

REACH OUT

shaping climate resilient cities



Marketability: demand-side factors and market prospects for climate services

Public version

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Executive summary

Climate services aim to transform climate data into information that is useful for decision and policy makers. They have been proven useful to increase resilience, support adaptation and stimulate economic opportunities. However, the uptake of climate services, especially for non-profit and complex entities such as cities, is still low. Business models can help identify strategic choices and how values, both monetary and non-monetary such as cultural, social, environmental values, are proposed, created, delivered, and captured. In this report, we introduce the **City Hub Business Model**, a novel conceptual framework for identifying the benefits of climate services and effectively channeling them given the complexity of factors that shape cities.

The City Hub Business Model consists of three dynamic and interrelated components: Data and Tools, Communities of Practice and Marketplace. Data and Tools encompass the applications, datasets, and information necessary to support climate adaptation in urban area, specifically targeted towards specific risks. Communities of Practice are webs of interests, knowledge and experiences populated by providers, users and stakeholders involved in climate adaptation. Due to cities' complex structure where climate represents just one of many factors, Communities of Practice foster the inclusion of diverse interests and conflicting priorities, raise awareness, and facilitate efficient allocation of resources. Marketplaces are meeting points where supply and demand converge. They can be backed by the public authority or function through pricing mechanisms. By stimulating innovation, Marketplaces builds on the foundation laid by Data and Tools and Communities of Practices, serving as a catalyst for progress on adaptation and resilience building.

The REACHOUT project aims to bridge the gap in climate service delivery and better support European cities in their climate adaptation efforts. Through our application of the City Hub Business Model to the seven REACHOUT cities, we have identified strengths, weaknesses, and opportunities for improvement in each city's climate services. We have also highlighted the importance of partnerships and communities of practice in creating and delivering climate services that meet the specific needs of each city. The application of the City Hub Business Model in the REACHOUT project has demonstrated the potential for using business model concepts in the climate adaptation field to enhance the delivery and effectiveness of climate services. By understanding the diverse needs and priorities of city stakeholders, we can create solutions that are tailored to each specific context, increasing the likelihood of success and impact.

The City Hub Business model proved a useful framework for cities to assess their progress towards climate adaptation and resilience goals, as well as to identify gaps and opportunities for improvement. The strengths of the City Hub Business Model lie in its ability to provide a comprehensive overview of the city's capacity, data sources, communities of practice, and marketplaces related to climate adaptation and resilience. Building upon the preliminary screening and assessment described in this report, our future plans include turning the City Hub Business Model into a structured self-assessment tool enabling cities to evaluate their current capacity, data sources, communities of practice, and marketplaces. Regular assessments using the City Hub Business Model can help cities track their progress towards agreed goals and objectives and identify new opportunities for improvement.

1 Introduction

Climate change poses a significant challenge to cities worldwide, with its impacts particularly detrimental to vulnerable groups and fragile settlements. Consequently, cities prioritize building resilience and adapting to current and future changes. **Climate services**, which are tools, products, and services that collect, translate, and deliver updated and user-relevant information about current and future climate, **are essential to support science-based and policy-relevant decision-making**. They link sophisticated modelling with cutting-edge technologies and socio-economic needs, thus constituting the bulk of knowledge-based climate innovation. Accelerating the creation, adoption, and diffusion of climate services is crucial to achieving a low-carbon economy and increasing societal resilience.

Cities and municipalities are the primary demand side and prospective market for climate adaptation services. The REACHOUT project and the unprecedented challenges that climate change poses to urban areas motivate a focus on cities. Urban areas are complex webs of interests and experience changes from socio-economic, environmental, and governance perspectives. The Global Centre of Adaptation has called for the acceleration of the formulation of climate adaptation plans in cities worldwide. However, literature highlights challenges in delivering climate services in Europe, despite recent successful experiences. Significant portions of civil society and the private sector are still lagging behind in adopting these tools, thereby limiting the scope for local adaptation. Deliverable 4.2 aims to fill the existing research-practice gap by focusing on cities as key venues for climate services expansion.

The low uptake of climate services in cities can be attributed to a complex mix of factors, including limited resources, time horizons, competing priorities, and diverse competencies, skills, and equipment in local public administrations. Standardizing services' features and co-development processes also present challenges. To address these bottlenecks, this report proposes a novel conceptualization of the **City-Hub Business Model**, which provides a practical solution. The report first introduces the concept and its core features, then applies it to the REACHOUT City Hubs using a co-development approach. The approach reiterates the significance of the user as the center of climate adaptation services.

Business models are methodological and conceptual tools that represent the underlying logic and strategic choices for creating and capturing value. They enable co-designing of the values that different users assign to different services. Business models bridge the gap between climate data and user-tailored knowledge by identifying the internal and external resources needed to deliver the intended user-relevant values. **Business models** are not exclusively designed with a for-profit motif; they **support understanding of the what, why, when, and for whom, particularly when resources are scarce and aimed at delivering public goods**. Moreover, business models are adapted to specific circumstances and end-users.

Cities are unique configurations as they represent shared contexts and collective cultures. Their management involves different and ever-changing interests, with conflicting views on key priorities. Politicians and decision-makers are accountable for citizens and must operate in the collective agent's best interest due to a democratic mandate. The City Hub business models for REACHOUT account for these complexities and consider three components that co-create values with and for citizens: data and tools, communities of practice, and marketplaces. The City Hub business model considers profit and not-for-profit activities, social dynamics, and technical issues to address these complexities.

Business models are dynamic in nature, with every change in the system potentially leading to a new configuration of resources, needs, and stakeholders required to deliver the value proposition. The City Hub business model proposed in this report begins with an assessment of existing features in data and tools, communities of practice, and marketplaces. However, it also allows for identifying missed opportunities or potentialities for growth. In this report, the conceptual framework was applied to REACHOUT City Hubs using semi-structured interviews.

City Hubs and their Liaison Officers linked the story maps they use to engage with citizens and specific groups with the City Hub business model. By doing so, they detected how climate adaptation can be better linked to other sustainability and development efforts, minimizing conflicts and maximizing co-benefits of climate initiatives.

The City Hub business model is developed as a standardized conceptual framework for complex and not-for-profit collective agents. To move from being useful to being usable, this report proposes a co-design approach that assesses what cities need and desire for the future before discussing it. This process translates the standard business model concept, which is rooted in private interests and monetary gains, to public values creation and retention. It connects public value theory, management, and climate services literature.

REACHOUT is investing in climate adaptation services for municipalities, citizens, and the private sector within city hubs. The focus on City Hubs as an ecosystem of actors reunites diverse priorities and needs, while the use of business models as conceptual tools standardizes the understanding of climate services from a user point of view. Business models are allies in advancing the engagement of different actors and stakeholders, providing monetary and non-monetary opportunities for multiple user segments. Business models can be used "to operate as sites for scientific investigation and to act as recipes for creative managers" (Morgan, 2010). They trigger competitive advantages (Chesbrough, 2010), enhance productivity, and improve the efficiency of internal processes (Tikkanen et al., 2005), while also signaling market positioning (Doganova and Eyquem-Renault, 2009). Despite their recognition in the area of corporate sustainability, a common framework for the theorization of shared business model requirements for climate services is still missing. D4.2 fills this gap by providing one for cities.

The report is structured as follows:

Sections 2 discusses the different meanings of value in the context of climate services, highlighting how these services are linked to reducing uncertainty in decision-making and producing tangible private and public benefits. The section also emphasizes the need for scrutiny of public values beyond private values, and how public values are constructed by different groups and agents for various purposes and outcomes. Public values are influenced by non-economic factors such as the support and willingness of local politicians to invest time and resources in city hubs. The concept of City Hub business model looks at the knowledge produced, represented by data and tools generated by providers and received by users, the network of interests, awareness, and specificities this knowledge creates, i.e., communities of practice, and the opportunities to stimulate or give birth to market structures, i.e., marketplace.

Section 3 of the report details the application of the conceptual framework to REACHOUT Cities using desk review, semi-structured interviews, and analysis of the stock taking surveys. These surveys provided an overview of the cities' climate risks, capabilities, and key stakeholders, which were used to develop City Story Maps communicating adaptation options for specific risks. The components of the City Hub Business Model were mapped to identify the city's resources and capabilities, and whether they were developed internally or externally. The structured data collection produced conceptual maps of the city's endowment, identifying the current situation and necessary steps to achieve a complete City Hub Business Model. The proposed approach aims to better link climate adaptation with other sustainability and development efforts while minimizing conflicts and maximizing co-benefits.

Section 4 provides a summary of the key findings and insights from the analysis of City Hub Business Models across the REACHOUT cities. It also outlines future plans to turn the City Hub Business Model into a structured self-assessment tool. Such a tool can serve as a baseline to identify areas of strength and weakness, as well as opportunities for improvement.

2 A demand-side and public approach to business models

2.1 Capturing, detaining and delivering values

The scientific literature and policy practice have extensively explored the types of value that climate services provide to users. The meaning of value varies according to the context and scientific domains. In mainstream economics, value is often defined as (measured by) the individual's willingness to pay or accept, with a few exceptions (Bova, 2022; Quiggin, 1996, 1993). The willingness to pay is the maximum price the individual would accept to pay to buy the item, while the willingness to accept is the minimum price the individual is willing to accept to sell the item. In this sense, the willingness to pay represents the added value the alternative that can be bought generates compared to the current situation.

Economic values may differ in nature. The bequest value refers to the value people assign to something's mere existence, such as the Amazon forest, and is realized even in the absence of actual object use. The bequest value is the added value of having something compared to not having it. It can be the insurance value of a policy, which compares the expected utilities of being insured versus uninsured. Knowledge value can also be a form of economic value, referring to the utility achievable with and without a particular piece of knowledge. This type of value is most appropriate for climate services (Delpiazzo et al., 2023). It builds on Murphy's (1994) statement that a climate service generates economic value only if it impacts the final user decision.

From a philosophical perspective, values are conceptions, whether explicit or implicit, individual or shared, "of the desirable, which influences the selection of available modes, means, and ends of actions" (Kluckholm, 1951). Society also influences values, which are co-produced with the individuals within it. Sociologically, values are intangible features (beliefs and qualities) endorsed by a specific society that determine a preferred "course of action" (Haralambos, 1981). Regardless of the discipline, values share key characteristics: they are defined by an agent, they trigger a defined and measurable course of action, and they are influenced by culture, traditions, and a combination of internal and external factors.

According to the European Research and Innovation Roadmap for Climate Services (European Commission, 2015), climate services are defined as "the transformation of climate-related data - together with other relevant information - into customized products such as projections, forecasts, information, trends, economic analysis, assessments (including technology assessment), counseling on best practices, development and evaluation of solutions, and any other service in relation to climate that may be of use for society at large." They are immaterial Knowledge Intensive Business Services (KIBS) that strongly depend on the network of stakeholders (internal and external actors) that contribute to their design and deployment (Larosa and Mysiak, 2020). As they provide information, the values they produce are strongly linked to the uncertainty they reduce and the additional benefits they produce in terms of increased knowledge (Bennett et al., 2018).

Public values require careful understanding and scrutiny beyond private values (i.e., those set by individuals or representing individual courses of action). According to contemporary public management theories (Hartley et al., 2017), there are three often disparate components of public value: the first looks at the contribution to the public sphere, the second problematizes the value created by public organizations, and the third is a pragmatic tool that helps public administration managers strategically transform their objectives into actions. The first

approach complements and offers new insights into the notions of "public goods" and "public interest." Scholars exploring this approach tackle both "what public values are" and "what values are added to the public sphere" (Benington, 2011), exploring whether and how public value is constructed by different groups and agents for what purposes and with what outcomes (Bryson et al., 2014). The second approach tackles values pertinent to societal outcomes (Moore, 1995) and recognizes that the public sector differs from the private sector because of the responsibility it carries for present and future generations given the available resources. When designing business models for public organizations, these considerations need to be taken into account.

2.2 Applying a business model framework to City Hubs

2.2.1 Business models as values enhancers

Business models enclose different views and conceptualisations of values by developing structures which can reflect what users need, want and aim to. In their most basic framing, business models are designed with a supply-side approach in mind: service providers define the value they aim at creating and adding for specific user segments and – once done – they identify what means (i.e., resources, stakeholder contributions, capital disbursement) they need to achieve their propositions (Figure 1). As business models are models to delineate choices and optimal courses of actions, they are visually described by a set of key blocks that help practitioners and developers to make explicit presumptions, aims and tools at their disposal.

In their standard form, business models identify the proposition, creation, delivery and capture of the diverse values that each user and user type identify. The Values Proposition makes explicit what values the service aim at realising. Beyond monetary considerations, here service developers reflect upon the problems they are addressing and the decisions they are scientifically supporting. Once stated, the values proposition supports the clear identification of the Values Creation, which includes all the resources (internal and external) needed to reach the goals: the science (i.e., variables, datasets, processing procedures when needed and data analysis) and management (i.e., the service components development and marketing activities) are both falling into this group. The Values Creation requires providers to be mindful of different cultural, knowledge and disciplinary background. When designing the core of the climate services, co-design with the users can help and inform tailored routines. Values Delivery describes how the service and related values are delivered to the users. Providers are called to define which channels they plan on using to deploy and deliver the proposed and created values. Platforms, on-demand, e-marketplaces, data portals, repositories and software are examples of delivery options that teams can choose. In full co-production spirit, these channels are bespoke and tailored on users' requirements and needs. Finally, but not of least importance, values capture components describe how services are remunerated and rewarded. This involves economic and cost-benefit considerations: users are crucial as their bequest value reveals their willingness to pay or their willingness to contribute to the success of the service. Even in absence of for-profit motif, values capture components ensures that the service is economically sustainable, realising opportunities for legacy and further expansion.

The business model becomes a tool to i) understand how value is conceived, created and delivered and for whom; and ii) elaborate the options to achieve economic sustainability by covering fixed and variable costs. Therefore, the standard approach to business model design is the management-equivalent of the scientific method: assumptions, tests and re-assessments lead to novel configurations of strategic choices.

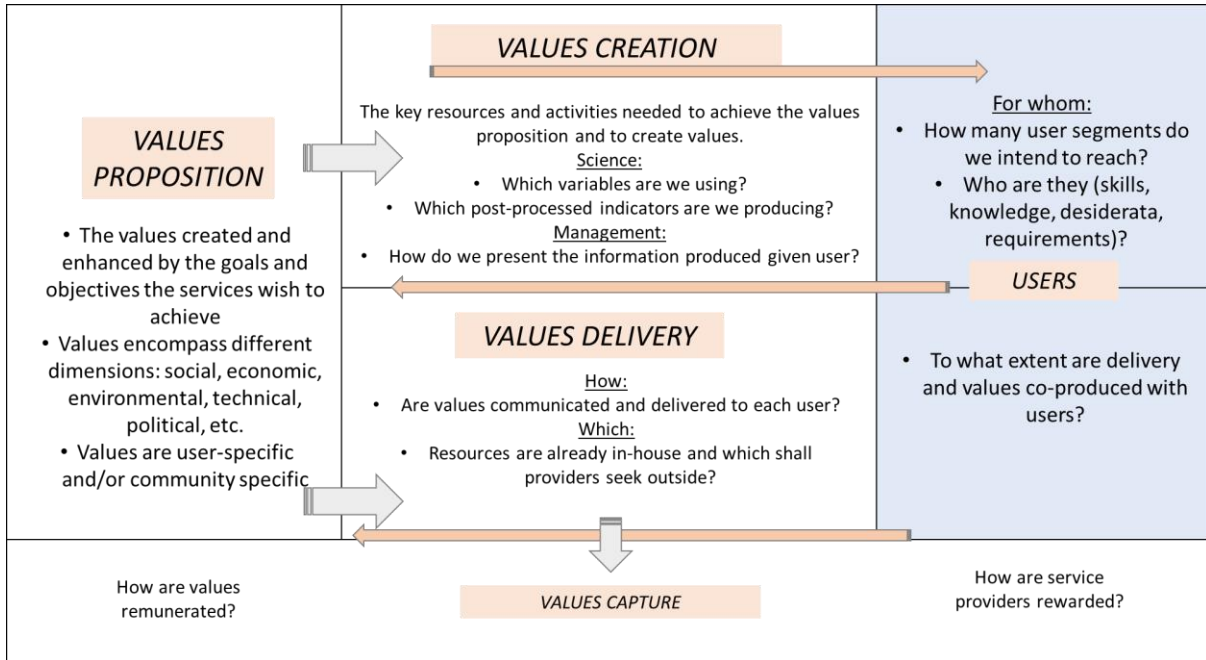


Figure 1 | The standard business model approach. A supply-side overview of values, user segments, key resources and network of stakeholders and means needed to fulfil the vision

2.2.2 From private to public values

Despite being an effective tool for identifying, sharing, and retaining values, business models link providers to individual user types, neglecting the forces and dynamics that shape the general public. In their standard form, business models are not the most appropriate tools, for example, to identify public values, which are often intangible and shared. Hence, their application to city hubs can lead to misrepresentation or partial understandings of the dynamics that shape climate services and their adoption at the city level. To transform and adapt the business model logic to public and collective agents like city hubs, we first need to shift from a private to a public values logic.

Public values research has become a core focus for public administration and public management scholars in recent years. It is developed around two main streams: the first (Moore, 1995) supports an understanding of how public administration employees can serve public value. The second seeks to define, identify, and classify public values using novel concepts, definitions, and frameworks (Bozeman, 2002, 2007; Jørgensen and Bozeman, 2007; de Graaf et al., 2016). Within this second stream, the literature has looked at responding to fundamental questions such as "what is public value?" and "what adds value to the public sphere?" (Benington, 2009). Additionally, the literature has explored how to explicitly develop regulations and frameworks to measure and classify values (Bozeman, 2007). Building on Fukumoto and Bozeman (2019), the literature has explored a variety of foci and approaches, mainly looking at classifications of public values based on their governance modes (hierarchy, network, and market) and dimensions (political and legal), or based on the nature of values (procedural or substantive values, ethical, democratic, professional).

	Focus	Relevance to classification and framework
Site of values	Governance modes	Values are classified depending on their governance or frames and typically involve organizational forms (hierarchy, network and market) and dimensions (political and legal). Core references are Beck Jorgensen and
	Values frames	

		Bozeman, 2007; Andersen et al., 2012 and Nabatchi, 2018.
Nature of values	Public service values categories	Values can be classified according to their dimension (ethical, democratic, professional), but they can relate to certain proximity (neighbourhood, city) or timeframe (old, new and emerging values). Core references are: de Bruijn and Dickie, 2006; Back Jorgensen and Bozeman, 2007; Rutgers, 2008.
	Proximity of values	
	Chronological order	

Table 1 | The categorization of public values as derived from core literature in public value theory. Classifications may or may not be applied to city hubs, but they still inform about the complexity behind them.

In the domain of climate services, values are determined by end-users, captured by service providers, and amplified by the ecosystem in which services operate. Therefore, they are not equivalent to the knowledge produced through and by the climate service, but rather they are expanded by the service itself, generating positive spillover effects (Vaughan et al., 2018). Moving from a private to a public domain, public values differ from the sum of individual parts due to differences in the utilities (i.e., net gains and benefits) of each individual agent. Utilities reflect preferences and tastes that are affected by various variables, including the context and institutions (Bowles, 2016). As a result, it is possible that some individuals may not perceive any utility from the climate service supply and may be unaware of its potential benefits, and thus need to be educated to evaluate them.

Public values are also highly influenced by non-economic factors that govern city hubs. City hubs depend directly or indirectly on the support and willingness of local politicians to invest time and resources. Such influence is indirect whenever the decision of city personnel depends on their expectations of politicians' approval or their alignment with their directives

Politicians operate within a complex web of constraints and pressures. Budgetary limitations, available human capital, and other resources are finite, and politicians must allocate them among competing goals. Meanwhile, stakeholders and shareholders exert pressure to advance their own interests, which can either provide resources and support or impede progress. To govern effectively and achieve their objectives, politicians need sufficient consensus, which reflects the degree of satisfaction of relevant actors. Politicians' value, in its simplest form, is measured by the number of individuals and organizations that have an expected utility higher with the politician than without. When this condition is met, the politician gains a potential vote. Therefore, when faced with a problem, politicians must aggregate the utilities of individuals and organizations to evaluate the consensus of available options and choose the one with the highest value. This process applies to city hubs and climate services and determines the type of commitment, its durability, and the resources (both material and human) allocated. Cultivating awareness is particularly relevant in shaping consensus and influencing politicians' evaluations.

2.2.3 The City Hub business model

To put public values into practice, it is necessary to rethink service systems, the types of services provided, and the values they create. The argument is that city hubs and other public organizations must prioritize end-user orientation, contextual relevance, and meaningfulness with regards to the risks and challenges citizens face. Building on the literature in Table 1, public values can be classified according to their governance nature. Since climate services depend on the network of resources that providers and users engage in the co-development process (Larosa and Mysiak, 2019), we use Anderson et al.'s (2012) classification of public values and distinguish between different governance modes: hierarchy, clan, network, and market.

Hierarchy reflects the democratic mandate to align climate services with other goals and strategic choices. Clan governance relies on the norms and goals of relevant groups and can profoundly shape climate services design to safeguard specific purposes. For example, climate services for disaster risk reduction could be tailored to specific sectors such as finance or insurance, leaving other sectors uncovered. As cities are bounded by multiple conflicting or overlapping interests, network governance allows for the identification and inclusion of diverse forces into climate services, enabling cross-influences with other societal challenges. Finally, market governance allows for price-setting mechanisms based on supply and demand factors, as well as specific interests and values delivery options.

In the context of climate services, each governance mode has a direct or indirect influence on the value proposition, creation, delivery, and capture (Figure 2). Therefore, it is crucial to consider the governance mode when designing business models for public organizations like city hubs. The adoption of a public values logic and the integration of different governance modes can help ensure that the needs and values of citizens are met in a comprehensive and inclusive manner.

Governance mode	Values			
	Proposition	Creation	Delivery	Capture
Hierarchy	<i>Alignment between political strategy and goals and services required</i>			<i>Public support through R&D and provision of free-of-charge services</i>
Clan		<i>Tailor-made processes to safeguard specific purposes</i>		<i>Ad-hoc structures closed to specific groups</i>
Network		<i>Stakeholder management</i>	<i>Co-production to generate co-benefits and spillovers</i>	<i>Deployment of unique infrastructures to maximise profits</i>
Market		<i>Price setting based on individual group interests</i>	<i>Price setting based on delivery mode</i>	<i>Price setting based on supply-demand dynamics</i>

Figure 2 | A novel framework to link public values governance modes to business models

To realize public values that are specific to city hubs and their governance modes, we propose a new concept of business models for climate services in the public sphere. This concept looks at the knowledge produced, represented by data and tools generated by providers and received by users, the network of interests, awareness, and specificities this knowledge creates, i.e., communities of practice, and the opportunities to stimulate or give birth to market structures, i.e., marketplace.

The City Hub business model is an ecosystem of climate services, including data sets, infrastructure, organizations, processes, policies, and guides that promote the integration of climate knowledge into policy and public and private decision-making. City hubs have the potential to galvanize and leverage transformative resilience building and preserve community values. Specifically, city hubs:

- Facilitate access to up-to-date, evidence- and know-how-based, actionable knowledge, guidance, knowledge-intensive tools, and adaptation and resilience services.
- Foster building enabling conditions and capabilities for transformation. By doing so, they inform tailored risk and performance assessment and help mobilize finance and resources to close adaptation financial gaps and scale-up solutions for larger impact.

- Create a collaborative environment where different actors come together for the purpose of innovation, experimentation, and experiential social learning.

By providing these three essential components, the City Hub business model enables the successful development and deployment of climate services in the public sphere. The **core components of city hubs** can be broken down into three main elements:

- **Common data and tool spaces:** These are composed of a combination of data infrastructure and governance mechanisms that promote the processing and sharing of interoperable and quality-assured datasets and services. The goal is to provide access to up-to-date, evidence-based, actionable knowledge, guidance, knowledge-intensive tools, and adaptation and resilience services.
- **Communities of practice:** These include a diverse group of actors such as knowledge producers, users, policy makers, regulators, businesses, innovation entrepreneurs, civil society, and citizens. The aim is to foster a collaborative environment where different actors can come together for the purpose of innovation, experimentation, and experiential social learning, and to build resilience to climate-related risks and exploit opportunities from accelerated and organized climate action.
- **Marketplaces:** These are platforms where climate service providers can come together to offer their products or services to a curated customer base. The goal is to stimulate market structures that can provide monetary and non-monetary opportunities for multiple user segments, while also signalling market positioning.

The data and tools component forms the fundamental raw resource that constitutes the infrastructure of the City Hub business model. This component stimulates the creation of communities of practice, where users and providers interact and share experiences. It also enables the coming together of multiple interests to fulfil the needs of the global city hub. The marketplace component follows and can emerge as a pioneering or established structure to promote new developments and expand the range of services developed and used.

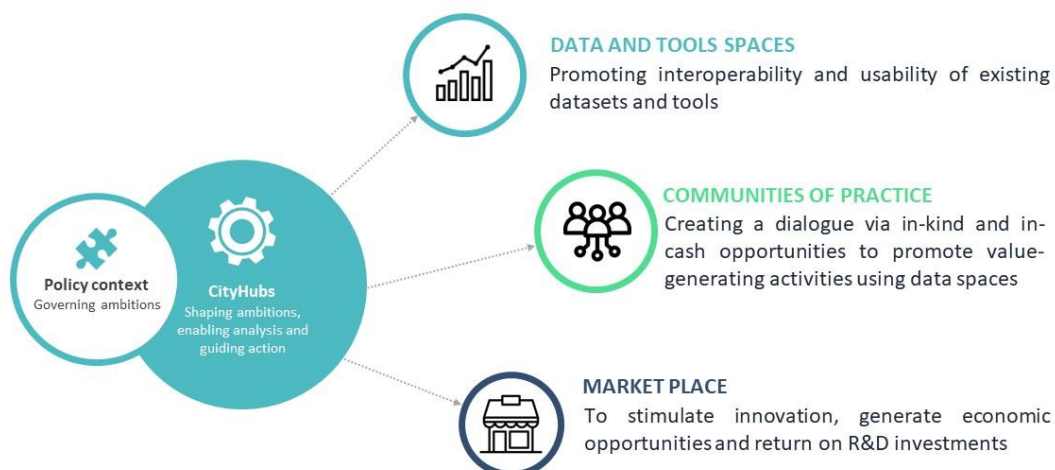


Figure 3 | The City Hub business model and its components

Climate data and information are essential for informed decision-making, and data portals such as Copernicus Climate Change Service (C3S) and Global Earth Observation System of Systems (GEOSS) provide comprehensive climate information. Climate services customize this information for specific users and their knowledge needs by combining it with non-climate related data. The Directive on Open Data and the Re-Use of Public Sector Information¹ promotes transparency, accountability, innovation, and economic growth by making public sector information available in a reusable format. The European strategy for data² aims to create a secure single European data space, open to data from around the world, to provide businesses access to high-quality industrial data. The EU Data Governance Act³ provides rules and safeguards for this re-use without compromising the protected nature of the data. **City data hubs can act as common data spaces** that bring together various stakeholders, including government agencies, academic institutions, private companies, and civil society organizations, to share data, knowledge, and expertise. By integrating and synthesizing diverse sources of data, city data hubs can provide a comprehensive understanding of urban climate risks and vulnerabilities and support the development of targeted policies and measures.

City data hubs play a key role in the co-creation and co-production of climate services that meet the specific needs and concerns of local communities. By fostering collaboration and knowledge-sharing, city data hubs promote effective and equitable decision-making, contributing to greater city resilience and sustainability. Co-production of climate services is essential for overcoming capacity gaps in the technical production, translation, transfer, and use of climate information. This requires engaging stakeholders from different sectors to address institutional disconnects and human resource constraints. Co-production can take different forms, including citizen science and structured stakeholder dialogues, and can lead to the formation of **communities of practice (CoPs)**. CoPs are groups of people who share a common interest or profession and engage in collective learning to share knowledge, experiences, and best practices. They can be informal or formal and can be found in various settings such as businesses, academia, and urban communities. CoPs as a vehicle of co-production can enhance collaboration between information providers and users, increase the usability of climate services for decision-making and policy, and strengthen knowledge sharing. However, challenges exist, such as evaluation and monitoring of performance and impact, acquiring competencies, using specialized language, and integrating local knowledge. Successful co-production requires equitable and sustainable partnerships, knowledge sharing, and a decision-centred framework.

Marketplaces for climate services are platforms that connect climate service providers with potential users, offering a range of services and products related to climate data, information, and knowledge. These marketplaces provide a space for buyers and sellers to interact and negotiate, allowing for a more efficient and effective exchange of climate services. Marketplaces can offer a wide range of climate services, including risk assessments, vulnerability analyses, adaptation planning, and climate impact assessments. They can also provide access to data and models, climate tools and software, and consulting services. Marketplaces for climate services can help to overcome some of the barriers that hinder the provision and use of climate services. For example, they can reduce transaction costs by providing a centralized platform for buyers and sellers, thereby lowering search costs and increasing transparency. Marketplaces can also help to build trust and credibility by providing a mechanism for verifying the quality and reliability of climate services. Moreover, marketplaces can also facilitate innovation and entrepreneurship in the climate services sector.

¹ Directive (EU) 2019/1024 of the European Parliament and of the Council of 20 June 2019 on open data and the re-use of public sector information (recast)

² Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions A European strategy for data COM/2020/66 final

³ Regulation (EU) 2022/868 of the European Parliament and of the Council of 30 May 2022 on European data governance

By providing access to a larger pool of potential users, marketplaces can help to create new markets for climate services and foster the development of new products and services.

The City Hub Business Model brings together different components to accelerate the development and adoption of climate services for effective and efficient management of climate-related challenges in cities. This holistic approach to turn a city into a **smart climate adaptation city** involves integrating various components such as data management, citizen engagement, infrastructure, and governance. The approach entails collecting and analysing data from multiple sources to aid decision-making, engaging citizens in co-creation and co-production of climate services, investing in resilient infrastructure and technologies, and implementing effective governance frameworks.

3 Assessing the City Hub business model

3.1 Introducing the pilot cities

The proposed concept of the city hub business model is being tested by REACHOUT through collaboration with seven City Hubs: Athens, Amsterdam, Milan, Cork, Gdynia, Lillestrøm, and Logroño. This report aims to evaluate the progress made by these City Hubs in advancing climate services and to identify gaps and opportunities for further development. Additionally, the report proposes ways to assist the City Hubs in self-assessing their progress and becoming truly transformative levers in the advancement of climate services.

The cities of Athens and Amsterdam are both capital cities of their respective countries and significant trade ports. Similarly, Cork and Gdynia are coastal or near-coastal cities with busy ports and a rich maritime history. Gdynia is part of the Tri-City metropolitan area, along with the nearby cities of Gdańsk and Sopot. Although Lillestrøm is a landlocked city, located within the greater Oslo metropolitan area, it is close to the largest inland delta in Northern Europe, the Northern Øyeren. Milan and Logroño are also landlocked cities and serve as the capitals of their respective subnational regional governments. Milan is the second largest Italian city and country's major financial centre.

The Eurostat Urban Survey includes all REACHOUT cities except Lillestrøm and collects data on various aspects of urban life in EU member states, such as population, employment, housing, transport, and environment. Its goal is to provide reliable and comparable statistics on urban areas across Europe. **Most of the cities are also part of the important global networks of local governments.** Milan and Athens are members of the C40 Cities Climate Leadership Group and the Resilient Cities Network. Together with Amsterdam and Logroño, they are also part of the Eurocities network. Gdynia and Lillestrøm are connected to these networks through their metropolitan areas which include Gdansk and Oslo. All REACHOUT cities participate in the Global Covenant of Mayors for Climate & Energy and commit to taking concrete actions to mitigate greenhouse gas emissions and adapt to the impacts of climate change. They pledge to develop and implement climate action plans, report regularly on their progress, and work with stakeholders to engage and mobilize the broader community to act on climate change.

Participation in global cities networks on climate change provides many benefits for the REACHOUT cities. By collaborating on joint initiatives and projects, they can learn from each other about successful climate initiatives and strategies, access resources like funding, technical assistance, and data to help them develop and implement climate initiatives. These networks are also useful in advocating for policies and programs at the national and international level that support their climate goals, using their collective voice. Being part of such networks allows cities to accelerate their climate action and make a greater impact towards a more sustainable future.

Some of the REACHOUT cities participate in the **EU Horizon Europe research and innovation missions**. Missions are ambitious, measurable, and time-bound initiatives to solve some of the biggest challenges facing our society today, such as climate change, soil conservation and clean oceans. They are designed to be highly visible and focus on specific goals that can capture the public imagination and mobilize a wide range of stakeholders, including researchers, innovators, policy makers, civil society organizations, and citizens. Each mission involves a large-scale, cross-disciplinary effort and aims to deliver concrete, tangible results that can make a real difference in people's lives.

Athens, Milan, Cork, and Amsterdam are part of the **Climate-neutral and Smart Cities Mission**, which aims to achieve 100 climate-neutral and smart cities by 2030. The mission also intends to establish these cities as centres for experimentation and innovation, in order to encourage all European cities to follow their lead by 2050. The mission focuses on developing innovative solutions and promoting sustainable urban development across Europe, with a particular emphasis on addressing social, economic, and environmental issues. The ultimate goal of the EU Mission on sustainable cities is to create more liveable, sustainable, and equitable cities for all.

Although the REACHOUT cities are not directly signed up to the **Mission Adaptation to Climate Change**, which aims to accelerate and intensify action on climate adaptation in Europe, they support its objectives. The mission's primary goal is to enhance the resilience and adaptation of European societies, economies, and ecosystems to climate change by promoting interdisciplinary research, developing innovative solutions and technologies, and driving transformative change. In the Netherlands for example, cities and municipalities are mandated to create local heat plans that prioritize the well-being of vulnerable populations within their communities and implement (spatial) measures to combat urban heat islands. Additionally, Dutch municipalities must develop a Climate Adaptation Strategy (CAS) that identifies and addresses specific climate risks and vulnerabilities through an action plan. These strategies should be integrated into the spatial planning and development policies, as well as the water management strategies of municipalities.

3.2 Data and method

We used a transdisciplinary approach that builds on co-production methods to connect the management and climate services literature. The approach was implemented in seven City-Hubs that are part of REACHOUT project. Each City Hubs has unique climate risk profiles and is governed by different structures. The City Hub Business model was used as a standardised approach to extract information on how cities use data and tools, to what extent they establish communities of practice and if they are support and encourage marketplaces.

In the initial phase of our analysis, we examined the stock taking surveys that were completed by the cities as part of the project's activities. These surveys - updated annually - provide a comprehensive overview of the physical, climate, and socio-economic characteristics of each city, as well as information about their internal and external capabilities in the field of climate services. Cities were asked to identify their key stakeholders and provide an overview of the climate services they were already using. Additionally, the surveys helped cities assess their main climate risks and identified their projected impacts on the economy and society. In the second year of the project, the updated stock-taking surveys served as a starting point to co-develop City Story Maps, which aimed to increase awareness and effectively communicate the most appropriate adaptation options for specific climate risks.

We have identified the fundamental components of the stock taking survey and allocated them to the three components of the City Hub Business Model - data and tools, community of practice, and marketplace. The purpose of this exercise was to map the city's resources and capabilities based on the specific climate risks they face. Additionally, we expanded the classification to determine whether the data and tools, communities of practice and

marketplaces were developed using internal or external capabilities. Since the stakeholder network plays a vital role in co-delivering climate services, this aspect has enriched the discussion by identifying potentially overlooked opportunities.

Based on a structured data collection, we created a conceptual map of the city's endowment. The main objectives of these initial maps were to identify the current situation of the City Hub and the necessary steps to achieve a complete City Hub Business Model, breaking down these steps for each climate risk. The maps also aimed to facilitate interactions and actions within the City Hub by co-creating a draft of the city endowment map.

These conceptual maps which represent the city's endowment were then shared and discussed with city representatives and their liaison officers. We used a semi-structured interview approach and asked the questions in Table 2.

- Does the presented developed by the team accurately reflect your city's current situation??
- Are the capacities located internally or externally to the city?
- Do you feel equally prepared for different climate risks, and if not, what are the gaps?
- How can the city hub business model assist your city's policy processes?
- In what ways has REACHOUT contributed to the development of your City Hub (Business Model) development?
- How is REACHOUT supporting your city with data and tools? Are they appropriate and fit-for-purpose?
- How is REACHOUT supporting the development of communities of practice in your city? What impact has it had on increasing resilience?
- How is REACHOUT supporting the development of the marketplace in your city? What impact has it had on increasing resilience?

Table 2 | interview questions

We used insights gained from interviews with the city representatives to refine the conceptual maps and to add new information where necessary. Initially, the stock taking survey data was combined with the insights provided by city representatives to update the city endowment maps. This update highlighted the coverage of climate risks in the City Hub Business Model and visualised both internal and external capacities. Additionally, based on the data gathered and feedback received from conversations with the city hubs, the team was able to map REACHOUT contributions to each City Hub Business Model and identify new opportunities for development.

3.3 The City Hub business model conceptual maps

In this section we present the results of the different methodological steps. For each city we provide and debate one conceptual city endowment map, two post-processed city maps, and the REACHOUT contributions and further opportunities.

3.3.1 Athens

The city of Athens faces several major climate risks, including heat waves, droughts, and flooding (pluvial and fluvial). Characterized by a hot-summer Mediterranean climate, Athens experiences prolonged hot and dry summers due to dry and hot winds blowing from the Sahara, and mild, wetter winters with moderate rainfall, caused by westerly winds. In addition to the physical climate aspects, the city is densely populated with limited green spaces, 70% of which are under the competence of the City of Athens itself. The city designs how to efficiently allocate city-owned green spaces through the Climate Adaptation Plan, which is

central to reducing and monitoring high temperatures, increasing biodiversity, and enhancing habitability and comfort.

The city has access to weather data provided by the National Meteorology Agency and National Observatory of Athens, but it is not directly responsible for data collection, sharing, or processing. As no impact assessments are available at the city level, the city of Athens has adopted the Extrema app, a mobile application that uses real-time satellite data to estimate the temperature, humidity, and discomfort index for every square kilometre in the city. The Extrema app maps temperature and uses results to target and reach the most vulnerable segments of the population. However, the app is not updated regularly, nor is it user-friendly, which constrains its usage. Further opportunities are envisaged to use it as a proper marketplace. The app has the potential to become the building block of further innovations and support tourism, which is the core economic activity of the city, and the local population.

The city does not have established communities of practice around climate services and climate adaptation. The Climate Adaptation Plan, Climate Mitigation Plan, and Sustainable Urban Mobility Plan constitute the top three climate strategies in place, but beyond the policy horizon, they do not effectively include citizens and civil society in reducing action in the medium and long run. Internally, the Resilience Department reunifies different competences and acts as a working group to connect different expertise and priorities.

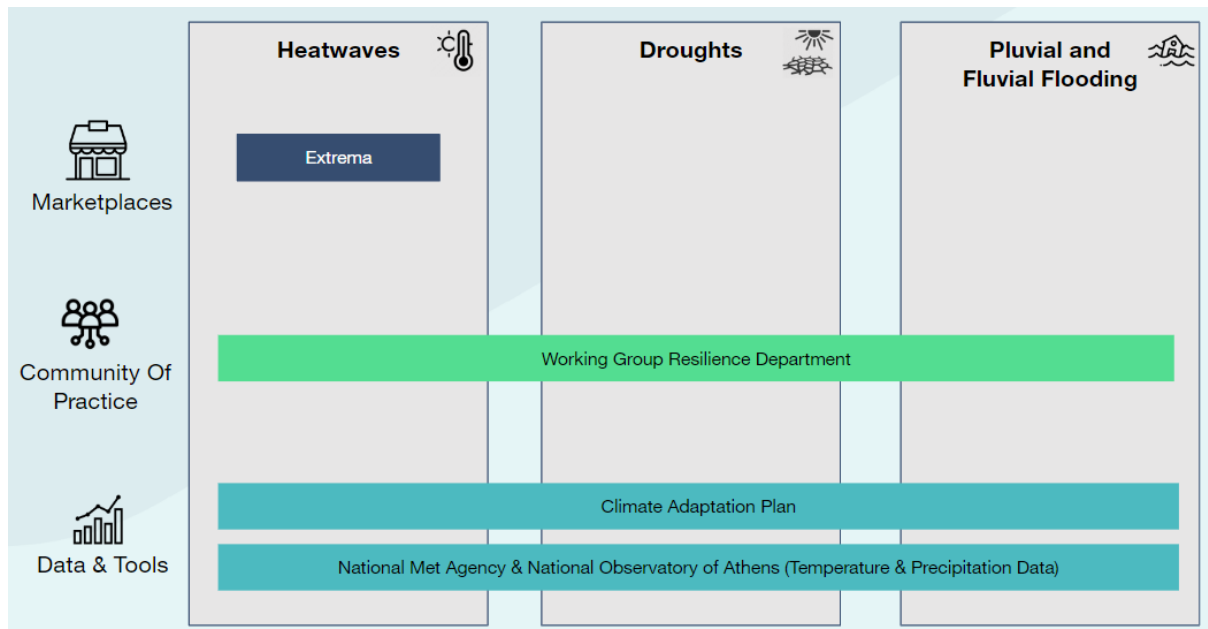


Figure 4 | Draft city endowment of Athens

We revised and completed the city hub conceptual map through the semi-structured interview with the City of Athens’ representative. The meeting led to the identification of unforeseen elements, populating the Data&Tools and the Community of Practice feature of the City Hub Business Model.

Beside the data provided by public weather services, the city is endowed with the Thermal Assessment Maps, a tool provided on a pro bono basis by a multinational data platform. This partnership achieves two goals: on one hand it raises awareness via categorising, naming and describing heat waves. This process contributes in strengthening understandings of three risk components: hazard, vulnerability and exposure. Second, this tool increases preparedness: by identifying vulnerable groups, city planners are better equipped to intervene with ad-hoc campaigns and tailored measures. As Athens is not the unique beneficiary of this partnership at global level, the Thermal Assessment Maps also enables comparisons between cities.

The interview highlighted the potential for hosting, sharing, and managing a data infrastructure beyond climate information in Athens. The City Geoportal (<http://gis.cityofathens.gr/>) currently hosts a catalogue of geospatial data of the Municipality of Athens, including data on health, society, transportation, utilities, and the environment. REACHOUT is engaging with geospatial specialists from the City of Athens to populate the platform with new data products and tools, which could eventually become available to researchers, city planners, practitioners, and civil society. Platforms like the Geoportal are useful in building a community of experts and supporting the creation of novel services that combine socio-economic, climate, environmental, and social datasets.

Currently, all available data and tools are developed externally to the city, with the exception of the Climate Adaptation Plan, which synergistically links different sources and becomes a broader and longer-term strategy. By stimulating the creation and development of active communities of practice, the city could foster internal capabilities and knowledge and complement them with external resources. This process not only leads to a higher awareness of internal resources but can also create new job opportunities within the public workforce of the City of Athens. Finally, flourishing communities of practice stimulate the creation of a flourishing marketplace, as updated, quality-assured, and documented datasets can give birth to user-friendly platforms and services.

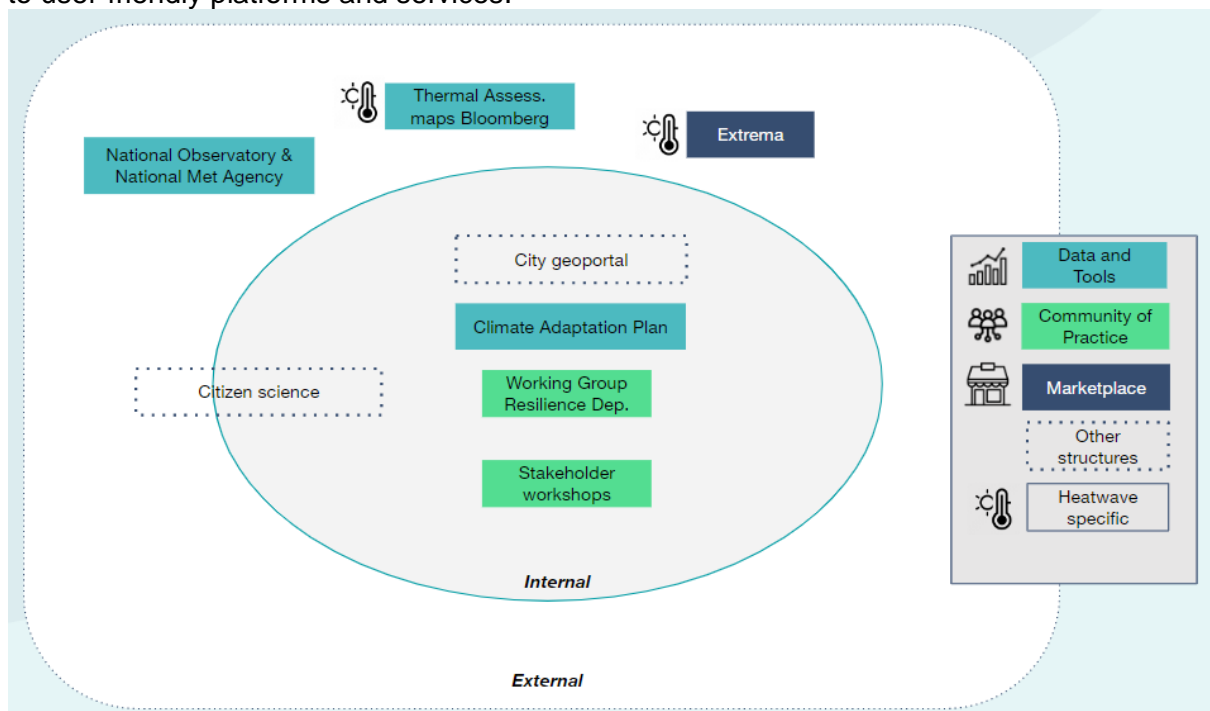


Figure 5 | Final city endowment of Athens

These opportunities came with challenges from multiple fronts and require coordination, vision and resources. Coordination is an essential ingredient to solve some of the bottlenecks reported during the interview. In particular, the City of Athens’ Resilience City Officer highlighted that – as the city is a complex and adaptive mechanism of conflicting or overlapping priorities and choices – processes of change can take time producing uncertain or unexpected outcomes. The technical competences and skills should be replenished and complemented with new staff to develop a cohesive and cross-cutting City Hub. This is particularly urgent in the context of the drought season, which harms economic sectors such as agriculture, tourism and utilities provision.

Internal coordination (between departments and different municipality offices) would benefit the development of a strategic agenda, while external coordination (between the City, the Municipality, the region and the state) would enhance the data provision, collection and sharing processes. For example, delays in collecting and processing census data can reduce the

potentialities of bespoke and user-oriented climate services as some crucial socio-economic information would be missing. This is a situation that the city already faced in 2022. While imputing part of the responsibility to the COVID19 pandemic, a stronger coordination avoids pitfalls in the future.

The interview also highlighted some opportunities in aligning the City of Athens' vision to other municipalities. The Resilient Cities Network (<https://resilientcitiesnetwork.org/>) is a great example of collaboration between cities to share good practices on urban resilience and to have fruitful discussion to update, revise and improve the Climate Adaptation Plan. As citizens and the civil society are involved through citizen science groups (especially on Air Pollution and Green Spaces), these interactions could be the seeds to scale up action across multiple levels of governance.

The REACHOUT project contributes to the city hub in three ways (Figure 6). First, it enhances the City Hub business model Data&Tools component by enabling cooperation between partners. This is the case for flood risks: the Flood Risk Assessment Map – a service offered by Reachout's partner Euro-Mediterranean Center on Climate Change (CMCC) – solves existing data and capacity gaps. As updated census information are not available yet, the tool employs machine learning and artificial intelligence techniques to estimate the impact of fluvial and pluvial flood events. Second, REACHOUT enables stronger and more frequent interactions with the Resilient Cities Network, which in turns stimulates cross-department collaborations. Finally, REACHOUT increases awareness on the top climate risks by using Story Maps to engage with citizens and by identifying new entry points to build efficient communities of practice and sustainable marketplaces.

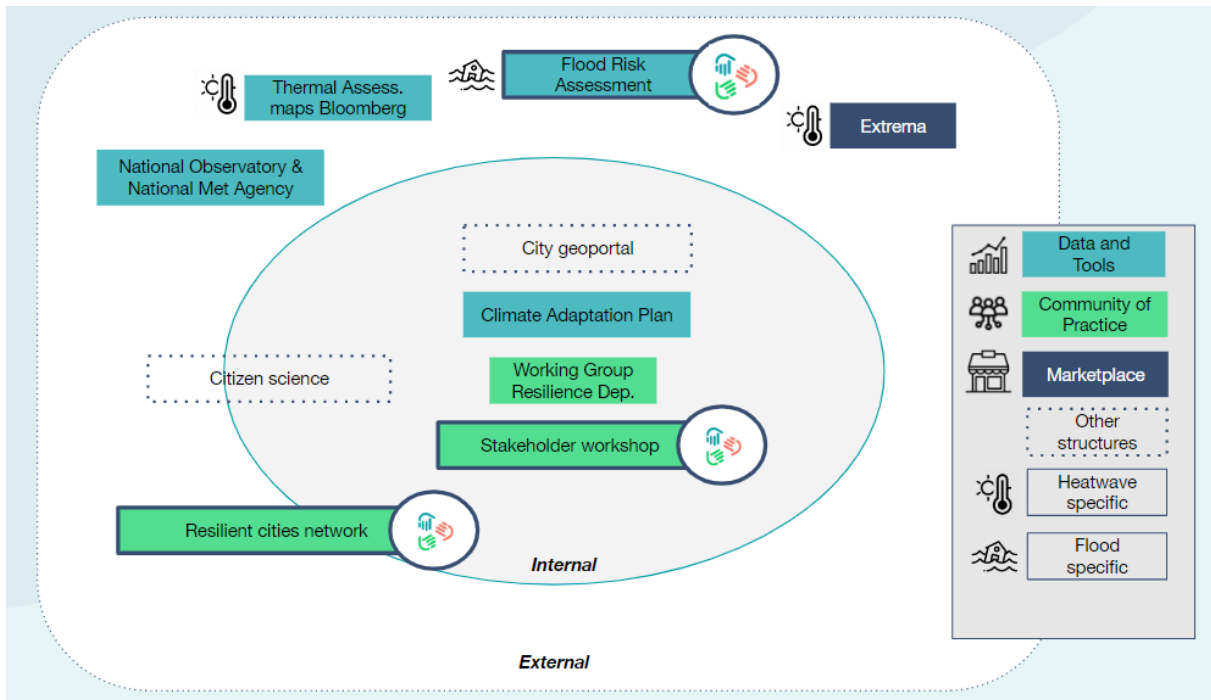
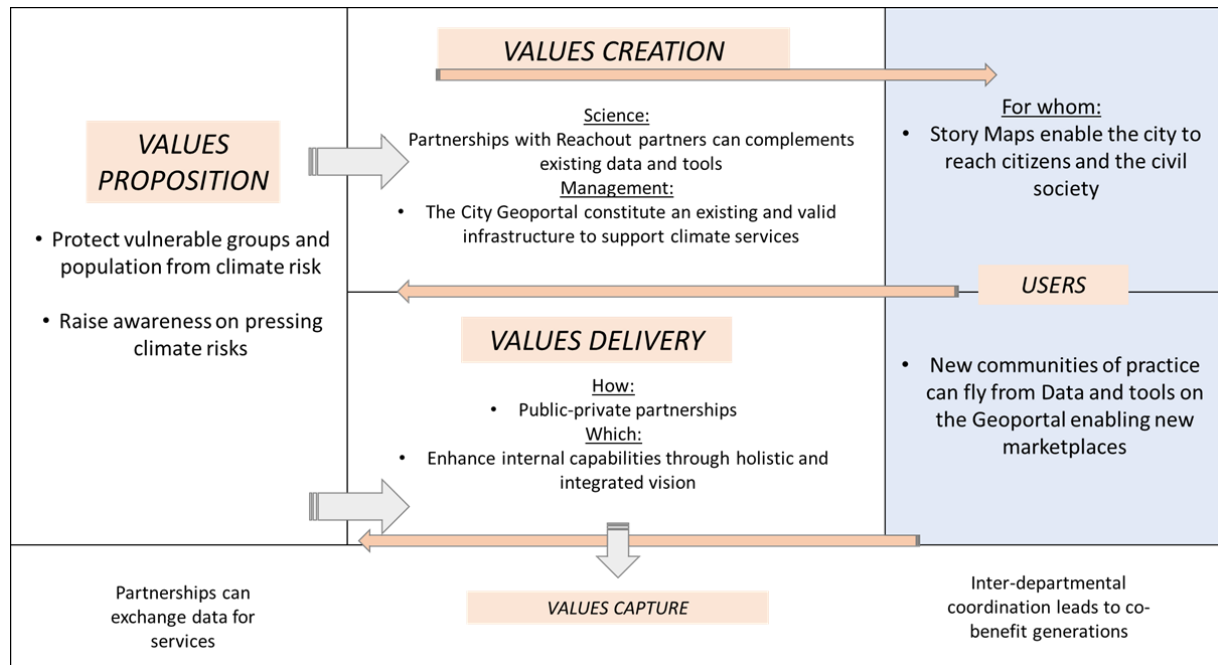


Figure 6 | REACHOUT contribution to Athens' city hub

The conceptual maps provide a clear overview of the opportunities and risks associated with each public value category. The interview with the City of Athens revealed that protecting the most vulnerable and increasing awareness are two crucial priorities for the city's climate services. These priorities can be addressed by developing strong communities of practice that are open to potential marketplaces. The cooperation between REACHOUT partners can offer new data and tools to tackle heat waves and flood risks, which will stimulate different users and potential applications. The Geoportal of the city of Athens can serve as the infrastructure to host updated databases and tools. However, this process requires coordination, vision, and

resources. To deliver social, political, and economic values, public-private partnerships (PPPs) can be an effective channel for the city to explore. PPPs can complement the goals of projects such as REACHOUT and further enhance public partnerships with international initiatives such as the Covenants of Mayors and the Resilience Cities Network. Including climate services in the Climate Adaptation Plan and its updates can also help deliver public values.

The analysis of Athens' City Hub business model reveals that the two biggest opportunities are to create and deliver data and tools through partnerships, which can in turn lead to the development of new and stronger communities of practice. The key channel for achieving this is the existing City Geoportal, which can be transformed into a solid and multi-purpose infrastructure to host both climate and non-climate related data and services. Additionally, the analysis reveals how different governance modes can shape public values for the city, highlighting the importance of considering different stakeholder interests and involving citizens and civil society in the development of climate services. The adoption of public-private partnerships (PPPs) is also suggested as a possible channel for delivering social, political, and economic values and complementing existing initiatives such as REACHOUT and international networks like the Covenants of Mayors and Resilience Cities Network.



Governance mode	Values			
	Proposition	Creation	Delivery	Capture
Hierarchy	Better alignment between climate services and the climate adaptation plan			
Clan	Identify vulnerabilities and spatial explicit exposures	Collect group-level needs and requirements		Establish collaborations that can cover maintenance and data collection costs
Network		Foster internal capabilities to manage data and tools	Deliver through established communities of practice	Establish practices to increase values beyond national borders (i.e., EU projects, C40)
Market				Strengthen public-private partnership to lower costs and provide free services

Figure 7 | The strategic steps to capture public values from the City Hub business model in Athens

3.3.2 Milan

The city of Milan identified heat waves and urban flooding as major climate risks. Extreme temperature such as heat waves are major challenges for urban planning and design. Climate deterioration exacerbates the already existing weaknesses in social systems, causing concerns around human health, comfort and easiness to live. The city of Milan and the Urban Resilience Department Office have engaged over the past decade in structures awareness campaign and strategies to protect the most vulnerable and to adapt to rapid changes. Dealing with climate risks in Milan means protecting the city from the social, economic and environmental perspective: in a city where population density is close to 7,700 inhabitants/km², adapting and responding to the impacts of climate change is not just an environmental issue, but a matter of exposure reduction, equity and vulnerability management.

Over the years, Milan Municipality has been moving forward toward a seamless integration between diverse data sources (i.e., satellite data, in-situ measurement, databases from external providers) to map in quasi real-time the needs of the city and to support sustainable planning. This integration is carried on through the strong involvement and participation to European and national projects (i.e., ClimaMi Urban Heat Maps and the Armonia project), and through the launch of city-sponsored and city-led initiatives. While on the heat wave level, data and tools are populating the city's geoportal, fewer resources were devoted to the flood risk. The City is also active in tackling air pollution through its in-house Air & Climate Plan (which includes databases and cross-cutting tools) and the "Milano cambia aria" initiative.

Due to its active role in promoting awareness and change around climate issues, the city has developed strong communities of practice. They operate online (like the app Campaigner) or offline (the Climate General Assembly and the citizen assembly born on February 2022). These communities constitute both tools to hold politicians and decision-takers accountable and a way to engage in a participatory and co-production process. They also represent a valid instrument to spread and distribute formalised and in progress marketplaces, such as the app Extrema (as in the case of the City of Athens) or the Milan Green Week, a fair where local, national and supranational stakeholders foster collaborations related to climate change. While not a marketplace in the strictest sense, Milano Green Week brings together the municipality, various stakeholders, and the citizens enabling and cultivating mutually advantageous exchanges. In this context, Milan is set to present the Climate Storyline produced within REACHOUT.

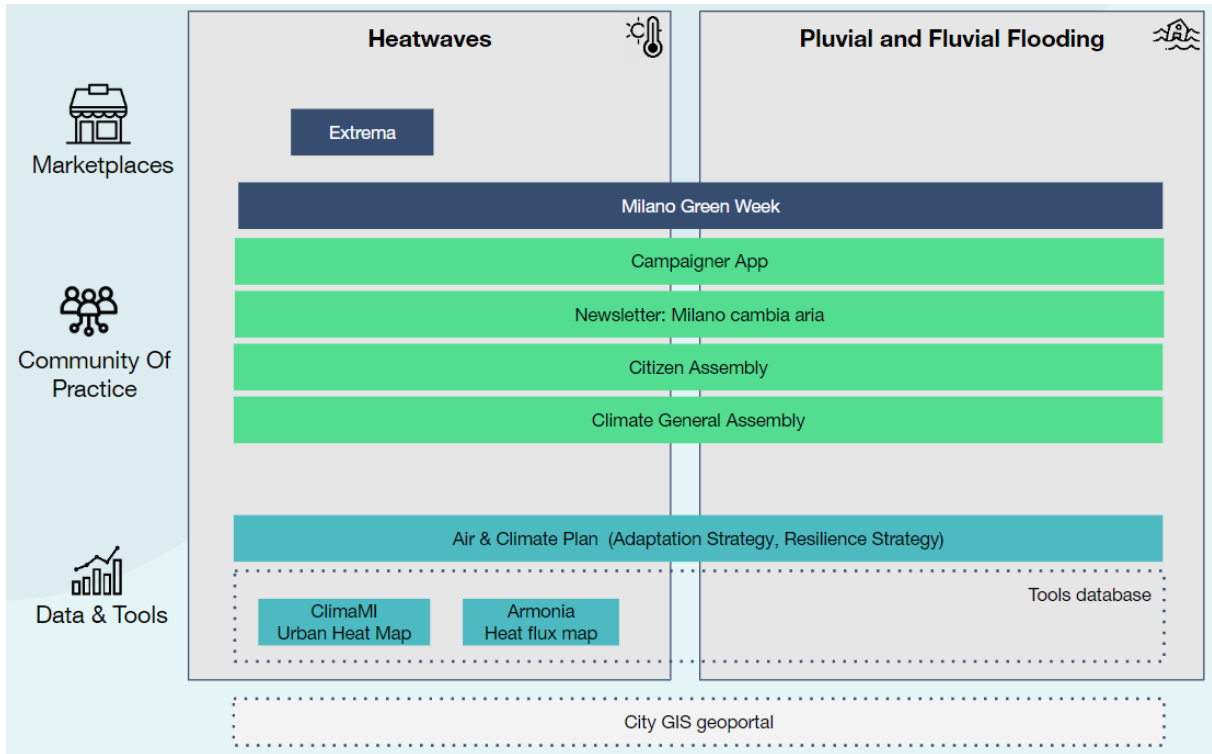


Figure 8 | Draft city endowment of Milan

The interview with Urban Resilience Department Officer of Milan allowed to elaborate the distribution of the capacity of the city (Figure 9). The technical capacity related to data and tools is mostly outside of the city offices while internal capacities are employed for policy processes and engagement initiatives, such as the Milano Green Week. These initiatives can be considered bridges between the internal and external sphere.

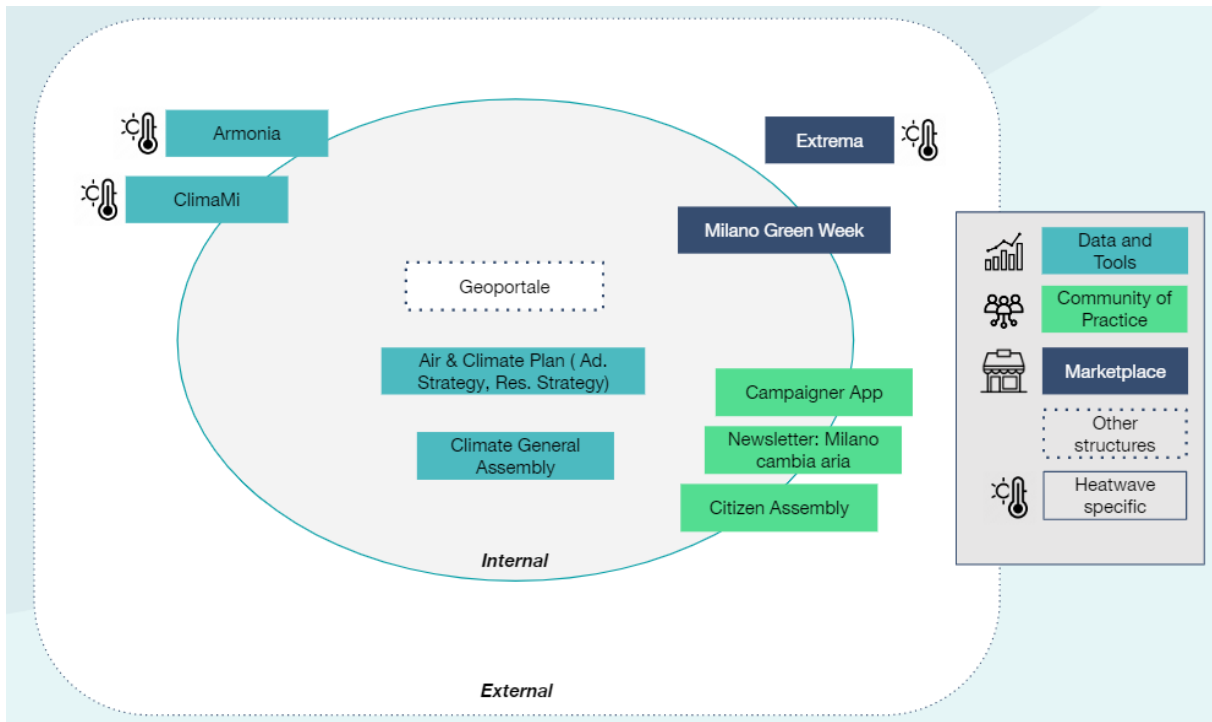


Figure 9 | Final city endowment of Milan

During the interview, opportunities and challenges to further strengthen Milan City Hub Business model emerged. The city is working to integrate better its heterogeneous tools related to different, but still loosely integrated projects and sources. The aim is to effectively connect the city officer and other stakeholders within the municipality and become the base to monitor and direct the Air & Climate Plan. REACHOUT is seen as an opportunity to expand the network with other innovative and green-oriented cities.

Milan's City Hub is already well-developed; nevertheless, REACHOUT is contributing by providing tools and connections. It offers two tools, the Thermal Assessment Tool created by Tecnalìa and the Flood Risk Assessment maps provided by CMCC. From a community of practice perspective, REACHOUT contributes to improving the city hub by connecting Milan to other European cities via the introduction to the Resilient Cities Network.

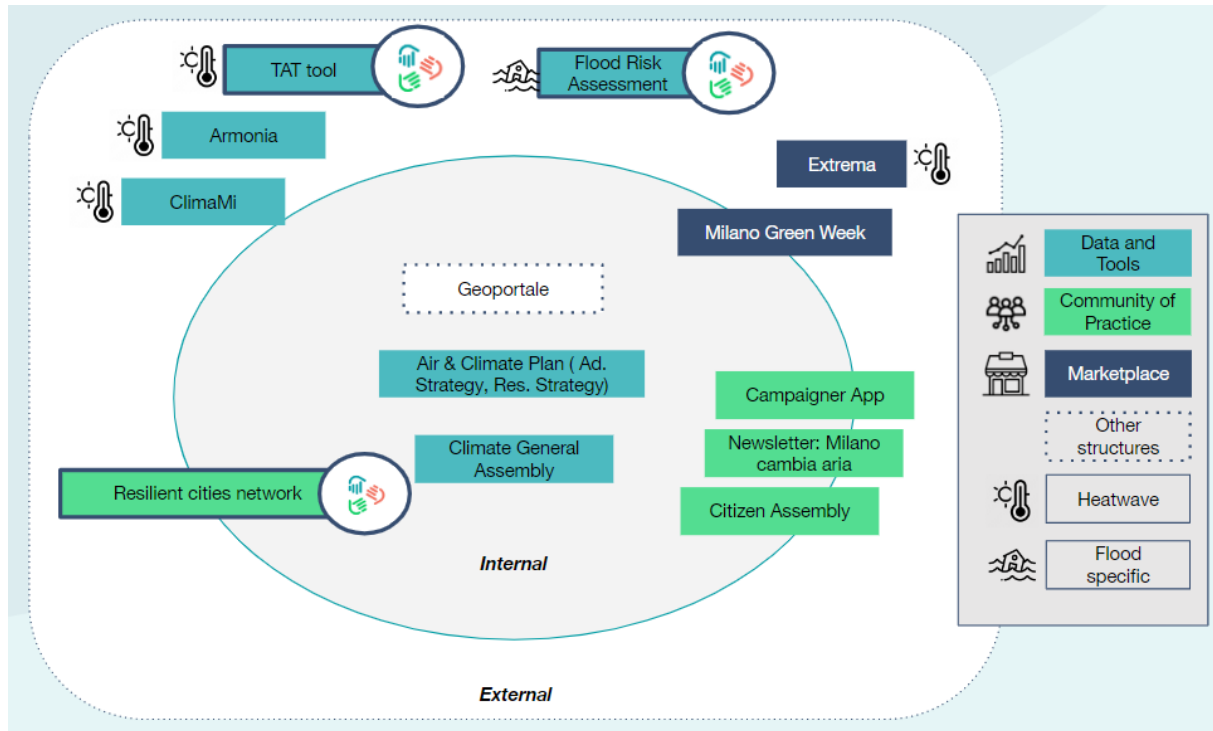


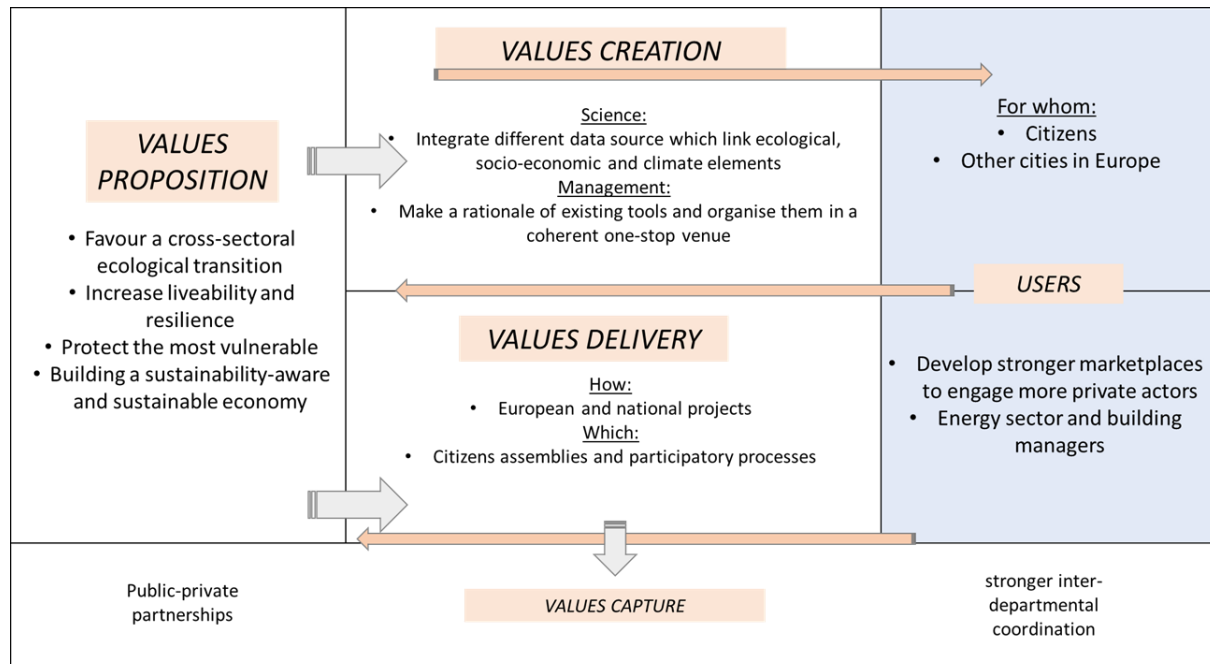
Figure 10 | REACHOUT contribution to Milan's city hub

The analysis of the endowment of the city of Milan allows us to suggest options to strengthen the City Hub business model and to enhance different values (Figure 11). The city has several goals, the first of which entails the support of a cross-sectoral transition, meant as the integration between socio-economic, ecological, political and climate elements. To achieve this proposition, the city can develop a coherent strategy to collect and publish data from different sources. Data, services and tools can be integrated in a one-stop window mirroring supranational experiences such as Copernicus Climate Change Service (C3S). These efforts should take into account multiple climate risks, expanding the activities around those which are currently less tackled (flood risk) with respect to top priority ones (i.e., heat waves). By advancing on multiple fronts, the city of Milan can achieve other major propositions: protecting the most vulnerable and building a sustainable economy.

As observed, the city can count on multiple off and online communities of practice. The province of Milan generates approximately 10% of the national GDP of Italy. The area of Milan has been a major industrial and manufacturing center since the late 1800s. Relevant industries active in Milan include chemicals, home appliances, food & beverages, machinery, medical technologies, plastics and textiles. The construction, retail and utilities sectors are also large employers in the Greater Milan. Milan is Italy's largest financial hub. The presence of a flourishing private sector constitute a value added to establish new collaborations and

strategies around climate adaptation and climate services benefit from and create benefits for the stakeholders who would engage with the city. Throughout the project, the city has expressed the interest in interacting more with building owners and developers to create energy efficient homes, offices and public spaces. This goal can be achieved by acting through established communities of practice and by starting new partnerships with private actors. As positive spillover, the city would be able to elaborate new ways to capture values and to guarantee economic sustainability of the tools.

Finally, stronger and novel partnerships can support the establishment of functional marketplaces that increase resilience and support innovation at city level. The data and tools endowment of the city and its technical infrastructure are the starting point for a more elaborate landscape that builds around service ecosystems. These ecosystems can make use of existing fairs (such as the Milan Green Week) to test how services can be used, combined and deployed.



Governance mode	Values			
	Proposition	Creation	Delivery	Capture
Hierarchy	Include flood risk as key priority to protect vulnerable population		Team up with the private sector to create new programs	
Clan		Focus on energy efficiency to restructure buildings and increase their resilience, while lowering carbon footprint		
Network	Assess synergies across multiple climate risks	Foster internal capabilities to manage data and tools in tandem with communities of practice	Link established communities of practice	
Market	Connect experiences from diverse, past and present projects to guarantee legacy		Strengthen public-private partnerships	

Figure 11 | The strategic steps to capture public values from the City Hub business model in Milan

3.3.3 Logroño

The city of Logroño faces three major climate risks: heat waves, droughts and flooding (pluvial and fluvial). Temperature changes affect the urban area in the form of heat waves representing a major risk for the city. Extreme rain events are also identified as a main climate impact. The presence of the river Ebro to the North of the city, with its tributary, Iregua, to the East and the reservoir of La Grajera to the Southwest provide remarkable ecosystem services to the city and its surrounding rural landscape. The territory has an extensive network of parks, gardens and river areas, which provides citizens with a green and blue infrastructure. Environment, as a provider of benefits in terms of beauty, health and productivity is considered by the city and its inhabitants essential and its prevention from degradation, such as soil erosion and desertification is considered important.

The city has access to the weather data provided by the Agencia Estatal de Meteorología (AEMET). At the moment the city has three weather stations in operation inside the urban area and one environment contamination station. The data from these technical stations are available directly to the municipality. The ambition is to improve the provision of weather data and especially collect data related to the soil temperature and the soil retaining water capability, through the awarding of the placement of three new weather stations. Regarding the hydrological data, the city has access to the Infraestructura de Datos Espaciales - IDE Rioja (<https://www.iderioja.larioja.org>), where is also available cartography on fluvial and pluvial floods as part of the Plan Especial de Protección Civil de la Comunidad Autónoma de La Rioja against floods (INUNCAR).

The City council doesn't have a system to collect and process data about the different climatic drivers, such as heat waves, extreme rain events and river flooding. The only available information comes from a study done by a technical assistant (2019), who provided climate projections for Logroño using data from Copernicus (2018), as part of the elaboration of a mitigation and adaptation plan for the city. Concerning non-climatic challenges the city identifies the air pollution and land use conflict as impacting climate risk.

The City has performed a climate risk and vulnerability assessment in 2019 as part of the Climate Change Adaptation Plan. The plan established 4 strategic objectives, 5 goals, 10 lines of action and 58 actions to be carried out between 2019 and 2030.

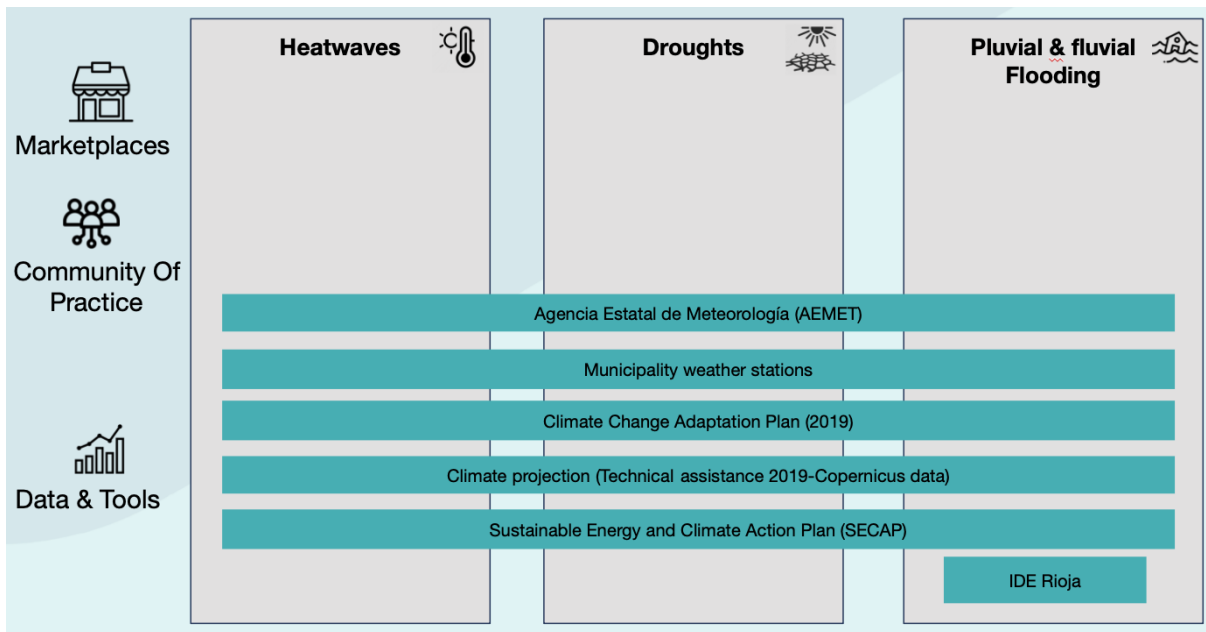


Figure 12 | Draft city endowment of Logroño.

Logroño has engaged during 2022-2023 in the formulation and implementation of the Sustainable Energy and Climate Action Plan (SECAP) as a vision on climate adaptation for the city. The ambition is to construct the Plan with the support of technical assistance and with the support of co-responsible and involved citizens. As part of the entire vision, the process is articulated toward the development of three parts: a Baseline Emission Inventory, Climate Change Risk and Vulnerability assessment as well a Sustainable Energy and Climate Action Plan (SECAP).

The city did not establish Communities of practice or Marketplace in relation to climate services.

A collaborative meeting with the Economic Promotion Department officer of the city allowed for the elaboration of the distribution capacity of the city (Figure 13).

During the interview, two planning-related tools were identified which were not present in the stock-taking survey: the Urban Agenda Strategic Plan and the City Portal - Smart City Platform. The Urban Agenda Strategic Plan is a city-wide strategic plan that is being developed to focus on climate change and resilience-related topics. It involves the Strategic Urban Planning department, working groups, and collaboration with other city departments. The representatives of the city hub viewed the Urban Agenda Strategic Plan as suitable for improving the city's resilience and encouraging the participation of various city departments and other community stakeholders.

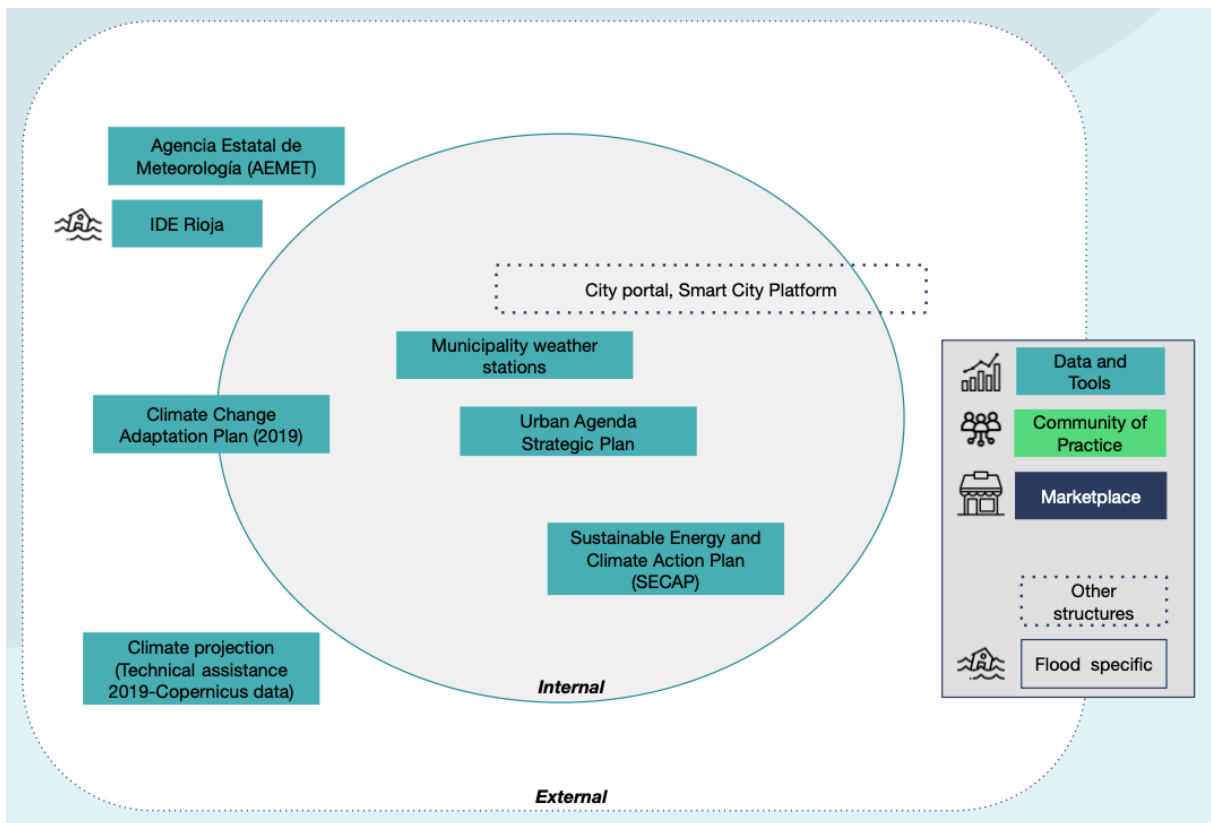


Figure 13 | Final city endowment of Logroño

The Smart City Platform (<https://ciudadinteligente.logrono.es>) is a virtual space that grants public access to data such as water consumption and traffic information, and in which citizens can upload information. In the future, it could be integrated with new models to gather different types of information. Through the City Portal, regional and municipal public cartography data are available.

During the interview, the municipality expressed concern regarding the obstacles in implementing the City Hub Business Model that emerged in the REACHOUT context, including

slow public administration, data management challenges, and interdepartmental communication complexity. The most significant challenge to further development, in particular in relation to the Community of practice and Marketplaces, is the time required for the public administration system to transform decisions into actions. Another issue relates to data management, as the municipality recognizes the challenge of integrating all the information collected into a common language that is interpretable by the different departments within the city. Finally, the complexity of interdepartmental communication is also perceived as a barrier that impedes the evolution of the Business Model. The Climate Change Adaptation Plan (2019) is programmed to be carried out between 2019-2030 but without budgeting and monitoring evaluation processes, this lack of operationalized phase is perceived as a barrier to developing the plan.

The interview highlighted the three main contributions of REACHOUT to the city (Figure 14). Firstly, REACHOUT provided relevant climate-related risks tools, including the Thermal Assessment Tool from Tecnalía, the Pluvial Flood Risk Map from CMCC, and the Social Vulnerability Tool from UCC. However, the city still lacks data for vulnerability assessment tools, such as an energy poverty indicator. Secondly, REACHOUT stimulated new meetings and initiatives within and between city departments, the ambition of the city is to collect the data and publish it on the city website to communicate the results of the project. In this phase feedback from the tool users, especially from different city departments, will be appreciated, accordingly to the Economic Promotion Department officer. Thirdly, REACHOUT provided the Climate Story tool, which is considered essential for internal dialogue on climate issues. The city plans to use the tool further to engage with the private sector, educational organizations, citizens' associations, and other community stakeholders.

A specific climate data team is not functioning at the municipality at the present time, but the personnel involved is part of related projects such as REACHOUT, SECAP and Urban Agenda 2030.

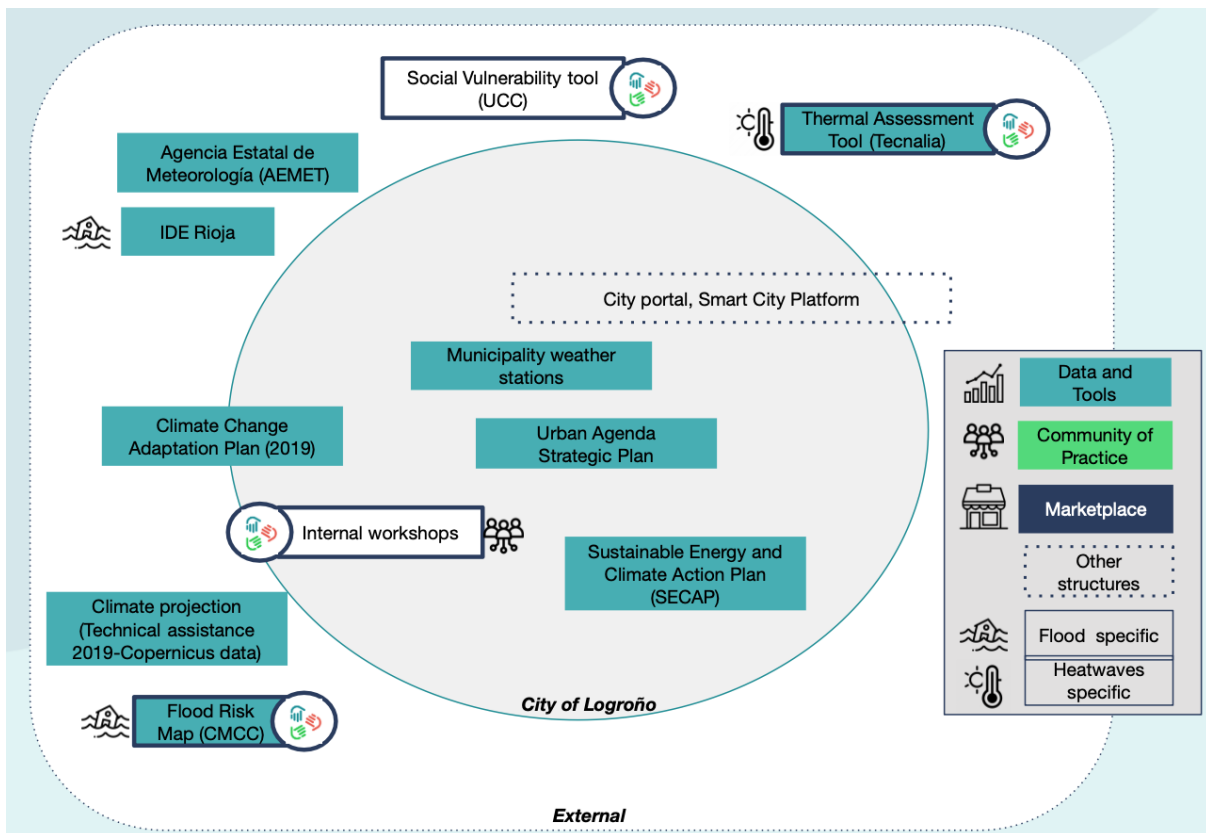


Figure 14 | REACHOUT contribution to Logroño's city hub

The analysis of the endowment of Logroño's city allows us to suggest opportunities to reinforce the City Hub business model and to improve different values (Figure 15).

Logroño has many objectives to improve the resilience of the city, starting from the task to combine the different tools offered and provided by REACHOUT partners and test the applicability in the context of the city. To achieve this goal the city can increase inter-departmental collaboration, such as promoting meetings and workshops among the different municipal dominions in order to promote a common dialogue that may corroborate the effective application of the climate data tools.

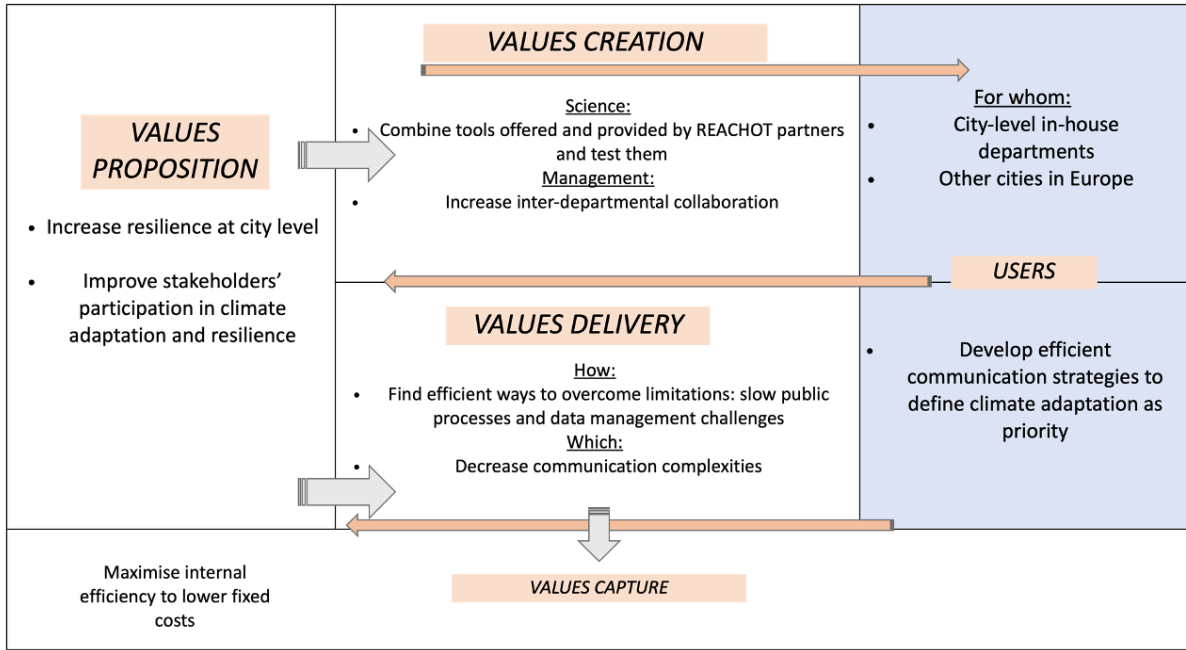
The collaboration of internal departments must be developed in combination with the involvement of the local community and citizens together with the sharing of good practices between the cities involved in the REACHOUT project.

The initial stakeholder screening identified 42 stakeholders and end users who could play a role in the development of climate services in Logroño. The first stakeholder screening identified stakeholders and end-users primarily at the *local level* who have key roles in adaptation implementation, for instance, the Directorate General of Strategic Urban Planning and Environment of Logroño City Council.

At a *regional level*, a variety of stakeholders working in the research, business and civil society levels were identified, for instance, the Directorate General for Ecological Transition and Climate Change of La Rioja and the Ebro Federation leading the river resilience strategy. Currently, there are few national organizations at the *national level* that were identified in the first stakeholder screening, at this level the National Institute of Meteorology (AEMET) stands out as a key potential partner. There are also several knowledge and research stakeholders identified, that include the University of la Rioja and some ongoing European projects such as WeSolve (<https://engage.eiturbanmobility.eu/processes/wesolve?locale=it>).

Stimulating the participation among different stakeholders in a structured participation pathway framework can increase the adaptation vision already taken in place by the municipality with the Urban Agenda Strategic Plan. Trying to gather different initiatives in a coherent path of actions and practices would allow for optimizing times and having a common language among different stakeholders.

Promoting the creation of Communities of practice supports the provisioning of different and multi-level knowledge and may orient the creation of city-specific climate services user-oriented. The goal of involving the local community can be achieved by sharing the Story Maps tool. This action firstly can spread knowledge about the project and its results, and secondly aims to innovate the local community making it more aware of the climate services theme. At the same time establish a beta Marketplace to share the experience and service developed, representing an opportunity to strengthen public and private partnerships.



Governance mode	Values			
	Proposition	Creation	Delivery	Capture
Hierarchy	Increase inter-departmental communication and efficiency			
Clan		Stimulate the participation of different stakeholders to create communities of practice	Use Story Maps to establish communication practices and share risks	
Network	Integrate different sources and information in a coherent way		Optimise time required to build common language by integrating different activities in one	
Market	Establish a beta marketplace to share experiences and services developed		Strengthen public-private partnerships	

Figure 15 | The strategic steps to capture public values from the City Hub business model in Logroño

3.3.4 Gdynia

The major climate risks faced by Gdynia are heatwaves, flash floods, storms, and droughts. Gdynia is a city in northern Poland and a seaport on the Baltic Sea. Its climate is relatively continental, characterized by pleasant summers with potential heatwaves and droughts, and cold winters with frequent but generally not abundant snow and possible Siberian cold waves. The city is situated in five natural catchments of surface watercourses and eighteen catchments of rainwater drainage collectors. The city may suffer strong winds, especially in winter. Winds and rains may generate storms, and these, combined with the position on the coast and rivers, cause risks of stormy, pluvial, fluvial, and coastal floods. In this regard, it must be noticed that the water sector is vulnerable to climate change impacts since the sewage management subsystems and the flood protection infrastructures are particularly weak. Gdynia is part of the Tri-City metropolitan area along with Gdansk and Sopot. Tri-City is a fertile economic area increasingly attracting startups and investments due to its geographical position, the presence of ports and many incubators, and the availability of human capital. It has a population of 244,969 inhabitants, is a vibrant cultural and educational city with ten universities, and has a thriving maritime and tourism economy. The city is divided into 21 districts, represented by District Councils, which have their own budget for local actions.

The City of Gdynia has access to various data sources at the national, provincial, and local levels. The national Institute of Meteorology and Water Management provides weather data, while Polish Waters, a national institution under the Ministry of Environment, produces water-related data. The Pomeranian Voivodeship Governor, a provincial institute, supplies drought data. Nine pluviometers in Gdynia, and 41 in the metropolitan area, continuously deliver pluvial measurements at the city level. The City of Gdynia also has an [open data portal](#) where it communicates and shares news and data with citizens, stakeholders, and shareholders. This portal has the potential to become the City Hub marketplace, which we will discuss further later.

In addition to the data sources previously mentioned, the City of Gdynia has access to three risk assessments that generate relevant data. First, the riverine flood risk assessment, provided by [Polish Waters](#), takes into account the probabilities of climate events repeating and refers to the main rivers flowing across Gdynia. However, there are no assessments for the other watercourses. The City also lacks hydraulic modelling of the water supply and sewage network as an input for the pluvial hazard and risk mapping. Second, the Maritime Office of Gdynia provides the City with a [storm surge flood risk assessment](#). Third, the City performed a climate risk and vulnerability assessment in 2018 as part of the Urban Adaptation Plan (MPA). The plan contains data on temperature changes, rainfall, snow levels, flooding, and disaster events. The MPA is available on the City's website and provides important information to stakeholders, citizens, and decision-makers.

The analysis of Gdynia's communities of practice and endowment reveals a promising landscape for climate adaptation. The city benefits from several internal structures that focus on climate change adaptation and sustainable development, such as the Section of Adaptation to Climate Change and the Section of Sustainable Development, as well as the interdepartmental and inter-institutional Climate 30 Team. The latter is an interdepartmental and inter-institutional municipal team focused on adaptation and that includes the City's Mayor's committee. The [UrbanLab](#) serves as a liaison office between different departments and facilitates citizen and stakeholder involvement through sub-projects like [Urban Café](#) which serves for boosting social innovation and adaptation. It bridges data, communities, and actions together with the municipality's various micro-scale actions and education initiatives. However, no marketplaces have been identified yet. The draft City endowment (Figure 16) summarizes the aforementioned elements. Overall, there is an opportunity for Gdynia to develop market-ready tools that can support flood preparedness and adaptation, and this could be facilitated by public-private partnerships between the city council and private sector actors. The open data portal could also potentially be developed into a marketplace to further enhance communication and data sharing.

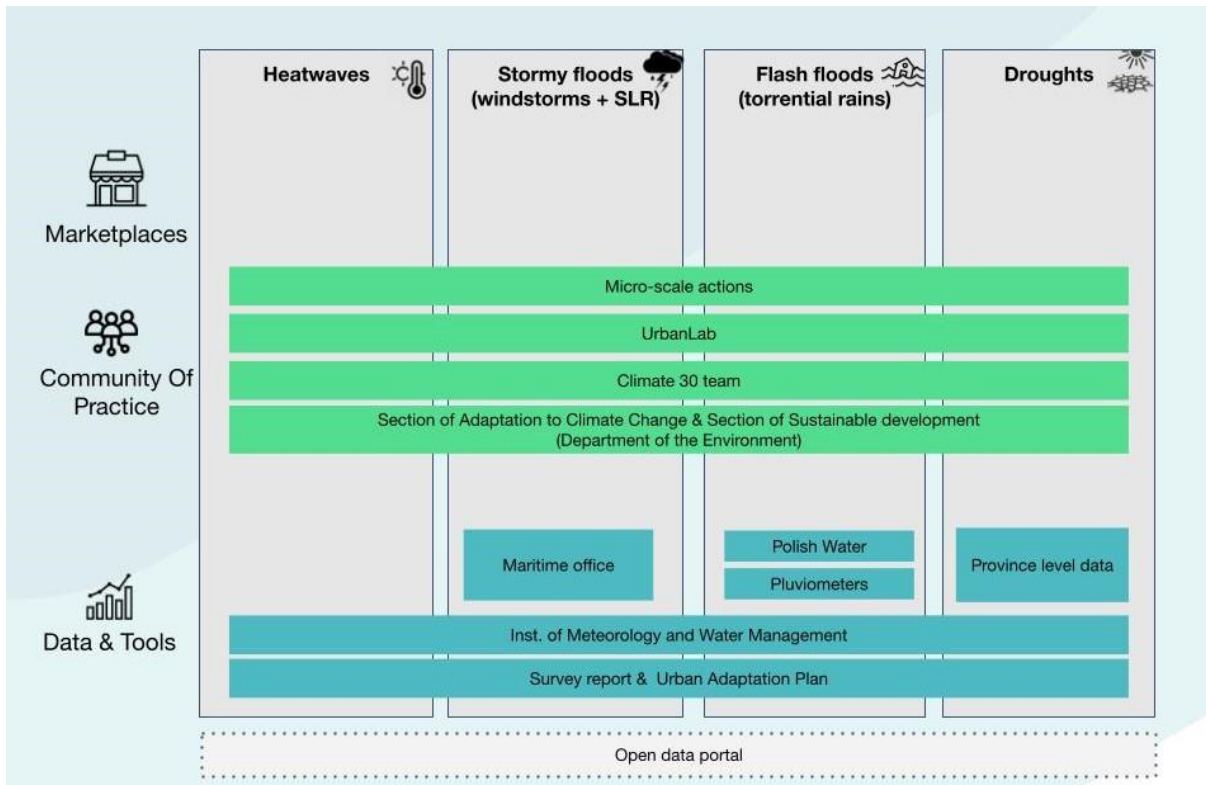


Figure 16 | Draft City endowment of Gdynia

We completed, revised, and validated the conceptual map through a semi-structured interview with representatives from the City of Gdynia. During the interview, additional elements emerged, allowing us to expand and complete the City Hub Business Model. In terms of communities of practice, we identified the working group Gdynia In Climate, which aims to educate the population on climate change, and the Association of Polish Cities network at the mayoral level. The Association of Polish Cities supports its member cities' efforts to develop socially and economically by disseminating best practices and involving public and private entities.

During the interview, no marketplaces were identified, but the municipality expressed interest in developing a virtual marketplace through the City's open data portal, which currently collects and shares municipal data. The Data Chief Officer responsible for the portal encourages the integration of data and its active use among different departments to improve interdepartmental communication. The open data portal is primarily geared towards providing raw data for specialists, particularly the IT community, to develop apps and similar digital tools. An embryonic virtual marketplace for public transportation already exists on the open data portal.

The interview allowed us to define the capacity distribution of the City Hub, as shown in Figure 17. Data are collected through external providers except for those collected by the Climate Adaptation Plan. All communities of practice, except for the Association of Polish Cities, are internal to the City. The Open Data Portal is also internal.

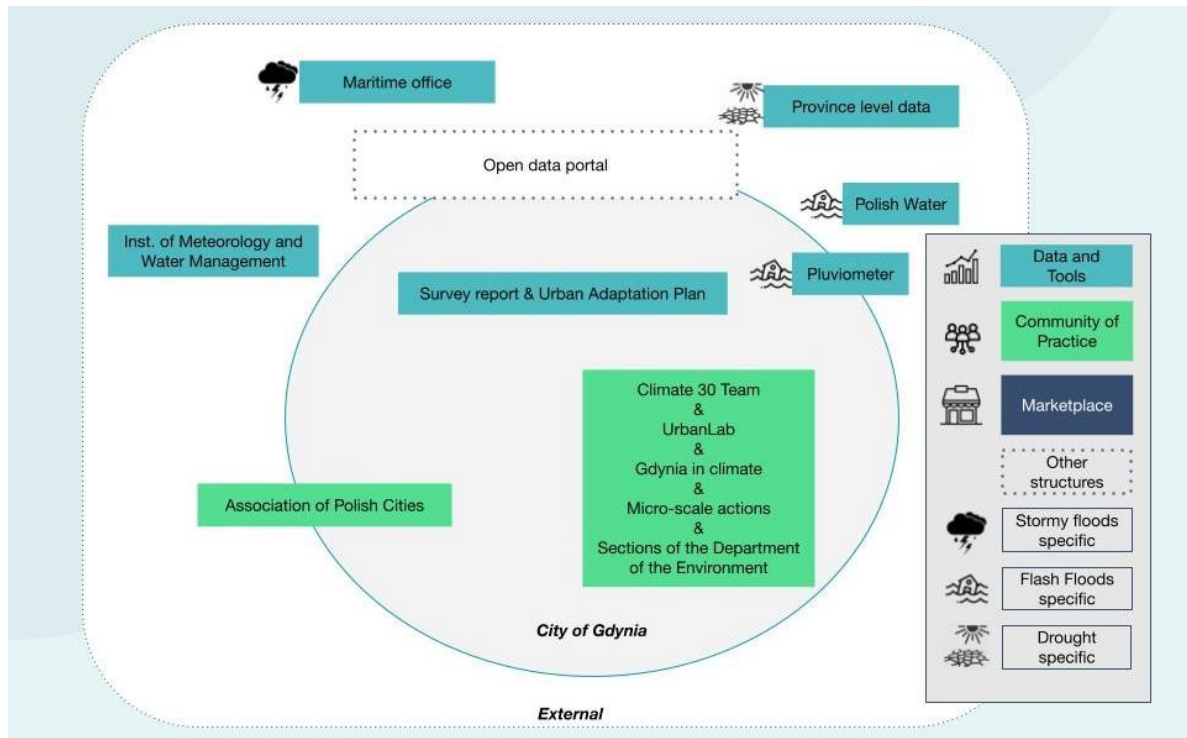


Figure 17 | Final City endowment of Gdynia

The City Hub faces several challenges. One of the main challenges is the limited financial resources, which hampers the City Hub's development. In addition, the personnel lacks competencies and awareness, which impedes the City Hub's ability to fully utilize available data and resources. Educational and awareness-raising projects are in place, but climate change is not always prioritized, which further slows down the City Hub's progress.

Another challenge is the difficulty in involving the private sector and investors. Private sector actors and investors appear to have a low awareness and sensibility towards climate change, which hinders their engagement in the City Hub's activities. Moreover, there is concern that investors may use the data for goals different from those the City Hub aims to serve, which further complicates collaboration.

Finally, the City Hub's actions are strongly constrained by the mayor's attention and willingness to activate their proposals. This lack of autonomy in decision-making terms can slow down the implementation of projects and initiatives.

The City has identified two main contributions from the REACHOUT project. Firstly, the integration of three tools into the City's structure: the Climate Resilient City Toolbox, the Community Flood Resilience Support System developed by Deltares, and the Pluvial Flood Hazard and Risk Assessment provided by CMCC. These tools are important to address the assessment gaps and support the city's water management adaptation. Secondly, the REACHOUT project has increased the understanding of the City Hub personnel regarding the value of climate services, stimulating their engagement and increasing the priority of climate adaptation. The City claims that a similar positive effect applies to citizens and stakeholders as well.

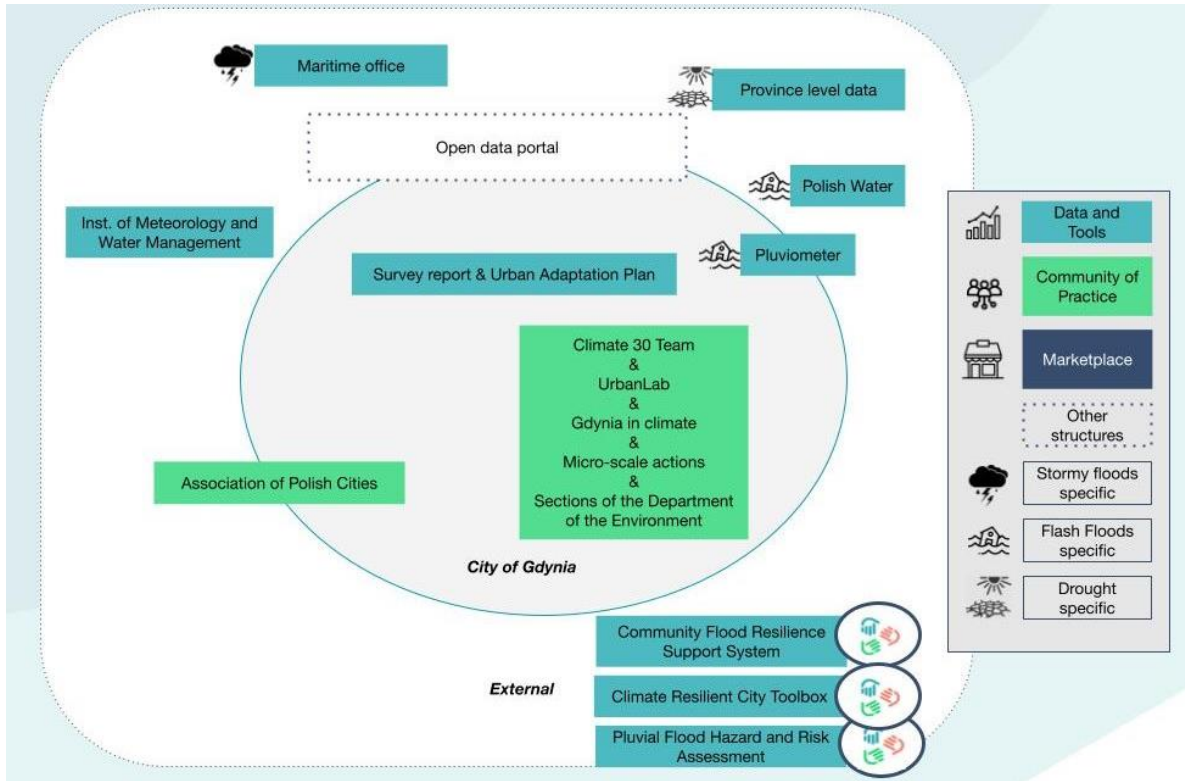
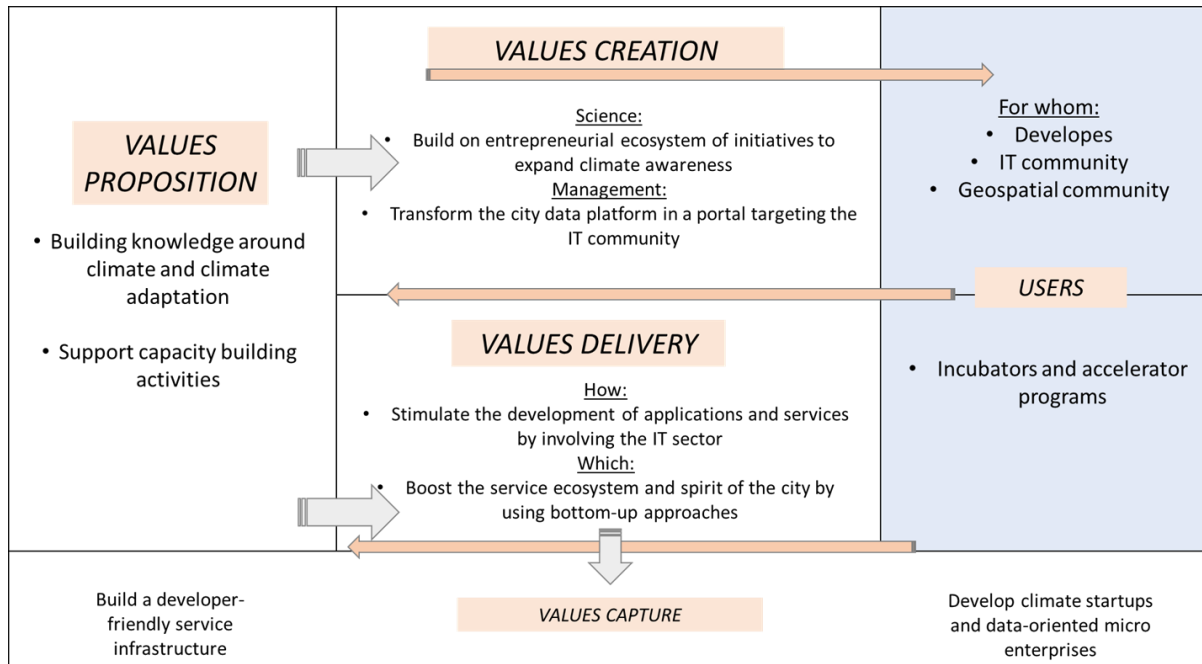


Figure 18 | REACHOUT contribution to Gdynia's City Hub

The primary finding from the analysis of Gdynia's City Hub business model is the need to develop a comprehensive marketplace, and the REACHOUT project supports this by identifying the City Portal as a potential platform for this marketplace due to its existing features. The marketplace can be designed as a multi-purpose infrastructure that accommodates both climate and non-climate data and services, and it can encourage developers to create knowledge-intensive applications. The Tri-City area presents an opportunity to transform awareness, knowledge, and relationships into new startups and businesses. The first priority is to increase awareness among personnel, stakeholders, and shareholders and involve them, which is complementary to the second priority of expanding the data coverage. This expansion can be achieved using the data and tools provided by REACHOUT, which can enforce synergies by increasing the City's data and the opportunities for new initiatives, without bureaucratic and hierarchical frictions. Overall, the potential value of the City Portal data can be turned into actual value by increasing public awareness and involvement, and a comprehensive marketplace can help achieve this.



Governance mode	Values			
	Proposition	Creation	Delivery	Capture
Hierarchy	Build decentralised governance structures to support entrepreneurial ecosystem			
Clan	Harness the power of data and services for the IT community	Build a developer-friendly data portal	API accesses and toolbox to use the data	Attract new competences and skills around data and IT
Network	Support a start-up friendly environment by leveraging on climate adaptation			
Market	Establish fairs and initiatives that support Micro, Small, and Medium enterprises		Design a KIBS-dominated economy	

Figure 19 | The strategic steps to capture public values from the City Hub business model in Gdynia

3.3.5 Cork

Cork City is situated in the southern region of Ireland, in the valley of the River Lee. With slightly over 200 thousand inhabitants, it is the second-largest city in Ireland by both surface area and population density. The city's proximity to the coast and the River Lee makes it vulnerable to climate events, as identified in the Cork City Council [Climate Change Adaptation Strategy 2019-24](#). The primary climate-related risks that Cork City and the surrounding River Lee valley face are of a hydrological nature, including fluvial and coastal risks. Storm events, coastal floods, and fluvial floods are the most relevant risks, which are the result of changes in precipitation, sea level rise, and storm surges. With nearly 300 flood events occurring between 1841 and 1988, and several severe events in 2009, 2014, and 2015/16, addressing flood risk is a high priority for Cork City. Beyond the hydrological risks, extreme heat and urban heat are also considered significant concerns for the urban context in the future

The city uses weather data collected by the Irish Meteorological Service, [Met Éireann](#), and obtains flow data of the river Lee and sea tide heights measurement via the open database of the Office of Public Works.

The city has access to a Flood Risk Assessment, which is a result of the National Catchment-based Flood Risk Assessment and Management (CFRAM) [Program](#). The city also conducted a risk assessment in 2019 to establish the Cork City Climate Change Adaptation Strategy. In terms of climate projections, Cork City uses a regional climate model (RCM) run at 3.8 and 4 km spatial resolution based on Nolan and Flanagan (2020), as well as standardized national climate projections created in the context of the project [TRANSLATE](#). The TRANSLATE project aims to standardize national climate projections for Ireland. Additionally, the city of Cork has access to the platform [WIRE](#) (Weather Impact Register), developed by the Climate Action Regional Offices. The platform allows local authorities to access information about projected climate change, related risks, and vulnerabilities of infrastructure, services, and the environment.

The city of Cork has a few communities of practice within the internal structures of the City Council, including the Climate Action Unit (CAU), the Climate Action Committee, and the Climate Action Team. The CAU is responsible for coordinating with external stakeholders, including universities, and providing technical advice to the Climate Action Committee and Climate Action Team. While the CAU is focused on adaptation, there is currently no systematic climate data management structure or dedicated team focused on data-related issues within the city endowment. The city has collaborated with universities on specific climate-related projects, but these collaborations do not appear to be structured or persistent communities of practice.

Moreover, the city has developed a PentaHelix framework, a model for collaborative innovation that involves government, industry, academia, civil society, and individuals, to socialize and collaborate on solving complex societal problems, including those related to climate change. However, the city does not have a dedicated marketplace for climate services and adaptation. The WIRE platform, which records and collates the actual impacts of weather events on various categories of infrastructure, services, and the environment, could potentially serve as a virtual marketplace if made available to the public. Currently, the WIRE app has only been tested internally, but it is set to be available to the public in the future. Figure 20 summarizes the city's draft endowment, including its communities of practice, which are limited to internal structures such as the Climate Action Unit, the Climate Action Committee, and the Climate Action Team.

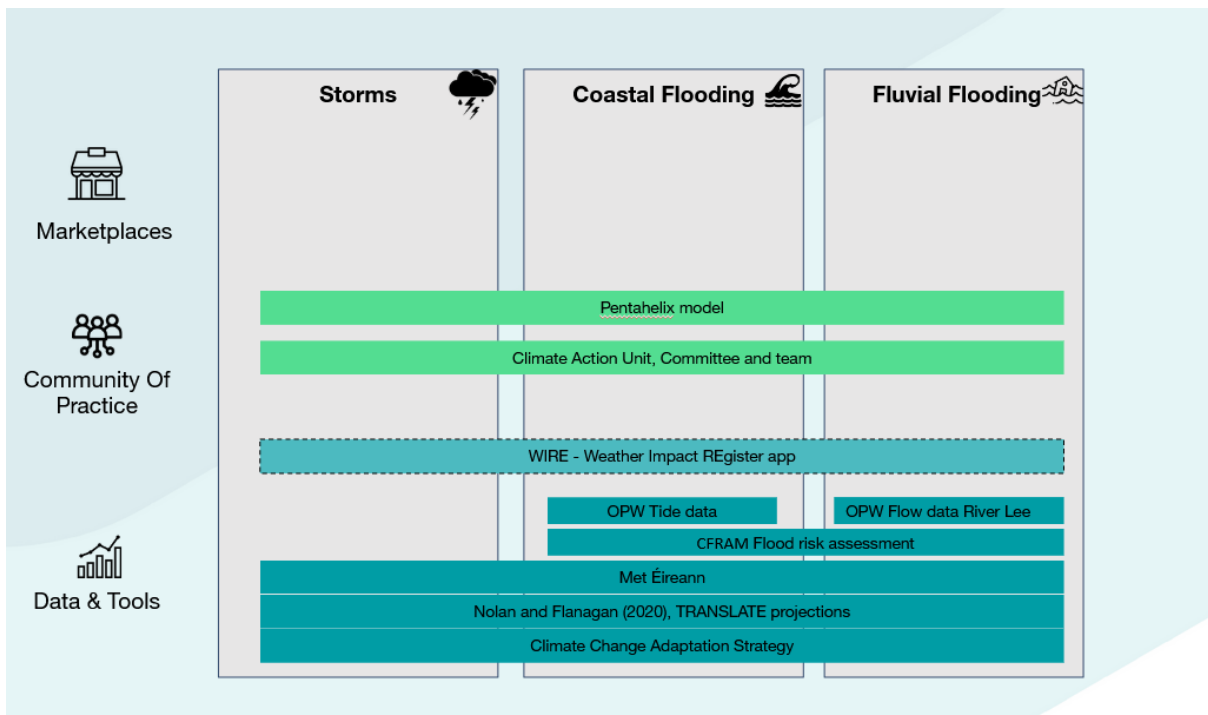


Figure 20 | Draft city endowment of Cork

Figure 21 illustrates the location of capacity related to different elements, whether internal or external to the city. Data, for instance, is collected through external sources at the national or regional level and is therefore located in the external area of the conceptual map. As discussed earlier, there are no communities of practices spanning beyond the city offices. However, the City mentions the PentaHelix approach, which aims to foster collaboration between public and private stakeholder groups, NGOs, and citizens, acting as a bridge between the internal and external sphere. Cork City recognizes the need to further develop engagement with citizens.

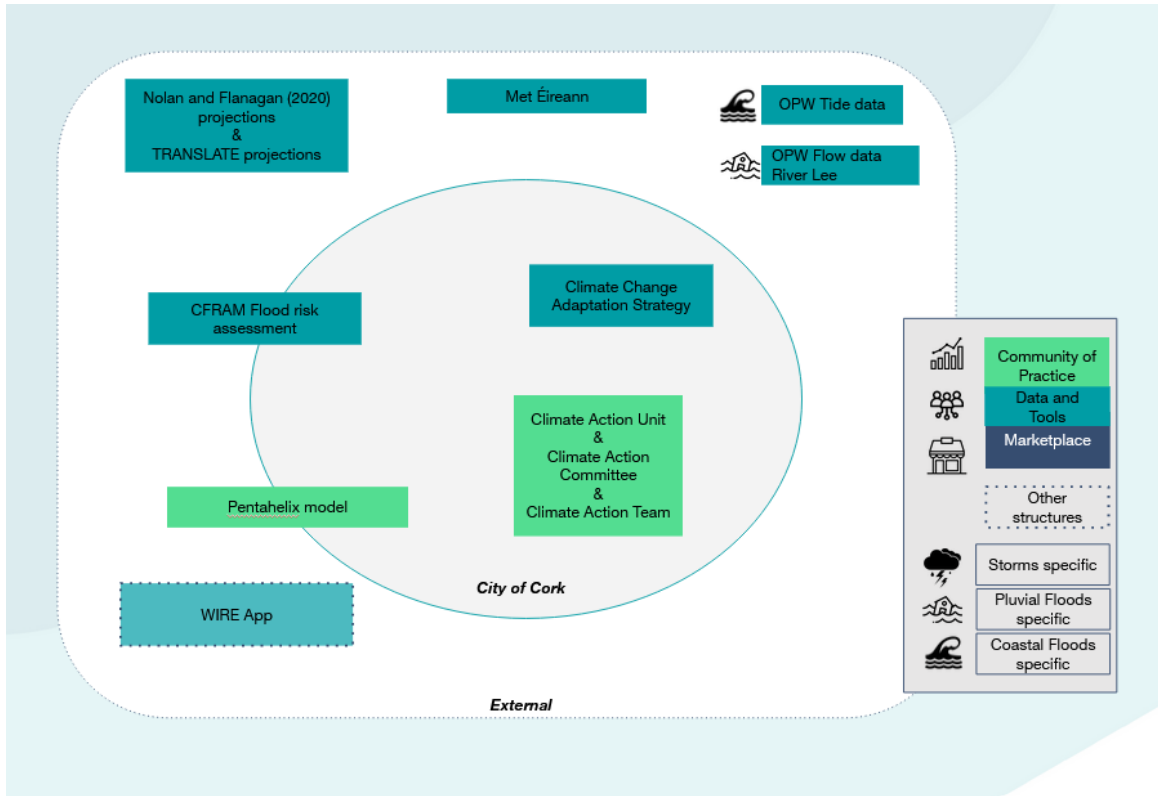


Figure 21 | Draft capacities distribution in Cork

The city plans to integrate three tools developed through the REACHOUT project into its City Hub Business Model (Figure 22). These tools are the Community Flood Resilience Support System (CFRSS) developed by Deltares, the Crowdsource for Climate Hazard Mapping Tool by CAS, and the Adaptation Pathways generator tool by Deltares. Additionally, the city will explore the tool by CMCC on pluvial flood hazard and risk assessment in urban areas.

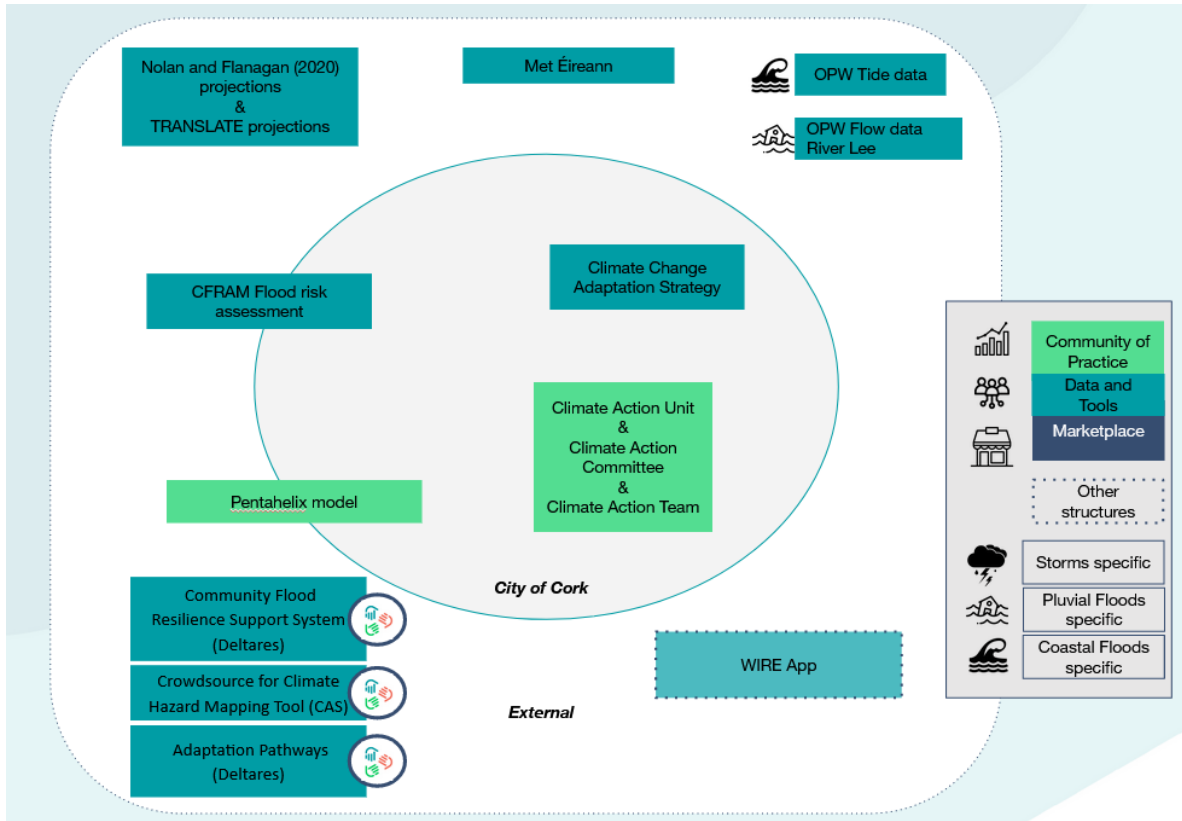
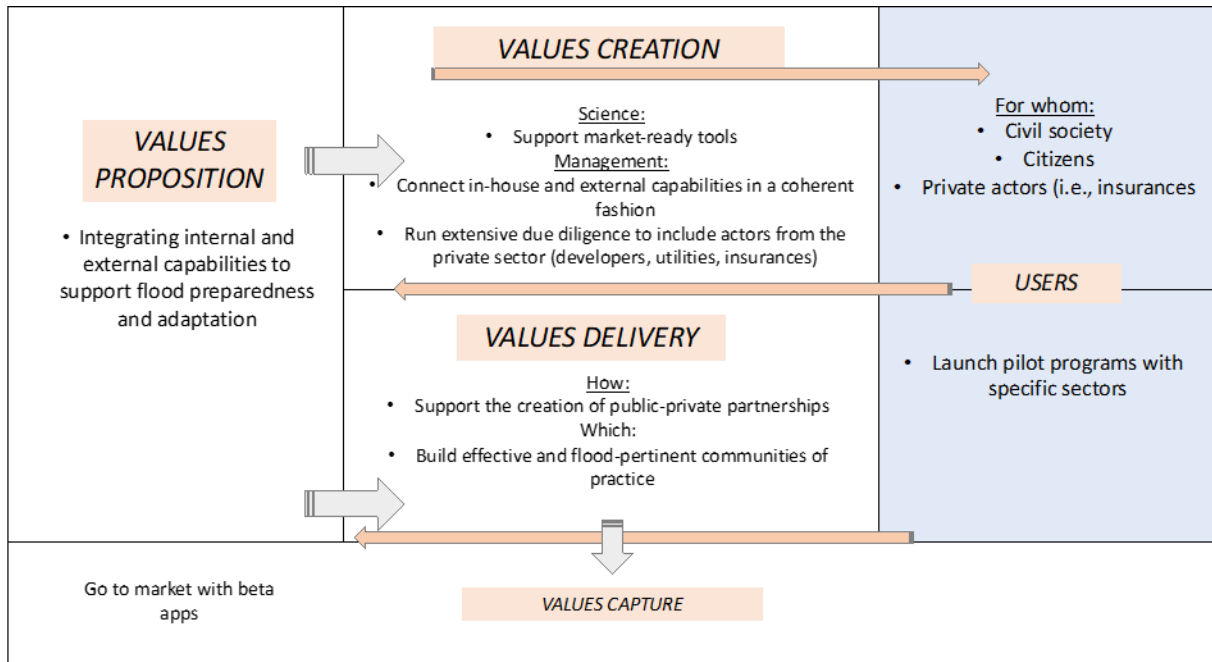


Figure 22 | REACHOUT contribution to Cork's city hub

The analysis of Cork's City Hub Business Model reveals that a key opportunity for the city is to develop market-ready tools to support flood preparedness and adaptation (Figure 23). Currently, the City has access to data and flood risk assessments, but such data has not yet been fully integrated into a tool. Bringing together the internal capabilities within the City Council with external knowledge from universities and other technical partners could be especially valuable and would facilitate the development of communities of practice focused on flood risk. The development of a market-ready tool could be structured via new public-private partnerships between the city council and private sector actors to deliver value for citizens as well as private actors, such as insurance companies.



Governance mode	Values			
	Proposition	Creation	Delivery	Capture
Hierarchy	Align in-house competences and external data providers			
Clan	Identify priority sectors	Identify private actors' needs and capabilities	Create stakeholder interactions	
Network	Invest in building public-private communities of practice centered around flood risks			
Market	Move from best to ready-for-market applications		Market the WIRE app	

Figure 23 | The strategic steps to capture public values from the City Hub business model in Cork

3.3.6 Lillestrøm

Lillestrøm is vulnerable to two major climate risks: floods, including pluvial and fluvial, and landslides. The municipality has several waterways, including the rivers Glomma, Leira, Nitelva, Svelle, and Øyeren, as well as a significant area of forest and lakes, which includes a large inland delta at the outlet of the river Glomma. The most common causes of flooding are melting snow and precipitation, and with more extreme weather events and floods expected in the future, the risks are likely to increase. Due to its location, a large part of Lillestrøm's municipality was below sea level during the glacial periods, which has resulted in the presence of marine sediments, including sensitive clay that can cause quick clay slides. Sensitive clay slides occur when clay deposits that have been historically unstable and compacted become destabilized and flow like a liquid, often triggered by heavy rain or changes in water content. These types of landslides are particularly dangerous because they can occur suddenly and without warning, often causing significant damage and loss of life. These slides have occurred in the past, causing casualties, such as in 2016 in Lillestrøm and in 2021 in the neighbouring municipality of Gjerdrum, where ten casualties were reported.

To prepare for and mitigate the impact of climate-related risks, Lillestrøm collects weather data from the Norwegian Climate Service Centre (Norsk Klimaservicesenter) and uses it to inform their climate adaptation planning. The Centre's open [webpage](#) on Oslo and Akershus provides climate projections, weather data and statistics, climate profiles, and other reports relevant for climate adaptation planning.

The municipality of Lillestrøm uses MIKE FLOOD model to simulate the flood risk. The locally calibrated model, developed in 2018, takes into account the capacity of the sewer network, surface runoff, and watercourses, and predicts how much water will accumulate during 2-, 20, and 200-year floods with and without the influence of climate factors. The model is currently only being used in the former Skedsmo municipality, a part of Lillestrøm. In addition, Lillestrøm has access to detailed mapping produced by the Norwegian Water Resources and Energy Directory (NVE). The NVE has created danger zone maps for floods, which indicate the areas that are likely to flood during events that occur at different recurrence intervals (20-, 200-, 1000-year events). These maps are publicly available (<https://temakart.nve.no/tema/flomsone>). National professional authorities have also mapped areas of quick clay, identifying several danger zones in Lillestrøm. A geotechnical assessment has been conducted in the municipality, and the data is accessible through the national database for geotechnical surveys (NADAG) or the municipality's archives.

The city has conducted an overall Risk and Vulnerability Assessment (RVA) at the municipality level, as well as for each planning project. However, a comprehensive climate risk and vulnerability assessment has not been conducted yet, although it is in line with the city's [Climate strategy](#) to do so. Additionally, Lillestrøm has a data portal called [Kartportal](#), where data and information are consolidated. The city does not currently have established communities of practice or marketplaces focused on climate services and adaptation. Figure 24 provides an overview of the draft city endowment.

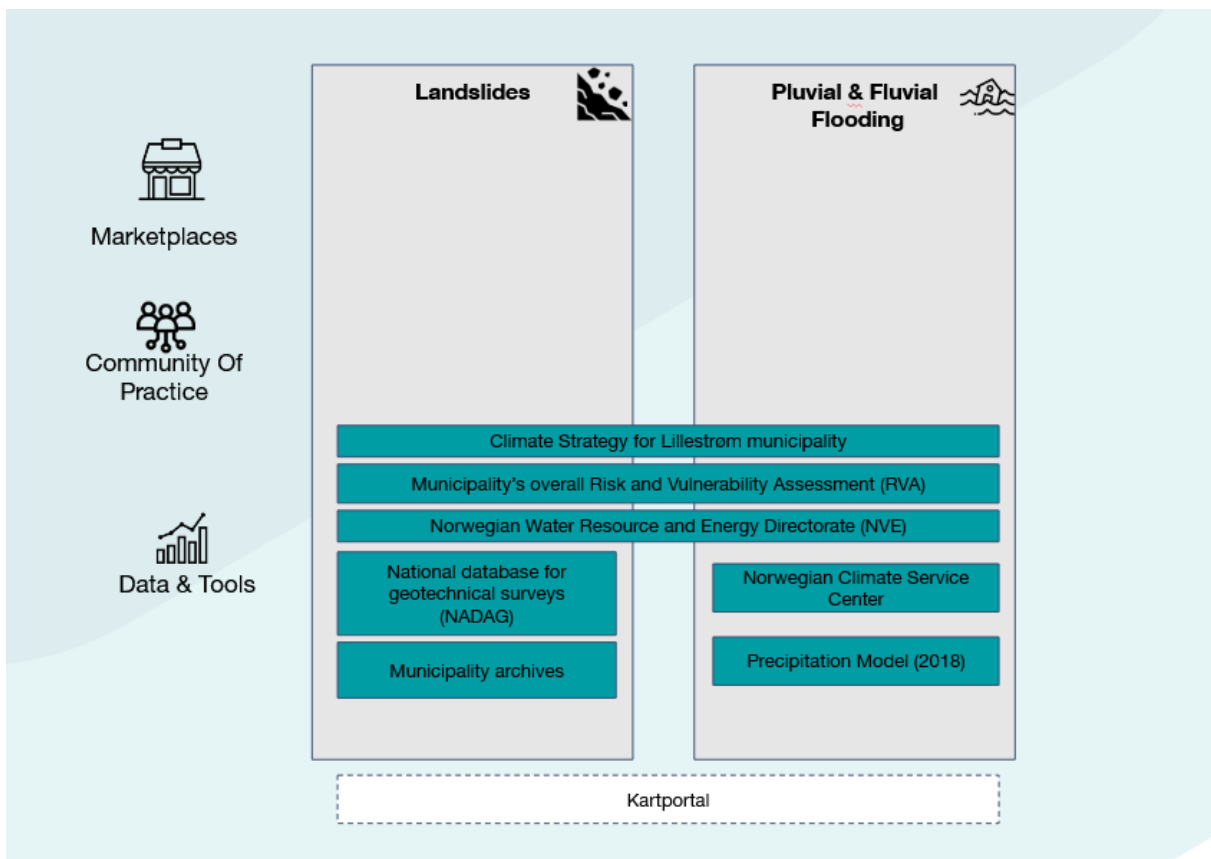


Figure 24 | Draft city endowment of Lillestrøm

The municipality of Lillestrøm relies mostly on national sources for collecting data, with the exception of the municipality archives on landslide events. While Lillestrøm has developed its own MIKE FLOOD-based model, it also utilizes nationally developed tools such as the danger zone maps produced by NVE. A draft capacity distribution chart for Lillestrøm is shown in Figure 25.

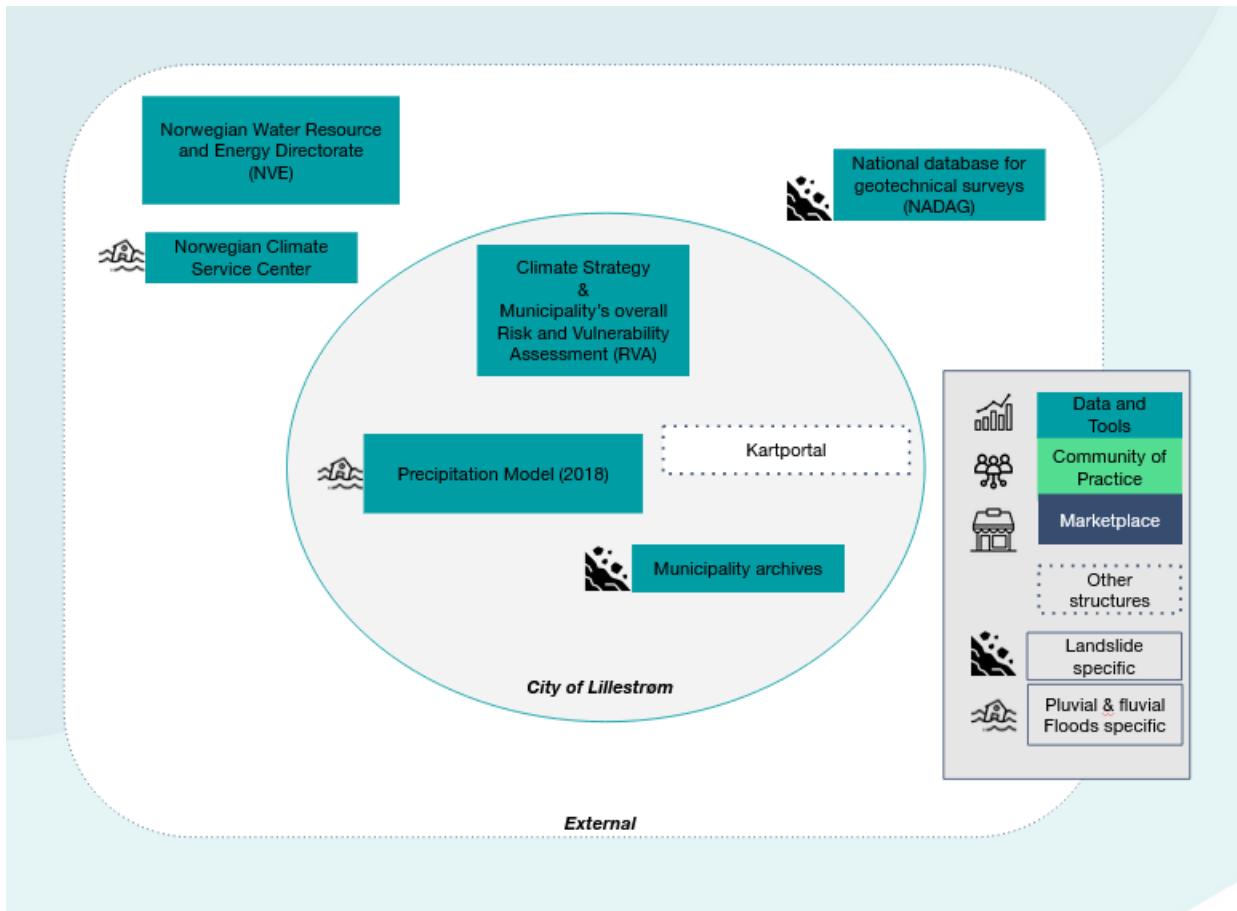
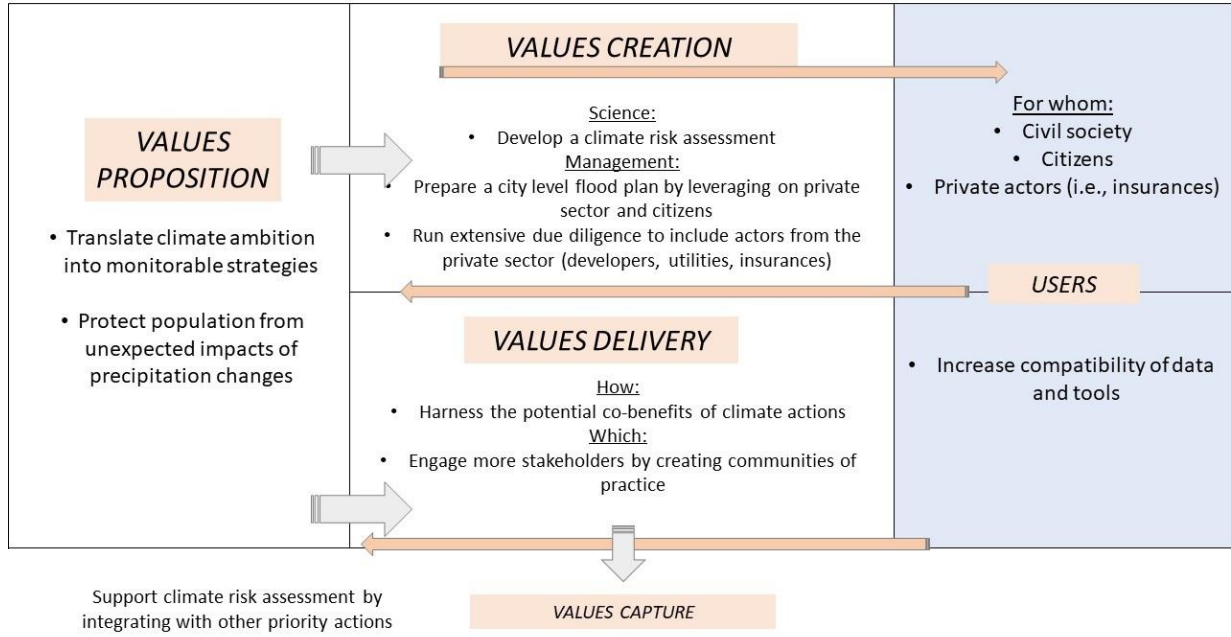


Figure 25 | Draft capacities distribution in Lillestrøm

The analysis of Lillestrøm municipality reveals that its goal is to protect its population from the unexpected impacts of precipitation, such as flood events or quick clay events, and to develop monitorable strategies to achieve its climate ambition (see Figure 26). To achieve this goal, the municipality should first develop a thorough climate risk assessment that integrates the current overall Risk and Vulnerability Assessment and is in line with the recommendations from the municipality's climate strategy. Secondly, the municipality should collaborate with the local private sector and the citizens to develop a city-level flood plan, which would be valuable in both a risk management perspective and in engaging local stakeholders. The private sector should be more closely involved, creating value for civil society, citizens, and private actors, such as the insurance sector.



Governance mode	Values			
	Proposition	Creation	Delivery	Capture
Hierarchy	Design, complete and update climate risk assessment			
Clan	Engage with civil society		Propose soft solutions to facilitate communication and involvement	
Network	Invest in co-benefits of climate action			
Market	Build partnerships on nature-based solutions and locally-relevant practical actions			

Figure 26 | The strategic steps to move capture public values from the City Hub business models in Lillestrøm

3.3.7 Amsterdam

The city of Amsterdam is particularly vulnerable to climate risks, including pluvial, river, and coastal flooding, as well as heat stress. With approximately two-thirds of its area at risk of flooding due to its low elevation, and given the country's high population density, flood risk is more significant than in other regions. Climate risks are driven by various climatic factors, including temperature increase, intense rainfall, and sea-level rise.

Natural sand dunes and engineered structures like dikes, dams, and floodgates provide protection against storm surges from the sea. The river dikes prevent flooding from water flowing into the country through the major rivers Rhine and Meuse. Moreover, a complex system of drainage ditches, canals, and pumping stations help keep the low-lying areas dry for habitation and agriculture. However, despite the significant progress made over the years, the flood risk management remains a high policy priority.

The Dutch Delta program is a comprehensive approach aimed at managing flood risks in the Netherlands. The program includes a series of measures to protect the country against floods,

such as building dams, dikes, and floodgates, as well as improving water management and drainage systems. In addition to the flood program, the National Heatwave Plan is another crucial strategy developed by the Dutch government to tackle the effects of extreme heat on public health. The plan outlines measures for preventing and managing heat-related illnesses and deaths, including heatstroke and dehydration, especially among vulnerable groups such as the elderly and those with chronic conditions. The plan was first adopted in 2007 and has been updated and revised periodically to address the evolving risks associated with extreme heat.

The Amsterdam City Hub is a unique among the REACHOUT pilots as it focusses on the Dutch pension investor group APG (Algemene Pensioen Groep) and the wider financial sector where appropriate, rather than the Amsterdam municipality. The primary focus is on the real estate sector, as APG manages assets in (the vicinity of) four of the seven REACHOUT City Hubs, including Amsterdam, Milan, Lillestrøm, and Gdynia. While the investment portfolios cover a wide range of exposed activities and assets, impacts from natural disasters related to climate change could lead to an increase in portfolios' risks and could ultimately lead to a shock of financial markets. Consequently, the disclosure of climate risks and measures to mitigate them has become mandatory. Advanced and customized climate services are necessary to fulfill these disclosure requirements and facilitate the identification of adaptation measures for the financial sector in order to minimize risks.

The TCFD (Taskforce on Climate-related Financial Disclosures), established by the Financial Stability Board, offers recommendations and guidelines for financial and non-financial organizations to voluntarily disclose how they integrate financial risks and opportunities associated with climate change into their decisions. The EU Taxonomy and Platform on Sustainable Finance also provide recommendations for technical screening criteria to reduce physical climate risks, with indicative classification of climate hazards and contribution to climate change adaptation. The ClimINVEST project (<https://cicero.oslo.no/en/climinvest>) studied financial actors' needs and practices regarding physical climate risk assessment. Findings showed that financial institutions underestimate the climate problem and require better data that is open, accessible, and transparent. A "black box" exists regarding the approaches used by commercial data providers, and financial institutions lack the expertise to assess the quality of climate data. Additionally, there is limited knowledge of adaptation perspectives. As the next step, a bottom-up research approach for a portion of the Real Estate portfolio will provide insight into the accuracy and usability of top-down products from commercial data services, enabling scalable and replicable climate risk assessment among different financial asset classes.

In the Netherlands, the Dutch supervisory authority (DNB) has established working groups on sustainable finance, bringing together different financial actors. One such group (DNB, 2018) focused specifically on climate-related risks and reflected on integrating TCFD-style information into risk/return decision-making. The DNB Sustainable Finance Platform's Working Group on Climate Risk united various Dutch asset managers, banks, and financial services firms.

APG has adopted a similar policy and strategy in response to climate risks. As a pension investor, APG aims to avoid investments in high-risk assets with financial and/or physical risks. If such risks arise, APG will divest or engage with the asset owner(s) to reduce the risk of the asset by implementing adaptation measures. Identifying and assessing adaptation actions takes place in the buying phase high-risk assets are identified and asked for their adaptation measures. As shareholder of real estate companies, APG engages with these companies to reduce impact by realizing (local) adaptation measures. On larger scales, adaptation measures are seen as opportunities too, with the investment in the Afsluitdijk renovation project as an example.

The availability of numerous methodologies and climate datasets with various assumptions and methodological choices is increasing. As these data sets influence APG's investment

decisions, the organization seeks a deeper understanding of the data and underlying science. Currently, APG relies on up-to-date datasets from commercial data providers such as CMIP5. However, information on past climate events is case-specific and not always directly applicable. APG has successfully implemented a method to incorporate the physical risk scores of two global data providers, Verisk Maplecroft and Moody's (previously Four Twenty Seven, Inc.), into the underwriting of real estate investments.

APG has an in-house expert in physical climate sciences as part of the Global Responsible Investment & Governance team. The climate data outputs provided by commercial data providers are used broadly within the organization, and the in-house expert is responsible for overseeing the climate data. APG plans to expand access to climate data and translate it into financial impact as a data climate hub, making it more widely available throughout the organization.

The stock-taking survey did not identify any communities of practice. As a private provider, APG serves as a marketplace itself. Figure 27 shows the draft city endowment map of Amsterdam.

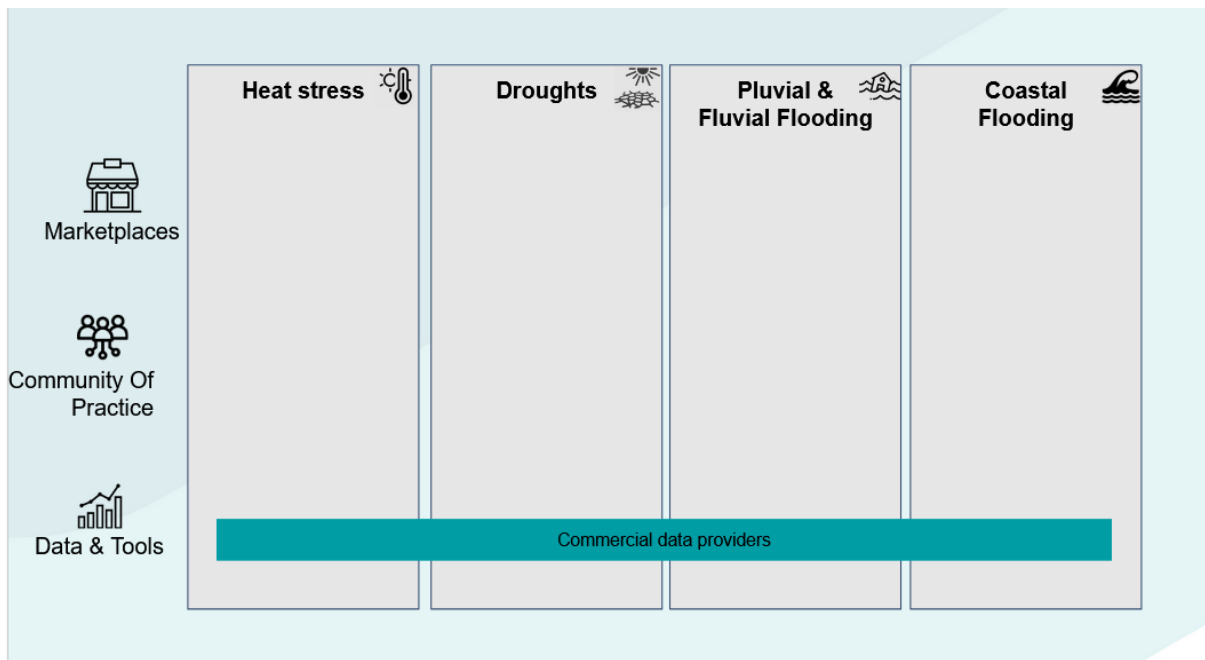


Figure 27 | Draft city endowment of Amsterdam

APG's climate adaptation vision is to achieve global coverage of "net risk", which entails having full insight into hazard risk, exposure, and impact at all scales, including country, city, and building levels, and engaging with assets about adaptation measures as an essential part of every investment process phase, such as pre-investment (due diligence) and active ownership. In the future, APG plans to expand its adaptation framework to the broader financial sector. This will involve moving from voluntary frameworks to mandatory disclosure on climate risks, implementing more standardized disclosure frameworks with clear guidelines and best practices, incorporating adaptation-linked indicators into these frameworks, and collaborating with the public sector to align financial flows for adaptation with local community development and national adaptation strategies (VBDO and UNEP FI, 2021).⁴

APG faces several challenges related to climate risk assessments, including the quality, availability, and compatibility of data. To address these challenges, they aim to scale up their approach spatially and across asset classes. Combining risk, hazard, and adaptation

⁴ Delivering Climate Resilience Through Financial Disclosure - <https://www.vbdo.nl/en/2021/02/delivering-climate-resilience-through-financial-disclosures/>

measures on different levels is another challenge, as is linking impact/damage functions to financial impacts. The lack of practical relevance for end-users, uncertainties, and lack of internal trust and credibility in the tools are also perceived as important barriers.

To improve the accuracy and usability of EU and national data for climate risk assessments, APG plans to use tools related to flooding, impact modelling, and scalability. The REACHOUT project will employ three such tools: the Pluvial Flood Hazard and Risk Assessment in Urban Areas (C3S) by CMCC, the Dynamic Integrated Flood Insurance (DIFI) model by IVM, and the Sector-based Impact Diagrams. These tools will enable APG to further address their adaptation ambitions and actions.

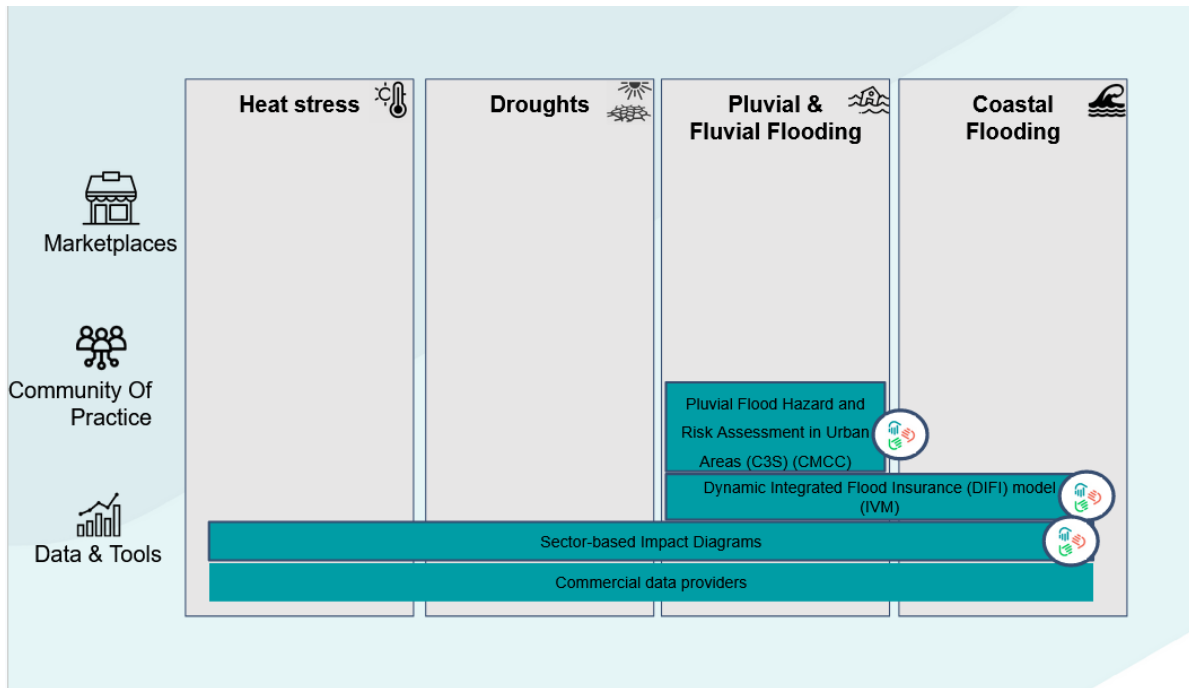


Figure 28 | REACHOUT contribution to Amsterdam's city hub

4 Conclusions and ways forward

The analysis of City Hub Business models across the REACHOUT cities has shown that integrating data, knowledge, and stakeholders is crucial to address climate risks and enhance adaptation strategies effectively. While all cities have access to relevant data sources and to some extent, risk assessments, a more organized and structured approach to data management is required to leverage the existing knowledge base fully. Developing common data spaces is essential to facilitate the exchange and integration of data in a more coordinated and effective manner, promoting effective collaboration and knowledge-sharing between stakeholders. By establishing shared platforms for managing climate data, cities can facilitate more effective collaboration and knowledge-sharing between stakeholders. This can help to ensure that data is being used in a consistent and meaningful way across different teams and departments, and can also help to identify gaps and opportunities for further research and development.

Common data spaces can also leverage the potential of communities of practice and other stakeholder engagement initiatives. Communities of practice can bridge the gap between the internal and external spheres of a city's operations. While many cities have already developed teams and liaisons to involve citizens, stakeholders, and private actors, there is still a need for further engagement and education to increase awareness of the potential value of climate services and encourage greater private sector involvement.

Effective engagement and education initiatives can play a critical role in fostering strategic partnerships. This can include targeted outreach efforts to raise awareness of the importance of climate services, as well as providing resources and tools to help stakeholders better understand the risks and opportunities associated with climate change. Additionally, initiatives that promote greater interaction and dialogue between stakeholders, such as focus groups, conferences, and other events, can help to build stronger relationships and trust among different groups.

Cities recognize the need to develop a complete marketplace to support the integration and dissemination of data and services. Existing city portals already have many of the necessary features and are feasible candidates for such a marketplace. The development of a marketplace can provide new opportunities for startups and businesses and can help turn potential knowledge into actual value.

The REACHOUT project has been instrumental in supporting the cities with the integration of various tools and services. The project has also contributed to increasing personnel's understanding of the value of climate services, stimulating engagement, and increasing climate adaptation priority. The City Hub Business model proved a useful framework for cities to assess their progress towards climate adaptation and resilience goals, as well as to identify gaps and opportunities for improvement. The strengths of the City Hub Business Model lie in its ability to provide a comprehensive overview of the city's capacity, data sources, communities of practice, and marketplaces related to climate adaptation and resilience. The integration of data, knowledge, and stakeholders is vital for this end, and the development of market-ready tools and marketplaces can help turn potential knowledge into actual value.

Building upon the preliminary screening and assessment described in this report, our future plans include turning the City Hub Business Model into a structured self-assessment tool enabling cities to evaluate their current capacity, data sources, communities of practice, and marketplaces. Regular assessments using the City Hub Business Model can help cities track their progress towards agreed goals and objectives and identify new opportunities for improvement. The strengths of the City Hub Business Model lie in its ability to provide a comprehensive overview of the city's capacity, data sources, communities of practice, and marketplaces.

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