



FUTURE CITIES
CANADA

Community Solutions Research Series

CANADIAN SMART CITIES A CASE FOR THE CIRCULAR ECONOMY IN THE AGE OF “SMART” INNOVATION

Vickey Simovic | December 2019



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Introduction

These papers frame early insight into smart city thinking by Canadian municipal governments and their community members. If future rounds of the SCC are issued, these lessons learned from Round One should help future applicants build more successful submissions.

In the last two years there has been a flurry of activity when it comes to smart city technology and its potential role in Canadian communities. From the project on Toronto's waterfront to the Government of Canada's Smart City Challenge (SCC), since 2017 this conversation has gained momentum and audience.

The Smart City Challenge is different from other vendor-driven smart city projects. In Round One of the SCC, the Government of Canada required municipal and Indigenous applicants, from the outset, to work with their community members. The intention here was to make sure that the technological aspirations pitched in the proposals were aligned with local goals and objectives, and not just funding for what technology vendors wanted to sell. Applicants

were also required, at the time of submission, to share their applications on their local websites so that community members could review what was proposed. This decision to make the applications open facilitated research on the SCC, its applicants, and their approaches, and it provides an easy way for communities to learn from each other.

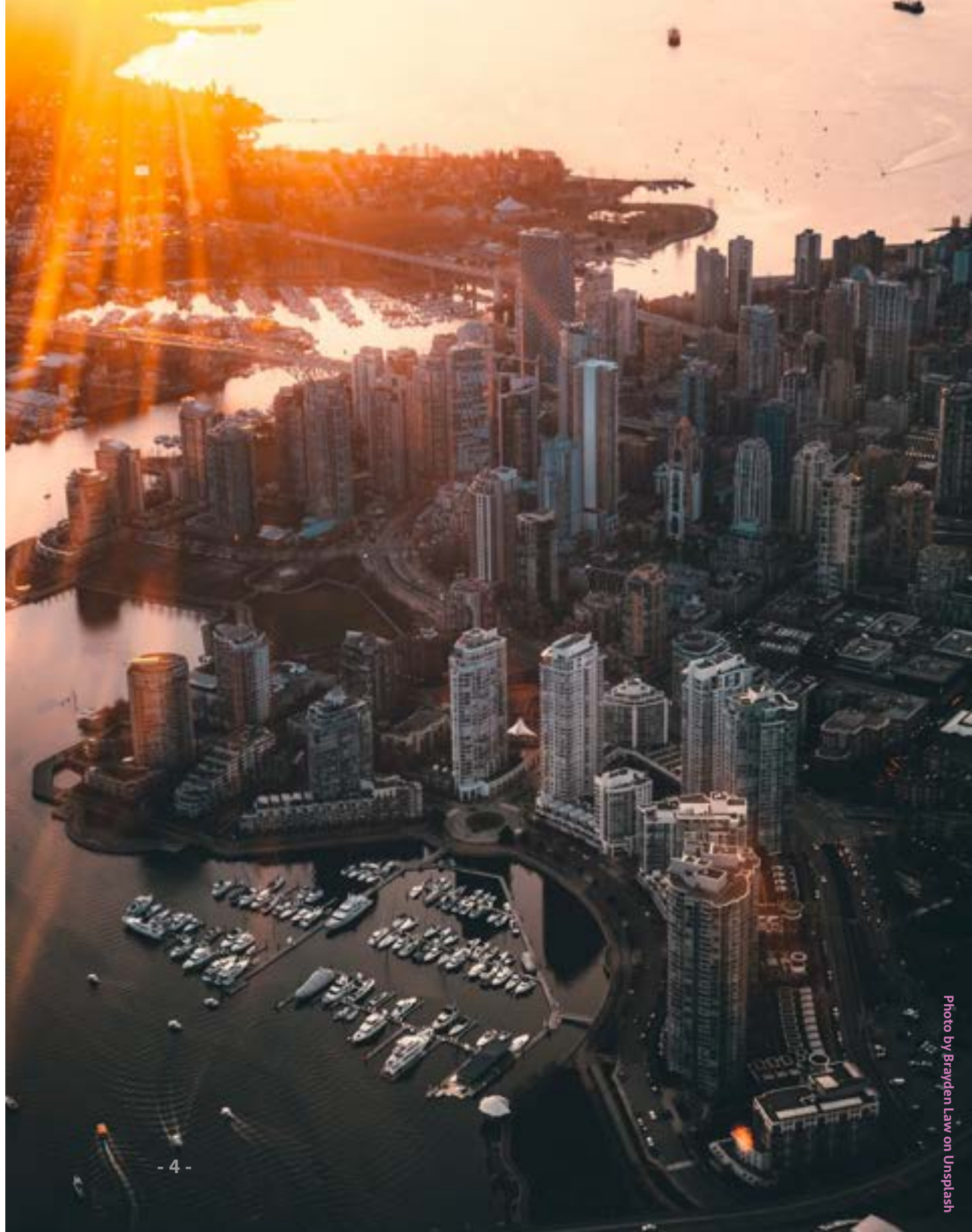
The Community Solutions Research Series includes four papers from a community-university research partnership between Evergreen and my research group in the School of Urban and Regional Planning at Ryerson University in Toronto. This research was funded by the Social Sciences and Humanities Research Council of Canada. These papers explore four different, yet complementary dimensions of

the SCC. Drawing from a comprehensive review of the Round One submissions, the public participation (Toth), maintenance (Kennedy), circular economy (Simovic) and public health (Ramsaroop) dimensions of the SCC proposals are explored.

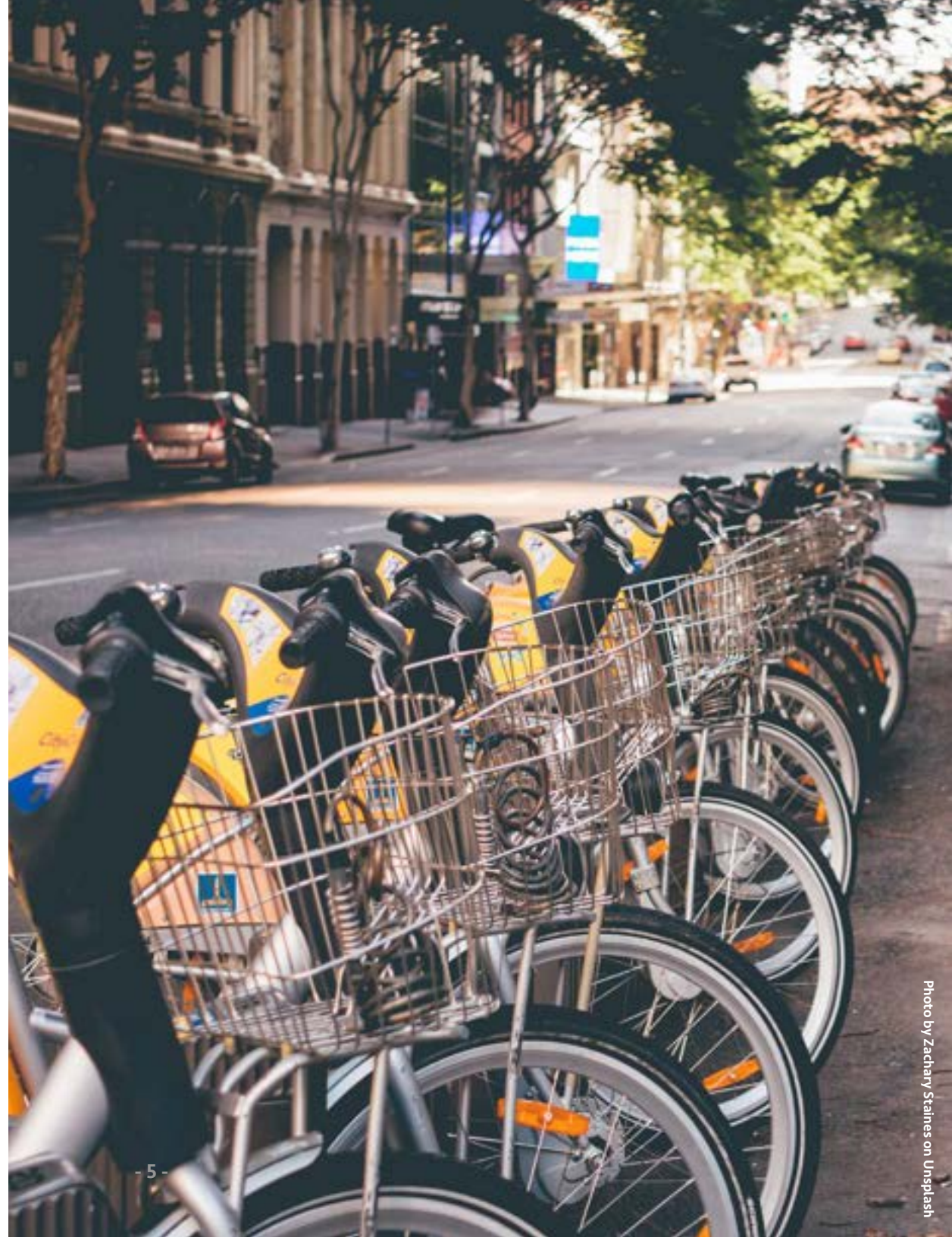
In innovation challenges much attention is paid to the winners. These papers are informed by a larger vantage point that comprises the range of projects proposed in Round One. By having this focus, these papers frame early insight into smart city thinking by Canadian municipal governments and their community members. If future rounds of the SCC are issued, these lessons learned from Round One should help future applicants build more successful submissions.

Pamela Robinson,
Director, School of Urban and Regional Planning at Ryerson University

Cities are experiencing a new wave of innovation, driven by emerging practices in governance and participation, new technologies, the availability of data, and new sources and forms of capital investment.¹ As governments modernize, can they catalyse circular economy (CE) efforts? Examining the Canadian Smart Cities Challenge (SCC) applications, this research paper found that CE thinking was not at the forefront of Canadian municipalities and Indigenous communities who submitted proposals, with only five of 102 applications involving CE principles (which, for the purposes of this paper, consist of regenerate, share, optimize, loop, virtualize and exchange).² This paper offers suggestions for ways to enable circular economy thinking throughout the advancement of smart city technology.



Cities and the **Circular Economy**



Cities have always been natural incubators for experimentation, change and progress.³ This is because they are the locus of complex problems that are difficult to address, including environmental pollution, traffic congestion, income inequality, and crumbling infrastructure.⁴ Due to the high concentration of talent, capital, data and resources in a small geographic area, cities are well positioned to embrace and lead creative city building solutions.⁵

Creative city building solutions: SFpark

The City of San Francisco's [SFpark](#) project uses wireless sensors to create smarter parking management through demand-responsive pricing. Installed in 8,200 on-street spaces in the piloted areas, the sensors can adjust prices in real time depending on the number of spaces available. This feedback is sent to app-users who can easily locate the closest available parking spot. The project helped reduce traffic and greenhouse gas emissions (GHGs) by 30% in the areas where the pilot was launched.

Cities are motors of the global economy. They account for 85% of global GDP generation and more than half of the world's population lives in urban areas.⁶ However, cities also account for 75% of natural resource consumption, 50% of global waste production, and more than 60% of GHGs.⁷ This is due to the fact that we currently operate within a global economic system that is based on the linear "take-make-dispose" model, where resources are extracted, products are created and waste is a by-product of the process.⁸ Urban economies mirror and amplify the challenges of this economic model, where we see increased environmental pollution, inequality, congestion and high levels of non-renewable waste.

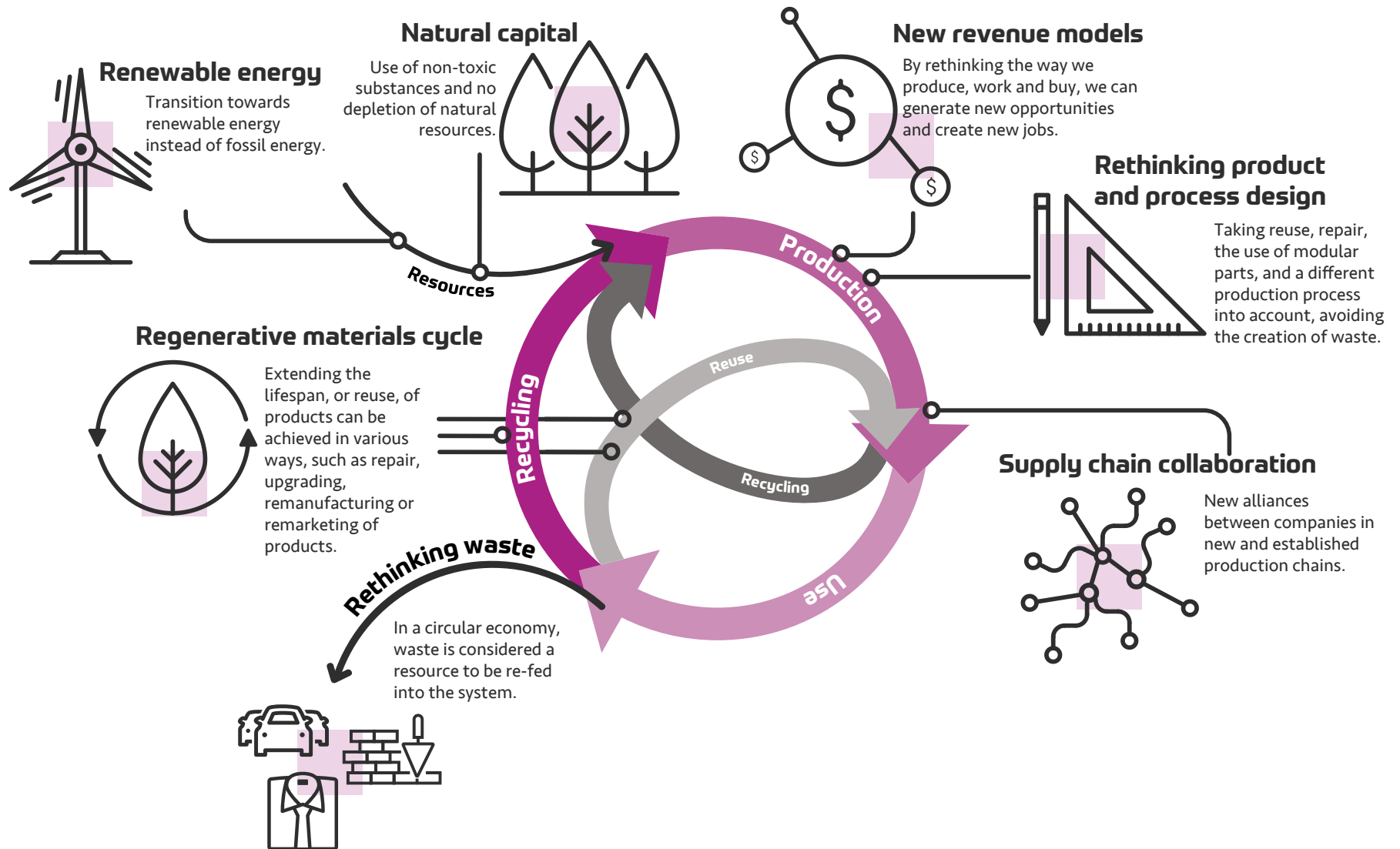
To bring the natural system into balance, a new economic model is needed—one that is sustainable and respects the limits of natural resources and the functions of ecosystems. This requires a shift in how Canadians value, use and dispose of resources, creating a circular system where waste is viewed as a resource.⁹ Transitioning to a circular economy provides opportunities to enhance social and environmental outcomes, improve economic performance and profitability, decrease the risk associated with relying on external sources

of raw materials and labour, and increase the resiliency of city services and infrastructure.¹⁰

The momentum of smart city tech is an opportunity to reinvent consumption habits. It offers possibilities for greater efficiency in product use and material flows and creates new ways of operating and participating in the global economy. Through the collection and analysis of data of materials, people and external conditions, tech has the potential to identify the challenges of material flows in cities, outline the key areas of structural waste, and inform more effective decision-making on how to address these challenges and provide systemic solutions.¹¹

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Elements of Circular Economy*



Using Smart **City Momentum**



Using the momentum of smart city tech to transition to a circular economy is important because over the last century, globalization and the impacts of human activity on natural ecosystems have led to wild plants and animals at risk of extinction, deforestation, land degradation, water scarcity, erosion, and climate change in many parts of the world.¹² The rise of industrial development has brought enormous economic growth, alongside increasing pressure on our planet's resources. Globally, material consumption has grown eightfold over the past 100 years and is expected to triple our current rate by 2050.¹³ The likely consequences of our habits include scarcity of resources, including fertile land, clean water and air.¹⁴ Most of us do not realize that what we use is directly related to the natural balance of the planet. Almost all consumer goods contain natural minerals and metals: a mobile phone can contain 50 different materials, and yet no country is self-sufficient in these materials.¹⁵ The current economic system is unsustainable, and the negative impacts to our planet cannot be ignored.

There is a world of opportunity to rethink and redesign how “stuff” is made. Through a change in perspective, the way our economy works can be redesigned - products can be “made to be made again” and the system can be powered with renewable energy.¹⁶ With creativity and innovation, we can build a restorative economy.

In a circular economy, economic activity builds and rebuilds overall system health. The concept

recognizes the importance of the economy needing to work effectively at all scales – for large and small businesses, for organizations and individuals, globally and locally.¹⁹ Cities of the future that apply a strong circular foundation, and the advancement of smart city solutions can help us get there. Decision-makers should be at the forefront of exploring ways and seizing opportunities for creating and maintaining resilient urban systems that will be inherited by future generations.

Creative city building solutions: Close the Loop

Close the Loop is an Australian company that has re-thought roads. It recovers value from old printer cartridges and soft plastics and turns these materials into roads. These products are mixed in with asphalt to produce a higher-quality road surface that lasts up to 65% longer than traditional asphalt.¹⁷ In every kilometre of road laid, the equivalent of 530,000 plastic bags, 168,000 glass bottles and the waste toner from 12,500 printer cartridges is used in the mix.¹⁸

As cities become smarter, there is an opportunity to redesign how we make and consume things, to incorporate circular economy principles. Incorporating digital technology is essential for society to accelerate the systemic shifts needed to create a circular economy.²⁰ Research has shown that political leadership, experimental

approaches (such as living labs), development of contextual knowledge about resource use, and diverse stakeholder engagement are important steps in adopting a circular economy strategy.²¹

liv-ing labs

[/'liviNG, lab/] *noun*

Using the city as a real-world testing ground for new ideas and technologies, from observing the living patterns of users in a controlled area, to larger scale projects that enhance innovation, inclusion, usefulness and usability of technology and its applications in society.²²

Through a change in perspective, the way our economy works can be redesigned - products can be “made to be made again” and the system can be powered with renewable energy.¹⁶ With creativity and innovation, we can build a restorative economy.

Challenges to **Getting There**



Despite its growing popularity among academics and businesses, the transition to a circular economy has many challenges, including:

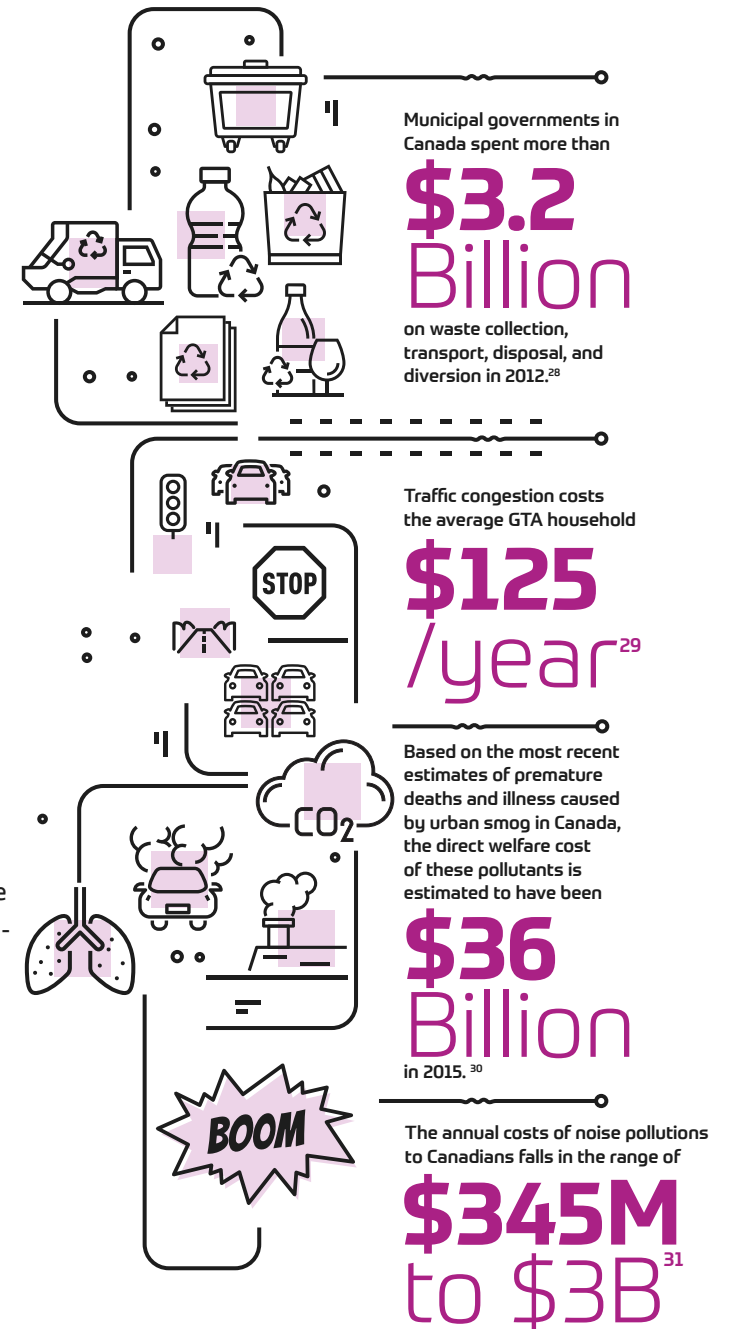
- a generally weak and fragmented policy support system, with the largest barrier being the lack of a national circular economy strategy.
- lack of financial support to enable businesses to transition to a circular economy, and the financial incentives to remain in the current state.
- low levels of resident engagement and individual awareness contribute to a lack of understanding about CE and its impacts.

This paper analyzes the federal Smart Cities Challenge, which provided an opportunity to bring circular economy principles to the forefront of city building as it inspired communities across the country to define their future with the help of their residents through the use of a smart cities approach.²³ However, considering that only five applications discussed circular economy principles, highlights an opportunity for the federal government to encourage circular economy thinking, and for local governments to bring system change.

All levels of government have a key role to play in building thriving, livable, resilient communities that are regenerative by design.²⁴

One of the solutions recommended in this paper is for the federal government to implement a Canadian circular economy strategy, which would set a direction of travel for local governments and offer an invaluable opportunity to raise ambitions and engage stakeholders in undertaking circular economy transitions.²⁶

On the other hand, local decision-making is important as cities provide the space in which a circular economy can flourish. Cities amplify their impact through the proximity of people, materials and data which are all contained in a small geographic territory. Proximity to the everyday concerns and needs of urban residents and businesses, and the policy levers at their disposal, gives them a key role. Local governments see, experience and often manage the negative consequences of the current “take-make-waste” linear economy, which includes funds spent on solid waste management; costs incurred from structural waste; cost of underutilized buildings; economic costs of congestion; and health costs of air and noise pollution.²⁷



A Circular Economy Framework

The purpose of a conceptual framework is to provide a lens through which to understand the ways a circular economy could manifest in a city. The framework on the following page should be used by local governments as a guide to build out their own circular economy efforts, and evaluate their performance, and embrace the smart city technology tools and momentum to help sustain the effort.

Policymakers have a role to play in guiding top-down change, and stimulating bottom-up business, residents and community activities to increase urban sustainability.³²

The Ellen MacArthur Foundation has created the [ReSOLVE framework](#), encompassing six circular city principles: Regenerate, Share, Optimize, Loop, Virtualize and Exchange.³⁵ This framework considers the social, economic and environmental dimensions of circularity and sustainability.



top-down change[/tăp- doun, CHānj/] *noun*

Top-down change is institution-driven change, such as strategy and policy decisions including public-private partnership projects that are concerned with developing and facilitating market initiatives.³³

bot-tom-up change[/ˈbādəm- doun, CHānj/] *noun*

Bottom-up change can describe social movements and social innovation, such as initiatives and entrepreneurial activities initiated and run by civil society, NGOs, communities and businesses.³⁴

Principle	Definition	Top-Down Example	Bottom-Up Example
Regenerate	The shift to renewable energy and materials—to reclaim, retain, and restore the health of ecosystems and return recovered biological resources to the biosphere.	Utilizing rooftops as solar fields, developing green space for biodiversity and to improve air quality.	Personal acquisition of renewable energy; solar panels, urban farming, electric or biogas-fuelled mobility.
Share	Sharing assets (e.g., cars, rooms, appliances), and prolong the life of materials through maintenance, design for durability, upgradability and encouraging reuse/ second-hand.	Policy innovation to support the collaborative economy, regulate sharing, tax and fiscal measures incentivizing sharing.	Car sharing, appliance sharing (washing machines, tools), repair (repair cafes), reuse (clothing, furniture, vehicles, appliances)
Optimize	Increase performance/ efficiency of a product, remove waste in production and supply chain, and leverage big data.	By using gathered data on traffic flows, the efficiency of cities' major transportation can be optimized, decreasing congestion. Installing smart LED lighting throughout the city to save energy. Retrofitting old buildings to increase their energy efficiency.	Smart citizen labs, Fab Labs, smart grids, smart communities.
Loop	Remanufacturing products or components; resources are processed, looped around and put back into the economy, rather than lost in a landfill.	Waste separation and recycling, district heating, bio-based economy, reverse logistics.	Community recycling initiatives, upcycling initiatives, community bio-digesters.
Virtualize	Dematerializing directly and indirectly (for example: e-readers replacing physical books, or a Netflix subscription replacing material DVDs).	Virtual city hall counters. Autonomous public transportation and semi- private transportation like taxis. Virtualization of public libraries, archives, legal information. A paperless municipality.	Community-led digital platforms, citizen-science climate monitoring.
Exchange	The process of replacing old technologies with advanced non-renewable materials, applying new technologies (such as 3D printing) and choosing new products/services.	Circular construction /demolition materials and processes, electric powered public transportation, procurement of circular office furniture.	Electric mobility, organic and locally sourced (super) markets, eco-fashion, e-readers

Circular
Economy
Leaders



Due to the pressures of urbanization and climate change, businesses and governments have begun to adopt circular economy principles as a route to resource efficiency in the face of rising material prices – such as [China](#), the [European Commission](#), and [Australia](#), among others.³⁶

The City of Toronto is another leader as it is working towards an aspirational [goal of zero waste and a circular economy](#). To drive innovation and the growth of a circular economy in Toronto, the City has established a Unit for Research, Innovation & a Circular Economy. The unit is involved in research and planning as well as incorporating circular economy principles into new programs, policies, procurement and processes. The overarching goal of the unit is to make Toronto the first municipality in Ontario with a circular economy. The City is a member of the [National Zero Waste Council Circular Economy Working Group](#) as well as the global [Circular Economy 100 Network](#), created by the Ellen MacArthur Foundation.

As part of this paper's review of the Smart Cities Challenge, each responsive application was evaluated against the ReSOLVE Framework mentioned above. Considering that only five of 102 SCC applications discussed circular economy principles underscores that more work can be done by the public sector to prioritize and encourage circular thinking. All levels of government have a key role to play in building thriving, livable, resilient communities that are regenerative by design.

Circular Economy proposals for the Smart Cities Challenge

The City of Port Alberni, British Columbia

Population: 17,678

Focused on becoming a true zero-waste community and fully utilizing the natural resources in its coastal area.

The District of Squamish, British Columbia

Population: 19,512

Focused on a zero-waste action plan that engages and empowers the community to sustainably grow while reducing overall waste, and turning waste into assets.

The City of Guelph and Wellington County, Ontario

Population: 222,726

Focused on becoming Canada's first tech-enabled Circular Food Economy, increasing access to affordable, nutritious food.

The Municipality of Hope Town , Quebec

Population: 344

Focused on creating a community exchange platform to encourage the reuse of consumer goods and encourage sustainable consumption behaviour.

The City of Coquitlam, British Columbia

Population: 140,028

Aimed to become a living lab and develop waste management solutions that address environmental and sustainability issues such as waste reduction and diversion, GHG reduction and use of renewable energies.

Guelph-Wellington: A Circular Economy in Profile

Of the five circular economy SCC applications, The City of Guelph and Wellington County (Guelph-Wellington) was selected as a finalist and ultimately was awarded the \$10M prize. Guelph-Wellington focused on becoming Canada's first technology-enabled Circular Food Economy, creating a food-secure ecosystem that increases access to affordable, nutritious food by 50%, where waste becomes a resource, to create 50 new circular businesses and collaborations, and increase circular economic revenues by 50%: 50x50x50 by 2025. Their application is profiled below:

- Guelph-Wellington is an already existing hub of food innovation and environmental sustainability. Leveraging local expertise, big data and the latest technology to transform the food ecosystem into a connected "living lab" where researchers, social innovators, farmers, entrepreneurs and other community partners can collaborate to solve complex food problems.
- Proposed solutions include the creation of baseline asset and behaviour mapping which will seek to understand what currently exists in the community and where gaps lie and identify geographic and demographic priority areas. The analysis of multiple layers of data, including behaviour, will also provide insights for public health interventions and a platform for community-wide evidence-based decision-making. The data will also be used to develop a Food Security and Health Action Plan for the region.
- Overall, Guelph-Wellington relied on CE principles throughout its application for the creation of a circular food economy. Social, economic and environmental sustainability goals were equally prioritized in the proposal. The following is an evaluation of the application against the ReSOLVE framework:

Principle	Assessment of Guelph-Wellington's SCC Application
Regenerate	The application seeks to create new opportunities and sources of revenue by valuing waste as a resource, and by re-imagining, re-using and revaluing food ecosystem inputs and outputs by maximizing their use, eliminating waste, optimizing economic value and reducing negative environmental impacts.
Share	The application discusses developing a circular innovation ecosystem that shares information and leverages social innovation and technology to advance new business models and collaborations to tackle food problems.
Optimize	The creation of baseline asset and behaviour mapping will help decision-makers understand the systems strengths and weakness and identify priorities for the community. The analysis of data will provide insights for public health interventions and a platform for evidence-based decision-making.
Loop	To help other local businesses buy and sell their own GHG/carbon offsets, Guelph is exploring the potential of developing a digital marketplace powered by blockchain technology to encourage more companies to reduce their carbon footprint by buying offsets generated from food waste.
Virtualize	Guelph is exploring the potential of developing a secure, open and accessible digital marketplace powered by blockchain technology, to help other local businesses buy and sell their own GHG/carbon offsets.
Exchange	"Collision" spaces will be established to promote new business collaborations and innovations to solve food system challenges through a technology- enabled platform.

The Route to Circular economy

Thinking and working within a circular economy challenges the profligate use of resources, material and energy.³⁷ It forces us to rethink, re-engineer and rebalance our behaviours in such a way that we become more mindful of the value and finite nature of the world's resources. Waste is simply "matter out of place"; it is part of the natural order of things.³⁸ In a circular economy, there is no waste, rather it is stuff in the wrong place. We need to start thinking of waste as a resource, rather than a byproduct of the linear consumption process.

The adoption of smart city tech is an opportunity to bring in circular economy thinking as governments modernize and respond to climate change and other environmental issues. The following paragraphs provide a summary of recommendations that can enable circular economy efforts using smart city momentum:



Educating Circular Economy Leaders

Every organization or individual has a role to play in creating and maintaining a successful circular economy. Each level of government is an enabler; businesses are drivers and people become users, instead of consumers of products.³⁹ The circular economy offers business leaders and government a clear opportunity for long-term growth that is less dependent on cheap materials and energy, and which can restore and regenerate natural capital.⁴⁰ It seeks to rebuild financial, manufactured, human, social or natural capital by ensuring enhanced flows of goods and services. Understanding where the most circular value could be optimized will allow for system effectiveness and the reduction of negative externalities such as pollution, dangerous chemicals, health hazards, and scarce resource-hungry systems.⁴¹ Educating all stakeholders about what a circular economy is, what it solves for and the various forms it takes, is an important step to advance a successful circular economy.

Policy Levers that Enable Circular Economy Transitions

The Ellen MacArthur Foundation identifies policy levers that decision-makers can use to enable urban circular economy transitions. These policy levers are interlinked and work to enable that waste and pollution be designed out of products and urban systems; materials be kept in use and maintain their value; and for natural systems in and around cities to regenerate.⁴² The policy levers are:

1. **Legislation and regulation:** shaping bylaws that stimulate circular economy practices; for example, organic waste treatment requirements for large commercial food retailers (grocery stores and restaurants).
2. **Fiscal measures** can be used to discourage or incentivize certain behaviours or market developments (including taxes, charges, fees, fines). Examples include tax benefits for circular economy products or businesses; tax reductions on use of recycled materials; tax increases on undesirable waste streams; and tax reductions for activities involved in share, repair and recycle businesses.
3. **Financial support** in the form of grants, subsidies, direct and indirect investments and procurements through which city governments can enable circular city developments within local governments, public asset management, public procurement and capacity building.
4. **Using circular economy criteria for public procurements.** These can range from the purchase of everyday office goods and services to large-scale urban infrastructure projects. Integrating circular economy criteria within public procurement policies and practices can stimulate the circular design, provision, management and servicing of goods. City governments have a large purchasing power which gives them the ability to create demand and shift the market to new ways of providing goods and services, from the individual product level to the system level.
5. **Identifying opportunities in city-owned physical assets.** The management of city-owned physical assets, including land, buildings, roads and bridges, water and sewage systems, amongst other items. The use of circular economy principles can help to unlock opportunities ranging from cost-savings to maximizing resource value, use and circulation (in the evaluation of the life cycle costs of the assets);

6. **Using urban planning to enable circular economy networks.** The physical shaping and development of a city. It assesses physical, social, and environmental factors and determines the allocation, development and usage of urban structures such as buildings, infrastructure and parks. It has a powerful impact on how people and goods move around in a city and whether materials, products and nutrients can be recaptured and kept in use.
 7. **Supporting capacity building** in the form of training and advisory support programs for individuals, companies and organizations, to help mainstream circular economy understanding and practices within society, such as incubator programmers, and material-exchange platforms.
 8. **Raising awareness of circular economy opportunities** is key to supporting local transitions (which includes knowledge sharing and communication campaigns).
 9. **Convening and partnering between public, private and civic leaders.** Engaging multiple stakeholders in public policy creation and delivery is particularly valuable when innovating and making system changes (for enabling and developing circular opportunities). It can also help to achieve greater scale, shared ownership and mutually beneficial impact;
 10. **Creating roadmaps and strategies that set a direction of travel for cities** offer an invaluable opportunity to raise ambitions and engage stakeholders in addressing future opportunities for the city.
- All of these tools can be used by any level of government, and any level of policymaker, to help encourage the use of circular economy principles and create circular processes that improve the environment and quality of life for residents. Cities of any size can be “innovation drivers,” if there is a willingness among local leadership to share responsibility for addressing urban issues with outside stakeholders.



LanewayConsultation_JamieMcMillan_15Dec2016 (110)

Understanding where the most circular value could be optimized will allow for system effectiveness and the reduction of negative externalities such as pollution, dangerous chemicals, health hazards, and scarce resource-hungry systems.⁴¹



End Notes

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