



## **Urban climate change governance and hot and arid zones: mutual learning and partnerships to build sustainable resilience solutions**

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Climate Governance Commission

# **Urban climate change governance and hot and arid zones: mutual learning and partnerships to build sustainable resilience solutions - Insights Report**

November 2023

Prepared by Prof. David Simon

## **About Earthna**

Earthna Center for a Sustainable Future (Earthna) is a non-profit policy, research, and advocacy organization, established by Qatar Foundation to promote and enable a coordinated approach to environmental, social, and economic sustainability and prosperity.

Earthna is a facilitator of sustainability efforts and action in Qatar and other hot and arid countries, focusing on sustainability frameworks, circular economies, energy transition, climate change, biodiversity and ecosystems, cities and the built environment, and education, ethics, and faith. By bringing together technical experts, academia, government and non-government organizations, businesses and civil society, Earthna fosters collaboration, innovation, and positive change.

Using their home – Education City – as a testbed, Earthna develops and trials sustainable solutions and evidence-based policies for Qatar and hot and arid regions. The organization is committed to combining modern thinking with traditional knowledge, contributing to the well-being of society by creating a legacy of sustainability within a thriving natural environment.

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# Key Insights

Cities are increasingly perceived as being both more vulnerable to and a key part of the solution to the challenges of climate change, unsustainability and inadequate resilience. However, current city-making policies and methods are not explicitly designed to meet these challenges in a progressively diverse set of contexts. Hot and arid cities face compounded challenges due to the increasingly extreme nature of their environment and the carbon-intense nature of the conventional technologies required to enable cooling solutions, water, and food provision.

Nevertheless, cities are also crucial to developing solutions to these challenges, but cities acting alone are generally less effective than working through knowledge and expertise-sharing processes and networks. Different models exist for achieving such objectives at different geographical, socio-cultural and politico-economic scales, as will be highlighted in this Brief.

Given the added stresses faced by hot and arid/semi-arid cities from climate change, a focus on hot and arid cities, which are often overlooked or underrepresented in existing global urban climate governance initiatives and membership organizations<sup>ii</sup>, could fill a significant gap and make a valuable contribution by meeting more ambitious emissions reduction targets towards achieving net zero in these challenging climatic zones. Climate and broader environmental change can greatly increase displacement, homelessness, hunger, inequality, poverty, thirst, and overall vulnerability among urban populations in conflict zones within hot and arid or semi-arid regions, as exemplified in recent years in Aleppo, Basra, Gaziantep, Mogadishu and Sana'a.

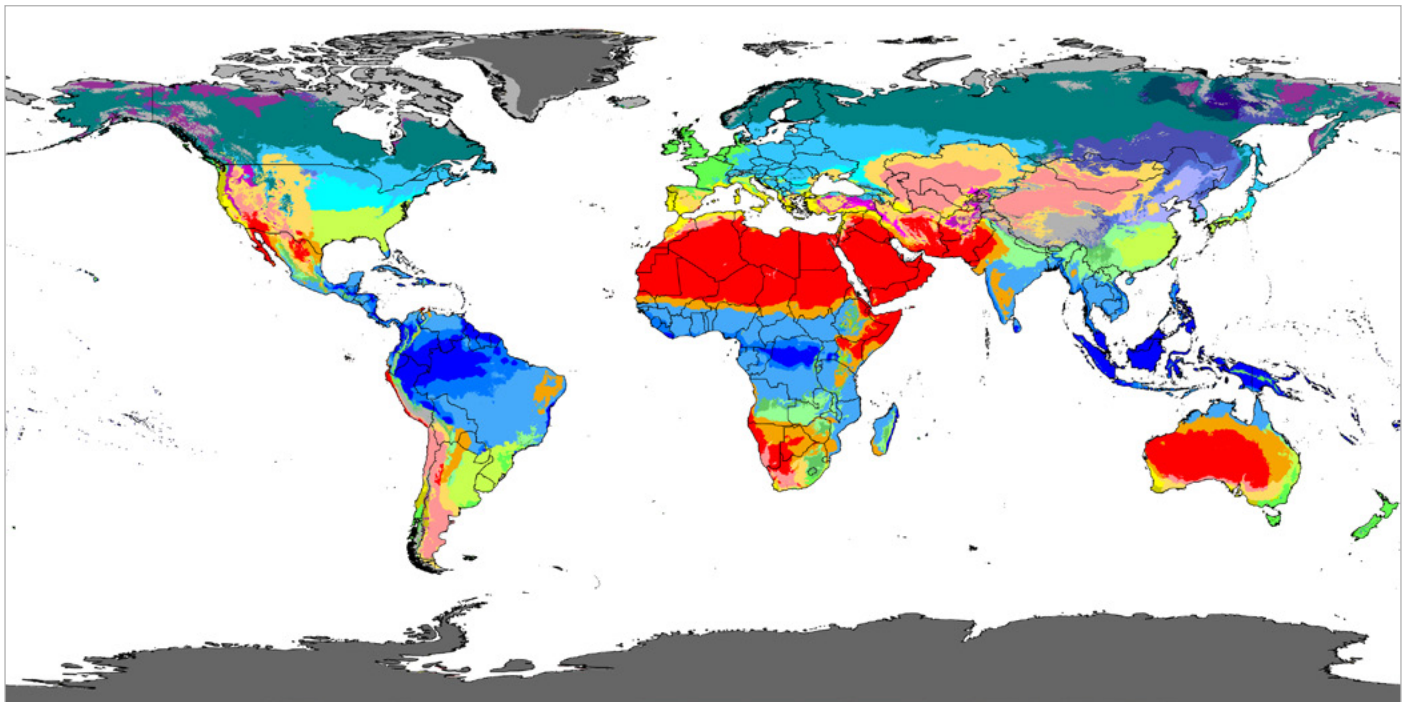
**This Policy Brief proposes that the Climate Governance Commission\* and Earthna Centre explore the development of mechanisms for city-level partnerships to accelerate the delivery of sustainable and resilient solutions at the regional and/or global scales.**

\* The Climate Governance Commission aims to fill a crucial gap in confronting the global climate emergency by developing, proposing and building partnerships that promote feasible, high impact global governance solutions for urgent and effective climate action to limit global temperature rise to 1.5°C or less. Worldwide greenhouse gas emissions need to be halved by 2030 and then halved again every decade to fall to zero by 2050, following the "Carbon Law". Among other partners, the Global Challenges Foundation has been one of several behind the initiative and the Commission is actively collaborating with partners such as the Stimson Center and the Exponential Roadmap Initiative. <https://globalgovernanceforum.org/climate-governance-commission/>

# Arid and semi-arid zones: Key facts and current situation

While most deserts or arid zones are hot, some – most notably parts of the Arctic and Antarctic and the high-altitude Atacama Desert in the Andes – are cold. A true desert receives less than 250 mm of precipitation annually and, a semi-desert less than 350 mm. Areas receiving no rainfall over an entire year are described as extremely arid. The Köppen-Geiger climate classification system divides non-polar arid zones into hot and cold desert and hot and cold semi-arid climates based on a combination of precipitation and mean temperature, with additional sub-categories based on the seasonality of precipitation and the proportion experienced as fog (Figure 1).

Figure 1: Köppen-Geiger climate classification map<sup>iii</sup>



Af	BWh	Csa	Cwa	Cfa	Dsa	Dwa	Dfa	ET
Am	BWk	Csb	Cwb	Cfb	Dsb	Dwb	Dfb	EF
Aw	BSh	Csc	Cwc	Cfc	Dsc	Dwc	Dfc	
As	BSk				Dsd	Dwd	Dfd	

Köppen-Geiger climate classification scheme symbols description table

1st	2nd	3rd
<b>A (Tropical)</b>	f (Rainforest) m (Monsoon) w (Savanna, dry winter) s (Savanna, dry summer)	
<b>B (Dry)</b>	w (Arid Desert) s (Semi-arid or steppe)	h (Hot) k (cold)
<b>C (Temperate)</b>	w (Dry winter) f (No dry season) s (Dry summer)	a (Hot summer) b (Warm summer) c (Cold summer)
<b>D (Continental)</b>	w (Dry winter) f (No dry season) s (Dry summer)	a (Hot summer) b (Warm summer) c (Cold summer) d (Very cold winter)
<b>E (Polar)</b>		T (Tundra) F (Ice cap)

Image source: [https://en.wikipedia.org/wiki/K%C3%B6ppen\\_climate\\_classification](https://en.wikipedia.org/wiki/K%C3%B6ppen_climate_classification)

Surprisingly many urban areas and a growing number of large cities are found in these inhospitable zones (see group B in colors red, orange and yellow in Figure 1 above), and therefore face distinct challenges in providing for the basic needs of their inhabitants, shelter from the extreme heat and cold and coping with increasingly evident changes in prevailing conditions as a result of climate and broader environmental changes.

Indeed, the rate of such changes is particularly marked – and the impact severe – in hot, arid and semi-arid zones, which form the subject of this Policy Brief. It is also important to distinguish those in coastal locations, which benefit from the moderating effect of the sea and onshore breezes and perhaps fog, from those inland, where aridity is often greater, and temperature fluctuations are more extreme. Figure 2 provides illustrative examples of selected hot and arid cities from around the world.

**Figure 2: Selected hot and arid cities worldwide<sup>v</sup>**





Inevitably, the urban challenges – economic, environmental, human, socio-cultural and technical – in these zones are more obvious and sharply defined than elsewhere. In poor cities, these prevailing conditions impose severe constraints on livelihood opportunities and quality of life. By contrast, the rapid growth of such cities in the Arabian Gulf and wider Middle East, parts of Central Asia and the USA, driven by oil and gas revenues, has enabled high-tech, western or 'international' style urbanization, albeit at the cost of a high carbon footprint and often low levels of sustainability.

**Urban areas in developed regions, particularly the US, have the largest ecological footprints in the world. High levels of resource consumption, widespread dependence on private automobiles, large-scale waste generation and low- density suburban sprawl eroding agricultural land are all key environmental issues for the future of cities in developed regions (UN-Habitat 2022, p.11)<sup>iv</sup>.**

This is even more prevalent in high-income hot and arid cities. The import of long-distance transport content of arid and semi-arid urbanism is high since few of the required resources are produced locally. This also applies to construction materials, food, and other basic needs. Vast oil and gas revenues over recent decades have enabled rapid high-tech and motor car-based urban development and wealthy consumption-based lifestyles in these regions. This urbanization combines energy-intensive high-rise tower blocks with predominantly low-density sprawl. Yet, conventional technologies cannot provide all the answers and may exacerbate the challenges of achieving effective climate change mitigation and adaptation, sustainability, and resilience. Experimentation to develop an appropriate hybrid or new technologies designed for such regions could play a notable role in meeting the sustainability challenge.

Dwindling oil and gas reserves in some regions and growing global commitments to reducing and eliminating dependence on fossil fuels, are making the need for urgent change more widely accepted. Economic diversification programmes are being adopted but to date, there has not been any fundamental rethink about the nature and sustainability of urbanism that is not directly and indirectly powered by fossil fuels. Such reassessments and reimaginings are urgent. So too are the training and deployment of appropriate skills and expertise since implementational capacity is inadequate or even absent in most arid/semi-arid urban contexts. The quality and appropriateness of governance and policies to drive urban transformations towards sustainability and resilience is therefore crucial.





# Critical governance and policy considerations for hot and arid cities in the global climate discourse

Key dimensions of the distinctive challenges facing urban areas in hot arid/semi-arid zones are well known and include particularly:

- **Extreme heat:** increasing intensity, duration, and frequency are now routine, not simply short-duration extreme events, with Kuwait and other cities regularly experiencing 50 °C and above. This poses a direct threat to life. Many cities now experience over 35 °C for long periods, affecting health and productivity.
- **Aridity:** desert and semi-deserts are expanding and pose health risks ranging from dehydration and heat exhaustion to heatstroke and risk of cardiovascular illness.
- **Water constraints:** freshwater resources are under increasing pressure as urban demand rises. Any perennial water courses increasingly run dry, subterranean aquifers are being depleted through unsustainable extraction so that water tables are falling in many regions, resulting in die-offs of trees and other vegetation and reducing potable water supply as well as desertification which also affect air quality, amongst many other side effects. Long-distance pipeline transport of potable water is expensive and potentially unreliable; and desalination using conventional methods is expensive and energy intensive.
- **Food supply and security:** in most cases, local production is limited to desert-tolerant foods like dates, coconuts, or saline-tolerant crops, while irrigated agriculture is unsustainable and may salinize soils unless undertaken with drip-fed irrigation or by means of hydroponics or innovative controlled environment technologies. With notable exceptions such as Doha, the potential for urban and peri-urban cultivation with such technologies, and the application of regenerative agriculture and indigenous knowledge as part of urban greening and promotion of economic circularity, remains poorly understood and underdeveloped.
- **Sustainable and renewable energy:** while in some arid cities, fossil fuel-produced energy is readily available and cheap or at least affordable by most residents: this is not sustainable. Climatic conditions favour production of solar energy at scale within and adjacent to urban areas as a key element of green and circular economies; in some areas, this also applies to wind energy. This could transform urban sustainability, not least in relation to the economics and carbon footprint of large-scale water desalination.
- **Waste disposal:** the high dependence on imported or long-distance domestic transport of food and manufactured goods and the lack of local recycling industries, including construction industry waste, means that landfill continues to account for much waste disposal. This wastes valuable materials and generates methane emissions. Sorting waste from domestic, commercial, and industrial sources for export or local repurposing and reuse is an urgent priority.



- **Circular economy:** as already implied, urban economies in hot and arid/semi-arid zones remain predominantly linear, based on single-use and disposal, rather than being circular. Some notable exceptions exist, such as the announcement of a zero-waste strategy in Doha, the circular economy council in the UAE, or the circular carbon economy framework in Saudi Arabia but economic transformation is urgent and will require a fundamental shift in circularity infrastructure development and policies. Informal activities, which are often based on elements of circularity, are important sources of livelihoods in many low-income communities and should be included in new initiatives.
- **Innovative architecture and urban design:** Urban design has often been predicated on high levels of motor vehicle ownership in high-income economies without spacial constraints, generating sprawl and unnecessary separation of potentially compatible land uses, which was previously a feature of indigenous urban design in many arid and semi-arid regions. The potential for sustainable cooling, urban greening and other elements of sustainable architecture and urban design appropriate for such regions remains poorly appreciated and under-researched. The relationship between individual buildings and their surroundings needs to be reimagined and re-designed. For instance, 15 or 20 minute neighbourhoods or cities, as currently being popularized internationally, will need modification for hot, arid conditions - where walking or cycling for more than a few minutes would be impracticable.
- **Urban governance:** The foregoing issues highlight that the appropriateness of existing construction design standards, regulations, land use zoning, and other urban planning rules and procedures, including materials red lists, life cycle assessments, environmental impact assessments and others to the required sustainable urban futures also needs to be assessed. More explicit mechanisms are required for integrating buildings into their surrounding urban fabric, at appropriate densities. Ultimately, the reimagining and design of urban sustainability has been shown elsewhere to have a greater chance of success with more active citizen engagement and participation, as well as more responsive and transparent urban governance. The most appropriate scale or unit of governance for such purposes should also be assessed.
- **Alternative technologies:** Many alternative technologies - such as renewable energy, passive cooling, and multi-functional lead uses - exist and could play a positive role. These include multimodal transport systems but further research is needed. For instance, the performance and durability of electric vehicles under hot arid/semi-arid conditions. There is also considerable potential to develop appropriate new or innovative hybrid technologies. The optimal solutions will be context specific.
- **Communications, awareness, and behaviour:** innovations and improvements in appropriate governance as well as raising awareness of options and how best to nudge or make larger behavioural changes will only be widely known and adopted if communicated effectively within and between cities, targeting particular groups. Much relevant experience and expertise now exists and can be shared widely, not least in how to utilize the potential of social media effectively to reach youth, elderly, and minority or marginalized groups.

As indicated, knowledge and expertise regarding how best to address many of these key elements of urban adaptive potential, in different hot arid/semi-arid contexts worldwide are inadequate and unevenly distributed. Some solutions already exist but may be costly, rely on outdated assumptions, and/or be inappropriate in many contexts. Others may have exciting wider potential but are little known beyond where they have been developed. Indigenous and traditional knowledge is often important reservoirs of local and contextualized experience and expertise.

Given the urgency of addressing climate and environmental change and achieving GHG reduction commitments in such challenging environments, there is not enough time for each town or city to explore options, experiment and derive its own approach. This would inevitably involve much 'reinvention of the wheel' and be hugely inefficient as well as vastly more costly than necessary. Some appropriate form of city forum, network or alliance to share knowledge, alongside comparative experimentation where necessary, is required. This will enable the acceleration of urban transformations, especially to ensure relevance and appropriateness to intermediate and smaller cities; often bypassed by big-city initiatives.



# Urban-focused policy and governance mechanisms to accelerate urgent action on climate change, in and for hot and arid environments

**Two not mutually exclusive options are presented and require systematic assessment.**

1. establishing a new forum, network, or alliance dedicated specifically to urban sustainability in hot arid/semi-arid zones, or
2. establishing an appropriate mechanism within or as an add-on to one or more existing global or regional economic/political communities or governance structures.

The former approach would be more ambitious and have the advantage of being focused entirely on this challenge but the disadvantages of incurring considerable start-up costs and requiring more time; and needing to establish a presence and reputation before becoming fully effective and credible. Nonetheless, the unique challenges and particular nature of hot arid/semi-arid zones require focused attention that has otherwise been missing from the global discourse. For this reason, this may be the better option, and consideration is given below to how such an alliance might most appropriately be structured.

The latter approach would be faster and cheaper since the host organization is up and running, and such a specific plan might appeal to the host organization without the need to develop it from scratch.

Conversely, there would probably be greater challenges or disadvantages in having to establish an urban focus within or attached to existing organizations with other remits that might not be immediately compatible and then having to abide by well-established institutional governance regulations, rules and procedures that might not be appropriate to urban agendas if the organization has a non-urban focus.

Addressing these issues most effectively also requires collaborative multi-level governance involving regional and national governments. While less of an issue in small Gulf states, consideration should be given to how well these respective models would lend themselves to positive multi-level engagement.





# Option 1: Establishing a bespoke mechanism

**This favoured route would require careful consideration, consultation and planning. Key issues to address include:**

- **engaging mayors and top officials in a representative sample of towns and cities in hot arid/semi-arid zones worldwide to test levels of interest and potential engagement. Such a survey would need thoughtful preparation and provide realistic alternatives, such as**
  - specific cultural factors around engagement – might local customary/traditional leaders in addition to the mayors or top officials need to be consulted?
  - membership of the alliance/network as of right by virtue of being in a hot arid/semi-arid zone or requiring qualifying criteria
  - whether and why a single global body/mechanism or a network or coalition of regional or thematically defined bodies would be preferable
  - whether this should be a limited-life or permanent body
  - willingness to pay a membership fee to support a secretariat and core activities and/or to contribute in kind to secretariat functions on a distributed model
  - which priority issues should be addressed
  - what appropriate monitoring and evaluation mechanisms would be appropriate and acceptable.
  
- **developing a feasibility plan to include (but not limited to):**
  - minimum levels of staffing and capacity to establish such a body with an appropriate remit as defined from the above survey and other consultations
  - optimal locations for the headquarters of a global body and/or set of regional bodies
  - relative advantages and disadvantages of providing the functions and expertise in-house and working through key focal points in member cities, versus distributing certain functions/tasks across member cities with appropriate expertise
  - likely start-up and recurrent costs in the different locations of these respective models
  - willingness of one or more trusts, foundations or other philanthropic bodies, such as the Qatar Foundation, to provide or contribute to the core funding and set-up costs in cash and/or kind (e.g., through provision of office premises). The anchor role of Bloomberg Philanthropies in respect of C40 Climate Leadership Group provides one pertinent example.



## Option 2:

**Attaching or integrating such a mechanism into an appropriate existing city network or transnational municipal network (TMN) already addressing climate change, sustainability and resilience issues.**

**The most appropriate existing international urban climate and sustainability membership governance institutions are well known and any others meriting consideration could be readily identified. These fall into several complementary categories:**

- **Transnational membership organizations for towns and cities of any size**, such as United Cities and Local Governments (UCLG) and Local Governments for Sustainability (ICLEI). UCLG is headquartered in Barcelona and ICLEI in Bonn; both also have regional divisions or branches. They do not address hot arid/semi-arid city challenges systematically at present but might be amenable to such an initiative.
- **Transnational city leadership membership organizations with specific membership eligibility requirements**, most prominently C40 and the Resilient Cities Network (RCN) – previously the Rockefeller 100 Resilient Cities Network. These criteria limit membership to larger (>1 million), relatively well- resourced cities with an existing Climate Action Plan (C40) or Resilience Plan for which a Chief Resilience Officer has direct responsibility (RCN). Moreover, only a handful of their current members are located in hot arid zones and a few more in semi-arid regions.
- **Cities Alliance**: a global partnership fighting urban poverty and supporting cities to deliver sustainable development, including tackling climate change. It focuses on 200 cities in 20 countries. Headquartered in Brussels, it has different stakeholder partners, including UN-Habitat and other UN agencies, city networks like C40, membership organizations like UCLG and ICLEI, other organizations, and several donor and recipient countries. Its fund is hosted by the United Nations Office of Project Services (UNOPS).
- **UN-Habitat**, the UN specialized human settlements agency. It has several climate change-focused programs, has responsibility for implementing the New Urban Agenda and SDG 11 on sustainable cities and communities, assesses cities' Voluntary Local Reviews on SDG implementation and the urban content of Nationally Determined Contributions to emissions reductions under the UNFCCC Paris Agreement. Nevertheless, hot arid/semi-arid zones are not a major focus in their work and are not addressed explicitly at all in the two most recent editions of its flagship biennial World Cities Report, in 2020 and 2022.
- **Regional economic/political communities and governance organizations**, such as the Gulf Co-operation Council (GCC), Association of Southeast Asian Nations (ASEAN), Southern African Development Community (SADC), African Union (AU), Economic Community of West African States (ECOWAS) or North American Free Trade Areas (NAFTA). These are very diverse, with mostly unrelated national and transnational economic, or political/security foci. Inserting or embedding an urban focus within them will not appeal to some of them or necessarily be practicable or straightforward, with the risk of becoming something of a 'cinderella' component.





**Key issues to explore in assessing these options would include:**

- How well hot and arid/semi-arid cities and their particular challenges are addressed in these institutions and mechanisms and what, if anything, is missing from them?
- Could any gaps and/or deficiencies readily be filled?
- Would existing organizations be amenable to consider establishing a workstream or entity specifically to address these areas and challenges, and if so, on what terms?
- Are there existing international NGOs or advocacy organizations that already work with TMNs, and are able to join in collaborative efforts or might be willing and able to do so?
- Might a hybrid model be feasible?





## Conclusions

Urbanization in the twenty-first century is not a singular pathway, but rather encompasses divergent paths to growth and many possible futures, including multiple threats. Despite the range of possibilities, it is important to consider desirable outcomes that make cities more equitable, ethical, inclusive, productive, green, compact, walkable and healthy as called for by the relevant components of the global development agenda (UN-Habitat 2022, p.24).

**This policy brief has provided an overview of the unique nature of hot arid/semi-arid zones and the particular challenges facing of cities in them and the role they can play in formulating and implementing appropriate climate, sustainability and resilience discourses. Such urban challenges are neglected or underrepresented in most existing global urban climate change and sustainability initiatives and reports.**

**The inaugural Earthna Summit and related discussions will provide a foundation for developing a follow-up project and process to answer the following four key questions:**





- **How could a global hot and arid cities alliance or a coalition of regional clusters help identify, share, and scale existing and innovative urban policy and governance mechanisms addressing climate change?**
  - There are different views regarding the relative benefits of global or regional groupings, or indeed a hybrid whereby several regional clusters or groupings form a global coalition.
  - Key factors to evaluate are the levels of common challenge that could serve as unifying stimulus in each case to form the basis for ownership of the narrative(s) and willingness to commit time and resources to such a partnership or alliance.
  - Regardless of organizational basis, a key focus should be on mutual learning/ capacity building and knowledge exchange to develop and deepen expertise and implementational capacity to promote effective mitigation, adaptive transformation, sustainability and resilience appropriate to hot and arid and semi-arid conditions. Such knowledge is currently inadequate and unevenly spread, with some local innovations lending themselves to wider dissemination and adaptation elsewhere.
- **What mechanisms could support a global hot and arid cities alliance?**
  - One potential mechanism would be a global or regional suite of regional partnerships or alliances comprising only cities in hot and arid/semi-arid zones
  - Another option would be to create an urban network or workstream within existing regional economic or political communities such as the Gulf Co-operation Council, which could serve as a host and provide existing momentum to kick-start activities
  - A third mechanism could be to develop a thematic focus on hot and arid cities within existing global membership organizations, such as ICLEI, UCLG, or the Cities Alliance, which serve a wide range of city sizes, or city leadership networks like C40 or RCN, which focus on million-plus cities and have other prerequisites for membership. Their willingness to do this and the level of enthusiasm for this model among hot and arid cities would need investigation.
- **How can such an alliance be an active member of the Climate Governance Commission and ensure that their narratives and issues are represented on a global stage?**
  - The Commission is currently in its 'high-level phase', working with diverse operational partners and releasing a flagship report in late 2023; it will support this initiative in several complementary ways:
    - Co-branding of this and any related Policy Briefs and dissemination on its website and through its stakeholder and policy networks
    - Feeding into the Commission's flagship report in 2023
    - Featuring in one or more of the Commission's expert roundtables during 2023 that will focus on cities and related governance topics
    - Inclusion within climate governance policy dialogues that several national governments are keen to accelerate
    - Inclusion within the Commission's activities in global events, including UNFCCC COP28 in Dubai (November 2023)
    - Providing access and connections to other venues, possible strategic partners, like-minded initiatives and policymakers, as appropriate.



- **How can non-governmental policy-focused entities, like Earthna, act and serve as a platform to enable these coalitions?**
  - Several possible mechanisms could be examined – from direct hosting of a global platform or hub for such an alliance or network of regional clusters, to acting jointly with like-minded entities to do so, perhaps regionally, or acting as a promoter with existing city networks, regional economic/political communities and intergovernmental organizations. These mechanisms may not be mutually exclusive and should be explored systematically. All should involve multiple stakeholders, including - but not limited to - the private sector (e.g. B Corp firms), civil society and community-based organizations.
  - An important consideration will be the basis of, and criteria for city membership. While in and of itself a second-order issue, it will influence the most appropriate governance arrangements. For instance, if it is deemed important for the alliance/network to be open to all hot and arid/semi-arid urban areas regardless of size, existing institutional capacity or level of current climate action, then establishing a new transnational municipal network (TMN) or establishing a focus within and existing TMN with minimal membership criteria would be appropriate. By contrast, seeking to create a hot and arid/semi-arid component within an existing transnational city leadership network on climate change (C40) or resilience (RCN) would require adherence to their existing and quite specific membership criteria, which would limit participation to larger cities with existing capacity and expertise.

## Next steps:

**Accordingly, discussions at and around the Earthna Summit 2023 should enable the production of the following outputs:**

1. A report summarizing the discussion and key conclusions regarding the most appropriate way forward, to be developed into an action plan.
2. A rapid follow-up study to
  - a. examine the top-ranked alternative structures/mechanisms for a hot and arid/semi-arid cities alliance or network, perhaps including a SWOT analysis,
  - b. make recommendations for the most appropriate mechanism to enable a coalition of city-level representation, and
  - c. formulate an action plan to develop a cities alliance or coalition supported by the CGC and identifying the roles of Earthna as partner entity
3. Subsequently, to develop a mechanism to review and evaluate progress and recommendations for future enhancing this and potential similar city-level coalitions.



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- <sup>ii</sup> For instance, the terms 'arid cities', 'hot cities' and 'desert cities' are not mentioned in the chapter on cities in the IPCC's Sixth Assessment, Working Group II report, UN-Habitat's World Cities Report 2022 or the World Cities Report 2020. In the last-mentioned, deserts appear only in the context of food and internet 'deserts'.
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