



FUTURE CITIES
CANADA

FINDING COMMON GROUND

**INTEGRATED CLIMATE ACTION FOR OPEN
SMART COMMUNITIES IN CANADA**



EVERGREEN



OpenNorth



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Preface



Merlin Chatwin

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For over a decade, Open North has been at the forefront of using data and technology for the common good. Since the organization's founding, Open North has focused on supporting governments to embrace new ways of working with data and technology; with new processes to standardize and open data, applying emerging technologies throughout the data lifecycle. Over the past year, we have been having internal conversations about how to best respond to the needs of our government partners in tangible ways that align with our values as individuals and as an organization. A recurring question is how we apply the ideals of 'smart' and 'open' to the complex problems that public-sector staff encounter on a day-to-day basis. We see complex problems, sometimes called 'wicked' problems, as those that defy traditional solutions, have multiple contributing factors, require an intersectoral approach to addressing them, and whose answer must emerge from within the context within which they manifest. Recently, UN-Habitat identified four major shocks that will impact the global economy and thus shape the future of cities: climate change, extreme poverty and inequality, the Fourth Industrial Revolution (4IR), and COVID-19.¹ These are truly complex or wicked problems that are all inextricably linked. Given the increasing frequency of extreme climate events impacting

communities across Canada, and the disproportionate impact that they have on the poorest residents within our communities, local governments are beginning to develop climate change strategies to reduce emissions, with numerous communities declaring a climate emergency.² With a desire to support public servants and their communities to address the tangible problems that they are facing on a day-to-day basis, a question emerges about whether there is a role for Open North in supporting climate change mitigation and adaptation, and if so, what is that role?

This paper is our first step in exploring how the open, smart city, data governance, and civic technology expertise that Open North possesses can support governments in their climate mitigation and adaptation efforts. The interconnectedness of climate change with public health, infrastructure, poverty, homelessness, and food security necessitates an integrated, intersectoral, and multi-level governance approach to identifying and iterating on solutions. For Open North, this means defining how local governments can use data and technology to advance integrated climate action in concert with the other ongoing challenges faced at the local level. We acknowledge the ongoing work of organizations that have been championing climate action and environmental justice for

[1] UN-Habitat, "Cities and Pandemics."

[2] See [Appendix: Case studies](#) for examples of climate change strategies.

years. In line with our organizational values, as we step into the climate action space we will seek to amplify the thinking and experience of others, engage in meaningful inter-organizational cooperation, and advocate for the use of contextually relevant data and technology to facilitate the collaboration required to confront such a difficult challenge. It is imperative that the open and smart city discourse more forcefully encompass climate action and that all acquisition and deployment of technology is done with climate change considerations.

One of Open North's stated values is to pursue the common good by working to identify and remove systemic barriers to participation for people on the margins. Often, the most meaningful action an

organization like Open North can take is to hold space for people to step into and take charge of the decisions that impact their lives. Healthy, just, and sustainable communities for all residents requires climate action that centers the lived experiences of systematically excluded populations. Without accurate data, these individuals and communities, and the disproportionate negative impacts that they experience as a result of climate change, are invisible. While we recognize that data and technology are not *the* answer to climate change, they do have a role to play, and Open North is committed to supporting local governments and environmental justice organizations in their pursuit of a healthy, just, and sustainable future.

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Founded in 2011, Open North is Canada's leading not-for-profit organization specializing in Open Smart Cities, public consultation, open data and open government, and data governance. Our mission is to drive research, capacity-building, and network collaboration across and within sectors to advance the responsible and effective use of data and technology in service of transparent, accountable, and inclusive communities. We support communities in reimagining how to govern with and for data and technology, as well as how to make informed decisions in the public interest. After developing tools and knowledge, we share them with the community so that all may benefit and move toward a better data and tech future.

For more information about Open North visit opennorth.ca.



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Open Smart Communities in a Climate Crisis

The smart city has been a dominant concept since the early 2000s. It is a broad term, and generally encompasses tools (technologies and services) and protocols (norms, regulations, and interoperability frameworks) that relate to the contemporary issues of municipal operations and service delivery in a digital age.³ The smart city discourse centers on ways that data and technology can improve urban governance, efficiency, and quality of life for residents. There have been significant advances in the field; many cities across the globe have adopted data policies and deployed smart-city technologies, such as real-time mobility supply-demand management, or trans-regional data interoperability protocols that improve coordinated service delivery. There have also been pitfalls: incursions into individual privacy; vendor lock-in; long-term resourcing for maintenance, accessibility, and social equity; and shortfalls in community engagement, to name but a few.⁴

There is a sectoral shift toward mitigating these harms and resisting the trend of deploying technology for its own sake, while nonetheless embracing the potential community-centered benefits of technology. Policymakers and technologists in large and small municipalities are calling for a redefinition of smart cities that foregrounds equitable value creation – a turn that has

been rebranded as **Open Smart Communities** (OSC).⁵

Canada has been a leader in smart cities and the shift toward incorporating civic values into a smart city approach. The federal Smart Cities Challenge (2017) provided the opportunity to involve multiple domains, sectors, and jurisdictions in exploring and implementing OSC concepts across Canadian communities. The program solicited and funded technology projects that were guided by resident engagement and had a clear mandate for social impact. Nevertheless, it continues to be challenging for municipalities to embrace OSC principles and deploy new technologies. Limited resources, lack of in-house technical capacity, and the complexity of changing standard municipal operations are only a few of the many barriers that exist. Additionally, barriers remain stubbornly high when there are no precise outcomes that justify lowering them. The field of OSC has largely focused on the *what* (e.g. what technologies are available or possible) and the *how* (e.g. the principles of using technology in the public interest), at the expense of defining a compelling and precise *why*. Although there are notable examples of truly impactful technology initiatives, most smart city projects are justified with vague gestures at improving urban life.

[3] Pembleton, Ahmed, Lauriault, Landry, and Planchenault, “*The State of Open Smart Communities in Canada.*”

[4] See, for example, Plamondon, “Decoding the Opportunities and Pitfalls of Open Smart Cities.”

[5] Claudel and Nitoslawski, “*Creating Civic Value in Open Smart Communities.*”

Meanwhile, the challenges of technology adoption are increasingly intertwined with a rapidly intensifying climate crisis. Municipalities contribute approximately half of the nation's emitted greenhouse gasses. They own over 60% of the public infrastructure that is vulnerable to extreme climate events.⁶ As such, the many and varied impacts of climate change are acutely felt in Canada's urban centres. Most importantly, climate change takes a toll on people – over 80% of the country's population is urban, and climate change disproportionately affects the vulnerable and marginalized residents of cities. These communities have the least access to resources (such as air conditioning during a heat wave), live in risk-prone areas (such as flood zones), and – because they have been structurally under-represented in government decision making – have the least access to government resources during extreme weather events (such as ad-hoc cooling or heating shelters).⁷ Climate change literature has begun referring to these as “frontline communities,” highlighting their precarious position as a matter of environmental justice.⁸ Cities are thus squarely in the center of climate

change – and have an opportunity to take bold, just, and equitable climate action.

Municipalities cannot shoulder this work alone. For a climate action agenda to be truly transformative – including both adaptation and mitigation strategies – it must be multilateral. It requires a forceful and coherent effort across *jurisdictions* (levels and regions of government), *sectors* (public, private, philanthropic, community, and academic) and *domains* (transportation, housing, health, and so on). In this paper, we define coherent initiatives across multiple dimensions as **integrated climate action**.⁹

There is federal support for integrated climate action. In his 2021 *Mandate Letter to the Minister of Intergovernmental Affairs, Infrastructure and Communities*, the Canadian Prime Minister issued a clear charge to “build on the foundation of the Disaster Mitigation and Adaptation Fund and continue seeking opportunities to scale the construction of climate-resilient infrastructure across Canada, with a particular emphasis on communities most at risk,” and “to ensure a well-coordinated and strategic approach on key priorities that have

[6] Federation of Canadian Municipalities and Insurance Bureau of Canada, *Investing in Canada's Future: The Cost of Climate Adaptation at the Local Level*.

[7] “Ces décisions sont prises quotidiennement, souvent de manière implicite, par plusieurs parties prenantes qui accordent différentes valeurs aux données tandis que d'autres parties impactées sont structurellement sous-représentées dans la prise de décision” [Decisions are made daily, often implicitly by several stakeholders who value data for different reasons, while some other impacted stakeholders are structurally underrepresented in decision-making] Gorce, “On a toutes et tous un rôle à jouer dans la gouvernance des données,” 1.

[8] “Frontline communities experience the compound effects of social, economic, and environmental injustices. Climate change is exacerbating the root causes of injustice in those areas, yet adaptation and mitigation strategies often fail to address the knowledge of frontline community stakeholders.” Fernandez-Bou et al., “3 Challenges, 3 Errors, and 3 Solutions.”

[9] The term “integrated climate action” is increasingly used to describe multidimensional initiatives around the world. See, for example, International Climate Initiative, “Unlocking the Power of Integrated Climate Action”; Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH, Factor, and International Climate Initiative, “A New Narrative of Resilient and Climate Smart Societies”; Canadian Climate Institute, “Mission,” which notes that “it's time for a more integrated approach to developing climate policy.”

significant provincial and territorial implications. This will include ensuring that the priorities of municipalities are reflected in our agenda.”¹⁰

With a mandate for climate action, adequate resourcing, and strategic alignment across sectors, jurisdictions, and domains, municipalities will play a crucial role in protecting the most vulnerable populations from climate-related shocks and stressors in the short term, in addition to proactively mitigating damage to ecosystems in the longer term.

In this paper, we propose that the OSC and climate change movements can merge in productive ways. There are tremendous opportunities for a new generation of smart-city technologies that measure and reduce the environmental footprint of urban areas – from shared electric vehicle fleets to air quality sensors to greenhouse gas emissions calculators to remote imaging that supports urban forest management. So too is there potential for environmental policies that build on climate science and promote the deployment of cutting-edge technologies in a way that is equitable, responsible, and sustainable. As urban technologists prioritize environmental outcomes, and as environmentalists embrace new technologies, local policymakers can strategically leverage both to advance integrated climate action.

That is to say, the possibility of integrated climate action is deeply tied to governance

in a dynamic and complex local system. Governance is the greatest challenge and it is the most fundamental means of action; it is the key. We introduce the concept of **transformative capacity** to discuss a region’s potential for effective climate action, as a function of good governance within local relational networks.¹¹

Through a landscape scan of small to medium-sized Canadian municipalities, we found that there are gaps in transformative capacity. Conversely, those same gaps are *opportunities to strengthen* transformative capacity. We outline how stakeholders across domains, jurisdictions, and sectors can interactively catalyze systemic change, using OSC governance principles and digital tools that have a renewed focus on environmental action.

In its work with Canadian municipalities, Open North witnessed the growing emphasis on climate change, and worked with civil servants to support the development of climate action plans and the use of data toward environmental goals. For example, the town of Churchill sought support from Open North to acquire and use geospatial data for local flood risk mapping. Similarly, Open North worked with the town of Georgian Bluffs to develop a new approach to stakeholder mapping, which informed strategic foresight and a local climate action strategy.

[10] Office of the Prime Minister, “Mandate Letter to the Minister for Intergovernmental Affairs, Infrastructure and Communities.”

[11] See Wolfram, “Conceptualizing Urban Transformative Capacity”; Shahani, Pineda-Pinto, and Frantzeskaki, “Transformative Low-carbon Urban Innovations”; Frantzeskaki, “Bringing Transition Management to Cities”; and Castán Broto, Trencher, Iwaszuk, and Westman, “Transformative Capacity and Local Action for Urban Sustainability.”

Climate change is the single crisis that cuts across the many challenges that cities must face. It is the *why*.¹² Open smart-city technologies and digital-native approaches to governance can meaningfully advance integrated climate action, when they are used according to the lessons learned over the past two decades of smart city discourse.

We see a compelling opportunity at the intersection of data-informed decision making and integrated climate action. This paper is a preliminary exploration of contemporary climate action in Canada, and a statement of Open North's intent to contribute. It is the beginning of a journey toward engaging with the current landscape of climate actors and humbly finding ways to complement their work. This may involve creating new digital resources, or curating existing ones and supporting implementation in public administrations. It might involve one-on-one engagement with municipalities, or creating cohorts of cities that are working on similar challenges. It may involve replicable policy templates or working closely with civil servants who are

building place-based knowledge and expertise. It could involve helping communities anticipate current and future needs; avoid focusing on short-term, politically motivated technology solutions; and address core issues that integrate all aspects of urban environments – from the digital to the ecological.

To these ends, we define a new agenda for Open North:

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Open North will serve as an intermediary organization that complements Canada's existing ecosystem of climate-focused organizations, with a strong focus on advancing integrated climate action by leveraging technology and OSC principles.

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Municipalities cannot shoulder the cost of adapting to climate change alone. Climate change adaptation is a shared responsibility among all orders of government, and will require a long-term commitment to action.



– Federation of Canadian Municipalities and Insurance Bureau of Canada, *Investing in Canada's Future*.

What Is Integrated Climate Action?

This section defines integrated climate action as initiatives that span sectors, jurisdictions, and domains. It gives an illustrative example (agriculture) and provides details on each dimension. It concludes by noting that the Open Smart Cities concept is similarly multi-dimensional. As such, Open Smart City principles and tools can become a foundation for enabling effective integrated climate action.

The negative effects of climate change are rapidly compounding and intensifying. Effective climate response will be the sum of many individual actions across all of society.¹³ These actions range from government-driven policy, investment, and regulation, to human-driven leadership and grassroots social movements, to technology-driven efficiency or monitoring and forecasting with data.

No single organization can do this work alone – it must be multidimensional. Fighting climate change is becoming a central objective across sectors, domains, and all levels of government. In this paper, we offer a new term for initiatives that bring together actors from across multiple dimensions in a complementary way: *integrated climate action*.

We define integrated climate action as: a strategic approach to sustainability initiatives that involves multiple actors within and across sectors, jurisdictions, and domains.

[13] Climate action depends on both proactive mitigation and reactive adaptation efforts. The latter are particularly influential for frontline communities—those at greatest risk during climate emergencies. Climate adaptation is a matter of environmental justice. “Responding to climate change involves two possible approaches: reducing and stabilizing the levels of heat-trapping greenhouse gasses in the atmosphere (‘mitigation’) and/or adapting to the climate change already in the pipeline (‘adaptation’).” NASA, “Responding to Climate Change.”

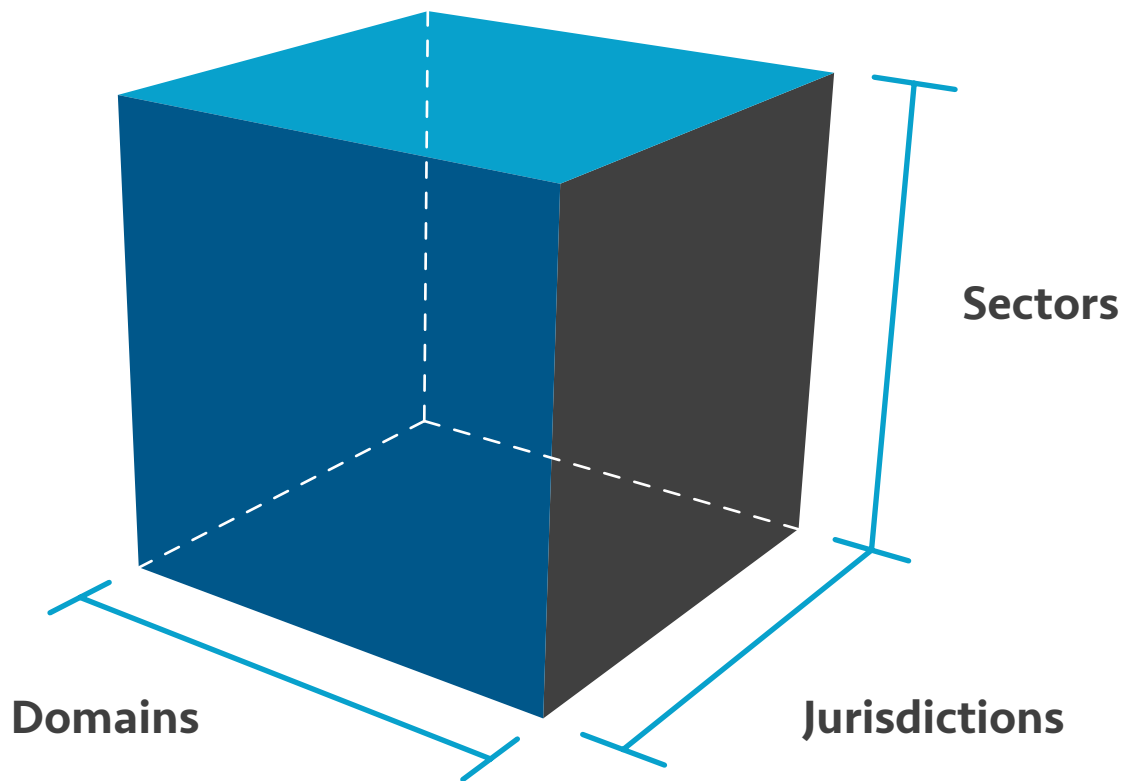


Fig. 1: Model for an integrated approach to climate action

Sectors. Climate action depends on innovation in the public and private sectors, academic research, philanthropic investment, non-profits, and social movements.

Jurisdictions. The effects of climate change do not stop at jurisdictional boundaries. Every order of government – federal, provincial, regional, Indigenous, and local – has unique resources and powers that can support climate action. Governments should also work across boundaries like adjacent counties, regions, or provinces.

Domains. Fields as disparate as transportation, nature-based solutions, housing, education, and public health all contribute to climate action. Climate action can have exponential impact when it breaks down domain siloes to create mutual and reinforcing solutions across these domains.

Example: Agriculture

The drivers of climate change are deeply interconnected across scales, levels, and domains. Solutions are equally multidimensional. One example is agriculture.¹⁴

The majority of agricultural activity is performed by large, for-profit companies that have a national footprint, or regional cooperatives composed of smaller local farms. These entities operate at a wide variety of scales, and ship products nationally and internationally. From an environmental perspective, agriculture is regulated at federal, provincial, and municipal levels, though it is primarily within provincial jurisdiction.¹⁵

Agriculture is typically performed in rural areas. Simple impact measurements would show intensive emissions from agriculture in these jurisdictions – while the majority of consumption happens in population centers. Harmonized and integrated measurement frameworks are necessary in order to identify and locate climate change drivers, as well as develop solutions.

The impact of agriculture is not only a result of the actions of farming companies themselves. It also depends on the equipment they use (and associated emissions standards); supply and distribution chains; the feedstocks, antibiotics, and fertilizers they use; their water management practices; and more. Important factors exist all along the equipment, supply, and distribution chain.

Any possible solution is equally interconnected, and involves many sectors. Positive change could be made in many ways: federal agricultural policy and regulations, local land use planning, industry norms

and standards, sustainable technology development, data-informed scenario modelling for emergency response, consumer education campaigns, and advocacy groups. Many of these “levers of change” are interdependent. Without effective coordination, the success of one might come at the detriment of another.

But it is also true that working in concert can create exponential impact – the ongoing growth and transformation of cities and territorial dynamics are demonstrating the benefits of metropolitan, regional, and territorial approaches to climate governance. Local land use policy, paired with a provincial investment and incentive strategy and an impact measurement framework adopted by a small business association, might, together, encourage small local farming. Cross-sectoral integration can create spaces of opportunity that invite imaginative approaches.

Lufa Farms,¹⁶ for example, has leveraged local land use policy, cutting-edge agricultural technology, community engagement, and entrepreneurial partnerships to create a vibrant food production and delivery service – built on Montreal’s unused industrial rooftops! Small initiatives like Lufa Farms do not solve climate change, food security, or regional food provision issues with a single initiative – rather, they emerge from multidimensional collaboration, strengthen regional networks, engage diverse communities, and demonstrate the power of integrative climate action. It will be the sum of many such initiatives that will meaningfully combat climate change.

[14] This example is brief and illustrative. For more information on integrated climate action in the context of the Canadian Agriculture industry, see Aunio, Aubert, and Begg, “Nourishing Smart City Solutions.”

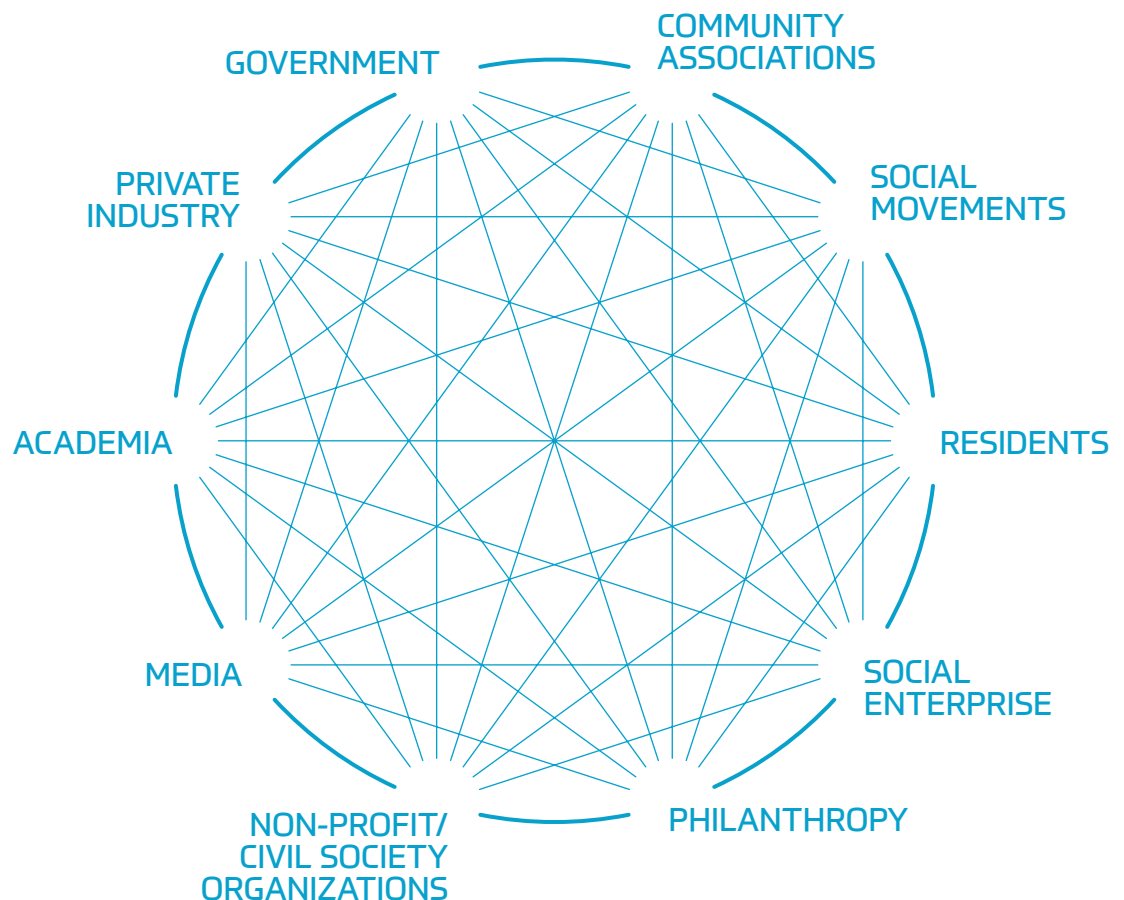
[15] “Each province has a regulatory agency managing the environmental impact of agriculture and a department or ministry responsible for the agriculture sector. These regulators operate with each other to address the unique environmental issues related to agriculture” (Johnson and VandenHoek, “Agricultural Law in Canada”).

[16] More information about Lufa Farms is available on their [website](#). See also Lindeman, “The Future of the Food Supply Chain Lives on a Rooftop in Montreal.”

Sectors

There is a robust discourse around sectoral integration – bringing together policy, industry, academia, and society (often referred to as the “quadruple helix”^[17]). These sectors each have unique constraints and strengths, which can be leveraged in a complementary way. The Open Smart City concept emphasizes the opportunities that can emerge through sectoral collaboration – for example, governments creating technology-forward economic development policy, universities producing commercializable

research, industries bringing products to market, and society taking up those products that are most desirable. There have also been warnings of the dangers that exist in sectoral collaborations – such as corporate capture, economic disparities, and incursions on individual privacy. Integrated climate action can build on the bridges that have emerged between sectors, and avoid the pitfalls of early technology projects and initiatives.



[17] See, for example, Schütz, Heidingsfelder, and Schraudner, “Co-shaping the Future in Quadruple Helix Innovation Systems” and Leydesdorff, “The Triple Helix, Quadruple Helix, ..., and an N-Tuple of Helices.”

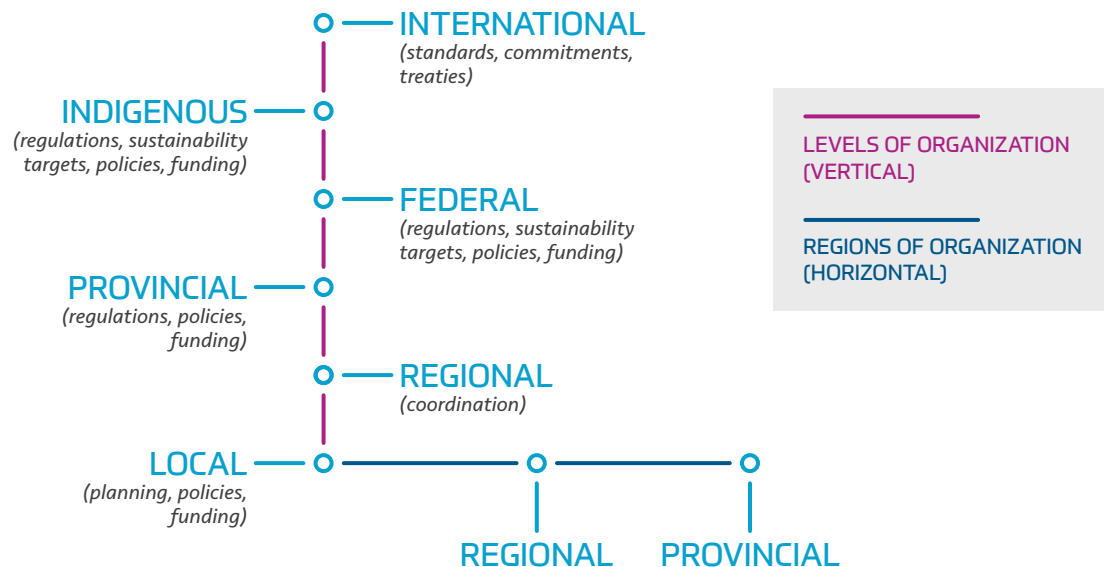
Jurisdictions

Climate change does not conform to jurisdictional divisions. Floods do not stop at municipal boundary lines, and greenhouse gasses emitted in one area pollute the air of another. It is crucial to coordinate across these “horizontal” boundaries¹⁸ – for example, contiguous jurisdictions, including urban, suburban, and rural, aligning their strategic initiatives, managing their shared natural assets, and reducing their mutual risks. According to UN-Habitat, “Urban and territorial planning contributes to increased human security by strengthening environmental and socioeconomic resilience, enhancing mitigation of, and adaptation to, climate change and improving the management of natural and environmental hazards and risks.”¹⁹

Data sharing and associated technologies can play an important role by facilitating, for example, emissions analysis and risk

modelling. Consistent measurement protocols yield good data that is longitudinal (long term) and actionable, and should be shared across jurisdictions. Well-aligned policies across jurisdictions help to ensure that the people most affected by climate change are not forgotten.

There are also “vertical” boundaries. Different levels of government have different mandates, regulatory powers, and sources of revenue. Multilevel governance is required to harmonize policy goals, sustainability targets, regulatory approaches, investment strategies, and more. Different orders of government can also use compatible technologies and share data standards and protocols. Success on any level depends on the actions of governments at other levels; each must take on responsibility for coordinating with the others.



[18] UN-Habitat defines these horizontal boundaries in a systematic way and offers a “universally applicable reference framework to guide urban policy reforms” and “support the development of diverse planning approaches adapted to different contexts and scales” (UN-Habitat, “International Guidelines on Urban and Territorial Planning”).

[19] UN-Habitat, “International Guidelines on Urban and Territorial Planning.”

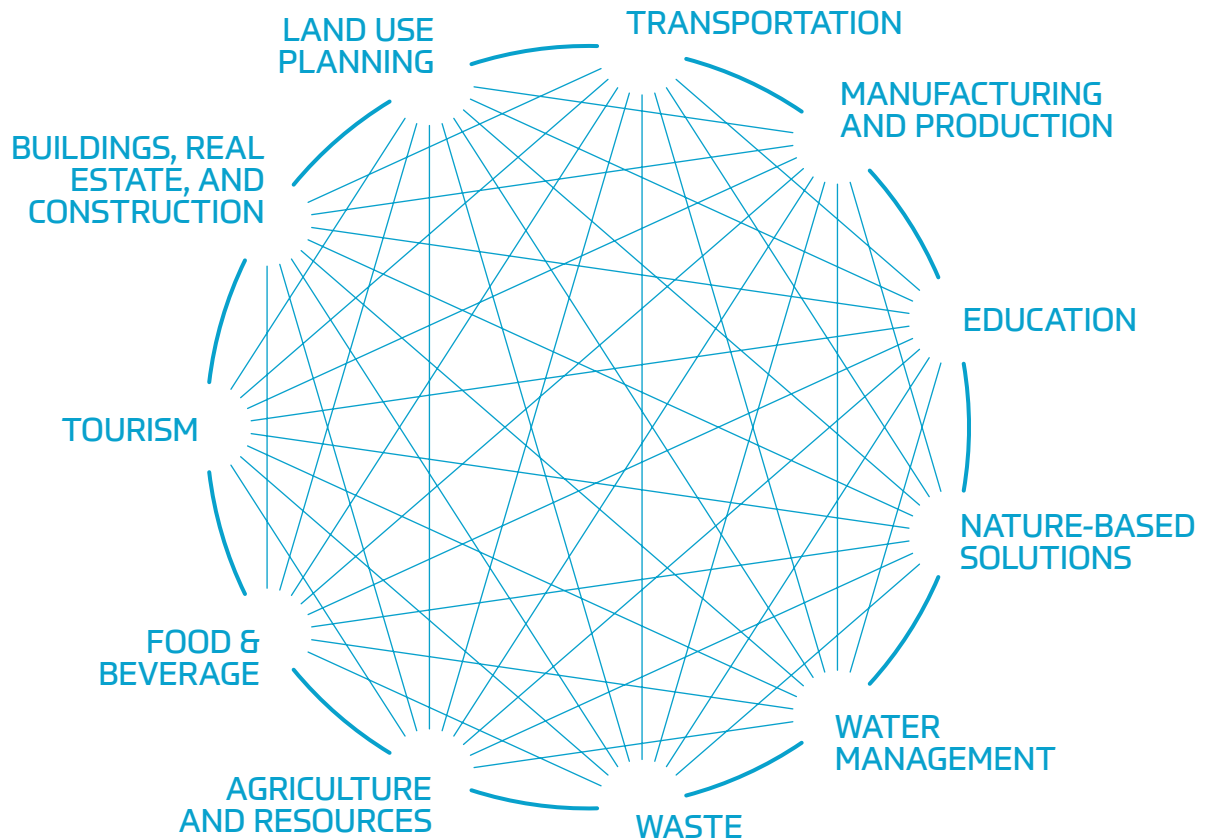
Domains

Cities are complex, heterogeneous systems, but they are commonly thought of as distinct “domains” (like transportation, health, or education). This simplifies urban planning, policy, management, investment, and so on. The downside is that domains typically operate in silos. Each has its own experts, and collaboration within and between domain experts remains challenging. Domains have independent objectives, mandates, operating protocols, technologies and systems, and sources of funding.

Climate change cuts across all domains: each is a contributor to climate change, and each has a role to play in climate mitigation and/or adaptation. Furthermore, remarkable synergies can emerge when domains leverage complementarities to advance shared initiatives – think of health,

transportation, and infrastructure agencies collaborating to promote active mobility in greenways. Some domains, like natural asset management, are well positioned to take leadership in finding these synergies, given their inherent environmental focus and transdisciplinary nature.

Technology will play an important role in advancing positive environmental outcomes within each of these domains, as well as creating links between them – from air quality sensors to electric vehicles to advanced biomass processing facilities. The concept of Open Smart Cities was carefully defined to enable continuity and adaptability across traditional domain divisions,²⁰ and several initiatives operationalized these links, such as shared data protocols or technologies with multidomain outcomes.



Open Smart Cities as a multidimensional space

The Open Smart City concept is equally multidimensional. Technologies have been explored in a variety of domains (from autonomous cars to data integration frameworks), policies and regulations have been issued at all jurisdictional levels, and every sector has been implicated. Open Smart City initiatives have made significant advances to date, including open data policies, technology demonstrations, new sources of funding, and emergent collaborative dynamics between traditionally siloed departments.²¹ These advances can serve as building blocks for integrated climate action in two ways: the technologies themselves, as well as the governance, organizational, and political experience of working in a multidimensional way.

Conversely, integrated climate action can sharpen the meaning of “open smart cities” in a tangible way, giving the movement a renewed purpose and spurring it with new momentum. Challenges still exist when it comes to local public administrations investing in a “transition” to become an Open Smart Community, because the principles are high level and the potential impacts are long-term and diverse. In some cases, public officials embrace the rhetoric of OSC without subsequent action or changes to the status quo. In other cases, suggesting to a civil servant in a resource-constrained,

mid-sized city that they should embrace OSC principles and technologies can feel abstract and daunting, disconnected from the realities of daily service delivery and implying an unknown but looming amount of effort and responsibility.

Climate change is an existential challenge that cities *must* face. Public health cannot be disentangled from climate change, just as infrastructure policy cannot ignore the technological developments and business models of vehicle providers. The stakes are high for individuals and organizations in all sectors, domains, and jurisdictions; climate change is a matter of spatial, environmental, and social justice. Climate action can reorganize actors across all dimensions to work together toward common goals. To this end, the multidimensional tools, principles, and modes of organization that are promoted for OSCs are readily at hand to support integrative work.

In short, diverse actors should take up the tools and principles of Open Smart Communities to do the work of integrated climate action.

...But it's easy to say that they *should*. More challenging is to understand *if they will*, or *why they won't*, then facilitate *how they can*. For this, we use the concept of “transformative capacity.”

[21] See, for example, Town of Bridgewater “Open Smart City Policy”: “The Town of Bridgewater desires to be an ‘open smart community’. We recognize the growing interest in, and value of, open smart community approaches to municipal governance and service delivery, as exemplified by the Energize Bridgewater program. At the same time, the Town recognizes that emerging smart cities technologies usually associated with these approaches have the potential to erode privacy rights, exacerbate social inequalities, introduce security and procurement risks, and create other challenges for the organization and the community. This policy establishes a framework to guide future decision-making and further policy development on this topic, to enable the safe and appropriate adoption of smart cities technologies and practices and the management of community data, while at the same time reducing risks to the organization and the community.”



We must not only continue taking real climate action, we must also move faster and go further. As Canadians are increasingly experiencing across the country, climate change is an existential threat. Building a cleaner, greener future will require a sustained and collaborative effort from all of us.



– Office of the Prime Minister, “Mandate Letter to the Minister for Natural Resources.”

What Is Transformative Capacity?

This section defines transformative capacity as the potential for an interconnected system (including various sectors, domains, and jurisdictions) to coherently implement climate action strategies. It outlines the key elements of transformative capacity, and notes that many are within the purview of municipalities. We then show that intermediary organizations aiming to promote climate action can use this framework in collaboration with municipalities to find critical gaps and then fill them by supporting specific missing elements.

Promoting integrated climate action

To effectively address climate change, concerted actions must be taken across sectors, jurisdictions, and levels of government. Of course, any given climate action initiative may not address every single sector, domain, or jurisdiction. Depending on the scope, it will address a few – taking up a certain amount of “space” within the cube.

The specific conditions of each city – its history, size, existing partnerships, climate action budget, and so on – will bring opportunities and constraints. These might include, for example, a recent public-private partnership that was unsuccessful, a crown corporation that runs the local energy utility, a strong relationship with the

provincial government, or a land use policy that has not been revised in light of the city’s climate action plan.

Some of these factors are within the municipality’s control, but most are not. Therefore, climate action is, above all, a challenge of effective, equitable, and exploratory governance across domains, jurisdictions, and sectors. The potential for successful integrated climate action is a function of the whole system, and how it works cohesively. We refer to this potential as the “transformative capacity” of the system (a term that is increasingly used by a number of climate change scholars).²²

[22] Our definition follows Wolfram, who frames transformative capacity as “what enables cities and urban stakeholders to purposefully initiate and perform [sustainability] transitions,” including specific “abilities required to create new system configurations where the existing one has become unsustainable.” Wolfram, “Conceptualizing Urban Transformative Capacity.”

Transformative capacity is the potential for stakeholders across domains, jurisdictions, and sectors to interact in a dynamic and complex system, with the goal of creating new opportunity pathways that can cause systemic change toward sustainability.

Example: Transformative Capacity in Two Regions

Region A:

Progressive provincial and local governments have coherent environmental policies, objectives, and measurement frameworks. They are also willing to experiment and try new approaches. There is a history of solidarity, social business, and public-private-charitable cooperation. Agriculture is a key industry, and it is largely performed by local cooperatives. Anchor institutions devote significant budget toward ethical spending. There is a vocal public that supports climate action and advocates for specific environmental policies.

Region B:

There are no strong policies at the provincial level that support sustainability initiatives, and progress toward climate targets is not well measured. Government and industry have well-established contracts, and are unwilling to deviate from norms. Agriculture is dominated by a small number of large businesses. The few that have made climate commitments do so in order to gain competitive advantage, and approach their siloed initiatives as branding opportunities. The public is hostile to climate policies, which they see as a burden on business and individuals.

In the example to the left, Region A has much greater transformative capacity than Region B, and it will be much more fertile ground for integrated climate action (of course, these examples are an extreme caricature of reality; any real-world situation will be somewhere in between). The point is that the existing conditions of a region – its transformative capacity – will make integrated climate action easier in some ways and harder in others.

The idea of transformative capacity is that “a multitude of vocational and academic skills are required for the application of a transition management approach including systems thinking, creativity, theory-to-practice application skills, diplomatic skills for forging partnerships and learning alliances, and openness to learning-by-doing during experimentation.”^[23]

The magnitude and complexity of integrated climate action across multiple dimensions makes it hard for any single actor, especially a small or medium-sized local government, to know where to begin. Diagnosing the transformative capacity of the system is a good place to start.

[23] Frantzeskaki, “Bringing Transition Management to Cities.”

The elements of transformative capacity

This table lists the elements of transformative capacity and associates them with specific OSC tools and principles:

Element: Inclusive and multiform governance ²⁴	
Action	Open Smart Cities Resources
Participation and inclusiveness; diverse governance modes and network forms; local intermediaries and hybridization	<ul style="list-style-type: none"> • Gagnon-Turcotte, Sculthorp, and Coutts, “Digital Data Partnerships” • Open North, “The Hub Model” • Ferron, “Open and Ethical Procurement Guide on Engaging with the Private Sector.” • The Firelight Group, “Open Smart City Initiatives as Tools for Indigenous Data Sovereignty.” • Wylie and Claudel, “Technology Procurement.” • Claudel and Nitoslawski, “Creating Civic Value in Open Smart Communities.” • Open North and British Columbia First Nations Data Governance Initiative, “Decolonizing Data.” • Wylie, Sculthorp, Gagnon-Turcotte, and Chatwin, “A Promising Path to Developing Data Governance in the Performing Arts Sector” • Free online courses <ul style="list-style-type: none"> - Fundamentals of Resident Engagement - Digital Literacy for Residents - Civic Tech in Open Smart Cities - Intro to Accessibility for Open Smart Cities - Social Procurement Solutions • Farmer, Matthews, and Rice, “Procurement Office or ‘Living Lab’?” • Carvalho, “Can Startups Solve Urban Sustainability Challenges?” • Meijer, Lips, and Chen, “Open Governance.”
Element: Transformative leadership	
Action	Open Smart Cities Resources
Leaders in public, private, and civil society who promote integrated climate action	<ul style="list-style-type: none"> • Chatwin and Landry, “Making Cities Open by Default.” • Landry, Webster, Wylie, and Robinson, “How Can We Improve Urban Resilience with Open Data?” • Sculthorp, “Dataware: Data Literacy for Engaged Youth.” • Free online courses <ul style="list-style-type: none"> - Civic Tech in Open Smart Cities - Fundamentals of Governance in Open Smart Cities • Aitken, “Governance in the Digital Age.”

[24] Multiform governance is “the participation of citizens and communities in decision-making processes through diverse governance networks that encourage collaboration and capacity building among stakeholders. This component highlights the intermediary connections between the government and other stakeholders to guide different actors and processes” (Shahani et al., “Transformative Low-carbon Urban Innovations,” 3).

Element: Active and engaged communities of practice

Action	Open Smart Cities Resources
<p>Communities of practice that address social needs and motives; community action and autonomy</p>	<ul style="list-style-type: none"> • Gorce, “On a toutes et tous un rôle à jouer dans la gouvernance des données.” • Lauriault, Bloom, and Landry, “Open Smart Cities Guide.” • Linder and Chatwin, “Canada’s Smart Tech Future.” • Faria and Lauriault, “Smart Home Technology Facilitated Violence.” • Aunio, Begg, and Aubert, “Nourishing Smart City Solutions.” • Qarri and Gill, “Smart Cities and Human Rights.” • Free online courses <ul style="list-style-type: none"> - Fundamentals of Resident Engagement - Digital Literacy for Residents - Civic Tech in Open Smart Cities • Free online courses <ul style="list-style-type: none"> - Intro to Accessibility for Open Smart Cities - Social Procurement Solutions - Fundamentals of Indigenous Data Sovereignty • The City of Montreal, “Montréal’s Digital Data Charter.” • CivicTechYYC, “Tech for Good.” • Municipal Innovators Community, “Communities of Practice.” • Alberta Smart City Alliance, “Innovating through Collaboration / Smart City Alliance.” • MISA/ASIM Canada, “Municipal Information Systems Association.” • Fosbenner, “Public Participation in Municipal Climate Action Planning: Exploring Deliberative Methods.”

Element: System awareness & memory

Action	Open Smart Cities Resources
<p>Baseline analysis and system awareness; recognition of path dependencies</p>	<ul style="list-style-type: none"> • Landry, Webster, Wylie, and Robinson, “How Can We Improve Urban Resilience with Open Data?” • Landry, “State of Open Data Chapter 16.” • Open North, “Open Smart Communities: Emerging Issues—Infrastructure & Sustainability.” [webinar] • Open North, “Open Smart Communities: Emerging Issues—Data Collaboration and Food Policy.” [webinar] • Kane, Levine, Orians, and Reinelt, “Contribution Analysis in Policy Work Assessing Advocacy’s Influence.”

Element: Sustainability foresight

Action	Open Smart Cities Resources
<p>Diversity and transdisciplinary co-production of knowledge; collective vision for radical sustainability changes; exploring alternative scenarios and future pathways</p>	<ul style="list-style-type: none"> • Nitoslawski, “Managing Urban Green Infrastructure for Climate Change Through an Open Smart City Lens.” • Biss and Robinson, “Parks and Open Spaces.” • Lauriault, Leone, and Ivanoff, “Shared Mobility in Canada.” • Aunio, Begg, and Aubert, “Nourishing Smart City Solutions.” • Open North, “Open Smart Communities: Emerging Issues—Technology Procurement & Shared Mobility in the Smart City.” [webinar] • Open North, “Open Smart Communities: Emerging Issues—Smart Home Technology-Facilitated Violence.” [webinar] • Free online courses <ul style="list-style-type: none"> - Fundamentals of Open Smart Cities - Fundamentals of Indigenous Data Sovereignty - Fundamentals of Resident Engagement

Element: Experimentation

Action	Open Smart Cities Resources
<p>Diverse community-based experimentation with disruptive technologies, systems, policies or processes</p>	<ul style="list-style-type: none"> • Open North, “Open Data for Smart City and Urban Development.” • Open North, “Open Smart Communities: Emerging Issues—Technology Procurement & Shared Mobility in the Smart City.” [webinar] • Farmer, Matthews, and Rice, “Procurement Office or ‘Living Lab’?” • Carvalho, “Can Startups Solve Urban Sustainability Challenges?” <ul style="list-style-type: none"> • Free online courses <ul style="list-style-type: none"> - Developing a Privacy Policy - Developing an IT Procurement Policy - Developing an Open Data Policy • Government of Canada, “Open Resource Exchange.” • Amnesty International and Access Now, “The Toronto Declaration.” • Université de Montréal, “Declaration of Montréal for a Responsible Development of AI.” • Goodman, Zwick, Spicer, and Carlsen, “Public Engagement in Smart City Development.”

Element: Embedding

Action	Open Smart Cities Resources
<p>Access to resources for capacity development; planning and mainstreaming transformative action; reflexive and supportive regulatory frameworks</p>	<ul style="list-style-type: none"> • Qarri and Gill, “Smart Cities and Human Rights.” • Government of Canada, “Analyze Consultation Data” • Free online courses <ul style="list-style-type: none"> - Fundamentals of Resident Engagement - Digital Literacy for Residents - Civic Tech in Open Smart Cities • Government of Canada, “Algorithmic Impact Assessment.” • Government of Canada, “Canada’s Digital Charter in Action.”

Element: Social learning

Action	Open Smart Cities Resources
<p>Practical know-how for evaluation and iteration of projects; visibility across projects</p>	<ul style="list-style-type: none"> • Gagnon-Turcotte, Sculthorp, and Coutts, “Digital Data Partnerships.” • Government of Canada, “Analyze Consultation Data” <ul style="list-style-type: none"> • Free online courses <ul style="list-style-type: none"> - Open Contracting Data Standard for Procurement - Open Standards for Data • Evans, Vacha, Kok, and Watson, “How Cities Learn.”

Element: Working across levels

Action	Open Smart Cities Resources
<p>Capacity-building for individuals, groups, networks, and organizations; interactions between political-administrative levels and units</p>	<ul style="list-style-type: none"> • Pembleton, Ahmed, Lauriault, Landry, and Planchenault, "State of Open Smart Communities in Canada." • Wylie, Ahmed, Landry, and Gagnon-Turcotte, "COVID-19: Challenges facing open and shared COVID-19 data" • Landry and Ferron, "COVID-19: The challenges and opportunities for Canadian interoperability and open government" • Free online courses <ul style="list-style-type: none"> - Fundamentals of Resident Engagement - Digital Literacy for Residents - Civic Tech in Open Smart Cities - Fundamentals of Governance in Open Smart Cities

Table adapted from Wolfram, "Conceptualizing Urban Transformative Capacity." See also Shahani, Pineda-Pinto, and Frantzeskaki, "Transformative Low-carbon Urban Innovations."

Articulating the transformative capacity of a particular region means identifying which of these elements are missing, and which are strongly present. For example, there may be cleantech innovations emerging from a local university that are failing because they are prohibited by an archaic land use policy. In this case, the system's strength is an empowered academic *community of practice*, but there are barriers to *experimentation and embedding*. We could imagine a test bed program for new technologies, where certain aspects of the zoning code are carefully suspended in order to examine the technology's potential. Improving the region's transformative capacity creates 'windows of opportunity for integrated climate action.'²⁵

The test bed example also shows that these elements work in concert. Climate action plans often focus on a single element of transformative capacity, such as local leadership, baseline data analysis, or a new technology experiment. It is crucial, however, to mobilize coherently on all fronts. Such mobilization depends on the aligned work of many different actors – it is a matter of sustained coordination. Digital tools can enable such "emerging innovative forms of governing cities...this requires an understanding of governance as a platform that facilitates an urban ecosystem." For this reason, "inclusive and multiform governance" forms a foundation on which the other elements of transformative capacity can build.²⁶

[25] Shahani et al., "Transformative Low-carbon Urban Innovations."

[26] See Meijer, Lips, and Chen, "Open Governance: A New Paradigm for Understanding Governance in a Digital Age": "The introduction of new tools for open collaboration in the public domain is rapidly changing the way collaborative action is organized. These technologies reduce the transaction costs for massive collaboration dramatically and thus facilitate new forms of collaboration that we could call "open governance": new innovative forms of collective action aimed at solving complex public policy issues, contributing to public knowledge, or replacing traditional forms of public service provision."



Small municipalities have a unique set of strengths and challenges in implementing climate change mitigation strategies. These factors must be addressed in order to take full advantage of climate action opportunities and reap the economic and quality of life co-benefits that they can generate.



– Partners for Climate Protection. “Small and Rural Communities Climate Action Guidebook.”

Supporting Integrated Climate Action in Open Smart Communities

This section begins with a summary of observations from the case studies (detailed information about the cases is included in the Appendix). Using the transformative capacity framework as an interpretive lens, these observations include challenges that small and medium-sized municipalities face, trends in municipal climate action, and what key resources or tools cities are missing. The section concludes with a discussion of how intermediary organizations can provide these key tools and support the development of transformative capacity, in partnership with municipalities.

How are municipalities currently approaching the challenges of climate change?

Are there common gaps in transformative capacity?

How can intermediary organizations increase the transformative capacity of municipalities and regions, and work with them to advance integrated climate action?

To answer these questions, we reviewed a broad spectrum of action frameworks, playbooks, and policy guides for climate action, as well as academic literature. We performed a cursory landscape scan of small and mid-sized Canadian municipalities and of the intermediary organizations that support them (resources and details about the cases are included in the Appendix).

A promising foundation exists in Canada. Commitments at the federal level gesture toward integrated climate action. The [A Healthy Environment and a Healthy Economy](#) plan states that “every order of Government, every sector of the economy, every region, every community, every Canadian has a role to play in this moment of our shared history. [The federal climate plan] is not an end point. Reaching the goal will require a sustained effort for years and decades to come.”²⁷

At the local level, coalitions like the [Climate Montreal Partnership](#) are working to “mobilize economic, philanthropic, institutional and community forces to accelerate the decarbonization of the metropolis and strengthen its resilience” in six priority areas:

building, mobility, business, adaptation, community-led initiatives, and finance.

And yet local climate action is heterogeneous. It is particularly challenging for small to medium-sized municipalities to translate federal agendas into the language and frameworks of local planning, and it can be challenging to marshal resources and partnerships across jurisdictions, sectors, and domains – both gaps in transformative capacity. In short, the cases not only highlighted a need for integrated climate action, but also provided several important insights about how best to bolster local transformative capacity. The following list is not exhaustive; rather, it includes important recurring challenges that stand in the way of integrated climate action.

Common challenges for small to medium-sized municipalities:

Misaligned climate targets.

Climate action commitments at the higher levels of government are difficult to apply at the local level. There are international frameworks and multilateral agreements – such as the Sustainable Development Goals and the Paris Accord – and there are national decarbonization and sustainability targets.²⁸ And yet it is difficult to bring those down to a local level. There are tools for accounting greenhouse gas emissions or modeling the impact of climate change, but they are not tuned to local conditions, or require an unrealistic level of technical expertise. This can make it difficult to align local action with higher levels of government, and to align local organizations toward shared goals.

Transformative Capacities: Working Across Levels; System Awareness & Memory

Resource constraints & outsourcing.

Small and mid-sized municipalities have fewer staff – especially staff devoted to climate action and staff with technical capabilities (e.g. knowledge of open data management). They also have fewer resources – especially for climate action planning and execution, and for technology procurement and deployment. For both reasons, these governments depend on external consultants for vision-oriented work and technical work related to climate change.

Transformative Capacities: Embedding; Social Learning; Transformative Leadership; System Awareness & Memory

[27] Government of Canada, “A Healthy Environment and a Healthy Economy.”

[28] See, for example, Government of Canada, “A Healthy Environment and a Healthy Economy,” a federal “plan that achieves both our environmental goals and our economic hopes: clean air, clean water and long-term secure jobs. It is a plan that builds on the strengths and achievements of our existing progress while ramping up our ambition with a series of new or strengthened federal measures. It is a plan that seeks to mobilize the full breadth of Canada’s ingenuity and resources to reimagine a future that is secure, just and clean.

Political polarization.

Some communities – particularly those that depend on greenhouse gas-intensive core industries, like manufacturing, oil and gas, or meat production – have a bias against climate change rhetoric. Communities may reject proposed climate action agendas, or choose not to align their resources and businesses with climate action initiatives.

Transformative Capacities: Embedding; Inclusive & Multiform Governance; Transformative Leadership; Empowered Communities of Practice

Technicality of measurement.

It is challenging to measure climate indicators and long-term progress over time – measurement can be technically complex and requires sustained commitment over many years. Intermediary organizations like ICLEI Canada provide tools, but using them remains a challenge. As a result, cities hire consulting firms to perform technical analyses. Furthermore, there are many shortfalls in measurement and accounting methods. For example, rural meat production bears the burden of emissions while consumption happens in cities. It can be difficult to identify the “depth” of accounting along a supply and distribution chain.

Transformative Capacities: Sustainability Foresight; System Awareness & Memory; Embedding

Election cycles & short-termism.

Democratic election cycles hinder long-term agendas. Inheriting a climate action plan from a prior administration confers none of the political benefit (branding) and introduces political risks (working to revise a poor plan, or working to fulfill the commitments of a rigorous one). Disclosure of poor performance, measured against a previous administration’s agenda, is a political hazard. For the same reason, it is often easier for a politician to launch a net-new program rather than change the city’s existing operations – even if the latter will have greater impact.

Transformative Capacities: Transformative Leadership; Embedding; Social Learning; System Awareness & Memory

Regional coordination.

There is little regional coordination across jurisdictions (e.g. adjacent municipalities in a county). Regional planning bodies can help (e.g. metropolitan planning associations, county-level working groups), but they seldom have the budget or political power to meaningfully advance climate action work.

Transformative Capacities: Working Across Levels; Sustainability Foresight; Inclusive & Multiform Governance

Leverage.

Most communities have some kind of climate plan and sustainability commitments, often through frameworks like the Partners for Climate Protection program through the Global Covenant of Mayors for Climate & Energy. However, those commitments are often based on factors that are not directly within municipal control. Success depends on partnerships, multilateral agreement, and indirect influence (e.g. new norms in the real estate development sector). Most municipal governments have a broad motivation to foster industry and economic development, but this can be a perverse incentive that undermines the ambitions of climate action.

Transformative Capacities: Experimentation; Embedding; Empowered Communities of Practice

What municipalities need

Gaps in transformative capacity can be filled with specific tools, programs, and initiatives. As the International Climate Initiative reports in *Unlocking the Power of Integrated Climate Action*, “instruments are needed to operationalize the integrated approach effectively into strategic planning.”²⁹ Many of these instruments will be digital, emerging from the field of smart cities. More broadly, the principles of Open Smart Communities should be applied. The following is a very preliminary list of resources (including tools and principles) that could bolster the transformative capacity of small to mid-sized Canadian communities.

1. Support, consulting, knowledge resources for municipalities to **build internal capacity**
2. Neutral convening spaces that enable effective **regional coordination**
3. Support, precedents, and templates for **writing climate action policies**
4. Environmental **data strategies**:
 - a. Data collection programs (using sensors or existing data sources)
 - b. Metadata that enables simplified, actionable data analysis
 - c. Data collection and management standards, interoperability frameworks³⁰
5. Quantitative and qualitative **scenario and risk modeling tools** that support decision making and communications
6. Digital and analog tools, as well as protocols for **meaningfully engaging stakeholders**³¹
7. Proactive and ethical **market engagement protocols** that municipalities can use to address technology providers
8. Support and strategic analysis for municipalities to **align disparate initiatives and capital projects** so that they support climate action initiatives

[29] International Climate Initiative, “Unlocking the Power of Integrated Climate Action.”

[30] There are many existing sources of environmental data (both public and proprietary), and some efforts at aggregation. However, these are heterogeneous. The Minister of Environment and Climate Change, the Minister for Natural Resources, the President of the Queen’s Privy Council for Canada, and the Minister of Emergency Preparedness are working collaboratively to “develop a climate data strategy to ensure that the private sector and communities have access to data to inform planning and infrastructure investments” (Office of the Prime Minister, “Mandate Letter to the Minister for Natural Resources”). Municipalities will need support in adopting and implementing this climate data strategy together with partners across sectors.

[31] Meaningful engagements means that residents and stakeholders are engaged for a clear purpose and that they are able to impact the policy-making process or outcome. Meaningful engagement builds trust and long-term relationships between those who are engaged and the government. Our definition of meaningful engagement derives from Arnstein’s “Ladder of Citizen Participation.”

The role of intermediary organizations

Integrated climate action is not the responsibility of any single organization, but it is challenging for any single organization – particularly a small or mid-sized municipal government – to know where to begin. It is here that intermediary organizations can provide support.

Intermediary organizations are bodies that aim to facilitate a hybrid praxis of research, policy, technology, and implementation. These organizations can act as knowledge generators and brokers,³² social capital and network builders,³³ program managers and administrators, and advocates.³⁴ Intermediary organizations play a vital role in local climate action. They provide resources for municipalities with potentially limited capacity and expertise; manage funding and training programs; and support network creation, peer learning, and knowledge sharing across local, national, and global scales, among many others. In short, intermediary organizations build capacity while also aligning stakeholders across domains, sectors, and jurisdictions around a common vision.

On a pragmatic level, the barriers to integrated climate action manifest at the seams between sectors, jurisdictions, and domains. Intermediary organizations can institutionalize and formalize structures that promote alignment and cooperation

– such as harmonized data collection and analysis methods. They can provide a neutral convening space – such as a cohort of urban climate action fellows – where disparate actors rally around shared initiatives, or overcome institutional histories that have generated mistrust. Intermediaries can provide on-the-ground support, helping civil servants to first evaluate the transformative capacity of their own complex local systems, then design integrated climate action initiatives accordingly. Finally, intermediary organizations can develop specific tools, such as greenhouse gas emissions accounting software,³⁵ and make them available to municipalities.

In the Canadian context, there are many organizations that focus on climate change and environmental action, including, but not limited to, the Federation of Canadian Municipalities (through programs such as Green Municipal Fund, Global Covenant of Mayors for Climate and Energy, and Low Carbon Cities Canada), The Canadian Institute for Climate Choices, ICLEI – Local Governments for Sustainability, Nature United, and the Canadian Environmental Law Association. Many youth-based organizations (e.g. Sunrise Movement Canada) have also emerged to support organizing and advocacy. Technology- and smart city-oriented organizations, such as Code for

[32] Cooper, “Knowledge Mobilization in Education across Canada.”

[33] Boakye-Danquah and Reed, “The Participation of Non-industrial Private Forest Owners in Forest Certification Programs.”

[34] Youtie, Ward, Shapira, and Schillo, “Exploring New Approaches to Understanding Innovation Ecosystems.”

[35] See, for example, the free GHG emissions tool by Evenements Verts.

Canada and the Canadian Urban Institute, provide information and resources on data-driven approaches to urban governance. Community-based organizations (e.g. Beta City YEG and Civic Tech Toronto) in particular have a key role to play in bridging gaps between the public sector, business, and citizens.

There is no binding institution at the intersection of data, technology, and climate action. As the lead technical partner for the Community Solutions Network, Open North is ideally suited to advance a powerful new agenda: to jointly build transformative capacity and promote integrated climate action with Canada's small and medium-sized municipalities.

Conclusion: Next Steps

The early years of the Open Smart Cities movement laid an important foundation for integrated climate action in three ways: First, the emergence of specific technologies, tools, and forms of expertise, primarily focused on automation, efficiency, sustainability, and data management (collection, analysis, interoperability, and openness); second, a values-led approach to contemporary issues related to technology, governance, and engagement; and third, a familiarity with multidimensional approaches to transformative projects (crossing domains, sectors, and jurisdictions).

The rapid acceleration of climate change has raised the stakes of environmental action and inaction. Today, the climate crisis binds us all together: every sector, domain, and jurisdiction. A broad and well-established landscape of advocacy groups, organizations, consultancies, and technology firms are focused on climate action – and their number is increasing.

This paper is a preliminary exploration of contemporary climate action, and it is, above all, a statement of Open North's intent to contribute. We see an opportunity for Open North to renew its organizational focus to include sustainability issues, specifically by aligning technology, data policy, and Open Smart Community principles with the far-reaching agenda of integrated climate action. Rather than delivering answers, this paper concludes with a number of important questions:

What are the existing strengths and gaps in the stakeholder ecosystem (intermediaries, firms, and higher orders of government) working on climate action in Canada?

How can Open North complement the work that others are doing?

What specific resources do municipalities and their partners need?

Which of those resources are already available, and might Open North be capable of offering?

How can Open North be held accountable in its climate action work?

The first step in answering these questions will be to engage with the existing landscape of actors. We hope that this paper is an open invitation to begin generative conversations. By listening, we believe that we can find collaborative pathways toward strengthening the foundations that others have built, and complementing the growing climate action movement with the specific expertise we can offer.

A partner-first approach will position Open North to collaboratively support capacity-building at the local government level, working with other actors to help cities evaluate the space of opportunity through a transformative capacity lens, and then design initiatives for integrated climate action, using new or existing resources.

The next step will be to fill the need for a neutral common ground that facilitates connections across regional networks

(multisector), across governmental levels and boundaries (multijurisdiction), and across areas of focus (multidomain).

By engaging stakeholders, exploring partnerships, and convening neutral spaces, we hope to cooperatively discover specific tools and resources that municipalities lack. These might include data collection programs and data standardization frameworks, climate impact scenario modeling, or stakeholder engagement tools, among many others. We are committed to finding these needs and working to fill them.

This paper is the starting point of a meaningful journey toward building internal capacity at Open North, and an external community of practice that allows our organization to leverage open smart-city technologies in keeping with OSC principles, with a goal of promoting integrated climate action.

Appendices

References

- Aitken, Kent. "Governance in the Digital Age." Public Policy Forum, September 26, 2018. <https://ppforum.ca/publications/governance-in-the-digital-age/>.
- Alberta Smart City Alliance. "Innovating through Collaboration / Smart City Alliance." <https://smartcityalliance.ca/>.
- Amnesty International and Access Now, "The Toronto Declaration." 2022. <https://www.torontodeclaration.org/>.
- Arnstein, Sherry R. "A Ladder of Citizen Participation." *Journal of the American Institute of Planners* 35, no. 4 (1969): 216-24. <https://doi.org/10.1080/01944366908977225>.
- Aunio, Anna-Liisa, Rachel Begg, and Anne-Marie Aubert. "Nourishing Smart City Solutions: Data Collaboration and Food Policy." Future Cities Canada, February 12, 2021. <https://futurecities-canada.ca/portal/resources/nourishing-smart-city-solutions-data-collaboration-and-food-policy/>.
- Biss, Danielle Lenarcic, and Pamela Robinson. "Parks and Open Spaces: Challenges and Opportunities of Smart Technologies." Community Solutions Network Research Brief. Future Cities Canada, March 24, 2021. <https://futurecitiescanada.ca/portal/resources/parks-and-open-spaces-challenges-and-opportunities-of-smart-technologies/>.
- Boakye-Danquah, John, and Maureen G. Reed. "The Participation of Non-industrial Private Forest Owners in Forest Certification Programs: The Role and Effectiveness of Intermediary Organizations." *Forest Policy and Economics* 100 (March 2019): 154-63. <https://doi.org/10.1016/j.forpol.2018.12.006>.
- Canadian Climate Institute. "Mission." <https://climatechoices.ca/what-we-do/>.
- Carvalho, Luís. "Can Startups Solve Urban Sustainability Challenges?" Regional Studies Association. <https://regions.regionalstudies.org/ezone/article/can-startups-solve-urban-sustainability-challenges/>.
- Castán Broto, Vanesa, Gregory Trencher, Ewa Iwaszuk, and Linda Westman. "Transformative Capacity and Local Action for Urban Sustainability." *Ambio* 48, no. 5 (May 2019): 449-62. <https://doi.org/10.1007/s13280-018-1086-z>.
- Chatwin, Merlin, and Jean-Noé Landry. "Making Cities Open by Default: Lessons from Open Data Pioneers." Open North, February 6, 2018. <https://opennorth.ca/publications/making-cities-open-by-default-lessons-from-open-data-pioneers/>.
- The City of Montreal. "Montréal's Digital Data Charter." October 2020. https://laburbain.montreal.ca/sites/villeintelligente.montreal.ca/files/25817-charte_donnees_numeriques_ang.pdf.

- CivicTechYYC, "Tech for Good." <https://civictechyyc.ca/>.
- Claudel, Matthew, and Sophie Nitoslawski. "Creating Civic Value in Open Smart Communities." Open North, October 28, 2021. <https://opennorth.ca/publications/creating-civic-value-in-open-smart-communities/>.
- Cooper, Amanda. "Knowledge Mobilization in Education across Canada: A Cross-case Analysis of 44 Research Brokering Organizations." *Evidence & Policy: A Journal of Research Debate and Practice* 10, no. 1. <https://doi.org/10.1332/174426413X662806>.
- Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH, Factor, and International Climate Initiative. "A New Narrative of Resilient and Climate Smart Societies: Aligning Adaptation, Mitigation and the SDGs." 2019. <https://www.adaptationcommunity.net/wp-content/uploads/2020/01/A-New-Narrative-for-Resilient-and-Climate-Smart-Societies.pdf>.
- Evans, James, Tomas Vacha, Henk Kok, and Kelly Watson. "How Cities Learn: From Experimentation to Transformation." *Urban Planning* 6, no. 1 (March 2021). <https://doi.org/10.17645/up.v6i1.3545>.
- Evenements Verts. "GHG Emissions Tool." <https://evenementsverts.com/boutique/>.
- Farmer, Tyler, Mairead Matthew, and Faun Rice. "Procurement Office or 'Living Lab': Experimenting with Procurement and Partnerships for Smart Cities Technologies in Canada." Information and Communications Technology Council, February 2021. <https://www.digitalthinktankictc.com/ictc-admin/resources/admin/ictcreportsmartcitieseng-1.pdf>.
- Faria, Olivia and Tracey Lauriault. "Smart Home Technology Facilitated Violence." Future Cities Canada, February 1, 2021. <https://futurecitiescanada.ca/portal/resources/smart-home-technology-facilitated-violence/>.
- Federation of Canadian Municipalities. "Rural Challenges, National Opportunity." May 2018. <https://fcm.ca/en/resources/rural-challenges-national-opportunity>.
- Federation of Canadian Municipalities and Insurance Bureau of Canada. "Investing in Canada's Future: The Cost of Climate Adaptation at the Local Level." February 2020. <https://data.fcm.ca/documents/reports/investing-in-canadas-future-the-cost-of-climate-adaptation.pdf>.
- Fernandez-Bou et al. "3 Challenges, 3 Errors, and 3 Solutions to Integrate Frontline Communities in Climate Change Policy and Research: Lessons From California." *Frontiers in Climate*, September 6, 2021. <https://doi.org/10.3389/fclim.2021.717554>.
- Ferron, Pierre-Antoine. 2020. "Open and Ethical Procurement Guide on Engaging with the Private Sector." Open North, December 15, 2020. <https://opennorth.ca/publications/open-and-ethical-procurement-guide-on-engaging-with-the-private-sector/>.
- The Firelight Group and Open North. "Open Smart City Initiatives as Tools for Indigenous Data Sovereignty." Future Cities Canada, December 10, 2021. <https://futurecitiescanada.ca/portal/resources/open-smart-city-initiatives-as-tools-for-indigenous-data-sovereignty/>.

- Fosbenner, Lauren. "Public Participation in Municipal Climate Action Planning: Exploring Deliberative Methods." Alliance for Sustainable Communities, August 27, 2019. <https://www.sustainlv.org/focus-on/public-participation-in-climate-action-planning/>.
- Frantzeskaki, Niki. "Bringing Transition Management to Cities: Building Skills for Transformative Urban Governance." *Sustainability* 14, no. 2 (2022): 650. <https://doi.org/10.3390/su14020650>.
- Gagnon-Turcotte, Sarah, Miranda Sculthorp, and Steve Coutts. "Digital Data Partnerships." Open North, February 1, 2021. <https://opennorth.ca/publications/digital-data-partnerships/>.
- Goodman, Nicole, Austin Zwick, Zachary Spicer, and Nina Carlsen. "Public Engagement in Smart City Development." *The Canadian Geographer* 64, no. 3 (Fall 2020): 416-32. <https://doi.org/10.1111/cag.12607>.
- Gorce, Lauriane. "On a toutes et tous un rôle à jouer dans la gouvernance des données" [We all have a role to play in data governance]. Think Tank Numérique, October 27, 2021. <https://thinktanknumeriquectic.com/nos-articles/on-a-toutes-et-tous-un-role-a-jouer-dans-la-gouvernance-des-donnees>.
- Government of Canada. "Algorithmic Impact Assessment." Last modified March 22, 2021. <https://open.canada.ca/aia-eia-js/?lang=en>.
- Government of Canada. "Analyze Consultation Data." Privy Council Office. Last modified March 18, 2020. <https://www.canada.ca/en/privy-council/services/public-engagement-resources/content-analysis-consultations.html>.
- Government of Canada. "Canada's Digital Charter in Action: A Plan by Canadians, for Canadians." Last modified October 23, 2019. https://www.ic.gc.ca/eic/site/062.nsf/eng/h_00109.html.
- Government of Canada. "A Healthy Environment and a Healthy Economy." Last modified August 4, 2021. <https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/climate-plan-overview/healthy-environment-healthy-economy.html>.
- Government of Canada. "Open Resource Exchange." <https://code.open.canada.ca/en/index.html>.
- International Climate Initiative. "Unlocking the Power of Integrated Climate Action." https://www.international-climate-initiative.com/en/iki-media/news/unlocking_the_power_of_integrated_climate_action/.
- Johnson, Eric, and Carol VandenHoek. "Agricultural Law in Canada: Overview." Thomson Reuters Practical Law. Law stated as at August 1, 2020. <https://uk.practicallaw.thomsonreuters.com/w-027-9006>.
- Kane, Robin, Carlisle Levine, Carlyn Orians, and Claire Reinelt. "Contribution Analysis in Policy Work Assessing Advocacy's Influence." Center for Evaluation Innovation, 2019. https://www.evaluationinnovation.org/wp-content/uploads/2017/11/CONT_ANAL_PAGES_081221.pdf.
- Landry, Jean-Noé, Keira Webster, Bianca Wylie, and Pamela Robinson. "How Can We Improve Urban Resilience with Open Data?" Open North, December 23, 2016. <https://opennorth.ca/publications/how-can-we-improve-urban-resilience-with-open-data/>.

- Landry, Jean-Noé. "State of Open Data Chapter 16. Urban Development." Open North, October 1, 2019. <https://open-north.ca/publications/state-of-open-data-chapter-16-urban-development/>.
- Landry, Jean-Noé and Pierre-Antoine Ferron. "COVID-19: The Challenges and Opportunities for Canadian Interoperability and Open Government." Open North, May 10, 2020. <https://opennorth.ca/publications/covid-19-the-challenges-and-opportunities-for-canadian-interoperability-and-open-government/>.
- Lauriault, Tracey P., Rachel Bloom, and Jean Noé Landry. "Open Smart Cities Guide." Open North, April 1, 2018. <https://opennorth.ca/publications/open-smart-cities-guide/>.
- Lauriault, Tracey P., Donato Leone, and Julie Ivanoff. "Shared Mobility in Canada: Considerations for Open Smart Cities." Future Cities Canada, March 3, 2021. <https://futurecitiescanada.ca/portal/resources/shared-mobility-in-canada-considerations-for-open-smart-cities/>.
- Leydesdorff, Loet. 2012. "The Triple Helix, Quadruple Helix, ..., and an N-Tuple of Helices: Explanatory Models for Analyzing the Knowledge-Based Economy?" *Journal of the Knowledge Economy* 3 (2012): 25-35. <https://doi.org/10.1007/s13132-011-0049-4>.
- Lindeman, Tracey. "The Future of the Food Supply Chain Lives on a Rooftop in Montreal." *Fortune*, February 6, 2021. <https://fortune.com/2021/02/06/brainstorm-reinvent-rooftop-farming-lufa-farms-montreal-canada/>.
- Linder, Thomas and Merlin Chatwin. "Canada's Smart Tech Future." *Monitor*, January 1, 2022. <https://monitormag.ca/articles/canadas-smart-tech-future-open-cities-or-opaque-surveillance>.
- Meijer, Albert Jacob, Miriam Lips, and Kaiping Chen. "Open Governance: A New Paradigm for Understanding Governance in a Digital Age." *Frontiers in Sustainable Cities* (August 28, 2019). <https://doi.org/10.3389/frsc.2019.00003>.
- Municipal Innovators Community, "Communities of Practice." <https://municipalinnovators.ca/communities-of-practice>.
- NASA. "Responding to Climate Change." Global Climate Change. Last updated March 23, 2022. <https://climate.nasa.gov/solutions/adaptation-mitigation/>.
- Nitoslawski, Sophie. "Managing Urban Green Infrastructure for Climate Change Through an Open Smart City Lens." Community Solutions Network Research Brief. Future Cities Canada. 2021. <https://futurecitiescanada.ca/portal/resources/managing-urban-green-infrastructure-for-climate-change-through-a-smart-city-lens/>.
- Office of the Prime Minister. "Mandate Letter to the Minister for Intergovernmental Affairs, Infrastructure and Communities." December 16, 2021. <https://pm.gc.ca/en/mandate-letters/2021/12/16/minister-intergovernmental-affairs-infrastructure-and-communities>.
- Office of the Prime Minister. "Mandate Letter to the Minister for Natural Resources." December 16, 2021. <https://pm.gc.ca/en/mandate-letters/2021/12/16/minister-natural-resources-mandate-letter>.
- Oulahen, Greg, Yaheli Klein, Linda Mortsch, Erin O'Connell, and Deborah Harford. "Barriers and Drivers of Planning for

- Climate Change Adaptation across Three Levels of Government in Canada.” *Planning Theory & Practice* 19, no. 3 (2018): 405-21. <https://doi.org/10.1080/14649357.2018.1481993>.
- Open North. “The Hub Model: The Potential for Philanthropic Intervention in Integrated Service Delivery.” June 19, 2018. <https://opennorth.ca/publications/the-hub-model-the-potential-for-philanthropic-intervention-in-integrated-service-delivery/>.
- Open North. “Open Data for Smart City and Urban Development: Cases of Open Data Production and Use in the Global South.” July 17, 2019. <https://opennorth.ca/publications/open-data-for-smart-city-and-urban-development-cases-of-open-data-production-and-use-in-the-global-south/>.
- Open North. “Open Smart Communities: Emerging Issues—Food Policy & Data Collaboration” [webinar]. Vimeo, June 30, 2021. <https://vimeo.com/579403382>.
- Open North. “Open Smart Communities: Emerging Issues—Infrastructure & Sustainability” [webinar]. Vimeo, June 16, 2021. <https://vimeo.com/579388757>.
- Open North. “Open Smart Communities: Emerging Issues—Smart Home Technology-Facilitated Violence” [webinar]. Vimeo, July 28, 2021. <https://vimeo.com/580683555>.
- Open North. “Open Smart Communities: Emerging Issues—Technology Procurement & Shared Mobility” [webinar]. Vimeo, July 14, 2021. <https://vimeo.com/579415217>.
- Open North and British Columbia First Nations Data Governance Initiative. “Decolonizing Data: Indigenous Data Sovereignty Primer.” 2017. http://bcfndgi.squarespace.com/s/Decolonizing-Da-ta-FN_DATA_SOVEREIGNTY_PAPER.docx.
- Partners for Climate Protection. “Small and Rural Communities Climate Action Guidebook.” 2021. https://assets-global.website-files.com/6022ab403a6b2126c03ebf95/607d839e9feb3a640fb82fd9_Small%20and%20Rural%20Communities%20Guidebook_EN.pdf.
- Pembleton, Corey, Nabeel Ahmed, Tracey P. Lauriault, Jean-Noé Landry, and Mélina Planchenault. “The State of Open Smart Communities in Canada.” Open North, 2019. <https://opennorth.ca/publications/the-state-of-open-smart-communities-2019/>.
- Plamondon, Marie. “Decoding the Opportunities and Pitfalls of Open Smart Cities.” Open North, May 19, 2021. <https://opennorth.ca/2021/05/decoding-the-opportunities-and-pitfalls-of-open-smart-cities/>.
- Qarri, Ana, and Lex Gill. “Smart Cities and Human Rights.” Open North, February 3, 2022. <https://opennorth.ca/publications/smart-cities-and-human-rights/>.
- Schütz, Florian, Marie Lena Heidingsfelder, and Martina Schraudner. “Co-shaping the Future in Quadruple Helix Innovation Systems: Uncovering Public Preferences toward Participatory Research and Innovation.” *She Ji: The Journal of Design, Economics, and Innovation* 5, no. 2 (2019): 128-46. <https://doi.org/10.1016/j.sheji.2019.04.002>.
- Sculthorp, Miranda. “Dataware: Data Literacy for Engaged Youth.” Open North, May 1, 2020. <https://opennorth.ca/publications/dataware-data-literacy-for-engaged-youth/>.

- Shahani, Fatemeh, Melissa Pineda-Pinto, and Niki Frantzeskaki. "Transformative Low-carbon Urban Innovations: Operationalizing Transformative Capacity for Urban Planning." *Ambio* 51 (2022): 1179-98. <https://doi.org/10.1007/s13280-021-01653-4>.
- Spicer, Zachary, Nicole Goodman, and Nathan Olmstead. "The Frontier of Digital Opportunity: Smart City Implementation in Small, Rural and Remote Communities in Canada." *Urban Studies* 58, no. 3 (2021): 535-58. <https://doi.org/10.1177/0042098019863666>.
- Town of Bridgewater. "Open Smart City Policy." September 28, 2020. <https://www.bridgewater.ca/town-council/town-by-laws-and-policies/policies/2026-policy-103-open-smart-community-pilot-new-28-september-2020/file>.
- UN-Habitat. "Cities and Pandemics: Towards a More Just, Green and Healthy Future." March 30, 2021. https://unhabitat.org/sites/default/files/2021/03/executive_summary_-_cities_and_pandemic_report_2.pdf.
- UN-Habitat. "International Guidelines on Urban and Territorial Planning." 2015. https://www.uclg.org/sites/default/files/international_guidelines_on_urban_and_territorial_planning_un_habitat.pdf.
- Université de Montréal. "Declaration of Montréal for a Responsible Development of AI." 2017. <https://www.montrealdeclaration-responsibleai.com/>.
- Weeden, S. Ashleigh and Wayne Kelly. "The Digital Divide Has Become a Chasm: Here's How We Bridge the Gap." Centre for International Governance Innovation, July 26, 2021. <https://opennorth.ca/publications/covid-19-the-challenges-and-opportunities-for-canadian-interopability-and-open-government/>.
- Wolfram, Marc. "Conceptualizing Urban Transformative Capacity: A Framework for Research and Policy." *Cities* 51 (2016): 121-30. <https://doi.org/10.1016/j.cities.2015.11.011>.
- Wylie, Bianca, and Matthew Claudel. "Technology Procurement: Shaping Future Public Value." Future Cities Canada, March 3, 2021. <https://futurecitiescanada.ca/portal/resources/technology-procurement-shaping-future-public-value/>.
- Wylie, Megan, Nabeel Ahmed, Jean-Noé Landry, and Sarah Gagnon-Turcotte. "COVID-19: Challenges Facing Open and Shared COVID-19 Data." Open North, August 11, 2020. <https://opennorth.ca/publications/covid-19-challenges-facing-open-and-shared-covid-19-data/>.
- Wylie, Megan, Miranda Sculthorp, Sarah Gagnon-Turcotte, and Merlin Chatwin. "A Promising Path to Developing Data Governance in the Performing Arts Sector: Exploring Charters and Principles for Data Governance." Open North, July 23, 2021. <https://opennorth.ca/publications/promising-path-to-developing-data-governance-in-performing-arts-sector/>.
- Youtie, Jan, Robert Ward, Philip Shapira, and R. Sandra Schillo. "Exploring New Approaches to Understanding Innovation Ecosystems." *Technology Analysis and Strategic Management* (September 2021). <https://doi.org/10.1080/09537325.2021.972965>.

Additional resources

- Canadian Climate Institute. "Climate Choice Reports." <https://climateinstitute.ca/reports/>.
- Carayannis, Elias G., Thorsten G. Barth, and David F.J. Campbell. "The Quintuple Helix Innovation Model: Global Warming as a Challenge and Driver for Innovation." *Journal of Innovation and Entrepreneurship* 1, no. 2 (2012). <https://doi.org/10.1186/2192-5372-1-2>.
- (carbon)plan. <https://carbonplan.org/>.
- Center for Open Data Enterprise. "Summary Report: Data for Climate Risk Assessment in Vulnerable Communities." August 2021. <http://reports.opendataenterprise.org/Climate-Summary-Report-Final.pdf>.
- Centre for Public Impact. "Engaging the Public on Climate Change: What We've Learned." April 23, 2021. <https://www.centreforpublicimpact.org/insights/engaging-the-public-on-climate-change-what-we-ve-learned>.
- Cullington, Judith, Jeremy Gye, and Sairah Tyler. "Planting Our Future: A Tree Toolkit for Communities." Union of British Columbia Municipalities, Ministry of Community Development, 2008. <https://www.toolkit.bc.ca/resource/planting-our-future>.
- Daepf, Madeleine I.G., Helen Fitzmaurice, Shawn Janzen, Jaime Ponce, Asta Roseway, Juliana Felkner, Wende Copfer, Wilfred Pinfeld, and Dev Niyogi. "Popping into Focus: Community Engagement for Environmental Impact and Awareness." Microsoft, 2020. <https://www.microsoft.com/en-us/research/uploads/prod/2020/10/Community-Engagement.pdf>.
- Federation of Canadian Municipalities. "Act Locally: The Municipal Role in Fighting Climate Change." December 8, 2009. <https://fcm.ca/sites/default/files/documents/resources/report/act-locally-municipal-role-fighting-climate-change.pdf>.
- Federation of Canadian Municipalities. "Case Study: Small Town Sets Big Goals for Climate Action." <https://fcm.ca/en/resources/gmf/case-study-small-town-sets-big-goals-climate-action>.
- Geels, Frank and Johan Schot. "Typology of Sociotechnical Transition Pathways." *Research Policy* 36, no. 3 (April 2007): 399-417. <https://doi.org/10.1016/j.respol.2007.01.003>.
- Global Covenant of Mayors for Climate and Energy. "The Multilevel Climate Action Playbook for Local and Regional Governments." <https://www.globalcovenantofmayors.org/press/the-multilevel-climate-action-playbook-for-local-and-regional-governments/>.
- Government of Canada. "Library of Climate Resources." <https://climate-change.canada.ca/climate-library>.
- Greenhouse Gas Protocol. "Global Protocol for Community-Scale Greenhouse Gas Inventories: An Accounting and Reporting Standard for Cities Version 1.1." World Resources Institute, 2021. https://ghgprotocol.org/sites/default/files/standards/GPC_Full_MASTER_RW_v7.pdf.
- Hendriks, Carolyn, Richard Obernosterer, Daniel Müller, Susanne Kytzia, Peter Baccini, and Paul H. Brunner. "Material Flow Analysis: A Tool to Support Environmental Policy Decision Making. Case

- Studies on the City of Vienna and the Swiss Lowlands." *Local Environment: The International Journal of Justice and Sustainability* 5, no. 3 (2010): 311-28. <https://doi.org/10.1080/13549830050134257>.
- Jost, François, Ann Dale, Robert Newell, and John Robinson. "Climate Action Assessment in Three Small Municipalities in British Columbia: Advancements vis-à-vis Major Neighboring Cities." *Current Research in Environmental Sustainability* 2 (2020): 10010. <https://doi.org/10.1016/j.crsust.2020.100010>.
- Mendelsohn, Matthew and Noah Zon. "No Country of San Franciscos: An Inclusive Industrial Policy for Canada." Canadian Inclusive Economy Initiative, January 2021. https://brookfieldinstitute.ca/wp-content/uploads/No_Country_of_San_Franciscos-1.pdf.
- Montreal Climate Partnership. <https://climatmontreal.com/en/>.
- Open Data Charter, World Resource Institute, and The Center for Open Data Enterprise. "Open Up Guide: Using Open Data to Advance Climate Action." <https://open-data-charter.gitbook.io/open-up-guide-using-open-data-to-advance-climate-a/>.
- Pantic, Vanja. "What Cities Can Do Now to Tackle Climate Change." CitizenLab, September 24, 2021. <https://www.citizenlab.co/blog/environment-sustainability/how-public-engagement-can-help-to-tackle-climate-change/>.
- Partners for Climate Protection. "Partners for Climate Protection Protocol." 2021. <https://www.pcp-ppc.ca/resources/partners-for-climate-protection-protocol>.
- Piña, William H. Alfonso and Clara Inés Pardo Martínez. "Urban Material Flow Analysis: An Approach for Bogotá, Colombia." *Ecological Indicators* 42 (July 2014): 32-42. <https://doi.org/10.1016/j.ecolind.2013.10.035>.
- Public Policy Forum. "Toward a National Adaptation Strategy: Report One: Resilience and Adaptation Project." August 16, 2021. <https://ppforum.ca/publications/towards-a-national-adaptation-strategy/>.
- Statistics Canada. "Population Centre and Rural Area Classification 2016." <https://www.statcan.gc.ca/en/subjects/standard/pcrac/2016/introduction>.
- Statistics Canada. "Population Centre (POPCTR)." February 8, 2017. <https://www12.statcan.gc.ca/census-recensement/2016/ref/dict/geo049a-eng.cfm>.

Case studies

Churchill - [Climate Change Adaptation Strategy](#): The plan identifies various common goals as well as cross-cutting actions to address each of these goals. These objectives are the first steps toward a longer-term agenda in areas where the municipality has the capacity and competence to make changes to reduce climate change risks and increase resilience.

Fredericton - [Climate Change Adaptation Plan](#): The Climate Change Adaptation Plan (CCAP) recognizes possible ramifications and steps to reduce risk and increase resilience vis-à-vis climate change. The strategy draws on 20 years of climate action by the city, covering infrastructure, operations, policies, and bylaws adjustments.

Guelph - [Energy and Climate Change Portal](#) : Currently, renewable energy accounts for over a quarter of the City's total energy consumption. The plan aims to cut the city's carbon emissions and use 100% renewable energy for all of our facilities, fleet, and operations by 2050 by further conserving energy and using greener sources.

Halifax - [HalifACT: Acting on Climate Together](#): HalifACT is a pledge to reduce emissions, transition to sustainable energy sources, and demonstrate local government leadership. This plan coordinates the city's efforts to support a fair transition to a net-zero economy by 2050.

Kelowna - [Our Kelowna as We Take Action: Kelowna's Community Climate Action Plan](#):

The plan looks at mitigation alternatives, or measures that reduce emissions, that the city may influence and lead to reduce GHG emissions through land use planning, transit options, building regulations, and waste services.

Mississauga - [Climate Change Action Plan](#):

The plan deals with both mitigation and adaptation lenses. In terms of mitigation, the goal is to cut greenhouse gas emissions by 80% by 2050, with a long-term objective of being a net-zero community. Regarding adaptation, the city aims to increase its resilience and capacity to endure and respond to future climate catastrophes by addressing the most serious climate-related hazards.

Quebec City - [Sustainable Development](#) (French only): The City has embarked on a strategic approach to further endorse the principles of sustainable development in its actions and projects. This approach is based in particular on the United Nations 2030 Agenda centered on 17 sustainable development goals.

Red Deer - [Environmental Master Plan](#): The purpose of this Environmental Master Plan is to offer a road map for the City of Red Deer and the citizens of Red Deer to improve their environmental performance. The plan includes defined goals and measurable environmental targets, as well as suggested activities for The City of Red Deer to follow when future implementation, budget scoping, and collaboration takes place.

St. John's - [Resilient St. John's Climate Plan](#): The plan identifies a 30-year strategy for reducing our community's greenhouse gas (GHG) emissions, as well as specific steps for the next years, while reinforcing efforts to stabilize energy costs by promoting energy efficiency. It will also include ideas to help the city better prepare for the challenges and possibilities that climate change will bring.

Trois-Rivières - [Climate Change Adaptation Plan](#) (French only): This Policy is part of the tools for implementing the Sustainable Development Policy adopted on February 5, 2019, and whose function is to ensure that the footprint of municipal activity to meet the current needs of the population does not compromise not the ability of future generations to provide for theirs.

Whitehorse - [Our Clean Future: A Yukon Strategy for Climate Change, Energy, and a Green Economy](#): This strategy lays out the concrete, actionable steps that the Yukon government will take to achieve these goals. Several Indigenous and municipal partners have also proposed initiatives to continue to pave the road for a cleaner future. Our Clean Future focuses on the next ten years, until 2030, despite the fact that we know we must continue to act well beyond that date.

Winnipeg - [Winnipeg's Climate Action Plan: Planning for Climate Change. Acting for People](#): This plan examines the community's challenges and possibilities in light of global climate change, proposes new emission reduction objectives, and makes recommendations for new and improved policies, programs, and actions.

Saskatoon - [Climate Action Plan](#): The City of Saskatoon (City) is trying to minimize greenhouse gas (GHG) emissions by proactively changing infrastructure, services, and programs in response to climate change. The City has adopted a number of programs and is formulating a plan to continue to enhance Saskatoon's environmental performance, which is supported by the Environmental Leadership aim of the 2018-2021 Strategic Plan.

Transformative Capacity Diagram

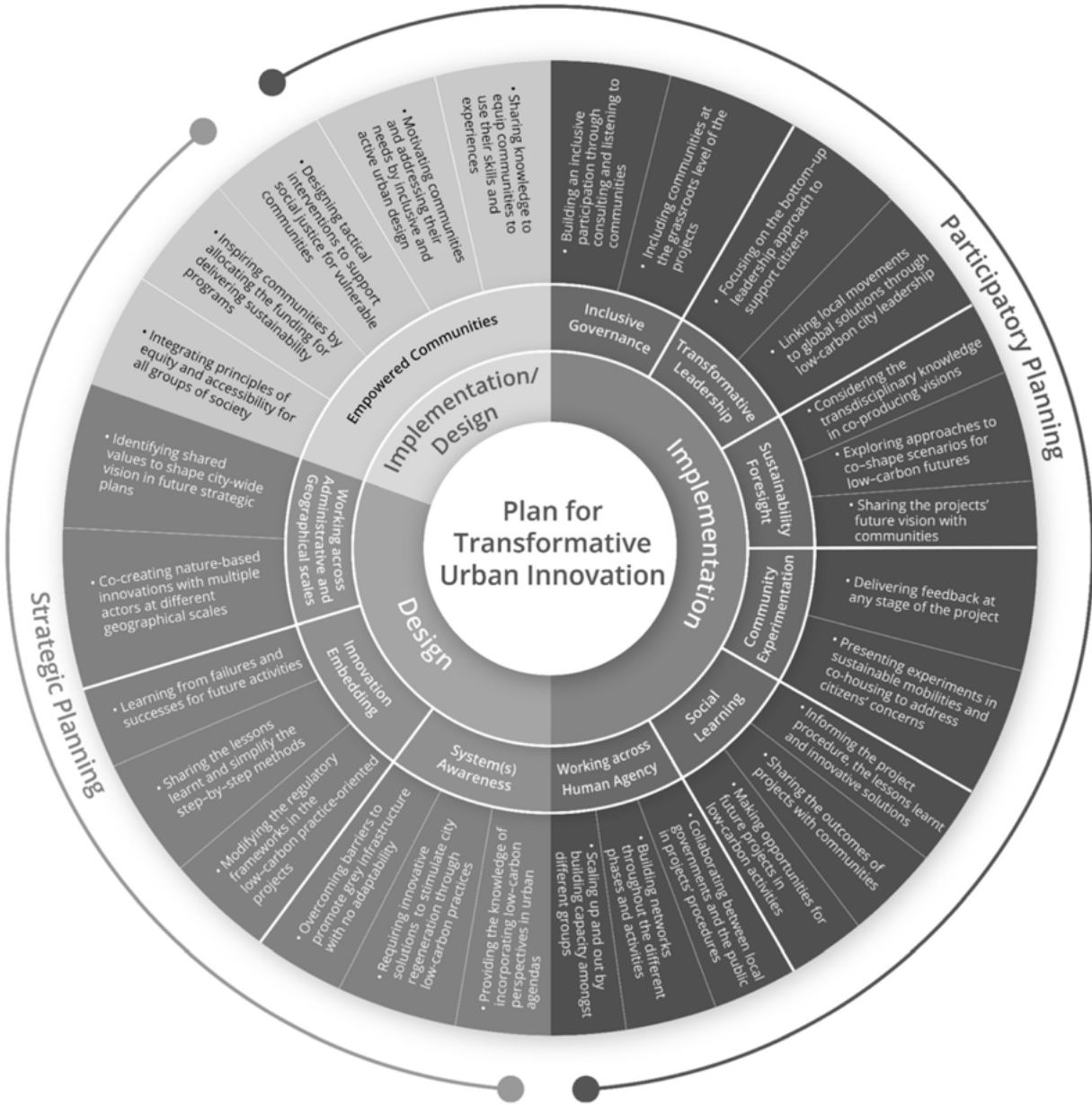


Fig. 2: Plan for transformative urban innovation through activities informed and guided by transformative capacity framework in strategic and participatory planning

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Open Smart Cities	<u>OSC100</u>	Fundamentals Of Open Smart Cities
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Data	<u>D100</u>	Fundamentals Of Data For Open Smart Cities
	<u>D102</u>	What Are Open Standards For Data?
	<u>D200</u>	Implementing An Open Data Policy
	<u>D201</u>	Data Governance In Open Smart Cities
	<u>D202</u>	Open Contracting Data Standard For Procurement
Governance	<u>G100</u>	Fundamentals Of Governance In Open Smart Cities
	<u>G101</u>	Protecting Resident Data And Privacy
	<u>G102</u>	What Is Open Procurement?
	<u>G103</u>	What Is Social Procurement?
	<u>G201</u>	Assessing Smart City Infrastructure For Privacy And Security
	<u>G202</u>	Implementing A Privacy Policy
	<u>G203</u>	Social Procurement Solutions
Hardware & Software	<u>HS100</u>	Fundamentals Of Open Source Policy
	<u>HS101</u>	Introduction To Artificial Intelligence
	<u>HS200</u>	It Procurement Policy
People & Engagement	<u>PE100</u>	Fundamentals Of Resident Engagement In Open Smart Cities
	<u>PE101</u>	Digital Literacy For Residents
	<u>PE102</u>	Civic Tech For Open Smart Cities