OPEN SMART CITIES IN CANADA: ENVIRONMENTAL SCAN AND CASE STUDIES

EXECUTIVE SUMMARY

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About this Publication

This executive summary is an output of *[Open Smart Cities in Canada](#)*, a research project led by OpenNorth and funded by Natural Resources Canada's GeoConnections program.

[OpenNorth](#), founded in 2011, is Canada's leading not-for-profit organization specializing in open data and civic technology. We are an active member of a global community working in favor of inclusive and innovative ecosystems, improving government transparency and accountability, and increasing public participation in democracy towards enhanced citizen and community well-being. Guided by our core values and strong track record in applied research, we work to enhance data standards, shared governance models, and multi-stakeholder and multi-sectoral partnerships.

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Financial support is provided by *[GeoConnections](#)*, a national collaborative initiative led by Natural Resources Canada. GeoConnections supports the integration and use of the Canadian Geospatial Data Infrastructure (CGDI), an online resource that improves the sharing, access and use of open geospatial information.

Introduction

Smart cities, intelligent cities, sustainable cities, sentient cities, cities as a platform, innovative cities, programmable cities, connected cities, and hackable cities are all labels used to describe new forms of data driven and networked urbanism. The technologies associated with these terms are generally praised for their ability to provide innovative, locally-based, technological solutions to trans-sectoral challenges, and the growth and adoption of related strategies and initiatives are becoming more present, increasingly incentivized and fixed in popular public discussion and opinion on a domestic and global scale.

The *Open Smart Cities in Canada* project is both relevant and timely in the wake of the Canadian government's [Smart Cities Challenge](#), an incentivized opportunity for municipalities, regional governments and Indigenous communities to engage in innovative smart city transformations. With a budget of \$300 million dollars and three rounds of prizes, it is intended to “achieve measurable, positive impact on communities”.¹ Officially launched on November 23, 2017, the Challenge also raises a number of uncertainties and questions surrounding openness and open data.

The questions that motivate this research are:

- Who creates smart cities? How are smart cities defined in Canada? How are smart cities communicated and to whom? How do Canadian practices in select cities compare to definitions and standards for smart cities?
- How will the push for innovation emphasize the creation of Open Smart Cities, as opposed to smart cities?
- Are open standards, interoperability, open data, licenses, usability, security and privacy part of smart city approaches?
- Will the federal Smart Cities Challenge be about an open, principles-based, and people-centric smart city? Will it include meaningful public engagement and participatory governance?
- Will solving urban issues and improving the quality of life of people and their environment be emphasized, or will it simply center on innovation, technology, efficiency and improved service delivery?

Some of these questions are included in the federal government's approach to the Smart Cities Challenge. We are happy to see, for example, the Challenge calling for participants to, “approach the challenge through a lens of transparency, experimentation, inclusiveness, empowerment, and knowledge sharing,” with the objective to improve the quality of life for city residents and communities.² Additionally, the application guide encourages “the use of open data approaches,

¹ <http://www.infrastructure.gc.ca/plan/cities-villes-eng.html>

² <https://impact.canada.ca/en/challenges/smart-cities/challenge>

industry standards, open architecture, and systems”.³ It is our hope that openness will be further discussed and critically addressed in submissions to the Challenge and in subsequent actions.

Scope

Open Smart Cities in Canada, while relevant in the context of the Smart Cities Challenge, was conducted with a broader, more strategic vision in mind. This report lays the groundwork for what is increasingly becoming a priority in Canada and ultimately proposes what an Open Smart City might look like.

The results of this research are intended to inform the approaches of decision-makers, policy experts, civil society groups, private sector actors, not-for-profits, and the public. We aim to provide a more holistic understanding of the current smart cities environment in Canada. This will inform the path toward promoting an more open, ethical, and values-based approach to smart cities.

Methods

An environmental scan (E-Scan) strategically surveyed who and what is involved in the creation and maintenance of Canadian smart cities (hereafter referred to as Smart City Shapers). This included an assessment of a multitude of Shapers: from Vendors to Think Tanks, Consultants to Academia, Events and Conferences, Indicators, Benchmarks and Ranking Systems, and Standards, to holistically assess the Canadian smart city landscape. Ten common smart city components were identified as a result of this analysis, helping to clarify the data driven and networked technologies that underpin smart cities.

An E-Scan was also conducted in an effort to better understand whether openness is presently understood, included, and/or prioritized in the smart city context. The need for our team to define and emphasize the relative value of an Open Smart City was identified.

In addition, individual smart city case studies were conducted for the cities of Edmonton, Guelph, Montréal and Ottawa and the province of Ontario to demonstrate how the smart city discussion is taking shape in Canadian strategies, initiatives, events and projects. These studies built upon the broader E-Scans to advance our understanding of the Canadian smart city landscape. Research for the case studies were conducted from the summer to the end of 2017 and findings were structured as follows: smart city strategy; governance; openness of smart city projects and processes; geospatial, big, and small data; and procurement.

The information provided in the smart city E-Scan is designed to help guide the conversation about Open Smart City concepts, the components that comprise the smart city, and how to use this knowledge to drive policy, standards and global best practices in Canada.

³ <https://impact.canada.ca/en/challenges/smart-cities/challenge>

Key Definitions

For the purposes of this document, it is important to clarify what we mean by, and assert to be, the differences between a city, a smart city, and ultimately, an Open Smart City.

A **city** is a complex and dynamic socio-biological-physical system. It is a territorially bound human settlement governed by public city officials who manage the grey (i.e., built form), blue (i.e., water) and green (i.e., land) environment and the people they serve as per their legal and within their jurisdictional responsibility. Cities are much more complex than this, however, for the purpose of this exercise, we have limited ourselves to a functionalist and an administrative definition.

Smart cities in the common sense of the term and as per their current manifestations are “[technologically] instrumented and networked [cities], [with] systems [that are] interlinked and integrated, and [where] vast troves of big urban data are being generated [by sensors] and used to manage and control urban life in real-time”. Public administrators and elected officials invest in smart city technologies and data analytical systems to inform how to innovatively, economically, efficiently and objectively run and manage the cities they govern. Predominately, a smart city is about quantifying and managing infrastructure, mobility, business and online government services and a focus oriented toward technological solutionism.

An **Open Smart City** is where residents, civil society, academics, and the private sector collaborate with public officials to mobilize data and technologies when warranted in an ethical, accountable and transparent way in order to govern the city as a fair, viable and liveable commons and balance economic development, social progress and environmental responsibility.

Smart City Shapers

While not exhaustive, the E-Scan identified key Smart City Shapers that include people, institutions and organizations, as well as monitoring mechanisms like standards and indicators, that are actively engaged in the social, technical, economic and political shaping and creation of the smart city (see below).

The E-Scan identified that most Smart City Shapers, at present, operate in the private sector; specifically, private firms have a strong presence in the shaping of smart cities and there is significant overlap between participating for-profit members, the roles they play and the contributions they make to smart city agendas and priorities. For example, the readiness guides, playbooks and best practices that help guide the creation of the smart city are created by a range of Shapers, including consultants, think tanks, alliances, standards organizations, and sometimes civil society organizations.

Citizens and civil society, comparatively, are both fewer and have a disproportionately small amount of influence in the present shaping of the smart city. Agendas typically involve technological solutionism and do not address complex and systemic Canadian urban issues typically emphasized by civil society and community advocacy groups, such as housing, accessibility, gentrification, a shortage of childcare, or income inequality; agendas focused on innovation and efficiency rarely do.

The key Shapers identified in the E-Scan are briefly described below.

Vendors

Smart city vendors provide cities with smart technological solutions. Vendors can be large multinational corporations offering large smart city platforms, or small local technology companies specializing in the delivery of smart components, such as energy, transportation or mobility. The products and services that vendors provide are wide ranging, including telecommunications infrastructures, Internet of Things (IoT) devices, smart phone applications,

and renewable energy systems (to name a few). Examples of large vendors include [IBM Smarter Planet](#), [Microsoft's CityNext](#), [AT&T Connected Cities Solutions](#), [ABB](#), [Huawei Smart City](#), Alphabet Inc.'s [Sidewalk Labs](#), and [CISCO Smart+Connected Cities](#). Smaller vendors may provide sensors and software on a smaller scale than the global technology firms. [SensorUp](#), based in Calgary, and [AlertLabs](#), based in Guelph, are examples of smaller sized vendors we have observed in Canadian smart cities.

Vendors also contribute smart city knowledge in the form of influential white papers, green papers, insight, indicators, case studies and reports. They also seek to sell solutions (both soft and firm-ware and consultation/planning services) to manage, host and publish city data.

Think Tanks

Smart city think tanks include organizations of expert professionals, such as IT, smart city experts, academics, retired public servants and others that promote smart city initiatives. Think tank initiatives can include experimentation with technologies and concepts, the production of academic literature, and sometimes the development of smart city benchmarks, indicators, standards and specifications. Examples include the [Aspen Institute](#), the [EY Center for Smart City Innovation](#), the [Institute of Electrical and Electronic \(IEEE\) Smart Cities](#), [Intel Collaborative Research Institute \(ICRI\) Urban IoT](#), TM Forum's [Smart City Think Tanks Group](#) and the [Wilson Centre Urban Sustainability Lab](#). Think tanks are often members of smart city alliances and associations.

Think tanks contribute to the smart city by producing smart city reports, while also providing test beds, concept papers and case studies. They sometimes convene smart city actors to develop benchmarks, indicators, and, in some cases, standards and specifications. For example, [The Intel Collaborative Research Institute \(ICRI\)](#) is a major collaborative effort between [Intel](#), University College London, Imperial, [Catapult Future Cities](#) and the Imperial College Department of Computing that directly addresses, "a number of user, technical and community challenges through the deployment of connected sensors and devices".⁴ Ultimately, the primary focus of the ICRI is centered on enabling future cities to be more connected and sustainable. More specifically, this involves not only "investigating, developing and deploying adaptive technologies that optimize resource efficiency and enable new services (that support and enhance the quality of life of urban inhabitants and city visitors), but also designing and evaluating IoT technology that optimizes participation and reflection with citizens".⁵

⁴ <https://uclic.ucl.ac.uk/research/interactions-in-the-wild/sustainable-connected-cities>

⁵ *ibid.*

This type of grey literature constructs what a smart city should look like according to these actors and provides the means (i.e., benchmarks and standards) by which smart city administrators assess or measure their initiatives and compare themselves with other cities.

Indicators, Benchmarks and Rankings

Smart cities are regulated, measured and shaped by various indicators to assess smart city readiness, innovation and, to some extent, quality of life, with smart city components as the variables. This is becoming increasingly relevant in smart cities, where real-time performance indicators and assessment measures are emerging alongside the smart city. The E-Scan identified indicators, benchmarks and ranking systems as another Smart City Shaper, helping cities to self-assess and determine progress toward their goals, to compare themselves with other cities, and to provide data to funders and governments wishing to invest in the growth of certain sectors. There are a number of non-peer reviewed and proprietary indicator systems that rank cities and inform contests and challenges that offer awards. Examples of indicators, benchmarks and ranking systems include [The UNECE-ITU Smart Sustainable Cities Indicators](#), [IoT Analytics City Rankings](#), WeGO Smart Sustainable City Awards, [IBM Smarter City Challenge Award](#) and [Intelligent Community Forum Indicators](#). Another important indicator system is the focus of the [World Council on City Data \(WCCD\)](#), which enlists cities globally to adopt common quality of life and sustainability indicators. In addition, open data indicators are also important, despite not being about smart cities. These include the [Open Data Barometer](#), [Global Open Data Index](#) and the [Open Data Charter](#); although not an indicator system, it is increasingly being used as one and is endorsed globally, especially by the [Open Government Partnership](#) and by Canada, with [OpenNorth](#) as the Steward.

Consulting Firms

Consulting firms are private or quasi private or public-sector organizations that advise cities and other Shapers to assess smart city readiness, develop smart city strategies, and offer solutions and operational plans. Their approach is typically informed by market analysis and forecasts and strategic opportunity assessments. Their often-large contracts or standing offers with governments result in their ability to define new strategic sectors and to set technology agendas. Notable examples include [Frost & Sullivan](#), [Deloitte](#), [PwC](#), [KPMG](#), [Juniper Research](#), and [Gartner](#).

Consulting firms not only contribute to the smart city by providing advice, but also by producing position papers, indicators, white papers, case studies and predictions, which are often disseminated publicly, but are not peer reviewed.

Alliances and Associations

Smart city alliances and associations are exclusive, membership fee-based organizations that provide a forum for the public sector, private sector (consultants, vendors), academia (think tanks) and, to a lesser extent, Non-Governmental Organizations (NGOs), to discuss projects, plans, strategies, technologies, standards and deployments at international venues. They often tackle issues surrounding business plans and the ability of computer systems to exchange and make use

of data and information. Alliances offer a niche platform where experts, vendors, consultants and think tanks can discuss a specialized topic with clients (often public officials). Examples include the [World Smart City Forum](#), the [Alberta Smart City Alliance](#), [Smart Cities Council](#), [ICanada150, TM Forum](#), and the [Intelligent Community Forum](#) (ICF).

Alliances and associations contribute to the smart city by providing a means for specialized, topic-based conversations on online forums, lists and webinars and often give prizes to the most innovative city. They also convene in public at international conferences and alliance meetings, or alliance working group sessions. The information they produce and the events they host are frequently tailored to members who pay a substantial fee to participate and provide exclusive access to public officials. The high membership fees typically preclude citizens, small businesses and civil society actors from joining, thus affecting their access to public officials.

Civil Society Actors

Civil society actors are context driven, problem solving entities that include not-for-profit organizations, cooperatives and collectives. They include open data, civic technology, maker, advocacy and ideation-oriented groups that aim to amplify the conversation about open, people-centered smart cities. They are community-based problem-solving entities that are small but can have global reach. They are often project funded with limited financial support from normal philanthropic streams in Canada and internationally; the lack of funding often precludes them from participation in international alliances, standards organizations and industry conferences. Despite these challenges, civil society actors play important roles in the shaping of the smart city. Their roles include:

- providing solutions that promote openness, transparency (in the form of open source, open platforms, open design, etc.) and ensuring that meaningful public participation is a core component of smart city plans;
- providing a critical perspective and often questioning the direction of technology deployments that typically favor large, locked-in proprietary vendors and lack open source and standards; and,
- offering alternative examples, spaces and social labs where citizens can co-create technologies and policy.

Identified civil society actors include, but are not limited to: [OpenNorth](#), [Tech Reset Canada](#), [Institute for the Future \(ITF\)](#), the [Open and Agile Smart Cities Initiative \(OASC\)](#), [Open Cities Project EU](#), [Open Knowledge Canada](#), [Smart Chicago Collaborative](#), [Smart Cities for All](#), and [Smart City Hack](#), and [Beta City YEG](#).

Academia and Scholarship

Critical academic scholarship on topics related to smart cities is growing. This type of inquiry explores the intersection between the technical, the social, and the political, with more academic focus on the implications of, for example, technologies and information on governance, ethics, people and complex urban issues. Examples of smart city scholars include, but are not limited to,

Rob Kitchin, Tracey P. Lauriault, Stéphane Roche, Pamela Robinson, Robert G. Hollands and Renee Sieber.

Academic work includes critical scholarship about smart cities and related urban topics, such as planning, AI, geomatics, technology, algorithms, big data and ethics and values in design and law, as well as new social science, engineering and urban geography domains, like critical data studies and software studies.

Procurement and Economic Strategies

Smart economy strategies include ways to both streamline procurement to be more innovative and efficient, and to create the necessary conditions for cities to become more conducive to technology-based business. Procurement strategies focus on investing in small and flexible pilot projects and, upon successful testing, scale them for broader application. An increasingly common example includes smart city challenges, where local developers and vendors compete to have their solutions selected for widespread deployment. Included in this are city business incubators, co-working spaces, maker spaces, or technology hubs that attract expertise in, for example, AI, robotics, or autonomous cars. In some cases, it is about the creation of a technology economic sector in a city. The objectives of these strategies and initiatives are to attract investment and research and development (R&D), while also supporting up-and-coming local business and talent to grow Canadian technology. For example, the City of Ottawa's smart economy focus in their official smart city strategy includes initiatives for attracting and retaining talent to grow the knowledge-based sector (e.g., the creation of a Talent Attraction and Retention Committee). Accelerators and venture capital firms include [Invest Ottawa](#), the [Guelph Civic Accelerator](#), [Capital Intelligent Mtl](#), [InnoCité MTL](#), [Venture Capital Association of Alberta \(VCAA\)](#), and Smart Districts and Economic Clusters (e.g., [Guelph Innovation District](#) and [Ottawa's Bayview Yards](#)).

Events and Conferences

Smart city-related events and conferences are opportunities for diverse groups of Smart City Shapers to collaborate and leverage resources under a shared agenda. These settings allow for connections to be made and for information to be produced and distributed, sometimes openly (with the public) and sometimes in a closed setting. These events are also ideal for vendors to display their platforms, sensors, dashboards, control rooms and any number of services or smart city component solutions. They are also excellent venues to distribute smart city awards and for the public sector to feature their progress.

Examples of smart city events and conferences include: [Smart Cities Week](#) (an annual conference held in Washington D.C., Silicon Valley and Sydney, Australia), [Cyber Security 2017: Securing the Smart City of the Futures](#) (held in Ottawa), the annual [Intelligent Community Forum Summit](#), and the [Accelerating Smart Communities](#) event, hosted by the [Canadian Institute \(CI\)](#) and held in Toronto in 2017, which included participants from the public sector, non-profit sector, private sector, and academia.

Smart city activities are also discussed at a variety of technology and policy events in Canada, such as [GovMaker](#), [Future Cities Forum](#), [Forward50](#) and the [Municipal Information System Association \(MISA\)](#), as well as vendor specific conferences such as those held by [Esri Canada](#). Many of these actors also host webinar events online to educate about and publicize smart city technologies and best practices.

Standards

The E-Scan heavily emphasized standards and standards organizations to (1), better understand how standards set the stage for smart city development, and (2), determine whether standards for open data fit within standards for smart cities. The E-Scan identified standards, regardless of type, as the foundations of smart city development; they are often discussed in terms of enabling efficiency and connectivity, which are two key defining characteristics of smart cities.

Standards Organizations (SOs) are large institutions that specialize in topics beyond the smart city. When it comes to smart cities, however, these standards development organizations and consortia propose mutually agreed upon vocabularies, ontologies, guidelines, frameworks, performance-based standards and technical specifications that attempt to achieve some sort of interoperability and comparability. Standards exist at the international, regional and national levels and are typically implemented via voluntary consensus procedures that navigate conflicting interests and agendas. Consensus is often achieved through the help of technical committees and working groups that are a part of SOs, but participation is often granted via: (1), payment of a substantial fee for membership, or (2) recognition as an expert in the desired field or as an industry leader.

Standards are crucial to ensuring consistency across smart city projects and initiatives. This is critical in light of our claim that high level, strategic consistency across smart city applications is unlikely due to major differences and varied interests of Smart City Shapers and the rate of change for smart city technology. Although Canadian cities will apply smart city objectives in accordance to specific needs and objectives, standards allow for and ensure consistency where possible (e.g., [PAS 181: Smart City Framework](#)). Consistency is applied to procurement of smart technologies, performance metrics of city operations, and for ensuring the compatibility of technologies. The [Municipal Benchmarking Network Canada \(MBNCanada\)](#), for example, is a partnership of multiple Canadian municipalities that provides a consistent operations indicator system enabling the collection, comparison and reporting of data about municipal operations.

Standards are divided and categorized into a variety of typologies, including but not limited to: vocabulary, guidance, technical, performance, framework and ontology. A vocabulary standard, for example, is intended to reduce confusion and facilitate understanding, while improving communication efforts among city officials, businesses, information systems, manufacturers and other stakeholders. An example of a vocabulary standard for smart cities is [ISO 37100:2016 Sustainable Cities and Communities](#), which includes definitions for terms pertaining to sustainable development in communities, smart community infrastructure and any associated subjects. [Open Geospatial Consortium \(OGC\) Smart Cities Spatial Information Framework](#) is another resource for learning about standards for smart cities developed by SOs. When it comes to standards

organizations for open data, the [World Wide Web Consortium \(W3C\)](#) is a leader in creating and promoting standards to automatically link open data across the web.

Our E-Scan intentionally sought to determine whether [standards for open data](#) fit within standards for smart cities. These standards/specifications for open data are referred to in a variety of ways, including data schemas, vocabularies, and Application Program Interfaces (APIs), but what they have in common is that they represent an agreed upon set of specifications for how some sets of government data should be made publicly available. Open data standards can lower barriers of entry to government data and technology due to their utilization of open licenses, tools to collect feedback from data end users, human readable formats, and machine-readable formats that make it relatively easy to interact with and share the data. We found that even though these standards are not typically labeled as smart city standards, many have emerged from the open data community and are adopted by cities to solve specific problems related to interoperability and comparability of administrative data, and in some cases, address government transparency. We also found that there are a variety of software and data protocols for IoT and smart cities that are the IP of [vendors](#). Accessing information about how these platforms standardize data is difficult due to their proprietary nature.

Finally, we found that, while standards are considered to be important, it is not clear to what extent they are adopted and implemented. An exception would be the [World Council on City Data](#), which tracks globally what cities comply to [ISO 37120:2014 Sustainable Development of Communities: Indicators for City Services and Quality of Life](#). There are also ad-hoc specifications and standards for open government data, although the W3C adopted the [Data Catalog Vocabulary \(DCAT\)](#) metadata vocabulary to facilitate interoperability between open data catalogs.

Legalities and Regulations

Smart city technologies, because they are relatively new and constantly changing, raise a number of legal and regulatory considerations and concerns. The following section provides insight about the current state of legalities and regulations in Canada related to smart cities. The [Open Smart Cities FAQ](#) was created by the [Canadian Internet Public Policy Interest Clinic \(CIPPIC\)](#) as a part of this project, and contains more details about these themes and any observed gaps.

Topics of legal and regulatory concern include:

Privacy: Common privacy concerns center on questions of how, by whom and for what purpose smart city data are collected, as well as who “owns” the data collected by smart city technologies and whether these technologies collect personal information. Additionally, questions surrounding the impact of privacy and data protection laws on smart city technologies, whether Privacy by Design is part of the process, how these technologies can/do obtain meaningful consent to collect, use and disclose personal information, and who is ultimately accountable for the personal information collected and used by smart city technologies, are common smart city privacy concerns.

Criminal Law and Data Security: Smart cities raise a number of criminal law issues, including, but not limited to, the challenges presented by illegal hacking and manipulation that are related to cybersecurity. Thus, an understanding of how criminal law regulates data breaches and the unauthorized use of smart city data, and an understanding of what can specifically be done to protect smart city data, is required for the safe regulation of the smart city.

Contract and Licensing: Specific questions surrounding what issues individuals, companies or municipalities should be aware of as a licensee of smart city technologies, and an understanding of an “open source” license, are some common questions of concern. Further, what to be aware of in using open source software, how contract law limits government transparency, and whether consumer protection laws apply to smart city technologies contracts, are some critical questions to understand.

Intellectual Property: There are three main types of Intellectual Property (IP) at play in smart city technologies; these include Copyright Law, Patents and Trademarks. With each form of IP, comes common questions of concern. Namely, when considered individually, cities must understand how Copyright Law, Patent Law, and Trademarks impact smart city technologies. See the [*Open Smart Cities FAQ*](#) for a detailed description.

Competition Law: How smart city technology providers are affected by competition law is a common area of legal inquiry in the development of the smart city.

Safety, Product Liability, Insurance, & Tort: Understanding the implications of smart and autonomous technologies and personal liability is a crucial area of consideration in the smart city. For example, questions will be raised as to whether humans or computers should be held liable in traffic accidents involving autonomous cars; tort law (in the common law provinces) will be relied upon to settle such disputes.

Environment: Common legal and regulatory questions revolve around how smart cities affect the environment and the role played by environmental law in smart cities and sustainability.

Components of the Smart City

The E-Scan discovered a number of common and recurring smart city components. While not mutually exclusive and lacking a common definition, these components are frequently mobilized by Shapers as smart city solutions. We have aggregated a variety of common definitions and the types of components most frequently encountered; these suggest to us what a typical, present-day smart city includes. What is common between all components is the reliance on the internet, namely: IoT and sensors, location-based services and Global Positioning Systems (GPS), platforms and apps, AI, machine learning, algorithms and data analytics, as well as a myriad of generally unstructured big and real-time data. Ultimately, the components identified below provide insight into some common understandings and key material characteristics of Canadian smart cities. Together, they paint a picture of what Canadian cities might include and what technologies they use to achieve their vision.

Table 1 - Components of the Smart City

Component	Description	Technologies
Smart Buildings	Are built or converted to accommodate new information communications technologies; have an Automated Infrastructure for a Building Information Management System; have network sensors and controls, wireless communication devices, IoT and high-speed internet.	Technologies are often applied to climate, heat, electricity and lighting controls, lighting, windows and blinds, security, surveillance, identification, parking, the allocation of work spaces and desktop software, doors and many other building attributes; Often framed as being green, sustainable and secure.
Smart Citizens	Smart Cities often framed as providing citizen-centric and personalized digital services; Success of smart city initiatives depends on ability to deliver on their value proposition; Citizens require an interest in, and proactive attitude towards, adopting and embracing smart concepts and solutions into their daily lives.	Typically refers to: engagement models, low cost sensors, smartphones, participatory government, crowdsourcing, citizen science and civic technology; Smart citizens may access government services online, such as permits and licences, file their taxes online, or register for events via calendar systems; Implies that municipalities have client facing digital strategies and services that communicate with many devices; In Estonia, for example, a smart citizen is an E-Citizen, whereby non-nationals can become citizens by registering to their e-citizenship platform.
Smart Economy	Refers to various types of businesses, such as vendors, consultants and think tanks, that provide services and technologies to the smart city; Includes initiatives to attract investment locally and is related to smart procurement and economy, <u>discussed earlier</u> .	May include procurement, economic districts, incubators, innovation centres, hubs, labs, accelerators, venture capital and payment systems.
Smart Education	Typically refers to training and education to ensure students and future workers are receiving the knowledge required to compete for emerging jobs and to operate and deploy smart solutions, or	May include university training, data science, R&D, science funding, university and private sector partnerships, AI education, and big data, IoT and robotics talent; In other cases, it means education platforms for schools,

	analyze urban data; Focus is to re-orient university and college programs towards meeting the needs of the private sector.	whereby students have laptops, log into education platforms, and teachers manage marking and reporting in these systems.
Smart Energy	Typically refers to the optimization of energy resources and to ensuring a continuous supply of affordable, sustainable, quality power and energy.	Often refers to Advanced Meter Infrastructure (AMI), distributed grid management, high voltage transmission systems and/or demand response for intelligent and integrated transmission and distribution of power; May include a focus on sustainable mixed energy supply, such as wind, solar or heat generated from waste management facilities; Also, smart online billing, where users can monitor energy consumption at the device level, or management of energy in smart buildings are included.
Smart Environment	Often refers to the balance between planning and construction initiatives and projects, with protecting natural resources; Often conceptually intersects with sustainability and resiliency indicators.	May include smart grid and smart mobility, as well as air quality sensor projects, waste reduction, smart bins and smart urban lighting.
Smart Governance	In relation to digital governance, refers to technologies that encourage engagement and communication practices between government and citizens; Includes use of technologies to ensure participation and collaboration at all levels of the governing process, enabling citizens to provide feedback to help government improve existing city conditions.	Often operationalized through online citizen engagement platforms, open data, e-government, open government, transparency, and beyond; Smart governance may also refer to e-citizenship, as mentioned above.
Smart Infrastructure	Considered foundational to the roll-out of smart city project; Defined by the International Standards Organization (ISO) as: “community Infrastructure with enhanced technological performance that is designed,	Typically refers to, but is not limited to, Telecom and Broadband, cellular networks, cloud computing, super and grid computing, server farms, smart utilities and metering, wireless, and alternative energy, and sometimes transportation; May also include sensors

	operated and maintained to contribute to sustainable development and resilience of the community <u>(ISO/TS 37151:2015)</u> .”	embedded within infrastructure to monitor functionality and to send alerts if repairs are required.
Smart Mobility	Refers to solutions deployed to maximize the planning, efficiency and effectiveness of movement around the city.	Includes, but is not limited to, ridesharing, bicycle commuting and bike sharing, car sharing, on-demand ride services (Lyft or Uber), GPS and NavTech, eCars, autonomous cars, electric cars, walkability indexes, 511, transportation analytics and smart transit; Often cities will have traffic communication and control centers to manage traffic lights and to monitor flow of traffic using cameras, despatch centres, dashboards and control rooms; Some larger cities integrate smart mobility strategies with emergency management systems to ensure despatch of paramedic, police and firefighter vehicles.
Smart Technology	Has a variety of definitions, but typically includes IoT applications and refers to the deployment of IoT in a multitude of forms.	IoT deployed in the forms of platforms and apps, dashboards and control rooms, surveillance technologies, virtual and augmented reality, sensors, meters, batteries, AI and machine learning, drones, robotics, and predictive analytics.

Open Smart City Shapers

The E-Scan revealed that “openness” is not necessarily mapped onto the smart city. This project argues that openness should be an underlying principle for the smart city and mapped onto existing technical conceptions of the smart city components defined [above](#). We have thus endeavoured to identify Shapers for the Open Smart City. Further information about the requirements of Open Smart Cities can be found in the [Open Smart Cities Guide](#) .

In defining the [Open Smart City](#), we had to first understand data and technology as socially constructed and values-based. In brief, data and technology:

- are considered as more than the unique arrangement of objective and politically neutral facts and things;
- do not exist independently of ideas, techniques, technologies, systems, people and contexts, regardless of them being presented in that way; and,

- are inseparable; data cannot be separated from their technological enablers (storage, computational power network ID, IoT) and are not neutral, nor apolitical.⁶

Thus, openness refers to the need for these components to be aligned to principles, rights, and ethics, as much as to governmental and technical framing. It requires the integration of digital practices, whereby openness and its components are “mapped” onto the smart city. We identified the following guidelines to reflect this “mapping,” to serve as a starting point for public servants seeking to advance the design and operations of their smart cities.

Smart cities demonstrate openness when they:

- favor, above all, the public interest and public good;
- reduce possible negative consequences as it pertains to dignity, privacy and democratic life;
- ensure equitable distribution of the benefits of the smart city and protect against potential discriminatory outcomes of the smart city;
- ensure that the benefits always outweigh the costs;
- ensure that all public-facing smart city technologies are accessible by design;
- accept that underlying systemic urban issues may require organizational and social innovations and not technological fixes; and,
- value a culture of critical thinking and debate.

For more information about conceptualizing the Open Smart City, please examine the [*Open Smart Cities Guide*](#).

Our E-Scan identified a number of Shapers that are pushing for a trend toward Open Smart Cities. These include references to civil society and civic technology actors, open data actors and barometers, and open source and open standards.

Civil Society Organizations

As was discussed earlier, [*civil society actors*](#) in smart cities typically focus on meaningful citizen engagement and emphasize the use of open standards and systems to benefit the public good.

Typical priorities for Open Smart City Shapers include ensuring:

- the data generated by and about the smart city are open data (wherever possible), in accordance with the [*International Open Data Charter*](#);
- low barriers to enable easy public access to the technology;
- public understanding of how Open Smart City technology works and functions;

⁶ <https://www.tandfonline.com/doi/full/10.1080/21681376.2014.983149>

- the public is empowered to think critically and provide feedback about this technology and its' impact on daily life and society; and,
- that it be a transparent, accountable, ethical and principles-based smart city.

Civil society organizations, for example, emphasize the ability of citizens to leverage open data, software and hardware innovations of government platforms and systems to actively shape and co-create government policies; they also emphasize the ability of citizens to engage with government without the use of technology. In this way, civil society organizations play a pivotal role in shaping the Open Smart City.

Open Source (Firmware and Algorithms) and Standards

Open Source was identified as a key practice and Shaper of the Open Smart City. The E-Scan revealed that open source and digital rights management strategies, when employed, typically have three guiding principles, namely that:

- products, such as APIs, software, firmware, infrastructure and algorithms, are made legible and available under an Open Source License;
- products are designed with future growth and adaptability in mind, and is made up of multiple parts working together to form a single, functioning product or system; and,
- all participants intend to reuse, optimize, repair, extend and add new components, in that order, as they are interoperable and standards based.

The tools created by these principles rely on geospatial tools and data for their implementation, with the intent to benefit city operations and citizen participation.

Open Data

The E-Scan was guided by the open definition developed by the [Open Knowledge Foundation \(OKFN\)](#) to identify the core components of open data. Ultimately, data are considered open when they are:

- raw and/or machine-readable data;
- freely accessible to anyone to use;
- can be re-used and re-purposed in new ways for users; and,
- are absent of royalties, fees or restrictive licenses.

Governments were identified as one kind of open data generator. To validate their open government data programs and to assess provisions of open data for public use, governments sometimes take any number of steps when it comes to administrative data, survey data, geospatial data, sensor derived data and scientific data, or the outputs of AI/Machine learning or analytics. Some such steps include:

- implementing official open government policies and/or frameworks;
- publishing datasets in an online open data catalogue for anyone to access and download;

- encouraging open data events (such as, but not limited to, hackathons and app contests) to encourage citizen interaction with government data;
- crowdsourcing data from citizens (Open311);
- including citizens to edit, revise and contribute to government-published data; and,
- ensuring citizens and governments are each receiving and giving data to one another (reflecting democratic open data governance).

The [International Open Data Charter](#) is now the most widely endorsed definition and benchmark by which to assess open data and to inform an open data strategy.

Specifications and Standards for Open Government Data and Technology

Specifications provide a “blueprint” for technology, outlining what the product has to do and what the design requirements are. This includes, but is not limited to, AI/machine-learning/algorithms and data analytics systems. In this way, specifications/source code act similarly to standards, except that standards require, by definition, that they be commonly agreed upon. Specifications and standards development for open government data often occurs in an ad-hoc way, with multiple stakeholders. These types of standards are typically situated in the open data and civic technology community and are [not normally labeled as smart city standards](#). Despite this, cities are adopting these standards to innovate and are rendering these data usable across discrete systems.

Developers of standards for open data are from the open data community and include: civic technology organizations; private sector; open data platform providers; and sometimes SOs.

Examples include, but are not limited to:

- [General Transit Feed Specification \(GTFS\)](#) for transit data;
- [Open311 GeoReport API](#) for open municipal service request data;
- [Open Contracting Data Standard](#) for open public procurement data;
- [Open511](#) for road incident data; and,
- [Data Catalog Vocabulary \(DCAT\)](#) for facilitating interoperability between data catalogs published on the web.

Open standards for geospatial data are created by SOs include but are not limited to:

- [ISO 19115 Geographic Information: Metadata](#)
- [City GML \(Open Geospatial Consortium \(OGC\)\)](#)

Our [Open Smart Cities Guide](#) expands upon and provides more details about important actors that are shaping Open Smart Cities in Canada and abroad.

Case Studies: 4 Canadian Cities and the Province of Ontario Smart Grid

We add the five case studies to the E-Scan for the added value of understanding how Canadian cities are shaping and applying the smart city concept in the context of their respective urban plans, strategies, Council priorities, programs, and projects. The case studies also provided an

opportunity to advance our understanding of openness in the Canadian smart city landscape, namely, whether openness is being considered in relation to smart city initiatives, and if so, how it is being considered and practiced.

The case studies consisted of collecting publicly available smart city documentation about the four collaborating cities of Edmonton, Guelph, Ottawa and Montréal. The project team also conducted interviews with Officials from each collaborating city to discuss their smart city plans and projects and validated research findings. Each city case study is structured as follows: smart city strategies, governance, openness, data and procurement. In addition to the four cities, the Province of Ontario Smart Grid case study was conducted to gain some insight on how smart cities intersect with other jurisdictions and governing bodies.

For further insights about these case studies, please refer to the [*Open Smart Cities in Canada: Assessment Report*](#).

The City of Edmonton (AB) Case Study

The City of Edmonton is one of Canada's top urban centres. As the provincial capital for the province of Alberta, the city is historically a central hub for Canada's oil and gas industry. The Edmonton Region is, however, diversifying its economy, capitalizing on opportunities related to the energy sector that include waste and wastewater treatment, waste management, remediation technologies, information and communication technologies and financial services. The city is governed by 12 city ward councillors, a Mayor and a number of council committees, as well as a number of boards with appointed citizens, boards with other appointments and City Corporations.

Edmonton: Smart City Strategy

According to the [*City of Edmonton's Smart City Strategy*](#), a smart city is about creating and nurturing a resilient, livable, and workable city through the use of technology, data and social innovation. The *Strategy* aligns with the city's citizen-informed and long term urban strategic plan, entitled [*The City of Edmonton Strategic Plan: The Way Ahead: 2009 - 2018*](#). Envisioned as a partnership between industry, community, government and academia, the *Strategy* enables Edmonton leaders to pilot innovative, smart projects in a way that is both flexible and agile, focusing on the overarching objectives of resiliency, livability and workability.

Edmonton: Smart City Governance

Edmonton views smart city governance as the provision of effective decision making, collaboration, cost reduction and resilient public services. The Smart City Steering Committee is the governing body and executive sponsor of Edmonton's smart city strategy and makes decisions regarding risk assessment practices and strategic pathways. Located within the city's Financial and Corporate Services, there is leadership from the Chief Information Officer, Chief Financial Officer, Executive Leadership Committee of key branch managers and collaboration laterally with other units. Edmonton plans to include citizen representation on its smart city steering committee, which raises questions regarding how the general public will be included in the governance structure, whether they will have a role to play in decision making, and what role civic technology

and civil society groups will play in a future smart city. Despite these questions, the City of Edmonton is making positive and strategic strides, with dedicated units for Open Data, Smart City and Spatial Analysis, and dedicated personnel within these units.

Edmonton: Smart City Openness

The City of Edmonton defines openness, in their open city initiative, as transparency and accountability in government practices. As such, open data and the open city are included as a part of the smart city. Edmonton's creation of an [Open Data Portal](#), its' *Open City Policy* framework, the adoption of the [International Open Data Charter](#) in 2017 and the awards received for its open data program, speak to the city's commitment to advance the principle of openness. Additionally, the case study identified Edmonton's Citizen Science Program, which emphasizes collaboration between the academic and research communities on various projects. Their Citizen Engagement branch emphasizes the city's focus on partnering with citizens to help shape their smart city strategy and initiatives, speaking to the transparency and accountability highly valued by the City of Edmonton. We await to see how this foundation for openness will be further integrated and mapped on to the smart city strategy and its forthcoming roadmap, and how residents will be included in setting priorities.

Edmonton: Geospatial, Big and Small Data

Discussions with smart city representatives revealed that geospatial data (big and small) will play an important role in Edmonton's plans for a smart city. Edmonton will continue to work towards ensuring real time data can communicate and work across systems, while also spatially enabling other open and administrative data assets with the leadership of their Spatial Centre of Excellence (SPACE). While Edmonton has a highly regarded open data program and [Citizen Dashboard](#), we await to see if their forthcoming roadmap will specify that smart city data be open data.

Edmonton: Smart City Procurement

The case study identified that Edmonton is considering a new strategy for procurement. This strategy may include the implementation of pilot projects for smart city technologies. Standards will be considered when procuring smart city technologies, although what standards will be considered are unknown.

The City of Guelph (ON) Case Study

The City of Guelph is a small city in Southwestern Ontario with a workforce that is largely professional, scientific and technical. The city is well-known for its diverse economy, driven by a multitude of industries that range from advanced manufacturing, to agri-innovation (i.e., an Agri-tech cluster), to burgeoning Information Communications Technologies (ICT) and green technology sectors that attract many entrepreneurs. As of 2016, Guelph's reported population was 131,794 people; it is a single-tier municipality with a mayor-council system and consists of 6 wards.

Guelph: Smart City Strategy

In Guelph, a smart city uses technology at every appropriate opportunity to support effective decision making and to streamline processes and simplify access to city services. The government's [*Corporate Technology Strategic Plan*](#) provides some direction for this smart city vision. While Guelph does not yet have a smart city strategy, it is currently developing a digital strategy to guide the smart city and the initiatives it presently deploys on an ongoing basis. These initiatives include, but are not limited to, their [*Civic Accelerator Program*](#) and advanced [*Open Data Program*](#). This signals a shift in Guelph's approach to viewing, managing and investing in technology, and demonstrates the strides being made to transition to a smart city.

Guelph: Smart City Governance

Guelph is currently redesigning its IT Governance Committee, which will be the governing body for the smart city and includes members of the city's Executive Committee. The redesigned committee will include the following subcommittees: digital, security and physical location security, innovation/service evolution, GIS, and, to some extent, citizens. Integral to Guelph's progress is the creation of a new "Digital Group," which will be part of the IT Governance Committee, in charge of developing the city's smart city strategy. The Digital Group and other subcommittees will be responsible for devising plans for engagement with citizens.

Guelph: Smart City Openness

The City of Guelph has demonstrated a commitment to open government, civic engagement, and transparency. Initiatives that align with these concepts are the publication of performance indicators for city services, an [*Open Data Portal*](#), and an open government framework. Furthermore, the city uses a Digital Community Relationship Manager and has a citizen community engagement team. Guelph is also unique for considering open source in their procurement strategy. Ultimately, how these open initiatives will translate into a "smart city" for the City of Guelph remains to be seen.

Guelph: Geospatial, Big and Small Data

Guelph stands out from other cities when it comes to deploying geospatial data and tools. Our case study revealed that the City of Guelph has an established [*Corporate GIS Strategic Plan*](#) and has included a GIS subcommittee as part of the smart city governance committee. In addition, Guelph has published [*indicators and benchmarks to track city services in the open*](#). The City also specifies data IP in contracts when procuring information technologies.

Guelph: Smart City Procurement

The case study revealed Guelph routinely specifies that data remain the intellectual property of the city. Guelph is notable when it comes to procurement due to their [*Civic Accelerator Program*](#), which aims to make it easier for the business units to test and possibly procure innovative technologies from small and medium enterprises to address business needs. The city staff have also incorporated citizen input into the Request for Proposals (RFP) process via [*their Citizen Relationship Manager software*](#).

The City of Montréal (QC) Case Study

La Ville de Montréal, in the Province of Quebec, is Canada's second-most populous city and one of Canada's largest metropolitan areas. Montréal acts as a cultural and economic metropolis for Québec that is at the heart of a greater region of more than three million people.⁷ It houses a strong local start-up culture, a sizeable civil society involved in civic technology, has relatively large investments in AI, and is home to many large and globally recognized IT companies, such as Ubisoft. The city has a reported 2016 population of 1,704,694, a City Council that consists of 65 members from its boroughs and a Mayor-appointed Executive Committee that manages contracts and grants, human and capital resources, buildings and supplies.

Montréal: Smart City Strategy

Montréal intends to become an international leader among smart cities. Montréal's smart city aims to provide better services for citizens, a universally higher standard of living and works to harness the metropolis's resources to ensure development is in line with the needs of the population. The city has an established smart city strategy, entitled, Montréal Smart and Digital City (2014), that provides their guiding definition for a smart city. In addition, Montréal's smart city is guided by a roadmap and guiding principles incorporated in the Montréal Smart and Digital City: 2015-2017 Action Plan. Within the *Action Plan*, a total of 70 projects are organized by 6 programs: Public WiFi, Ultra-High-Speed Multiservice Network, Smart City Economic Cluster, Smart Mobility, Participatory Democracy and Digital Public Services.

Montréal: Smart City Governance

At present, the *Bureau Ville Intelligent et Numerique (BVIN)* is the dedicated unit responsible for the smart city strategy, designating strategic initiatives and formulating funding/partnerships to implement projects; it sits organizationally just below the City Manager and aligns operations with the city's central services. A member of the Montréal Executive Committee is responsible for the smart city. The 70 smart city projects that were incorporated into the *Action Plan* (and are currently ongoing) emerged directly from citizens, who submitted proposals. Smart city experts were brought in to help adopt, execute and advise on these projects, which the *BVIN* promotes, supports and facilitates.

It is unknown to what extent the overall urban development plan for Montréal and the urban plans of each borough are integrated with the smart city strategy, as boroughs are largely responsible for managing their own jurisdictions according to their own needs and strategies.

⁷ http://ville.Montréal.qc.ca/portal/page?_pageid=2762,3099669&_dad=portal&_schema=PORTAL

Montréal: Smart City Openness

Montréal is notable for extensive citizen consultations to set focus areas for their *Strategy* and for encouraging citizens to suggest smart city projects (some of which were adopted into their *Action Plan*). It will be interesting to see if and how this level of citizen engagement will be sustained.

The BVIN prioritizes open standards and open data, and open and interoperable technology architecture is a stated policy guideline for the smart city strategy. There is a high level of collaboration with civic technology groups, and the open data program follows the [Sunlight Foundation's Open Data Guidelines](#). Montréal also deploys open standards, such as the [Open Contracting Data Standard](#) as part of its public procurement of data, and uses the [Open311 API](#) for city service requests. The city is still working on how to ensure they control smart city data collected via Software as a Service.

Montréal: Geospatial, Big and Small Data

Ultimately, the City of Montréal and its partners that span jurisdictions manage big, real time and geo-visualized data via the [Centre for Mobility \(CGMU\)](#). Some of the data collected and processed at this [control center is pushed to the open data portal](#).

Montréal's IT Services staff are working to revise the GIS strategy for the city and increase their ability to geocode information. Currently, most of the city's geospatial data is specified by addresses and place names. Government also publishes Municipal maps from their [Open Data Catalogue](#) and spatial metadata specify the data's spatial reference, model element accuracy, data types, and boundaries.

As for cartographic data standards, the Quebec Ministry of Transport guidelines have been adopted since 2015. The Geomatics Division has collected Light Detection and Ranging (LiDAR) data since 2015 and these have been made open data. These data provide 3D topographic information for digital terrain models, contour lines, planning, calculating tree height, mapping building roofs, and 3D modeling of the city.

Additionally, the case study revealed the innovative sharing of geospatial data via a partnership with [Waze](#) (the first city in Canada to do so), a proprietary crowdsourced traffic and navigation application. City government signed a free partnership with Waze for a two-year pilot project that exchanges geo-located traffic obstruction data to Waze, and in return, Waze shares their real-time and anonymous incident and slow-down information.

Future considerations will include how Montréal will ultimately decide on the adoption of standards for integrating geospatial data, how data will be geocoded, and whether groups specializing in GIS and mapping techniques will contribute to and/or be incorporated into the smart city initiative.

Montréal: Smart City Procurement

The *Action Plan* supports the development of Montréal's startup technology industry. Montréal funds a venture capital firm, [Capital Intelligent MTL](#), which provides financial support to

innovative companies working on urban solutions. In addition, it is a partner of Canada's first smart city accelerator, [InnoCité MTL](#), which provides training and opportunities for startups to test products with the government and partners.

Requests for Tenders (RFTs) by the city often include specific requirements that do not easily align with existing software services. InnoCité MTL addresses this issue by making the software lightweight and by implementing a Software as a Service (SaaS) model. While these solutions are innovative, the BVIN is still working out how to negotiate conditions in user agreements to enable city staff to exert complete control over the data generated by outsourced systems and to ensure that these can be archived for the future.

Montréal is also working to change requirements in the municipal building permit contracts, which will require that builders disclose detailed data related to traffic construction and closures. Disclosing detailed geospatial information about traffic closures and construction helps the city improve mobility, which is a key goal set forth by the *Strategy*.

The City of Ottawa (ON) Case Study

As Canada's national capital, Ottawa is a center for clean technologies, defense and security, health and life sciences and engineering industries. A capital city with two universities and proximity to Silicon Valley North, Ottawa has established itself as a center for R&D. Bordering the city of Gatineau, Quebec, the two cities comprise the Ottawa-Gatineau census metropolitan area (CMA) and the National Capital Region (NCR). Ottawa has a reported 2016 population of 934,243, with 1,323,783 people accounted for in the Census Metropolitan Area (CMA); it is a single tier municipality that uses a council-mayor system of government.

Ottawa: Smart City Strategy

The City of Ottawa recently launched its smart city strategy and roadmap in November 2017, entitled [Smart City 2.0](#). The strategy outlines Ottawa's smart city goals, which includes a connected city, a smart economy and an innovative government; it offers a sample of possible initiatives, focusing heavily on technology and innovation growth and its ability to improve and enhance the lives of residents and businesses. The goal of an innovative government will be supported by the city's forthcoming *Digital Services Strategy*. While Ottawa has components that characterize a smart city, the administration has been working across sectors to frame, package, and label its' smart city status. The forthcoming smart city *Action Plan* will establish an informed and official smart city definition.

Ottawa: Smart City Governance

According to the *Strategy*, the Economic Development and Long Range Planning and Service Transformation Committee will lead and work with [Invest Ottawa](#) and [Hydro Ottawa](#) on the Smart City Working Group, and a smart city governance model is forthcoming. A number of questions surrounding Ottawa's action plan include:

- whether the public will be integrated into the governance structure for the smart city;

- whether citizens will have a decision-making role and be empowered to critically engage with the smart city; and,
- what role civic technology and civil society groups will play in the development of the smart city focus areas and priorities.

Ottawa: Smart City Openness

Open data is part of the innovative government goal in their smart city strategy. Components of the city's open data program include their [Open Data Catalogue](#), open formats, open maps and web mapping services, implementation of an open license and the open source CKAN open data platform. There is no specific plan for meaningful public engagement for the smart city at this time beyond open data hackathons. We await to see if open source or open standards will be a consideration for Ottawa's smart city *Action Plan*.

Ottawa: Geospatial, Big and Small Data

Ottawa city government [piloted a system of sensors to measure water quality](#) and has openly released real time transit information via the [OC Transpo Next Bus Data Feed](#). The city currently deploys geospatial data for their [GeoOttawa map](#) and autonomous vehicle testing and includes harnessing big data and advanced analytics in their smart city strategy and roadmap. How the city will decide to adopt or reject standards for integrating and linking geospatial, big, and small data is yet to be determined.

Ottawa: Smart City Procurement

Ottawa smart city representatives are studying international smart city procurement models, where the private sector proposes innovative solutions to city problems rather than responding to traditional RFP's. While *Smart City 2.0* does not specify what procurement models will be studied, it is anticipated that the forthcoming action plan will provide more details regarding consideration of smart city procurement models and their guiding standards, performance metrics, and stakeholder processes.

The Province of Ontario Smart Grid Case Study

The four city case studies above intersect with jurisdictions, sectors, and governing bodies. In Canada, provinces and territories have jurisdiction over vital public goods, such as health care, education, natural resources, and social welfare. In order to capture the complexity of inter-jurisdictional processes and coordination related to smart cities, we have provided an additional case study about the governance and management of Ontario's electricity grid and smart meter data. While a brief introduction to this case study is provided below, please refer to the [Open Smart Cities in Canada: Assessment Report](#) for more details.

The Ontario case study is informed by publicly available documents and information obtained from public officials at the province of Ontario (i.e., Ministries of Energy, Municipal Affairs, Economic Development and Research Innovation and Science (jointly), Transportation, Land Information Ontario, and the Treasury Board Secretariat). After broad research about Ontario's initiatives related to smart cities, we chose to focus on the inter-jurisdictional approach to the

deployment of Ontario's Smart Grid and its related meters and the plan to allow third-party access to de-identified energy-use data. This case study provides insight into how people, processes, and technology are coordinated to responsibly and ethically share and extract value from sets of data derived from smart technology. This study also explains the complexity of utilities operations in Canada and clarifies a relationship between the province of Ontario and two of our case study cities, namely Guelph and Ottawa.

Our study found that cities in Ontario shape how smart meter data and technology are managed, but do so at a distance, via their participation or representation in formal committees. While Local Distribution Companies (LDCs) (e.g., [Hydro Ottawa](#) or [Guelph Hydro](#)) collect data measured from meters in cities, the management of Ontario's electricity systems is directed by the provincial [Independent Electricity System Operator \(IESO\)](#) and regulated by the [Ontario Energy Board \(OEB\)](#). Customers of LDCs may access data on their energy use via their billing and the '[Green Button](#)', a suite of data standards that enables customers to decide whether or not to share their energy-use data with third party services. Smart meter data in Ontario are also anonymized, aggregated, deposited and stored in a central repository and managed by the IESO's Smart Meter Entity. The governance of the implementation plan to allow third party access to Ontario's smart meter data is carried out by an Executive Steering Committee and informed by cross-sector experts represented on the Data Strategy Advisory Council. The external consultation process was extensive, as was the pilot and the audit trail to ensure privacy. This is an excellent example of professional, expert and government collaboration and the operationalization of privacy by design. The fully de-identified smart meter data managed by the IESO are expected to be made available for third party access by 2019. 2018 will include continuation of privacy and de-identification assessments, choosing the type of data offering and the costing model for smart meter data that is accessed and used by third parties.

Case Studies: Key Takeaways

The four city case studies and the provincial smart grid case study revealed a number of key takeaways and gaps that can be examined in more detail in the [Open Smart Cities in Canada: Assessment Report](#). Key takeaways, briefly described, are as follows:

- Smart cities and smart grids are new in Canada and are a work in progress.
- Smart cities are defined, governed and operationalized differently in each city and the Province of Ontario.
- Economic incentives are inspiring current smart city initiatives.
- Most cities have environmental initiatives as components of their smart initiatives.
- Civic technology groups are not obvious actors.
- Data analytics units are emerging in Edmonton and Montréal.
- At present, Montréal has meaningful public engagement with a multi-sector advisory committee.
- Smart cities are starting to be integrated into urban plans and digital strategies but are currently structured as stand-alone programs.

- Despite being created as stand-alone programs, they are evolving in parallel with open and digital practices in Canadian cities and these sometimes intersect.
- For some cities, a digital strategy is considered the same as a smart city strategy.
- It is assumed that smart cities will be inherently “open,” because they have open data programs, but smart city software, hardware, analytics and data are not open by default.
- Standards are considered important, but standards have not been officially adopted.
- All four cities have a Geographic Information System (GIS), although only Guelph includes their GIS team in their smart city governance structure.
- The province of Ontario case study provides an example of data management at the device level (i.e., meters). In the plan to allow third party access to Ontario smart meter data, the Independent Electricity Systems Operator has been advised to appoint an ethics committee and specifies privacy by design as a guiding principle.

Limitations

The process we implemented to gather this information was not without its limitations. Namely, the case studies focused on the administration of smart cities and the smart grid, which resulted in the absence of a deeper investigation of civil society actors and their perspectives and contributions in the smart city space.

In future assessments, a more comprehensive approach that includes perspectives from the public, smart city collaborators and civil society organizations is recommended. The *[Open Smart Cities Guide](#)*, however, may help bridge the gap by observing smart city initiatives that are formed and owned by civil society and other collaborators.

Findings and Gap Analysis

The E-Scan and case studies revealed findings and gaps that we believe represent Canada’s current and fledgling smart city landscape. These findings represent the potential for, and barriers to, the development of Open Smart Cities in Canada. Further research is required to more deeply examine these and to provide recommendations.

From the E-Scan and case studies, we conclude that:

- smart cities and IoT are often synonymous and platforms are promoted by vendors. On the other hand, they are sometimes discussed in a way that is indistinguishable from digital strategies;
- cities tend to assume smart cities are open;
- critical considerations of the consequences and repercussions of data and the networked smart city are missing from smart city discussions;
- there is a need for guidelines that address threats to privacy, security, human rights, data portability, transparency, and critical thinking about urban issues;

- standards are considered important, but many have not been officially adopted or considered;
- many frameworks, benchmarks and indicators exist, but most are not peer reviewed, nor do they have empirical grounding;
- strong critical academic literature exists, but it is not reflected in reports, benchmarks or beyond;
- there is little discussion of surveillance and mission-creep from the private sector, with regards to smart city plans, and connectivity is sometimes framed as a goal rather than serving a specified purpose;
- comprehensive legal and regulatory frameworks are absent, especially those related to IP, licencing, Digital Rights Management (DRM), privacy and cybersecurity;
- private sector and industry actors are dominant in the Smart City Shapers space;
- there are many promises of well-being, citizen empowerment, sustainability, efficiency and data-informed decision making, but there are very few civil society actors with influence and there is limited meaningful public engagement, which does not reflect or align with these values; and,
- downstream benefits and impacts of programs and projects are not clearly articulated by those implementing them.

Conclusion

Smart cities are a work in progress, evolving with or without common understandings of what a smart city is. They continue to evolve in the absence of a shared framework for the implementation of smart city initiatives and with ad-hoc adherence to principles of openness. Concurrently, the many ways cities and the province understand and implement “smartness” is also the result of differing historical, economic, legal, political, social, cultural, geographical and institutional contexts.

The smart city E-Scan and case studies have compiled and drawn attention to a fledgling Canadian smart cities ecosystem with many Smart City Shapers. Vendors, consultants, think tanks, conferences, standards organizations, local governments, civil society, and citizens (to name a few), are all contributing to the smart city discussion in Canada and beyond, and are shaping the general direction that Canadian cities are taking as they begin, or continue to make, the transition to smart cities. This report finds that smart cities differ not only due to the context of where they are being operationalized, but also according to which Smart City Shapers are engaged in building them. Most visions do not align with our definition for an Open Smart City, although the Canadian government’s Smart City Challenge may present opportunities for promising change.

The new and emerging status of smart cities does, however, raise a number of questions that we have recognized as opportunities for future study and reflection, namely:

- Are citizens aware of the of the changes coming with the growth of smart cities? If aware, are they driving the conversation and demanding “smart” change, or are smart cities being

imposed on citizens regardless of awareness or input? More data and connectivity does not necessarily result in better governance.

- Technological citizenship and literacy, or the need for citizens to have agency, power and knowledge of and over digital technologies may become a requirement to actively participate in society; this may be especially so with the growth of smart cities. With this in mind, is the smart city what is best for the city and its residents, or have we entered an age of innovation bias, where we believe in the benefits of wholeheartedly adopting new technologies?

Open Smart Cities in Canada does not end here. Listed below are more outputs from this project:

- *[Open Smart Cities Guide](#)*
- *[Open Smart Cities in Canada: Assessment Report](#)*
- *[Open Smart Cities FAQ](#)*
- *[Webinar 1](#)*
- *[Webinar 2](#)*
- *[Webinar 3](#)*