Titel: **Supplementary Materials to the article „Understanding, communicating, and imagining urban biodiversity in Germany and Italy“**

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Supplementary Material

Supplementary Note 1 - Scopus Analysis

To get an overview of the research on urban planning for climate adaptation in cities concerning urban biodiversity, we conducted a Scopus search in July 2024 with the following string: Climate AND Adaptation AND planning AND urban OR city AND nature OR green (limited to Social Sciences and EU, results in English, Italian, and German). 118 documents were found and scanned to collect the information reported below.

The search revealed an exponential growth of interest within the urban studies literature addressing greening and biodiversity concerning climate change-induced challenges in the urban context, especially from 2020. This might be linked to the EU Biodiversity Strategy for 2030 draft or the COVID-19 pandemic (Supplementary Supplementary Figure 1). We checked the geographical location of the case studies investigated in the 118 documents specifically for Europe (Supplementary Supplementary Figure 2). The results show that Germany and Italy have the highest amount, but no research addresses both cases simultaneously. Additionally, we checked for the sizes of the cities these 118 documents address in combination with the publication year. The case studies analysed in these works are for 28% of small- and medium-sized cities, for which we have noticed increased research that addresses smaller municipalities since 2020 (Supplementary Supplementary Figure 3).

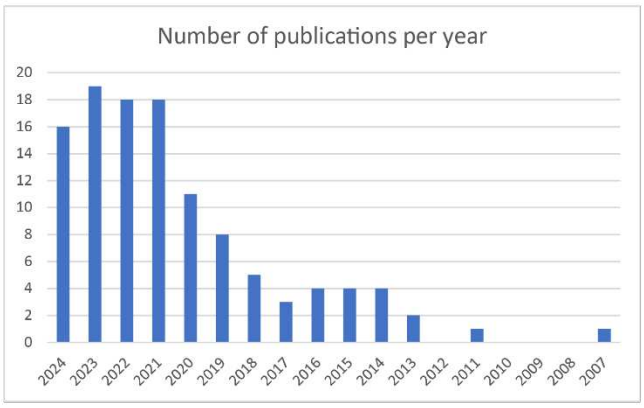
Interestingly, not only urban studies are interested in this type of research. Supplementary Supplementary Figure 4 shows a variety of research fields dealing with urban biodiversity, demonstrating a high awareness for a holistic perspective on this topic, at least in the research. Because of this plethora of research fields, the methods used to investigate urban biodiversity are diverse (Supplementary Supplementary Figure 5). The studies deploy primarily quantitative data science methods to collect and analyse the data, such as modelling or statistical analysis; some literature reverts to qualitative and quantitative governance and stakeholders' analysis, or data collected through surveys and interviews that are analysed qualitatively with content analysis or quantitatively with statistical analysis. The majority conduct document analysis and literature review mainly to deepen specific problems.

Finally, calling for integrating innovative solutions in the portfolio of public administrations, research in this field focuses primarily on uncovering different hurdles in the governance of change and its implementation (Supplementary Supplementary Figure 6). The most common hurdles vary from a lack of cross-collaboration between actors and integration of policy fields, limited funding, knowledge, and personnel resources to misinterpretation and different prioritisation of actions derived from divergent interests [1–4]. Others highlight that the absence of an overarching vision is often the cause of failures, which can let different resistances emerge [5–7]. Still, despite the considerable amount of knowledge generated on possible reasons for low or non-action, the effort undertaken by municipalities in combating climate change and biodiversity loss is considered insufficient.

Among the 118 results, seven documents addressed this issue by analysing the processes of urban biodiversity planning from a discourse perspective. Some refer to the form of the vision itself and its content using qualitative content analysis [8–10] or detailed interviews with practitioners [11]. These studies show that urban biodiversity is somewhat addressed in plans or strategies but is poorly defined, and its relationship to other policies is unclear. Others investigate the alignment of visions to specific discourses rather than others, deploying a discourse analysis [12] or a narrative analysis [13], engaging mainly in a descriptive manner without seeking to uncover implementation gaps. Lastly,

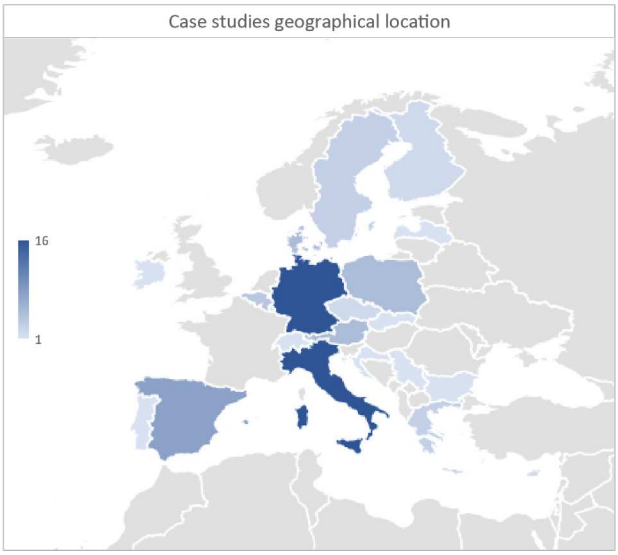
others concentrate on the effort of collaboration building between different actors [14] and different governance elements [15], trying to understand the dynamics behind certain decisions. However, it is unclear how these structures affect the urban environment.

RQ A	In which years are publications on this topic most frequent? Is there a pattern recongisable?		
Reason	To justify the importance of the topic within the European context		
Expectation(s)	The influence from the EU in the European context should be linked to the blossom of research in this field		
Data	2024	16	14%
	2023	19	17%
	2022	18	16%
	2021	18	16%
	2020	11	10%
	2019	8	7%
	2018	5	4%
	2017	3	3%
	2016	4	4%
	2015	4	4%
	2014	4	4%
	2013	2	2%
	2012	0	0%
	2011	1	1%
	2010	0	0%
	2009	0	0%
	2008	0	0%
	2007	1	1%
Findings	From 2019 and 2020 (the years of the EU Green Deal and the EU BDS 2030) an increase in the number of publications is clearly observable. Additionally, if we consider that the scopus search was conducted in the middle of 2024, it is possible to approximately state that the real number of publications in 2024 is double of the number in this graph.		



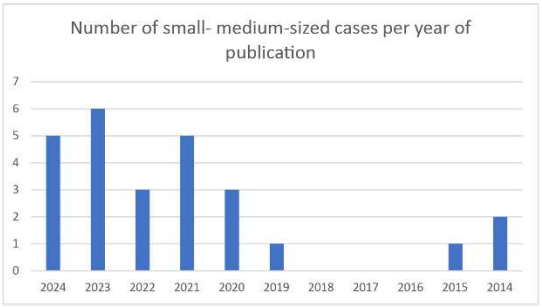
Supplementary Figure 1 Years of publication (authors).

RQ B	In which European countries are located the case studies?		
Reason	To justify the importance of Germany and Italy as cases where most research is done, but nevertheless there are still problems of implementation		
Expectation(s)	Germany and Italy have the highest share among the European countries, but are not addressed simultaneausly although very similar		
Data	Austria	5	6%
	Belgium	4	5%
	Bulgaria	1	1%
	Croatia	1	1%
	Cyprus	2	3%
	Czech Republic	2	3%
	Denmark	5	6%
	Finland	2	3%
	Germany	16	20%
	Greece	3	4%
	Ireland	1	1%
	Italy	16	20%
	Latvia	1	1%
	Luxembourg	1	1%
	Poland	5	6%
	Portugal	1	1%
	Serbia	1	1%
	Slovakia	1	1%
	Spain	8	10%
	Sweden	3	4%
	Switzerland	1	1%
	The Netherlands	15	19%
	UK	12	15%
	Ukraine	1	1%
	Undefined	20	
Findings	Germany, Italy, and The Netherlands are the most addressed cases in this order. Thus Germany and The Netherlands are both nothern countries, Germany and Italy represent the perfect pair. However, there is not a research that addresses perfect pair. However, there is not a research that addresses both cases simultaneausly.		



Supplementary Figure 2 Geographical location of the case studies (authors).

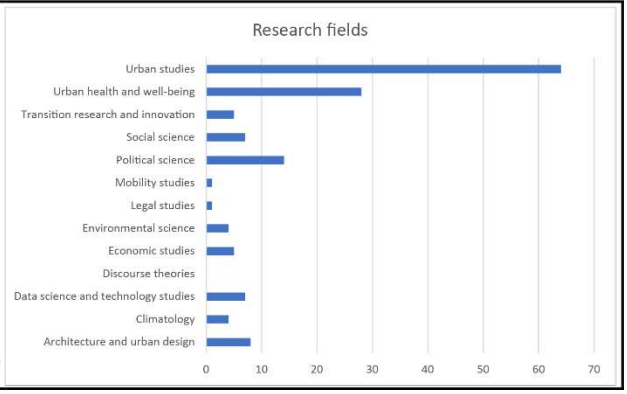
RQ C	Within the case studies above, how many small- and medium-sized cities are analysed?		
Reason	Since my research is about these cases, I am interested in understanding how many publications are dealing with such case studies		
Expectation(s)	Not much research has been conducted on this case studies typology as these cities are not the usual suspects		
Data	Non small-medium	88	
	Small-medium size	25	
	Ratio	28%	
Findings	28% of the publications refer to small- and medium-sized cities which is not a low number. This means that analysing such cases is of interest		
Follow up RQ C1	When was research conducted on these cases?		
Reason	To find out if the anylsis of such cities is a new trend or not		
Expectation(s)	It is a new trend due to the EU influence is in the RQ A		
Data	2024	5	
	2023	6	
	2022	3	
	2021	5	
	2020	3	
	2019	1	
	2018	0	
	2017	0	
	2016	0	
	2015	1	
	2014	2	
Findings	It seems that analysing such case studies is a new trand, especially if we consider that the publications analysed for 2024 are limited to half a year		



Follow up RQ C2	Where are these cases located? In which countries?		
Reason	To understand if there is a majority of such case studies in Germany and Italy.		
Expectation(s)	There is a majority of cases in Germany and Italy. If yes, this confirms the importance of my research. If not, this might show the need to do this in the two countries		
Data	Austria	2	8%
	Belgium	2	8%
	Croatia	1	4%
	Czech Republic	1	4%
	Germany	4	15%
	Italy	9	35%
	Poland	1	4%
	Portugal	1	4%
	Slovakia	1	4%
	Sweden	1	4%
	The Netherlands	2	8%
	UK	1	4%
Findings	Germany and Italy do have the majority of small- medium- sized cities analysed		

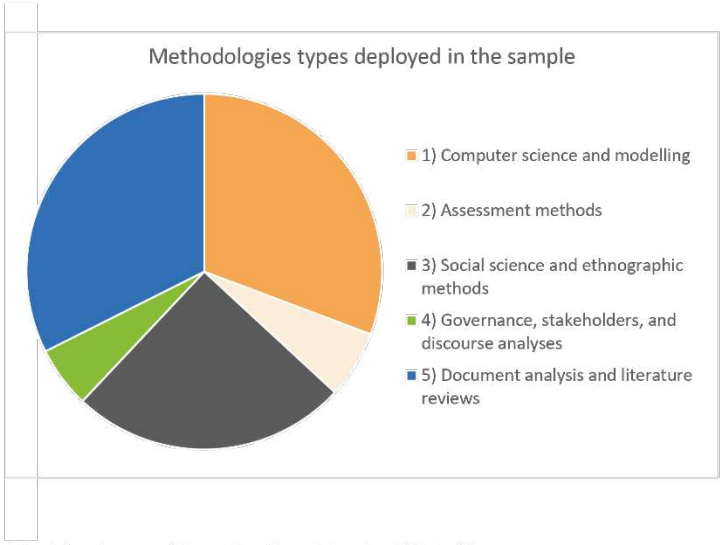
Supplementary Figure 3 Small- and medium-sized case studies addressed (authors).

RQ D	Which fields of research are observable?		
Reason	To find out whether the research are situated within discourse theories or political-related studies		
Expectation(s)	Very few papers frame their research within discourse theories and political studies		
Data	Architecture and urban design	8	5%
	Climatology	4	3%
	Data science and technology studies	7	5%
	Discourse theories	0	0%
	Economic studies	5	3%
	Environmental science	4	3%
	Legal studies	1	1%
	Mobility studies	1	1%
	Political science	14	9%
	Social science	7	5%
	Transition research and innovation	5	3%
	Urban health and well-being	28	19%
	Urban studies	64	43%
Findings	Only 1 publication refers to discourse theories. However, some (10/126) are framed within political studies and decision-making, although very few		



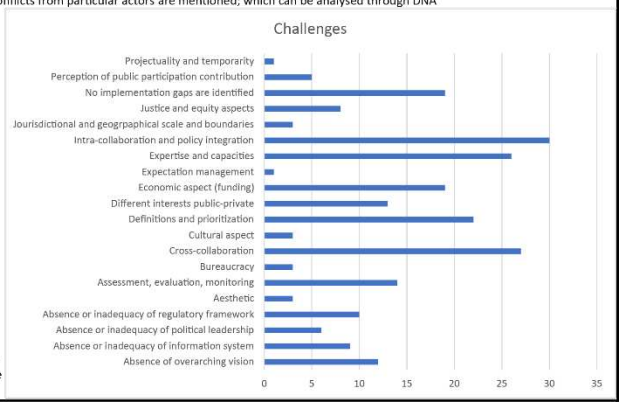
Supplementary Figure 4 Research fields interested in urban biodiversity research (authors).

RQ E	Which methods are used?		
Reason	To find out whether the papers use discourse analysis or similar types		
Expectation(s)	Very few papers deploy such kind of methods		
Data	Analytic hierarchy process	1	
	Attitudinal analytical framework	1	
	Citizens science	1	
	Climate approach	1	
	Content analysis	3	
	Cost-benefit analysis	2	
	Critical case analysis	1	
	Deductive thematica analysis	1	
	Discourse analysis	1	
	Document analysis	34	
	Focus group	1	
	Governance assessment tool	1	
	Governance capacity framework	1	
	Interviews	18	
	Life Cycle Assessment	1	
	Literature review	24	
	Modelling	32	
	Morphological analysis	21	
	Multi-criteria analysis	2	
	Multi-criteria assessment	1	
	Multiple case study approach	5	
	Narrative review	1	
	Network-based analysis	1	
	Participatory observation	4	
	Planning assessment tool	2	
	Qualitative content analysis	1	
	Quantitative analysis	1	
	Selection process of indicators and monitoring framework	1	
	Stakeholder analysis	1	
	Survey	10	
	SWOT analysis	1	
	Vulnerability assessment	1	
	Workshop	2	
Findings	None of the papers use discourse analysis, although some use content analysis and refer to the concept of discourse. Most of the methods can be subdivided as follows		
	1) Computer science and modelling	55	31%
	2) Assessment methods	11	6%
	3) Social science and ethnographic methods	45	25%
	4) Governance, stakeholders, and discourse analyses	10	6%
	5) Document analysis and literature reviews	58	32%



Supplementary Figure 5 Methods delpoyed to investigate urban biodiversity (authors).

RQ F	Which are the gaps of implementation that are mentioned?		
Reason	To find out if the political will, public debate, resistence or conflicts from citizens or other organizations are the main obstacles besides the usual ones.		
Expectation(s)	Beside the usual lack of funding, personnel, time, I expect that political will or resistence/conflicts from particular actors are mentioned; which can be analysed through DNA		
Data	Absence of overarching vision	12	5%
	Absence or inadequacy of information system	9	4%
	Absence or inadequacy of political leadership	6	3%
	Absence or inadequacy of regulatory framework	10	4%
	Aesthetic	3	1%
	Assessment, evaluation, monitoring	14	6%
	Bureaucracy	3	1%
	Cross-collaboration	27	12%
	Cultural aspect	3	1%
	Definitions and prioritization	22	9%
	Different interests public-private	13	6%
	Economic aspect (funding)	19	8%
	Expectation management	1	0%
	Expertise and capacities	26	11%
	Intra-collaboration and policy integration	30	13%
	Jourisdictional and geogrpaphical scale and boundaries	3	1%
	Justice and equity aspects	8	3%
	No implementation gaps are identified	19	8%
	Perception of public participation contribution	5	2%
	Projectuality and temporarity	1	0%
Findings	The top five gaps/challenges/barriers are cross-collaboration, definitions and prioritization, economic aspect, expertise and capacities, intra-collaboration and policy integration. These were expected and potentially applicable to the cases.		



Supplementary Figure 6 Challenges identified (authors).

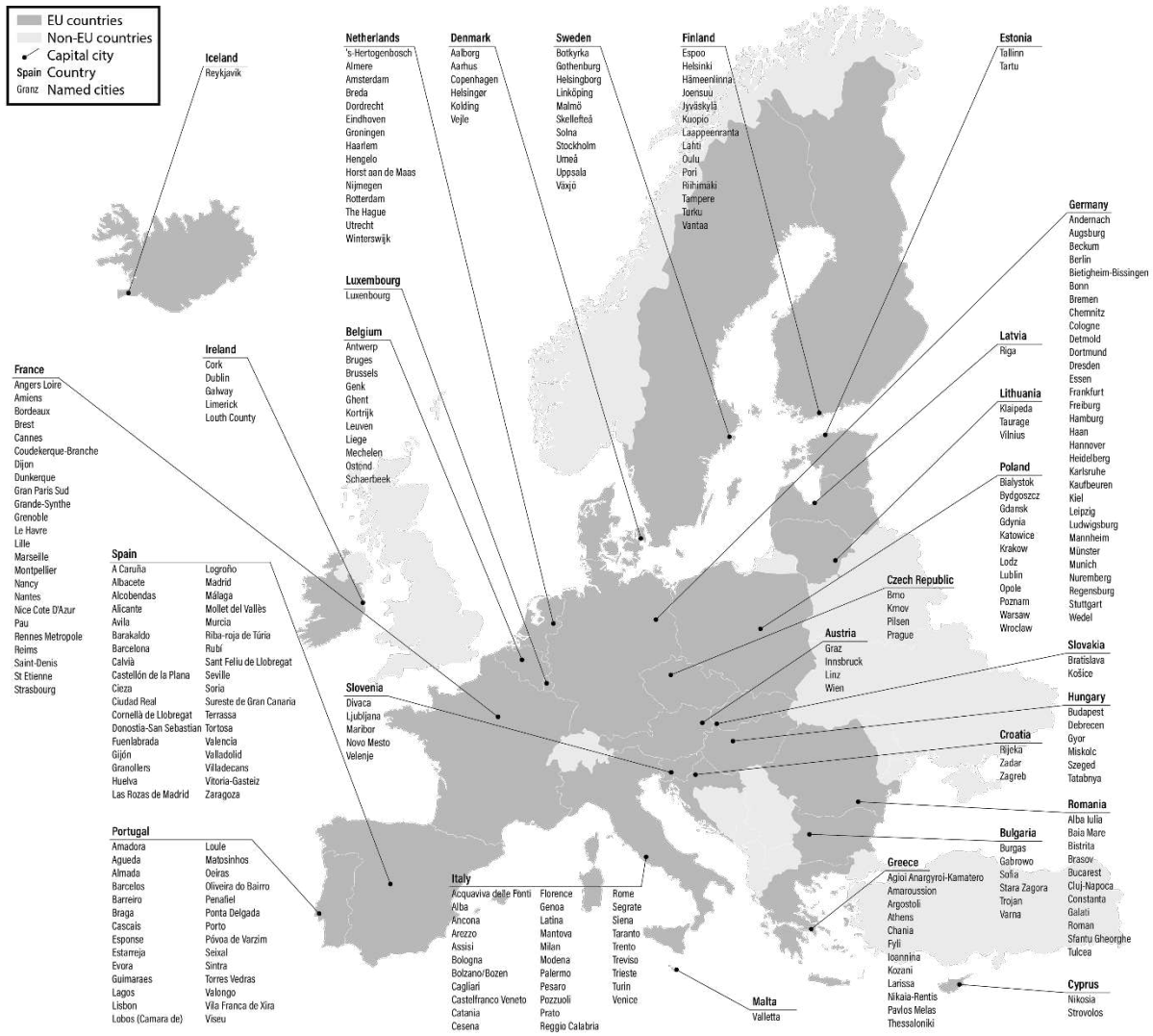
Supplementary Note 2 – Case study selection

The case study selection was conducted to find committed cities in Europe for which we could expect to find enough material on the public debate of urban biodiversity. The selection criteria were based on the work of [16] (2021) and [17] (2018) who analysed the efforts of European cities in drafting urban climate adaptation and mitigation planning documents.

We looked at diverse networks of cities and EU funding programmes to identify the potential cities for our analysis (Supplementary Supplementary Table 1). These cities are depicted in Supplementary Supplementary Figure 7.

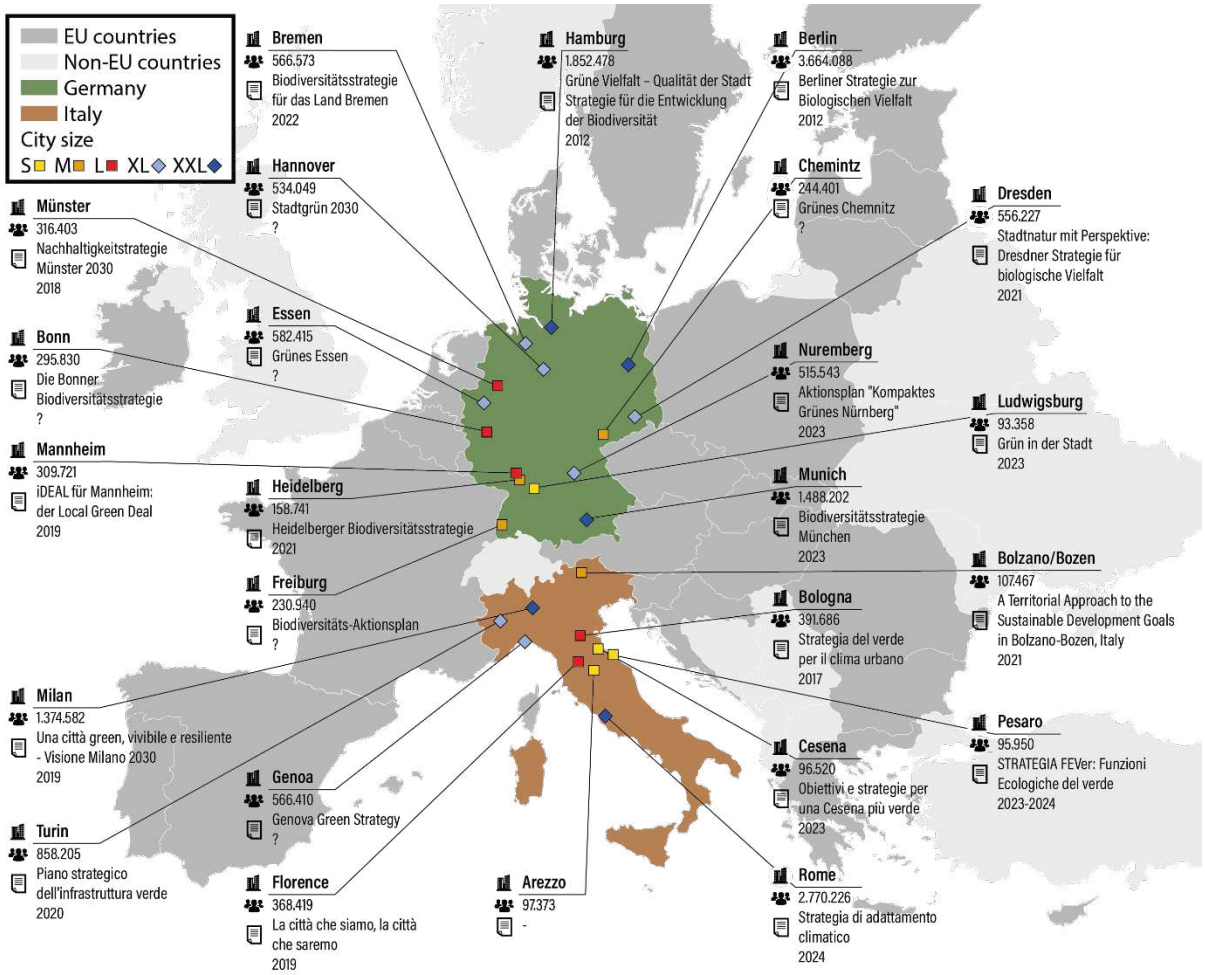
Supplementary Table 1 Lists of screened city networks and EU funding programmes for the case study identification (authors).

Networks of cities	**EU funding programmes**
Gren City Accord	H2020
Eurocities	Horizon Europe
European Green Capital/Leaf	ESPON
C40 Cities	URBACT III
Carbon Neutral Cities Alliance	The LIFE Programme
Climate Alliance	Urban Innovative Actions
Covenant of Mayors for Climate and Energy	
Local Governments for Sustainability	
Resilient Cities Network	
Aalborg Charter	



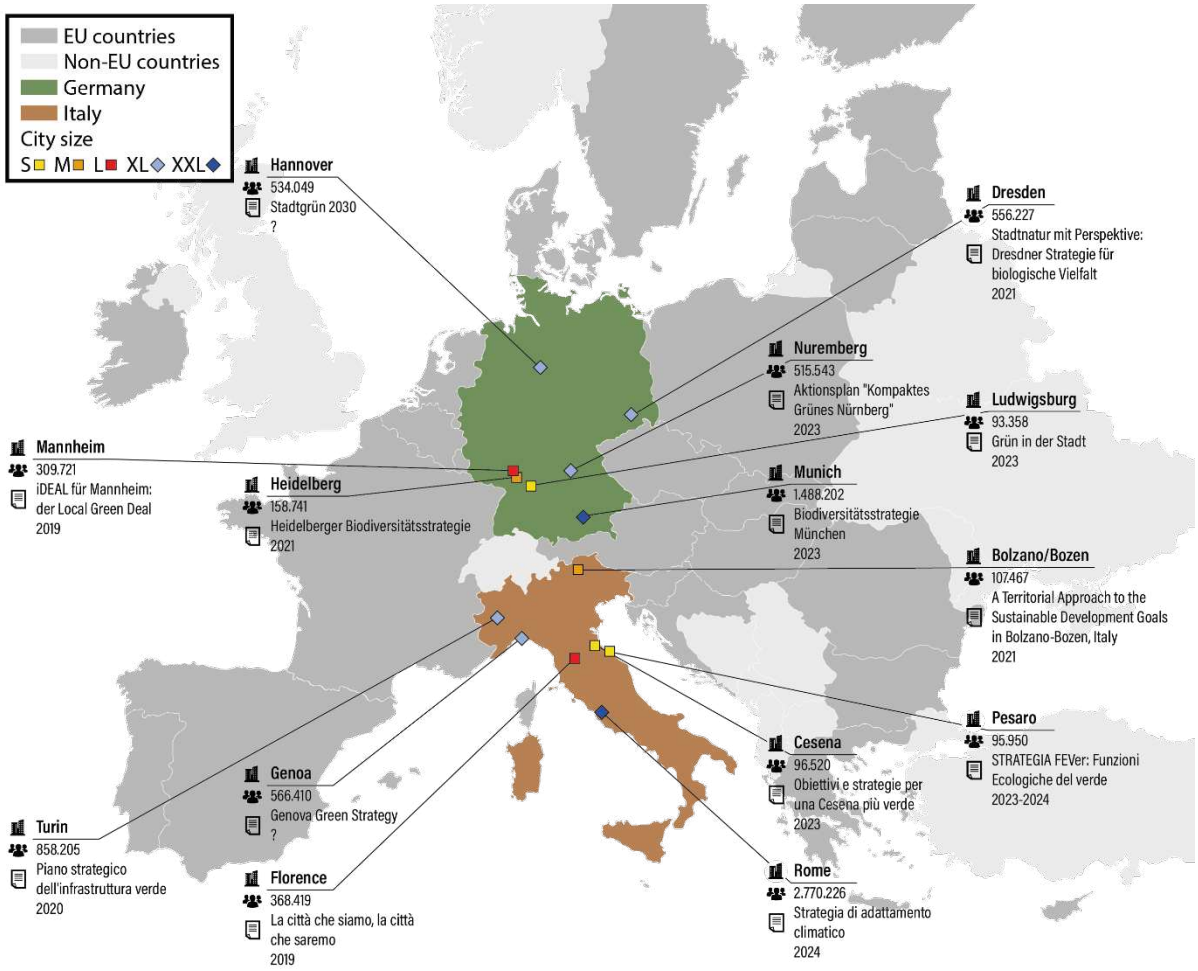
Supplementary Figure 7 Committed cities in Europe (authors).

The following step consisted of eliminating those cities with less than 20,000 inhabitants. The simple count of how many times different cities were mentioned revealed that most were in Germany, Italy, and Spain. The choice was then between Italy and Spain to compare northern and southern Europe. Italian cities were chosen because German and Italian planning and governance systems have more commonalities than Spain's. For the identified German and Italian cities in, we selected the cities named at least 4 times: we got 15 cities for Germany and 10 cities for Italy (Supplementary Supplementary Figure 8).



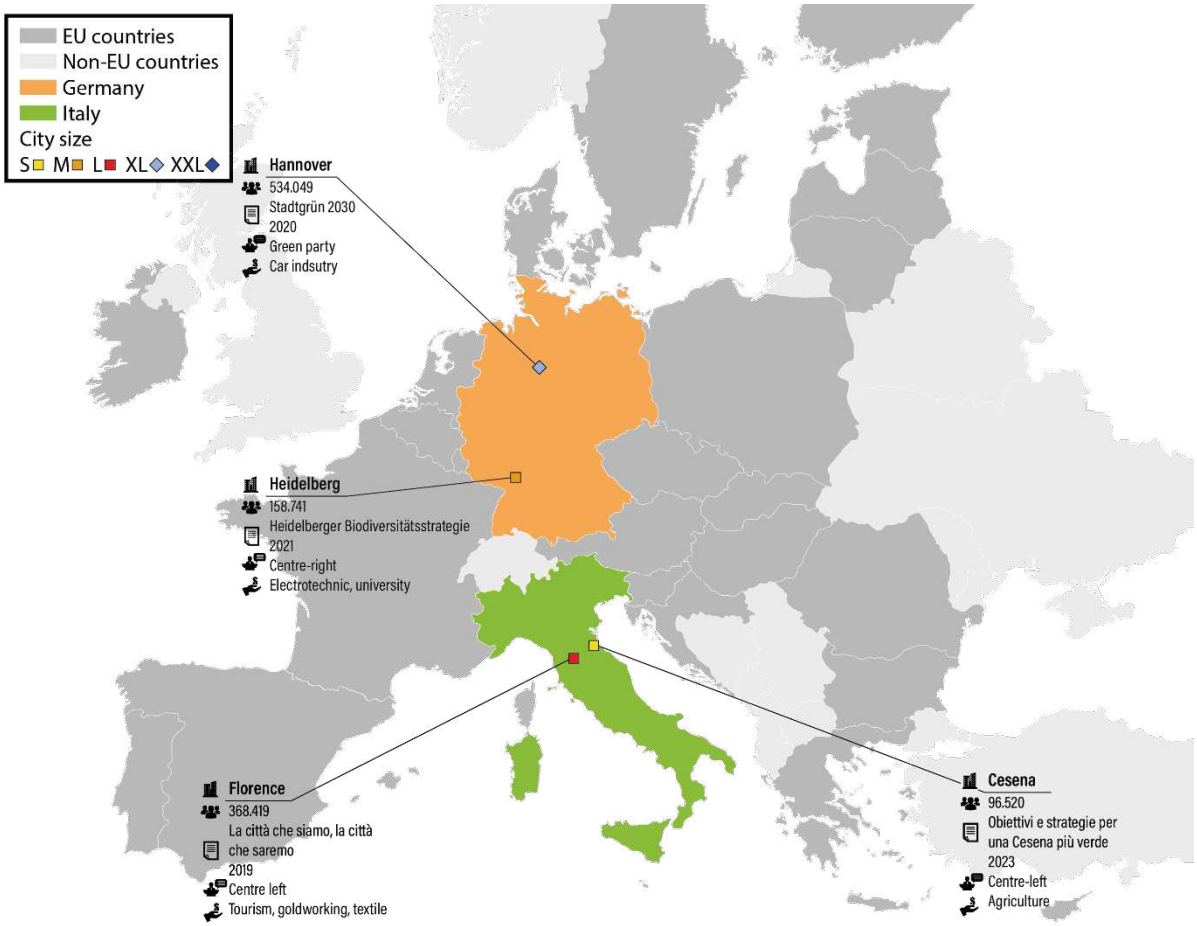
Supplementary Figure 8 Commited cities in Germany and Italy with more than 20,000 inhabitants (authors).

Successively, we have proceeded with the identification of regional regulations, plans, or strategies for each city and the relative planning document at the local level addressing urban biodiversity. We discarded those cities that did not have such a document and cities with special status, such as city-states (like Hamburg, present only in Germany) and capital cities (i.e. Berlin and Rome). These criteria led to the definition of the cities depicted in Supplementary Supplementary Figure 9.



Supplementary Figure 9 Committed cities in Germany and Italy, second step (authors).

The final selection looked at the general availability of data and looked closely at the UGPs found. Additionally, we prioritised the selection of cities located in different federal states (Germany) and regions (Italy) as this level considerably influences local action. Using the matching cities approach, we arrived at the final selection for Heidelberg and Hanover, Cesena and Florence (Supplementary Supplementary Figure 10). The decision to analyse four cities was considered a good number to infer similarities and differences while keeping the volume of data manageable.



Supplementary Figure 10 Committed cities in Germany and Italy, final selection (authors).

Supplementary Note 3 - Organisations and concepts

In this section, we present the main information that we used to code with the dna program. Supplementary Supplementary Table 2 presents all organisations that we have identified with their definition. Supplementary Supplementary Table 3 provides an overview of all concepts identified inductively and deductively and their definitions in case of agreement and disagreement. Creating these definitions is a fundamental step in the coding procedure. In this way, the authors could code individually following the same code book after commonly agreeing on their definition. Notably, the number of ideas in the code book is 35; however, not all were part of the ten most frequent concepts. Thus, the most used concepts are highlighted (in red for German only, in green for Italian only, and in light blue for both), while the others are grey. Finally, Supplementary Supplementary Figure 11, Supplementary Supplementary Figure 12, Supplementary Supplementary Figure 13, and Supplementary Supplementary Figure 14 provide the overview of the entire data set year by year from 2020 to 2024 in each case study. We used one-mode subtract networks of concepts and organisations per year from 2020 to 2024. The visualisation of five concept and five organisation networks for each city results in 40 networks among the four cities. We have decided to focus only on the top 10 frequent nodes to be able to represent and study only the main nodes and their respective relations. The areas of nodes vary according to the frequency by which that specific concept or actor appears, while its position in the network is based on its centrality. The ties' thickness, instead, is based on the weighted betweenness, thus showing the net frequency of time when the two nodes are positively connected. The position of the concepts follows the radial layout, which places the nodes according to the degree of centrality. The organisations are placed close to similar nodes due to the Visone network visualisation software layout algorithm we used.

Supplementary Table 2 Definition of the organisations (authors).

Organisations	**Definition**
Public-sector economy	All organisations from the public sector with some degree of private participation, such as Fondazione Cassa di Risparmio di Cesena (Foundation of the Bank of Cesena), are included in this category. The logic in this area is not primarily profit maximisation but rather the provision of a public service for the population.
Science and education	We categorise scientific research institutes, universities, and other independent or state-funded research institutes or think tanks that are neither profit-oriented nor part of governmental or political organisations. Their main task is the production of scientific studies. This category also includes individuals or organisations in the health, medical, and agricultural sectors (e.g., Società Toscana Orticultura). Schools are included in this category.
Grassroot initiative	This category covers social movements and citizen initiatives that bring together groups of individuals with similar interests. Their organisation is not as formal as that of NGOs. Single, private individuals expressing their views in public debates are included here, too.
NGO	Here, we have included non-governmental actors except those with a clear scientific mission (coded as “Science”). The German legal status “e.V.” indicates that these organisations are not profit-oriented. Hence, we have included non-governmental organisations that are socially or environmentally oriented (such as BUND and LEGAMBIENTE for environmental issues). Trade unions representing employees are also covered in this category (e.g. Confcommercio).
Politician	This category includes political parties and other political organisations (such as think tanks/organisations affiliated with/working for political parties) not part of the public administration, i.e., not in a governing position. It also applies to the representatives of a political party within a governmental institution (e.g., Bundestag MPs affiliated with the Green Party).

Public administration	These organisations belong to the government and administration of a city, region, state, or nation. Examples are ministries (Bund or Länder), authorities, courts, and all organisations affiliated and led by governmental actors.
Economy (better than third sector)	This category contains all economic actors, private firms, and business associations with a clear profit-maximising focus (S.p.A. and S.r.l.). This category also contains environmentally oriented economic actors (e.g. Aboca and Bioplanet).
Citizen	Single persons who act in a general manner without belonging to a specific organisation mentioned above.

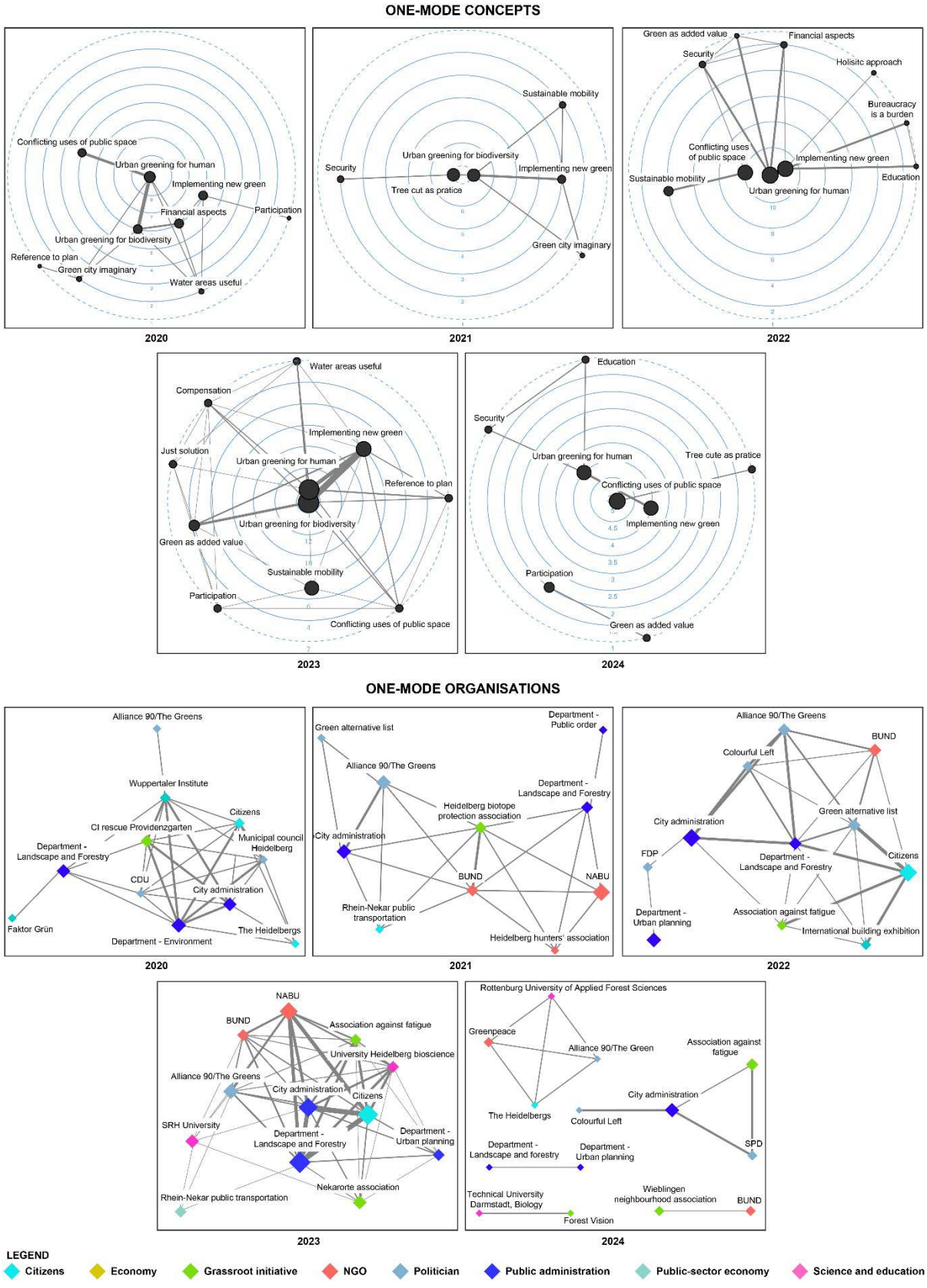
Supplementary Table 3 Definitions of concepts agreements and disagreements (authors).

Concept	**Agreement**	**Disagreement**	**Explanation**
Urban greening for biodiversity	Urban greening is for nature, i.e. biodiversity increase is the scope	Urban greening is not for nature, i.e. biodiversity increase is not the scope	Urban greening can be realised for human benefits, e.g., air quality and reduced temperature, as well as for nature (plants and insects). Measures to improve the health of plants, animals, and insects are to be included here. When the word biodiversity is mentioned
Urban greening for human	Urban greening is for human	Urban greening is not for human	The opposite of the above. When the benefits (or not) for humans are expressively mentioned, e.g. health, leisure, aesthetic...
Holistic approach	Considering green together with other policy sectors - through a holistic approach - is important	Considering green together with other policy sectors - through a holistic approach - is not important; punctual solutions are better	It is important to point out that a strategic, holistic approach spread all over the municipality is needed.
Green city imaginary	Green city concept is good; we should invest in it	Green city concept is not useful	The green city concept can be supported or not. Is it worth investing in this concept? Use this code only if the green city concept (or biodiversity city / nature-based city) or ideas of a greener future are expressively mentioned.
Other imaginaries	Integration with the green city concept	No integration with the green city concept	This is linked to the above one. Here, the focus is on other concepts. The key is understanding whether these other concepts (e.g. smart city, etc.) are used with the green city or against it.
Trust in the institutions	Actors trust the democratic approach of the municipality	Actors mistrust the democratic approach of the municipality	Although municipalities try to be open to suggestions, the ways and means to do it can be criticised by citizens who do not feel represented by the politician and do not share the same democratic value

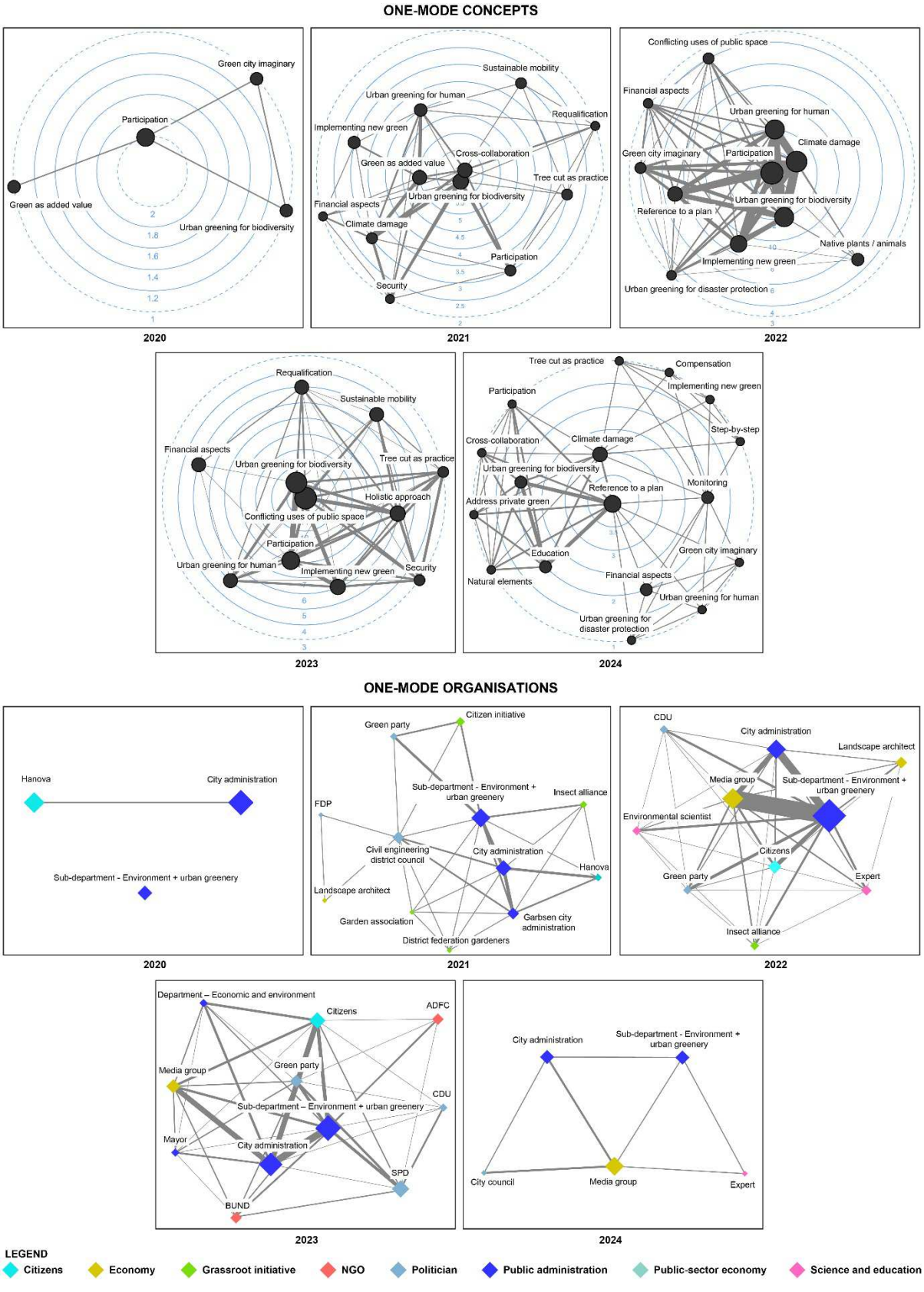
Financial aspects	It is important to talk about funding; more economic incentives are needed to implement greening measures; costs are not barriers, but investment	Costs are barriers; we cannot invest in green	Some actors bring up the question of costs when it comes to realize greening interventions. Usually, more financial incentives are adduced as reasons to allow the implementation of greening measures, thereby blocking the implementation.
Natural elements	Natural elements measures are key to addressing urban challenges	Natural elements measures are not key to addressing urban challenges	Natural elements as tools for sustainable development
Sustainable mobility	Sustainable mobility measures are key to greening	Sustainable mobility measures are not key to greening	Sustainable mobility as tools for sustainable development
Sustainable building	Sustainable building measures are key to greening	Sustainable mobility measures are not key to greening	Sustainable building as tools for sustainable development
Binding by law	It is necessary to have a law that makes greening binding	A binding law for urban greening is not necessary	Some may think that a more standardised approach can hinder the greening process, while others require rules referring to other levels of governance (national, provincial ...)
Regulations are barriers	Law and regulation are barriers to implementing green	Law and regulation are not barriers to implementing green	Existing laws and regulations are regarded as impediments to acting freely, preventing greening measures
Bureaucracy is a burden	We have too many steps, and the process is too long and costly to implement green	Bureaucracy problems can be overcome by implementing green	Stages, processes, time, costs ... bureaucracy is sometimes an impediment to proceeding with the implementation of greening measures
Reference to a plan	Guiding framework, such as the greening plan, is necessary	Guiding framework, such as the greening plan, is not necessary	The plans (of various types) are mentioned in the articles. The scope is to find out if the reference to a plan serves to strengthen the argument or as a barrier
Security	It is important to control the green areas for security reasons	It is not important to control the green areas for security reasons	Security in cities is a hot topic in Italy. Not only about natural catastrophes (especially hydrogeological risks) but also about security in public parks. Some actors refer to the need to install cameras or to have police agents controlling public areas to prevent "undesired" practices
Green as added value	Green is important to be considered in other interventions	Green is not important to be considered in other interventions	I notice that mobility is a big issue in these cities. Usually, when they talk about new projects, greening is always mentioned
Tree cut as practice	It is necessary to cut trees for development	It is not necessary to cut trees for development	Especially in Florence, I have noticed that many news refers to tree-cutting

Greenwashing	The measure can be categorised as a greenwashing action	The measure is not a greenwashing action	The word greenwashing does not have to be specifically mentioned, but it can be derived from the context
Requalification	It is important to manage and improve the existing besides the implementation of new green	Management and improvement of greening is not important	It refers to the necessity of working with the existing or to implement new. Usually, the former is less costly, and sustainability-related reasons against land use consumption accompany it; the latter is linked to the necessity of creating new things
Participation	We need to engage with citizens for a successful implementation of greening measures	Engaging citizens is costly and more of a burden, with the risk of conflict	Public participation of citizens (or laypersons) is considered very important in the urban greening literature to increase trust, knowledge, and learning
Cross-collaboration	It is necessary to collaborate with different stakeholders	As less stakeholders as we can is easier and better	It refers to the importance of working with different types of stakeholders, opening up the process to people outside the public administration, such as NGOs, businesses, etc. (not to confuse with citizens participation above)
Implementing new green	In favour of implementing new greening areas	Not in favour of implementing new greening areas	This covers all implementation types related to greening, e.g. tree planting, community gardening, etc.
Address private green	importance of addressing private green through public policies as well	Private green should not be addressed	Every green area in the city counts. Dealing with private green is more difficult than public green from the administration's perspective
Climate damage	Trees or green infrastructure suffer due to climate impacts	Climate change does not affect green infrastructure	Climate impacts on green spaces and plants are causing damage that has to be replaced. Sometimes, other plants have to be used instead.
Health issues	Health issues due to sick trees	Urban green is healthy for the people living there	The framing of nature can be that this causes potential health issues such as sick trees with fungal disease
Water areas useful	Water areas are important for plants and living quality	Water is not necessary for parks	Water resources are important for green spaces and should be included in green areas.
Education	Education regarding urban nature and climate impacts is key to transforming cities	Education is not helpful, people know already enough	Educating and raising awareness among urban actors plays a role in the general acceptance of urban biodiversity and its implementation
Urban greening for disaster protection	Urban greening is useful for protecting from natural disasters and climate change	Urban greening is not useful; other solutions are better	Many measures linked to urban biodiversity are led by the goal of climate mitigation and adaptation

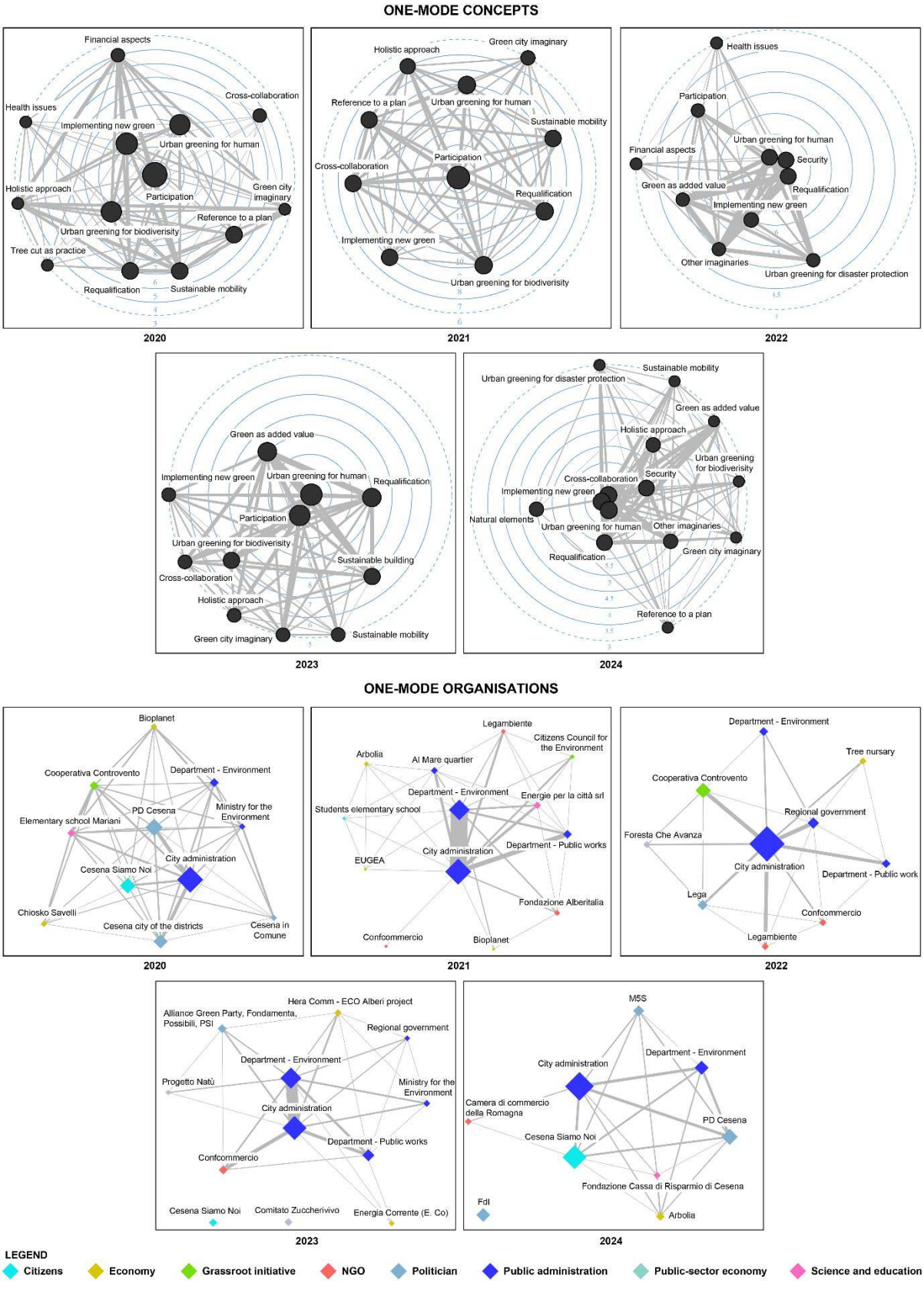
Compensation	Replanting trees as a form of compensation is a good practice	Healthy trees should not be cut, and compensating for their cutting is not a solution	Urban biodiversity can be fostered a priori or as a side effect
Conflicting uses of public space	The public space should be used for other important things, such as parking lots	No, the public space should be primarily used for greening of the city	Land use in public spaces is an important resource in cities
Native plants/ animals	Native plants and animals are better for the green spaces because they do not harm the animals/plants here	Other exotic plants/animals from Asia or other countries are sometimes better due to changing weather conditions	There is a debate regarding the use of only native plants vs uses of plants in general; this is a debate specific to Florence, for example
Fine bad behaviours	It is necessary to introduce fines for bad behaviours	Fines are useless and do not lead to any change	Wrong behaviours should be addressed, but the ways to do it can be many
Transparency	The process was transparent and open to everyone	The process was not transparent	This concept refers to the entire process and the inclusion of different actors also in terms of information, while 'participation' is mainly citizens and relates to co-creation
Tourism	Urban greening is important for promoting tourism	Tourism is critical, and we should stop it	In Florence, some actors criticise the fact that too many tourists are present in the city, while the municipality speaks about the added value of greening for tourists
Monitoring	Maintenance and monitoring of greening are necessary	We do not need maintenance and monitoring of greening; it can grow by itself	Monitoring is one fundamental step of the UGP; it allows to keep track of the impacts of the measures implemented



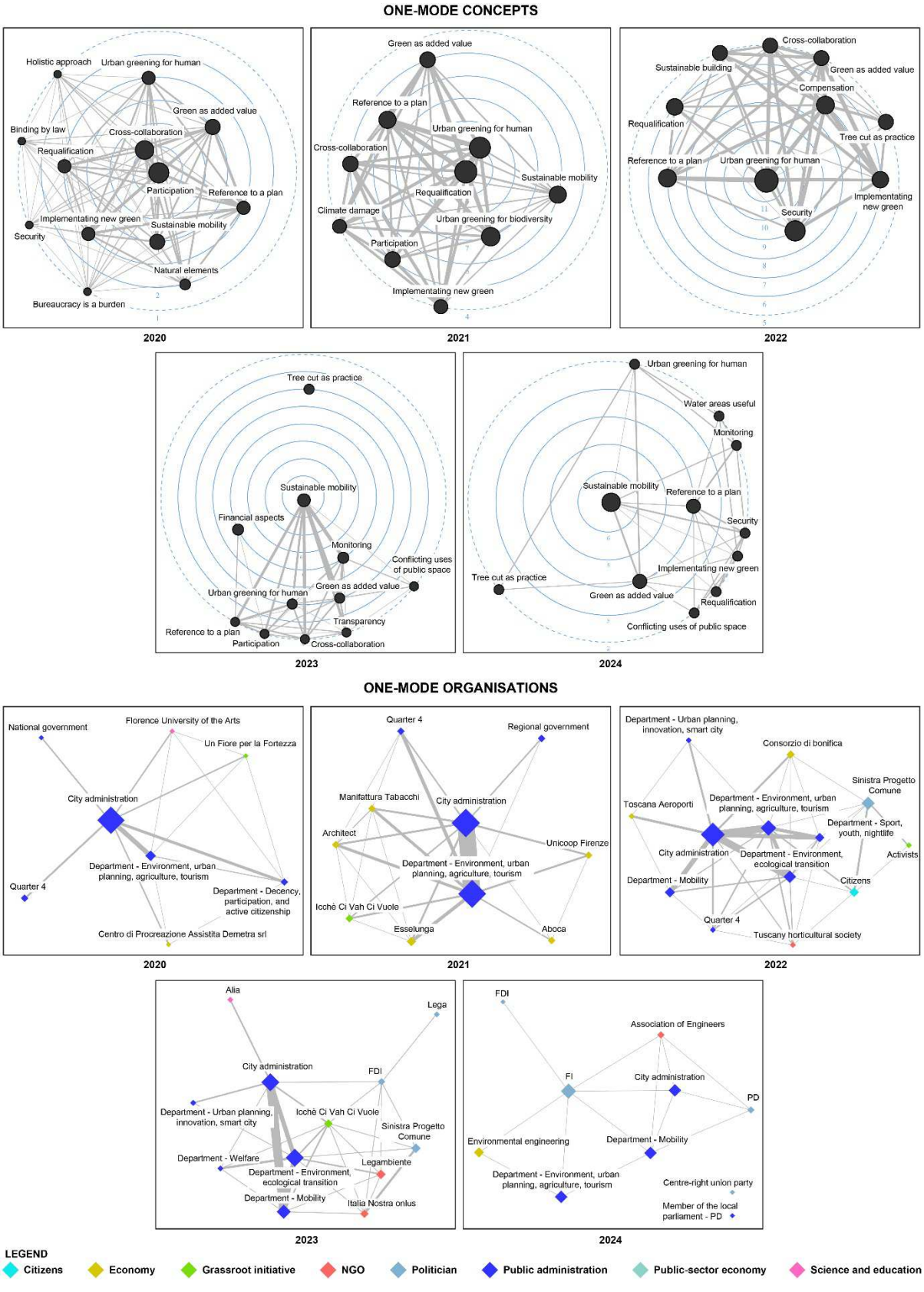
Supplementary Figure 11 DNA results year by year for Heidelberg (authors).



Supplementary Figure 12 DNA results year by year for Hanover (authors).



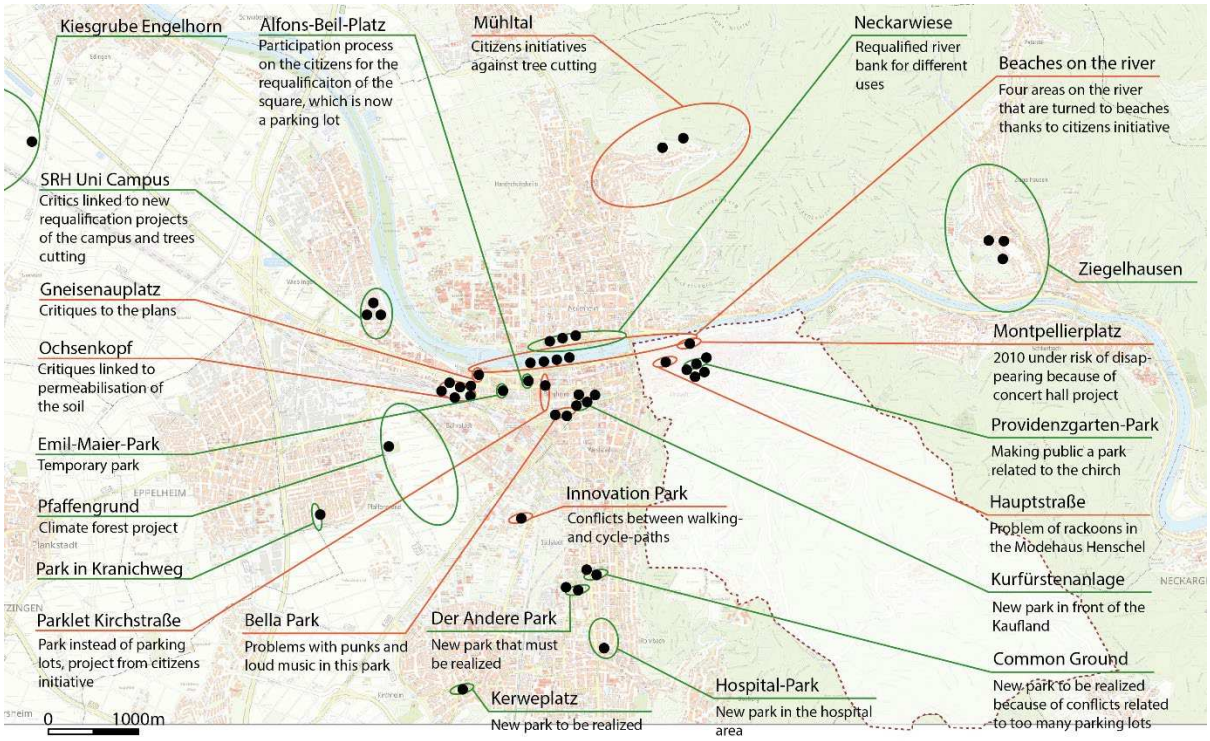
Supplementary Figure 13 DNA results year by year for Cesena (authors).



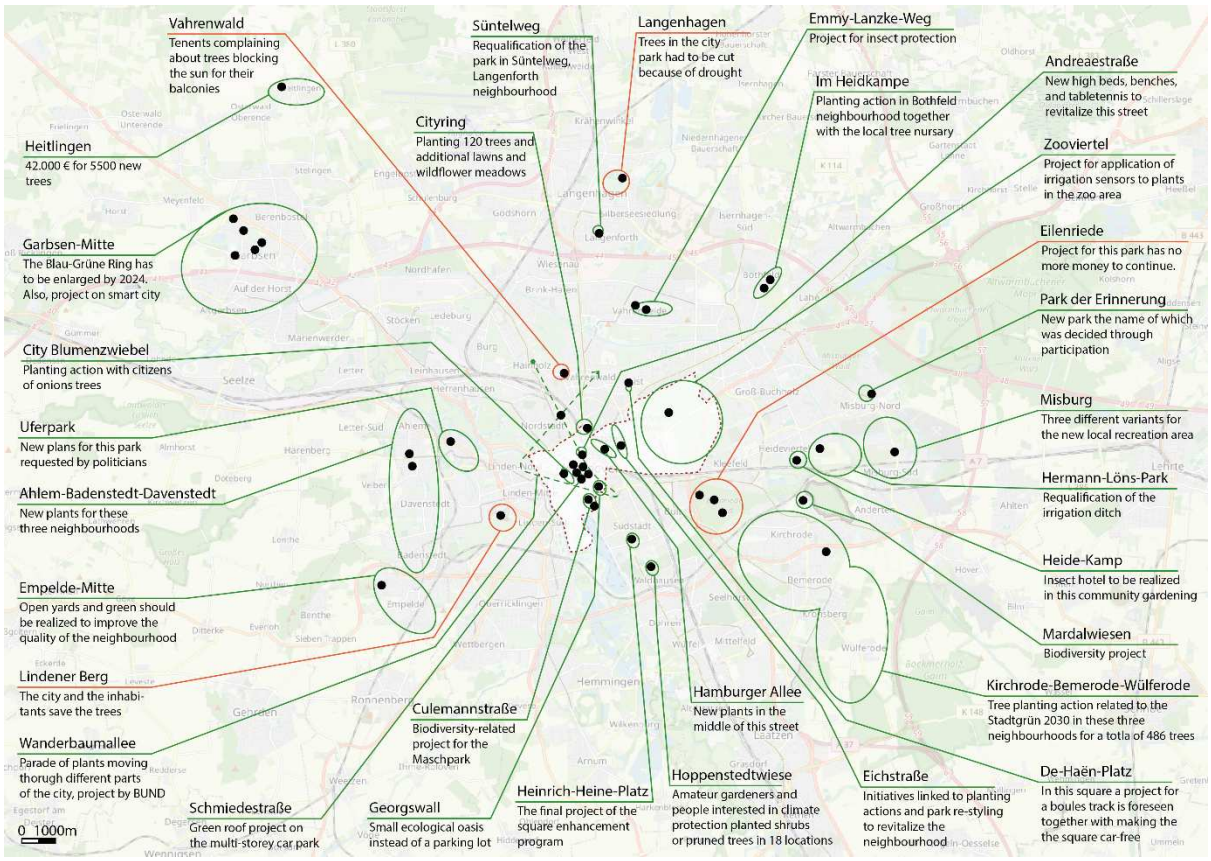
Supplementary Figure 14 DNA results year by year for Florence (authors).

Supplementary Note 4 – Spatialization of the public debate

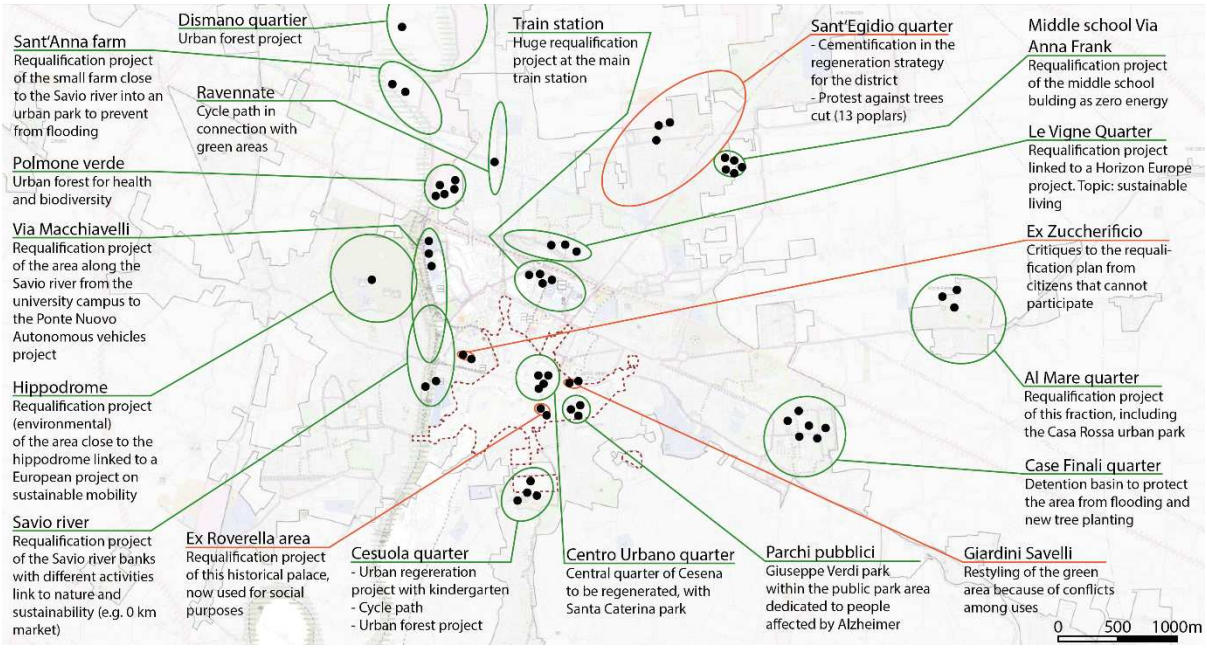
In this note, we depict the detailed maps for every city analysed with the description of each project.



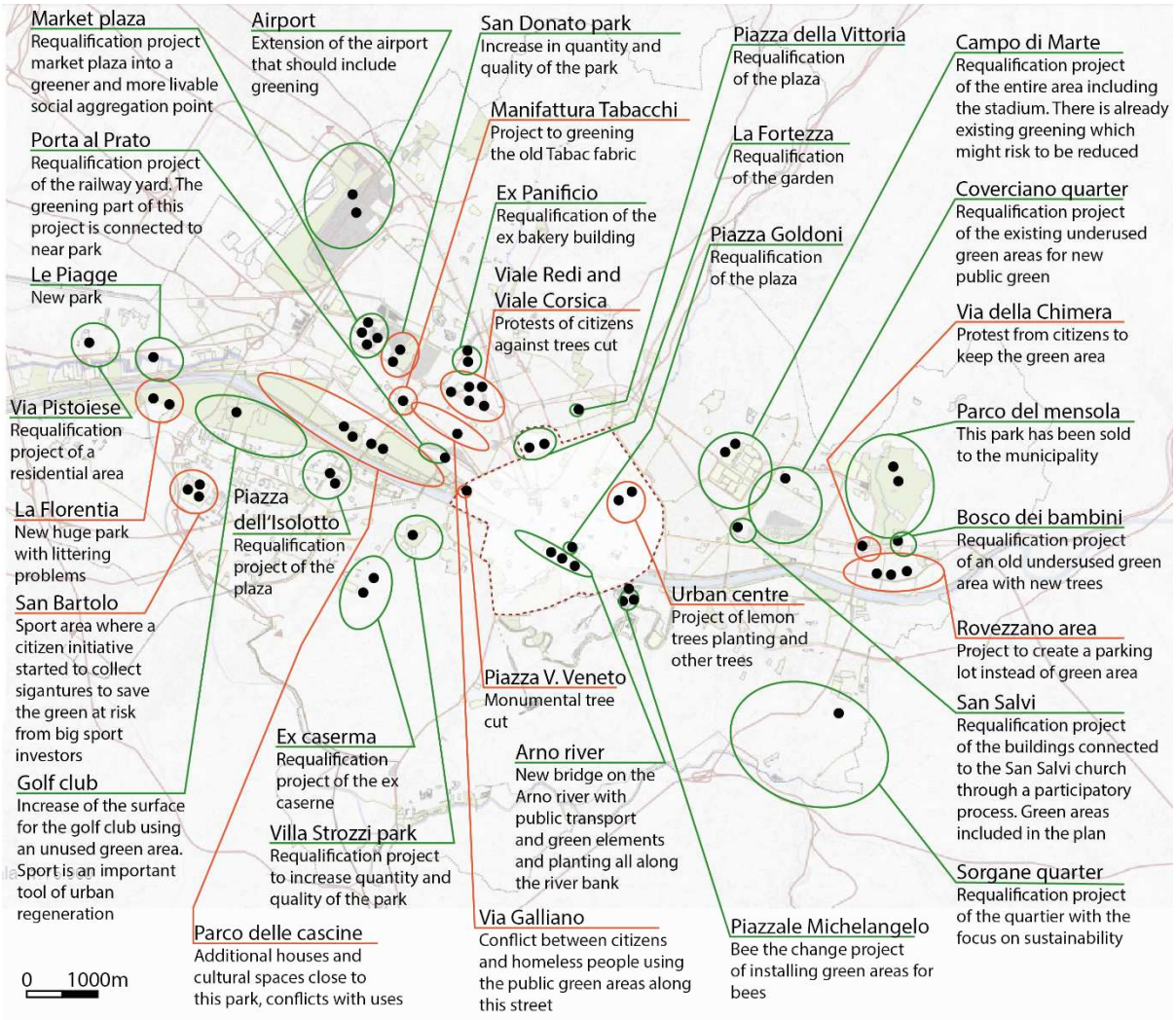
Supplementary Figure 15 - Spatialisation of the public debate in Heidelberg (authors).



Supplementary Figure 16 - Spatialisation of the public debate in Hanover (authors).



Supplementary Figure 17 - Spatialisation of the public debate in Cesena (authors).



Supplementary Figure 18 - Spatialisation of the public debate in Florence (authors).

Supplementary Note 5 – Interviews

In this section, we provide additional information about the interviews that we conducted for this study. Supplementary Table 4 provides an overview of the structure used for the interviews. Supplementary Table 5 shows the characteristics of each interviewee.

Supplementary Table 4 - Semi-structured interview guidelines. The question contents change slightly according to the case study and the interviewees' expertise

0 About you
Can you briefly introduce yourself by giving me information about your role within the institution where you work?
1 Definitions of urban biodiversity
As a concept, urban biodiversity is very complex and vague. Can you define what urban greening is for you in two or three sentences?
2 Process of plan/strategy draft
How did you experience the process of creating the plan? If I read it correctly, the Green Team was quite interdisciplinary. How were you approached to work on it? Do you think there was a need for a green plan? Did you draw on existing tools? How much thought is included about urban biodiversity?
3 Impression of public debate
What is, in your opinion, the level of awareness in the public debate? Are there other conflictual topics, such as more pressing issues?
4 Alternative pathways
Do you think [name of the city] is on the right track to implement a good urban green system based on the plan? What would be the next steps? Or what is missing?
5 Further actors:
Do you have additional contacts that you think I could interview to get another point of view?

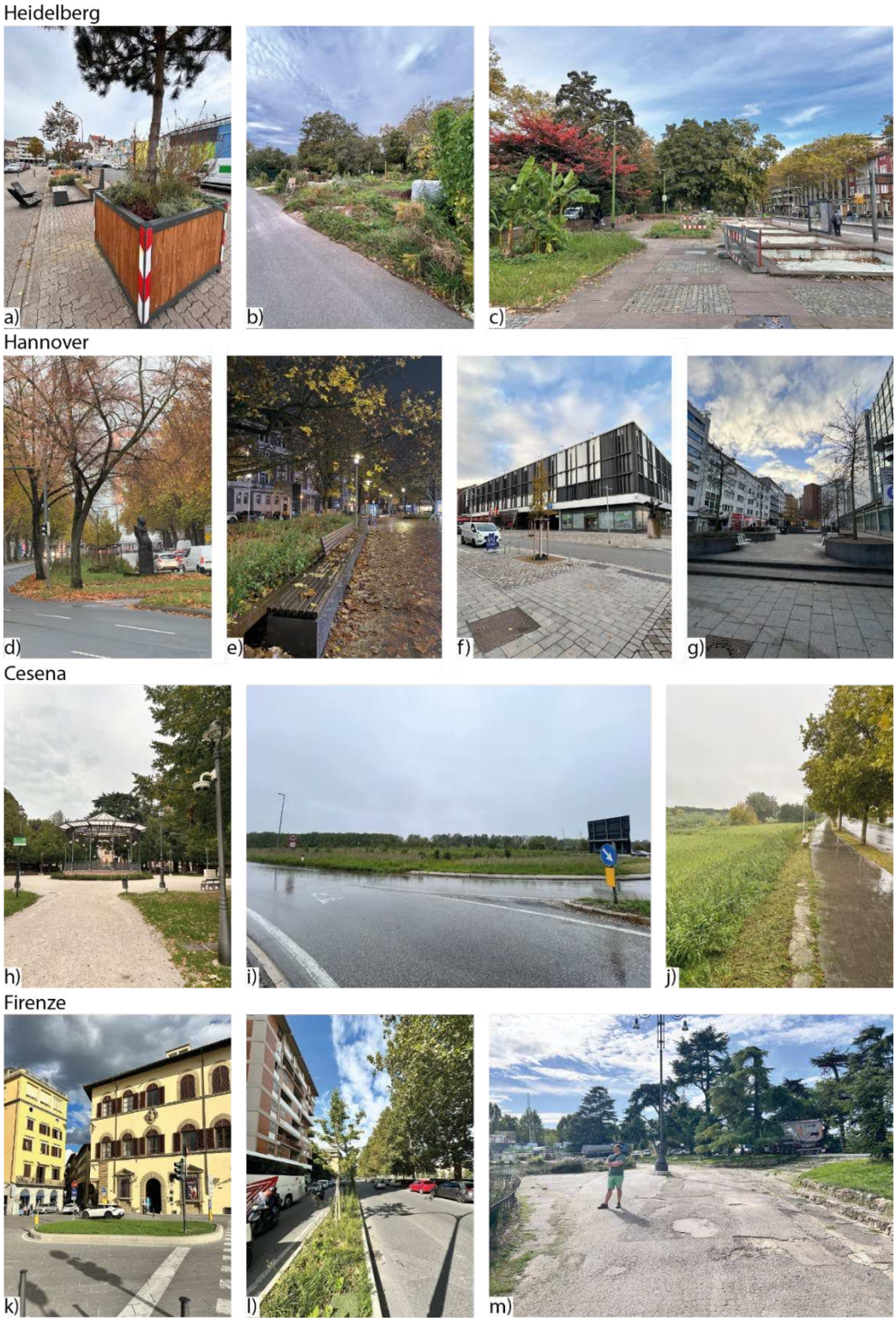
Supplementary Table 5 - List of interviews conducted.

City	Code	Organisation type	Date	Duration	Mode
Heidelberg	*HE_1a* *HE_1b*	*NGO* *NGO*	*21.10.2024*	*00:56:03*	*Online*
	HE_2	*Public administration*	*25.10.2024*	*00:46:57*	*Online*
	HE_3	*Public administration*	*29.10.2024*	*01:01:27*	*Online*
Hanover	*HA_1*	*Public administration*	*23.10.2024*	*00:47:46*	*Online*
	HA_2	*NGO, public administration (retired)*	*24.10.2024*	*00:51:30*	*Online*
	HA_3	*NGO, public administration*	*04.12.2024*	*00:50:47*	*Online*
Cesena	*CE_1a* *CE_1b*	*Public administration* *Public administration*	*02.10.2024*	*00:54:32*	*In-person*

	CE_2	*Grassroots initiative*	*03.10.2024*	*00:50:34*	*Online*
Florence	*FI_1*	*Public administration*	*11.09.2024*	*00:42:59*	*Online*
	FI_2	*Science and education, economy*	*01.10.2024*	*00:54:41*	*In-person*
	FI_3	*Economy*	*28.11.2024*	*00:54:04*	*Online*

Supplementary Note 6 – Fieldwork

To have a real-life impression about the projects mentioned in the newspaper articles, we visited the four cities between September 2024 and November 2024. Supplementary Figure 19 shows the impressions about some of the projects.



Supplementary Figure 19 - Pictures from the fieldwork: a) Emil-Maier-Park, b) Ochsenkopf, c) Kurfürstenanlage, d) Hamburger Allee, e) Heinrich-Heine-Platz, f) Schmiedestraße, g) Andreaestraße, h) Parchi pubblici, i) Polmone verde, j) Via Macchiavelli, k) Piazza Goldoni, l) Viale Redi, m) La Fortezza (authors).

Supplementary Note 7 – Discussion structure

The supplementary Figure 20 shows the main discussion points related to the three analytical dimensions for each city.

	Understanding	Communicating	Imagining future
Heidelberg In a nutshell | High density-land use problem, 40% of communal land is forest and the Neckar river are important ecological drivers but used as excuses „we have enough" department of greenery always asked at the end and new urban development projects do not have much greenery	o Definition: very practical examples of technolgoical + natural solutions (all actors) o Sensitivity: Higher sensitivity of public administration actors o History: early engagement (2014) and strong legal frame o Multi-level support: National and regional levels helpful o Capacity: Lack resources (personell) and expertise o Challenge: Implementation hindered by limited space o Oppopportunity: Public adminsitration should break silos	o Dominant concepts: Urban greening for humans and urban greening for biodiversity, conflicting use of public space o Dominant actors: public administration + many others o Challenge organisational level: silo effect, housing o Challenge discoursive level: biodiversity is abstract and scientific o Challenge measure level: more adaptation (human-centric) than mitigation Challenge participation: mainly top-down communication	o Type of document: strategy, ambitious, no responsibilities o Focus: integration with planning o MSs: 1 participation, no; 2 vision, no; 3 inventory, yes; 4 action and time plan, partly; 5 communication. partly; 6 monitoring, partly o Gaps: resources (economic, human), data, coordination, implementation, only outside the built environment o Positive: vision to address urban spaces as multifunctional o Promoted projects: distributed o Conflictual projects: mainly in the centre
Hannover In a nutshell | Insektbündniss (NGO), „unlimited project, big alliance of different actors (voluntary and no fees), one common logo, focus on clear and potent communication, different interests represented but no silo problem, best work saved the way	o Definition: linked to sustainability, something that should be planned (Pub Adm); diversity of species and ecosystems (Reg. Hann); Habitat abundance and diversity, and autochtonous plants (NGO) o Sensitivity: Higher sensitivity of public administration actors o History: biodiversity is important for human sake, landscape planning for permeability and green corridors o Multi-level support: National and regional levels helpful o Capacity: No lack resources and expertise o Challenge: Implementation is not impactful and not visible o Opportunity: Public adminsitration should spread culture and education	o Dominant concepts: urban greening for biodiversity and its relationship with climate damage o Dominant actors: public administration, parties, media, citizens o Challenge organisational level: no silo effect o Challenge discoursive level: historical preservation of gardens, biodiversity is abstract and scientific o Challenge measure level: no preference o Challenge participation: intense participation through the Insektbündniss, intense communication and diffusion of information	o Type of document: concept of free spaces, structured, no responsibilities o Focus: nature-experiencing activities, education, biodiversity o MSs: 1 participation, no; 2 vision, "keep Hannover as green as it is"; 3 inventory, yes; 4 action and time plan, yes; 5 communication, no; 6 monitoring, no o Gaps: resources (temporal), integration (tto many plans and strategies) o Positive: well-staffed greenery department o Promoted projects: well distributed, big and small o Conflictual projects: well distributed, few and small (due to the good communication action of the insect alliance)
Cesena In a nutshell | CpA, founded by the government, direct involvement of citizens in the decision-making (voluntary, suggesting, but also proposing, managed to be independent from the gov., internal problems among different actors, Green City Accord membership	o Definition: infrastructure that provides ecosystem services (Pub Adm); habitat and multilayered (Grassr Init) o Sensitivity: Higher sensitivity of public administration actors o History: outside the urban fabric, general planting tree actions, UB for disaster protection, holistic approach o Multi-level support: National and regional levels not helpful, only funds and sometimes even as a obstacle o Capacity: Lack resources and expertise o Challenge: Implementation is not impactful and not visible o Opportunity: Public adminsitration should spread culture and education	o Dominant concepts: participation and urban greening for humans o Dominant actors: public administration, politicians, citizens and grassroots active at the beginning but later less active o Challenge organisational level: no silo effect o Challenge discoursive level: biodiversity is abstract and scientific o Challenge measure level: no preference Challenge participation: reactive (NIMBY), a priori against, silent nodding	o Type of document: in between strategy and plan, structured, no clear responsibilities o Focus: holistic perspective, five dimensions of Green City Accord o MSs: 1 participation, yes; 2 vision, "to encourage the establishment of nature in the city"; 3 inventory, partly; 4 action and time plan, partly; 5 communication, no; 6 monitoring, no o Gaps: real planning effort is missing, resources (economic, human), data, implementation o Positive: different levels of naturality, efficient maintenance budget allocation o Promoted projects: well distributed, big o Conflictual projects: mainly in the centre, small
Firenze In a nutshell | UGP crafting in a high collaborative effort including different types of actors, vision of developing a plan for the open spaces in a holistic way, historic past and tourism, high density-land use problem	o Definition: element of climate democracy for ecological transition (Pub Adm); from the big parks to the small grass within brick walls, autochtonous plants (Edu + Economic) o Sensitivity: Higher sensitivity of public administration actors o History: ecological transition for pollution reduction, climate adaptation through reforestation, historical landscape should be preserved o Multi-level support: National and regional levels not helpful, only funds and sometimes even as a obstacle o Capacity: Lack resources o Challenge: Implementation is not impactful and not visible o Opportunity: Public adminsitration should spread culture and education	o Dominant concepts: participation, cross-collaboration, urban greening for humans, sustainable mobility tree cuts as practices o Dominant actors: public administration, politicians, NGOs, economic actors o Challenge organisational level: silo effect, mobility o Challenge discoursive level: historical preservation of gardens and buildings, conservatism, mistrust, biodiversity is abstract and scientific Challenge measure level: more adaptation (human-centric) than mitigation Challenge participation: reactive (NIMBY)	o Type of document: political programme + UGP, structured, no clear responsibilities o Focus: holistic perspective coming from the PNRR and ecological transition discourse o MSs: 1 participation, partly; 2 vision, partly; 3 inventory, no; 4 action and time plan, partly; 5 communication, no; 6 monitoring, no o Gaps: resources (temporal, economic), data, implementation, communication o Positive: extended involvement of urban professionals and more o Promoted projects: well distributed, big and small o Conflictual projects: well distributed, big and small

Supplementary Figure 20 - Summary of the main information for each city divided by understanding, communicating, and imagining dimensions.

Supplementary Note 8 - Translation of organisation

This section shows our translation to each organisation we encountered in analysing the local documents and newspapers. Supplementary Figure X provides an overview of these organisations for the German and Italian cases connected with their type.

Supplementary Table 6 - Translation of German organisations.

German terms	English translations	Type
Bezirksverband der Kleingärtner	District federation gardeners	Grassroot initiative
Bündnis 90/Die Grüne	Alliance 90/The Greens	Politician
Bürger	Citizens	Citizens
Bürgermeister	Mayor	Public administration
Deutscher Wetterdienst	German Weather Service	Public-sector economy
Die Heidelberg	The Heidelbergs	Citizens
Eilenriedebeirat	Eilenriede advisory board	Grassroot initiative
FB Umwelt + Stadtgrün	Sub-department – Environment + urban greenery	Public administration
Hanova	Hanova	Public-sector economy
Heidelberger Jägerveinigung	Heidelberg hunters' association	NGO
Insektenbündnis	Insect alliance	Grassroot initiative
Kleingartenverein	Garden association	Grassroot initiative
Landschafts- und Forstamt	Department – Landscape and Forestry	Public administration
Nabu Hannover	Nabu Hanover	NGO
Rathaus Garbsen	Garbsen city administration	Public administration
Stadt Hannover	City administration	Public administration
Städtische Baumschule	Municipal tree nursery	Public administration
Stadtplanungamt	Department - Urban planning	Public administration
Stadtrat	City council	Politician
Stadtwerke Garbsen	Garbsen public utilities	Public administration
Tiefbau Bezirksrat	Civil engineering district council	Politician

German terms	English translations	Type
Verein gegen Müdgkeit	Association against fatigue	Grassroot initiative
Verein Heidelberger Biotopschutz	Association for biotope protection Heidelberg	Grassroot initiative
Werkhof Bothfeld	Bothfeld depot	Public administration
Wirtschaft- und Umweltdezernat	Department – Economic and environment	Public administration

Supplementary Table 7 - Translation of Italian organisations.

Italian terms	English translations	Type
Alleanza Verdi, Fondamenta, Possibili, PSI	Alliance Green party, Fondamenta, Possibili, PSI	Politician
Assessorato – Ambiente e transizione ecologica	Department – Environment, ecological transition	Public administration
Assessorato – Ambiente, urbanistica, agricoltura, turismo	Department – Environment, urban planning, agriculture, tourism	Public administration
Assessorato – Decoro, partecipazione, cittadinanza attiva	Department – Decency, participation, active citizenship	Politician
Assessorato – Lavori pubblici	Department – Public works	Public administration
Assessorato – Mobilità	Department – Mobility	Public administration
Assessorato – Sport, politiche giovanili, città della notte	Department – Sport, youth, nightlife	Public administration
Assessorato – Urbanistica, innovazione, smart city	Department – Urban planning, innovation, smart city	Public administration
Assessorato – Welfare	Department – Welfare	Public administration
Cesena città dei quartieri	Cesena city of the districts	Politician
Città di …	City administration	Public administration
Consorzio di bonifica	Remediation consortium	Economy
Consulta per l'Ambiente (CpA)	Citizens Council for the Environment	Grassroot initiatives
Ministero dell'Ambiente	Ministry for the Environment	Public administration
Ordine degli ingegneri	Association of Engineers	NGO

Italian terms	English translations	Type
Quartiere	Quarter	Public administration
Società Toscana Orticultura	Tuscany horticultural society	NGO
Toscana Aeroporti	Airports Tuscany Region	Economy

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