

SUMMARY BOOKLET OF THE PHD DISSERTATION

DOCTORAL SCHOOL OF EARTH SCIENCES

**Spatial differences in municipal climate protection from the
perspective of decision-making mechanisms**

-

**A proposal for the development of climate-oriented governance
practices based on the example of the city of Pécs**

Óvári Ágnes

UNIVERSITY OF PÉCS
FACULTY OF SCIENCES

PÉCS, 2024

Name and address of doctoral school: University of Pécs,
Doctoral School of Earth Sciences
7624 Pécs, Ifjúság útja 6.

Head of Doctoral school: Dr. István Geresdi DSc,
full professor, head of doctoral school,
Institute of Geography and Earth
Sciences, University of Pécs
Department of Geology and
Meteorology

Doctoral programme: Physical Geography, Geology and
Meteorology

Head of doctoral programme: Dr. habil János Kovács PhD,
full professor, deputy head of institute,
head of the department,
Institute of Geography and Earth
Sciences, University of Pécs
Department of Geology and
Meteorology

Advisors: Dr. Dénes Lóczy DSc,
professor emeritus,
Institute of Geography and Earth
Sciences, University of Pécs
Department of Physical and
Environmental Geography

dr. Viktor Varjú PhD,
senior research fellow,
HUN-REN KRTK RKI

1 Introduction

Climate change is a complex issue that affects various territorial scales, including municipalities. Financial situation, resources, public attitudes, community involvement and climate change legislation influence municipal climate action. These factors are embedded in local decision-making practices in different municipalities in different contexts.

2 Objectives

The objective of climate policy is to make decisions at global, national and local scales, considering the collective set of perspectives from different sectors. In this complex set, the following factors naturally vary in weight over time and from region to region in current climate change decisions: economic considerations, institutional structures and capacities, income conditions, territorial exposure to climate change impacts, political-economic (policy) orientations, and the development of social and individual awareness. The objective of my research is to ascertain how effective local planning, incorporating continuous feedback mechanisms, could provide a framework within which local authorities can cope with the climate change challenges they face while increasing both the satisfaction and resilience of local populations and thus generating economic and social benefits. My research therefore seeks to answer the following questions:

Q1: What strategies might be followed to ensure that local climate change considerations become integral to the local urban decision-making apparatus?

Q2: What strategies can be employed to ensure that dissemination and adaptation efforts receive the same level of attention as those given to action plans supporting local mitigation efforts? In other words, how can local decision-makers ensure that short-term economic interests with rapid results do not supersede the need for consensual decision-making that considers long-term climate protection goals?

Q3: What is the impact of the climate commitments of actors involved in local decision-making on the achievement of medium- and long-term EU climate objectives?

Q4: What paradigm shift is required for climate action to succeed in Hungary?

Finally, based on the results of my research, I formulate **a proposal for a local climate governance framework for the city of Pécs**, which allows for the full dissemination of climate change concerns in urban development practice, while providing the municipality with the ability to actively involve local stakeholders in the planning, analysis and implementation phases, and ensuring long-term climate synergies through continuous benchmarking.

3 Research methods

European cities with similar characteristics to Pécs in terms of status, size and climate challenges were identified to enable a comparative analysis of their climate-relevant decision-making methods. The objective was to develop a representative sample of cities from Western Europe demonstrating good practices, cities from Central Eastern Europe, that are facing climate change challenges and can already provide solution instruments at a certain level, and Eastern European cities and non-EU Member States, that are lagging in climate change evolution. By mid-2022, 14 of the invited cities had completed the questionnaires assessing their climate performance and vision.

The sample is composed of seven medium-sized or large foreign cities and seven Hungarian county seats (see Figure 1). During the study period, ICLEI launched the EU Mission on Climate-Neutral and Smart Cities (NetZeroCities) program. While Krakow was selected from among the sample cities in other countries, Budapest, Miskolc, and Pécs were identified as potential climate-neutral sample cities from Hungary. Therefore, the Mayor's Office of Budapest was incorporated in 2023 into the study, representing a municipality of a distinct size from those included in the preceding categories, yet with a regional central role. to enable a comparison of the status quo of local climate decision-making processes among the Hungarian NetZeroCities.

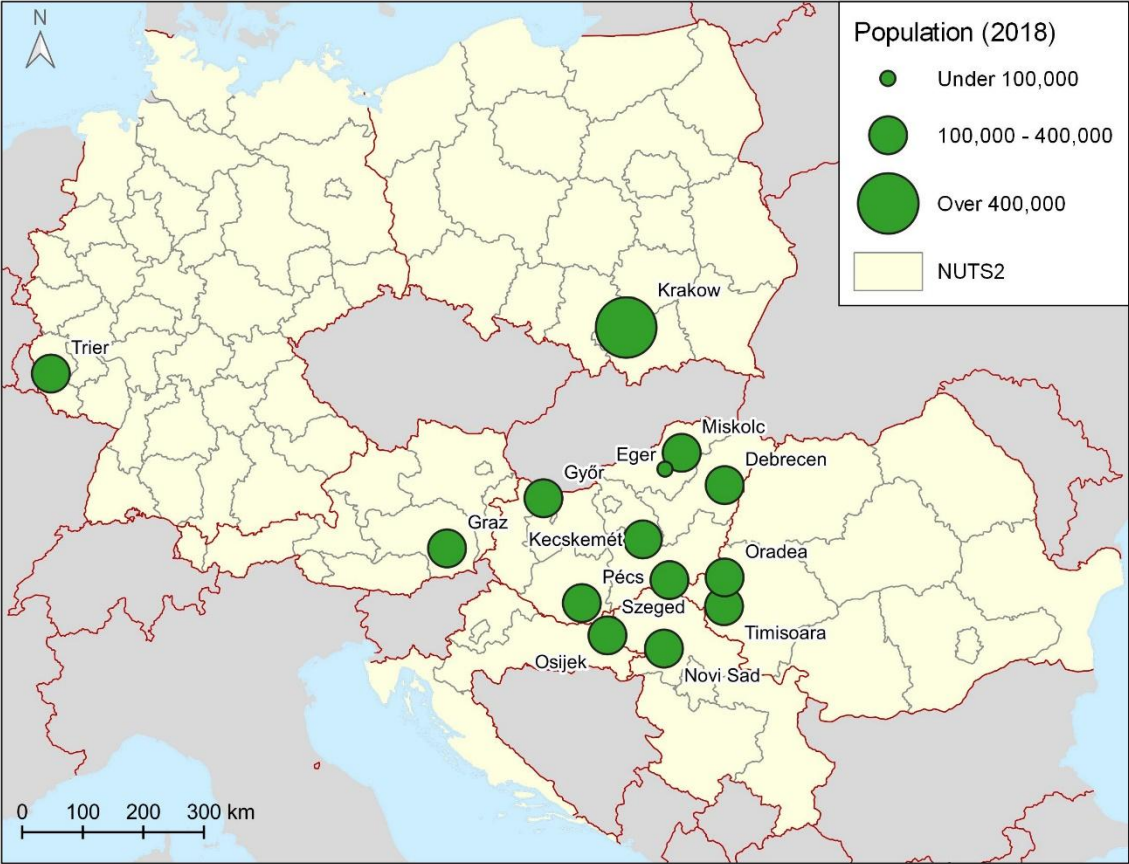
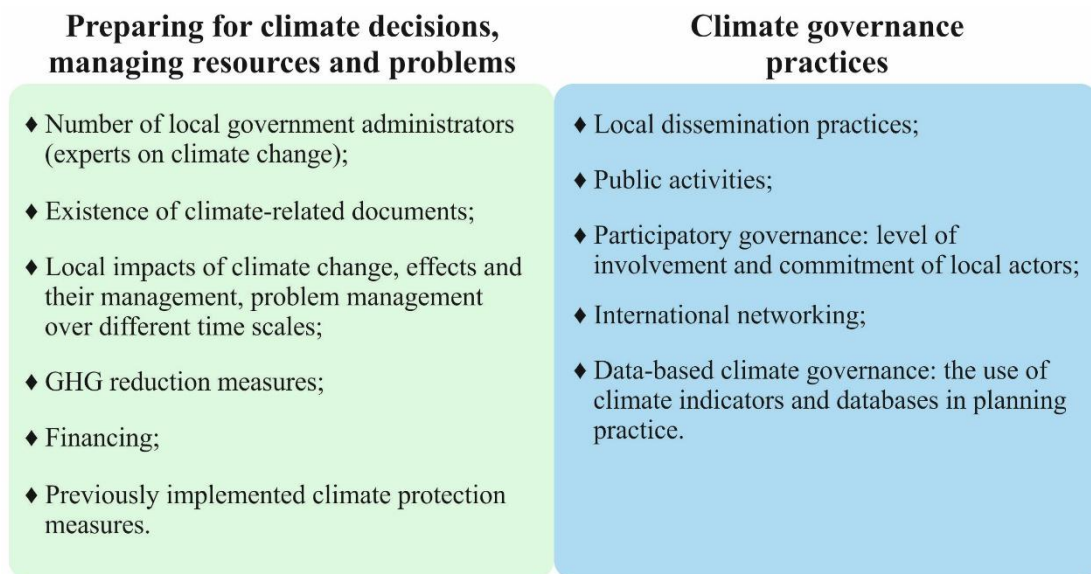


Figure 1. Sample cities by population (source: Eurostat, own editing)

In some cases, the municipal representatives also responded to the in-depth interview questions in writing or orally, which enabled the collection of substantial qualitative data on various aspects of climate protection activities in surveyed municipalities. These included e.g. the characteristics of the decision-making processes and the cities’ future climate protection plans. The quantitative and qualitative responses collected through the questionnaires were evaluated in MS Excel. In the analysis, two principal categories were identified (see Figure 2.):

1. The climate protection measures, resource and problem management characteristics of the municipalities of the sample cities;
2. Analysis of climate governance practices in the sample cities’ municipalities.



*Figure 2. The analysed climate indicators
(Source: own editing)*

The following comparative analyses have been conducted for the two categories of study:

- i. Combined analysis of all sample cities – except Budapest – responding for different local climate protection aspects,
- ii. Comparative analysis of the data and responses of the Mayor's Office of Budapest and the municipalities of the Hungarian sample cities,
- iii. A comparative analysis of the responses of the Hungarian and foreign sample cities – except Budapest –, pattern analysis.

The local implementation of national, EU and global trends, as well as the current legislative environment, influencing municipal climate governance and planning practices, is carried out by several governmental bodies, professional support organisations and experts at the national and EU level. Their perspectives and experiences are essential in interpreting the cities' responses to the questionnaire survey. Therefore, the analysis of the processes behind the data and their expected impacts was carried out through semi-structured interviews with several external experts with different professional backgrounds but several years of experience in climate change-related support functions at the local level. In selecting the 13 Hungarian and 3 foreign interviewees, I aimed to find external experts from the sample cities involved in local climate planning and/or project implementation.

The semi-structured interviews were based on a consistent set of questions, irrespective of the expert's background. In several instances, the interviews progressed into professional discourse, which also permitted me to gain a more comprehensive understanding of the climate policy perspective at the national level.

The interview questions were primarily concerned with the tools and practices that local governments can utilise to become successful in the field of climate protection. In addition, the external and internal factors that shape their climate governance practices were discussed, as well as the lessons learned from any projects, they have implemented that they have been able to incorporate into their climate strategies.

In order to supplement the research methods and gain a more comprehensive understanding of the governance practices of the PMJV municipality, document analysis was conducted in multiple stages. In this

respect, I incorporated relevant findings from previous research carried out in collaboration with my colleagues on the quantitative analysis of climate strategies of Hungarian cities. Furthermore, I examined the climate-relevant strategic documents of Pécs adopted by the Municipality until 2022 and their consistency with climate protection. In this way, an analysis was performed of the range of baseline data used in the planning process, the targets set in the strategies and how they are quantified, as well as the purpose of the documents and their weight in local climate governance.

In a literature review of climate governance practices at the municipal level, I examined the academic research and good practices that have emerged in cities around the world from the 2010s to the present. The literature review aimed to identify governance and decision-making structures that could be applied in the constrained Hungarian local government system. Based on a selection of good practices, I have developed a proposal for a potentially applicable alternative decision-making practice for the PMJV Municipality for the successful implementation of its 100 NZC programme.

4 Results

4.1 Local adaptation tasks

Even though the sample cities – based on the survey –, have faced the consequences of damages in the past, have experienced periods of drought and occasional flash floods, and are facing increasing numbers, lengths and intensity of heat wave periods based on prevailing climate patterns, only a few sample cities are planning solutions for water retention or to mitigate the social and health impacts of heat island effect in the short, medium or long term. For expert interviewees, on the other hand, these are rather important climate considerations. All interviewees addressed or even prioritised, the issues of rainwater harvesting and heat island effect mitigation measures.

Although these issues necessitate a long-term, complex planning approach, the expert opinion is that it is advantageous for municipalities to transition from the prevailing economic approach to climate-friendly planning practices. The implementation of climate protection projects has the potential to induce positive changes in the short and long-term concerning the economic, social and competitive perception of the city.

4.2 Local GHG mitigation and data collection measures

Over half of the sample cities have a coherent development policy that considers long-term mitigation objectives. However, only two of these cities have project management structures aligned with EU climate change objectives. The fact that only two cities are planning to meet the EU's medium- and long-term mitigation targets in their local development policy highlights the complexity of the EU's mitigation strategy for EU cities and the need for cities to change their current practices to meet the targets.

In three of the Hungarian sample cities examined, neither a development policy focusing on long-term mitigation, nor a management approach adapted to EU objectives is observed. The planning practice of Hungarian sample cities in this regard is characterised by a lack of local autonomy resulting from the allocation of resources in Hungary. This is because the project plans of Hungarian cities do not focus on climate protection-oriented development, but rather on the utilisation of development funds currently available within the funding period. This is evidenced by an examination of the content of the climate strategies' action plans and an analysis of the cities' tendering practices, as well as by the thoughts and information provided by national experts.

The results of the survey and the opinions of the experts thus corroborate hypothesis H2, namely that considerations of climate change at the municipal level are present in local decision-making practice, but that local development policy is essentially based on economic considerations.

The efficacy of the implemented mitigation improvements and the GHG emission reduction rates provided by the municipalities are considerably below the EU 2030 mitigation target, except for Miskolc. Furthermore, there is a notable absence of correlation between the resources allocated from the municipal budget and the observed mitigation outcomes. Furthermore, the data demonstrate that the sample cities in the EU Member States have a distinct advantage in terms of the utilisation of subsidy funds compared to Novi Sad, where most of the mitigation efforts have been financed from the local budget.

The survey shows significant differences in project funding between the Hungarian sample cities. Local adaptation projects are not self-funded in the county seats. These rely solely on the central allocation of funds to implement their programmes, which are often unrelated to all other programmes.

The role of climate indicators in conscious planning is significant, but the survey shows an incoherent status quo of the data collection practices among the sample cities. At the time of the research, none of the responding cities had a local database in which data could be systematically collected, maintained, and used for data-driven long-term planning. The main deficits occur in the application of indicators related to resource management.

4.3 Governance practices in the sample cities

The results show that the involvement of external experts working with municipalities has a crucial potential for climate-related decision-making in most of the sample cities. However, according to some Hungarian interviewees, expert governance is not a reality today, at least in Hungary.

The survey data also show that the level of public engagement is equal to or higher than that of decision-makers in only three of the sample cities, suggesting that bottom-up climate governance is not implemented in most of the sample cities and also indicates the low effectiveness of dissemination activities.

The low level of public awareness and engagement also makes the long-term sustainability of projects uncertain, as experts suggest that engaged citizens also understand and support the need to implement projects that may have short-term drawbacks.

Survey data show that the most popular climate protection measures among residents are those that offer rapid and obvious benefits (e.g. cycle paths and greening projects). This also shows that local NGOs can easily transfer a practical approach to the wider society, therefore decision-makers and experts should not focus on technical objectives - e.g. GHG emission reduction targets - in their communication, but on the practical benefits of projects - such as long-term economic profits, the potential for social progress, the potential for neighbourhood revitalisation - to engage their citizens.

This confirms hypothesis H3, that the commitment of urban decision-makers is essential for the success of climate action.

The engagement of local decision-makers can be significantly improved through vertical and horizontal knowledge and experience-sharing networks, international and national organisations and alliances. The experts

interviewed perceive these organisations and their programmes as having significant potential. However, the results of the survey indicate that most of the sample cities are not actively engaged in the work of international climate organisations. Besides this, half of the sample cities prefer not to make use of vertical or horizontal networking opportunities and only half of the sample cities are exploiting the climate protection potential of the local economic and academic actors and civil society. This approach is more frequently observed in foreign contexts, with examples including Trier and Graz. In these cases, professional organisations have been utilised to facilitate engagement with citizens, thereby establishing a framework of participatory governance in the context of local climate decision-making.

In the view of numerous interviewees, the lack of human resources represents a significant challenge for most of the municipalities in Hungary. The questionnaire surveys show that the municipalities with an effective climate protection strategy and project planning based on internal resources have enough officers with expertise in the field of climate protection.

Increasing trust in local leaders in our country could help experts return to their role as supporters of decision-making, as they would not have to be concerned that expressing their professional opinion would be perceived by the public as a commitment to a political party.

However, according to some experts, participatory governance "need not be synonymous with complete service to the will of the citizens", i.e. "a good mayor should be the leader of the city". The latter statement points back to the importance of ensuring synergies in climate change decision-making.

It can be concluded that there is little role for citizens and knowledge transfer at different levels in climate change decision-making in the Hungarian sample cities. In addition, the lack of legal, financial and human resource autonomy in decision-making at the city level provides little room to break through the constraints imposed by centralised funding. Based on these findings, it can be stated that a paradigm shift is necessary in Hungary to achieve the climate goals, although it cannot be assured that the societal paradigm shift - according to hypothesis H4 - will take place in Hungary in the medium term and that this will have positive consequences for the success of urban climate protection in Hungary.

4.4 SWOT analysis

The survey and the in-depth interviews with experts revealed insights into the strengths, weaknesses, opportunities and threats of climate governance practices in the sample cities.

	Facilitators	Barriers
Internal Factors	<p>Strengths</p> <p>Sample cities work with local organisations on dissemination.</p> <p>In most sample cities, the population can be involved in local climate issues.</p> <p>All but one of the sample cities have some level of climate strategy.</p> <p>Sample cities have dedicated external expert groups.</p> <p>The general public is eager to engage in climate action that yields immediate outcomes and offers tangible benefits.</p>	<p>Weaknesses</p> <p>Lack of complexity in responding to local climate challenges.</p> <p>Overstaffing of local government administrators in most of the sample cities.</p> <p>Only a few municipalities are members of a national or international climate organisation.</p> <p>Local developments are assessed on a cost-benefit basis. Long-term climate advantages or disadvantages are not considered.</p> <p>In the majority of the sampled cities, local leaders are rated medium or below regarding climate commitment.</p>
External Factors	<p>Opportunities</p> <p>The work and benefits of national or international climate organisations are known to most of the sample cities.</p> <p>The high level of climate engagement of external expert groups provides an opportunity for appropriate professional cooperation in local climate planning.</p> <p>Seven cities responded with a dissemination rate of between 11-30%, which is a sound starting point for increasing public activity.</p>	<p>Threats</p> <p>Only two of the cities surveyed are currently developing the databases needed for climate-related planning. The other cities do not have a database and do not plan to develop one.</p> <p>In most of the sample cities, traditional (linear) decision-making practices are not conducive to mainstreaming climate change issues at a high level in local development policy.</p> <p>The great majority of sample cities do not make use of direct EU funding.</p>

Figure 3. SWOT analysis of the climate change performance of the municipalities participating in the survey (Source: own editing)

The SWOT analysis (Figure 3) shows that for each sample city, there is still potential to be tapped for successful climate action in

- i. broadening decision-making platforms,
- ii. implementing data-driven climate planning,
- iii. leveraging funding on a larger scale, and
- iv. increasing public activism.

There is a risk that the European Court of Auditors' report (2023) will not be met and that European cities will not be able to contribute sufficiently to the 2030 GHG emission reduction targets unless the municipal structure can stimulate internal processes more effectively and encourage local emitters and stakeholders through cooperation and good examples.

The traditional decision-making mechanisms of local municipalities in Hungary are inadequate for dealing with local climate protection, therefore new methods need to be introduced (H1).

4.5 Evaluation of climate governance mechanisms in Pécs in the light of the survey and in-depth interviews

At present, climate governance is not a priority in the structure of the local government of Pécs. Climate decisions are currently made in a hierarchical, linear decision-making process.

In the case of local projects, monitoring of the climate results is only carried out when required by the fixed framework of the development itself, e.g. the grant agreement.

To achieve success in climate protection in Pécs, motivation for both the general public and decision-makers must be increased.

Nowadays, Pécs's climate protection committee is redundant and determines local development policies based on economic development, without considering long-term climate protection effects beyond what is required by law.

Based on the results of my previous research and the opinions of local experts, the targets set in the 2022 local climate strategy documents do not include a plan for process management, structural change and a willingness to partner with the public to offer a viable solution rather than the current politically driven decisions.

4.6 Suggestions for the restructuring of the local municipal decision-making process in the light of climate change: the case of Pécs

Based on the research results, the restructuring of the decision-making mechanisms of the local government of Pécs is necessary for the successful implementation of local climate protection. The performance assessment framework developed by Jones in 2019, based on an analysis of good practices, defines the key elements of local climate decision-making (goal clarity, measurement, incorporation, and use). The synergies-based local development policy and climate governance built on his methodology require the following minimum requirements to be met:

1. Widespread public awareness and organised education for local government actors involved in climate decision-making.
2. Participatory governance and support for citizens' initiatives in climate protection.
3. Establishing a climate platform for professional interaction with local stakeholders.
4. Creation of a spatial database and implementation of planning based on the use of an indicator system - collection and utilisation of social, economic and environmental data into a complex decision-making process.
5. Promoting climate-friendly decision-making practices in local development and investment.
6. Developing the human resources of the department for climate change in the municipality.
7. The need to redefine the powers of decision-makers and decision-makers in climate governance.
8. The need to introduce multi-criteria analysis of variability and complex development thinking into local climate governance practice to ensure synergies.

The advantage of multicriteria analysis is the ability to consider different aspects of local decisions using quantified indicators. This decision-support method is only a tool. When integrated into the current linear structure of local government in Pécs, it doesn't ensure local implementation of long-term climate goals. This requires

changes in both the current decision-making hierarchy and practice. A model for this is provided by the Jones benchmarking of a circularity-based corporate governance system. Building on these and taking maximum account of the principles of the New Leipzig Charter for Local Governance and Development Practice, I developed a new municipal decision-making flowchart (Figure 4) to support climate-proof governance practices. The new decision-making framework includes multi-criteria analysis, a communication tool and feedback sub-processes. The key aspects of the developed local climate-proof decision-making process can be described as follows:

The first step in urban development is the practical formulation of development needs in the form of **project ideas**. Actors within the municipal hierarchy or external factors can initiate these. The latter may include legal obligations, currently available grants, and the local relevance of good examples, but may also come from actors outside the municipality e.g. from the Climate Platform. The latter is an organisation of external stakeholders, such as citizens, local economic actors, academia, chambers, NGOs, etc., who can formulate climate protection goals and contribute to their implementation based on their local interests.

Dissemination of project ideas is an important aspect from the beginning of the decision-making process, as it ensures the involvement of the communities concerned in the planning process, whether they are inside or outside the municipal hierarchy.

The first step in the decision-making process is the design of **climate-resilient alternatives** of the project idea, in which relevant external expert groups play an important role in supporting decision-making, while the technical coordination of the work remains within the municipality's internal hierarchy. Climate resilience assessment is the evaluation of the vulnerability of local systems, such as infrastructure, ecosystems and social structures, to help prioritise areas for intervention.

Assessing the **integration of climate-resilient project designs** into local strategies and development objectives requires a detailed consideration of social, economic and environmental aspects based on data and expert knowledge. In this process of multi-criteria analysis, the experts can confirm the different local priorities of the project through a commonly agreed project weighting, and also modify the environmental, economic or social focus of the proposed development through feedback mechanisms. The review is based on the collection and aggregation of data into a **database**.

The local assembly of **the municipality decides** on the selected project option by consensus. If it is accepted, the financial conditions will be determined in parallel with the design of the project, coordinated by the local project manager (PVF Zrt.). The municipality will inform the interested parties about the decision and how it will be implemented, involving the relevant **dissemination** organisations.

It is the responsibility of implementers to integrate project performance **indicators** and data, experience and knowledge gathered during the maintenance period into a local database for continuous improvement, as these can be used to plan and implement synergies and interdependent long-term project objectives. Ongoing monitoring and evaluation will ensure effective decision-making and **adjustments** at the appropriate decision level in response to changing climate conditions and new information.

Capacity building is a fundamental prerequisite for the process described above. This means on one hand continuously improving the climate protection toolbox and providing the necessary resources for data collection, and on the other hand training local officials, managers and the public.

The developed decision-making methodology based on circularity and benchmarking outlined above **is generally applicable to municipalities of any size** but also has some limitations in the municipal structure. On the one hand, although decision support systems are an essential instrument for local climate protection efforts and offer a long-term alternative, experience shows that in the short and medium term, external economic and social crises override the course of action, as the buffer capacity and tolerance of local authorities is low, as experts have shown. On the other hand, benchmarking is essentially a corporate governance system based on the operation of profit-oriented economic organisations, where the organisation using the method can use various incentives to make the elements that make up the system interested in maximising profit. However, local climate protection interests are organised around soft concepts that are difficult for stakeholders to conceptualise, such as preventing a mean temperature increase of more than 1.5°C compared to pre-industrial levels. Consequently, for each project, the municipality should set project-specific objectives that stakeholders can identify with, e.g. the increase of property prices, the increase of the quality or reduction of the cost of public services, the improvement of human health services, or the increase of the performance of green spaces.

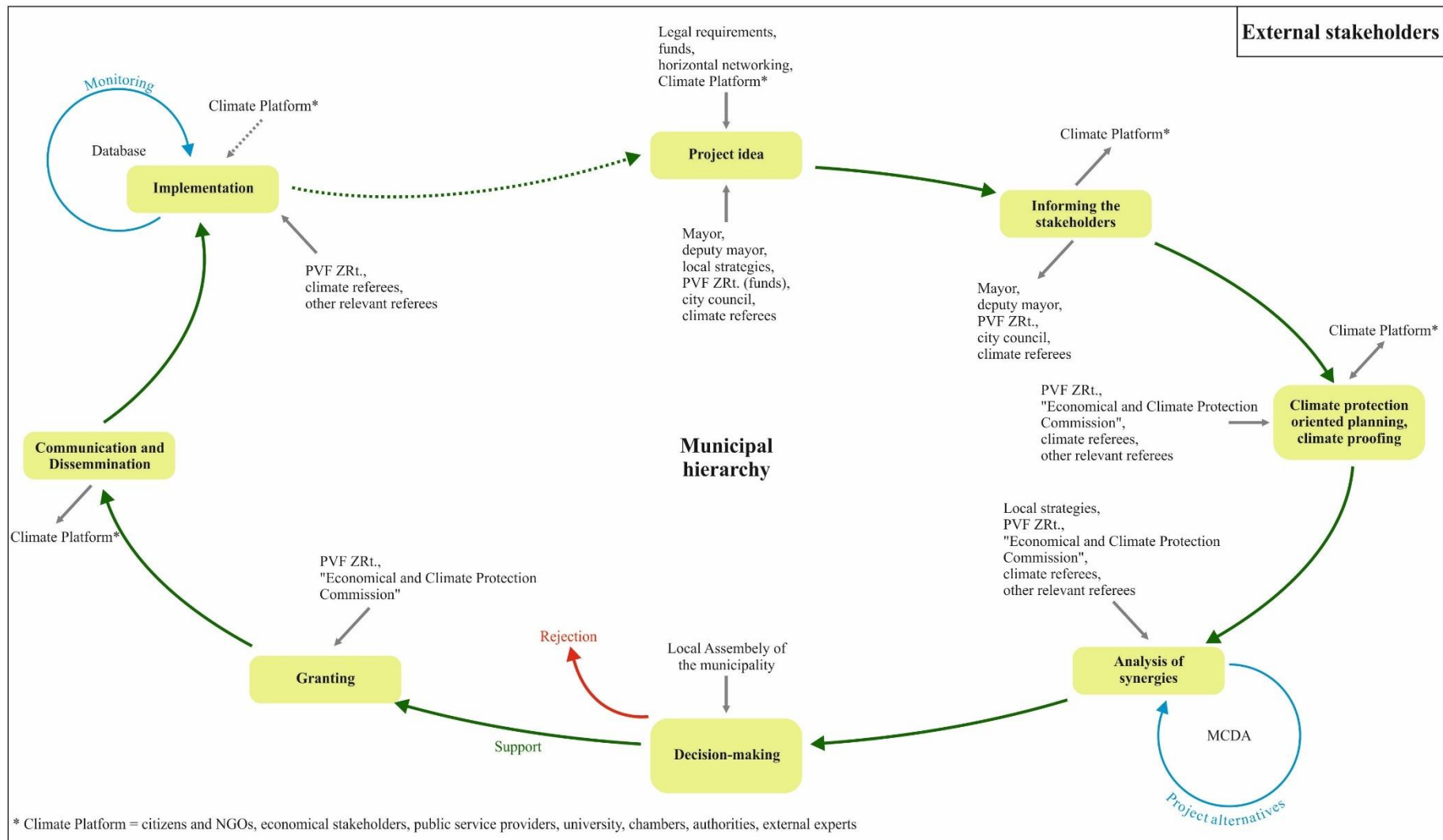


Figure 4. Municipal climate governance plan using the example of the modified decision-making process of the Municipality of the City of Pécs (Source: based on research result, own editing)

Publications

- Varjú, V., & Óvári, Á. (2024). Challenges of applying circular economy principles in urban planning practice in Pécs (Hungary). *Planning Practice & Research*, 1–14. <https://doi.org/10.1080/02697459.2024.2349465>, (Q2)
- Óvári, Á., Farkas, J. Z., & Kovács, A. D. (2024). A klímavédelem realitásai a hazai városokban. *Tér És Társadalom*, 38(1), 110–128. <https://doi.org/10.17649/TET.38.1.3512>, (Hazai A)
- Óvári Á. (2023). A klímaalkalmazkodás forrásai. In Koós B. (Ed.), *Területi Riport* (pp. 298–322). HUN-REN Közgazdaság-és Regionális Tudományi Kutatóközpont, Regionális Kutatások Intézete.
- Óvári, Á., Kovács, A. D., & Farkas, J. Z. (2023). Assessment of local climate strategies in Hungarian cities. *Urban Climate*, 49. <https://doi.org/10.1016/j.uclim.2023.101465>, (D1)
- Varjú, V., Óvári, Á., Mezei, C., Suvák, A. and Vér, C., 2022. Efforts and Barriers Shifting a City Region Towards Circular Transition – Lessons from a Living Lab from Pécs, Hungary. *Future Cities and Environment*, 8(1), p.10. DOI: <https://doi.org/10.5334/fce.157>, (Q2)
- Sanjuan-Delmás, D., Taelman, S. E., Arlati, A., Obersteg, A., Vér, C., Óvári, Á., Tonini, D., & Dewulf, J. (2021). Sustainability assessment of organic waste management in three EU Cities: Analysing stakeholder-based solutions. *Waste Management*, 132, 44–55. <https://doi.org/10.1016/j.wasman.2021.07.013>, (D1)
- Óvári, Á. (2020). Kerényi, A. and McIntosh, R.W.: Sustainable Development in Changing Complex Earth Systems *Hungarian Geographical Bulletin* (2009-) 69: 1 pp. 73-75., 3p. (2020) DOI: <https://doi.org/10.15201/hungeobull.69.1.6>, (Q2)

Conferences

- Miszori, K., Óvári, Á., Czímber, K. (2022). Zöldterületi geoinformatikai nyilvántartó és elemző rendszer fejlesztése. In: Abriha-Molnár, Vanda Éva (szerk.) *Az elmélet és gyakorlat találkozása a térinformatikában XIII*. Debrecen, Magyarország: Debreceni Egyetemi Kiadó, pp. 221-229., 9 p.
- Óvári, Á., Farkas, J. Zs., Kovács, A. D. (2022). Assessment of local climate strategies in Hungarian cities and the potential effects of the Ukrainian war on local climate policy. In: Kajos, L. F., Bali, C., Puskás, T., Horváth-Polgár, P., Glázer-Kniesz, A., Tislér, Á., Kovács, E. (szerk.) *XI. Interdiszciplináris Doktorandusz Konferencia 2022. november 25-26 = 11th Interdisciplinary Doctoral Conference 25-26th of November 2022: absztraktkötet = Book of Abstracts*, Pécs, Magyarország: Pécsi Tudományegyetem Doktorandusz Önkormányzat 253 p. p. 12
- Óvári, Á. (2021). Air Quality Improvement Measures and their Effectiveness in Pécs, Hungary. In: Kajos, L. F., Bali, C., Preisz, Zs, Polgár, P., Glázer-Kniesz, A., Tislér, Á., Szabó, R. (szerk.) *10th Jubilee Interdisciplinary Doctoral Conference: Book of Abstracts = 10. Jubileumi Interdiszciplináris Doktorandusz Konferencia: Absztraktkötet*. Pécs, Magyarország: Pécsi Tudományegyetem Doktorandusz Önkormányzat 347 p. pp. 138-138., 1 p.
- Óvári, Á. (2021). Életciklus-elemzés a települési hulladékkezelésben, mint az üvegházhatású gázok kibocsátásának városi szintű csökkentését támogató eszköz. In: Karátson, D., Nagy, B. (szerk.) *X. Magyar Földrajzi Konferencia = 10th Hungarian Geographical Conference: Absztraktkötet*. Budapest, Magyarország: A Földgömb az Expedíciós Kutatásért Alapítvány (2021) 213 p. pp. 195-196., 2 p