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Green capital East of the Leitha? The chances and disadvantages of major cities in the Pannonian Basin to win the European Green Capital Award

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Abstract

This study focuses on the chances of major cities (over 100,000 inhabitants) in the Pannonian Basin to win the European Green Capital Award. The 28 cities covered by the analysis can be divided into two groups: eleven cities that have already applied (one of them, Ljubljana was a previous winner) and seventeen cities that have not yet applied for the award. During the research, we divided the cities according to these two groups. In the study we applied various statistical and spatial analysis methods to capture similarities and differences in their environmental indicators. The results show that there are no significant differences in environmental indices between these two groups, and the values of the 2016 winner city (Ljubljana) are most similar to Austrian, Slovenian, and Croatian cities. Furthermore, based on the results of the similarity search, it can be stated that the further east we go, the less similar the examined cities are to Ljubljana. We also examined the probability of reaching the finals, indicating that cities that have not yet applied have a low likelihood of winning the award.

Keywords: European Green Capital Award, green cities, environmental indicators, sustainable urban development, Pannonian Basin

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Introduction

Adapting to climate change and mitigating its potential negative impacts will become an increasingly important task for European cities, where nearly 80 percent of the population will be urban by 2050 (Hardi, T. *et al.* 2014; Clark, G. *et al.* 2019). The pursuit of environmental and social resilience and municipal sustainability is becoming increasingly popular among cities (Andersson, I. 2016; Nzimande, N.P. and Fabula, Sz. 2020; Buzási, A. *et al.* 2022). This may include, among others, the need to respond to various external impacts (e.g., natural disasters, extreme weather events), transforming water and waste management at municipal level (e.g., rainwater retention, recycling), reducing air and noise pollution, increasing the number and size of green spaces, or boosting the commitment towards sustainability. However, there are differences between the cities of Western and Eastern Europe about the perception and evaluation of the challanges of sustainability and climate change.

They are reflected by differences in goals, priorities, and structures that appear in European urban development. In former state-socialist countries, territorial and urban development was determined by the state, resulting in limited autonomy for local stakeholders. Urban planning and development were centrally directed and controlled ('top-down'), as noted by Kovács, Z. (1999),

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Sailer-Fliege, U. (1999), Szirmai, V. (2004), and Konecka-Szydłowska, B. *et al*. (2018). In contrast, Western Europe saw the emergence of new urban functions in former industrial areas after deindustrialisation, with a significant focus on brownfield rehabilitation (Dannert, É. 2016). In Western European cities local communities play a crucial role in the urban development process, partly due to varying levels of co-financing and a limited role of the central state (Barta, Gy. 2009; Puczkó, L. and Jószai, A. 2015). Following the transition to democracy, many post-socialist cities struggled with the shift to a 'bottom-up' planning approach, a transition they had to go through (Hervainé Szabó, Gy. 2008; Hirt, S. and Stanilov, K. 2009). In the new system, funding became primarily available from external sources, requiring local governments' activity, embeddedness and commitment. Further challenge appeared after the Leipzig Charter (European Commission, 2007) with the transtion to an integrated urban development approach, as it posed difficulties for most post-socialist cities in terms of democratising planning and involving local stakeholders (Bajnai, L. 2007). Furthermore, other factors could not be overlooked either, including the economic decline and unemployment stemming from the collapse of industry, the lack of functioning real estate market until the political transformation, the adverse effects of privatization on land use, the neglect of environmental pollution, the growing social inequality and segregation, the lack of capital for local governments, the absence of an established partnership system, and the negligible presence of the civil sector (Hervainé Szabó, Gy. 2008; Barta, Gy. 2009; Hirt, S. 2013).

To address these challenging issues, post-socialist cities aimed for a secure transition, with governments acting as partners, as seen in the case of Hungary. During this transitional period, while urban development was under government control with the involvement of supervisory authorities, local governments had the opportunity to apply, plan, and execute independently. According to Pintér, T. "the persistence of the eastern periphery was also necessary for the development of the western countries" (Pintér, T. 2015, 127), meaning that the handicap of Eastern European cities inadvertently contributed to the strengthening of Western European cities.

In urban development, the role of the European Union became crucial not only in terms of financing but also in introducing policy measures and fostering cooperation (Verdonk, H. 2014), which can stimulate the development of post-socialist cities. Today, one of the most highlighted aspects of EU urban development is the creation of sustainable and green cities, contributing to mitigating the negative effects of climate change. To achieve this, the European Commission established the European Green Capital Award (EGCA) in 2008, which encourages cities to transition onto a "green path" and promotes long-term development that positively impacts residents' quality of life (Gudmundsson, H. 2015). The effects of implemented developments can be measured through monitoring studies, which can also be considered as performance evaluations, thus, revealing the extent of progress in a given city. The European Union also advocates for the monitoring of cities based on various indicators, which also serve as the basis for awarding the EGCA.

This study focuses on the major cities (i.e., above 100,000 inhabitants) within the Pannonian Basin in East Central Europe. There have been numerous publications related to sustainability in the region, with the application of various environmental indicators being relatively popular. For instance, Bănică, A. *et al.* (2020) examined several Central and Eastern European cities to explore the connections between green infrastructure, resilience, and adaptability. Similarly, Csete, Á.K. and Gulyás, Á. (2021) investigated the urban green infrastructure network of Szeged, and the role of vegetated surfaces in urban water management. Herbel, I. *et al.* (2016) studied the urban heat island phenomena in Cluj-Napoca, which are considered "byproducts" of increasing urbanization and climate change. Popescu, R-I. and Zamfir, A. (2012) analysed the competitiveness of green cities in the field of "ecological marketing" based on the European Green Capital Award and the Romanian Green City program, finding a close relationship between a city's ecological values and its competitiveness. Buzási, A. and Jäger, B.S. (2021) assessed the sustainability of Hungarian county capitals using various statistical methods, while Sikos, T.T. and Szendi, D. (2023) examined Hungarian major cities from economic and environmental sustainability perspectives based on specific topics related to the UN Sustainable Development Goals. Some publications specifically analyse individual sustainability indicators, such as cycling in Osijek (Dimter, S. *et al.* 2019), the per capita green space in Romanian, Slovenian, and Croatian cities (Badiu, D.I. *et al.* 2016; Selimović, A. 2022), or energy management in Pécs (Kiss, V.M. 2015). Despite the growing number of studies, a comparative analysis of sustainability indicators of cities in the Pannonian Basin is still missing.

The European Green Capital Award

The establishment of the European Green Capital Award began in 2006 with an initiative led by Jüri Ratas (Prime Minister of Estonia between 2016 and 2021, and former Mayor of Tallinn from 2005 to 2007). Fifteen European cities joined this initiative, including Tallinn, Helsinki, Riga, Vilnius, Berlin, Warsaw, Madrid, Ljubljana, Prague, Vienna, Kiel, Kotka, Dartford, Tartu, and Glasgow. The Estonian Cities Association also became associated with the initiative (Sareen, S. and Grandin, J. 2019). The fundamental principles and objectives of the award were outlined in a declaration known as the Tallinn Memorandum 2006. In this memorandum, the award's purpose and thematic areas were defined as follows:

"Following the initiative of Tallinn, we, representatives of European cities, propose to the European authorities to establish the European Green Capital title. This is to be awarded each year to a city that is an environmental role model for other municipalities, e.g., by having followed a consistent environmental policy, implemented sustainable mobility solutions, including an improved public transport system, expanded the territories of parks and green areas, successfully introduced modern waste management principles and technologies, or implemented innovative and enterprising solutions to improve the quality of the urban living environment." (Tallinn Memorandum 2006).

The European Commission introduced the award in 2008, creating the first official recognition by the European Union aimed at promoting and supporting the development of green and sustainable cities (Lönegren, L. 2009; Gulsrud, N.M. *et al.* 2017). The justification for the existence of the European Green Capital Award is based on the growth of urban populations, which has led to the concentration of environmental and social issues primarily in these regions. Cities are seen as having to adapt to these challenges (Kahn, M.E. 2006; Beatley, T. 2011; Carter, J.G. 2011; Beretta, I. 2014). The award aims to evaluate how municipalities respond to various environmental challenges, recognizing efforts directed at improving the urban environment and contributing to the creation of more sustainable and healthier cities. Additionally, it encourages cities to share their experiences, fostering a collaborative and continuously evolving system (Ruiz del Portal Sanz, A. 2015; Diverde, H. 2016; Cömertler, S. 2017; Nurse, A. and North, P. 2020).

Cities with a population of over 100,000 can apply for the award, provided that their country is a member of the European Union, a candidate for accession, or located within the European Economic Area or Switzerland. If the city with the highest population in the country does not meet this threshold, the city with the highest population is allowed to apply.

For cities interested in applying, an annual workshop is organized to explain the application process and allow participants to share experiences and ideas. The first step in the application is registration, which is entirely non-binding. In other words, cities are not obliged to compete later on, but this registration provides insight into the details and processes of the application. If the city leadership decides to proceed with the application, the application documents must be submitted through an online platform, which needs to be signed by the mayor or the highest-ranking city representative (Gudmundsson, H. 2015). Cities applying for the award must meet various criteria (Meijering, J.V. *et al.* 2014), including presenting their current state, developments carried out in the past five to ten years, and future goals in various thematic areas. It is also important to showcase commitments, agreements, partnerships, and the role of the community in these developments (European Commission, 2021).

At the time of the launch of the award, cities competed based on ten criteria, which have undergone multiple revisions since then *(Figure 1).* This study examines cities based on the thematic areas specified in the 2022 competition announcement. The reason for this is that starting from the 2023 round, the "sustainable land use and soil" criterion is challenging to quantify with data (e.g., soil sealing). Furthermore, this new criterion did not apply to cities that had already applied for the award, and their application materials do not provide information on this aspect.

The submitted applications are evaluated by international experts who create rankings of cities based on the points they have earned. The decision regarding which cities advance to the finals is made by the European Commission based on expert opinions (Gudmundsson, H.

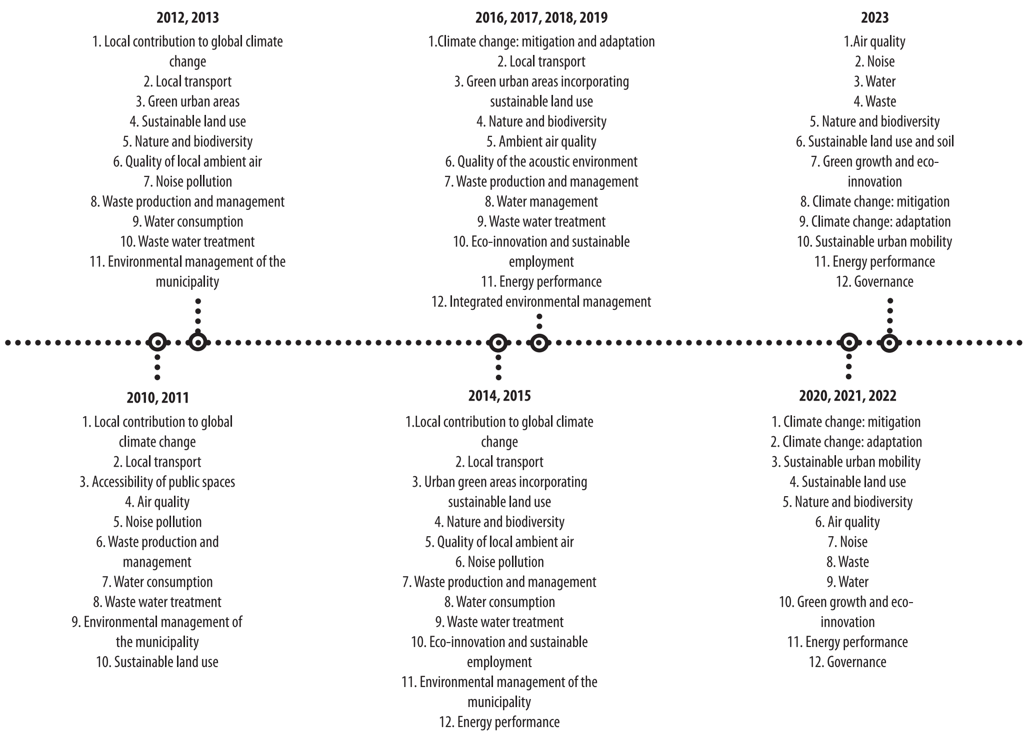

Fig. 1. The change of the EGCA-criteria over time. *Source*: Authors' own elaboration based on the documents of the European Commission.

2015). In the final circle, cities are required to present their results and explain why they could serve as examples to other cities.

By focusing on the identified areas of improvement in the examination of thematic areas, cities can effectively manage their financial and temporal resources. They can prioritize areas of development that are crucial for sustainability, thereby increasing their chances of success in the competition and enhancing the overall sustainability of their city. The results of this study can contribute to the development of sustainable, resilient, and green cities, serve as a model for city governments, and be used to enhance the chances of successful participation in the award competition.

Financial background of the award

The European Green Capital Award does not have its own budget, so it cannot provide direct financial support to the applying cities. Cities must seek other European Union funding opportunities to finance their urban development activities. However, the winning city is entitled to a cash prize introduced since 2019. In 2022, this prize amounted to 350,000 EUR, while the 2023 winner received 600,000 EUR. This prize is funded from the budget of the LIFE program. Cities whose countries do not participate in this program are not eligible for the financial reward (European Commission, 2021).

Benefits after winning the award

Winning the award can come with several benefits. The winning city can gain international recognition and media coverage, which can positively impact tourism and promote the green city brand. New collaborations may be established within the city or with other cities. A notable example is the European Green Capital Network (since 2014)[3], through which winning and finalist cities can share their ideas and experiences, represent European cities in the field of environmental protection and sustainability, encourage other cities to engage in sustainable urban planning, and collaborate with the European Commission. Environmental projects can receive greater emphasis, strengthening the commitment to sustainability. The documentation generated through the award process can help in measuring and analysing the city's development, highlighting weaknesses and problems, and providing comparable data for other cities. Involving city residents in development through public opinion research, informational campaigns, and forums can enhance their commitment to their city, enabling them to contribute to creating a more livable, healthier, and attractive city, ultimately improving their quality of life. Since 2019, the cash prize awarded to cities can be spent on sustainable urban development investments (European Commission, 2021).

Review of the literature on research focusing on the European Green Capital Award

The European Green Capital Award has been of interest to the European Commission since 2006, but it only gained significant recognition in public discourse after the announcement of the first winning city in 2010. Consequently, the research on this topic dates back to around that time. Since the inception of the award, the European Commission has annually published official evaluation documents, and the publications of the winning cities are also made available on the European Union's document repository online[4]. The scholarly literature on the award includes five-year retrospective reports and final publications issued by the municipalities of the winning cities, as well as reports following the evalua-

[3] Available at https://environment.ec.europa.eu/topics/urban-environment/european-green-capital-award/about-awards_en#eu-green-capital-network

[4] Available at https://circabc.europa.eu/ui/group/c6e126de-5b8c-4cd7-8d36-a1978a2a63de/library/017bb562-fdd8-4adeb1ff-d1ac296c79b7

tion of the applications (accessible from 2010 to 2019). One of the earliest publicly available studies on the European Green Capital Award was conducted by Lovisa Lönegren, who wrote her thesis in 2009 titled "The European Green Capital Award – Towards a sustainable Europe?". In her research, she sought to answer whether the European Green Capital Award is a suitable method for addressing environmental challenges in the European Union. She approached the topic from the perspective of environmental protection and ecological modernization, using the example of Stockholm. The most important publications related to the European Green Capital Award are listed in *Table 1*.

Table 1. Research topics and references connected with EGCA

Approaches	Topics	References
Analysing the 12 EGCA criteria	Sustainable land use	Hårsman, B. and Wijkmark, B. (2013); Ruiz del Portal Sanz, A. (2015)
	Local transportation	Müller, M. and Reutter, O. (2020)
	Green space features and green infrastructure networks	Cömertler, S. (2017); Kerr, L. (2017)
	Climate protection	Müller, M. and Reutter, O. (2020)
	Every criteria	Ratas, J. and Mäeltsemees, S. (2013); Pantić, M. and Milijić, S. (2021)
Evaluation process of the applications	Focusing ont he topic of local transportation	Gudmundsson, H. (2015)
Political background, environmental policies	Analysis of winning cities	Ozcan, N.S. (2015); Polato, E. (2017)
	The EGCA as a political tool in municipal sustainability	Diverde, H. (2016); Gulsrud, N.M. *et al.* (2017); Kurstjens, N. (2017); Manca, L.R. (2020)
	Urban governance	Ersoy, A. and Hall, S. (2020)
	Responsibility and accountability	Sareen, S. and Grandin, J. (2019)
	Entrepreneurial spirit and increased economic competitiveness after winning the award, as well as its significance for city management	Nurse, A. and North, P. (2020)
City branding and marketing	Place branding through green spaces and the concept of a green city	Gulsrud, N.M. *et al.* (2013); Andersson, I. (2016)
	Marketing activities of green cities	Demaziere, C. (2020)
	The impact of social media on inter-organizational collaborations	Korpela, T. (2021)
Environmental indicators	Measurement of environmental sustainability	Meijering, J.V. *et al.* (2014); Zoeteman, B. *et al.* (2014, 2015)
	Examination of city monitoring	Sarubbi, M.P. and Schmidt Bueno de Moraes, C. (2016)
	Comparison of urban environmental indexes	Georgi, B. (2016); Feleki, E. *et al.* (2018)
Analysing the cities applied	Based on completed developments	Biscossa, F. *et al.* (2017); Maior, J-C. (2019)
	Revitalization of city centres and renewal of public spaces	Poljak Istenič, S. (2016); Svirčić Gotovac, A. and Kerbler, B. (2019)
	The role of civil organizations and grassroots initiatives	Ersoy, A. and Larner, W. (2019)

Source: Authors's own elaboration.

The cities that have won and applied so far

Between the 2010 and the 2024 round of the EGCA, 110 cities have applied for the award, ten of which are located in the study area of the Pannonian Basin *(Figure 2).* Among the winners, we primarily find cities from Western and Northern Europe. Germany, France, and Spain have each had two winner cities from the inception of the award up to 2024. There is an ″axis of winners″ to be observed in the map from Lisbon to Lahti, and also, there is a spatial concentration of the finalist cities in the Northwest of Europe. Among the post-socialist cities, there are only two succesfull candidates: Ljubljana (2016) and Lahti (2023) were able to win the award after many years of continous applications. Over time more and more post-socialist cities have applied to the award, altough most of them have not even reached the final round before the decision.

Research questions and methodology

Up until the 2024 round of the EGCA, a total of 110 cities have applied for the award. Among them, ten are located within the Pannonian Basin, although none of them became finalists or winners. In this study, the cities geographically closest to the cities under examination include Ljubljana (2016), whose environmental values serve as a reference point in some of the analyses. When selecting the reference city, we considered (relatively) similar geographical conditions and urban development paths, as the majority of cities

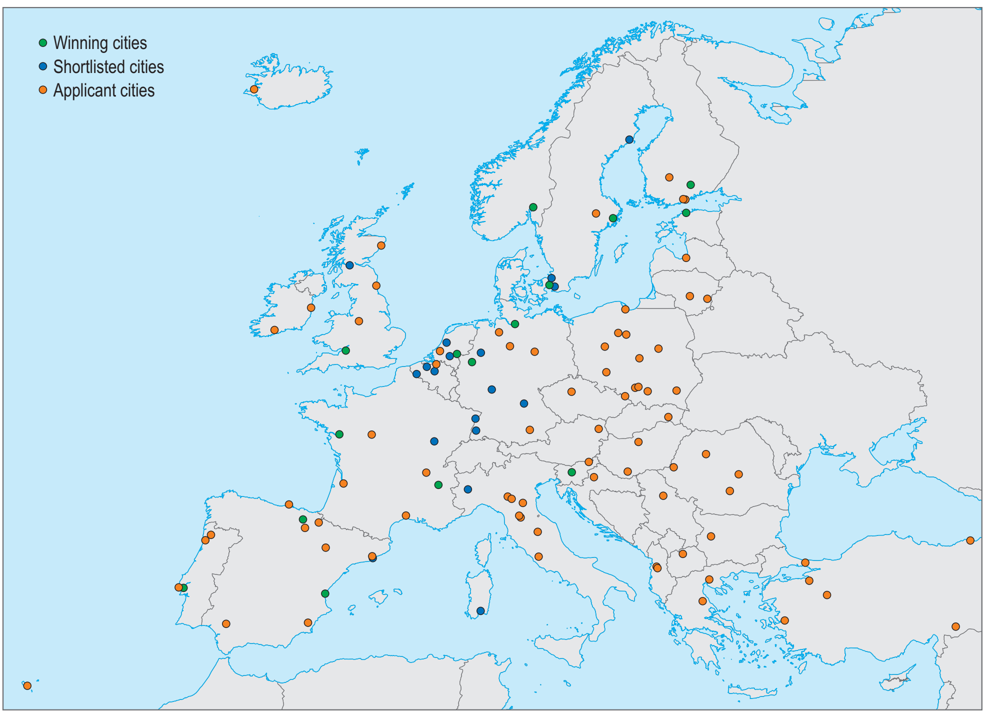

Fig. 2. Cities that applied for the award (2010–2024). *Source*: Authors' own elaboration.

in the Pannonian Basin belonged to the Eastern Bloc, i.e., the state-socialist bloc (Hirt, S. *et al*. 2017).

The primary question in the examination of cities in the Pannonian Basin with a population of over 100,000 was *whether the environmental values of Hungarian cities differ from those of the reference city? If so, which indicators and to what extent do they differ?*

Another question that arose was *whether the two 'Western' cities in the study are positioned higher in the similarity ranking or if their environmental values are more similar to those of post-socialist cities?*

Among the 27 cities examined in this research (excluding Ljubljana), 17 have not yet applied for the award *(Figure 3)*. Therefore, we considered these as 'potential applicants' and sought to *determine if there was a variable in which their values were worse than those of the cities that had already applied*.

Furthermore, aside from Ljubljana, can it be concluded that among the examined cities, *those that have not applied for the award have any chance of making it to the final round?*

To explore the similarities and differences in environmental values, we used independent samples *t*-test (Student's *t*), Mann-Whitney *U*-test, Chi-square test of independence, random forest and a geospatial tool, the similarity search. It is important to emphasize that this research is conceived as an exploratory analysis (EDA), i.e., we do not aim to prove or disprove specific hypotheses, as EDA uses different statistical methods to test the strength of the relationship, not to prove hypotheses (Velleman, P.F. and Hoaglin, D.C. 2012). Tukey, J.W. (1977) described EDA as detective work, the aim of which is to uncover patterns. The purpose of a discovery analysis is to detect some pattern, difference or similarity in the values of the items under investigation (Fife, D.A. and Rodgers, J.L. 2022). Although controversial, it appears that the p-value has at least some relevance in exploratory studies (Rubin, M. 2017), and

Fig. 3. Cities covered by the analysis. *Source*: Authors' own elaboration.

therefore these values are included in the results along with the effect size, generally recommended in the literature (Fife, D.A. and Rodgers, J.L. 2022).

Different methods were found to be appropriate for comparing cities that have and have not yet applied for the EGCA, due to the characteristics of the variables under study *(Table 2).* For the normally distributed variables, the independent samples *t*-test was used, while for variables with a non-normal distribution, the Mann-Whitney *U*-test was applied. The relationship between binary variables and the fact of applying was analysed using Chi-square test.

The chances of cities in the Pannonian Basin to reach the final round were calculated using the random forest method. This first required the creation of a database to determine which sustainability indicators would determine the outcome of the EGCA application. In the database, the values of 100[5] cities that applied for the EGCA were collected according to the indicators identified above. These 100 cities already include the ten applicant cities in the Pannonian Basin. The cities were divided into two groups: the finalists (including the winners) and the non-finalists who didn't make it to the finals. This binary division served as the dependent variable in the binary logistic regression[6]. The independent variables consisted of the applied indicators, totaling 33, which were determined for each city based on the 2019 or 2020 values[7], primarily sourced from pan-European databases and documents and plans issued by local governments.

This uniform definition raises two problems which are seen as limitations for this research. Firstly, the EGCA application process takes into account not only the current ecological values of cities, but also recent changes and future plans. Second, by defining a single point in time, there is a risk that a city that applied for the EGCA at an early round may have improved significantly (or, on the contrary, stagnated[8]). It may not have been a finalist at the time of application due to its poor scores, but due to improvements since then, the model would incorrectly mark it as a finalist. The estimation does not take into account which cities applied in a given year, how strong the competition was, but it is relative to the total sample of 100 cities. This is justified because we do not know the competitors of a potential candidate city, which would apply in the future, so it is appropriate to compare them with the full sample of applicant cities.

Also, the values of the 100 applicant cities were used for the similarity search. As a first step, a rank scale transformation was performed based on all the scale variables of the 100 applicants and the 15 potential candidate cities. Then, as a dimension reduction approach, we run a Multiple Factor Analysis (Pagès, J. 2002). Seven dimensions were created above an eigenvalue of 1, explaining 60.2 percent of the total variance. The reason for using the MFA procedure is that the 33 indicators are unevenly distributed across the EGCA themes, and if all of them had been included with equal weight, some categories could have biased the analysis. The reason for including 100 cities was to get a clearer picture of the relationship between the 33 variables and to avoid the bias due to the small number of elements and the limited geographical location that would have occurred if we had only created dimensions based on the values of the cities located in the Pannonian Basin.

The random forest machine learning method was used to determine the chances of the cities (except Ljubljana) to reach the final round. This is an ensemble method based on decision trees, the results of which are sum-

[5] A total of 110 cities applied to the EGCA, but in ten cases there were missing data for most of the indicators.

[6] If a city applied multiple times, the most recent result was used as the dependent variable.

[7] If these were not available, the data closest in time was used. The difficulty of collecting pan-European sustainability indicators at a single point in time was also identified as a problem in the study by Zoeteman, B. *et al.* (2015).

[8] On the problem of green city indices without temporal monitoring, see Pace, R. *et al.* (2016).

*Table 2. Indicators and data sources used for the analysis of cities in the Pannonian Basin, as well as descriptive statistics for the indicators**

Variable	Mean	Standard deviation	Minimum	Maximum	N	Data source(s)
CO_2 emissions, t/person/year (1)	3.98	2.25	1.19	11.35	27	Eurostat, city documents (Climate Strategy, SECAP, SEAP), Covenant of Mayors website
CO_2 emissions, t/person/year – percentage of the national average (1)	77.62	39.92	31.33	222.63	27	Own calculation based on Eurostat data
Length of cycle paths, m/person (3)	0.37	0.31	0.01	1.01	28	City documents, local media, national statistical offices
Number of cars per 1,000 inhabitants (3)	361.29	67.96	190.00	526.00	28	Documents from Eurostat, national statistical offices, national offices
Number of cars per 1,000 inhabitants – percentage of the national average (3)	97.32	23.55	57.57	183.27	28	Own calculation based on Eurostat data
Percentage of inhabitants travelling to work by car, % (3)	40.44	11.70	23.00	71.00	27	Eurostat, city documents, Sustainable Urban Transport Plan (SUMP), CIVITAS, European Platform on Mobility Management – Modal Split Tool
Percentage of inhabitants travelling to work by public transport, % (3)	28.89	11.05	13.00	49.00	27	Eurostat, city documents, Sustainable Urban Transport Plan (SUMP), CIVITAS, European Platform on Mobility Management – Modal Split Tool
Percentage of inhabitants walking to work, % (3)	23.54	10.25	1,60	42.00	27	Eurostat, city documents, Sustainable Urban Transport Plan (SUMP), CIVITAS, European Platform on Mobility Management – Modal Split Tool
Percentage of inhabitants cycling to work, % (3)	6.68	6.34	0.00	26.70	27	Eurostat, city documents, Sustainable Urban Transport Plan (SUMP), CIVITAS, European Platform on Mobility Management – Modal Split Tool
Size of green areas, m^2/person (4)	15.30	10.13	3.78	43.77	28	Eurostat, Urban Documents, Joint Research Centre – The future of cities (Urban Data Platform)
Population density, inhabitant/km^2 (4)	1,584.14	1,120.84	343.52	4,335.00	28	Eurostat, city documents
Proportion of Natura 2000 sites in relation to the area of the municipality, % (5)	10.66	11.47	0.00	44.90	28	Natura 2000 Network Viewer
NO_2 annual average, $\mu g/m^3$ (6)	26.91	7.90	11.20	48.03	28	Eurostat, city documents, European Environment Agency – Air Quality Statistics
PM_{10} annual average, $\mu g/m^3$ (6)	25.77	5.31	18.47	39.20	28	Eurostat, city documents, European Environment Agency – Air Quality Statistics
$PM_{2.5}$ annual average, $\mu g/m^3$ (6)	16.49	3.03	11.28	23.00	25	Eurostat, city documents, European Environment Agency – Air Quality Statistics
Proportion of people living in > 65 dB noise pollution, %; along roads (7)	15.25	11.10	3.90	54.02	25	European Environment Agency (The Noise Observation and Information Service for Europe), city documents, regional, national environmental documents

*Table 2. Continued**

Variable	Mean / Median**	Standard deviation / Mode***	Minimum	Maximum	N	Data source(s)
Proportion of people living in > 55 dB noise pollution, %; along roads (7)	17.95	13.57	2.07	65.21	25	European Environment Agency (The Noise Observation and Information Service for Europe), city documents, regional, national environmental documents
Amount of waste, kg/person/year (8)	349.23	92.65	228.71	566.00	28	Eurostat, Assessment of separate collection schemes in the 28 capitals of the EU (European Commission, Final Report 2015), city documents, local media
Amount of waste, kg/person/year – percentage of the national average (8)	97.66	26.08	51.33	162.71	28	Own calculation based on Eurostat data
Recycling rate, % (8)	24.67	18.03	2.00	69.00	28	Eurostat, Assessment of separate collection schemes in the 28 capitals of the EU (European Commission, Final Report 2015), city documents, local media
Recycling rate, % – percentage of the national average (8)	90.62	63.65	13.33	278.57	28	Own calculation based on Eurostat data
Drinking water consumption, l/person/day (9)	121.04	26.94	77.30	180.00	28	Eurostat, city documents
Drinking water consumption, l/person/day – percentage of the national average (9)	117.52	25.41	70.58	158.75	28	Own calculation based on Eurostat data
Volume of waste water, population.equivalent – p.e. (9)	497,523.3	659,589.8	106,497	2,867,796	26	Urban Waste Water Treatment Directive, Urban Waste Water Treatment Viewer 2018
Number of electric car charging stations per 1,000 inhabitants (10)	0.08	0.07	0.01	0.31	28	Chargemap, Electro Maps, city documents
Energy consumption, MWh/person/year (11)	13.70	6.04	4.38	28.06	28	Eurostat, City documents, Covenant of Mayors website, Energy Cities, European Energy Research Alliance
Energy consumption, MWh/capita – percentage of the national average (11)	301.18	128.44	100.55	701.58	28	Own calculation based on International Energy Agency and Statista data
Existence of a climate strategy (2)	1**	1***	–	–	28	Municipalities' websites
Existence of Sustainable Energy Action Plan (SEAP) / Sustainable Energy and Climate Action Plan (SECAP) (11)	1**	1***	–	–	28	Municipalities' websites
Covenant of Mayors membership (12)	1**	1***	–	–	28	Covenant of Mayors website
Aalborg Charter signatories (12)	0**	0***	–	–	28	Sustainable Cities Platform
Circular Economy Declaration signatories (12)	0**	0***	–	–	28	Circular Cities Declaration website
ICLEI - International Council for Local Environmental Initiatives membership (12)	0**	0***	–	–	28	ICLEI website

*First column: The numbers in brackets indicate the related EGCA theme, showcased in the introduction section.
Source: Authors' own calculations.

marized in the final model (Ho, T.K. 1995). The advantage of random forest is that it is not sensitive to multicollinearity (Triscowati, D.W. *et al.* 2020), so it is not necessary to drop correlated variables. It has excellent high-dimensionality, so it does not require a dimensionality reduction procedure, thus, avoiding the risk that reduced dimensions carry information that is not suitable for estimation (Cutler, A. *et al.* 2012). Thus, for variables, only centering and scaling preprocessing procedures were performed.

The random forest model was fine-tuned to produce the following settings. For each decomposition of the decision tree, 20 random variables were included (mtry), the criteria for the partitioning of the nodes were defined by the extra-tree algorithm (Geurts, P. *et al.* 2006), and the minimum number of observations in each node was set to one. These parameters were selected by grid search during cross-validation. Cross-validation was performed using k-fold cross-validation. Although there is no default recommended value for k, most studies use 5 (Zhou, J. *et al.* 2019), so we adopted it. Since the number of finalists and non-finalists was disproportionately distributed across the 100 cities, care was taken to ensure that each breakdown preserved the proportions of these two groups. The k-fold cross-validation was repeated three times.

As the final model, we chose the one with the highest specificity because this model is the best at correctly categorizing non-finalists, meaning it has the lowest chance of misleadingly giving a city false hopes of being a finalist. The reason for this is that our estimator model aims to provide a realistic presentation for cities. As no other analysed city apart from Ljubljana has yet made it to the final, and as overall Central and Eastern European cities do not excel in the competition, it is advisable to exercise caution in the estimation. The model with the highest specificity is the best at correctly classifying non-finalists, so in this case the chances of falsely misleading a city with finalist hopes are the lowest.

Research results

The analysis shows differences in some variables, but we cannot say that applicant cities are clearly more environmentally oriented *(Table 3).* An independent samples *t*-test and the associated effect sizes show that for two variables the effect size is medium, so an observable difference has been found. The values for NO_2 annual mean and energy consumption are more favourable in the case of the potential candidate cities. If the data table of the 100 cities that have applied for the EGCA is analysed together with the cities in the Pannonian Basin have not applied yet, it can be seen that five potential applicants (Subotica, Szeged, Satu Mare, Baia Mare, Debrecen) are among the top 25 cities with the lowest NO_2 emissions even in this sample. While Brasov and Cluj-Napoca are among the bottom five cities overall, Budapest and Zagreb are also in the bottom third of the list.

These highlighted cities also show that even within countries there can be significant differences, especially in Hungary and Romania (Constantin, D.E. *et al.* 2013), which are linked to the city's role in the countrywide transport and industrial network. In Cluj-Napoca, for example, the overall proportion of people travelling by car or public transport is 63 percent, which increases NO_2 emissions, and the fact that the city has a high number of windless days, which means that air pollutants are not being emitted from the city, further worsens the situation (Chereches, I.A. *et al.* 2023). Furthermore, NO_2 emissions are also closely related to the population size of the settlement (Lamsal, L.N. *et al.* 2013). Energy consumption is also strongly determined, as differences in the political, cultural, economic and climatic conditions of different countries can affect spatial disparities in energy use (Borozan, D. 2018). If the energy use of individual cities is compared with the national average, only small effect size level is associated with a more favourable value for the cities have not applied yet.

There is no clear difference between those who have already applied for the award and

Table 3. Results of the independent samples t-tests

Variable	Mean (cities have not applied yet) (n = 17)	Mean (cities already applied) (n = 11)	t	Cohen's d	Effect size
NO_2 annual average	24.543	30.567	-2.088*	-0.808	medium
PM_{10} annual average	25.716	25.865	-0.071	-0.027	–
$PM_{2.5}$ annual average	16.919	15.846	0.861	0.351	small
Number of cars per 1,000 inhabitants	35.882	369.661	-0.516	-0.199	–
Percentage of inhabitants travelling to work by car	41.406	39.045	0.507	0.198	–
Percentage of inhabitants walking to work	23.268	23.954	-0.167	-0.065	–
Amount of waste – percentage of the national average	99.062	95.511	0.345	0.133	–
Drinking water consumption	121.574	120.220	0.127	0.049	–
Drinking water consumption – percentage of the national average	120.778	112.494	0.837	0.324	small
Energy consumption	12.375	15.747	-1.471	-0.569	medium
Energy consumption – percentage of the national average	285.470	325.470	-0.799	-0.309	small

*$p < 0.05$. *Source*: Authors' own calculations.

those who have not applied yet, as confirmed by the Mann-Whitney *U*-test *(Table 4)*. The results show that there is only a notable difference between the two groups in the proportion of people cycling to work and using public transport and recycling (the latter also compared to the national average), as well as in the number of cars per 1,000 inhabitants compared to the national average and in population density. All of those variables have an effect size above the small level.

Of the variables, the proportion of people who cycle to work is the only one that shows a result opposite to the expected pattern, i.e., more people cycle in cities that are potential candidates than in applicant cities. Of the potential candidate cities, Bratislava, Graz and Szeged have rates that are among the highest of all European cities that have already applied for the EGCA. The difference is also somewhat explained by the geographical location: the inhabitants of Košice, Pécs and Brasov, which are partly located on hill slopes and have already applied for the EGCA, rarely use bicycles. However, there is no longer a big difference in the extent of the cycle path network, and in fact the applicant cities have somewhat higher values.

The difference in cycling is also explained by the fact that public transport is much more popular in the applicant cities. Cities that have the worst values in terms of bicycle use (e.g., Pécs and Košice) are among the leaders in terms of public transport usage. Public transport is a priority in all the capital cities surveyed except Ljubljana. In relation to the EGCA criterion "sustainable urban transport", the inhabitants of the applicant cities have fewer cars than the national average, but the difference in terms of travelling by car to work is smaller.

The considerable difference in population density values is influenced by the fact that the potential candidate cities with the lowest population density are located mainly in the lowlands (e.g., Kecskemét, Nyíregyháza, Debrecen), where there was no geographical limit to the dispersion of settlements. However, it is important to note that the population density value does not really tell us much about the compactness of the settlements (which would indeed be a significant

Table 4. Results of the Mann-Whitney U-tests

Variable	Mean (cities have not applied yet)	Mean (cities already applied)	Mann-Whitney U	Biserial rank correlation	Effect size
CO_2 emissions	4.066	3.878	83	-0.056	–
CO_2 emissions – percentage of the national average	81.80	71.45	95	0.079	–
Number of cars per 1,000 inhabitants – percentage of the national average	99.014	94.705	127	0.358	medium
Percentage of inhabitants cycling to work	8.843	3.545	134*	0.522	large
Percentage of inhabitants travelling to work by public transport	25.756	33.454	51.5**	-0.414	medium
Length of cycle paths	0.301	0.480	69	-0.262	small
Percentage of people living in > 65 dB noise pollution	14.834	15.890	87	0.160	small
Percentage of people living in > 55 dB noise pollution	18.098	17.741	96	0.280	small
Size of green areas	15.405	15.152	92	-0.016	–
Proportion of Natura 2000 sites in relation to the area of the municipality	9.032	13.198	69	-0.262	small
Population density	1,140.366	2,269.975	35*	-0.625	large
Amount of waste	339.326	364.551	84	-0.101	–
Recycling rate	19.120	33.254	45*	-0.518	large
Recycling rate – percentage of the national average	71.258	120.558	55.5**	-0.406	medium
Volume of waste water	296,493.687	819,170.881	64	-0.200	small
Number of electric car charging stations per 1,000 inhabitants	0.069	0.111	79	-0.155	small

*p < 0.05, **p < 0.1. *Source*: Authors' own calculations.

factor for sustainability), as it would require a ratio of the population to the actual built-up area rather than to the total administrative area.

There is a considerable difference between the two groups in the value of recycling. This difference remains even when compared to the national average. The data show an interesting pattern, as the Romanian applicant cities have outstanding values at European level compared to the national value, while the Hungarian cities that are potential candidates are mostly in the bottom of the list.

Among the binary variables, the Circular Economy Declaration shows the largest difference between applicant cities and those that are potential candidates *(Table 5)*. Among those already applied, there are three signatories (Ljubljana, Maribor, Budapest), while among the potential candidates, none has signed the declaration. ICLEI membership is also characterised by medium effect size. A total of five cities are ICLEI members, three of which have already applied for the award. All this suggests that EGCA is more popular among cities that are members or signatories of these two organisations.

Table 5. Results of the Chi-square tests

Variable	Chi square	Cramer's V	Effect size
SEAP/SECAP	1.000	0.042	small
Covenant of Mayors membership (12)	0.226	0.294	medium
Aalborg Charter signatories	0.671	0.138	small
Circular Economy Declaration signatories	0.050*	0.430	medium
ICLEI membership	0.0617**	0.3880	medium
Existence of a climate strategy	1.000	0.073	small

*p < 0.05, **p < 0.1. *Source*: Authors' own calculations.

Results of the similarity search

In the similarity search analysis, 24 of the 28 cities were compared on the basis of the seven dimensions created by the MFA procedure (the Serbian cities had missing data and Ljubljana was the benchmark). Based on the analysis, the cities most similar to the winner of round 2016 in terms of their ecological values are: 1. Bratislava, 2. Zagreb, 3. Maribor, 4. Vienna, 5. Graz; the least similar are: 21. Debrecen, 22. Cluj-Napoca, 23. Košice, 24. Oradea. The similarity search also reveals some geographical differences: the western cities are more similar to Ljubljana, while the cities marked in red and orange are all located east of the Danube *(Figure 4)*. The top five cities are very similar or identical in terms of location, culture, history, language use, legislation, and so it can be assumed that they are making decisions and implement sustainable developments according to similar guidelines. Bratislava, which closely resembles Ljubljana, is on track to meet the SDG criteria like no other capital city in Central and Eastern Europe (apart from Ljubljana)[9].

The top five most silimar cities also include Graz, which in Egri and Paraszt 's study was placed in a joint cluster with Ljubljana, called "Innovative Green Cities and Urban Areas". (Egri, Z. and Paraszt, M. 2013). The least similar cities to Ljubljana are mainly those that are major transport hubs (Oradea, Debrecen) or have an industrial past or are currently industrialised (Košice, Cluj-Napoca). Among the cities most similar to Ljubljana, Bratislava and Graz have not yet applied for the award.

Each of the cities in the study scored worse than Ljubljana on only two variables: the length of cycle paths per capita and the amount of waste compared to the national average. In terms of CO_2 emissions per capita, only Budapest, Győr and Kecskemét were slightly worse than the winning city. Târgu Mureș has the lowest number of cars per 1,000 inhabitants (while Graz has the highest value) and also the highest share of pedestrians, while Bratislava has the highest share of cyclists. In terms of green spaces per capita, the Hungarian cities (except Pécs) are in the lead, while Baia Mare has the worst green space coverage. For Natura 2000 sites, the winning city is ranked fourth in our database, and Ljubljana has lower air pollution scores than most cities. Ljubljana ranks in the middle of the pack in terms of night and daytime noise pollution and drinking water consumption, Nyíregyháza has the lowest waste generation (Ljubljana is the fourth). There is no major difference in the amount of waste water treated, but Ljubljana scores poorly in terms of annual energy consumption (per capita). Regarding population density, the Hungarian (except Budapest) and some Romanian cities have values below 1,000 inhabitants/km^2, while the other cities have higher figures.

The position of the Hungarian cities

The ranking of Hungarian cities is as follows: Pécs 6th, Győr 8th, Miskolc 9th, Szeged 12th, Nyíregyháza 13th, Budapest 14th, Kecskemét 19th, and Debrecen 21st. Pécs excelled in the percentage of commuters using public transportation, the representation of Natura 2000

[9] Available at https://euro-cities.sdgindex.org/#/

Fig. 4. Result of the similarity search analysis. *Source*: Authors' own elaboration.

areas within the city, per capita CO_2 emissions, and daily drinking water consumption compared to the national average. These factors placed it among the top three cities. However, its performance in other indicators was somewhat poorer, falling more into the middle range. Pécs benefits from a high proportion of Natura 2000 areas within its city limits due to the presence of the Mecsek Mountains, many of which are located within the administrative boundaries of Pécs and are under various protection statuses. Győr did not rank among the top three in any environmental indicators. In fact, it falls into the bottom three cities regarding per capita CO_2 emissions and the percentage of pedestrians in the city. On the positive side, Győr has the third highest per capita green area in the ranking, with 29.8 m^2 per person. It is surpassed only by Szeged (34.7 m^2/person) and Kecskemét (36.4 m^2/person). Miskolc excels in terms of Natura 2000 areas, where it holds the first position when considering its city size (44.9%). However, it ranks second in terms of PM_{10} and $PM_{2.5}$ levels and third in terms of energy consumption compared to the national average. In other variables, Miskolc falls within the middle range. In Szeged, the lowest percentage of people commute by car to work (23%), while 17 percent of the population cycles to work (ranking third best), and the annual average for nitrogen dioxide is the lowest here at 15.3 μg/m^3. Nyíregyháza ranks third highest in terms of PM_{10} annual average levels (31.9 μg/m^3). However, it generates the least municipal waste per capita annually (228.7 kg), making it the second lowest compared to the national average. Nyíregyháza also ranks third best in recycling with a 47 percent recycling rate.

Budapest ranks third highest in terms of per capita annual CO_2 emissions but only slightly exceeds the national average. It takes the first place in the percentage of commuters using public transportation (45%). However, in terms of daily drinking water consumption (and its value compared to the national average), Budapest does not fare well. Budapest residents use 148 liters of water daily, making it the second highest-consuming city (Debrecen shares the same values in water consumption). Budapest also produces the highest amount of wastewater, which is also influenced by its population size, as it is the second most populous city in the sample. Additionally, Budapest's energy consumption per capita exceeds the national average, ranking it second highest.

Kecskemét and Debrecen show a significant contrast in per capita CO_2 emissions, with Debrecen emitting the second lowest amount while Kecskemét emits the most among all cities in the sample. Kecskemét also stands out for having the second highest difference in the number of cars per 1,000 people compared to the national average (116.9%). Debrecen ranks third best in terms of municipal waste generated per capita (237 kg/person/year), but this does not correspond to a high recycling rate (10%). Kecskemét consumes more energy annually than any other city, including the national average. Regarding population density, Budapest is the most densely populated city, Győr is of average density, and the other Hungarian cities have relatively low population density.

Results of the random forest classification

The AUC of the random forest model run on previously applied 100 cities is 0.74, with a sensitivity of 81.4 percent and a specificity of 40.4 percent. Based on the model, the ten most influential variables are the existence of a climate strategy, the length of cycle paths per capita, the proportion of people using public transport, ICLEI membership, the number of electric car charging stations per population, the exictence of the Aalborg Charter signatory, the proportion of people commuting to work by public transport, population density, the annual average PM_{10} value and recycling. If these variables are examined for the raw data of the 100 applicant cities, it can be seen that the finalists do indeed have better sustainability scores (the only exception being the proportion of people using public transport, where the average for non-finalists is higher). If, therefore, the cities in the Pannonian Basin have good environmental values for these indicators in particular, their chances of reaching the final round of the competition could be increased in a possible bidding process. From the random forest model estimation for 27 cities, the finalists'chances for each city are shown in *Table 6.*

Table 6. The chances of the investigated cities to reach the final round in the EGCA competition

Potential candidates	Probability of reaching the final round, %	Applicant cities	Probability of reaching the final round, %
Bratislava	43.8	Vienna	67.0
Târgu Mureș	32.8	Maribor	32.6
Graz	26.0	Budapest	31.4
Miskolc	18.0	Zagreb	30.6
Győr	17.2	Brașov	14.6
Timișoara	14.4	Arad	9.8
Kecskemét	12.4	Pécs	9.6
Osijek	11.2	Cluj-Napoca	9.2
Szeged	11.2	Košice	6.6
Sibiu	10.6	–	–
Satu Mare	9.2	–	–
Debrecen	8.6	–	–
Baia Mare	8.6	–	–
Nyíregyháza	8.2	–	–
Oradea	5.4	–	–

Source: Authors' own calculations.

Compared to the results of the similarity search presented above, the random forest gives a more accurate estimate, since in the latter case the values of the cities are not compared to a single winning city, but to all winner or finalist cities. In addition, the random forest did not estimate the ranking based on dimensions, created by dimension reduction, but on the values of all indicators, and also took into account which indicators have the most influence on the chances of the outcome of the application. The top ranking based on estimated odds is consistent with the results of the similarity search. Bratislava, Zagreb, Maribor and Vienna all have scores above 30 percent. Vienna's chances are particularly promising, the last time the city applied for the award was in 2014, but failed to make it to the final round. Târgu Mureș has shown a significant improvement compared to its similarity search result, mainly thanks to its favourable population density and air pollution indicators. Oradea is the least likely to make it to the final according to the random forest, which is in line with the result of the similarity search.

Discussion

The study focuses on the examination of cities in the Pannonian Basin with populations exceeding 100,000 based on the EGCA criteria system, for which there are no other existing scholarly examples. Therefore, it can be said that the presented results are novel. The findings of this study gave evidence that there is no significant difference between the two groups of cities in the Pannonian Basin, those that have already applied for the award and those that have not, based on the 33 environmental indicators. However, as Schmeller, D. and Sümeghy, D. (2023) gave evidence, Eastern European cities have less favourable environmental indicators compared to Western European cities.

The most significant differences are observed in air pollution, transportation, waste management, population density indicators, as well as the presence or absence of various documents. It is important to highlight that not all variables are worse for Eastern European cities. For instance, the percentage of commuters using public transport, which is favourable for sustainable urban transportation, is higher in Eastern European cities. However, the number of cyclists and the length of cycling paths per capita are much lower compared to Western European cities. Furthermore, Eastern European cities have lower population density values, which are unfavourable in terms of sustainable land use. The presence of documents related to local governance and climate change is more common in Western European cities than in the East. Therefore, the degree of lagging behind of Eastern European cities, specifically those in the Pannonian Basin, can be reduced through the development of the aforementioned topics, along with changes in political views, goals, and the attitude of local residents.

The chances of cities making it to the final round of the award competition can be influenced by decisions made by city administrations. According to the study by Sümeghy, D. and Schmeller, D. (2023), the intentions of city administrations and the proportion of green-oriented representatives in local councils are correlated with submitting applications. Left-leaning city municipality and a higher proportion of green-oriented representatives in local councils have a positive effect on the chances of application, increasing the intention to apply. However, the studied cities are characterized by predominantly right-leaning city administrations and a low proportion of green-oriented representatives (Sümeghy, D. and Schmeller, D. 2023). The cited literature also reveals that political factors can also be associated with reaching the final round. Making it to the finals is positively influenced by a higher proportion of green-oriented representatives, experience with the award (how many times the city has applied), and a lower environmental index of the local city administration. In the case of Eastern European cities, multiple applications do not guarantee reaching the finals since they perform poorly in other political variables: they have a low proportion of green-oriented representatives in the local council, and due to right-wing party ideologies, economic interests take precedence over environmental concerns. In general, Eastern European cities have a high environmental index, which is unfavourable (Sümeghy, D. and Schmeller, D. 2023). Based on these findings, the question arises as to whether Eastern European cities apply for the award because they genuinely seek change and aspire to become sustainable and green cities in the long term, or if the applications are merely driven by trends and greenwashing.

Obtaining the award is not just about campaigning for sustainable and green cities during elections; it requires long-term commitment and continuous engagement and education of the population. It is worth noting that a city can still be sustainable, green, or resilient even if it does not apply for the award. Amsterdam and Vienna are good examples of this. They applied for the award initially but have not done so since, yet they are considered among the world's most livable cities according to various indices and are leaders in various sustainability initiatives. The results can provide a solid foundation for the potential success of future applications by cities in the Pannonian Basin. However, there is also the possibility that based on the results, a city that has not applied yet might believe it has no chance of making it to the finals, leading the city administration not to submit an application to the European Green Capital Award. It is essential to consider the limitation that the analysis only examined each city based on data from a single year and did not take into account the strength of the competition in a given year.

Considering the trend that the gravitational centre of cities applying for the European Green Capital Award is shifting towards the south and east, prospective cities in the Pannonian Basin may not need to compete directly with cities like Stockholm or Copenhagen, which have outstanding sustainability indicators. Instead, they would be competing with other cities more similar to them. Thus, despite the relatively low percentage shown in the chance estimation compared to all previous applicant cities, if the field of applicants continues to evolve as per current trends, the chances of making it to the finals will inevitably increase. To illustrate this, even though Graz had a chance estimation of only 26 percent, it had a higher chance than any other city that applied for the 2025 round and did indeed make it to the finals. Furthermore, the model only estimates the likelihood of making it to the finals for the first application (when cities typically do not make it to the finals), and it does not account for the positive impact that can emerge based on experiences from previous applications. In the case of a city reapplying, the real chance of success would likely be even higher than the estimated value. Cities can undoubtedly be sustainable and green without the European Green Capital Award, but the criteria and indicator set of the award can be valuable for achieving sustainability goals and measuring the political, environmental, and livability "performance" of cities across Europe.

Conclusions

The results show that cities that have already applied for EGCA have indeed performed better regarding some environmental indicators, but when looking at Europe as a whole and the 100 EGCA applicant cities, the vast majority of the applicant cities from the Pannonian Basin region are in the bottom third of the ranking. Ljubljana's chances of winning were significantly boosted not only by its continuously improving environmental indicators but also by the fact that the city administration submitted their application to the competition five times. This determination to apply for the award was supported by the estimation made using binary logistic regression.

Both the random forest and the similarity search results show a certain geographical pattern, where the further east we go, the less likely the cities are to be finalists and the less similar they are to Ljubljana (the exception in the case of the random forest is Târgu Mureș).

It can be observed that the similarity among the examined Hungarian cities is closer to the successful Western cities than to the previously unsuccessful Eastern ones, indicating that they are making progress towards achieving the appropriate environmental values. However, it is important to emphasize that compared to the Western or Northern winning cities, Hungarian cities tend to fall more in the middle or even towards the lower end of the ranking. In the cases of Pécs and Miskolc, the high percentage of Natura 2000 areas within the city boundaries positively influenced their rankings in the similarity search.

The analysis also identified areas where urban policies should focus locally if the goal is to join the elite club of green capitals. In the cases analysed, the average discrepancies in the individual indicators are generally not striking, but the estimates of the probability of being a finalist provided by the similarity analysis can be quite sobering, as in 33 percent of the cities analysed it is less than 10 percent. Some of the existing differences can be attributed to geographical factors or to local conditions created by path dependency, which cannot be changed in any meaningful way. Examples include population density, topography, which has a strong influence on the use of bicycles, and some energy economy issues, which are partly the result of the national energy mix and partly the result of local economic conditions. These factors are very difficult to adjust locally and in the foreseeable future. However, it is also possible to identify the elements on which a green-capital focused urban development policy should focus: the shortcomings can be addressed with the least investment and in the shortest time in terms of strategic planning and international conventions, organisations. It is also possible to expand the network of cycle paths or electric charging stations with low investment compared to other areas. However, specific analyses focusing on the specificities of the cities concerned are needed to explore the potential effectiveness and investment required for an urban policy that puts the recognition of green capital status at the heart of the local green transition.

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