



Scaling high impact
mitigation and adaptation
actions in Brazilian cities
on the way to COP 30



Climate Action Planning

Scaling Methodology

TRACKING CHANGES

DATE	AUTHORS	VERSION
10/08/24	OEF and ICB&B	1.0
04/11/2024	OEF and ICB&B, after BPJP comments	2.0
07/16/2025	OEF and ICB&B	3.0

PRESENTATION OF THE PROJECT

I Care Brasil, Brisa Soluções and Open Earth Foundation present the **Climate Action Planning Scaling Methodology** for the development service of the public RFP “Scaling high impact mitigation and adaptation actions in Brazilian cities on the way to COP 30” driven by C40 Cities, GCoM and CDP, with funding from Bloomberg Philanthropies. The objective of this project is to develop a scalable methodology for defining adaptation and mitigation actions in 50 Brazilian cities, with the aim of achieving meaningful outcomes in the lead-up to COP30, setting a precedent, replicable framework and overall model for other CHAMP countries.

This document presents the reference methodology to be implemented in order to achieve the objective highlighted above. It introduces an approach to establish alignment on commitments and governance for both the selected CHAMP Country (i.e. Brazil) as well as the implementation team throughout the process, considering key stakeholders and partners with associated responsibilities that will be involved. The document also sets the criteria for selecting participating cities and details the monitoring & Evaluation (M&E) framework at project and city level.

The primary technical elements of the document define the methodology for developing GHG emissions inventories and profiles, as well as performing Climate Risk and Vulnerability Assessments (CRVA). The methodologies and reporting formats are designed in consideration of the ‘Getting Started’ terminology of the “Briefing Note Global Data Landscaping Assessment (2023)” report, particularly relevant for cities with low resources and capabilities, as well as the GCoM’s Common Reporting Format (CRF) for compliant level reporting required by GCoM signatories. This overall process supports cities in advancing high-impact actions targeting major emissions sources and climate risks through a prioritized list of potential actions tailored to the city’s profile.

This document further outlines how the systematic selection of high impact actions are then matched with available funding sources, ensuring that financial needs and the scalability of each action are thoroughly assessed. By doing so, the methodology provides cities with a feasible plan to implement the proposed measures.

A core premise of the methodology is to validate all results throughout the process with the selected cities, ensuring that the piloting phase provides valuable feedback for refining the methodology. Accordingly, this document should be updated at the end of the project to incorporate improvements based on the insights from the pilot cities.

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GLOSSARY OF TERMS

The following glossary defines key terms, acronyms, and tools used throughout the methodology for scaling climate action in Brazilian cities. Terms are organized into **General Climate Action Terms**, **Brazil-Specific Terms**, and **Digital Platforms and Tools**.

General Climate Terms

- **Adaptation:** Efforts to adjust infrastructure, policies, and behaviors to minimize the damage caused by the impacts of climate change.
- **Climate Risk and Vulnerability Assessment (CRVA):** A process for assessing potential climate hazards, risks, and vulnerabilities of cities to better inform adaptation and resilience strategies.
- **CCRA (Climate Change Risk Assessment):** This refers to a specific CRVA methodology and framework developed and advanced by C40 Cities, including a 'Rapid' approach to develop it.
- **Climate Action Plan (CAP):** A strategic framework that outlines specific actions a city will take to mitigate GHG emissions and adapt to climate impacts.
- **CDP-ICLEI Track:** A unified global reporting platform and progress accountability mechanism for cities, to help them understand their impact and take action. Using one questionnaire, the platform allows simultaneous reporting to key climate initiatives from ICLEI, C40, WWF and the Global Covenant of Mayors, and measures a city's progress against UN-backed climate campaigns (such as Race to Zero and Race to Resilience).
- **CRF (Common Reporting Framework):** A reporting standard developed by the Global Covenant of Mayors (GCoM) to harmonize GHG inventories, climate risk and vulnerability assessments, target setting, climate action and energy access plans, and reporting formats and periods that cities following the GCoM pledge shall follow.
- **GHG (Greenhouse Gas):** Gases that trap heat in the atmosphere, contributing to global warming. Common GHGs include carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O).
- **GHG Inventory (GHGI):** A comprehensive accounting of all GHG emissions and removals associated with a city or region over a specified time period.
- **GPC (Global Protocol for Community-Scale GHG Emissions Inventories):** An international standard for measuring and reporting GHG emissions in cities, endorsed by C40 and the Global Covenant of Mayors.
- **MER (Monitoring, Evaluation, and Reporting):** A framework used to track the performance of climate action initiatives, ensuring accountability and progress towards stated goals.
- **Nationally Determined Contributions (NDCs):** Climate action plans submitted by countries under the Paris Agreement, outlining their GHG reduction targets.
- **National Adaptation Plans (NAP):** Formal climate adaptation plan for countries under the Paris Agreement, outlining commitments and approaches to manage the implications of a changing climate with warmer average temperatures.

- **CHAMP (Coalition for High Ambition Multilevel Partnerships):** An initiative that fosters collaboration between national and subnational governments to enhance climate action and NDC ambition.

Project and Brazil Specific Terms

- **AdaptaBrasil:** A Brazilian platform that provides climate data on risks and vulnerabilities to inform adaptation planning across different regions and sectors.
- **Bloomberg Philanthropy Joint Program (BPJP):** Represents a coalition between C40, GCoM and CDP, supported by Bloomberg Philanthropies to advance key projects on data, tools, CHAMP and other critical frameworks to empower cities in their climate transition and Paris alignment. The BPJP commissioned the RFP for this Brazil project.
- **CityCatalyst:** An AI-powered digital platform that automates the creation of GHG inventories and climate risk assessments, helping cities rapidly generate climate action data.
- **High Impact Actions (HIA):** This term refers to the prioritized mitigation and adaptation actions selected for each city based on its emissions and risk profile. The project seeks to deliver at least 1 high impact action in both mitigation and adaptation for each city, with a total of 100+ action across the 50 cities.
- **IBGE (Instituto Brasileiro de Geografia e Estatística):** The Brazilian Institute of Geography and Statistics, which provides data used across various sectors including demographics and environmental statistics.
- **MMA (Ministério do Meio Ambiente):** Brazil's Ministry of the Environment, responsible for national climate and environmental policies, including Brazil's National Climate Plan.
- **SEEG (Sistema de Estimativa de Emissões de Gases de Efeito Estufa):** Brazil's national system for estimating GHG emissions, commonly used for creating city-level GHG inventories.

1. SUMMARY AND HIGHLIGHTS

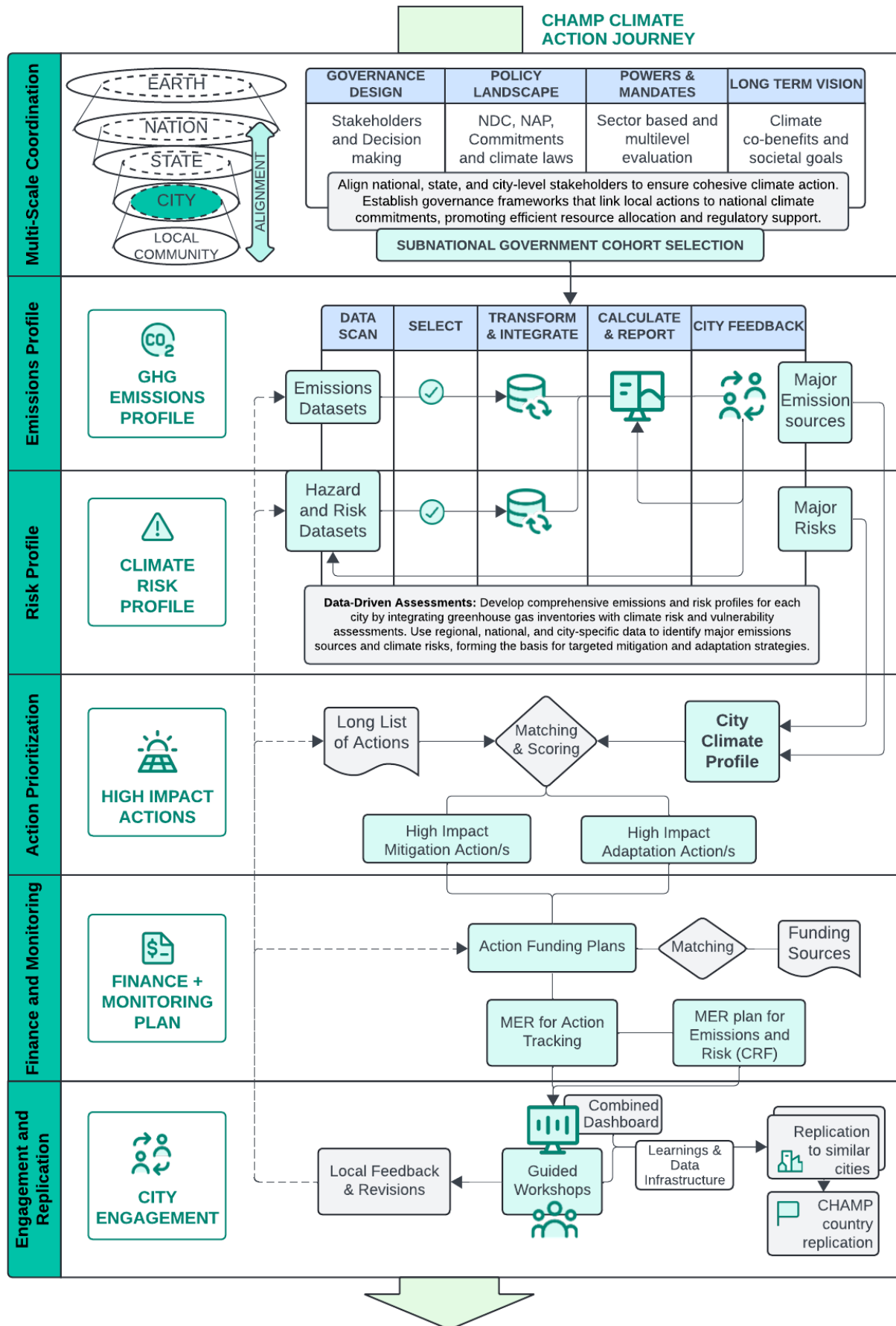


Figure 1. CHAMP country playbook and executive summary of overall process flow

This methodology aims to scale high-impact climate mitigation and adaptation actions across 50 Brazilian cities, leveraging open-source digital tools, local data, and multilevel governance structures. As part of the CHAMP (Coalition for High Ambition Multilevel Partnerships) initiative, this project prepares Brazilian cities for enhanced climate action in the lead-up to COP30, with a framework that is adaptable to other CHAMP countries.

The primary goal is to develop a replicable, data-driven climate action planning process that integrates local realities with national and global climate goals. This methodology addresses both **mitigation** (greenhouse gas emissions reductions) and **adaptation** (climate risk resilience), in alignment with Brazil's Nationally Determined Contributions (NDCs), the National Adaptation Plan, and global frameworks like the Paris Agreement and GCoM's Common Reporting Framework.

Key Components:

- **GHG Emissions Inventories:** Leveraging AI-powered tools like CityCatalyst to streamline the generation of accurate emissions profiles.
- **Climate Change Risk Assessments (CCRA):** Utilising national data platforms (e.g., AdaptaBrasil) and global standards to assess vulnerability and prioritise resilient actions.
- **High Impact Actions (HIAs):** Providing a set of suggested actions for mitigation and adaptation and respective plans tailored to each city's context, prioritising interventions with the highest impact.

Highlights of the Methodology:

1. **Digital Scalability:** The methodology is powered by **CityCatalyst**, an open source digital platform integrating AI, open data sources, and automation to reduce the time and complexity of GHG inventory generation and risk assessments.
2. **Replicable Framework:** The country agnostic generic framework adopted ensures that the methodology can easily scale beyond Brazil to other CHAMP countries, adapting to different urban contexts with minimal modification. Furthermore, the open source digital infrastructure further streamlines the ability to replicate the actual data processes to other countries.
3. **Multilevel Governance (CHAMP model):** The methodology fosters collaboration across local, state, and national governments, ensuring alignment with Brazil's climate goals and international climate agreements. This approach is designed not only for Brazil but as a pilot model that can be adapted across CHAMP countries to help meet global climate targets.
4. **Local Data, Global Standards:** By integrating data from Brazilian cities with global climate standards, the methodology ensures high accuracy and relevance, while also meeting international reporting requirements (e.g., GPC, GCoM frameworks).

The figure 2 provides a visual framework of the components and overall context considered in the project, and in green the primary areas of focus and concrete outputs.

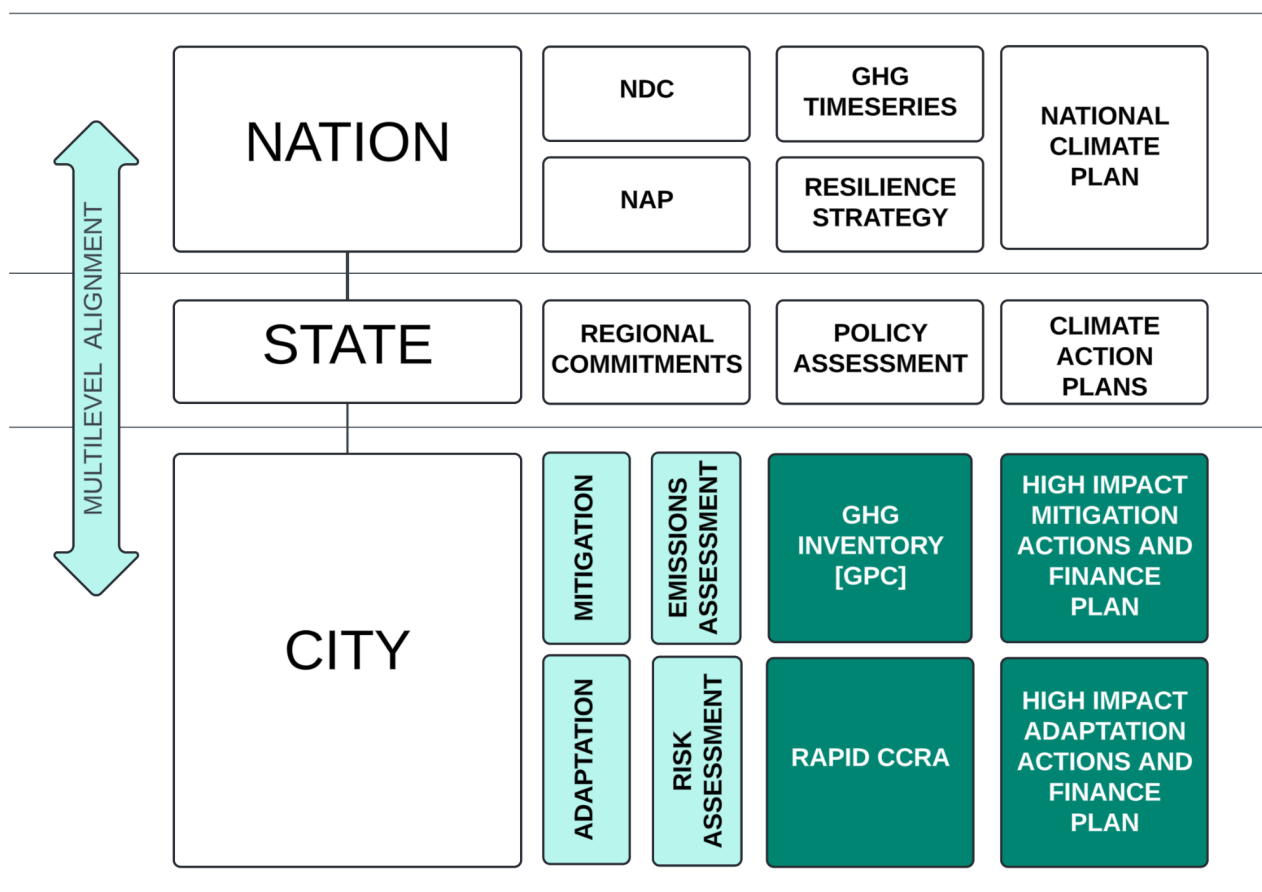


Figure 2. Program scope and focus areas.

2. OBJECTIVE AND MAIN PRINCIPLES FOR SCALING AND ADAPTABILITY TO OTHER CHAMP COUNTRIES

The Coalition for High Ambition Multilevel Partnerships (CHAMP) is a global initiative launched at COP28 to enhance collaboration between national and subnational governments — such as cities, states, and regions — in planning, financing, and implementing climate strategies (citation). CHAMP is essential for advancing the goals of the Paris Agreement by integrating local climate actions into Nationally Determined Contributions (NDCs) and other national climate commitments. To date, 75 countries have signed the CHAMP pledge, recognizing that effective climate action requires coordinated efforts across all levels of government.

CHAMP addresses a critical gap in climate governance: while cities are responsible for 70% of global emissions, many lack the technical capacity and resources to align with national climate strategies. By fostering multilevel partnerships, CHAMP ensures that subnational actors are fully engaged in the climate action process, making national plans more ambitious, inclusive, and actionable. This is particularly vital as countries prepare updated NDCs for submission by COP30, aiming to limit global warming to 1.5°C.

With this context, the present methodology aims to propose a replicable, data-driven, and policy informed climate action planning process for CHAMP Countries and its subnationals to adopt, introducing it through a first case study for Brazil. To directly inform NDCs and NAPs, the process focuses on delivering actions with measurable GHG reductions and climate resilience for each city, streamlining this tailored process through digital tools and open-source infrastructure. The following principles have guided the development of the methodology and project design to ensure it achieves a scale and magnitude relevant to the CHAMP ambition.

Scaling Principles

1. **Data-Driven Decision Making:** Using the most robust local and global datasets to ensure cities have accurate, actionable insights for climate action, particularly their GHG emissions profile (or when possible complete GHG inventories) and climate risk assessments. We aim to bring quantitative approaches with documented methodologies in order to create trusted evidence for action selection.
2. **Open-Source Infrastructure:** The project is centred on open-source principles for creating a fully transparent, replicable, and customizable digital and data-driven framework. By making the code and data models openly accessible, cities and governments can inspect and understand the system, building trust in the tools being used. This transparency enables them to adapt the infrastructure to local needs while ensuring that the methodology is not restricted by proprietary software or vendor lock-in. The open-source nature allows for continuous improvements and customizations by different stakeholders, fostering collaboration across cities and ensuring that the system can evolve without

dependency on a single provider. This approach promotes innovation and ensures that the digital infrastructure is scalable and adaptable to various contexts.

3. **Prioritisation of High-Impact Actions**: Prioritising actions that cities have the power to develop and that have the highest GHG reduction potential and resilience impact ensures that resources are directed toward interventions that deliver the greatest return for all stakeholders. This focus on proven, high-impact actions creates traction for other projects to be tackled sequentially, and for proven high impact projects to replicate implementations across cities and countries.
4. **Multilevel Governance**: Throughout the project, we ensure alignment on ambition, data, policy, communication and implementation capacity between **local, state, and national governments** within Brazil. This coordination guarantees that city-level climate actions are integrated into national climate strategies, such as NDCs, and that national and state governments provide the right support for implementing those actions.
5. **Multiscale Alignment**: This principle is about ensuring that local actions in one city or country are **aligned with global standards and goals**, enabling the methodology to be scalable across CHAMP countries. By aligning the data driven approaches and action selection with frameworks from GCoM and C40, cities can ensure that their efforts contribute not just to national but also **global climate ambitions**, and are easily replicable.

Adaptability Beyond Brazil to other CHAMP Countries

The methodology is designed as a generic framework that can be adapted to diverse local contexts without losing its scalability. It aims to balance customization and replicability —ensuring that it can be tailored to fit local governance structures, available data, and national climate priorities, while maintaining a core structure that can be efficiently implemented across CHAMP countries. By developing a clear, stepwise approach —with the goal of achieving a CHAMP Implementation Playbook— the methodology provides a structured guide for other countries to follow, allowing them to adapt the same infrastructure and processes within their specific context.

The open-source nature of the digital tools also promotes affordability, as the marginal cost of each implementation decreases with replication. Cities can leverage the same foundational code and data models, reducing the need for building solutions from scratch.

In addition, we aim to contribute towards a global learning network for cross-country exchange of data, best practices, and tools, creating an ecosystem of continuous improvement. Such a network could enhance collaboration between CHAMP countries, enabling them to share lessons learned, refine their approaches, and scale climate action more efficiently.

3. PROJECT SETUP AND ALIGNMENTS ON COMMITMENT AND GOVERNANCE

This section introduces key elements and processes that need to be established both at the country level (eg. Brazil and subnationals) and at the project implementation team level (i.e. BPJP, OpenEarth and I Care & Brisa) prior to conducting data driven assessment at each selected city.

3.1. Project governance and coordination

3.1.1. Adjusting global climate frameworks to the local country context

C40, GCoM and other international organizations have published critical climate action frameworks and methodologies for global adoption (cite). However, when applying them in practice, such as in a CHAMP country deployment, it's important to define the processes on how to adapt them to the local context, inviting dynamic inputs from national and subnational stakeholders. As such, the methodology in this document is first defined by integrating these global frameworks with the knowledge from the implementing partners. For this project, implementing partner I Care and Brisa provide proven experience and local knowledge for the target country (i.e. Brazil), while OpenEarth provides implementation experience on digital and data tooling design for adoption by city officials in global south context (eg. Latin America). Through coordination with other local technical partners (see next section), the local data and political context is also incorporated into the methodology.

Furthermore, while the project leaders and implementing organisations have developed together the initial knowledge and approach consolidation, the engagement with a first group of pilot cities is then used to review and adapt further the methodology and approach, prior to scaling to the remaining selected cities.

Throughout this process, two key elements are developed and adapted. On one hand this Methodology Document, which represents a synthesis of the knowledge and references used to guide the project, and on the other hand the development of open source code and data pipelines, which also follow the logics outlined in this document. Figure 3 represents this overall process for adjusting global knowledge to local context through a participatory and lean approach with pilot cities.

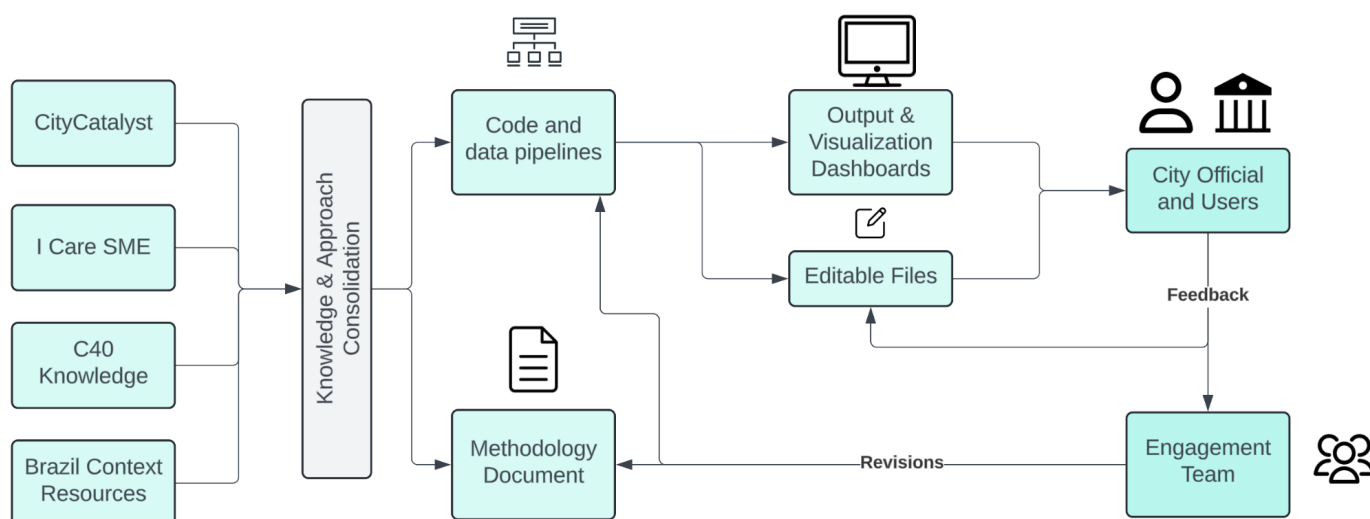


Figure 3. Overall process for adjusting document methodology and technical code based on both a global and local country context.

3.1.2. Engaging key local stakeholders and partners with associated responsibilities

Achieving multi-scale governance on climate action, in line with CHAMP commitments, requires first identifying the critical government and non-government institutions at all scales within the target country, and second incorporating them into the project implementation process and inviting their inputs into the proposed methodology. Each country may have different organisational structures and institutions around managing climate actions and subnational coordination. In general, this should include the following:

General Engagement of National and Subnational Level Stakeholders

- **Ministry of Environment:** Most countries have such a ministry, but particularly relevant is engaging with the subdivision on climate change, responsible for drafting and tracking the NDC and/or NAP.
- **Ministry or Secretary of International Affairs:** These institutions (which have a wide variety of terms) represent the nation under international treaties, UN, agreements and commitments, and regarding climate change will coordinate with the environment agency counterparts. CHAMP commitments may often fall under this or the environment agency.
- **National Risk, Adaptation or Emergency Organizations:** Countries also have a variety of agencies responsible for emergency response, particularly natural disasters. Agencies that respond to wildfires, hurricanes, flooding and other events that can be considered climate hazards should be identified and engaged.
- **National Finance Institutions:** Identifying key agencies that relate to finance frameworks relevant to climate action, particularly those that liaise with multilateral development banks (MDB) are essential. These should also include

those that regulate relevant financial instruments, such as climate bonds and municipal bonds.

- **Subnational government coordination agencies:** Countries often have a federal office (or multiple ones) that relate to State/Province and city governments coordinations and affairs.
- **City Network government and non-government agencies:** Cities often engage with diverse NGOs that support and help coordinate mayoral actions, including those specific to climate change, such as C40, GCoM and ICLEI. Local city climate networks and NGOS are also critical to these groups.

Brazil Specific Stakeholders

For the Brazil CHAMP implementation and coordination, the following stakeholders are proposed as key agencies that [have/will be] engaged through specific moments in the process, and for which their inputs to the methodology and process are sought:

- **Ministério do Meio Ambiente e Mudança do Clima (MMA):** The MMA is leading two strategic planning initiatives that are very close to the project objectives. The Plano Clima Mitigation and Adaptation Components are crucial planning tools that should be integrated in both directions. The actions developed by Plano Clima have potential to inspire municipal climate planning. The measures designed on those instruments should be incorporated into the long list of actions. The methodology developed with this project can also be promoted on those initiatives to achieve the selected objectives. The 2024 and 2025 commitment is the AdaptaCidades Program aiming to implement adaptation plans for 260 municipalities in Brazil.
- **Ministério das Cidades:** The Ministry of Cities has a strategic role in guiding the public policy implementation of climate planning on a municipal level. The Plano Clima mitigation and adaptation scopes have a sectoral city component that should be integrated into the project initiative.
- **Frente Nacional dos Prefeitos (FNP):** The National Front of Mayors and Mayors (FNP) is the only national municipal entity exclusively led by acting mayors in exercise. Its focus is on 400 municipalities with more than 80 thousand inhabitants.
- **Associação Nacional de Municípios e Meio Ambiente (ANAMA):** National Association of Municipalities and Environment is a relevant player for promoting the environmental policy on municipal level in Brazil and can be a relevant partner on the diffusion of the implementation of the methodology.
- **ICLEI Brazil:** ICLEI is a relevant player for promoting climate action planning at the municipal level in Brazil. It also holds a network of cities that can be achieved. Promoting the methodology developed on this project within the ICLEI network of cities can scale up
- **GIZ-Proadapta:** The German Public Company GIZ holds strategic initiatives in Climate Change in Brazil and is going to be the MMA implementation partner of the AdaptaCidades program and has been financing and developing many projects both with Mitigation and Adaptation at city Level.

- **Banco Nacional de Desenvolvimento Econômico e Social (BNDES):** Fundo Clima is one the main financial mechanisms in the Brazilian context for climate public policy implementation. There are many and strong financial mechanisms available at the BNDES Fundo Clima that should be considered for the implementation process.

3.1.3. Monitoring & Evaluation (M&E) framework at project and city level

A standardised Monitoring and Evaluation process is crucial for the success of the overall CHAMP project implementation, for tracking that the proposed high impact actions achieve the impact they were designed for, and to trace how the subnational actions are directly contributing to the NDC. This section encompasses the M&E framework for the project and city level.

3.1.3.1. M&E Project Level

The project level monitoring and evaluation was developed based on the Implementation Plan outlined in a separate document. [Implementation Plan Link >](#)

3.1.3.2. M&E City Level

This stage includes the definition of goals and indicators for monitoring the implementation of adaptation and mitigation measures and periodically evaluates its results, making it possible to adjust activities forecasts in the plan and learn lessons about the implementation process. The Monitoring and Evaluation Process on city level is a crucial step on climate planning to achieve. Cities have many public policy goals in a context of financial restrictions and priorities.

To monitor the implementation and results of the proposed measures on the municipal climate plan, it is necessary to design the parameters that will be used for monitoring and evaluation of the measures implementation. These are important management tools, which allow:

- **Check** whether adaptation and mitigation measures are being carried out as per the plan;
- **Verify** whether the measures are achieving the objectives for which they were thought.

With this, it is also possible to obtain a series of information and lessons learned, which may be relevant for management and improvement of the plan, as well as for future planning processes. The M&E Monitoring process is developed with the following steps:

1. **Definition of goals and indicators:** First determine individual goals for each measure. Then, establish the indicators that will allow you to monitor the progress of each individual measure to achieve the general goal. They can match data and quantitative and/or qualitative information, of an environmental, economic and social nature. The selection of indicators should consider the data availability, data quality and be guided by relevant methodologies for designing indicators. For

example the SMART methodology. Where the indicator should be S - Specific, M - Measurable, A - Achievable, R - Relevant and T - Temporal, or other relevant methodologies that guide the definition of good monitoring indicators.

2. **Planning monitoring processes:** Specify, for each measure, target and indicator: what information and data will be needed to monitor results; how they will be organized (e.g. through surveys and/or reports, primary or secondary data); how frequently they should be gathered and analyzed; who will be responsible for the activities.
3. **Planning evaluation processes:** Establish processes to evaluate both the functioning of the measures and the direction of the plan as a whole, according to the following characterization. The Operational assessment analyses the performance of measures over time, based on the designed monitoring data, in order to identify possible needs adjustments in its implementation. The strategic assessment: analysis of the progress of the adaptation and mitigation plan, based on the operational assessment, in order to determine possible needs for adequacy from a strategic point of view. Determine the frequency and objectives of each planned evaluation cycle and indicate who will be responsible for its execution.

3.1.4. Financial considerations for project implementation

The approach to this project was shaped by the need to maximize scalability and breadth across 50 cities, given the relatively constrained budget of approximately \$4,800 per city. This budget allowed to focus on building a scalable data infrastructure for the generation of streamlined GHG emission profiles, rapid Climate Risk and Vulnerability Assessments (CRVA), and the prioritisation and selection of high impact actions (i.e. HIA) based on national policy and data integration. The emphasis was placed on developing tools and processes that could be expanded to other cities within the target country and easy replication to other countries, ensuring that foundational data systems are in place for long-term climate action planning and deployment following the CHAMP agenda.

Our approach prioritized broad coverage over detailed, city-specific analysis. This means the project delivered essential climate profiles and action plans that help cities “Get Started,” but did not allow for deep, localized exploration in each city. For the Brazil specific implementation, since we leveraged the CityCatalyst tool and the country had existing robust databases, we were able to deliver not just GHG emissions profiles (considered ‘Getting Started’) but full GPC based inventories (GHGI). However, the infrastructure has been designed to accommodate future iterations and improvements, both in terms of depth and precision, as well as in terms of reach.

With more funding, we could enhance the project in several key areas:

- **GHG Inventories (GHGI) with city-sourced data:** Additional funding would allow for more comprehensive data integration from local Brazilian sources, particularly from each city directly, enabling a deeper and more accurate assessment of emissions. A more detailed data quality assessment could also be conducted to validate and cross-check local datasets with international standards, improving the robustness of the inventories.

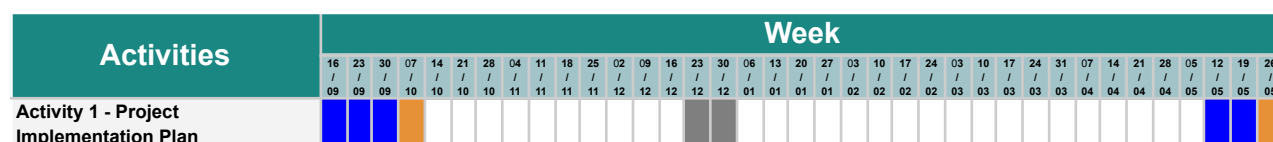
- **Action-based emission projections:** Although the 'no action' emission forecast is useful for the selection of actions, which can take into account future changes in the distribution of emissions, we could assess how ongoing or planned actions, in addition to the HIA, would reduce emissions in the face of this business-as-usual scenario. In other words, we would no longer have a 'no action' emission forecast approach only, but also an action-based emission forecast approach, i.e. with the inclusion of decarbonization levers.
- **Climate Change Risk Assessments (CCRA):** We could incorporate geoprocessing techniques and intra-municipal data to provide a more granular view of climate risks. This would allow cities to better understand specific vulnerabilities within their boundaries, supporting more targeted adaptation strategies.
- **Training and Capacity Building:** Additional funding could be used to train local institutions, government agencies, and city staff to independently use the CityCatalyst platform and other tools developed in this project. This would promote long-term capacity building and ensure cities can continue refining their GHGI, CCRA, and CAPs after the project's completion.
- **Broader Reach:** The current projects targeted a total of 50 cities. With further funding, or economies of scale (eg. working throughout multiple countries at once), a higher number of cities and city typologies and geographies could be achieved. We expect that with each CHAMP country application, the marginal costs per country and per city would reduce. However, each country may have diverse new challenges around data readiness and access, which may introduce new costs.
- **Tailored Action Implementation Plans:** The methodology develops high level finance plans and MER plans for each of the suggested actions. However, cities may require more detailed action plans to fully implement those actions, including sophisticated blended project finance frameworks, technology sourcing and procurement, siting and permitting, community benefit plans, policy design, and project management plans, to name a few.

In addition, these improvements align with the sections “**Improvements for Future Versions**” throughout the document, which detail specific enhancements for GHGI, CCRA, and High Impact Actions that could be implemented with further investment.

While the current budget has enabled the creation of a scalable and replicable framework, more funding would allow for deeper analytical work, higher data quality, and the empowerment of local institutions through targeted training programs.

3.1.5. Timeline

A simplified timeline is shown below. The complete timeline for the project was developed based on the Implementation Plan outlined in a separate document. [Implementation Plan Link >](#)



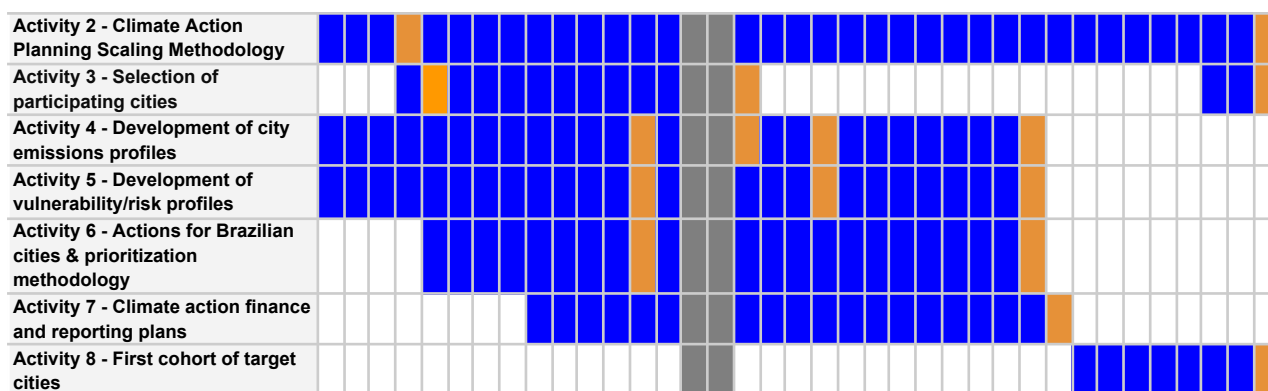


Figure 4. Overall project timeline

3.1.6. Criteria for selecting participating cities

General Criteria for City Selection

The criteria for selecting cities has two steps. First is the classification and cluster of all country cities to define common typologies for city climate planning on the national level. Since one of the main objectives of the work is to scale up the climate planning process there is an opportunity to support country level city classification for climate planning before selecting cities. The definition of the clusters should guide the selection of the participating cities.

The methodology for city selection has the objective of defining aggregate pathways for city climate planning. Even though cities are unique entities they share similar social, economic, urban and geographical dimensions that can help define similar pathways for climate planning. The methodology aims to define a common national city classification method that can classify and aggregate cities into common climate planning pathways that can help identify the most suited actions for them.

- A. Definition of the dimensions:** definition of the relevant dimensions for the analysis and concept definition with conceptualization of the parameters and fundamentalization of choice. The dimensions should be selected based on the country context considering the social, economic, geographical and environmental context that are relevant for the city classification and selection process.
- B. Selection of Indicators:** based on selected parameters build the selected indicators to be used on the cities classification process. The indicators need to capture the relevant dimensions and serve as a proxy for the city classification method and also consider the availability of data in each country's particular context.
- C. Data Collection and Treatment:** After the definition of the indicators we collect and provide the statistical treatment of the data for the classification process.
- D. Selection of Cluster Method for classification:** The selection of the statistical classification method for the city classification process. The method has the objective to classify the cities in homogenous groups that can support the cities in the climate planning process.

- E. Application of the Approach:** After the methodology of the clustering process the application of the approach for city classification and aggregation of homogenous clusters the assessment of the results
- F. Identification of the target cities:** Cities will be grouped using a clustering methodology based on shared socioeconomic, geographic, and climate characteristics. A representative pilot city will be selected from each cluster to apply and refine the methodology. This enables classification of all cities into scalable climate planning pathways and ensures the methodology can be effectively adapted across diverse urban contexts.

Table 1 presents the dimensions that are relevant for the city classification process. These dimensions should be selected based on the country context but serve as a guide for inspiration of the definitions of the indicators.

Table 1. Definition of Dimensions for criteria

Dimension	Relevance
Socioeconomic	The socioeconomic indicator aims to provide support for the main elements related to climate planning. Aspects of climate justice, exposure and sensibility of the population. Where are the most vulnerable populations that might be affected by extreme events (children and the elderly), but also the most dynamic cities with higher per capita emissions. It is also an important indicator for exposure. For the mitigation side the bigger cities answer for the most of the energy consumption and air travel emissions.
Urban Hierarchy	Urban hierarchy is related to the urban function that a city has and its position in the urban network. Bigger cities with more complex commerce and service activities have an emissions profile that is related with its social and economic size but also have higher exposure to climate hazards. This is only a small example of how the city position in the urban hierarchy relates with the city climate planning. The position of the city on the urban hierarchy is a fundamental dimension for city climate planning. The urban scale directly reflects the transport emission sectors, metropolitan cities have higher and presence of air travel, cargo relevance and many other mitigation profiles correlated with urban profiles, but also other relevant aspects such as the institutional capacity. Intermediate cities in some countries have higher economic and population growth rates. The urban hierarchy also directly correlates with the presence of public and private institutional capacity and urban structure.
Geographical aspects	The biome location has a strong relationship with some of the mitigation profile and socioeconomic conditions.. Biodiversity presence is also an important role for resilience and is directly associated with carbon storage.
Institutional Capacity	Fundamental to assess the city capacity to implement the city climate planning. Also assess the payment capacity of the city which would scale up climate finance.
Geomorphology	Rivery, Mountains, Coastal, Forest and other geomorphological elements have a direct relationship with the hazards that can affect the city. The geomorphology component is a relevant indicator for the exposure and

	the sensitivity.
Economic Profile	Industrial, Agricultural or Commerce and Service profiles are directly associated with the mitigation profiles. Metropolitan and intermediate cities are more diverse and are directly related with Commerce and Services have higher emissions from the transport sector. The level of value added in a relevant indicator for exposure
Mitigation	The mitigation profile is a relevant dimension for city selection. Metropolitan and intermediate cities concentrate most of the Transport, Waste and Energy Emissions, while intermediate and smaller cities concentrate most of the Agriculture and Land Use Emissions.
Adaptation	The Adaptation profile of the cities are directly related with the Urban Hierarchy. Bigger cities with higher exposure but combined with geomorphological context.

The next step is to collect and treat the indicators for each dimension to support the statistical classification method for city selection. The treatment and operationalization of the indicators will base the application of the statistical method for identification of the clusters and cities classification type. The statistical approach has the objective to identify insights for city classification but the knowledge of climate planning and urban context in Brazil can in a preliminary way highlight some expected profiles that can support the identification of the target cities.

Brazil Project City Selection

Since the project aligns with the national climate action strategy and integrates with the Green Resilient Cities Program (PCVR), the cities were selected from the 260 cities currently participating in the PCVR and Adapta Climates programs.

A [public call](#) was opened to all 260 cities, allowing those interested to express their interest and register for the program.

In total, 70 applications were received from cities interested in joining the program. Among the criteria listed in the call, specifically in section 6. *Prioritization Criteria* — the following were highlighted:

- **Regional diversity**, as the first factor to be considered, in order to ensure representation from all regions of Brazil.
- The [Municipal Vulnerability Ranking](#) developed by the Adapta Climates Program. This ranking was considered a key factor in the selection of municipalities. A [technical note](#) on the ranking is also available.
- **Diversity of emissions profiles**, based on the [Typology of Brazilian Municipalities](#) according to their emissions characteristics, as outlined in the available [technical note](#).
- **Different population sizes.**

The program aimed to select a highly diverse group of cities, ensuring representation across the **8 typology groups** (according to the *Typology of Brazilian Municipalities*), **varying population sizes**,

and **prioritization based on vulnerability scores**. The goal was to form a group representative of the wide range of Brazilian municipalities, thus facilitating project replicability.

The list of applicant cities was initially divided by region to ensure broad regional representation. Of the 45 available slots, **9 were allocated to each of Brazil's five regions**. After this initial distribution, cities were selected based on the **Adapta Climates Priority Index**, giving priority to those with the highest scores.

Since the South Region received fewer than 9 applications, **the remaining spots were reallocated to cities with higher vulnerability scores**. In the case of a tie, the tiebreaker was **the absence of climate planning instruments** (such as a Climate Action Plan, GHG Emissions Inventory, or Climate Risk and Vulnerability Assessment). Cities without such plans were prioritized.

This process ensured a **balanced distribution across regions, representation of the eight municipality typologies, different population sizes, and prioritized municipalities with the greatest need for climate action**, promoting a diverse representation among the participating cities. The remaining applicant municipalities were placed on a waiting list in case any selected city withdrew.

3.1.7. Identification of typology for city climate planning

The preliminary climate and urban context suggests the adoption of five cities typologies for climate planning. The selection of the 50 cities should be distributed on the selected typology combined with political engagement on the initiative. The statistical method should help in the identification of the typologies.

Table 2. City Typologies

M/A	Sector/ Hazard	Target Groups	Justification
Mitigation	Energy	Metropolitan regions and Intermediate Cities.	Metropolitan and intermediate cities answer for the most Energy, Waster and Transport Emissions since those sectors are strongly correlated with population size.
	Waste		
	Transport		
	Industrial Processes and Product Use (IPPU)	Industrial cities with IPPU Sectors. Metropolitan regions and Intermediate Cities.	Many of the IPPU sectors plants: Cement, Aluminum, Limestone are related to geographical aspects, the presence of the minerals in particular areas. Others related to chemicals tend to occur in bigger and more urbanized cities.
	Agriculture, Forestry, and Other Land Uses (AFOLU)	Cities with a high share of forest rates of deforestation and high biodiversity.	There is a negative relation between the urban land value and the presence of agricultural activities. In general smaller cities tend to have.

	Agriculture	Cities with the highest GHG intensive agricultural production.	Agriculture is a relevant sector for GHG emissions in some countries and also a very relevant commodity for the economy. There are many opportunities for developing integrated climate action for the agriculture sector with the adoption of mitigation and adaptation actions.
Adaptation	Drought	Agricultural and Forestry commodities producers.	
	Sea Level Rise	Coastal cities with higher population and urban growth.	Some countries have a high share of population and assets in the coastal areas population and GDP on Coastal cities. Sea level rise has the potential to impact a relevant amount of Brazilian infrastructure.
	Floods	Intermediate cities with big rivers and high exposure population size, vulnerable population, extreme rainfall hazards.	Intermediate cities with a history of relevant floods and potential increase in flood hazard can be a potential focus area for climate planning.
	Landslides	Intermediate Cities with high exposure. Population size and urban growth.	Intermediate cities with a history of relevant floods and potential increase in extreme rain can be a potential focus area for climate planning.
	Diseases		Biggest population and more vulnerable populations. Intermediate cities have the highest growth rates with increasing exposure.

The identification of the typologies is followed by the political engagement of the cities.

3.1.8. Final Brazil City Selection

The selected 5 cities for the pilot phase are the following:

City	State	Sector Typology	Selection Notes
Caxias do Su	RS	Energy	
Serra	ES	Industrial	
Rio Branco	AC	Forestry and Land Use	
Camaçari	BA	Energy	
Corumbá	MS	Forestry and Land Use	

Table 3. Pilot Cities

The Final 45 Cities selected for the project are the following:

City	State	City	State	City	State
Abaetetuba	PA	Crato	CE	Palmeira Dos Indios	AL
Altamira	PA	Cruzeiro do Sul	RS	Parintins	AM
Aracruz	ES	Cuiabá	MT	Petropolis	RJ
Arapiraca	AL	Formosa	GO	Porto Alegre	RS
Boa Vista	RR	Fortaleza	CE	Ribeirao Das Neves	MG
Caceres	MT	Goiania	GO	Rio De Janeiro	RJ
Cajazeiras	PB	Gravataí	RS	Sao Cristovao	SE
Camaragibe	PE	Ilheus	BA	Sao Joao De Meriti	RJ
Cameta	PA	Itapipoca	CE	Sao Leopoldo	RS
Campo Grande	MS	Ji-Parana	RO	Sinop	MT
Campo Largo	PR	Juazeiro	BA	Sobral	CE
Caracarai	RR	Manaus	AM	Sorocaba	SP
Cariacica	ES	Miranda	MS	Tangara Da Serra	MT
Contagem	MG	Montes Claros	MG	Tarauaca	AC
Coxim	MS	Mossoro	RN	Vitória De Santo Antão	PE

Table 4. 45 additional engaged cities in 3 cohorts of 15

3.1.9. Appointment of city climate change focal points

For each city, we identify a technical and policy focal point responsible for the climate agenda, and a political appointee focal point. Technical contacts support on data, review the technical outputs produced and share any existing preliminary work to consider. Political focal points support reviewing the local stakeholders, existing priorities, manage the political will and considerations of the project vision, and assess the feasibility for high impact action implementation and finance plans.

3.2. Policy context, city powers and capacity

A critical aspect of the CHAMP initiative is to identify and **map the policy landscape** and **governance powers** across both multiple scales (eg. national, state, municipal) and sectors (such as energy, transportation, waste, and land use) for each participating country. The policy frameworks that guide climate action—whether mitigation or adaptation—are distributed across various levels of government and sectors, each with its own authority, priorities, and capabilities. To successfully align national climate targets with local action and vice versa, understanding this **multi-scale and multi-sector**

matrix of policies and powers is key to then engage the right stakeholder (i.e. previous section), but also suggest climate actions to governments that indeed can implement them.

A crucial part of this process is assessing the **capacity of city governments** to act within these frameworks. The interaction between these governance scales determines the extent to which a city or region, often at the front lines of climate impact, can autonomously implement climate actions, or whether collaboration with national or state bodies is required.

The section presents an approach to identifying this multi-level policy landscape and power structures, describing a general approach applicable to most CHAMP countries, followed by a specific case study on Brazil.

3.2.1. Policy landscape and priorities at the national and sub-national level

General approach to policy landscape assessment

At the multi-scale level, national governments set broad climate targets, often through NDCs, NAPs and national development strategies. However, the implementation of these targets frequently depends on subnational governments, which may have jurisdiction over critical areas like infrastructure, public transportation, and urban planning. Understanding how policies are distributed between national and local governments helps identify which level of government is best positioned to take action on specific climate priorities.

In terms of **sectoral governance**, climate policies often span different areas such as **energy, transportation, waste management, land use, climate impact response and adaptation**. Each of these sectors may fall under the jurisdiction of different levels of government depending on the country's legal framework. For example, energy policies might be controlled at the national level, while waste management could be under municipal jurisdiction. Identifying these sectoral responsibilities within the broader governance structure is essential to pinpoint which entities can implement, regulate, or finance climate actions.

Brazilian policy landscape for emissions reduction and resilience

The following elements form the backbone of the Brazil's climate action policy context:

Brazilian NDC: In 2015, Brazil presented its intended Nationally Determined Contribution (INDC) to the Paris Agreement. With the deposit of the instrument of ratification of the agreement by the country, in September 2016, Brazil's Nationally Determined Contribution (NDC) was no longer "intended". Brazil assumed, through the agreement, which came into force at the international level on November 4, 2016, the commitment to implement actions and measures that support the achievement of the goal established in the NDC. For the purpose of planning the implementation and financing

of these actions and measures, the Ministry of the Environment coordinates the elaboration of a National Strategy for the Implementation and Financing of Brazil's NDC to the Paris Agreement.

Plano Clima Mitigação: The Brazilian government is committed to leading the global effort to contain global warming below 1.5°C, a level at which the unprecedented worsening of the global climate crisis would be avoided. Unlike most countries, Brazilian emissions are not primarily driven by the burning of fossil fuels, but by deforestation. Second are emissions from agriculture, led by enteric fermentation, produced by the digestive process of cattle. In third place comes the energy sector, with the burning of fossil fuels in transport and industry. But even the already officially launched target of zero deforestation in 2030 is not enough to meet our commitments in the global climate agenda. (MMA, 2024)

Plano Clima Adaptação: The MMA coordinates, under the technical-scientific guidance of the MCTI, a broad participatory and collaborative process for the elaboration of the new Climate Plan, which will collectively agree on the construction of a long-term sustainable development path (2024 to 2035). The Climate Plan's challenge is to increase the country's resilience to climate change while tackling inequalities to achieve climate justice. The Climate Plan – Adaptation will be built on a solid basis in science and in tune with the knowledge obtained from listening to different sectors of society, traditional knowledge, regional needs and, above all, all the voices representing the diversity that makes up Brazilian society. It will consist of 15 sectoral plans that will provide goals, forms of implementation and necessary financing means. The MMA coordinates, under the technical-scientific guidance of the MCTI, a broad participatory and collaborative process for the elaboration of the new Climate Plan, which will collectively agree on the construction of a long-term sustainable development path (2024 to 2035). The Climate Plan's challenge is to increase the country's resilience to climate change while tackling inequalities to achieve climate justice. The Climate Plan – Adaptation will be built on a solid basis in science and in tune with the knowledge obtained from listening to different sectors of society, traditional knowledge, regional needs and, above all, all the voices representing the diversity that makes up Brazilian society. It will consist of 15 sectoral plans that will provide goals, forms of implementation and necessary financing means. (MMA, 2025)

AdaptaCidades: Recently launched as a program to support 260 cities distributed in all states to develop their municipal adaptation plan.

3.2.2. National and subnational sectoral power structures

General Approach to Identify Power Structures within CHAMP Countries

While policies set the overall *direction* for climate action, the **power structures** at different levels of government determine *who* has the authority and capacity to implement these policies. A critical component for a replicable CHAMP methodology is to assess the **distribution of powers** across national, state, and municipal levels,

particularly in key climate-related sectors like **energy, transportation, waste management**, and **urban planning**. Understanding these **sectoral power structures** is essential to identify which level of government has the legal mandate and resources to take high impact actions on climate mitigation and adaptation.

Policies and powers are interrelated but distinct. A policy may outline a country's commitment to emissions reduction or adaptation, but the ability to enforce, regulate, or implement that policy often depends on the specific **powers and mandates** assigned to different levels of government. For example, national governments might control energy generation and large-scale transportation infrastructure, while local governments might oversee zoning, public transit, and waste management. However, local actions are often constrained by the level of authority delegated from national or state governments, as well as the **capacity**—both technical and financial—available to subnational entities.

To accurately map these power structures, tools such as the '**City Powers and Related Capacity Assessment Survey Sheet**' developed by C40 are particularly useful. Table X below provides a high level summary of the key variables in the assessment tool. This survey provides a framework for assessing sectoral powers across levels of governance by posing sector-specific questions to cities about their mandates in areas like energy, transportation, and land use. This tool helps clarify the areas where cities have autonomy and where they may need support from national or state authorities.

By understanding both **formal powers** (legally defined mandates) and **functional capacities** (the actual ability to act based on resources and expertise), CHAMP countries can tailor climate action strategies to each governance level and sector, ensuring that the right actors are mobilized for the right tasks.

[To add later]

Table X. Key Areas to Assess in City Power and Mandates

Brazilian Municipal Powers and Capacities for Scaling Climate Actions

Brazil is a federal country with three basic levels within its federation: National, state and municipal level. Cities are politically associated with the constitutional level of the municipality and can be interpreted as the urban nucleus of a politically autonomous territory in a given state. All the municipalities, independently from its size, share almost the same political autonomy and constitutional responsibilities. Specifically, the 1998 Brazilian constitution states that the municipalities have power to:

- I - Legislate on matters of **local interest**;
- II - **Supplement federal and state legislation** as applicable; (See ADPF 672)
- III - **Institute and collect taxes within its competence**, as well as apply its income, without prejudice to the obligation to render accounts and publish balances within the deadlines set by law;

IV - Create, organize and suppress **districts**, in compliance with state legislation;

V - Organise and provide, directly or under concession or permission, public services of local interest, **including public transport**, which are essential in nature;

In addition to this general context for Brazilian municipalities, the specific powers and mandates that are relevant to climate action for mitigation and adaptation are as follows.

Table 6. Powers and mandates

Sector	City powers (5,570)	State powers (26)	Central Government powers
Energy	- Public lighting infrastructure - Discount on IPTU (Property Tax) for energy efficiency actions	- Supervision of energy concessionaires - Promoting incentive programs for energy production or energy savings	- Power generation and distribution - Authorization for energy production auctions - Concession grants for new transmission facilities
Transport	- Mobility planning - Regulation of local public transport (buses, bike lanes, active transportation) - Traffic management - Creation of low-emission zones - Control of local vehicular pollution	- Intercity public transport - Administration of state highways and roads - Environmental licensing inter-municipal road works	- Railways, Airports, Shipping, and Ports regulation - Concession of federal highways
Housing	- Promotion of housing construction programs and improvement of housing conditions (shared responsibility)	- Social housing and community amenities	- Mortgage assurance - Funding for housing
Waste	- Waste collection, disposal and treatment - Water supply and sanitation - Recycling programs	- State Solid Waste Plans	- National Solid Waste Plan
Economy	- Municipal budget usage - Control of the municipal collection - Investments in energy and environment	- Distribution of the state budget and control of activities carried out and financed - Control of the state collection - Action plans	- Stipulation and control of the annual national budget - Control of the manufacture and circulation of money produced

			- Federal financing for energy and environment - Action plans
Urban and Rural Planning	- Master Plan for urban and rural planning for municipalities of over 20 thousand inhabitants - Authorization for land parcelling - Protection of historical and cultural heritage - Control and inspection of built spaces - Zoning, building codes and land-use management	- Inspection, incentive, and regional planning	- National urban policies
Environmental Protection	- Management of green spaces - Environmental Licensing (shared responsibility that can be delegated from the State) - Environment protection and pollution control - Forest, fauna, and flora preservation	- Environmental Licensing for regional activities (shared with municipalities) - Forest, fauna, and flora preservation	- Regulation of Environmental Licensing through CONAMA (National Council for the Environment) - Protection, improvement, and recovery of environmental quality through SISNAMA (National Environment System) - Licensing for companies operating in multiple states through IBAMA (Brazilian Institute of the Environment) - Forest, fauna, and flora preservation
Infrastructure	- Basic sanitation infrastructure - Asphalted streets - Management of public spaces (parks, squares, woods)	- Major infrastructure projects within the state - Highways connecting state cities, regional airports, public supply works	- Large infrastructure projects spanning more than one state

3.3. Long-term vision and political commitment for a CHAMP project scale plan

A successful CHAMP climate action plan requires a clear **long-term vision** and strong **political commitment** at all levels of government. This vision not only sets climate

mitigation and adaptation targets but also outlines **how** these targets will be achieved, emphasizing co-benefits such as improving livelihoods, creating economic opportunities through green jobs, supporting marginalized communities, improving energy access, and addressing poverty. As such, commitments and visions focus on both the **outcomes** of climate action and the **process** through which these outcomes are delivered.

3.3.1. Mitigation and Adaptation Targets and Political Commitment

Setting ambitious but achievable **mitigation and adaptation targets** is essential for scaling climate action. These targets should align with national commitments, such as **Nationally Determined Contributions (NDCs)** and long-term strategies like **Long-Term Low Emission Development Strategies (LT-LEDS)**. Cities and subnational governments must ensure their targets and climate actions are in sync with national goals, ideally also with GCoM's CRF while also addressing local needs.

The main targets to review at the different levels of government for the target country include:

Mitigation Targets: These include measurable goals for reducing greenhouse gas emissions, such as achieving net-zero emissions by a specified year. National targets should be aligned with international frameworks and science, while subnational targets should align with, and ideally surpass, national targets, ensuring coherence across levels of governance.

Adaptation Vision: Beyond reducing emissions, cities must also prepare for the impacts of climate change by setting adaptation targets. This could involve increasing urban resilience, enhancing infrastructure, or implementing nature-based solutions. Cities should aim for equitable adaptation, prioritizing support for the most vulnerable populations.

Political commitment is key to achieving these targets. At the national, state, and local levels, governments should publicly commit to climate action by implementing policies, laws, and funding mechanisms that support long-term climate goals. As mentioned, the vision should incorporate co-benefits that go beyond emissions reductions, focusing on social and economic outcomes.

A well-defined vision and political commitment can help integrate climate action into broader societal goals, ensuring that climate strategies not only reduce emissions but also contribute to social equity, poverty alleviation, and sustainable development.

Brazilian Climate Target and Political Commitment Context

Climate change policies at the national level in Brazil progressed with the introduction of the National Plan on Climate Change in 2008, followed by the National Policy on Climate Change in 2009 (law 12.187/2009).

The National Climate Change Plan provides a comprehensive framework and aims to encourage the development and improvement of mitigation actions in Brazil. Some of these actions are:

- Reduce annual deforestation rate in the Amazonia, by 80 % by 2020 (Decree nº 7.390/2010);
- Expand domestic consumption of ethanol;
- Double the area of planted forests;
- Replace one million old refrigerators per year for 10 years and increasing recycling of solid urban waste;
- Increase cogeneration electricity supply and reducing non-technical losses in electricity distribution;
- Creation of a national cap-and-trade system for carbon emissions.

Considering the actions detailed in the National Climate Plan, The National Policy on Climate Change formalized Brazil's voluntary commitment to the UNFCCC to reduce GHG emissions between 36.1% and 38.9% of projected emissions by 2020. These targets were updated in the following Nationally Determined Contributions (NDC).

Brazil's NDC is currently in its third update, underscoring the country's commitment to reduce greenhouse gas emissions by 48.4% by 2025 and 53.1% by 2030, relative to 2005 levels. The Brazilian government has also reaffirmed its long-term objective of achieving climate neutrality by 2050. Additionally, at COP26, Brazil pledged a 30% reduction in methane emissions by 2030.

In the area of adaptation, the National Adaptation Plan is being developed in 2024 with extensive public engagement. It is being developed by the Interministerial Committee on Climate Change (CIM), made up of representatives from 22 ministries, the Climate Network and the Brazilian Climate Change Forum.

The Plano Clima Adaptação is setting the country Adaptation Goals:

- Long-Term Climate Risk Management: Implement strategies for managing and reducing long-term climate risks through the National Adaptation Plan (NAP).
- Increase Adaptive Capacity: Enhance the resilience of municipalities and communities, particularly those with low adaptive capacity.
- Sectoral Adaptation Plans: Develop 15 sectoral adaptation plans that address regional needs and incorporate traditional knowledge and community voices.
- Participatory Approach: Engage diverse stakeholders in creating and implementing the NAP to ensure equitable adaptation strategies.
- Address Climate Inequalities: Focus on reducing inequalities to achieve climate justice while adapting to climate change impacts.

Brazil's climate goals, particularly in mitigation and adaptation, reflect both the urgency and complexity of addressing climate change. The commitment to significant emission reductions hinges largely on tackling deforestation, a primary driver of greenhouse gas emissions in the country. The official target of achieving zero deforestation by 2030 is commendable; however, it raises questions about feasibility and enforcement, especially

given recent trends of increasing deforestation rates. Effective implementation of this goal necessitates not only robust regulatory frameworks but also sustained political will and active engagement from local communities.

3.3.2. Identification of Signatories and Memberships in Climate Initiatives

Participation in **national, regional, and global climate initiatives** strengthens a subnational actor's ability to act by providing access to resources, peer networks, and technical assistance. As such, concrete climate commitments can also be evaluated by identifying which initiatives the national, regional and city governments are part of. The following are examples of initiatives that each government scale may have taken, and thus identify.

National Level Memberships: In addition to CHAMP, Nations can be signatories or members of several multilateral climate initiatives like the NDC partnership, Race to Zero and Race to Resilience Campaigns, UNFCCC Climate Ambition Alliance, Fossil Fuel Non-Proliferation Treaty, High Ambition Coalition, Global Methane Pledge, Article 6 Coalition and many more. Evaluating whether the CHAMP country belongs to any of these or other initiatives further outlines the political commitments and targets to advance.

Regional Level Memberships: States, Provinces or Regions may be signatories to the Under2 Coalition, States and Regions Alliance under GCoM, The R20 - Regions of Climate Actions, ICLEI and others. In addition to these international initiatives, regions can have specific initiatives developed within their own specific country.

City Level Memberships: Cities can be signatories of several climate alliances and commitment frameworks, including C40, GCoM, ICLEI, CDP, the Urban Transition Mission, Resilience Cities Network and many others. Countries very often host their own local city climate network, through a national NGO.

By becoming **signatories** to these initiatives, governments can not only demonstrate their political commitment but also gain access to funding, data, and expertise that helps them scale their actions effectively. These memberships also enhance accountability and ensure that local actions are aligned with global climate goals. Identifying the level of signatories within CHAMP country is thus essential to leverage these existing commitments and resources.

Brazilian Climate Memberships Across Scales

(To add by IC&B, after city selection)

3.3.3. Joint Political Mayoral Statement for CHAMP Action Alignment

To solidify their commitment and ensure public accountability, local leaders within a CHAMP country should consider issuing a **joint political statement** that aligns their climate actions with national and global climate targets. These joint statements can serve as a public declaration of their unified approach to climate action, detailing for example: specific commitments to both **mitigation** and **adaptation** goals, actions to support national strategies, such as contributing to NDCs, and collaborative efforts to promote **green and resilient development** at the local level.

Such a statement would also emphasize the role of cities as critical actors in **scaling climate actions** and could include commitments to prioritize underserved communities, enhance local resilience, and promote sustainability through **inclusive governance**. By aligning city-level actions with broader goals, cities can demonstrate leadership while ensuring coherence in climate action across multiple scales.

Brazilian Mayoral Statement for CHAMP

(to be added at the end)

3.4. Identifying Common Project Risks and Challenges

The implementation of the scaling methodology may face several challenges. Identifying and addressing these risks early is critical to ensure project effectiveness and replicability.

- **Data Quality and Availability:** Incomplete or inaccurate GHG inventories or climate risk data can hinder effective planning. *Mitigation:* Establish partnerships with local universities, civil society organizations, and national data platforms to enhance data access and improve quality assurance processes.
- **Governance and Institutional Coordination:** Misalignment across municipal, state, and federal levels may create bottlenecks. *Mitigation:* Develop a multi-level governance framework with clearly defined roles and communication channels among stakeholders.
- **Financial and Political Constraints:** Limited access to sustained funding or political changes may disrupt implementation. *Mitigation:* Diversify funding through blended finance models and public-private partnerships (PPPs), and seek early political commitment through formal agreements and stakeholder engagement.

4. ASSESSMENTS AND EVIDENCE TO INFORM ACTIONS

Effective climate action planning relies on a robust evidence base that enables cities to understand their emissions profiles and vulnerabilities to climate risks. This section outlines two critical assessments that guide decision-making: the GHG Emissions Profile (which can be as detailed as a full GHG Inventory), and the Climate Risk and Vulnerability Assessment (CRVA). Both assessments need to be designed for scalability, allowing for the evaluation of 50+ cities simultaneously. Rather than relying on city-by-city approaches, the methodology focuses on leveraging global and national datasets with municipal granularity, ensuring efficiency and consistency across all cities. The GHG emission profile helps identify high-emission sectors and set reduction targets, while the CRVA assesses vulnerabilities to climate hazards, allowing cities to prioritise adaptation measures. In this section we present the approach for the development of a GHGI, and a CCRA as the framework for a CRVA. Together, these assessments form the foundation for data-driven prioritisation of climate actions, aligning with broader national and global goals, and accessing climate finance.

4.1. Developing GHG Emissions Inventories and Profiles

The development of GHG emissions profiles for cities is a critical step in understanding urban emissions, identifying and quantifying key activity data, and informing effective climate action to address emissions directly, or alter activity data that will also (indirectly) reduce emissions. In this methodology, we present an approach to a full GHG Inventory based on the best available regional and global datasets, ensuring a standardised and efficient approach across all target cities. Cities can then review these inventories and provide feedback to refine the data.

The process, outlined in Figure 5, consists of six key steps: scanning datasets, selecting the most relevant ones, adapting them to the GPC framework, transforming and integrating the data into a cloud-based system, calculating and reporting emissions through a dashboard following the CRF framework, and finally, gathering city feedback through guided workshops. Each of these steps is detailed in the following subsections, providing a clear path from data collection to actionable insights. This scalable approach allows for simultaneous development of emissions profiles for multiple cities, ensuring consistency while incorporating local expertise.

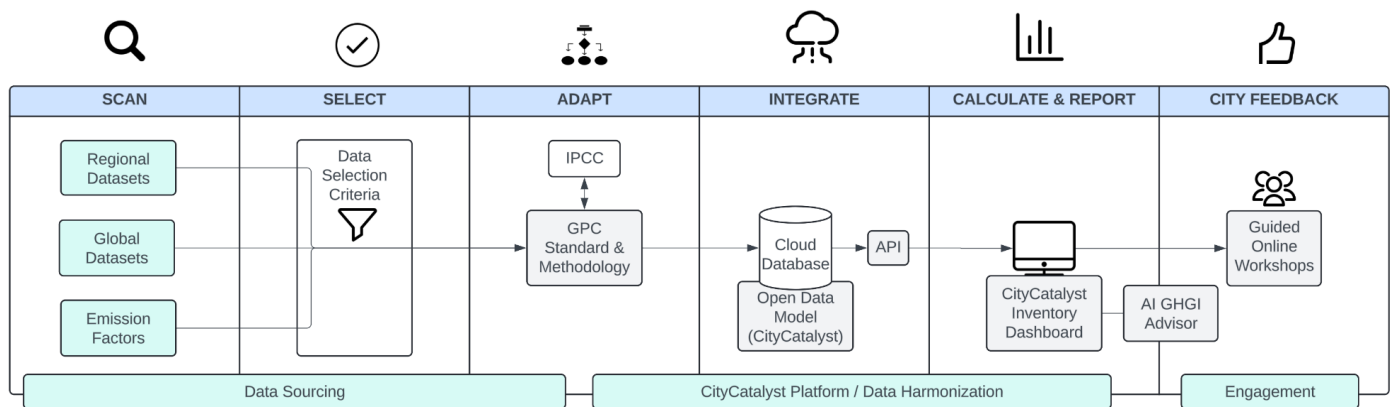


Fig 5. General process for data sourcing and process flow for building GHG inventories. In the case of the Brazil project, the CityCatalyst digital platform was used and the figure illustrated the role it plays in the generic process flow.

4.1.1. Reviewing GHG datasets and tools for developing emissions profiles

The development of accurate GHG emissions profiles begins with the selection of the appropriate standard methodology and tools. When developing subnational emission profiles in CHAMP countries, the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) is suggested as the standard framework to organize emissions profiles. The GPC was selected for this specific project and methodology over other frameworks, such as the IPCC guidelines, because it is specifically designed for urban contexts, aligns with international best practices for city-level reporting, and supports a granular analysis of emissions across multiple sectors. GPC has a BASIC scope, including energy, transport and waste sector, and a BASIC+ scope that further includes Industrial Process and Product Use (IPPU), and Agriculture, Forestry and Land Use (AFOLU). For this project, we placed specific efforts to identify and integrate datasets that could cover the BASIC+ scope.

The overall formatting and reporting standard adopted for GHG Emissions Inventories, in complement with the GPC, is GCoM's Common Reporting Framework (CRF), which further outlines accounting, notation and emission source principles. While not all targeted cities may be signatories to GCoM, or formal GHGI may not be possible in some country contexts, the CRF ensures a global standard for reporting and thus interoperability.

In addition to defining the emission profile standard, a specific tool to conduct the data driven emission profile assessments is needed in order to have consistency and scalability across multiple subnationals of the CHAMP country. To ensure fast and low costs replication across cities and countries, an open source platform that can host open data pipelines, transformation libraries and public data catalogues is highly recommended.

For the Brazil country implementation across 50 cities, the CityCatalyst platform tools was selected, given it is purpose-built to handle large-scale, city-specific GHG

inventories. CityCatalyst is integrated with AI and cloud-based infrastructure, enabling it to process data efficiently for multiple cities simultaneously. It offers a streamlined workflow from data ingestion to emissions reporting and visualisation, positioning it as a best-in-class tool for urban climate action.

General Dataset Review and Selection Process

In line with Figure 5, the steps for emissions and activity data sourcing follow a structured process: **Scan, Select, Adapt, Integrate, Calculate, Report**, and finally, **Gather Feedback** from cities.

In **Step 1** (Scanning Datasets), a wide range of global and regional datasets is identified to source emissions data for the selected cities and subnational areas. Regional datasets (e.g., national or state-published datasets) provide high-level estimates across multiple cities, enabling a high-throughput approach that quickly covers large areas. **Emission factor data** should also be gathered with as much local specificity as possible to increase accuracy.

While city-level data offers the most precise activity data for benchmarking selected actions, gathering city-specific information can be challenging when working with many cities simultaneously. However, through an iterative engagement approach, cities can progressively refine their emissions profiles as data quality and availability improve. This process begins with a “**Getting Started**” profile that identifies primary emissions sectors, which can evolve over time into a detailed GHGI, enriched with city-sourced data for a comprehensive view.

In **Step 2** (Selecting), datasets can be evaluated against several selection criteria, including:

- **Validation:** Cross-reference datasets with benchmarks derived from previously reported inventory values to ensure consistency, and facilitate data quality assessment.
- **Granularity:** This considers both spatial granularity and data granularity. Municipal-level spatial granularity is ideally prioritised to capture the most detailed emissions profiles possible. Datasets that include activity and emission factors are also prioritised, and breakdown of emissions by individual gases, instead of only providing CO₂-equivalent totals, is also considered to enhance clarity and precision.
- **Ease of Access:** Datasets with reliable, open access are favoured to ensure long-term usability.
- **Provider Engagement:** Priority of datasets can be given to sources from providers/publishers that engage with public-sector data users often and will collaborate throughout a CHAMP country setup to address questions and propose data quality improvements.
- **Formatting and Compliance:** Datasets formatted according to or easily adaptable to the GPC framework are also prioritized to ensure seamless integration.

- **Subsector Coverage:** Datasets that provide comprehensive coverage across critical subsectors like Residential buildings, Energy industries, On-road transportation, Solid waste disposal are also selected.
- **Transparency:** Public and detailed technical and methodology documentation explaining data gap, limitations and assumptions.

Data Adaptation and Integration

In **Step 3** (Adapting to the chosen framework or standard), the selected datasets are mapped to the GPC's emissions reporting categories. This step ensures that all data fits the standard subsector breakdown required by the GPC framework, which facilitates consistent emissions reporting across cities.

Following the standard adaptation, **Step 4** (Transforming & Integrating Data) involves loading the data into the selected tool, ideally through a cloud-based infrastructure like the one provided by CityCatalyst. A comprehensive data mapping process is then carried out to align the original dataset schemas with the data model of the selected tool (eg. CityCatalyst's GPC-compliant open data model), ensuring that all data is structured and processed according to the same standard. The data pipelines (i.e. the process for cleaning, adapting and transforming data) are ideally saved in libraries for replicating the process in future instances (eg. inventory updates). Once the data is transformed and cloud hosted, the final data points are ideally made accessible through open API endpoints.

As a reference for technical documentation on emissions data API and data model documents, see the following links from CityCatalyst:

- <https://ccglobal.openearth.dev/docs#/>
- <https://dbdiagram.io/d/Global-API-6656582eb65d933879ec1b42>

4.1.2. Forecasting Emission Trajectories: 'no-action' scenarios in 2030 and 2050

Once emission data is calculated and compiled for a city emission profile, understanding the projected trend of emissions is key for planning, and choosing a replicable methodology for doing this forecast is also important. We present here a reference 'no action' emissions scenario methodology for development of future GHG emissions for 2030 and 2050 at city level, assuming no additional mitigation measures beyond current policies. This scenario helps cities understand the potential impact of continued growth without intervention, providing a baseline for comparison against climate action strategies.

The projections are developed using a Business-As-Usual (BAU) model, which factors in key growth drivers such as economic expansion, population growth, and GHG sectoral emission trends. The model integrates sector-specific activity data, reflecting expected

increases in energy use, transportation demand, waste generation, industrial production, and land-use changes, including deforestation.

The BAU model incorporates several key assumptions:

- **Economic Growth:** National-level economic forecasts, aligned with regional growth projections for cities, were used to estimate how emissions might scale with increased industrial activity, energy consumption, and transportation demand.
- **Population Growth:** Urban population growth rates were factored in, as urbanization drives emissions increases through higher energy demand, transportation use, and waste generation.
- **Sectoral Growth:** Each sector was evaluated separately, applying historical trends to project future activity levels in energy, transportation, waste, and industrial processes. In the case of land-use change, deforestation rates were projected based on current policies and land management practices.

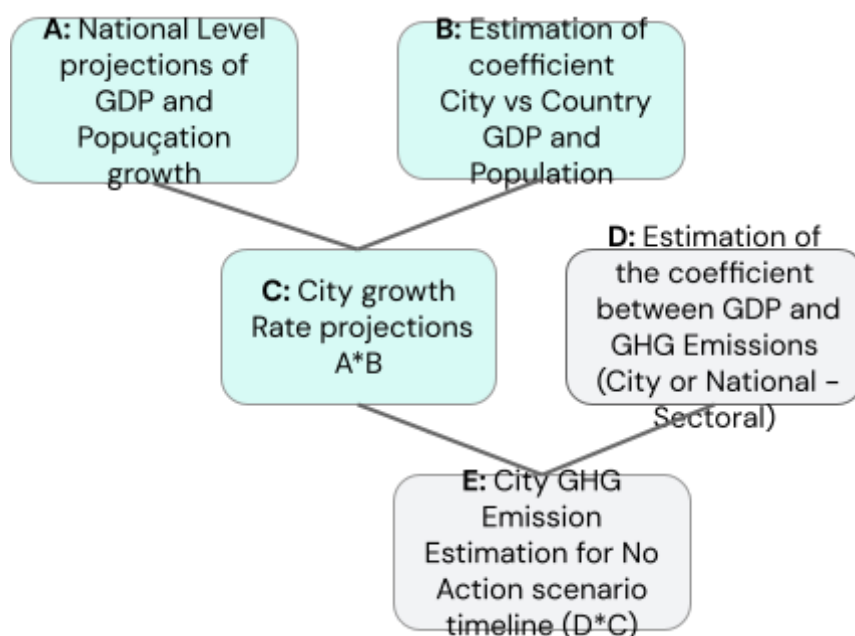


Fig 6. No Action Forecast Model structure

4.1.3. Building City-specific GHG Inventories and Emission Forecasts for Brazilian Cities

While the previous two sections provide an overall country-agnostic approach to developing emission profiles, this section outlines the specific data selections and methodologies taken for the Brazil country project. The process flow adopted for Brazil follows the same steps outlined previously and illustrated in Figure 5. The Brazil project also involved leveraging the CityCatalyst platform as the primary tool to compile GPC compliant GHG Inventories.

Brazil-Specific Data for All 50 Inventories

Following steps 1 and 2 for emission, activity and emission factor dataset ‘Scanning and Selection’, both global sources and Brazil specific sources were gathered. Among the most important datasets reviewed was the [SEEG \(Sistema de Estimativas de Emissões de Gases de Efeito Estufa\)](#), which provides detailed emissions data across all municipalities in Brazil. Other datasets from the CityCatalyst’s curated catalogue were also evaluated, including global sources such as Google EIE, EDGAR, and Climate TRACE, which provide valuable insights into specific emissions sectors. Emission factors were taken from IPCC.

The following Table 7 outlines the key datasets used to build the inventories for each subsector, ensuring alignment with the GPC framework and covering the unique emissions challenges of Brazilian cities.

Below are the preliminary core selection of datasets

Sector	Dataset	Reason for Selection
Energy	SEEG (scope 1)	Municipal-level emissions data with detailed sectoral breakdowns.
Energy	EPE (scope 2)	Energy Research Company (EPE) provides annual electricity consumption data by sub-sector at the state level in Brazil
Transportation	SEEG	Based on fuel sales data and has national coverage this was chosen over Google EIE since it doesn’t have estimated data for all cities that can be imported in bulk.
Waste	SNIS and SNIR	National data on waste generation and management practices, broken down by municipality.
Industrial Processes (IPPU)	SEEG and ClimateTrace	This is included selectively for city profiles. The data from SEEG is scaled down from regional or national data. There is some difficulty getting reliable city level estimates. Suggest using city level data if available.
AFOLU (Deforestation)	SEEG	Essential for tracking land-use changes and deforestation emissions in Brazil.

Table 7. Primary GHG Datasets

Table 8 outlines supporting datasets that can be used to improve emissions estimates, particularly where the primary datasets are believed to have higher uncertainty.

Selection and integration of these will depend on data scoring and suitability of the chosen cities.

Sector	Dataset	Reason for Selection
Energy	EPE (Energy Research Company)	State-level electricity generation data with detailed sectoral breakdowns.
Energy	SIRENE	This provides national inventory emissions data.
Transport	ANP	Fuel Sales by municipality, proxy commonly used for transport emissions.
Waste	SINIR	National data on waste generation and management practices, broken down by state.
Waste	SNIS	National data on wastewater generation and management practices, broken down by state.
AFOLU	IBGE	Herd data by municipalities. Number of heads of main herds.
AFOLU	IBGE	Agricultural production data by municipalities.

Table 8. Supporting GHG Datasets.

A more detailed outline of datasets defined by subsector, including their source link, are included in the Brazil Data Catalog sheet ([see document link here](#)). These are the initial datasets integrated to ensure as much comprehensive emissions coverage for all 50 cities and all subsectors, while minimizing the quantity of datasets to evaluate, clean, transform and integrate.

Once the relevant datasets are selected, they are adapted to GPC, transformed into a homogeneous data model and integrated (i.e. Step 2 and 3) into the CityCatalyst platform using its open data pipeline infrastructure. All data transformations are available on a public github repository ([CityCatalyst Data Repo](#)) there is also methodology documentation for reviewing the datasets and explaining data transformation ([CityCatalyst Methodology Documentation](#)). With all datasets integrated the process of Calculating & Reporting (i.e. Step 4) GHG inventories for each city begins. CityCatalyst automates much of the emissions calculation process, reducing time and manual effort while ensuring consistency across all 50 target cities. The following elements provide more information of this process:

- **Emission Factors and Activity Data Integration:**

With the activity data and emissions factors already loaded into the CityCatalyst

cloud infrastructure (including IPCC, GPC), the platform uses these inputs to calculate emissions across various subsectors. This includes assigning Brazil-specific emission factors to sectors like energy, transportation, waste, and industrial processes, ensuring accuracy in reflecting local conditions.

- **Automated Emissions Calculation:**

CityCatalyst automatically calculates total emissions by multiplying the activity data (such as energy use or waste generation) by the corresponding emission factors, or, when necessary, applying more advanced calculations. The platform ensures that all calculations adhere to the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) framework, maintaining consistency across all inventories.

- **Data Visualization and Reporting:**

The calculated emissions for each city are displayed through a user-friendly dashboard, allowing for easy interpretation of the results. This includes detailed breakdowns by subsector and scope, helping cities visualize their emissions profiles. The platform also offers insights and recommendations through its AI-based GHG inventory advisor, guiding users on key emissions sources and potential areas for action.

For more information on the CityCatalyst GHG Inventory process, see Appendix X and review the platform's [Wiki documentation](#).

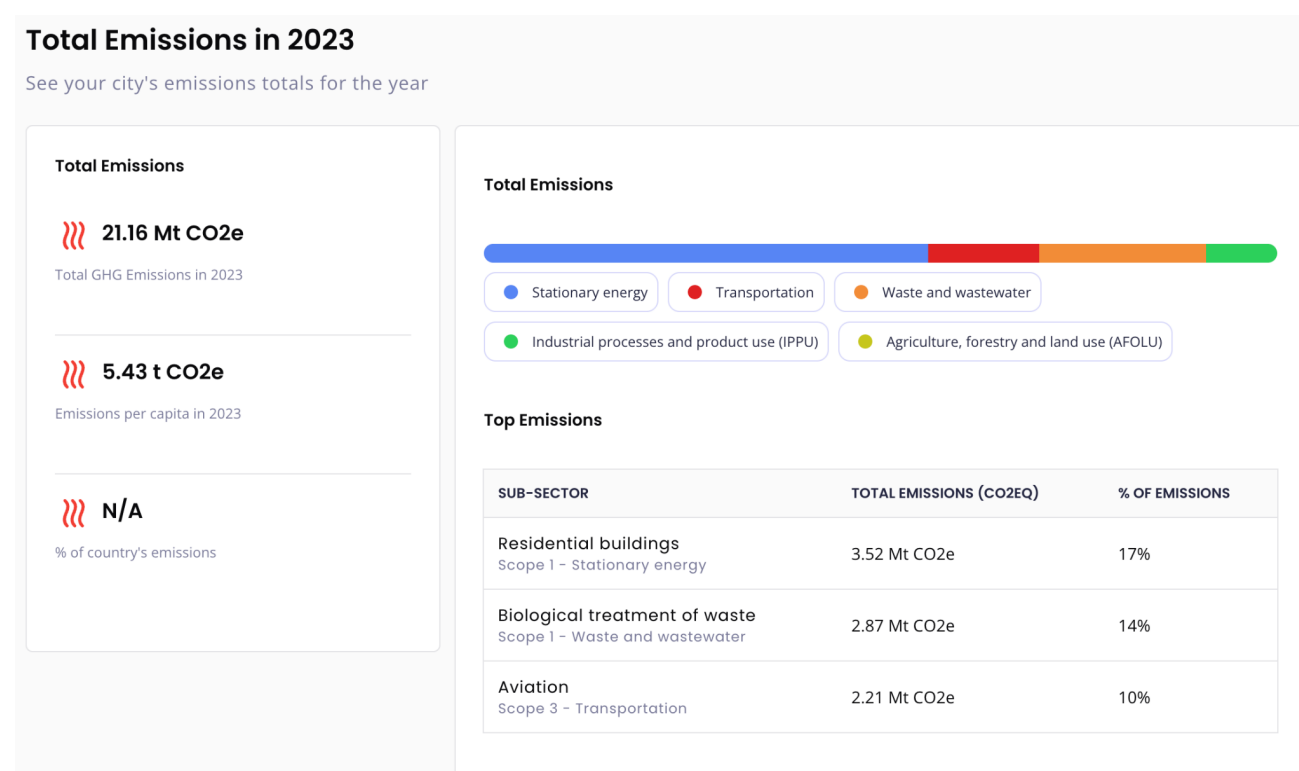


Fig 7. CityCatalyst summary of emissions inventory by sector and highest emitting subsectors

'No Action' Emissions Forecast for Brazilian Cities in 2030 and 2050

The calculation of 'no action' emission forecasts for the selected Brazilian cities was done following the general methodology outlined in section 4.1.2. The specific data sources for this model include national economic growth projections, municipal-level population data, and sectoral data from sources such as SEEG and IBGE. For the AFOLU (Agriculture, Forestry, and Other Land Use) sector, we used datasets like Mapbiomas, which monitor deforestation trends, crucial for Brazilian cities given the role of land-use change in emissions growth.

4.1.4. Engaging cities and validating their emissions profiles

General Approach to Piloting Emissions Profile with City Engagement

The piloting and validation process directly with the city officials is a critical step to ensure the accuracy and usability of the emissions profiles and 'no action' scenarios for each city.

Data Revisions, Data Additions and Output Feedback

The process begins with city engagement, where the point of contact of each participating city is invited to review its emissions profile, first through access to the digital platform (eg. CityCatalyst) or published GHG emissions profile, and then through a collaborative, guided approach. This includes city workshops, where local officials and technical teams are introduced to the GHG inventories and forecasted scenarios. The goal of the first workshop is to ensure that local stakeholders understand the data, provide input on local conditions, and make necessary adjustments to improve accuracy.

The process ideally continues by sourcing city-level datasets, particularly for the high emissions sectors, to improve the quality and accuracy of the emission profile developed. Having locally sourced activity data improved the MER process in future stages. Understanding how to source data locally and how to improve data quality also empowers the city to update inventories in future years.

Capacity Building through Engagement Workshops and Tools

Capacity building is an essential element of the methodology and the mission for empowering CHAMP countries across their different government levels. It ensures that cities not only receive accurate emissions profiles but also have the tools and knowledge to maintain and improve them over time. The ideal process provides capacity through two main avenues: dynamics workshops and reference tools.

Through the city engagement process, capacity building is facilitated via content and information in tailored workshops. These sessions are designed to help local governments and technical teams understand the methodology behind the GHG inventories, how to interpret emissions data, and how to make adjustments based on local insights. The workshops also guide cities on how to effectively use the digital platform selected (eg. CityCatalyst) for ongoing emissions tracking and reporting.

A second avenue for capacity building involves providing cities online tools and reference where they can gather more technical information about emission profiles, how to leverage the insights from its assessments, and resources to consult questions.

Brazil Specific Approach to Piloting Emissions Profile

Emissions Profiles in CityCatalyst

Within CityCatalyst, each city's emissions profile is presented in an interactive dashboard. Each city receives an invitation email that is connected to their specific account. The platform allows cities to explore their emissions by sector, scope, and subsector, providing clear visualisations and breakdowns of each emissions source. Users can view the calculated GHG inventory.

CityCatalyst includes tools for reviewing and editing emissions profiles. Local governments can make adjustments by inputting new data or refining existing estimates based on city-specific information, such as local emission factors or activity data, and review the datasets selected for each of their GPC subsector. These edits or suggestions can be done through a guided interface, or provided in the guided workshops for the OpenEarth team to incorporate them into revised inventories.

Brazil City Engagement Workshops

[Add snapshot of capacity building content once its developed]

CityCatalyst Capacity Building Tools

CityCatalyst includes built-in capacity-building tools, in the form of a multi-language AI Climate Advisor chatbot. This feature provides personalised recommendations for cities, helping them understand their data and emission profile through a conversational interface, including how the inventory is compiled, deep understanding of the GPC methodology, and understanding the most impactful sectors for action. The advisor also offers suggestions on how to improve the accuracy of their GHG inventory and provides guidance on using the platform's features effectively. For more information on the the AI Climate Advisor in city catalyst see [Appendix XX or GitHub link]

Additionally, CityCatalyst has a Learning Hub that provides articles and resources about the GPC methodology and other frequent questions for users to learn more about the GHGI development process.

By combining hands-on training with AI-driven insights, cities are equipped to manage their own GHG inventories over time more effectively and contribute to long-term climate action efforts.

Engagement with Brazilian Emission Data Providers

The success of the GHG inventory process relies on the accuracy and quality of external datasets. Engaging with data providers is important to ensuring the validity of the methodology and maintaining high standards of data integrity.

A primary partner in this process has been SEEG, which provides municipal level emissions data for Brazil. Our team worked closely with SEEG to validate the methodology used to map and integrate their datasets into the CityCatalyst platform. This collaboration ensured that the datasets were aligned with the GPC framework, applicable to the urban context, and that we were able to best characterise the data quality and uncertainty factors.

Each dataset undergoes a technical review where we look at several key factors that impact its quality and transparency. Here's an overview of the criteria we consider:

Category	Low (1 point)	Medium (2 points)	High (3 points)
Technical Documentation	Limited documentation; few references.	Summary of data sources and methods.	Detailed documentation with comprehensive data sources and methods.
Activity Data	Not available for most categories.	Available for key categories with basic data.	Available for all categories; detailed and frequently updated.
Emission Factors	Not available in the dataset	Adapted IPCC default values.	Country-specific values; regularly monitored.
Methodology	Tier 1 IPCC applied for all categories.	Tier 2 IPCC methodologies applied and sector-specific methods used.	Tier 3 IPCC methodology applied; complex models for key categories.
Spatial Granularity	National level activity or emissions data	Regional level activity or emissions data	Local or spatial level data for activity or emissions
Coverage	Relevant for only a few cities.	Relevant for a region.	Relevant for the entire country.
Types of Gases	Final emissions in CO ₂ e with limited information.	Final emissions in CO ₂ e with more detail such as global warming potentials	Comprehensive emissions covering several sectors and GHG types.

Table 9. Data quality and transparency rubric.

We combine these scores into an overall rating high, medium, or low that reflects the dataset's overall quality. This process helps ensure the data is transparent, reliable, and suitable for city-level GHG inventories, while also identifying any uncertainties or limitations.

Looking forward, we plan to maintain an active feedback loop with SEEG and other data providers. This includes regular updates on how their data is being used in our platform

and recommendations for improving data quality and granularity, particularly for city-specific applications. We aim to foster ongoing collaboration, enabling continuous improvements to the datasets for use in future iterations of the methodology and expanding the use of these datasets in other CHAMP countries.

4.2. Understanding major climate risks and hazards through CCRA's

The Climate Change Risk Assessments (CCRA's) conducted for this project are designed to assess the climate risks and hazards that Brazilian cities face, utilising a structured, data-driven methodology. The following section provides a stepwise CCRA process flow and detailed explanations of the methodologies, tools, and datasets used in developing city-specific climate risk profiles. This methodology is customised to leverage the CityCatalyst data infrastructure for scalability and adaptability. Similar to the development of the GHG Inventories, Figure 8 and the steps described below show the general process involved:

1. **Scan** for Climate Risk and Hazard Datasets: Identify global and national datasets covering climate risks (e.g., temperature rise, flooding, drought) relevant to cities.
2. **Select** Datasets and Tools: Choose datasets based on criteria such as granularity, accuracy, and applicability to urban settings.
3. **Adapt** Data to Conform with a selected methodology: Align selected datasets with the CCRA framework. Transform and map the data to a common open data model in CityCatalyst.
4. **Integrate** into the CityCatalyst System: Load datasets into CityCatalyst's cloud infrastructure, linking risk and vulnerability modules for streamlined data access and calculations.
5. **Calculate and Display** Risk Profiles: Generate climate risk scores by calculating hazard, exposure and vulnerability. Visualise results on a separate CCRA dashboard.
6. **City Feedback** and Refinement: Cities review and adjust the profiles via editable files, contributing with local knowledge to refine assessments.

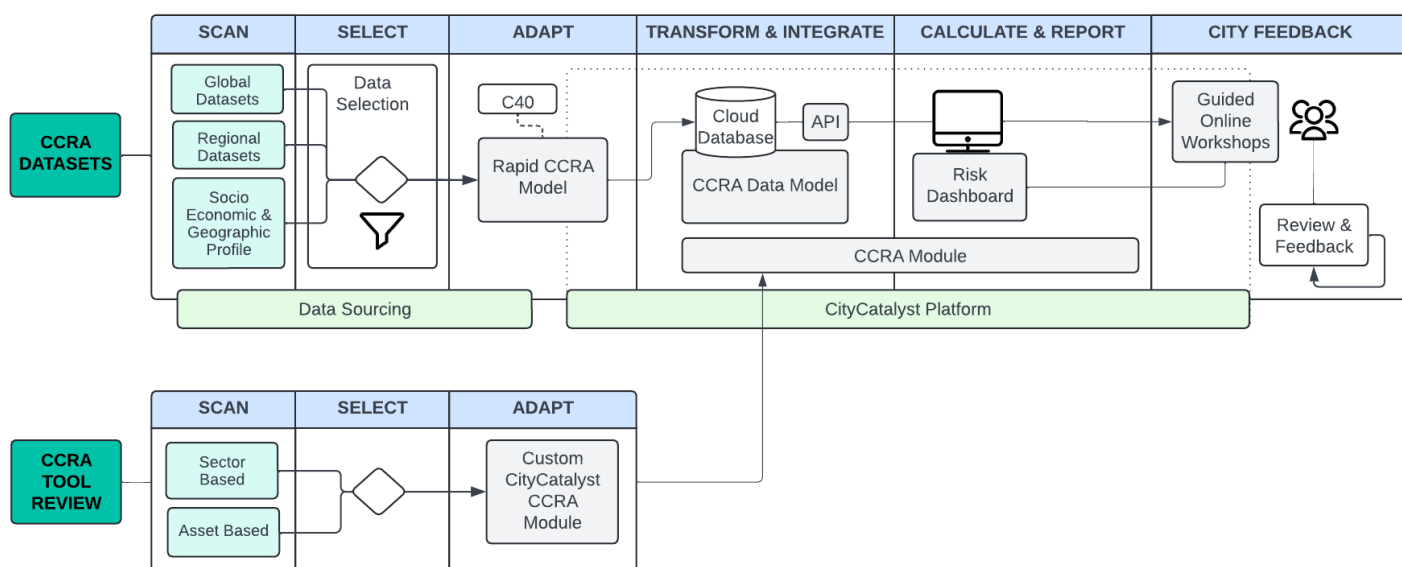


Fig 8. Example of a Climate Risk Assessment process flow for data and tools

4.2.1. Reviewing CCRA standards and climate risks and hazards datasets and tools

Standards and Methodologies Reviewed

For the development of the methodology, we reviewed two primary CCRA standards: ISO 14091 and the C40 Rapid CCRA Guidance. The ISO 14091 standard provides a comprehensive framework for assessing vulnerabilities and adaptation needs, but its broader scope is more suitable for long-term strategic adaptation planning. The C40 Rapid CCRA was ultimately selected for this project due to its focus on urban environments, its structured approach to hazard identification, and its alignment with C40's Climate Action Planning Framework. This method also integrates well with the Global Covenant of Mayors (GCoM), making it highly applicable for cities looking for practical, actionable climate risk insights.

CCRA Tools Reviewed

The following tools were reviewed to complement the selected approach:

- **C40 Rapid CCRA:** Offers a quick and structured method for identifying climate-related hazards, impacts, and vulnerabilities. Suitable for cities needing rapid assessments as part of their climate action planning.
- **OSC Physrisk:** Focuses on climate-related physical risks, primarily for financial and infrastructure sectors. It provided useful hazard mapping, but required customization for urban applications.
- **World Bank Climate Risk Screening Tools:** Well-suited for infrastructure project risk assessments, but less specific to broader urban planning needs.

- **Climaax:** Contains a framework and toolbox focused on developing standardised climate risk assessments at the regional and local levels across Europe.
- **IBM EIS:** A cloud-based platform that integrates geospatial, weather and climate data to help organisations manage and mitigate environmental risks. A demo of the tool's free trial showed it is not designed for conducting a CCRA directly but used for monitoring a CCRA once it is done.
- **SCAN / IC&B + C40:** The SCAN tool, developed with support from C40 Cities and I Care & Consult Brazil, provides a user-friendly platform to assess climate variables, future urban expansion, and climate threats like floods, heatwaves, landslides, and rising sea levels. It is tailored for Brazilian cities and integrates climate models (like ETA-HadGEM2-ES and ETA-MIROC5), land use change drivers, and urbanisation indicators to generate localised assessments.

Based on these reviews, we decided on a customised Rapid CCRA Tool, leveraging some of the CityCatalyst infrastructure for efficiency in data handling, scalability in future iterations, integration with the GHGI module and climate action selection, and alignment with our core approach. This tool is fundamental based on the C40 Rapid CCRA methodology.

CCRA Datasets Reviewed

We evaluated several climate datasets to identify those most suitable for creating detailed risk profiles:

- **AdaptaBrasil:** A key source for climate hazards like heatwaves, droughts, and floods, with sectoral breakdowns for health, water, energy etc. The dataset and tool was developed by Brazil's Ministry of Science, Technology and Innovation (MCTI).
- **Atlas of Brazilian Disasters:** Offered historical data on climate-induced disasters, such as floods and landslides. The dataset and tool was developed by Brazil's Ministry of Integration and Regional Development (MIDR).
- **AdaptaClima:** Offers valuable data essential for risk assessment such as hazard data (e.g drought), exposure data (e.g., population density), and vulnerability indices (e.g., HDI, GINI Index). The dataset and tool was developed by Brazil's Ministry of the Environment and Climate Change (MMA).
- **MapBiomas:** Provides high-resolution land use and land cover maps, crucial for analyzing environmental hazards, such as soil erosion and deforestation, and their impacts on agriculture and water resources. The dataset and tool was developed by an initiative of SEEG/OC (the Climate Observatory's System for Estimating Greenhouse Gas Emissions) and is produced by a collaborative network of co-creators made up of NGOs, universities and technology companies organized by biomes and cross-cutting themes.
- **Brazilian Institute of Geography and Statistics (IBGE):** Offers comprehensive demographic, economic, and infrastructure data, helping assess population exposure and socio-economic vulnerabilities to climate hazards like droughts and floods.

- **Institute for Applied Economic Research (IPEA):** Provide the Social Vulnerability Index (SVI) derivable from 16 variables grouped into the following three dimensions: i) urban infrastructure, ii) human capital, and iii) income and work. The SVI varies from 0 to 1. This dataset offers important insights into the relative climate risks faced by the population.
- **Brazil's National Institute for Space Research (INPE):** Specialized in satellite and climate monitoring, offers real-time data on droughts, deforestation, and hydrological changes to assess environmental hazards and exposure. INPE developed **PCLIMA**, a tool which provides future projections for temperature and precipitation, essential for long-term risk assessment.
- **Climate Change Knowledge Portal:** Provides global data on historical and future climate, vulnerabilities, and impacts. Explore them via Country and Watershed views. The dataset and tool was developed by the World Bank.

Dataset Selection and Transformation

From the reviewed datasets, AdaptaBrasil was chosen for its national coverage, integration of multiple hazards, sectors, indicators and final risk scoring, for its granularity at the municipal level and API access, making it compatible with the CityCatalyst system. In addition to AdaptaBrasil, the team derived vulnerability and exposure indicators from sources such as IBGE, IPS Brasil, Agencia Nacional de Aguas(ANA), Empresa de Pesquisa Energética (EPE), Google Earth Engine, World Database on Protected Areas (WDPA), DATASUS (Tecnologia da Informação a Serviço do SUS), MapBiomas, Brazilian National System for Water and Sanitation Data (SNIS), Brazil's National Agency for Waterway Transportation (ANTAQ), Institute for Applied Economic Research (IPEA), GloBio (GRIP Global Roads Database. See the hazard, vulnerability and exposure indicators used for each key impact [here](#).

Based on the C40 CCRA Guidance and the AdaptaBrasil data structure, we developed an open data model for CCRA, mapping the datasets to the 'hazard- exposure- vulnerability- risk' framework. This data was integrated into CityCatalyst infrastructure through an API. See documentation for CCRA Data model and pipelines in Figures 9 and 10..

4.2.2. Developing City-Specific Climate Risk Profiles

The development of city-specific climate risk profiles follows a custom methodology that assesses hazards, exposure, and vulnerabilities across multiple key impacts or sectors. The CityCatalyst platform data infrastructure facilitates this process using the following methodology:

- **Key Impacts:** Focuses on key impacts or sectors that are relevant to each city. Examples of these key impacts are food security, water resources, energy security, biodiversity, infrastructure, public health etc.
- **Hazards:** Natural or human-induced events or phenomena that pose potential harm to people, property, ecosystems, or economic activities. Examples of hazards that are relevant to a city include drought, floods, heatwaves, sea level rise, diseases, landslides, wildfires etc. Hazard indicators can be found in datasets such as AdaptaBrasil.
- **Vulnerability:** The degree to which a system, community, or individual is susceptible to and unable to cope with the adverse impacts of hazards. It is influenced by multiple factors, including physical, social, economic, and environmental conditions. Vulnerability determines how severe the impact of a hazard will be on a particular system or population. Vulnerability indicators such as income, age and poverty data can be found in datasets such as the IBGE, IPEA and IPS Brasil.
- **Exposure:** The presence of people, assets, infrastructure, ecosystems, or economic activities in areas where they may be adversely affected by climate-related hazards. Exposure indicators such as population density and agricultural areas can be found in datasets such as IBGE, WDPA and IPS Brasil.
- **Risk Calculation:** Calculates risk by combining hazard, exposure and vulnerability assessments for each key impact or sector (e.g., risk of floods on food security, risk of drought on water resources, risk of heatwaves on public health) to highlight areas of high priority.
- **Qualitative Analysis:** After the risk of each hazard on key impacts are calculated for a city, a questionnaire will be provided within the CCRA tool to assess how resilient a city is to adapt to the effects of climate change. These questions will be based on [The Disaster Resilience Scorecard for Cities](#), a platform developed by the United Nations Office for Disaster Risk Reduction (UNDRR) with the support of USAID, European Commission, IBM, AECOM and other partners and cities participating in the Making Cities Resilient Campaign 2010-2020. The Scorecard provides a set of assessments that allow local governments to assess their disaster resilience, structuring around UNDRR's Ten Essentials for Making Cities Resilient.

Cities will be asked 5 general questions on their climate resilience and the result of this would be used to adjust the vulnerability score, hence the risk score of each hazard and key impact. [Here](#) is a detailed explanation on how this qualitative indicator will be applied.

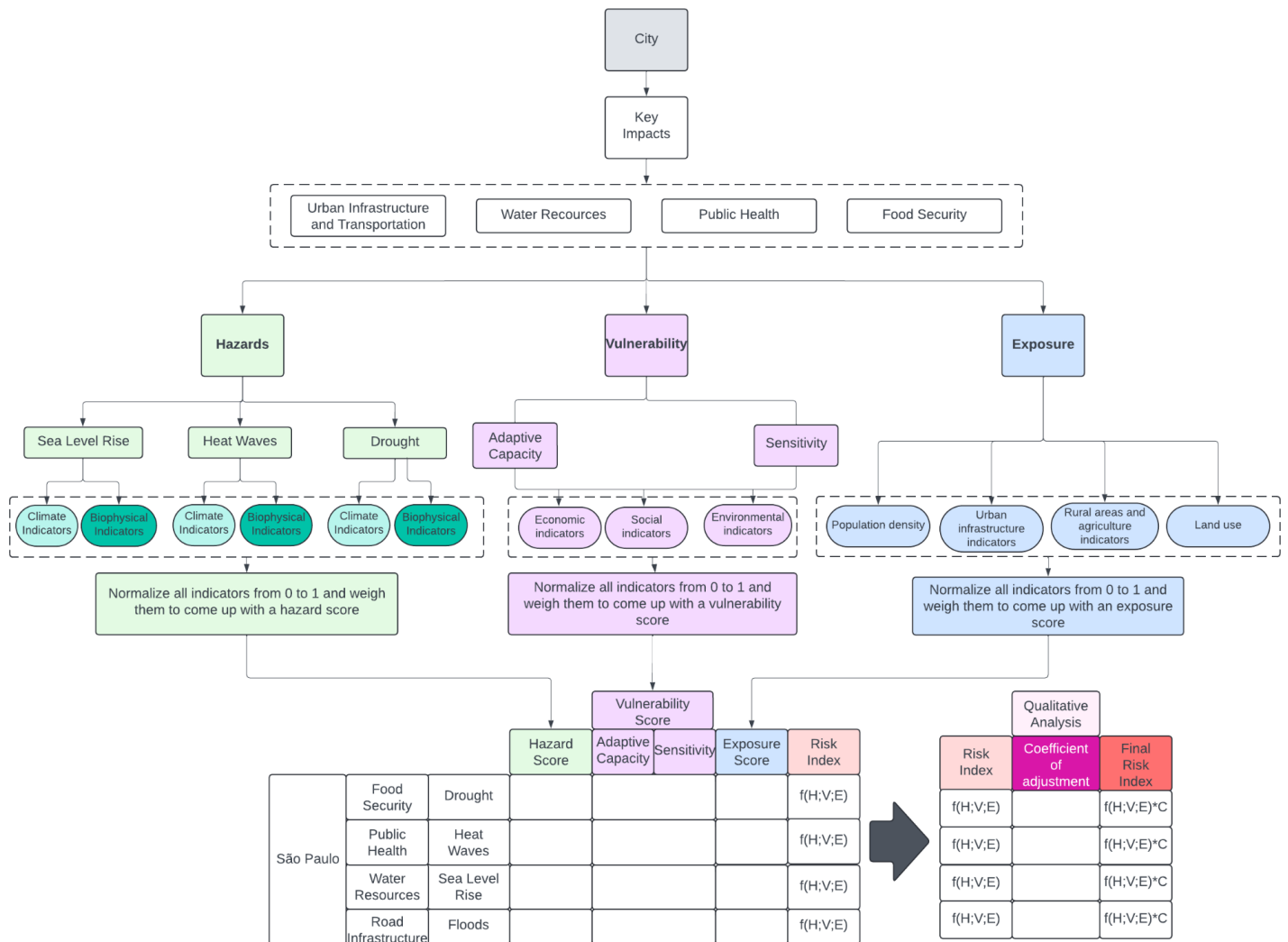


Fig 9. Structure of the Climate Risk Assessment process flow for the project

Risk Score Calculation Methodology

Risk is calculated by the following formula

$$Risk_{sector,hazard} = Hazard_{sector,hazard} \times Exposure_{sector,hazard} \times Vulnerability_{sector,hazard}$$

Each component Hazard, Exposure, and Vulnerability is represented by indicators that have an expected relationship with the component. Indicators are initially on different scales, so they are normalised between 0.01 and 0.99.

Normalisation Methodology

1. **Identify Outliers:** Adjust scores using the 0.05 to 0.95 percentile range to ensure they fall within lower (LB) and upper bounds (UB).

$$X_{adj} = \{LB \text{ if } X < LB, X \text{ if } LB \leq X \leq UB, UB \text{ if } X > UB\}$$

2. **MinMax Scaling:** Scale scores to range from 0 to 1.

$$X_{scaled} = \frac{X - X_{min}}{X_{max} - X_{min}}$$

3. **Rescaling for Extreme Values:** Adjust scores to avoid extremes of 0 or 1, using:

$$X_{rescaled} = \frac{x_{scaled} \cdot (1 - \varepsilon) + \frac{\varepsilon}{2}}{1 - \varepsilon}$$

where $\varepsilon = 0.01$

With indicators normalised, component values for Risk, Exposure and Vulnerability are calculated as the equally weighted sum (average) of the normalised indicator scores, using:

$$Component = \frac{1}{n} \times (i_1 + i_2 + \dots + i_n)$$

Note: If the indicator has a negative relationship with the component, adjust the indicator by using the value $(1 - i)$

Since the risk is calculated by multiplying these three values, which are each less than 1, we need to apply the normalisation process for the risk scores across each sectors and hazard to maintain a scale from 0.01 to 0.99.

Resilience Score Calculation Methodology

The resilience score is calculated from a qualitative assessment questionnaire that produces a percentage score. For instance, a score of 0.5 indicates that some strategies are in place for the event of the hazard. This score influences the overall risk by impacting the vulnerability indicator.

According to the questionnaire design, low resilience scores (below 0.5) are expected to increase vulnerability, while high resilience scores (above 0.5) should decrease vulnerability.

The adjusted vulnerability is computed using the formula:

$$AdjustedVulnerability = Vulnerability + Vulnerability \times (0.5 - ResilienceScore)$$

Risk scores are then recalculated using the adjusted vulnerability and normalised accordingly.

Below is the CityCatalyst Data Model that stores the information

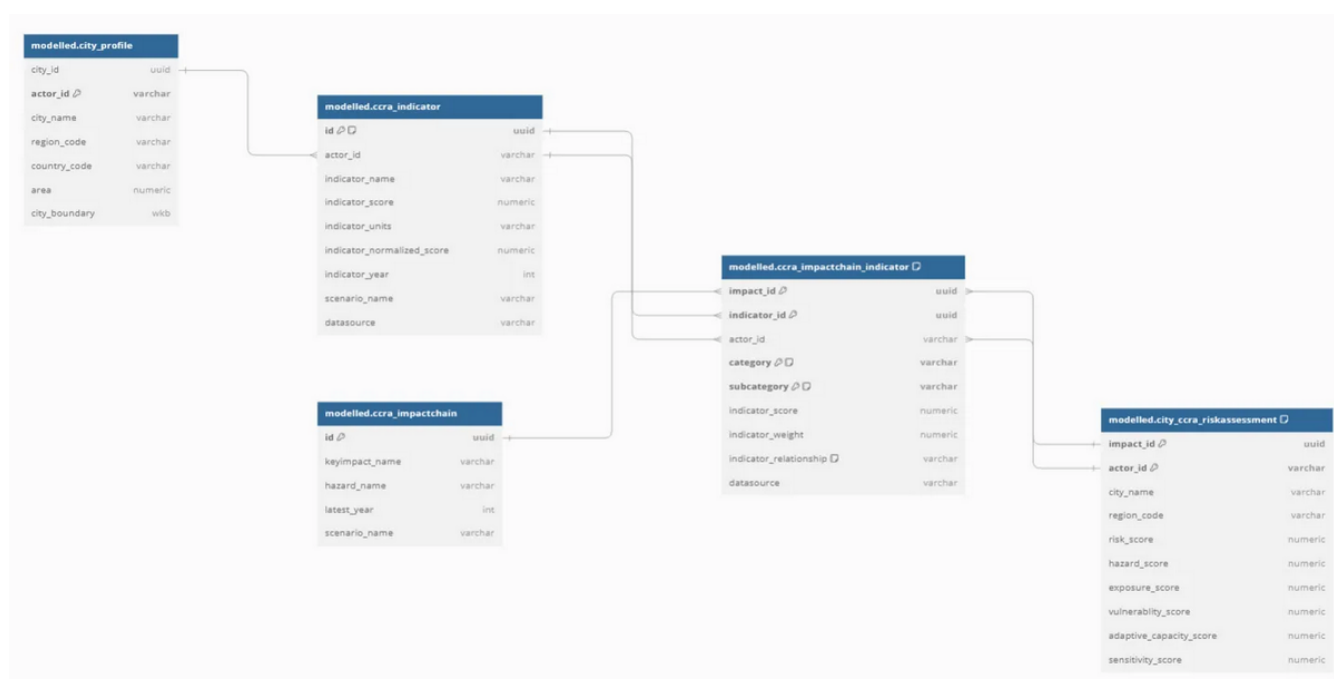


Fig 10. CityCatalyst CCRA relational Data Model

4.2.3. Piloting, rolling out and validating climate risk and hazard profiles

Once climate risk profiles are generated, they are presented to city stakeholders for review. These dashboards are separate from the GHG Inventory system, offering specific tools for exploring climate risk data across sectors.

Public CCRA dashboard for all 50 cities are published in the following link:

<https://citycatalyst-ccra.replit.app/>

Cities are invited to participate in guided workshops where they can access their detailed calculated risk data and assumptions. The platform also facilitates ongoing revisions, allowing cities to refine their profiles based on new data or feedback from community stakeholders. The platform includes a qualitative analysis questionnaire where we ask cities some questions weretrieved from the [Disaster Resilience Scorecard for Cities \(by UNDRR\)](#). A coefficient of adjustment is obtained from these questions which is used to enhance the vulnerability and final risk index/score. Find the resilience score calculation methodology [here](#).

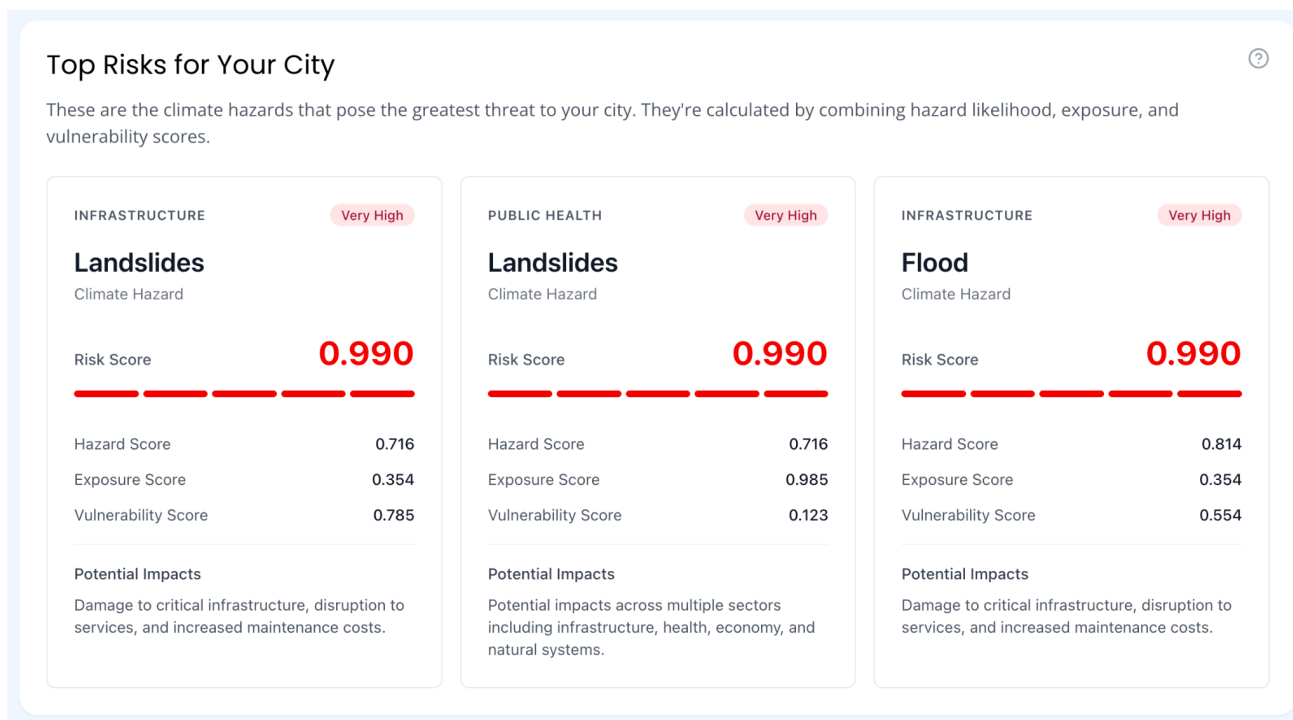


Figure 11. Top 3 Risk Summary presented in the CityCatalyst CCRA Dashboard page

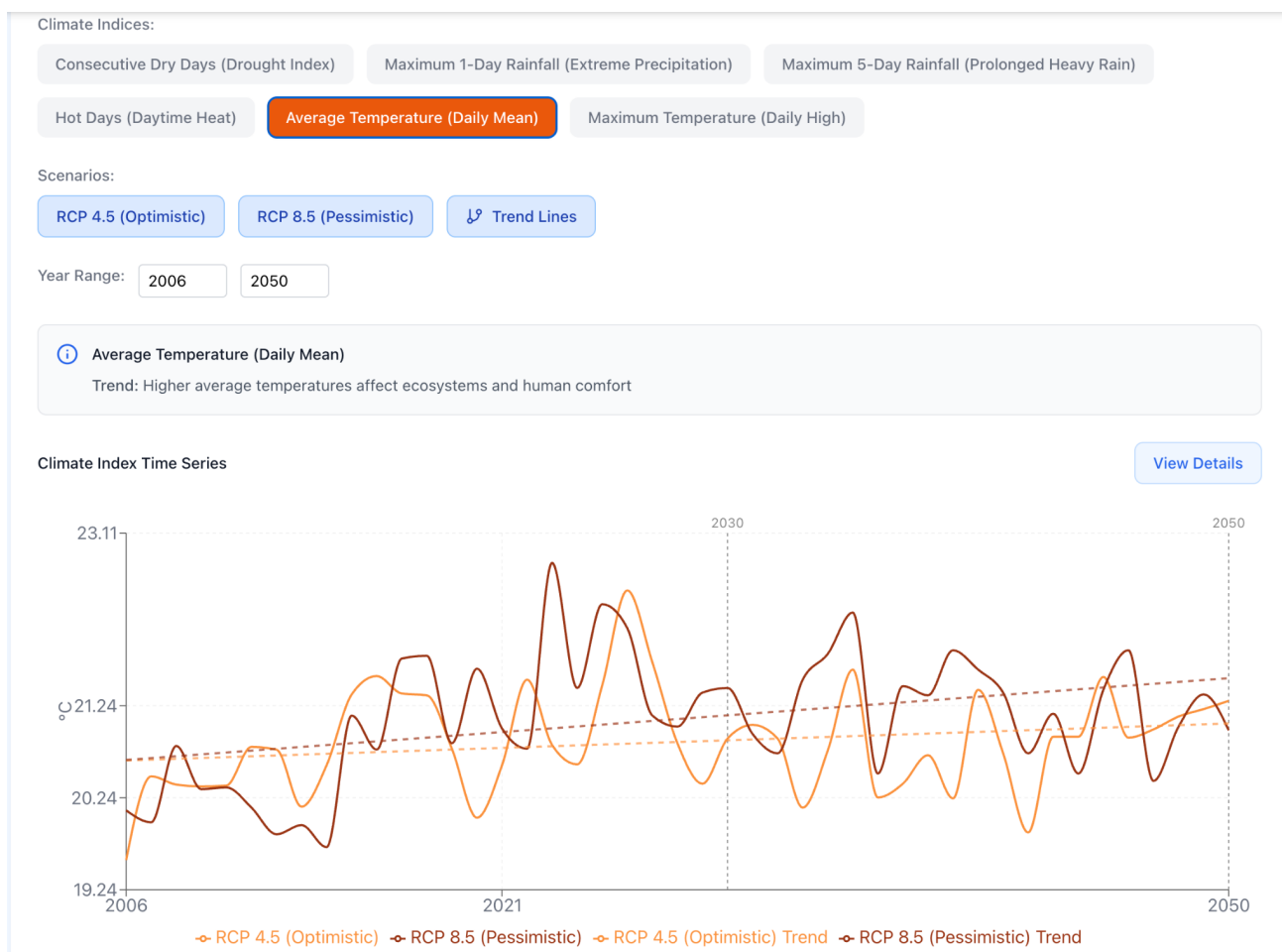


Fig 12. Forecasted time series of climate indices under different climate scenarios, displayed in the CityCatalyst dashboard presented to cities

4.2.4. Engagement with data and tools providers

Engagement with data and tool providers is critical to ensuring that the CCRA methodology remains accurate and relevant to the Brazilian context. Our primary collaborations have been with:

- **AdaptaBrasil:** Worked closely with AdaptaBrasil to validate the climate hazards data used for municipal-level assessments.
- **C40 Adaptation**
- **Experts:** Engaged with C40's technical team to align the rapid CCRA methodology with their broader climate action framework.

Data sources used to retrieve indicators

- AdaptaBrasil: Hazard and vulnerability indicators
- Brazilian Institute of Geography and Statistics (IBGE): Exposure and vulnerability indicators
- IPS Brasil: Vulnerability indicators and exposure indicators
- Agencia Nacional de Aguas (ANA): Vulnerability indicators
- Empresa de Pesquisa Energética (EPE): Exposure indicators
- Google Earth Engine: Vulnerability indicators
- The World Database on Protected Areas (WDPA): Exposure indicators
- DATASUS Tecnologia da Informação a Serviço do SUS: Vulnerability indicators
- MapBiomas: Exposure indicators
- The Brazilian National System for Water and Sanitation Data (SNIS): Vulnerability indicators
- Brazil's national agency for waterway transportation ANTAQ: Exposure indicators
- Institute for Applied Economic Research (IPEA): Vulnerability indicators
- GloBio (GRIP global roads database): Exposure indicators

We aim to establish ongoing feedback loops with these data providers to ensure continuous refinement of datasets and tools. This will include regular updates on how the data is used in city-level risk assessments and suggestions for improving dataset granularity and accuracy for future iterations. Collaborations with providers will help ensure that the tools evolve in line with the growing needs of cities, particularly as climate risks become more acute.

5. IDENTIFYING HIGH IMPACT ACTIONS FOR MAJOR EMISSIONS SOURCES AND PRIORITY CLIMATE RISKS

This section is critical in consolidating the previous assessments of both emissions and climate risks to identify high-impact climate actions. The process integrates city-level emissions data, climate vulnerability assessments, and contextual information on city powers, mandates and alignments to the NDC, creating a mechanism for prioritising actions that yield the most significant mitigation and adaptation benefits. The use of AI within CityCatalyst plays an assistant role by synthesising input knowledge, streamlining the information on the longlist of actions, and planning selection of actions based on both quantitative and qualitative data.

Figure 13 highlights how inputs from GHG inventories, climate risk assessments, and contextual factors are processed through a custom CityCatalyst module to generate a prioritised list of climate actions.

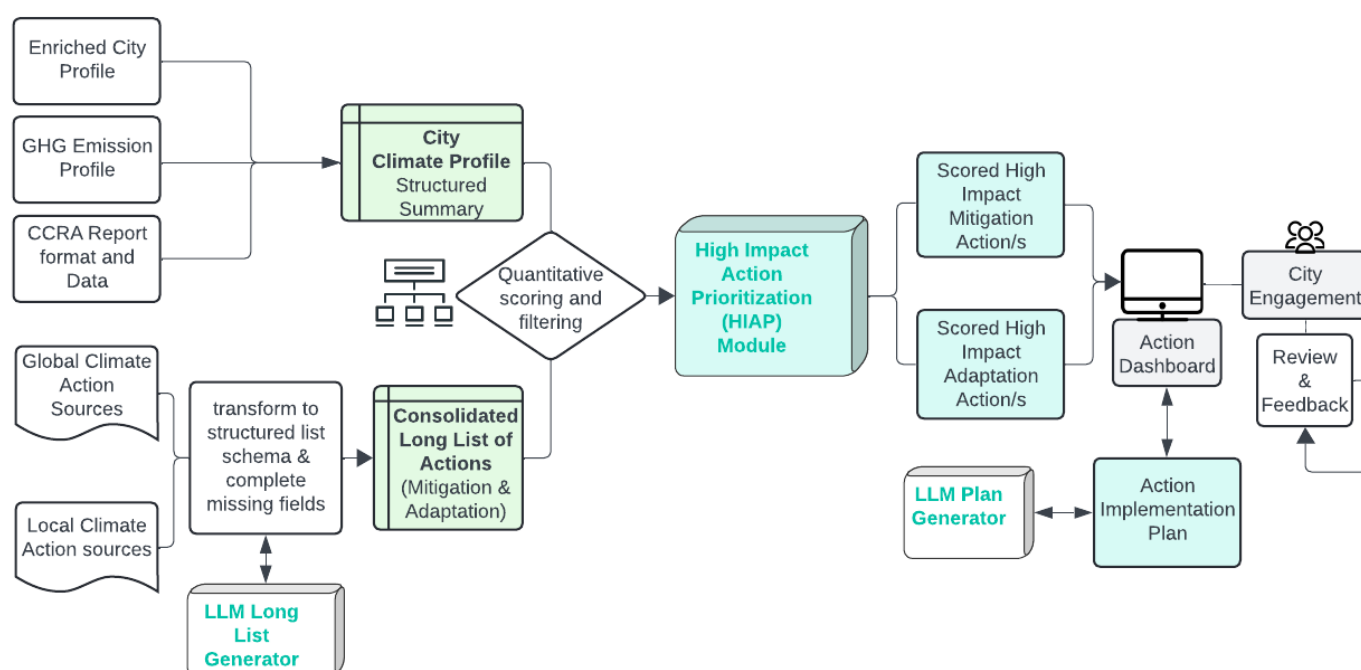


Figure 13. Overall process flow for high impact action selection based on the city's climate profile.

5.1. Process and Methodology Overview

Methodology Review: The selection methodology was initially informed by established tools such as the ASAP (Adaptation Strategy Assessment Protocol) and the C40 Cities Climate Transition Framework. The process was also inspired by reviewing the CAPA tool prototype developed by GCoM. After the initial evaluation, a custom solution was developed leveraging CityCatalyst's backend infrastructure, improving on these existing frameworks by adopting a more quantitative scoring approach, as opposed to a purely

qualitative assessment used in ASAP. This ensures greater objectivity in evaluating potential actions, allowing for data-driven decision-making based on both local and global datasets.

By standardizing data models and integrating AI across all processes, CityCatalyst delivers a scalable and adaptable solution. This system continuously enhances its performance through dynamic feedback loops and regular updates of climate and policy data, ensuring it remains relevant and effective.

Platform Implementation: The implementation process within a web-app is similar to the modular design of the [climate risk assessment \(CCRA\) tool](#). It involves defining a flexible data model, synthesising city-specific emissions and climate risk data already stored in the platform, and setting up software modules to execute the action-scoring approach. This ensures that each city's unique characteristics are fully integrated into the decision-making process.

The platform consolidates data from GHG inventories, climate risk assessments, and city contextual data to generate a comprehensive overview of each city's most pressing sectors and emissions sources.

The actions from the 'Long List' with greatest impact are prioritised by automatically scoring each action based on a predefined criteria and rubric adapted from the C40 ASAP tool utilizing a machine learning model. This rubric was refined in a collaborative workshop between I Care and OEF. Scoring criteria include dimensions like cost, feasibility, GHG reduction potential, and adaptation effectiveness. The machine learning model has been trained on feedback gathered via a self developed tool for validating action-city pairs by experts.

The system then uses AI to further develop an initial high-level implementation plan for each top-rated action, ensuring that decision-makers have detailed, data-driven insights of what implementing the action entails.

This approach aims to streamline the traditionally manual process of action planning, allowing city officials to focus on the highest-priority actions while the platform handles the data synthesis and prioritisation.

Feedback Loop and Continuous Improvement: City officials are encouraged to refine the action plans through interactive feedback loops within the CityCatalyst platform. This enables the platform to update action prioritization in real-time based on local insights, ensuring that the final plan is responsive to the city's unique needs. The collaborative process ensures that AI-driven recommendations are not final but are adaptable based on direct input from local stakeholders.

Scalability and Replicability: The flexibility of the data model, combined with the scalable AI infrastructure, makes the methodology easily replicable across other CHAMP cities. This allows for rapid deployment of climate action plans with minimal customization, ensuring that the process can be scaled effectively while maintaining local relevance.

5.2. Developing a Long lists of action

The long list of actions is the primary source from which both mitigation and adaptation actions are suggested and prioritised for each city. This list is developed by consolidating high-impact actions from multiple trusted databases, including [C40's Climate Action Library](#), IPCC's mitigation options from [IPCC AR6 WG3 2022](#) inspired by the actions mentioned in the [Transition Element Framework](#), IPCC adaptation options from [Climate Change 2022: Impacts, Adaptation and Vulnerability](#) and [I Care's list](#).

5.2.1 Categorization of Actions

Each action in the long list is categorised by sector (e.g., stationary energy, transportation, waste, Industrial processes and product use (IPPU), and agriculture, forestry and other land use (AFOLU)), hazard (droughts, heatwaves, floods, sea level rise, landslides, storms, wildfires, diseases) and type (mitigation or adaptation). This categorization ensures that the most relevant actions for a city's emissions profile and climate risks are considered during the prioritisation phase.

5.2.2 Data Schema for Actions

The action databases vary in the depth of information and the way actions are categorised. To ensure consistency, we first developed a defined data schema that every action must comply with. This schema ensures that all actions have standardized, relevant information, making them easier to evaluate and compare using CityCatalyst's action scoring and AI tools.

For example, actions derived from IPCC's mitigation options—which is focused on mitigation—are assessed for their GHG reduction potential, while those from C40 adaptation frameworks include details on climate resilience. The schema helps CityCatalyst's enrich the dataset by consolidating and normalizing information from different sources into a coherent list with a common ontology.

Below is an example of some key fields in the data schema. For the full schema list and description see ([generic_action_schema](#))

- **Action ID:** A unique identifier assigned to each action. Example: *"action_01"*
- **Sector:** The relevant sector for the action (e.g., Stationary Energy, Waste, Transportation). Example: *"Stationary Energy"*
- **Action Type:** Specifies whether the action is Mitigation or Adaptation. Example: *"Mitigation"*
- **GHG Reduction Potential:** A percentage range representing the potential for reducing GHG emissions. Example: *"20-39%"*
- **Cost:** Considers the cost of implementing the action. The lower the cost of an action, the higher the action scores..
- **Timeline for Implementation:** Assesses how quickly the action can be implemented and delivers results. Shorter-term actions may be prioritized for

immediate impact, while longer-term actions are considered based on their strategic importance.

5.2.3 Data Integration and AI-Enhanced Processing

CityCatalyst's AI infrastructure processes all the information contained in the long list and enriches each action by automatically completing missing or incomplete fields, for example, if an action lacks information for co-benefits or other fields. This ensures that every action in the long list is detailed and consistently structured. This was done using large language models (LLMs) and climate action specific context to fill in the missing fields with plausible and coherent data.

Once the actions are consolidated and enriched, the long list is loaded into CityCatalyst's database. The actions are ready for scoring and prioritisation, allowing the platform to suggest the highest-impact actions based on city-specific data.

5.3. Refining Climate Action Prioritization with Expert Input and a scalable Climate Action Labeling Tool

We developed a web-based Climate Action Labeling Tool to further refine the action scorings through expert perspectives. At the core of this process there is a pairwise comparison mechanism, where experts evaluate two climate actions at a time and determine which is more impactful for a given city.

These comparisons take into account various factors such as GHG reduction potential, adaptation effectiveness, cost, feasibility, and co-benefits for local communities for each action in the scope of a specific city.

A machine learning model then processes these expert inputs to refine and adjust the weighting of each factor in the scoring system. It helps assign relevance scores to actions based on a city's specific characteristics, ensuring that recommendations are tailored to local realities. Over time, as more expert comparisons are made, the model improves, fine-tuning the rankings and making the prioritization framework more accurate.

By linking city parameters, such as emissions profiles and climate risks, with action parameters, like emission reduction potential and adaptation effectiveness, we create a scoring system that is not only evidence-based but also contextualized to city profiles. This approach allows cities to receive recommendations that are both high-impact and locally relevant, supporting more strategic decision-making.

We conducted two workshops with over 15 experts, each one assigned to a specific city, where they participated in a structured scoring process using our Climate Action Labeling Tool. Each expert completed at least 100 pairwise comparisons. These expert evaluations were then aggregated and processed through our machine learning model, which analyzed the patterns in their choices to assign weights and scores to different

criteria. This enabled us to refine the ranking process, ensuring that each action's priority level reflects both expert judgment and city-specific needs, creating a more robust and data-driven framework for climate action planning.

The web-based tool presents an overview of the city being evaluated and two actions side by side. It asks users to determine which is more impactful for the selected city based on key criteria and their relevance. Experts can filter action pairings based on their specific expertise, and add qualitative notes to justify their decisions.

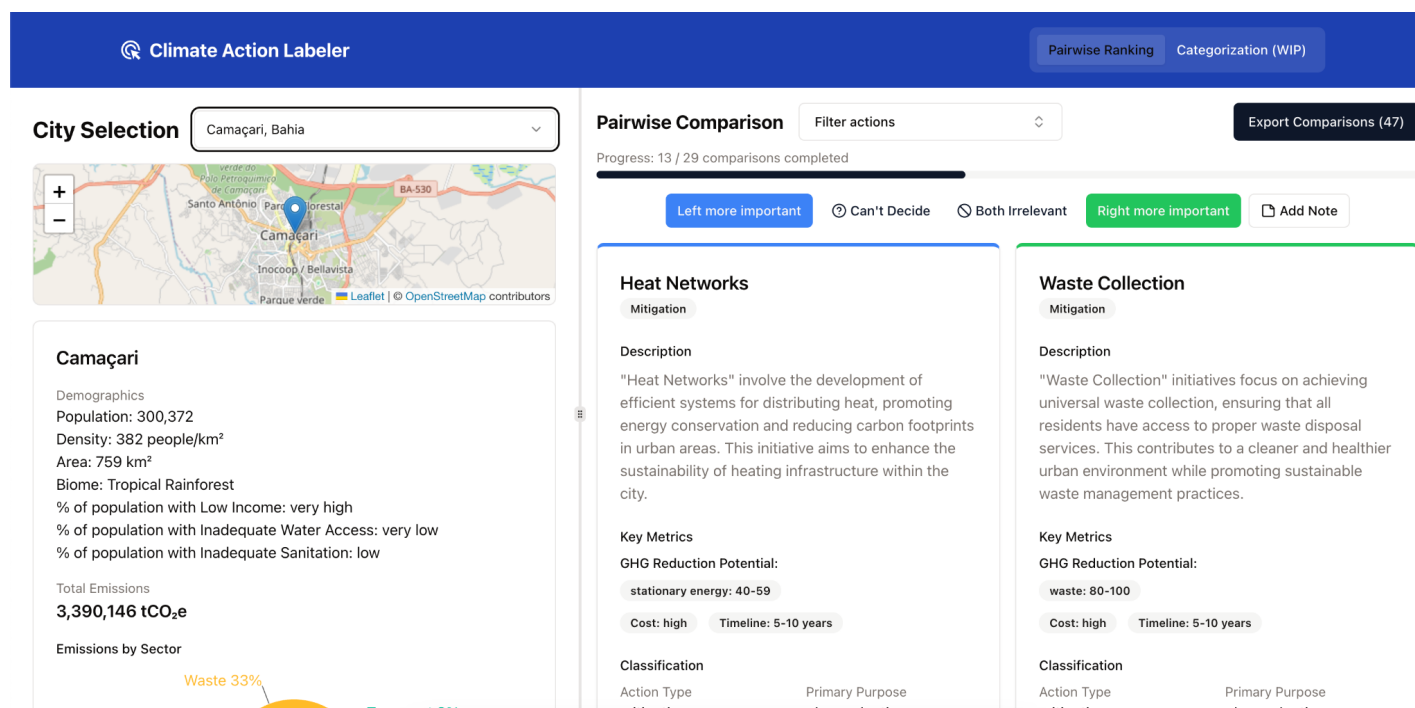


Figure 14. Climate Action Labeler tool built in CityCatalyst for expert-led city specific action prioritization for the HIA ranking

You can visit the tool here: <https://climate-action-labeler.replit.app/>

And [watch a video on how the tool works here >](#)

How Pairwise Ranking is Implemented for HIA Prioritization

The output of the pairwise ranking gives information about which action (action A or action B) is preferred for a given city by an expert. The expert is coming to this decision based on the city profile and the action features.

This information is then used to train a machine learning model (a classifier). The model learns from the decisions of the experts and optimizes an internal parameter set to learn and match the decisions of the experts. After the training process is done, this model can then be used on any two action comparisons for a given city, to select either action A or action B.

Utilizing a “tournament style” mode we can then match all available actions for a city and create a list of most relevant actions.

From a technical viewpoint this process of ranking two actions against each other seems superior over ranking all actions in a leaderboard style. The reason is that the data contains many actions with a higher degree of uncertainty. Saying one action is on a certain rank with dozens or hundreds of other actions is more difficult than having a single comparison of “this action is better than that action”.

5.4. Criteria for Action scoring, selection and prioritisation

The process for selecting and prioritising actions follows a **two-stage approach**, where actions are first filtered based on feasibility and then scored against a detailed rubric to determine their overall impact and priority.

Step 1: Filtering

The first step is to filter the long list of actions to ensure that only relevant and feasible options are considered for prioritisation. This filtering process involves assessing each action against the biome of the city to e.g. remove actions that are only applicable to coastal cities if the city itself has no exposure to the sea.

After this filtering step, only actions that meet these feasibility and alignment criteria advance to the next stage for detailed scoring.

Step 2: Scoring and Prioritization (quantitative)

Once actions pass the initial filtering, they are evaluated using a **scoring rubric** designed to assess each action’s potential impact, cost-effectiveness, and additional benefits. The following criteria are used to score and rank actions:

- **GHG Reduction Potential:** Measures the action’s ability to reduce greenhouse gas emissions. Actions targeting major emissions sources identified in the GHG inventory or reducing more overall emission from a city receive higher scores.
- **Adaptation Effectiveness:** Evaluates how well the action mitigates climate risks identified in the Climate Change Risk Assessment (CCRA). This is especially important for actions focused on adaptation, such as flood defenses or heat-resilient infrastructure.
- **Cost:** Considers the cost of implementing the action. The lower the cost of an action, the higher the action scores..
- **Timeline for Implementation:** Assesses how quickly the action can be implemented and delivers results. Shorter-term actions may be prioritized for immediate impact, while longer-term actions are considered based on their strategic importance.

- **Hazards:** Measures how specific an action targets the identified climate risks (floods, heatwaves, ...). The more hazards of the city are tackled by an action, the higher ranks the action
- **Co-Benefits:** Indicates the additional co-benefits or adverse side effect of an action

Step 4: Ranking and Revision

After each action is scored, it is ranked based on its total score. Only the top actions per category of mitigation and adaptation actions are being further considered. This ensures that only high-impact, feasible actions are included in the final climate action suggestions.

The top-ranking actions are then prepared for further development into detailed implementation plans, while lower-scoring actions may either be re-evaluated in future planning cycles or refined based on city-specific feedback. The whole process is reviewed by the team's climate action and Brazil context experts to ensure it aligns with current knowledge.

5.5 Outlining Initial Implications and Considerations for the Prioritised Actions

Once a city is provided with a list of high-impact mitigation and adaptation actions, we utilize our **Climate Action Implementation Plan Creator** to develop a structured and actionable implementation plan. This tool assists city officials in effectively translating climate actions into concrete steps for execution.

To ensure city officials gain a comprehensive understanding of what each action entails, the implementation plan automatically includes the following key elements:

- **Description:** Provides an overview of the city's context, how the proposed climate action aligns with local priorities, and its connection to Brazil's broader climate strategy.
- **Subactions:** Outlines the specific steps required to successfully implement the climate action.
- **Involved Municipal Institutions:** Identifies key municipal agencies responsible for executing and supporting the action.
- **Goals:** Defines the objectives that the action aims to achieve.
- **Monitoring, Evaluation, and Reporting (MER) Indicators:** Lists key performance indicators to track progress and measure success.
- **Climate Risks:** Identifies the climate risks that the action mitigates.
- **Mitigation Sectors:** Specifies which mitigation sectors are impacted by the action.
- **Relationship with SDGs:** Highlights the SDGs that the action supports.

To enhance the relevance and accuracy of these implementation plans, our AI integrates data from a wide range of authoritative [sources and documents](#). Currently, we have incorporated nearly 100 documents, including Brazil's Nationally Determined Contribution (NDC) Plan, city-specific climate action plans, and single case studies for individual actions.

Our AI-driven tool analyzes and extracts precise, actionable insights from these sources, ensuring that each climate action implementation plan is tailored to the specific needs of the city. This approach provides city officials with data-driven, context-specific guidance for implementing effective climate adaptation and mitigation strategies.

5.6. Piloting and City Engagement for validation the high impact mitigation and adaptation actions

The validation of prioritised actions is a collaborative process, drawing on feedback from city officials and stakeholders. This process mirrors the engagement strategy used in the GHG inventory and CCRA phases, ensuring that actions are locally relevant, feasible, and supported by the community.

Dashboard Review: Using the CityCatalyst backend and data infrastructure, we provide a static visual dashboard where city officials can review the top 20 prioritised actions per category. The city officials receive:

- **Data Visualization:** Key data that informed the selection of each action, including GHG reduction potential, adaptation effectiveness, and cost estimates, is visualised in an easily interpretable format.
- **Editable Files:** These files allow officials to review and provide feedback or challenge the assumptions and data used in prioritising actions. This flexibility ensures that the final plan reflects local conditions and preferences.

These are the top 40 actions we recommend based on your GHG inventory, Climate Risk Assessment, and City Context data. You will find 20 actions for Mitigation and 20 for Adaptation in their respective tabs.

▸ Mitigation  Adaptation

Top mitigation climate actions

 GENERATE PLANS

 VIEW IMPLEMENTATION PLANS

Here are your top climate actions –initially prioritized by our experts. Reorder the table below to see new priorities in this section. You can generate a complete implementation plan for your top 3 actions at any time.

#1

■ EXPERT'S CHOICE

Vehicle Emissions

"Vehicle Emissions" reduction strategies focus on minimizing the environmental...

Reduction Potential 80-100

Sector Transportation

Estimated cost Medium

Implementation time <5 years

[See more details](#)

#2

■ EXPERT'S CHOICE

Implementation of urban toll.

Establishment of a congestion charge and/or license plate rotation for light...

Reduction Potential 80-100

Sector Transportation

Estimated cost Low

Implementation time <5 years

[See more details](#)

#3

■ EXPERT'S CHOICE

Incentive to create bike-sharing programs in urban areas, with a focus on electric bikes.

This action encourages the establishment of bike-sharing systems in cities, specificall...

Reduction Potential 60-79

Sector Transportation

Estimated cost Medium

Implementation time <5 years

[See more details](#)

Figure 15. Top actions ranked by the CityCatalyst HIAP tool, showing the top 3 Mitigation actions

Climate Actions Ranking

Apply your local expertise to customize action priorities. Reorder based on your city's specific needs, feasibility, and potential impacts. You can also download the complete table to share with stakeholders.

 MODIFY RANKING

 DOWNLOAD ▾

Ranking	Action Name	Hazards covered	Effectiveness	
#1	■ Relocation and Environmental Restoration in Vulnerable Areas	2 Hazards		⌵
#2	■ Implementation of urban gardens	3 Hazards		⌵
#3	■ Strengthen programs for control and conservation of protected areas	4 Hazards		⌵
#4	Establish a Plan for Preparation and Emergency Response Measures in the event of extreme weather events	8 Hazards		⌵
#5	Encourage sustainable land use practices	5 Hazards		⌵
#6	Implement permeable pavements and increase green areas in roadways	3 Hazards		⌵
#7	Maintenance and Revitalization of Riparian Forests	4 Hazards		⌵
#8	Hydrological Monitoring System with Telemetry Stations	3 Hazards		⌵
#9	Develop diagnostics and restore areas of Special Social Interest Zones (ZEIS)	5 Hazards		⌵
#10	Food storage/distribution improvements	4 Hazards		⌵
#11	Strengthen the healthcare network to attend to climate victims	6 Hazards		⌵

Figure 16. The top 20 actions are also ranked and displayed by the CityCatalyst tool, allowing City Officials to modify the ranking, and comment on preferences during the workshops.

Workshops for Expert Engagement: Facilitated workshops are organised to engage city officials, community leaders, and experts. These workshops are designed to:

- **Explain the Suggested Actions:** Experts walk participants through the rationale behind the prioritised actions and the data used for scoring.
- **Gather Feedback:** Cities provide input on the feasibility and appropriateness of each action, ensuring that it fits with local needs and capacities.
- **Refinement of Actions:** Based on the feedback gathered in the workshops, actions can be further refined or adjusted to improve alignment with city priorities.

Revised Action Plan: After the workshops and dashboard reviews, the action plan is updated to incorporate city feedback. This revised plan is then prepared for final approval and implementation, ensuring that it reflects the unique context of the city while maintaining alignment with broader climate goals.

This iterative process guarantees that the action plan is locally relevant, technically feasible, and enjoys broad support from key stakeholders, significantly increasing the likelihood of successful implementation.

Engagement with the Brazilian Cities

The engagement with the pilot cities is structured around four key meetings, with a strong focus on collective discussions and the application of tailored forms to guide and facilitate the process.

- **First Contact:** between C40 and pilot cities, GCoM and OEF/ICB&B form with basic information (contact points, actual position, experience...). **Commitment letter**
- **First workshop: Introduction and City Presentations (All Together)**
The initial meeting will serve as an **introduction to the project and deliverables**, where cities will present their context, focusing on their climate-related challenges, actions, institutional structures (e.g., secretariats, forums, committees, working groups), allocated budgets. A presentation template will be sent to the cities so that they can fill it in and present it at this meeting. This presentation should take between 5 and 10 minutes and will allow the level of maturity of each city to be assessed. The objective is to gather a comprehensive understanding of each city's context, setting the foundation for further collaboration. This will be complemented by the completion of a tailored form, which will include a maturity assessment questionnaire to collect specific data. **+C40**
- **Check-point:** Maybe, let's check cities availability (we might have problems with holidays)
- **Profile Presentation and Feedback (Individual)**
Prior to the meeting, another tailored form will be sent, with a small list of actions, previously selected by the team based on the information from the first meeting and the result of the profiles. The cities will rank those actions. By doing that, cities will assist in defining the criteria for filtering high-impact actions, ensuring that the actions selected are aligned with the local and institutional context. Then, in

the second meeting, the emissions and risk profiles will be presented to all participating cities, allowing for cross-comparison and peer feedback. Also, the HIA selected for the cities will be discussed. The focus will be on refining the understanding of city priorities and climate actions.

- **Session for understanding the platform better?**

- **Second workshop: Developing a Finance Plan (All Together)**

This meeting will have a joint part and an individual part. The process/dynamics to be carried out will be explained jointly, but then the cities will be divided into breakrooms so that they can work individually. Hence, this session will involve smaller, focused breakout groups where cities will work collaboratively to develop financial plans that support the implementation of the identified HIA. These financial plans will outline potential funding sources, resource allocation, and strategies for securing necessary support to carry out the selected actions. In each breakroom, each city will receive guidance tailored to their specific contexts. Cities will then share their insights at the end of the session, when all cities will be put together again.

- **Third workshop: Presentation of Results (All Together)**

In the final meeting, all cities will come together to present the results of their piloting efforts, including their prioritized actions and corresponding financial plans. This will serve as a validation of the methodology, allowing for final feedback and adjustments to ensure that the actions are feasible, impactful, and scalable across other CHAMP countries.

For the cohort, the same method will be applied, but with less emphasis on gathering extensive feedback compared to the pilot session, as the methodology will have already undergone revisions based on previous input.

6. FROM PRIORISATION TO IMPLEMENTATION: CONNECTING ACTIONS WITH FINANCE & DEVELOPING MONITORING & EVALUATION PROCESSES

General Approach to Finance Matching and MER

6.1. Overview of Climate Finance Options for High Impact Actions

Available Finance Mechanisms:

- **Public Finance:** National, regional and municipal funds, climate-specific public grants, such as the Green Climate Fund or municipal green bonds.
- **Private Finance:** Investment opportunities from private-sector stakeholders, venture capital for climate tech, and impact investing.
- **Blended Finance:** Combining public and private funds to reduce risk for private investors while increasing project viability.

- **International Climate Funds:** Highlighting global finance mechanisms such as the Clean Development Mechanism (CDM), Global Environment Facility (GEF), and more.
- **Own resources:** use of internal capital from government revenue.

6.1.1. Matching Actions with Available Funding

Once the mitigation and adaptation actions have been selected, the next step concerns the feasibility of projects that promote them, through financing. The actions will then be connected to available financial instruments.

Assessing the municipality's financial characteristics, needs and scalability of each action to determine appropriate funding types.

There are different types of financial solutions for climate projects, which meet the most diverse profiles. In the case of municipal projects, it is possible to use own resources, public or private funding, blended finance or even donations. Thus, to select the best possible solution, it is essential to know the characteristics of the municipality and the project, which are: size, debt capacity¹, amount necessary to fund the action/project and implementation deadline, among others.

For example, in the case of small projects, it is possible to carry out actions with the city's own resources, if an annual budget is provided for climate actions, which is the case of cities that have Climate Action Plans. In the case of large projects, it is possible to resort to direct financing with multilateral institutions. However, the criteria tend to be rigorous, and projects must have high technical quality. In other words, the selection of the financial instrument and its managing institution is directly linked to the characteristics of the municipality, the action and the project.

Thus, the solution suggested by this methodology is the presentation of financing options available from a previously carried out mapping, which shall be frequently updated as new financial instruments and solutions emerge in the market.

The dynamics work as follows: key information about the municipality, action and project must be captured, and this information will be cross-referenced with a database containing various types of financial solutions available in the market. This can be done by filling out a form or checklist, to be developed by the consultancy.

Table X: example of form

¹ CAPAG: in Brazil, CAPAG (Payment Capacity) determines the fiscal situation of subnational entities that wish to take out loans guaranteed by the Union. Learn more at: <https://www.tesourotransparente.gov.br/temas/estados-e-municipios/capacidade-de-pagamento-capag>

Municipality: _____	State: _____
Number of inhabitants: _____	CAPAG: ____
Amount required: _____	
Period of implementation (years): _____	
Is there a Climate Action Plan?	Yes No

Matching actions to specific climate funds.

- Although the specific characteristics of projects are the main factor that defines the ideal financial instrument for financing, it is possible to indicate types of solutions, depending on the action. For example, GHG reduction initiatives may qualify for support from the Green Climate Fund, while infrastructure-related adaptation projects may attract blended finance.

6.2. Developing High Level Implementation Plans for the Prioritised Actions

For each of the top-rated mitigation and adaptation actions identified during the scoring and prioritisation phase, an initial Implementation Plan is developed. This plan outlines the path from action selection to practical execution, ensuring that the city is aware of the implications to implement the actions. The Action Plan covers three main components: Implementation Steps, Finance Requirements, Timeline, the Selected Finance Options and Ownership & Accountability. The Action plan is produced through Generative AI, using the source knowledge from the action and the C40 climate action planning guidelines.

Implementation Steps: Outlines the specific steps needed to bring each prioritised action to execution. The steps include:

- **Detailed Action Breakdown:** A clear, step-by-step guide that translates the high-level strategy into practical tasks. This includes setting interim goals, defining timelines, and identifying the necessary resources (e.g., technical, legal, and human resources).
- **Project Milestones:** Key milestones that will mark progress, from initial development to final implementation, ensuring the action stays on track.
- **Risk Management:** Identification of potential risks and contingency plans to mitigate delays or challenges that may arise during the implementation phase.

Finance Requirements: The Action Plan identifies the initial financial considerations needed to cover implementation costs. This includes detailing public, private, and blended finance approaches to consider. For example, actions may be funded through municipal budgets, climate finance initiatives (e.g., Green Climate Fund), through public-private partnerships (PPPs), or exclusively by the private sector with assistance of tax incentives. This section of the Action Plan will integrate with the broader Finance Plan, where more detailed suggestions are provided on accessing specific funding sources (refer to **Section 6.1** for Finance Plan details).

Ownership and Accountability: Successful implementation of climate actions requires clear ownership and accountability structures. The Action Plan identifies:

- **Responsible Entities:** Clearly defines which stakeholders (e.g., city planning departments, municipal offices, or private sector partners) are responsible for executing the action.
- **Role of Community or Private Sector:** Highlights the role that the private sector, civil society, or community groups may play in implementing or co-funding the action.
- **Key Performance Indicators (KPIs):** Specific KPIs are developed to monitor progress and performance. These metrics help track the effectiveness of the action over time (e.g., reduction in GHG emissions, number of jobs created, improvements in air quality).

Each Action Plan also incorporates potential **co-benefits**, such as public health improvements, job creation, or economic resilience, ensuring that actions contribute positively across multiple domains.

6.3. Monitoring, Evaluation & Reporting of HIAs, Climate Progress & CHAMP Alignment

6.3.1. Monitoring Systems for City-Level Implementation

Overview of digital tools and platforms like CityCatalyst for real-time tracking of action progress. Empower cities to renew the assessments every year. Integrations with CDP-ICLEI track, and other reporting formats.

6.3.2. Key Performance Indicators (KPIs)

Defining KPIs for Effective Monitoring:

- GHG emissions reductions: Tons of CO₂ equivalent reduced per year.
- Adaptation progress: Percentage reduction in climate vulnerability (e.g., heatwaves, flooding).

- Economic and social benefits: Job creation, cost savings, public health improvements.
- Timeline KPIs: Milestone-based metrics to ensure timely implementation (e.g., percentage of project completed by specific dates).

6.3.3. Reporting Systems and Feedback Loops

Reporting for Governance and Stakeholders:

- Use of digital to generate automated reports for internal governance and public transparency.
- Creation of a feedback loop with city officials, enabling the adjustment of plans based on real-time data and input from local communities.
- Strategies for involving external stakeholders (e.g., investors, civil society, international organizations) in the reporting process.

6.4. Brazil Specific Approach to Finance Matching and MER

[To Add after being developed]

7. LOOKING AHEAD: SUSTAINING AND EXPANDING IMPACT

7.1. Continuous improvement and feedback loops

Learning from Pilots to Inform Future Phases:

- Capturing lessons learned from the initial pilot cities to refine future action plans and improve processes.
- Establishing an ongoing feedback loop where cities can report challenges and adjustments, allowing for continuous platform improvements.
- Periodic updates to the CityCatalyst data model based on feedback and new data from pilot cities.

7.2. Methodology Improvements and Scope Enhancement for Future Versions

7.2.1. Emissions and Climate Risk Assessments Improvements

CCRA improvements

From the perspective to improve and adapt the tools to reach a

- **Expanded Hazard and Sector Coverage:** More climate hazards and sectors (such as coastal flooding or agricultural impacts, eg. from MapBiomas) could be integrated to improve the scope of the CCRA.
- **Dedicated Asset-Based Impact Module:** A future enhancement would be the development of a module that estimates infrastructure damage and economic losses based on projected climate risks, providing cities with direct economic impact insights.
- **Dynamic inputs from users:** Integrate the CCRA module fully in the CityCatalyst experience, where users can edit their preliminary risk profiles as well as upload data or further context.

7.2.2. High Impact Action Prioritization and high-level plans Improvements

As CityCatalyst and the climate action planning methodology evolve, several areas have been identified for future improvement and refinement. These enhancements will help cities better manage their climate risks and opportunities, and ensure that the platform continues to deliver high-quality, actionable insights.

- **Integration with the Full CityCatalyst User Experience:** Currently, CityCatalyst provides a simplified dashboard for city engagement. Future versions will expand this functionality, offering a fully interactive user interface with dynamic data exploration tools, allowing cities to run their own analyses, simulate action impacts, and receive real-time updates on performance metrics.
- **Expansion of Action Sources:** Future iterations will aim to incorporate additional sources of climate actions, such as emerging global best practices, sector-specific innovations, and city-specific knowledge bases. This expansion will ensure that the long list of actions remains up-to-date and reflective of the latest research in climate mitigation and adaptation.
- **Integration of Activity Data Tracking:** Building on ClimateView's Transition Element Framework (TEF), future improvements can introduce the ability to track activity data for key mitigation actions. By integrating this data, cities can monitor progress on actions related to energy consumption, transport, and waste management, providing more granular insights into action effectiveness.
- **AI-Driven Enhancements:** As AI technology advances, CityCatalyst will further develop its AI-driven capabilities. This includes more sophisticated predictive modelling for climate impacts, improved action scoring algorithms, and integration with machine learning models that adapt based on city-specific outcomes. This will provide cities with increasingly accurate and actionable recommendations as they implement their climate action plans.

7.2.3. Improvements in City Engagement and Multi-Level Coordinations

[To Add]

7.3. Further strategies to expand beyond the project scope to other cities and countries

Expanding to Other Cities and Countries:

- Developing a roadmap for scaling the methodology to other CHAMP countries.
- Identifying key success factors for replication in different national and regional contexts.
- Leveraging partnerships with organizations like C40 and ICLEI to support knowledge sharing and best practices across cities.
- Highlighting how CityCatalyst's flexible data model can be adapted to different regulatory environments and data availability levels.
- Economies of Scale when replicating across 74 countries
- Ability to create a CHAMP Fund model to support replication and action finance