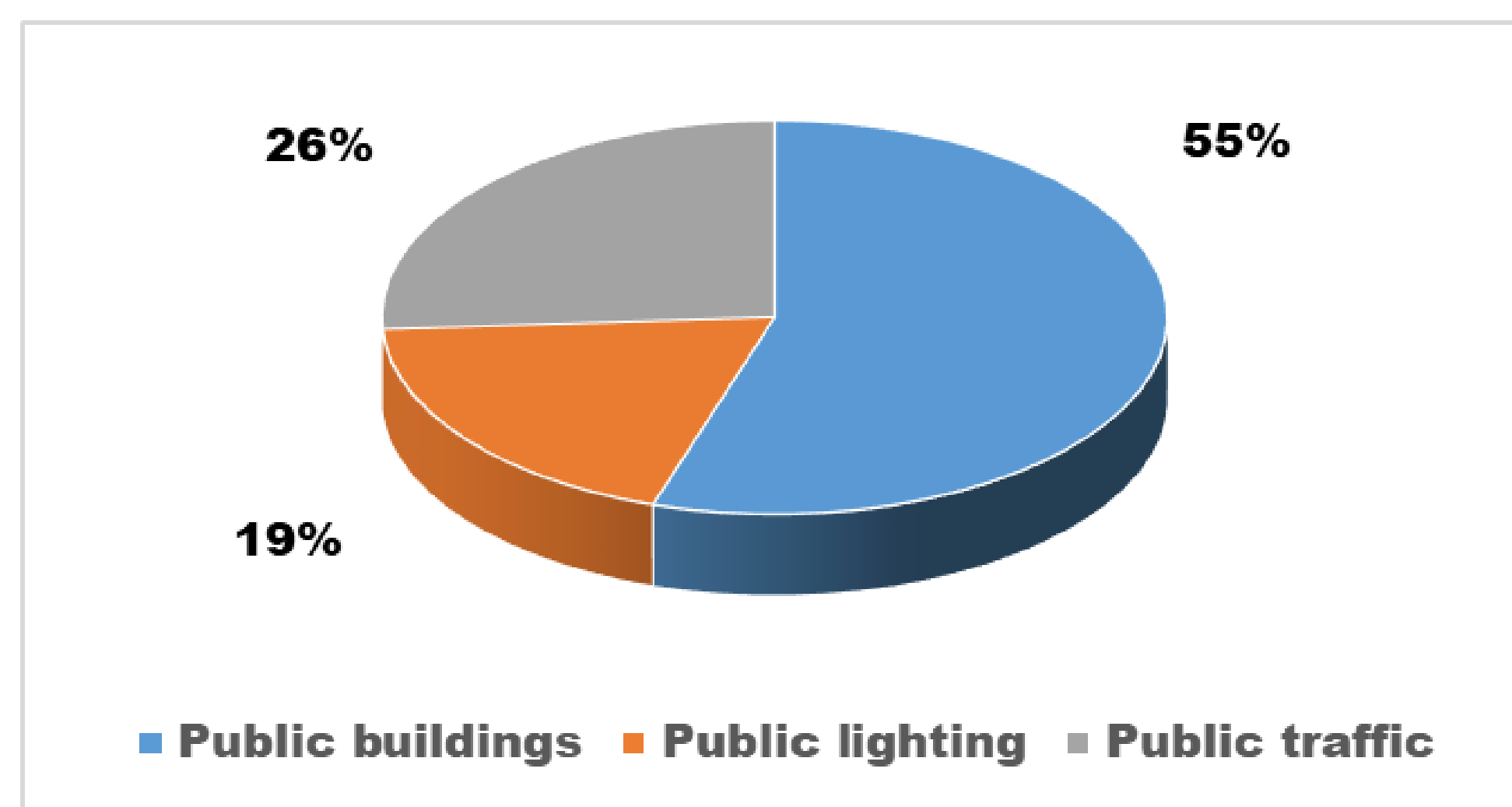
The most of the final energy is consumed in the building sector - 44.623,41 kWh, then in the transport sector 21.292.824,95 kWh and in the public lighting sector 15.997.937,60 kWh. The most public sector CO<sub>2</sub> emissions originate from the public buildings' sector - 56%, public lighting 32% and public transport 12%.

## INTRODUCTION

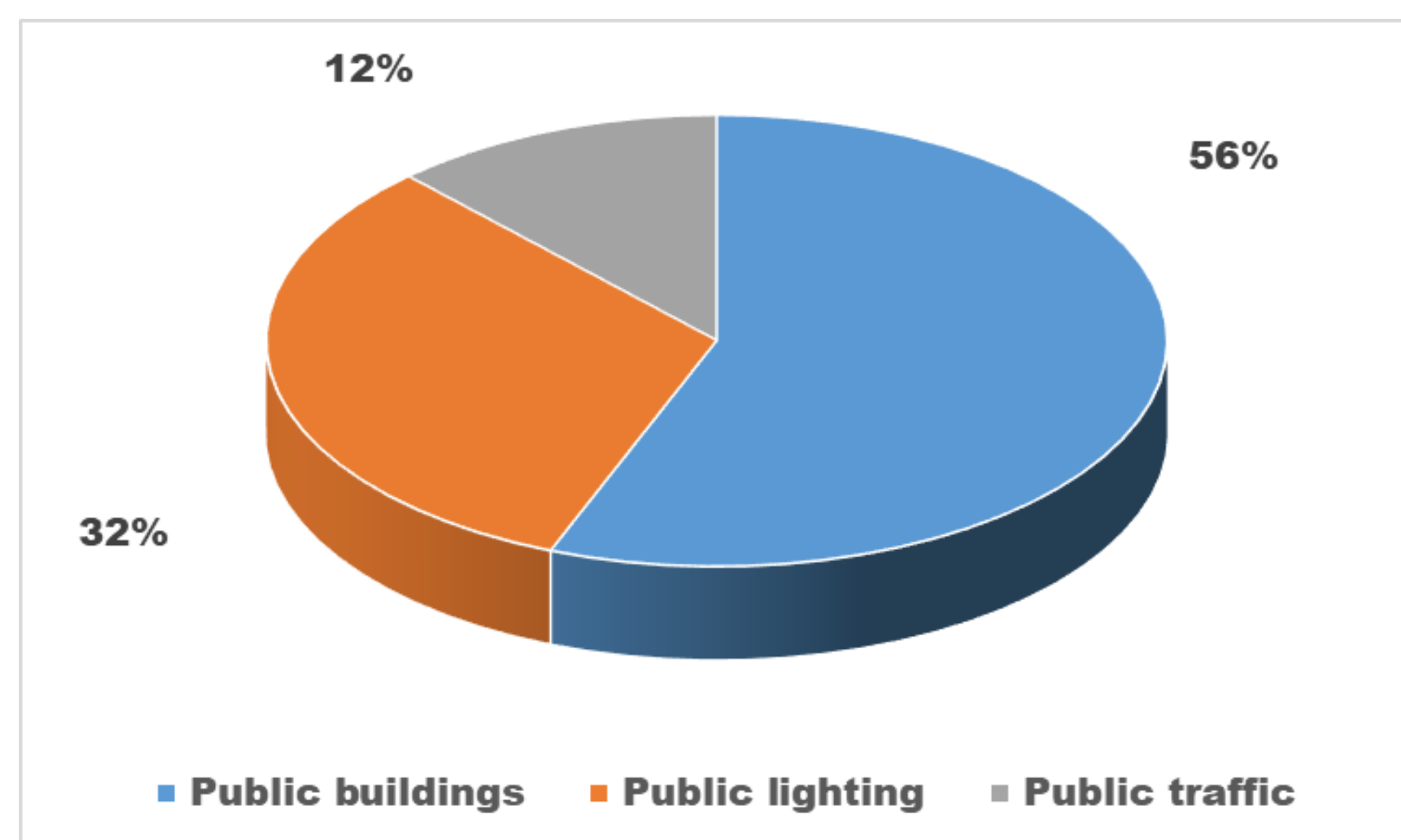
The environment is threatened by global warming and upcoming climate change, which are a direct consequence of energy consumption. Carbon dioxide (CO<sub>2</sub>) is a gas that is also formed as a result of burning fossil fuels, and it is responsible for the "greenhouse" effect. In order to limit the increase in average temperature and mitigate climate change, it is considered necessary to halve the world's CO<sub>2</sub> emissions by 2050 (compared to 1990), from 20 billion tons per year, to about 10 billion tons. Serbia has set a goal of reducing carbon dioxide emissions by 9.8% by 2030 compared to 1990.

Local authorities have a major role to play in reducing CO<sub>2</sub> emissions by implementing energy efficiency measures and using renewable energy sources. This paper analyzes energy consumption and CO<sub>2</sub> emissions in the public sector, which includes three sectors - public buildings, public lighting and public transportation.

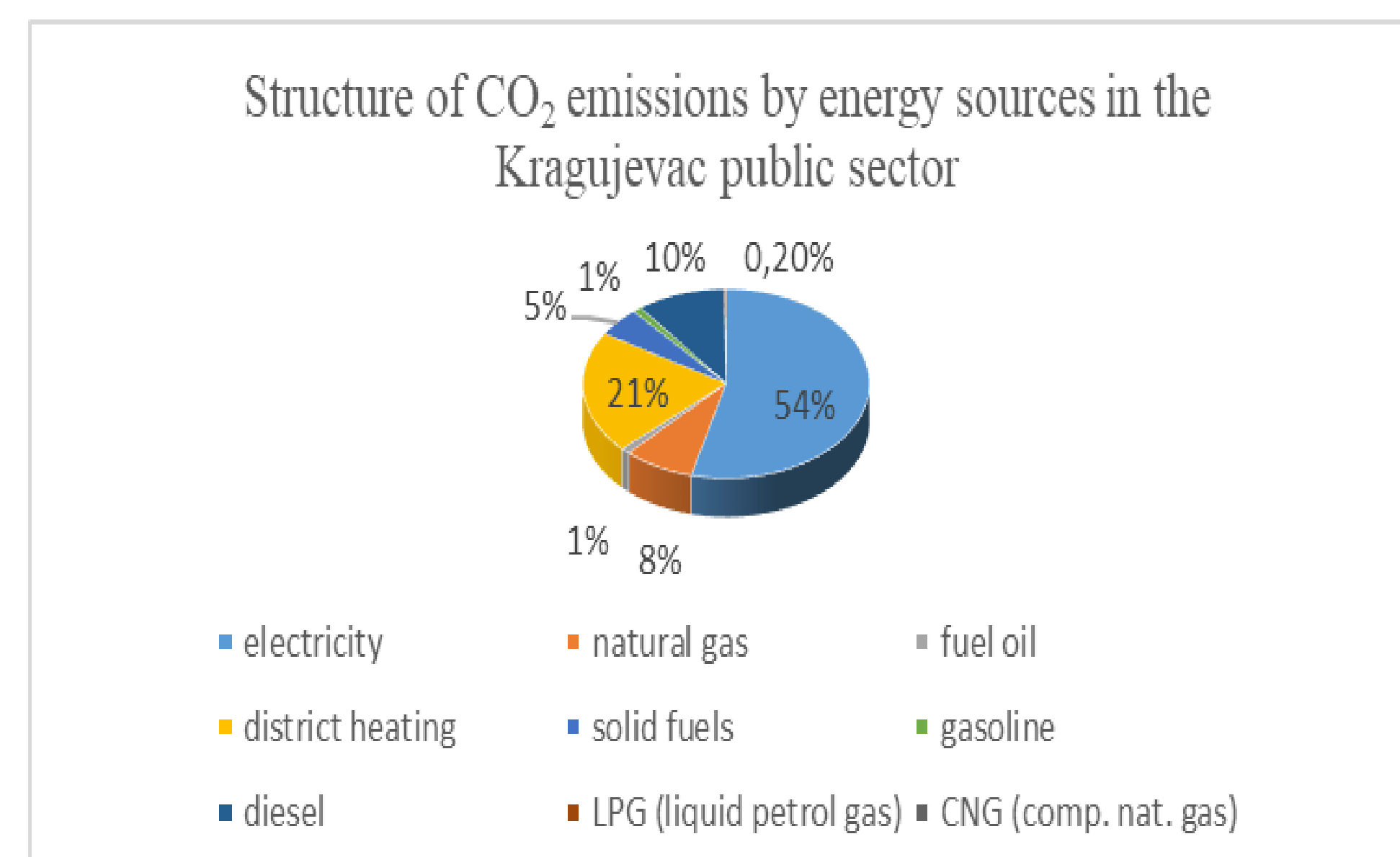
## RESULTS



**Figure 1.** The structure of primary energy consumption in the public sector of the City of Kragujevac



**Figure 2.** The structure of CO<sub>2</sub> emissions in the public sector of the City of Kragujevac



**Figure 3.** The structure of CO<sub>2</sub> emissions by energy sources in the public sector of the City of Kragujevac

**Table 1.** Estimation of annual energy consumption in the public sector of the city of Kragujevac.

Sektor potrošnje/ Consumption sector	Finalna energija/ Final energy [kWh]	Primarna energija/ Primary energy [toe]
Javne zgrade/Public buildings	44.623.803,41	6.133,17
Javno osvetljenje/Public lighting	15.997.937,60	3.438,94
Saobraćaj/Transportation	21.292.824,95	1.830,85
<b>UKUPNO/TOTAL</b>	<b>81.914.565,96</b>	<b>11.402,96</b>

**Table 2.** Annual CO<sub>2</sub> emissions in the public sector of the city of Kragujevac

Consumption sector	CO <sub>2</sub> emission [t]
Public buildings	22.246,17
Public lighting	12.798,35
Public transport	4.755,10
<b>TOTAL</b>	<b>39.799,62</b>

**Table 3.** Structure of CO<sub>2</sub> emissions by energy sources from the public sector of the city of Kragujevac

Energy source	TOTAL CO <sub>2</sub> emissions from public sector [tCO <sub>2</sub> ]
Electricity	20.889,458
Natural gas	2.929,404
Fuel oil	392,342
District heating	7.815,760
Solid fuels	1.985,194
Gasoline	454,553
Diesel	3.731,622
LPG (liquid petrol gas)	77,346
CNG (comp. nat. gas)	1.110,364
<b>TOTAL</b>	<b>39.386,044</b>

## CONCLUSION

The paper analyzes energy consumption and CO<sub>2</sub> emissions for the public sector of the city of Kragujevac, on which local government and decision-makers have the most influence. The public sector includes public buildings, public transport and public lighting. The analysis of energy consumption of the public sector shows that the most final energy is consumed in the building sector - 55%, followed by the transport sector - 26% and the public lighting sector - 19%. The highest CO<sub>2</sub> emissions in the public sector come from the public buildings sector - 22,246.17 t CO<sub>2</sub> (56%), public lighting 12,798.35 (32%) and public transport 4,755.10 (12%). The total CO<sub>2</sub> emission for the public sector of the city of Kragujevac is 39,799.62 t CO<sub>2</sub>.

## LITERATURE

- [1] Tian C., Feng G, Li S, Xu F.: Scenario Analysis on Energy Consumption and CO<sub>2</sub> Emissions Reduction Potential in Building Heating Sector at Community Level, *Sustainability* 2019, 11(19), 5392, <https://doi.org/10.3390/su11195392>; [2] V. Castán Broto, H. Bulkeley: A survey of urban climate change experiments in 100 cities, *Glob. Environ. Change*, 23 (2013), pp. 92-102 <https://doi.org/10.1016/j.gloenvcha.2012.07.005> ArticleDownload PDFView Record in ScopusGoogle Scholar; [3] Peduzzi E., Giulia Baldi M., Pisoni E., Kona A., Bertoldi P., Monforti Ferrario F.: Impacts of a climate change initiative on air pollutant emissions: Insights from the Covenant of Mayors, *Environment International*, Volume 145, December 2020, 106029; [4] Palermo V., Bertoldi P., Apostolou M., Kona A., Rivas S.: Data on mitigation policies at local level within the Covenant of Mayors' monitoring emission inventories, *Data in Brief*, Volume 32, October 2020, 106217; [5] The Covenant of Mayors. Origin and development, <https://www.covenantofmayors.eu/about/Covenant-Initiative/Origins-and-Development.Html>. (accessed in July 2020). Google Scholar; [6] Ishii S., Tabushi S., Aramaki T., Hanaki K: Impact of future urban form on the potential to reduce greenhouse gas emissions from residential, commercial and public buildings in Utsunomiya, Japan, *Energy Policy*, Volume 38, Issue 9, September 2010, Pages 4888-4896; [7] del Río González P.; Policy implications of potential conflicts between short-term and long-term efficiency in CO<sub>2</sub> emissions abatement, *Ecological Economics* Volume 65, Issue 2, 1 April 2008, Pages 292-303; [8]. Amanda Ball, Ian Mason, Suzana Grubnic & Phil Hughes The Carbon Neutral Public Sector, Early developments and an urgent agenda for research, *Public Management Review* Volume 11, 2009 - Issue 5, Pages 575-600; Energy Efficiency Program of the City of Kragujevac for period 2018-2020, *Official Bulletin of the City of Kragujevac*, No.13/2018; V. Karamarković, B. Ramić, M. Stamenić, M. Matejić, D. Djukanović, M. Stefanović, R. Karamarković, S. Jerotić, D. Gordić, M. Stojiljković, M. Kljajić,