Canada's Resilient Capital: Ottawa in the Next Half Century

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Canada's Resilient Capital: Ottawa in the Next Half Century

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SURP 826 Project Team
Emily Goldney, Ben McCauley, Taylor Sharpe, Jillian Simpson, Sydney Tasfi, Mark Tanner, and Robert Tran

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Executive Summary

Ottawa is currently embarking on a planning study under the project name *Ottawa Beyond 2036: Setting the Stage for Ottawa's Next Official Plan* (*Beyond 2036*). Under the auspices of this project, the City will use a scenario planning process to analyze its responsiveness to environmental, demographic, technological, and economic 'drivers of change' which could significantly affect the City's future over the latter half of the 21st Century. Opportunities to enhance the City's responsiveness to these changes will be identified.

The purpose of this report is to:

1. Identify and review the primary drivers of long-term change which could affect Ottawa's future;
2. Explore municipal best practices for city resilience; and,
3. Make recommendations on how the City of Ottawa can best conduct its scenario planning process.

The project team began by reviewing recent research pertaining to scenario planning. The team then examined the existing long-range planning context of the Ottawa region. This was done to explore which 'drivers of change' Ottawa had identified across four categories: environmental, demographic, technological, and economic. The term 'driver of change' refers to any issue, challenge, or opportunity which will affect Ottawa's future growth and development.

The team then gathered 37 municipal resilience and long-range growth plans to determine which drivers of change were identified in each municipal plan. Next, a workshop was held with students, academics, and professional planners in attendance. The participants identified the drivers of change and municipal plans they felt were most relevant and important to Ottawa's future. The list of 37 cities identified as important for each category of driver was then narrowed using different selection criteria, with the results seen in **Table 1**. The strategies these cities used to address Ottawa's most important drivers were then examined.

Table 1: Cities with long-range plans identified as relevant to Ottawa for each category of driver

Environmental	Demographic	Technological	Economic
Athens, Greece *Athens Resilience Strategy for 2030*	Birmingham, UK *Birmingham 2026: Our Future Vision*	Baltimore, USA *City of Baltimore Master Plan*	Calgary, Canada *Calgary Resilience Strategy*
Boston, USA *Resilient Boston*	Boston, USA *Resilient Boston*	Berkeley, USA *Berkeley Resilience Strategy*	Edmonton, Canada *Edmonton Metropolitan Growth Plan*
Calgary, Canada *Calgary Resilience Strategy*	Chicago, USA *Go To 2040: Comprehensive Regional Plan*	Birmingham, UK *Birmingham 2026: Our Future Vision*	New York City, USA *OneNYC: A Strong and Just City*
Istanbul, Turkey *2013-2023 Istanbul Regional Plan*	Christchurch, NZ *Resilient Greater Christchurch*	Helsinki, Finland *Helsinki City Plan Vision 2050*	Pittsburgh, USA *OnePGH: Resilient Pittsburgh*
London, UK *City of London Local Plan*	Edmonton, Canada *Edmonton Metropolitan Growth Plan*	Manchester, UK *Core Strategy Development Plan*	
New York City, USA *OneNYC: A Strong and Just City*	Melbourne, Australia *Resilient Melbourne*	New York City, USA *OneNYC: A Strong and Just City*	
Paris, France *Paris Adaptation Strategy*	New York City, USA *OneNYC: A Strong and Just City*	Tokyo, Japan *Creating the Future: Long Term Vision*	
Pittsburgh, USA *OnePGH: Resilient Pittsburgh*	Vejle, Denmark *Vejle Resilience Strategy*		

The project yielded the following recommendations for Ottawa's scenario planning project:

1. Scenario planning is a valuable tool for building resilience.
2. Consider the 41 drivers of change listed in **Table 2** in Ottawa's scenario development process, as they are particularly important to Ottawa's future.
3. Respect relationships between drivers in scenario development.
4. Consider Ottawa's varying degree of control over drivers of change in scenario development.
5. A multi-layered approach should be taken when building scenarios, including foundational elements, vulnerabilities, and opportunities.
6. Develop scenarios in a collaborative process involving diverse stakeholders like that outlined in the Conclusions & Recommendations **(Chapter 8)**
7. Develop a mechanism for multi-jurisdictional cooperation to address drivers of change.
8. Ensure future resilience strategies embrace a range of uncertainty.
9. Identify specific strategies to address drivers of change.

Table 2: List of drivers identified as important to Ottawa's future.

Environmental	Demographic	Technological	Economic
Floods	Immigration	Autonomous Vehicles	Employment Skills/Training
Transition to Renewable Energy	Population Growth	Ageing Infrastructure	Diversification
Supply of Developable Land	Ageing Population	Digital Infrastructure	Globalization
Extreme Storms	Housing	Transit Oriented Development	Economic Competition
Demand for Power	Shifts in the Labour Market	Infrastructure Demand	Automation
Increase in Rainfall Intensity	Social Mobility	Inadequate Public Transit	Economic Change
Urban Heat Islands	Placemaking	Regionalization (Transit)	Regionalization
Wastewater Capacity	Unemployment	Cyber Security	Industry Mix Changes
Damage to Natural Areas	Retention	Renewable Energy	Inequality
Warmer Temperatures	Education	Infrastructure Failure	Economic Uncertainty
Decreased Air Quality			

- Opportunities

- Vulnerabilities

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INTRODUCTION

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1.1 Project Context

Ottawa is currently undertaking a planning study under the project name *Ottawa Beyond 2036: Setting the Stage for Ottawa's Next Official Plan* (*Beyond 2036*).[1] In this project, the City of Ottawa will conduct a scenario planning process to analyze its responsiveness to environmental, demographic, technological, and economic drivers of change which could significantly affect the City's future beyond the next fifty years. The term 'driver of change' refers to any issue, challenge, or opportunity which will affect Ottawa's future growth and development.

This report identifies and reviews the main drivers of long-term change that could affect Ottawa's future growth and development, summarizes municipal best practices relating to building resilience to these drivers of change, and makes recommendations on how Ottawa can best use scenario planning to build municipal resilience.

1.2 Geographic Context

The City of Ottawa is located in the Ottawa Valley in Eastern Ontario. It is situated on the Ontario-Québec border across the Ottawa River from the Ville de Gatineau, Québec. Ottawa, Gatineau, and rural area municipalities combine to form the 'National Capital Region' (NCR). The current City of Ottawa was created in 2000 with the amalgamation of eleven municipalities from the former Region of Ottawa-Carleton. It is a single-tier municipality, and is located within the traditional territory of the Algonquin Nations.

In 2016, Ottawa had a population of 934,243 people living in nearly 400,000 households.[2] The population of the combined Ottawa-Gatineau census metropolitan area (CMA) was 1,323,783, the fifth largest in the country.[2] With an average age of 40.1 and 44% of the population under the age of 35, Ottawa has a relatively young population.[2] Approximately one in five residents were born outside of Canada, one in seven residents are visible minorities, and trends indicate that the majority of the City's future population growth will depend on international immigration.[3] The main languages spoken are English and French, with 38% of residents speaking both languages.[2]

The City of Ottawa has an area of 2,790 km.[2] Ottawa is unique as it encompasses an urban area, suburban areas, agricultural and rural lands, wetlands, forests, and the Canadian Shield.[2] A notable feature of the City is its Greenbelt, a 20,000-hectare band of protected green space established by the federal government in the 1950s to prevent urban sprawl.

Ottawa's economy is dominated by employment in the government and high-tech sectors, with approximately one in five workers employed by the federal government.[2] Families and individuals have some of the highest median incomes in the country.[2] However, poverty does exist and approximately one of every four households spend more than 30% of their gross income on housing; this is the generally accepted threshold for affordable housing.[3, 4]

1.3 Future Trends

The population of the City of Ottawa is expected to grow to 1.15 million by 2031, and the population in the greater Ottawa-Gatineau region is projected to increase to 1.8 million by 2036.[5] This population will shift to become older, with the percentage of the population over 64 expected to increase from 12% to 20%.[3] With climate change, the area is expected to grow warmer, and it is anticipated that an increased number of extreme weather events such as heavy rain, ice storms, flooding, and heat waves will occur.[3]

Heavy rain on Metcalfe Street – Ottawa, Ontario. (Credit: Tim Spears, 2016)

1.4 Planning Context

City of Ottawa

The primary planning agency for the City of Ottawa is the City's Planning and Growth Management Department. The City of Ottawa's *Official Plan* was adopted in 2003, and applies across the entire City. It contains goals, policies, and objectives to manage the City's growth and development until 2031, according to the qualities most valued by the municipality's residents.[6] It addresses the matters of provincial interest indicated under the *Planning Act, 1990*, and the *2014 Provincial Policy Statement*. Official Plan Amendments #150 and #180 were adopted as part of major *Official Plan* reviews in 2013 and 2016, respectively, with the latter amendment pending ministry approval.[6]

Many non-statutory Master Plans have also been created. In 2003, under the Ottawa 20/20 planning process, the City approved an *Economic Strategy*, a *Human Services Plan*, an *Arts and Heritage Plan*, and an *Environmental Strategy* to direct and manage growth to 2020. In 2013, the City completed the *Building a Liveable Ottawa* initiative, which was a comprehensive review of City policy with respect to land use, transportation and infrastructure. The results of this process were the *Transportation Master Plan*, *Official Plan Amendment #150*, the *Infrastructure Master Plan*, the *Ottawa Cycling Plan*, and the *Ottawa Pedestrian Plan*. Together, these five integrated plans establish the vision for Ottawa's growth to 2031 based on the qualities most valued by Ottawa residents. Lastly, the 2014 *Air Quality and Climate Change Management Plan* describes how Ottawa will adapt to and manage climate change from 2014 to 2024.

National Capital Commission

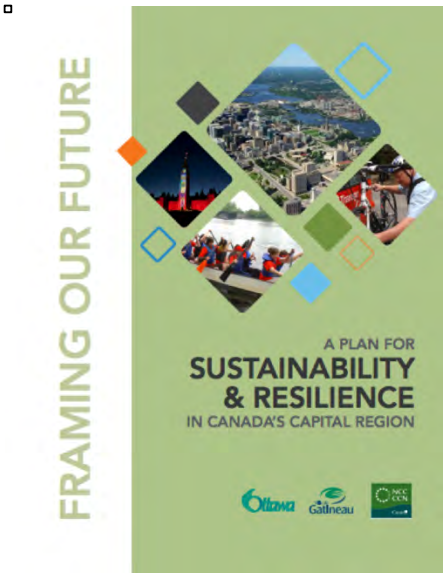
The National Capital Commission (NCC), is a federal crown corporation mandated to build a better capital for all Canadians. It is the largest landowner in the NCR, and acts as the main planner and administrator for these lands. It has prepared a 50-year long-range plan for the NCR, titled *The Plan for Canada's Capital, 2017-2067*. The plan was the product of nation-wide consultations, and establishes a vision for the capital's development, and is

meant to complement the existing municipal Official Plans.[7]

Regional Initiatives

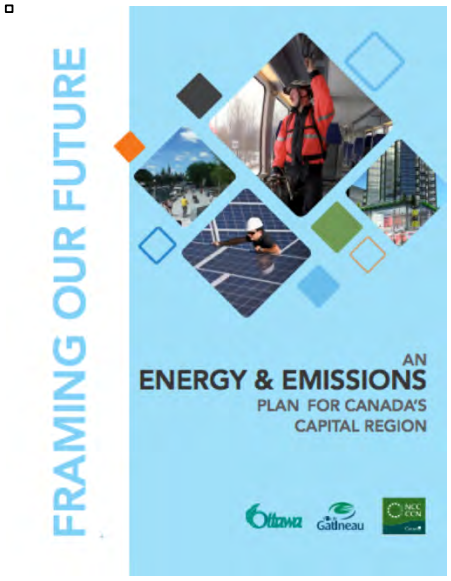
Choosing our Future was an initiative of the City of Ottawa, completed in conjunction with the Ville de Gatineau and the NCC to develop long-range plans for the future of the NCR. The initiative's final output was released in 2012 as three plans:

- *A Plan for Sustainability and Resilience in Canada's Capital Region*: An over-arching plan identifying a vision for the Capital Region in 2060, and outlines goals, strategies, and actions to achieve this vision.[3]



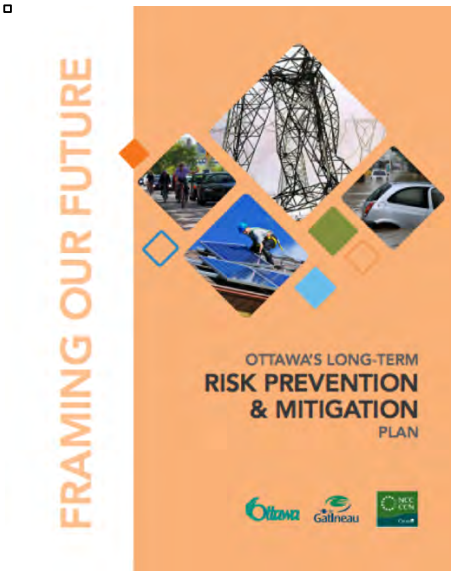
The cover page of the Framing Our Future: A Plan for Sustainability and Resilience in Canada's Capital Region

- *An Energy and Emissions Plan for Canada's Capital Region*: a sub-plan describing strategies to increase the region's use of renewable energy and reduce its energy consumption.[3]



The cover page of the Framing Our Future: An Energy and Emissions Plan for Canada's Capital Region

- *A Risk Prevention and Mitigation Plan for the City of Ottawa*: a sub-plan which examines the region's vulnerabilities to trends and drivers of change, describing how the strategies in the Sustainability and Resilience Plan help mitigate or prevent these risks.[3]



The cover page of the Framing Our Future: Ottawa's Long-Term Risk Prevention and Mitigation Plan

Province of Ontario

Ottawa may not be able to address all drivers of change that will affect the city. In Canada, municipalities are "wholly creatures of the provincial legislature," and may only exercise the powers given to them by the province.[8] In Ontario, the majority of planning and development authority rests with the municipality, subject to provincial legislation.[9] The Province of Ontario also retains jurisdiction over certain matters, including the protection of provincially significant wetlands and natural features.[10]

1.5 Report Overview

The report begins with a summary of recent research, which provides an understanding of what scenario planning entails. This summary defines scenario planning and provides insight on the creation, evaluation and classification of scenario plans. This classification was used to evaluate existing long-range plans in the Ottawa-Gatineau region.

The process to identify important precedent plans and drivers of change for the City of Ottawa is then presented. The report provides a detailed explanation of important drivers for Ottawa in four primary categories - environmental, demographic, technological, and economic - and explores the strategies different municipalities have used to address the drivers in these categories.

The report concludes with nine recommendations for how the City should develop its own alternative scenarios. This includes the key drivers to consider, processes for scenario development, and considerations for the development of a scenario-based resilience plan. Additional materials on precedent plans and the drivers of change selection are contained in **Appendix A: Precedent Catalogue.**

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(Sydney Tasfi)

PLANNING CONCEPTS

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2.1 Summary of Research

The purpose of the following summary of research is to present current knowledge and findings about scenario-based planning within the urban planning context. This includes researchers' theoretical and methodological contributions as to how scenario planning can be used as a tool for managing urban growth. Part of this review includes an extensive look at Chakraborty and McMillan's (2015) classification of scenario plans in complex urban planning situations, and how this can guide urban planners in the development of scenario plans. In addition to the summary of research, an annotated bibliography of the research presented in the summary of literature can be found in **Appendix B: Annotated Bibliography**. The purpose of this annotated bibliography is to highlight the relevance, accuracy, and quality of the sources cited.

2.2 Defining Scenario Planning

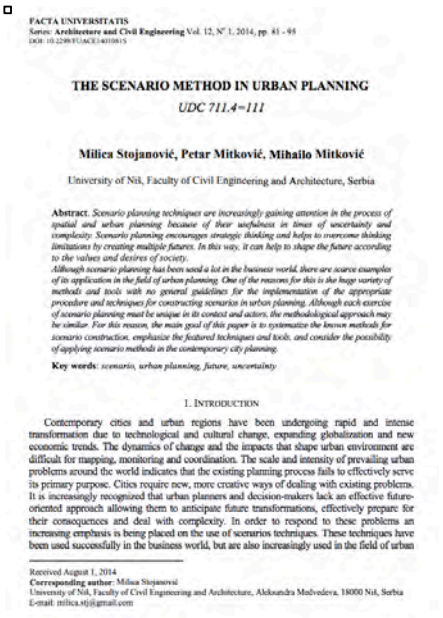
Traditional planning typically involves the extrapolation of historical trends to plan for a likely future. However, the future is highly uncertain, and planning for current trends reinforces the continuation of these trends. Conventional thinking only envisions one scenario, whereas scenario planning explores multiple alternatives (Chakraborty & McMillan, 2015). When a set of alternative scenarios is prepared by a diverse set of stakeholders, the resulting scenarios contain different futures that reflect different assumptions about the future. In this sense, scenario planning is a strong tool for organizational learning and option exploration, as it forces stakeholders to appreciate diverse perspectives and critically think about the consequences of different planning strategies (Xiang & Clarke, 2003).

There is no standardized definition of scenario planning within academic literature. For the purpose of this report, the following definition was developed:

"Scenario planning is a strategic planning method used by planners to conceive, develop, and evaluate multiple plausible futures for the growth and development of a city or region. This process allows planners to identify a preferred course of action and to set priorities."

Stojanovic et al. (2014) argue that scenario planning encourages strategic thinking and helps overcome thinking limitations by creating multiple possible futures. Schoemaker (1993) describes scenario planning as a way to identify key uncertainties in the future, suggesting that scenarios should not be modelled based on best estimates or isolated variables. Building upon this idea, Hoch (2016) defines scenario planning as a middle ground between 'perfect,' hopeful views of the future (one that ignores the possibility for negative change and conflict in the future), and plans that balance all possible options into the future. Bishop et al. (2007) suggest that scenario planning is more of a complete foresight study, where scenario development is concerned with creating actual stories about the future. Similarly, Bartholomew (2007) defines scenario planning as an "internally consistent view of what the future might turn out to be - not a forecast, but one possible future outcome."

Ratcliffe and Krawczyk (2011) discuss the limitations in current scenario planning exercises, stating that city planners and policy makers lack an effective future-oriented approach to planning which prevents planners from being able to shape a preferred future condition or anticipate impending change. Durance and Godet (2010) further argue that there is no point in forming scenarios if they are not pertinent, coherent, and plausible.



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THE SCENARIO METHOD IN URBAN PLANNING
UDC 711.4=111

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Abstract. *Scenario planning techniques are increasingly gaining attention in the process of spatial and urban planning because of their usefulness in times of uncertainty and complexity. Scenario planning encourages strategic thinking and helps to overcome thinking limitations by creating multiple futures. In this way, it can help to shape the future according to the values and desires of society.*
Although scenario planning has been used a lot in the business world, there are scarce examples of its application in the field of urban planning. One of the reasons for this is the huge variety of methods and tools with no general guidelines for the implementation of the appropriate procedure and techniques for constructing scenarios in urban planning. Although each exercise of scenario planning must be unique in its context and actors, the methodological approach may be similar. For this reason, the main goal of this paper is to systematize the known methods for scenario construction, emphasize the featured techniques and tools, and consider the possibility of applying scenario methods in the contemporary city planning.

Key words: *scenario, urban planning, future, uncertainty*

1. INTRODUCTION

Contemporary cities and urban regions have been undergoing rapid and intense transformation due to technological and cultural change, expanding globalization and new economic trends. The dynamics of change and the impacts that shape urban environment are difficult for mapping, monitoring and coordination. The scale and intensity of prevailing urban problems around the world indicates that the existing planning process fails to effectively serve its primary purpose. Cities require new, more creative ways of dealing with existing problems. It is increasingly recognized that urban planners and decision-makers lack an effective future-oriented approach allowing them to anticipate future transformations, effectively prepare for their consequences and deal with complexity. In order to respond to these problems an increasing emphasis is being placed on the use of scenarios techniques. These techniques have been used successfully in the business world, but are also increasingly used in the field of urban

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The cover page of Stojanovic et al. (2014)

2.3 Creation and Evaluation of Scenario Plans

Xiang and Clarke (2003) outline the features of a good scenario, which include it being plausible, having vivid information, being thematic, incorporating a timeframe, and being a size that is both effective and safe to use. Scenarios that do not have these features are generally ineffective (Xiang & Clarke, 2003). Volkery and Ribeiro (2009) explain that the success of scenario planning is contingent on key factors such as societal values and interests, public participation, and organizational willingness.
Borjeson et al. (2006) present their own typology which is composed of two categories of scenario planning: predictive, and explorative. Van Notten et al. (2003) identify a typology for scenario planning that is based on three themes: project goal (exploration and decision support), process design (intuitive approach and formal approach), and scenario content (complex and simple).

Building on this, Amer et al. (2013) conclude that three to five alternative scenarios are best, as this range of scenarios can capture the dynamics of the situation and communicate the core issues effectively. Through the literature it was determined that two scenarios do not capture a situation as effectively as they depict one extreme versus another. If there are too many scenarios, however, then people tend to have difficulty understanding the various outcomes. An even number of scenarios should be considered in order to prevent an automatic selection of the “middle-ground” for an odd number of scenarios. The ideal number of scenarios ranges from three to five, as an ideal number of scenarios are captured in detail without too many options (Xiang & Clarke, 2003).

Tevis (2010) notes that both enactment theory and scenario planning must be combined to create goal-oriented scenario planning. This enables a bridge of what the world wants to see for their future with what the world expects to see.

Perveen et al. (2017) examine the challenges of scenario-based evaluation in the transport externalities of urban growth scenarios. Common weaknesses of scenario-based plans include lack of data, poor coordination of stakeholders, and researcher bias due to conflict of interest, or an excessive focus on factors relevant to them.

2.4 Scenario Plans within the Literature

Vasteras, Sweden: Khakee (1991) constructed scenarios through a participatory approach, then used those scenarios to develop and implement development strategies.

South East Queensland, Australia: Abbot (2005) constructed a regional growth management strategy to demonstrate how environmental uncertainty can lead to the initiation of planning processes and the review of plans. The resulting exploration of alternative futures can create or reduce causal, organizational and value uncertainties.

Baltimore-Washington Region, USA: Chakraborty et al. (2011) found that scenario plans need robust and contingent planning through the use of multiple uncertainties and plans that address the most likely outcomes.

Edinburgh City Region, Scotland: Docherty and McKiernan (2008) examined scenario plans used to generate new ideas and visions, cultivate engagement with various

Edinburgh, Scotland (Credit: Celtic Tours, 2017)

***VISIONS Project*, Europe**: Rotmans et al. (2000) identified a number of deficiencies in current scenario studies by analyzing the VISIONS project in Europe.

Denmark: Rowland and Spaniol (2017) observed a planning process with a non-governmental organization to better understand the interplay between two phases of a linear model in scenario planning. They placed an emphasis on the role of social negotiation.

Utah, Maryland, California, Washington, USA: Zapata and Kaza (2015) identified four scenario plans; *Envision Utah, Region Forward 2050* (Washington), *Maryland Scenario Project, and the Valley Future Project* (California). These plans were analyzed against various categories to assess the use of multiple futures and the diversity of each case study.

Portugal: Zegras and Rayle (2012) looked at scenario plans as a way to enhance collaboration amongst various actors through a revitalization case study in Portuguese cities.

Chakraborty and McMillan (2015): reviewed and synthesized 63 articles and 25 projects from 2004 to 2014. They constructed a planning typology with nine components that captures the important variations in scenario projects.

2.5 How Chakraborty and McMillan (2015) Classify Scenario Plans

Chakraborty and McMillan (2015) identifies and classifies components of scenario planning within urban planning. Nine major components of scenario planning and their corresponding sub-components are identified in **Table 2 – 1.**

2.6 Existing Planning Policy

To better understand the current planning context, Chakraborty and McMillan's (2015) typology was applied to the existing plans for Ottawa. The City of Ottawa's plan, *Framing Our Future: A Plan for Sustainability and Resilience in Canada's Capital Region* (2012), and the National Capital Commission's (NCC) plan, *A Plan for Canada's Capital* (2017), were both analyzed to determine which major components and sub-components of scenario planning were used to develop these plans. The project charter for *Beyond 2036***,** the next planning process for Ottawa, was also examined to understand the type of scenario planning process that is being proposed and how this compares to previous processes. A summary of the classification of each of these plans can be found in **Appendix C: Plan Classification.**

2.7 Framing Our Future: A Plan for Sustainability and Resilience in Canada's Capital Region

Framing Our Future: A Plan for Sustainability and Resilience in Canada's Capital Region (*Framing Our Future*) (2012) is the existing long-range comprehensive planning document that addresses a wide range of planning issues for the City of Ottawa. The document's organizational structure is strong leader. The Plan is organized by the City of Ottawa; while the City of Ottawa coordinated with the City of Gatineau and the NCC, these agencies did not have a clear leadership role in the process. The Plan's scope is comprehensive as the City of Ottawa looked at a variety of issues including sustainability, energy, and resiliency. The scenario type is normative due to the involvement of participants in developing the targets and goals of the Plan. The outcome of the document is policy recommendation as it provided specific future policy direction. With respect to stakeholder engagement, a combination of the general public, government agencies, and stakeholders were involved in the preparation of the Plan. These participants were involved in joint fact finding, rather than simply being informed of the goals and targets by the City of Ottawa. The resources are statutory or recurring as long-range planning is part of the City of Ottawa's mandate, and it will have long-term support. The engagement medium was 'hybrid', as both online and face-to-face engagement were used. Scenario construction used both 'qualitative data' and 'computer modelling'.

Table 2 – 1: Chakraborty and McMillan's Scenario Plan Typology

Major Component	Sub-Components
Organizational Structure *What is the relationship between those involved in the process?*	1. **Unitary:** A single agency is responsible for the process and decisions. 2. **Strong Leader:** When the process involves more than one agency, but one agency has a distinctive leadership role. 3. **Loose Coalitions:** When the process involves more than one agency and there is no clear leadership role or each is responsible for an aspect of the process.
Scope *What is the focus of the planning project?*	1. **Single Issue:** The project is topic specific (ex: transportation). 2. **Comprehensive:** Several issues or domains are analyzed in the project (ex: energy use in relation to land use changes). 3. **Problem Oriented:** The project focuses on specific challenges (ex: climate change).
Scenario Type *Why are these scenarios being developed/evaluated?*	1. **Normative:** If there is a defined target or participants provide input to identify targets. 2. **Predictive:** Scenarios are designed based on attempting to predict the most likely future or due to decisions from an earlier time. 3. **Explorative:** Scenarios are designed based on what can happen or based on possible futures (ex. how a policy may have multiple outcomes).
Outcome *What is the final result or product?*	1. **Awareness:** Knowledge of planning issues are developed and exchanged with stakeholders. 2. **Vision:** Shared goals or a future state are identified. Participation is usually encouraged. 3. **Policy Recommendation:** Scenarios are developed based on present decisions or to discuss policy choices.
Stakeholder Engagement *Who do we want to involve in the scenario process?*	1. **General Public:** The public is directly involved in the process (i.e.: scenario workshops). 2. **Government Agencies:** Public departments work together in the scenario development process. 3. **Interest Group:** Stakeholders are specifically engaged in the process (ex: neighbourhood organizations).
Participation Extent *How do we want to involve participants in the scenario planning process?*	1. **Inform Only:** The process is used to educate and inform others about potential futures and their impact. 2. **Seeking Feedback:** The process encourages knowledge sharing amongst the scenario designers and outside individuals/groups. 3. **Joint Fact Finding:** The process encourages collaboration to inform the creation of scenarios.
Engagement Medium *How do we get participation input?*	1. **Web-based:** Scenarios are created and compared primarily through web-based tools. 2. **Face-to-face:** Scenarios are created and compared primarily through stakeholder meetings, collaborator meetings and public forums. 3. **Hybrid:** When both sub-components 1 and 2 are used.
Scenario Construction *How will we develop the different scenarios? What tools will we use?*	1. **Qualitative:** Interviews, opinion surveys, essays, personal experiences, etc. 2. **Planning Support System (PSS):** Interactive computer-based tools (ex. mapping and analysis). 3. **Computer Modelling:** Computing capabilities that are less interactive than sub-component 2, but can model multiple urban phenomenon and their interactions, as well as how they respond to any policy changes.
Resources *What capacity do we have for this project? What resources do we have at our disposal?*	1. **Statutory or Recurring:** If the project is required as part of the agency's mission or if there is long-term support available. 2. **Opportunity-based:** If the project is based on resources available for only one time or support is limited to a short period of time. 3. **Fundraised:** If the project is supported by various sources (ex. predominantly private) and are for limited periods of time.

2.8 A Plan for Canada's Capital

The NCC's *A Plan for Canada's Capital* (2017) focuses on the next 50 years in the National Capital Region and considers the emerging trends and challenges that face the region, such as urbanization, resource scarcity, and ageing population. The organizational structure of the Plan is strong leader. Although other groups were involved, the development of the Plan was primarily led by the NCC. The scope of the Plan is comprehensive, as the NCC looked at a variety of issues such as connectivity, the environment, and the economy. The scenario type for the Plan is normative due to the defined goals that were outlined at the beginning of the project. Stakeholder engagement in the preparation of the Plan included the general public, government agencies, and stakeholders. The resources for the Plan were statutory or recurring, as the Plan is part of the NCC's mandate and long-term support will be provided to ensure its development and implementation. The outcome of the Plan is policy recommendation because specific policies and projects, such as National commemorations, Canadian diversity and regional identity, and Confederation Boulevard, were recommended. With respect to the participation extent, it is seeking feedback, as the public was asked to comment on the proposed Plan, but not collaboratively involved in its construction. The engagement medium is hybrid, as both face-to-face engagement and online engagement occurred. Scenario construction occurred using qualitative data only.

2.9 Beyond 2036: Setting the Stage for Ottawa's Next Official Plan (Beyond 2036)

Beyond 2036 is the proposed planning process that is set to take place by the City of Ottawa. *Beyond 2036* was classified to better understand how this proposed process compares with previous processes. The Plan's organizational structure is unitary, as it is solely led by the City of Ottawa. The scope of the Plan is classified as comprehensive due to the variety of topics, issues, and drivers it analyzes. The proposed scenario type is explorative because the Plan looks at a wide variety of options for how the future will unfold in the City of Ottawa. The outcome is a vision, as it seeks to develop future visions which will inform future policy recommendations. Stakeholder engagement includes a combination of general public, government agencies and stakeholders. The Plan's resources are statutory or recurring because the Plan is intended for long-range use as part of the City of Ottawa's mission and it will have long-term support. The participation extent will be joint fact finding as the public will be collaboratively involved in all stages of the process. A hybrid engagement medium is proposed, including web-based and face-to- face engagement. Scenario construction will be done using qualitative data.

In comparison to the previous plans by the City of Ottawa and the NCC, the proposed process differs most prominently in its scenario type and outcome. The proposed process' scenario type will be explorative as it seeks to understand the many possible

futures for Ottawa, rather than attempting to set targets from its outset by being normative. The outcome seeks to provide a vision, rather than concrete policy recommendations. This vision will be used to inform future policy, but will not constitute policy itself. This will make *Beyond 2036* fundamentally different from the planning processes that have occurred before.

The classification for *Beyond 2036* will be used within the report for comparison purposes (refer to **Chapter 3: Methods).**

Engaging diverse stakeholders is essential to plan development. (Credit: Shutterstock, n.d.)

2.10 Scenario Planning and Drivers of Change

There has been extensive research conducted regarding the drivers of change that are incorporated into scenario plans. These drivers range from environmental, demographic, and economic stressors, to unexpected and sudden shocks. A brief overview of each category and examples within the literature is outlined below.

2.11 Environmental Drivers

Water Management

Willuweit and O'Sullivan (2013, 2016) explain how the Dynamic Urban Water Simulation Model (DUWSiM) links urban water balance concepts with the land use dynamics model MOLAND and the climate model LARS-WG to provide a platform for long-range planning of urban water supply and water demand. DUWSiM provides the functionality for assessing the feasibility of centralised and decentralised water supply and water demand management options based on forecasted water demand, stormwater and wastewater generation, whole life cost and energy and potential for water recycling (Willuweit and O'Sullivan, 2013). Accommodating variations in runoff between the scenarios and flexible decentralised systems such as green roofs and pervious pavements have a vital role in increasing the adaptability and long-range sustainability of water infrastructure (Willuweit & O'Sullivan, 2016)

Urban Heat Islands

Existing empirical studies have not addressed whether smart growth policies reduce the urban heat island effect. Deilami and Kamruzzaman (2017) address this issue by exploring alternative neighbourhood planning scenarios for Brisbane, Australia regarding urban heat islands, including: a) business as usual, b) transit-oriented development, c) infill development, d) motorway corridor oriented development, and e) sprawl development.

2.12 Demographic Drivers

Housing Demand

Increasing levels of urbanization, combined with growing populations and a need to manage urban redevelopment more sustainably has prompted the need for new tools for urban regeneration in established urban areas. Trubka and Glackin (2016) created a way in which end users can quickly generate visualizations and assessments for a variety of housing scenarios, allowing them to determine fit-for-purpose solutions that address a range of issues relevant to contemporary planners and policy makers.

2.13 Economic Drivers

Resource Scarcity

Simulation of population dynamics provides useful information for planning rapidly developing manufacturing metropolises. Li et al. (2013) explore an agent-based model for simulation of spatial population dynamics, which addresses the influence of the labour market on individual residential decisions, and simulates the economic behaviours and residential decisions of population individuals.

Unemployment

Jobs and housing imbalances occur when residential areas are a considerable distance from locations of employment, and as a result there is a need for substantial commuter travel (Corcoran et al., 2011). Corcoran et al. (2011) propose an optimization modelling approach to identify scenarios of improved jobs-housing balance. This approach estimates future jobs by sector in local areas under conditions of growth and change, and assumes that commuters will seek greater efficiencies in their journey to work (Corcoran et al., 2011).

Passengers and commuters boarding and departing OC Transpo buses. (Credit: Errol McGihon, 2016)

2.14 Sudden Shock Drivers

Pandemics

Continuity of Operations Planning is action taken before, during and after a disaster to maintain the delivery of an organization's essential services. Its application in public health saves lives and protects population health when disaster strikes (Reeder & Demiris, 2010). Reeder and Demiris (2010) developed twelve scenarios of use for public health decision-making roles during a pandemic, and determined that scenario-based design can be a powerful tool in designing decision support systems for public health needs during a crisis.

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METHODS

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3.1 Summary of Research

In Beyond 2036: Setting the Stage for Ottawa's Next Official Plan (Beyond 2036), the City of Ottawa identified an interest in using scenario-based planning studies as one of its primary strategies for informing the City's next long-range growth management plan.[1] Preliminary research was conducted by looking at scenario planning in existing literature.[1] This summary of research established a preliminary theoretical framework on which the project based its priorities and recommendations. It ensured that any future research considerations were framed within the context of how it would fit into a scenario plan. The summary of research addressed the following questions:

1. What is a scenario plan? Is there a consensus about the definition of the theory and practice of scenario planning?
2. What makes a "good" scenario plan? What are the components of a "good" plan and how are these plans evaluated?
3. What does the literature say about best practices, trends, patterns and observations of the theory and practice of scenario planning?

How is scenario planning used to address drivers of change (environmental, demographic, technological, and economic)?

3.2 Selecting Plans and Cities

Following the summary of research, long-range municipal plans were gathered from around the world for review. The objective of this exercise was to develop an understanding of how different cities identified drivers of change that could have the greatest effect on the growth and development of the city, and how they chose to address them. From this exercise, there was a compilation of 37 municipal long-range growth plans, city resilience plans, and relevant strategies to address drivers of change that could be applied to the Ottawa context.

A number of factors contributed to the selection of the 37 plans. First was the Rockefeller Foundation's 100 Resilient Cities project (100RC).[7] The 100RC Network has created a database of urban resilience strategies from around the world that reflects each city's distinct needs for the future. A number of cities and their associated resilience strategies were selected from this database.

Second were the areas of interest identified by the client. The client expressed interest in Scandinavian and European cities, and for this reason, a number of plans from Scandinavian and European cities were selected.

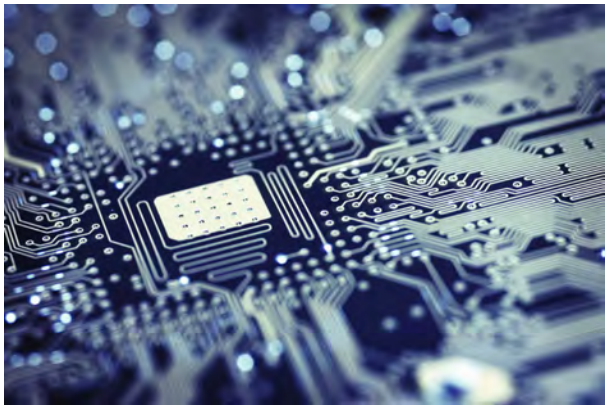
Third were other plans that were not included in either of the first two contributing factors, but that were discovered through the background research review.

Time commitments and accessibility issues limited the inclusion of additional plans to the final list. Additionally, a number of long-range and resilience strategies were not yet published, some of which belong to 100RC Network. Further to this, other plans were excluded from further analysis as they had

little reference to a policy or strategic framework for pursuing their vision. Lastly, linguistic barriers prevented potentially relevant plans from being selected, as the team was unable to read plans that were not in English or French.

3.3 Drivers of Change

Drivers of change are important to consider in a 50-year scenario plan for the City of Ottawa. These drivers affect the City's capacity to manage urban growth. Within the scope of this project, four themes, or categories, of drivers were identified: environmental, demographic, technological, and economic.



Nano technology is an example of a growing technology sector. (Credit: Citelighter, 2017)

A number of external resources were used to identify the themes of drivers of change. To begin, an analysis of the City of Ottawa's *Framing Our Future* report provided context for the issues the City was expected to face in the next 50 years.[2] Three supporting documents were created to guide Ottawa towards a more sustainable, resilient and livable future: Ottawa's *Long-Term Risk Prevention and Mitigation Plan*, Ottawa's *Plan for Sustainability and Resilience*, and Ottawa's *Energy and Emissions Plan*.[2,3,4]

These documents outlined current vulnerabilities in Ottawa, including anticipated environmental, demographic, technological, and economic vulnerabilities. These plans were valuable assets for both the identification of drivers of change and the creation of themes or categories to organize the drivers of change.

In addition to the documents created by the City of Ottawa, the selected plans were used to develop a catalogue of future drivers of change. From this, it emerged that drivers were typically categorized as environmental, demographic, technological, or economic. Next, Ottawa's existing planning framework was cross-referenced with the list of drivers identified by these other cities to identify gaps and similarities.

3.4 Workshop

On October 27th, a mix of experts, professionals, professors and students (the majority of whom were from Ottawa, worked in Ottawa, or had interest in the project) were invited to participate in a workshop. The objective of this exercise was to have the workshop attendees provide feedback on what they thought the City of Ottawa's areas of interest and priorities were for developing a long-range growth plan.

The workshop attendees were split into three groups, and each group attended the three prepared breakout sessions. The breakout sessions were based on the four major categories of drivers: environmental, demographic, technological and economic. The technological and economic drivers were grouped together for the workshop, as it was

initially determined that there were many similarities between the two drivers of change. Each session was approximately 20-30 minutes long, and after each session, the groups would rotate. In each breakout session, the relevant drivers of change were reviewed, and the long-range plans that addressed these drivers were discussed. Tables presenting the drivers addressed by each category of driver, in addition to the precedent plans that addressed these drivers can be found in **Appendix D: Workshop Materials.**

In each workshop session, feedback was gathered following an activity involving the experts' opinions. This involved workshop attendees identifying the drivers of change they thought were most important to Ottawa's future, and identifying plans of interest from which precedents could be drawn. This activity included selecting ten drivers of change per category which workshop attendees identified as most critical to Ottawa's future. The results of the expert opinion activity were presented in a group debrief session as a point of reference for discussion and further commentary.

As noted, the technological and economic categories were merged together for the workshop because they were considered to be closely related and had overlapping content that could be discussed in one of the three sessions. However, for the expert opinion activity, its results, and the analysis, technological and economic categories were considered distinct and separate categories. As such, they have since been discussed and analyzed as separate categories of drivers throughout the report.

3.5 Narrowing Precedent Plans

Following the workshop, the 37 municipal plans and their precedent strategies were narrowed down to determine which plans were most relevant for Ottawa's consideration

Four comparison systems were developed, each offering its own variation of a top ten list of plans to consider based on the category of driver. The comparison systems were based on qualitative methods, including general impressions and a review of best practices from a variety of cities.

Variation 1: The first comparison system was based on Chakraborty and McMillan's typology of scenario plans.[5] The typology was first applied to *Beyond 2036* in order to create a baseline example of the type of scenario planning Ottawa may use in their future long-range growth plans.[1] The typology was then used to classify the structure and organization of the 37 plans in order to identify plans that were structured most similarly to *Beyond 2036*. The objective of this exercise was to create a list of similarly structured plans that Ottawa may look to for comparable analysis.

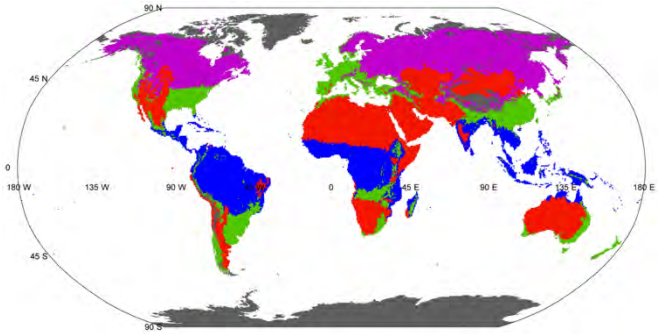
Variation 2: The second comparison system was based on the outcome of the expert opinion activity from the workshop. The results from all the attendees were tallied in order to come up with a list of ten plans per category of driver that participants had identified as sharing similar goals, challenges, or city characteristics to Ottawa.

Coloured stickers used for the expert opinion activity. (Credit: Amazon, 2017)

Variation 3: The third comparison system involved taking the top ten drivers of change per category as identified in Variation 2, and cross-referencing them with all 37 long-range growth plans. The objective of this was to see which of the 37 plans addressed the most top drivers that were considered critical to Ottawa's future.

Variation 4: The fourth comparison system was applied to just the environmental drivers of change. The Köppen Classification is a widely used system which aggregates temperature and precipitation data to assign a three-letter climate type to each region of the world. Under the Köppen system, the first letter represents the main climate groups, which are A (tropical), B (dry), C (temperate/mesothermal), D (continental/microthermal), and E (polar). The second and third levels are subdivisions representing the seasonal precipitation type and the level of heat, respectively.
The objective of this comparison system was to identify which plans existed in a climate that was most similar to Ottawa's. Cities with a similar climate to Ottawa are likely to experience similar environmental issues in the future. As such, Ottawa, Ontario is classified as 'Dfb', meaning that it has a temperate climate (D), has no dry season (f) and has a warm summer (b). This classification is also referred to as 'warm summer humid continental' climate. Only six of the 37 cities examined were of the same primary climate group as Ottawa.

The municipal plans that ranked in all three or four comparison systems were considered the most important precedent plans. However, those which ranked in two out of three comparison systems (or three out of the four) were also considered significant. It is these municipal plans which are most relevant for further examination to determine how, or whether, they have found creative solutions to address different drivers of change.



The Köppen Classification map classifies the world's climates based on regions. (Credit: Chen, n.d.)

3.6 Lessons Learned from Workshop

The cities deemed important through multiple comparison systems were selected and their respective plans were further analyzed to determine how they addressed the drivers identified as being most important to Ottawa. Some drivers were also analyzed using plans from cities that did not appear in

multiple comparison systems, as some drivers were only recently known. This offered insight as to how Ottawa could potentially address the drivers. Included in the analysis was an explorative discussion for how Ottawa could address the known and unknown drivers in the demographic, economic, technological and environmental categories of drivers. This helped to identify areas of development, gaps, and potential challenges.

The analysis from each category of driver also helped to identify lessons learned and key takeaways. By looking at specific cities from the comparison systems, it was easier to identify the most important drivers and how they could be addressed, or if they could be addressed. While some cities had plans that were vague or did not include specifications for how to address their driver of change, others had programs, additional plans, or initiatives in place. These programs and plans are important for developing potential scenarios for the City of Ottawa, as cities with similar drivers may have found unique ways to address those drivers. The analysis and recommendations will help to build a foundation for the City of Ottawa as they develop various scenarios and a long-range plan.

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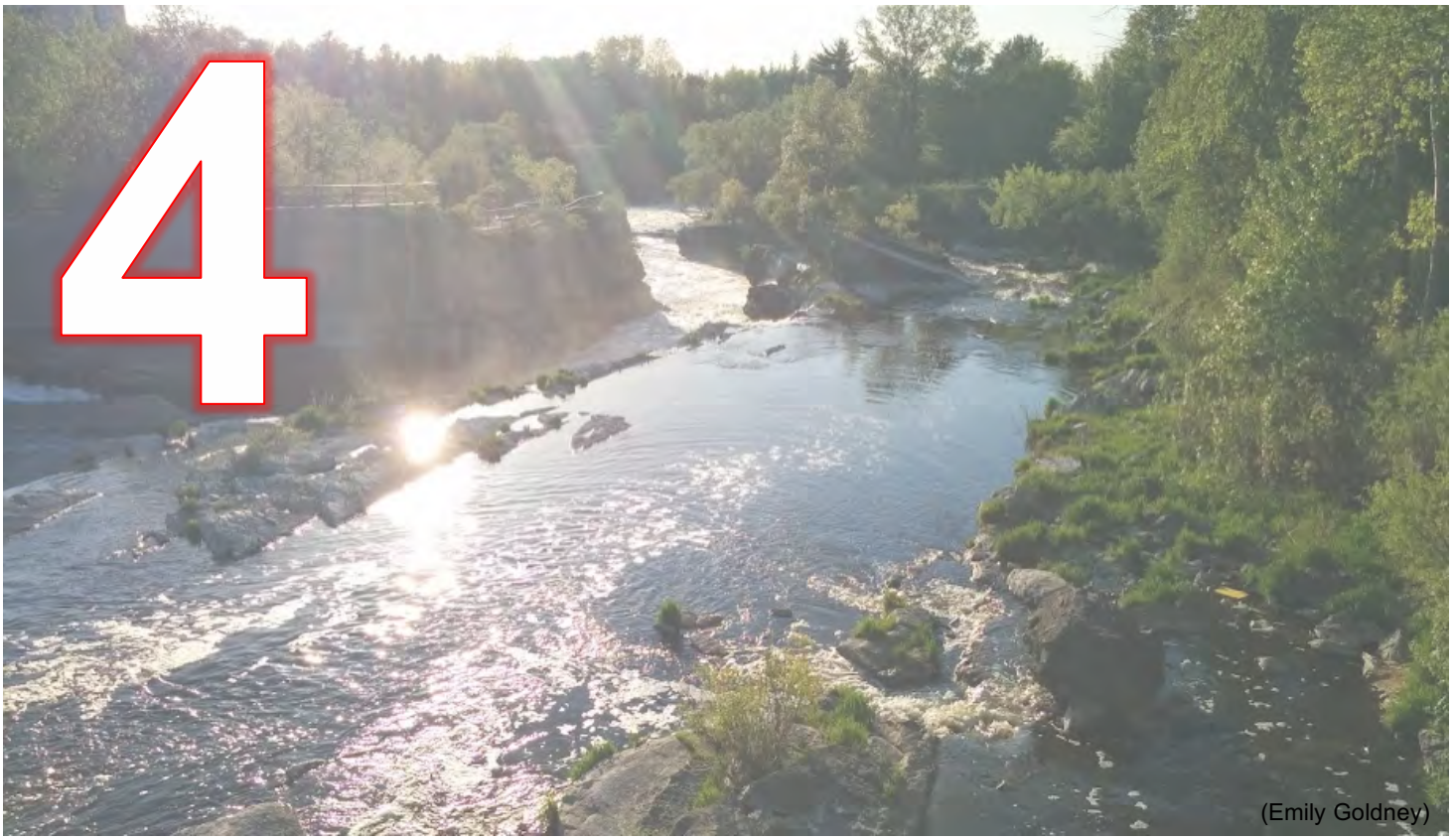

(Emily Goldney)

DRIVERS OF CHANGE: ENVIRONMENTAL

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4.1 Overview

The following City of Ottawa long-range plans and Master Plans were reviewed to determine what the City has already identified as future drivers of environmental change in its planning initiatives:

- *Framing Our Future: Sustainability and Resilience Plan* (2012)
- *Framing Our Future: Energy and Emissions Plan* (2012)
- *Framing Our Future: Risk Prevention and Mitigation Plan* (2012)
- *Infrastructure Master Plan* (2013)
- *Transportation Master Plan* (2013)
- *Official Plan* (2013)
- *Air Quality and Climate Change Management Plan* (2014)
- *Emergency Management Program Emergency Plan* (2016)
- *Urban Forest Management Strategy* (2016)
- *Water Environment Strategy* (2016)

Generally, Ottawa has identified that climate change, population growth, and the rising cost of oil will affect the City's environmental future.

Although there is always significant uncertainty with climate projections, current predictions indicate that in 2050, Ottawa will have a 2 to 3°C increase in summer temperatures, milder winters with fewer days below 0°C, and more extreme weather events. While summer precipitation will remain relatively stable, winter precipitation is expected to decrease by 10 to 20%. [1,2]

This will profoundly affect Ottawa in ways which are still unclear. The changing climate will yield many challenges but also many opportunities. For example, warmer temperatures will generate more frazil ice on the Ottawa River, which will likely block drinking water supply intakes. Conversely, warmer temperatures will result in a longer growing season, perhaps allowing for increased local food production. Heat waves could push electricity beyond peak demand. More freeze-thaw cycles will shorten the life of paved infrastructure. Increased evaporation will lead to drier soils, which could result in damage to building foundations and basements. The winter recreation industry will experience losses. More intense storms could result in a higher risk of flooding, downed power lines, and damage to built infrastructure.[1,2]

Industrial emissions have a negative effect on air quality. (Credit: CBC, 2014)

Ottawa-Gatineau's population is forecast to increase to 1.8 million by 2036, which represents a 30% increase above 2011 figures.[3] Population growth will ultimately lead to the consumption of more water, the production of more wastewater, and more vehicles on the roads. More people will consume more energy and food, and will consume more land through the construction of dwellings and places of work. This will create pressure to develop on existing agricultural lands and natural lands.

Lastly, oil prices are predicted to rise between 40% and 130% by 2020.[3] This will increase the cost of transporting goods and people; resulting in a global increase in food prices and energy cost. This in turn may result in increased energy conservation, more local food consumption and production, and a shift towards renewable energy sources.

4.2 Drivers Identified by Other Cities

The long-range plans and resilience plans of 37 cities were reviewed to determine which environmental drivers of change other cities intended to address. **Appendix D: Workshop Materials** outlines the list of drivers and plans identified. The environmental drivers of change identified in the plans were classified into six overarching categories:

- Climate Change;
- Disasters;
- Water and Wastewater;
- Energy;
- Food and Agriculture;
- Parks and Nature; and,
- Other

Drivers were listed using the terminology which appeared in the cities' plans, and similar drivers were not grouped together in order to capture the full range of different cities' considerations.

Comparing the list of drivers identified in other cities' plans to the drivers identified by Ottawa showed that, environmentally, Ottawa has generally identified the full range of drivers considered by other cities in its planning initiatives. The only drivers not identified by Ottawa included sea level rise, and tsunamis, which are irrelevant to the Ottawa context. This indicates that Ottawa has previously identified many of the issues which may affect its environmental future, and is largely consistent with other cities' plans.

4.3 Narrowing the Focus: Top Tens

The plans for 37 precedent cities were narrowed down during and following the workshop using the four variations outlined in **Section 3: Methods.** Once prioritized, the top ten plans according to each comparison system were listed in **Table 4 – 1.** In the event of a tie for tenth place, all plans were included, and were listed alphabetically.

It is unsurprising that several of the 'most important drivers' identified as a result of the workshop are related to storms and flooding. Ottawa-Gatineau experienced severe flooding in Spring 2017, and the months preceding the workshop received abnormally high rainfall.[4] As these floods were recently experienced by many workshop participants, they likely highly ranked its importance relative to other drivers. Workshop participants also stated that they felt that storms and flooding were extremely important because city infrastructure was built and plans were written based on precipitation patterns and predictions that, in the context of climate change, will no longer be relevant. What constitutes a 100-year floodplain will change, and zoning will need to change accordingly. In the workshop, participants also highlighted the issue of relocating people and facilities based on their new level of flood risk.

Table 4 – 1: Prioritization of Plans Related to Environmental Drivers

Rank	Matching Plan Classification	Workshop	Addressed Ottawa's Top 10 Drivers	Climate (Köppen Classification)	Top 10 Environmental Drivers of Change
1	Chicago *Go To 2040: Comprehensive Regional Plan*	Edmonton *Edmonton Metropolitan Growth Plan*	Istanbul *2013-2023 Istanbul Regional Plan*	Calgary (Dfb) *Calgary Resilience Strategy*	Floods
2	Vejle Vejle Resilience Strategy	New York City *OneNYC: A Strong and Just City*	Paris *Paris Adaptation Strategy*	Edmonton (Dfb) *Edmonton Metropolitan Growth Plan*	Renewable Energy
3	New York City *OneNYC: A Strong and Just City*	Mississauga *Our Future Mississauga*	Athens *Athens Resilience Strategy for 2030*	Helsinki (Dfb) *Helsinki City Plan Vision 2050*	Supply of Developable Land
4	Thessaloniki *Resilient Thessaloniki: Strategy for 2030*	Helsinki *Helsinki City Plan Vision 2050*	London *City of London Local Plan*	Mississauga (Dfb) *Our Future Mississauga*	Extreme Storms
5	Birmingham *Birmingham 2026: Our Future Vision*	Boston *Resilient Boston*	Mexico City *CDMX Resilience Strategy*	Chicago (Dfa) *Go To 2040: Comprehensive Regional Plan*	Demand for Power
6	Boston *Resilient Boston*	Berlin *Urban Development Concept Berlin 2030*	New York City *OneNYC: A Strong and Just City*	New York City (Dfa) *OneNYC: A Strong and Just City*	Increase in Rainfall Intensity
7	Bristol *Bristol Resilience Strategy*	Wellington *Wellington Resilience Strategy*	Bangkok *Resilient Bangkok*		Urban Heat Islands
8	Calgary *Calgary Resilience Strategy*	Mexico City *CDMX Resilience Strategy*	Berlin *Urban Development Concept Berlin 2030*		Wastewater Capacity
9	Christchurch *Resilient Greater Christchurch*	Christchurch *Resilient Greater Christchurch*	Boston *Resilient Boston*		Damage to Natural Areas
10	Melbourne, Pittsburgh, Rotterdam, Wellington	Boulder, Calgary, Chicago, Pittsburgh, Stockholm, Victoria	Canberra, Manchester, Pittsburgh		Warmer Temperatures, Decreased Air Quality

Workshop participants felt that renewable energy and demand for energy were important because population growth and the forecasted shift to electric vehicles will yield significantly higher demand for power. Furthermore, as the use of fossil fuels becomes increasingly expensive and unsustainable, Canadians will need to reduce their energy consumption and use more renewably-sourced energy. Ontario's *Long-Term Energy Plan* includes measures to make renewable sources 46% of provincial generating capacity by 2025, which is forecasted to yield a 33% increase in average residential electricity bills by 2028.[5]

This prioritization process is intended to reveal which plans are most relevant to Ottawa. Across the four criteria for prioritization, only New York City appears on all four lists. Boston, Pittsburgh and Calgary appear in three of the four categories. Istanbul, Paris, Athens, London, and Mexico City all identify similar drivers to Ottawa, and are therefore also relevant for Ottawa's consideration.

4.4 Integrating Drivers into Ottawa's Planning Regime

The eight plans identified as being important to Ottawa were reviewed in detail to identify the strategies they use to address the environmental drivers deemed the most important to Ottawa. Calgary is still in the initial stages of their planning project; while they have identified environmental drivers, they have not identified specific strategies to deal with these drivers. As such, Calgary was excluded from the detailed review.
The following section lists the major drivers identified as being important to Ottawa, the City's ability to address these drivers, and examples of interesting strategies that the identified plans have undertaken to address these drivers.

Rainfall and Floods
A changing global climate is leading to altered patterns of precipitation and an increased frequency and severity of flooding. Ottawa cannot directly control the climate changes which will yield changing precipitation patterns and flooding; however, it can mitigate and adapt to its impacts through planning and approvals processes. Ottawa's building code and zoning processes must continue to flood-proof development on floodplains, and direct city facilities and services away from floodplains. As climate projections change, Ottawa will need to continually update its floodplain mapping according to best available climate projections. The City must also update its stormwater infrastructure to ensure that the system's capacity is not overwhelmed as storms become more intense. Finally, Ottawa can continue to enhance its green infrastructure through the use of bioswales, permeable pavers, rain gardens, and green roofs.

To address stormwater management, Ottawa can continue to require that any new development absorb certain proportions of pre-development rainfall levels on site. While it cannot do the same for existing buildings, it should continue to promote best practices in stormwater

management retrofits. As proposed in its 2012 *Green Building Promotion Program*, Ottawa should continue to explore the development of a 'green development standard.' This is a set of performance measures requiring new private and public development to adhere to certain sustainable site and building designs, including best practices in stormwater management.[7]

All cities reviewed are working to build and enhance their green infrastructure, but there are specific plans that had notable initiatives regarding rainfall and floods. Paris' *Adaptation Strategy: Paris Climate & Energy Action Plan* is currently creating rainfall zoning with defined minimum levels of rainwater to be eliminated via infiltration, evaporation, and evapotranspiration.[8]

New York City's *OneNYC* plan has a grant program to encourage private property stormwater retrofits.[9]

Boston's *Resilient Boston: An Equitable and Connected City* plan is prioritizing flood-vulnerable neighbourhoods and working with them to co-design targeted upgrades to stormwater and flood-prevention infrastructure, with an emphasis on green infrastructure. [10]

Pittsburgh's *ONE PGH* plan is inviting organizations to submit project proposals that can transform their blocks with up to $1,500. Initiatives may include stormwater capture, creating green spaces, and building emergency preparedness.[11]

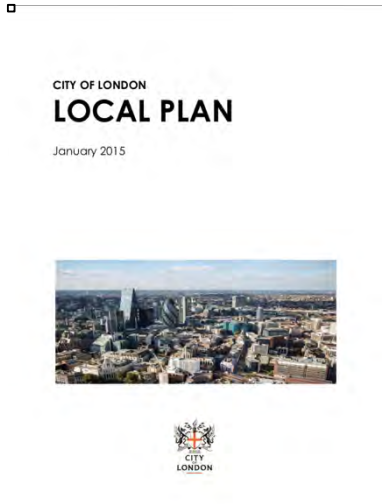
Istanbul's *2014-2023 Istanbul Regional Plan* is preparing for its response to flooding disasters by raising public awareness, strengthening civil society organizations on disaster management activities, ensuring coordination and determining responsibilities for activities concerning preparedness, mitigation, response and recovery, and preparing response plans.[12]

Energy Demand and Renewable Energy

A growing population is leading to a growing demand for energy. Efforts to combat climate change include a transition from fossil fuels to renewable energy sources. The City of Ottawa exerts little direct control over the power supply, as the provincial government has jurisdiction over both the generation and production of electricity, and local utilities are responsible for its distribution. The City can continue to work to reduce its energy consumption as a corporation, and can promote behavioural change to reduce the consumption by residents. It may also require energy efficiency for new developments through development standards, and to facilitate renewable energy projects through planning and approval processes. As proposed in its 2012 *Green Building Promotion Program*, Ottawa should continue to explore the development of a local improvement charge program, in which the municipality would provide a long-term low interest loan for energy efficiency retrofits, with the loan being placed on the property repaid on property tax bills.[7]

New York City's *OneNYC* plan is investigating the use of food waste as an energy source for a local microgrid.[9]

The City of London Local Plan calls on developers to identify and plan for the use of decentralized energy networks, and to submit energy statements with planning applications to demonstrate that building design minimizes demand for power and minimizes carbon emissions.[13]



The cover page of the City of London Plan (2015)

Istanbul's *2014-2023 Istanbul Regional Plan* is establishing energy efficiency and clean energy centres to support private research and development, raise energy awareness in the private sector, and build the local clean energy industry.[12]

Supply of Developable Land

A growing pressure for developable land can be primarily attributed to Ottawa's growing population and expanding urban area. The City of Ottawa has direct control over land use within their city limits. Actions such as maintaining an urban containment boundary, and incentives to direct new development inward to existing urban core areas can be used by Ottawa to limit growth at the urban fringe. Appropriate zoning to prevent further outward urban growth and accommodate intensification of existing areas can also be used. These methods allow Ottawa to control where the City will grow, and limit the necessity for further supply of land by encouraging densification of already developed land.

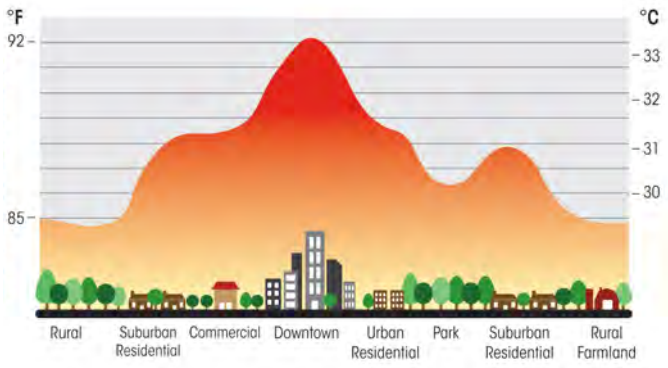
Mexico City's *CDMX Resilience Strategy* is implementing the *Borde Activo* (Active Edge) initiative where pilot projects at the urban-rural interface are implemented to link socio-economics and the environment. The initiative will involve multiple stakeholders to offer technical input and a long-range strategy designed to limit urban growth at the edge of the City.[14]

New York City's *OneNYC* is proactively trying to find places for growth in the existing urban core. The City actively pursues large rezoning in transit-accessible neighbourhoods, encourages the development potential of under-utilized sites, and looks for ways to encourage intensification of existing areas, including modifying parking requirements.[9]

Urban Heat Islands

An urban heat island is a phenomenon where the temperature is warmer in an urban environment compared to its surrounding areas. One of the major drivers of urban heat islands is warmer temperatures brought on by climate change – something Ottawa has little control over. The other contributing factors are elements of the urban environment,

such as roads, large parking lots, and buildings which absorb heat, as well as the lack of vegetation. Ottawa can control these factors through urban design requirements and green infrastructure.



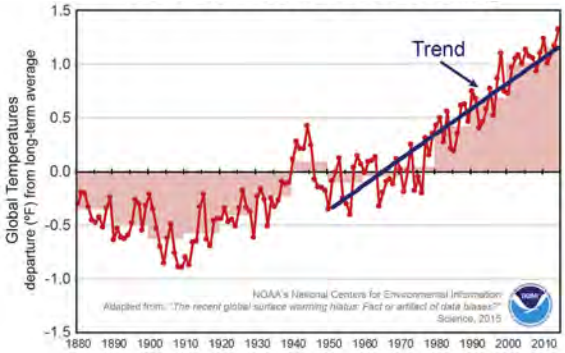
Urban heat island profile. (Credit: World Atlas, 2015)

In *Resilient Boston: An Equitable and Connected City*, Boston has committed to explore heat island reduction strategies, including the deployment of home cooling equipment, incentivizing cool roofs, expanding the tree canopy, and installing cool pavements. This will be accompanied by a Vulnerability and Heat Analysis to find high-priority locations for green infrastructure.[10]

Athens Resilience Strategy for 2030 has identified green infrastructure as a priority to reduce the urban heat island effects. This includes maintaining current green spaces, enhancing green infrastructure in the regeneration of public spaces, designing green corridors within the City and on the metropolitan scale, establishing new green public spaces, developing green spaces on abandoned properties, promoting community farming, and designing blue corridors with water features throughout the City. Examples of green infrastructure include pocket parks, parklets, green roofs, vertical gardens, roof gardens, community gardens, and water fountains. Athens will also regulate new public works to use cool materials, shading structures, and vegetation, and design and develop shading and natural cooling solutions in street furniture.[15]

Warmer Temperatures

Climate change will lead to higher average global temperatures as well as more extreme weather events, like heat waves. As with other climate-related drivers, Ottawa cannot reverse the warmer temperatures resulting from climate change. It can only adapt to, and mitigate its effects. As temperatures increase, the City can continue to prepare emergency plans for heatwaves, manage the urban forest to provide local cooling, and provide public access to cooling facilities like parks and air-conditioned environments.



Global temperature rise trend. (Credit: NOAA, 2015)

As identified in *Resilient Boston: An Equitable and Connected City*, Boston is working with a variety of stakeholder partners, including Greenovate Boston, the Environment Department, the Office of Emergency Management, the Boston Public Health Commission, and others to build on existing neighbourhood preparedness efforts and collaborate to

advance an education campaign with special focus on vulnerable populations. This program will explain climate risks and adaptation strategies to Bostonians.[10] *Athens Resilience Strategy for 2030* calls for the development of underground routes and shelters to protect citizens from extreme heat.[15]

New York City's *OneNYC* is creating a citywide air temperature monitoring system to guide heat mitigation and response.[9]

Paris' *Adaptation Strategy: Paris Climate & Energy Action Plan* has a well-developed outreach program which includes the distribution of a map of publicly accessible 'cool areas' to go to in the event of extreme heat. Locations mapped include public and semi-public areas such as malls, movie theatres, museums, places of worship, and parks. *Paris* also plans to extend the opening hours of parks, improve access to drinking water in public spaces, install shade structures in public places, and install temporary misters in public spaces during heat waves.[8]

Wastewater Capacity

A growing population will produce increasing wastewater volumes, requiring sufficient municipal infrastructure capacity. This could be further impacted by flooding, as many municipalities - including Ottawa - still have combined sewer systems in historic neighbourhoods. The City of Ottawa has full control over the development and maintenance of wastewater and stormwater infrastructure. Wastewater volume can also be managed through initiatives to limit wastewater production, and fees to charge for those that produce the most wastewater.

Istanbul's *2014-2023 Istanbul Regional Plan* aims to increase public awareness to reduce wastewater production while building new water treatment infrastructure such as advanced biological wastewater treatment plants and grey water recycling in large residential areas.[12]

Through *ONE PGH*, Pittsburgh is developing a value proposition for green infrastructure in order to help the City and region comply with federal sewer overflow mandates. An example of this was a workshop held on green infrastructure to address the issue of sewer overflows into the Negley Run watershed.[11]

New York City's *OneNYC* has adapted its regulations and instituted a grant program to promote the on-site re-use of greywater, blackwater, and stormwater for non-potable uses.[9]

Damage to Natural Areas

Urbanization and industrialization has led to damage to natural areas and ecosystems through habitat removal, habitat fragmentation, and pollution. Ontario mandates that municipalities identify and protect natural heritage systems, provincially significant natural features, and provincially significant wetlands in their Official Plans.[16] Beyond this, Ottawa has direct control over which lands are developed and how they are developed. The City can continue to identify, protect, and acquire important natural features to

prevent their degradation through its *Urban Land Acquisition Strategy*.[7] It can also restrict development on natural features; for example, its *Air Quality and Climate Change Management Plan* includes a target of no net loss of forest and wetlands.[17] Through its *Official Plan*, it can continue to require environmental impact statements for developments within a certain radius of important habitat and environmental features. It can also require that developments analyze their cumulative environmental impacts to prevent excess natural area damage and fragmentation.

Natural areas at risk to environmental degradation (Ministry of Natural Resources, n.d.)

Mexico City's *CDMX Resilience Strategy* is planning to implement an active edge initiative where pilot projects for environmental restoration and urban area containment will be implemented. This will create a productive link between the urban and natural areas.[14]

In Istanbul's *2014-2023 Istanbul Regional Plan*, Istanbul has established water basin protection areas where urbanization will be prevented.[12]

In *OneNYC*, New York City uses ecosystem services accounting to prove that watershed protection is more cost-effective than building a new water filtration plant.[9]

Air Quality

Internal combustion vehicles, and industrial and agricultural processes are the primary causes of declining air quality. The City of Ottawa can mitigate the effects of air quality through facilitating public transit use, facilitating alternative modes of transportation, and bylaws limiting vehicle idling. Regulations related to emissions from industry or agriculture, as well as the allowable vehicle emissions are decided by provincial and federal governments, which limits Ottawa's ability to regulate this issue.

Istanbul's *2014-2023 Istanbul Regional Plan* plans to establish an inventory of air emissions, prepare a *Clean Air Action Plan*, raise the number of air quality monitoring stations, improve inspections to prevent air pollution from industrial areas, and proliferate audits to check the formation of dust from construction, demolition and excavation. To reduce vehicle emissions, Istanbul plans to improve public transportation to give priority to rail and sea transportation and encourage the use of environmentally friendly fuels and engine systems.[12]

OneNYC has enhanced enforcement of the current air pollution regulations, has encouraged 'citizen-science' to help New York City identify sources of emissions, and has started a program to convert buildings away from using heavy heating oil. To reduce vehicle emissions, *OneNYC* is

ensuring its city-owned fleet meets emission standards, offers rebates to companies replacing diesel trucks with cleaner vehicles in certain areas, and has enacted gateless tolling to reduce idling vehicles.[9]

The City of London Local Plan requires developers to consider the impact of their development on air quality and, where appropriate, provide an Air Quality Impact Assessment. Developers are encouraged to install non-combustion low- and zero-carbon energy technology. Air quality impacts must be minimized for construction, demolition, and transportation of construction materials.[13]

4.5 Lessons Learned

Ottawa's previous long-range planning initiatives, such as *Framing Our Future*, include most of the environmental drivers that were identified as part of the precedents review. Ottawa has adequately identified the type of environmental issues that are going to be most pressing for the City in the future. These environmental drivers can be primarily linked to either climate change, or growth and development. Depending on the individual driver, the City of Ottawa's ability to control it is varied. In some cases, Ottawa will need to develop strategies to modify and mitigate the environmental driver's effect on the City. In other cases, the City of Ottawa will only be in a position to adapt to the driver's impacts. Proactive strategies and reactive responses will need to be developed, adopted as policy, and implemented through specific actions.

Predictions about the extent of these environmental drivers are subject to change with changes in population and emission patterns. Ottawa must ensure that its environmental planning and programs embrace a range of uncertainty. They must also be reviewed regularly to ensure that its future planning initiatives are responding to the future most likely to happen.

The drivers identified in **Table 4 – 2** are those that are most important to building a more environmentally resilient Ottawa; the City must consider these drivers in their development of scenarios for long planning purposes. They are listed based on the number of votes they received in the workshop. Each of these drivers can be seen as opportunities (yellow) upon which Ottawa could capitalize, or vulnerabilities (blue) which may cause significant negative effects if proactive strategies are not implemented.

Table 4 – 2: List of environmental drivers identified as important for Ottawa's future.

Environmental
Floods
Transition to Renewable Energy
Supply of Developable Land
Extreme Storms
Demand for Power
Increase in Rainfall Intensity
Urban Heat Islands
Wastewater Capacity
Damage to Natural Areas
Warmer Temperatures
Decreased Air Quality

Environmental Lessons Learned:

- Ottawa has identified that climate change, population growth, and the rising cost of oil will affect the City's environmental future.
- Several 'most important drivers' identified are related to storms and flooding, as city infrastructure was built and plans were written based on precipitation patterns and predictions that are no longer accurate. Renewable energy and demand for energy were also identified as important drivers as the use of fossil fuels will become increasingly expensive and unsustainable.
- Long-range plans that are most relevant to Ottawa environmentally include New York City's *One NYC*, Boston's *Resilient Boston*, and Pittsburgh's *ONE PGH*.

Since predictions about the extent of these environmental drivers are subject to change due to changes in population and emission patterns, Ottawa must ensure that its environmental planning and programs embrace a range of uncertainty.

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DRIVERS OF CHANGE: DEMOGRAPHIC

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5.1 Overview

Ottawa's Demographic Drivers of Change

By examining *Framing Our Future* for demographic drivers of change, a better understanding was developed of the City of Ottawa's priorities and the drivers of change relevant to its urban growth.[1] Ottawa has since updated their priorities and now considers the drivers identified in *Framing Our Future* to be outdated.[1] The following list details the demographic drivers of change Ottawa identified in *Framing Our Future:*[2]

Increased Demand on Health Services

A downturn in the global economy may reduce income and increase levels of unemployment. The effects of economic downturns may threaten access to health care, health benefits, and other health related items such as maternity leave and disability insurance. These losses can decrease quality of life and life expectancy. Furthermore, the ageing population will require more health care services, including emergency care.

Social Tension

The inevitable increase in immigration may increase social tension, particularly if there is an economic downturn. Increasing diversity in Ottawa may require more culturally appropriate services and languages beyond English and French.

Capacity to Attract and Retain Immigrants

Ottawa's rate of attraction and retention of immigrants could decrease due to more successful offers from other municipalities and provinces. Declining birth rates will require a significant portion of Ottawa's net labour force to come from immigration.

Airport security measures attempt to preserve citizen safety and prevent illegal immigration. (Credit: New Straits Times, 2017)

Increased Housing Demand

Housing demand and housing price pressures may increase due to population growth. The ability for some to afford adequate housing is already a growing issue. The City needs to provide a greater mix of affordable, rental, and supportive housing in throughout the entire urban area. The City needs to strategically support the diversification of housing type and tenure inside the Greenbelt and suburban locations.

Skills Shortage for Age-Friendly Services

An increase in the ageing population may require more age-friendly services and facilities; however, the skilled labour in these services may be limited.

Provision of Family and Senior Friendly Services

The ageing population will require Ottawa to provide new services and facilities to meet their needs. Ottawa may need to provide new services and facilities to meet the needs of young families. An increase in culturally diverse households will require services such as clinics, cultural facilities, and family-friendly recreational facilities to meet their needs.

Public Works Infrastructure

Existing public works infrastructure includes sewage, drinking water and electrical supply. Public infrastructure may experience significant operating pressure as they must meet the needs of a growing, ageing and diverse population. The adoption of new services, technologies, distribution procedures and consumption bylaws are avenues to explore.

The Robert O. Pickard Environmental Centre is a waste water treatment facility in Ottawa (Credit: Emily Goldney, 2015)

Ottawa identified seven demographic drivers of change in *Framing Our* Future. However, omitted drivers have been identified through the analysis of precedent plans.[1] In this analysis, thirteen demographic drivers were identified and have been defined below.

Immigration and Migration

Immigration and migration focuses on refugees, asylum seekers, temporary residents, the social integration of newcomers, and the active recruitment of skilled workers. Migration includes the effects of 'brain-drain,' declining youth populations, and migration due to climate related issues such as climate change and environmental shocks.

Shifts in the Labour Market

Shifts in the labour market refers to the change from low-skilled work to skilled work in new sectors, and the supply versus demand of those occupations.

Ageing Population

Ageing population includes the growing demand of health-care systems and services, and the risk of social isolation for those born between 1946 and 1965, also known as 'baby boomers.' This driver also focuses on inter-generational responses to changes in the labour market.

Unemployment

Unemployment examines the effects of unemployment among youth populations, adapting to an ageing population, and the difference between the demand for employment and the jobs that are available.

Population Growth

Population growth considers increased demands on services and physical space in a city when the population continues to increase.

Housing

Housing identifies housing issues such as housing shortages, demand for affordable housing, housing supply, and temporary housing for the homeless.

Social Mobility

Social mobility includes issues that make stability or upward mobility difficult. This refers to the inequity of access to health care, and social inequality based on gender, race, ethnicity, disability or ability, and broader global structures that support economic inequality.

Resource Scarcity

Resource scarcity considers the effects of challenges such as food insecurity, and the affordability of resources. It also refers to the depletion of non-renewable resources.

Education

Education seeks to improve standards of education and access to formal education. Non-formal education in the form of inter-generational, or "21st Century" skills, are also considered.

Crime

Crime focuses on reducing crime rates by deterring violent behaviour through the design of public spaces and the built environment. Crime is closely related to other drivers such as social tensions, unemployment, and resource scarcity.

Retention and Attraction of Youth

Retention and attraction of youth refers to creating an environment where social, cultural, and economic opportunities exist to attract and retain younger populations in cities that face higher rates of migration.

Placemaking

Placemaking involves the building and spatial protection of ethno-cultural identities in a city, and adjusting spaces to include newcomers as cultural dynamics and demographics shift. This driver focuses on using art as an expression of place.

An example of Indigenous place making at Mohawk College (Credit: Indigenous Place Making Council, n.d.)

Social Tension

Social tension considers various factors that contribute to civil disturbances. This includes gentrification, inter-group tension, race relations, and the victimization of those in vulnerable populations, such as people of colour, the elderly, children, people with language barriers, low-income individuals, and those with disabilities or medical illnesses.

Based on the thirteen drivers of change identified in the precedent plans analysis, Ottawa is missing: shifts in the labour market, education, placemaking, retaining and attracting youth, unemployment, crime, and resource scarcity. These drivers may be important to consider moving forward.

5.2 Narrowing the Focus: Top Tens

The three variations of top ten plans and the top ten demographic drivers selected in the workshop are in **Table 5 – 1**. The process behind the creation of these variations is discussed in **Section 3: Methods.**

Table 5 – 1: Prioritization of Plans Related to Demographic Drivers

Rank	Matching Plan Classification	Workshop	Addressed Ottawa's Top 10 Drivers	Top 10 Demographic Drivers of Change
1	Chicago Go To 2040: *Comprehensive Regional Plan*	Chicago *Go To 2040: Comprehensive Regional Plan*	New York City *OneNYC: A Strong and Just City*	Immigration
2	New York City *OneNYC: A Strong and Just City*	Edmonton *Edmonton Metropolitan Growth Plan*	Istanbul *2013-2023 Istanbul Regional Plan*	Population Growth
3	Vejle *Vejle Resilience Strategy*	Boston *Resilient Boston*	Christchurch *Resilient Greater Christchurch*	Ageing Population
4	Thessaloniki *Resilient Thessaloniki: Strategy for 2030*	Calgary *Calgary Resilience Strategy*	Melbourne *Resilient Melbourne*	Housing
5	Birmingham *Birmingham 2026: Our Future Vision*	Birmingham *Birmingham 2026: Our Future Vision*	Boston *Resilient Boston*	Shifts in Labour Market
6	Boston *Resilient Boston*	Helsinki *Helsinki City Plan Vision 2050*	Chicago *Go To 2040: Comprehensive Regional Plan*	Social Mobility
7	Bristol *Bristol Resilience Strategy*	San Francisco *Resilient San Francisco*	Glasgow *Our Resilient Glasgow*	Placemaking
8	Calgary *Calgary Resilience Strategy*	Mississauga *Our Future Mississauga*	Edmonton *Edmonton Metropolitan Growth Plan*	Unemployment
9	Christchurch *Resilient Greater Christchurch*	Vejle *Vejle Resilience Strategy*	Mexico City *CDMX Resilience Strategy*	Retention
10	Melbourne, Pittsburgh, Rotterdam, Wellington	Manchester Local Dev. Framework. Core Strategy Dev. Plan	Berkeley Berkeley Resilience Strategy	Education

Chicago's *Go To 2040: Regional Comprehensive Plan* and Boston's *Resilient Boston* were the only two city plans to be included in each variation. This is significant because the plans for these cities were not only among the top ten plans based on expert opinion, however they were considered to be similarly structured to Ottawa's *Beyond 2036* document, and they addressed most of the top ten drivers of change. Other city plans that were present in two out of three variations include: New York City's *One NYC*, Christchurch's *Resilient Greater Christchurch* Plan, Edmonton's *Edmonton Metropolitan Regional Growth Plan*, Melbourne's *Resilient Melbourne* Plan, Birmingham's *Birmingham 2026: Our Future Vision,* and Vejle's *Vejle Resilience Strategy*.

5.3 Integrating Drivers into Ottawa's Planning Regime

The thirteen demographic drivers of change found in the 37 plans were further analyzed to determine those that could be addressed by the City of Ottawa, and those that could not be addressed by the City. The cities and their applicable plans from **Table 5 – 1** were then examined to determine what strategies they had in place to address their respective drivers.

Immigration

Immigration is a driver that concerns federal, provincial, and territorial governments across Canada. Immigration, Refugees, and Citizenship Canada have established agreements with provincial and territorial governments regarding shared responsibilities of immigration. Although the City of Ottawa is not directly involved with the shared responsibilities of immigration, the City still plays an important role as they can lobby the federal government for a larger share of immigrants and provide services and programs to assist those relocating to Ottawa through housing, employment services, and other services.

Vejle, Denmark, is considered the strongest municipality in the country for socially integrating newcomers.[4] Its strong welfare model has been used to help integrate immigrants into the country. The City's key policy areas for immigrants are employment, education, and Danish language skills.[4] With regards to language training, the *Dansk Simulator* (Danish simulator) introduces a computer-based platform for Danish learning for students on an individualised basis. To support the employment of immigrants, the City allocates funds to a program called *Jobcentre Vejle*, for self-supported employment, and creating internships and employment opportunities for spouses.[4] *Jobcentre Vejles* also focuses on immigrant integration through its *Digital Inclusion* project, which specializes in developing solutions to integrate target citizens into digital society. Target citizens are vulnerable peoples, immigrants, and the elderly.[4]

The cover page of Vejle's Resilience Strategy plan.

Ageing Population

As the ageing population is expected to significantly increase in Canada, the City of Ottawa plays a pivotal role in ensuring that adequate services and programs are in place for an ageing population. The City of Ottawa can examine the implementation of new services and programs as well as improve and update existing services and programs such as housing, transportation, health and well-being.

Birmingham 2026: Our Vision for the Future identifies various strategies to address and support the ageing population for the City.[5] The plan identifies various services and programs that have been developed to accommodate the needs of an elderly population, including:

- Improving support for elderly people of all ethnic groups, genders and sexual orientations, including extra-care villages;
- Improving access to health care, foot care and exercise;
- Providing practical support to live independently at home, such as 'handy person schemes' across the city; and,
- Support for local befriending services which help to reduce feelings of isolation.[5]

Unemployment

The City of Ottawa cannot specifically address unemployment, as it does not have control over global forces such as an unstable economy and shifts in the labour market. However, Ottawa may continue to improve and implement new programs and services for those who are less skilled.

Melbourne's *Resilient Melbourne Plan* includes strategies and policies aimed to address unemployment among the youth population, and supports the retention of a younger adult population in the City.[6] The development of *Young and Resilient* living labs connect young people with other individuals and professionals to examine, build, and design technology-based strategies to promote the well-being of individuals, communities, and society as a whole.[6] The City's *STEM* (*Science, Technology, Engineering, and Mathematics*) mentoring program provides opportunities for young people to connect with individuals in senior professional roles and to develop a better understanding of potential future career opportunities in various fields.[6] The program is critical for Melbourne, as there has been a shift from traditional manufacturing employment to non-traditional employment opportunities, as well as an increase in immigrants who may not have established networks for employment opportunities.

Growing Population

The City of Ottawa is expected to grow to over 1.15 million people within the next two decades in both urban and rural areas. The City of Ottawa may address the anticipated population growth through management strategies and initiatives ranging from the planning and development of communities to the delivery of municipal services and infrastructure.

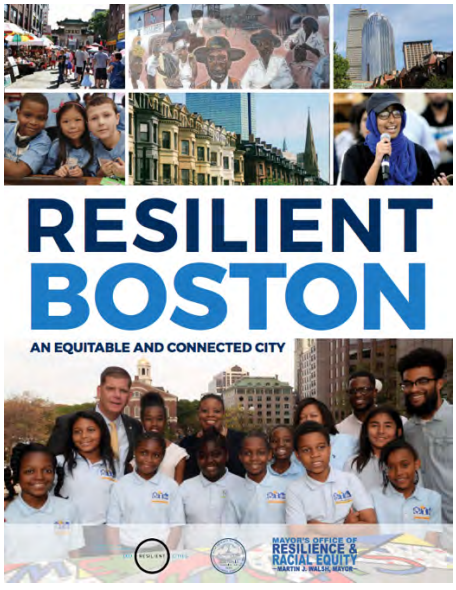
Edmonton's *Metropolitan Region Growth Plan* addresses population growth through improving housing and transportation.[7] Edmonton is a major economic hub for northern Alberta; in order to address its growing population, the City is focusing on improving infrastructure and transportation connections to ensure these areas can accommodate future employment growth.[7] Additionally, Edmonton is managing population growth through housing; diverse housing types are strategically placed within close commuting distances to major employment areas and hubs.[7] As a result, the City can plan proactively for population growth by directing the geographic and spatial organization of growth.

The cover page of Edmonton's Metropolitan Region Growth Plan.

Housing

Housing issues continue to be an area of concern for the City of Ottawa, particularly when combined with other factors such as an increase in housing prices, affordable housing shortages, the quality of housing, and the supply versus demand of housing. The City of Ottawa should consider updating and improving housing policies and strategies to address several of these challenges.

The City of Boston's *Resilient Boston: An Equitable and Connected City Plan* aims to address the issues surrounding housing through three strategic actions.[8] Their *Home Ownership and Maintenance* strategy encourages home ownership in various ways, including housing payment assistance, educational support, and guidance during the purchasing process. This strategy supports existing homeowners, including older adults and working families.[8] To help individuals and families stay in their homes, a no-interest loan for home repairs is provided by the *Boston Home Center* through a homeowner assistance program. The City's *Affordable Housing Production* strategy aims to improve policies that further encourage and support the maintenance of deed-restricted low- to middle-income housing.[8] Finally, Boston's *Anti-Displacement Legislative Package* includes policies to make legal representations in eviction proceedings a right; require the City to be informed of evictions; allow tenants and non-profits to purchase foreclosed properties before they are publicly listed; and provide landlords with tax credits when providing unsubsidized units at below-market rates to eligible households.



The cover page of Boston's Resilient Boston: An Equitable and Connected City Plan.

New York City's *OneNYC* acknowledges that as the City's population continues to increase in the future, the demand for housing will limited.[9] The plan provides strategies to address two demographic drivers: housing and significant population growth. The first initiative is aimed at creating and preserving 200,000 affordable housing units over the decade to ease the rent burden on New Yorkers, while also meeting the needs of a diverse population.[9] This is further supported through the efforts of the private sector which will produce over 150,000 additional housing units to meet the needs of a growing population. Other housing initiatives include supporting efforts to create new housing and jobs throughout the region, as well as expanding housing and services that will support the City's most vulnerable populations.

Retention of Youth

The retention of a younger adult population is critical to balance the expected growth of an ageing population, particularly in employment. It also serves to preserve the social-cultural identity of a city. The City of Ottawa should concentrate its efforts on strategies and initiatives that not only retain, but attract a younger population.

Although the City of Mississauga was not identified as one of the top cities to appear in more than one of the variations, it was selected during the workshop's expert opinion activity. The City of Mississauga's *actionplan: Our Future Mississauga* outlines strategies for the retention of youth and a young adult population.[10] The strategies include: implementing a youth attraction and retention strategy; implementing a young adult retention strategy; building attractive places for youth and young adults; developing programs and activities for young adults; and promoting employment opportunities by attracting colleges and universities to the City.[10]

The cover page of Mississauga's Strategic Plan: Our Future Mississauga.

Shifts in the Labour Market

The City of Ottawa is not able to control shifts in the labour market as any shift is caused by global forces outside of Ottawa's sphere of influence and authority. Although Ottawa may not be able to control shifts (such as the shift towards smart technologies), they are certainly able to ease the transition by establishing the appropriate programs and services to promote these new sectors and aid in the teaching of inter-generational skills.

In Chicago's *Go To 2040 Plan*, strategies focus on enhancing their existing workforce development programs to support individuals from various levels of education in order to gain meaningful skills for employment.[11] Improvements to data and information sharing through a centralized system provides information on the progress and effectiveness of education and workforce programs.[11] This ensures that businesses and residents are

equipped with the necessary skills and education to contribute to the economic prosperity and competitiveness of the City.[11]

The cover page of Chicago's Go To 2040 plan.

Social Mobility

Addressing the difficulty or ease of social mobility in Ottawa is not an issue that can be solved by a single program or initiative. Upward mobility involves an inter-generational process of changing the structures that guide society, including education, income, and social standing. Changing these structures will require shifts in attitude that are outside of the City's control. The City of Ottawa can direct its efforts towards improving equitable access to resources.

The City of Boston's *Resilient Boston: An Equitable and Connected City* approaches the issues associated with economic inequalities from a non-traditional approach which focuses on 'community wealth building.'[8] The traditional approach to economic development focuses instead on attracting outside firms for the purpose of creating new employment opportunities. The 'community wealth building' strategy focuses on the promotion of growing local assets and ownership; creating inclusive employment opportunities that pay living wages; and developing new supportive and collaborative opportunities for a non-traditional generation of economic activity.[8]

Placemaking

It is important for placemaking to be a bottom-up, grassroots initiative. It is not a specific program, but a process of building and conserving an identity that is attached to a physical place. Similar to shifts in the labour market, the City of Ottawa cannot directly address how this process will occur, but the City can encourage the process by making certain resources and spaces available for various communities to use.

This community garden in the City of Ottawa is an example of placemaking (Credit: Just Food, n.d.)

Christchurch's *Resilient: Greater Christchurch Plan* provides various strategies and actions for dealing with placemaking in order to build stronger communities and to develop connectivity.[12] Strategies focus on creating events and providing local resources that will help new residents establish connections with those individuals from their immediate communities.[12] The development and improvement of support programs for

vulnerable peoples will ensure that individuals are connected with their communities and the appropriate programs and services.

The cover page of Christchurch's Resilient Greater Christchurch plan.

Education

The City of Ottawa cannot address formal education as a driver of change because it is outside of the City's authority. Each of the following boards receive their funding from the Ministry of Education:

- The Ottawa-Carleton District School Board (OCDSB) is responsible for the operation of all English public schools in the City;
- The Ottawa Catholic School Board is responsible for the operation of all English Catholic schools in the City;
- The Conseil des écoles catholiques du Centre-Est is responsible for the operation of all French Catholic schools in the City of Ottawa; and,
- The Conseil des écoles publiques de l'Est de l'Ontario is responsible for the operation of all French public schools in the City of Ottawa.

The City of Vejle, Denmark has prioritized the teaching of *21st Century Skills* as an important component of its strategy for informal education in order to aid the City's goals for inter-generational resiliency.[13] As a policy, the City of Vejle has partnered with the *Partnership for 21st Century Learning* to promote the teaching of these skills to communities, youth groups, immigrants, and the elderly. Examples of these skills include: financial, economic, business and entrepreneurial literacy, civic literacy, health literacy, environmental literacy, and 'life and career skills'.[13] The aim of these interdisciplinary *21st Century Skills* are to supplement Denmark's educational system with programming that can be used across different age groups.

5.4 Lessons Learned

Ottawa's previous long-range growth strategy, *Framing Our Future*, identifies a number of demographic drivers that were also identified during the precedent plan review.[1] However, for Ottawa to have adequately considered the most important demographic drivers of change that will affect the City over the next 50 years, it needs to examine how shifts in the labour market, education, placemaking, retention of youth, unemployment, crime, and resource scarcity will shape the City's future. These are seven pressing drivers of change that need to be planned for, but have not yet been addressed in *Framing Our Future*.[1]

The City of Ottawa's control over each driver varies. When the City does not have jurisdictional control over a driver, the City needs to adopt strategies to support the

delivery of services and programs that have been developed by other parties. In other circumstances, the City will be in a position to adapt to the driver's impacts, and should shape its proactive strategies and reactive responses based on the precedents that have been discussed in this report. These precedents can be found amongst the 37 city plans reviewed.

The drivers identified in **Table 5 – 2** are those which are most important to building a more resilient Ottawa from a demographic perspective; the City must consider these drivers in their development of scenarios for long-range planning purposes. They are listed based on the number of votes they received in the workshop. Each of these drivers can be seen as opportunities (yellow) upon which Ottawa could capitalize, or vulnerabilities (blue) which may cause significant negative effects if proactive strategies are not implemented.

Table 5 – 2: List of demographic drivers identified as important to Ottawa's future.

Demographic
Immigration
Population Growth
Ageing Population
Housing
Shifts in the Labour Market
Social Mobility
Placemaking
Unemployment
Retention
Education

Demographic Lessons Learned:

- Ottawa has identified the following demographic drivers of change: an increased demand on health services; social tension; capacity to attract and retain immigrants; an increased housing demand; skills shortage for age-friendly services; provision of family and senior friendly services; and public works infrastructure.
- Long-range plans that are the most relevant to Ottawa demographically include Chicago's *Go To 2040 Comprehensive Master Plan*, Boston's *Resilient Bostom*, New York City's *OneNYC*, Christchurch's *Resilient Greater Christchurch*, Edmonton's *Edmonton Metropolitan Growth Plan*, Melbourne's *Resilient Melbourne*, Birmingham's *Birmingham 2026: Our Future Vision*, and Vejle's *Vejle Resilience Strategy*.
- For Ottawa to adequately consider the most important demographic drivers of change that will affect the City over the next 50 years, it needs to examine how shifts in the labour market, education, placemaking, retention of youth, unemployment, crime, and resource scarcity will shape the City's future.

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(Emily Goldney)

DRIVERS OF CHANGE: TECHNOLOGICAL

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6.1 Overview

Framing Our Future was reviewed to develop a better understanding of the technological drivers that could impact the City. Through this review, several technological drivers were identified as concerns or challenges that the City of Ottawa may face in the next 50 years. The review also helped to outline the City's priorities and any possible omitted drivers which should have been included.

The following section highlights the technological drivers identified in *Framing Our Future*.[1]

A robotized factory in Germany demonstrates how technology has replaced humans in manufacturing. (Credit: Andrew Schrank, 2015)

Infrastructure Failure

Framing Our Future notes that municipalities within Ontario are facing an increasing infrastructure deficit. The cost of building and maintaining infrastructure will continue to increase as the City services new communities on the urban periphery. Some of the infrastructure at risk includes: water, sewer, telecom, electricity, information technology and natural gas.[1]

Social Isolation

Social isolation is associated with an unhealthy immersion or dependency on technology, such as senior citizens in low-density, car-dependent neighbourhoods. Social isolation is caused by technological advances in communication that alters the way in which people interact or communicate. This driver of change may affect the social cohesion of communities and negatively impact mental health and communication skills.[1]

New Forms of Crime

This vulnerability identifies technology as a method to commit crimes such as identity theft, fraud and other crimes.[1]

Health Problems

The increased use of technology may also increase health risks such as obesity. This driver may be caused by the increased dependency or use of automobiles, a decreased accessibility to green space, new technologies that limit to need to go outdoors, or the increased use of technology (such as television, streaming services, computer-based work) that encourages a more sedentary lifestyle.[1]

Loss of Local Business Opportunities

This is considered a vulnerability for the City of Ottawa as e-commerce is becoming more in-demand and convenient, affecting opportunities for local businesses. Large online retailers may force local and small-scale businesses to become more competitive and involved in online services.[1] Online retailing may also affect the competitiveness of big box retailers.

A vacant storefront in Ottawa (Credit: Metro News, 2017)

Employment

Employment is considered a vulnerability under technological drivers as new technologies are forcing traditional industries to make changes. This includes replacing humans and large-scale operations with smaller, more efficient operations.[1]

Framing Our Future's Risk Prevention and Mitigation Plan lists technological advancements that should be considered as opportunities, including:

- Transit technology (e.g. Smart Card technology and Transit Signal Priority);
- Electric cars;
- Car-sharing;
- Miniaturization; and,
- Public participation and outreach.[2]

Although *Framing Our Future* identifies several possible drivers of change, the City of Ottawa has acknowledged that an update is required to ensure current and future drivers of change are not omitted in their long-range urban planning policy. Several gaps have been found between *Framing Our Future* and the analysis of precedent plans. Drivers unidentified by Ottawa, but found in the long-range plans of precedent plans include:

- Infrastructure demand;
- Inadequate infrastructure;
- Ageing infrastructure;
- Increased availability of infrastructure;
- SMART technology;
- Automated vehicles;
- Digital infrastructure; and,
- Cyber terrorism.

Since these drivers were identified in other municipal contexts, they may not be relevant to Ottawa; however, they may be important for Ottawa to consider in order to future-proof or better prepare the City for new technological innovations or challenges. It was also interesting to find that social isolation and health problems are unique drivers for the City of Ottawa.

Following the review of *Framing Our Future* and the precedent cities' plans, the selected technological drivers were classified into the following sub-categories:

- Infrastructure;
- Technologies;
- Public Transit;
- Cyber; and,
- Energy.

Infrastructure, public transit and energy drivers were included in the technological category as it was considered the most appropriate category of driver to discuss these drivers.

Table 6 – 1: Prioritization of Plans Related to Technological Drivers

Tech Rank	Matching Plan Classification	Workshop	Addressed Ottawa's Top 10 Drivers	Top 10 Technological Drivers of Change
1	Chicago *Go To 2040: Comprehensive Regional Plan*	Tokyo *Creating the Future: Long Term Vision*	Berkeley *Berkeley Resilience Strategy*	Autonomous Vehicles
2	New York City *OneNYC: A Strong and Just City*	Helsinki *Helsinki City Plan Vision 2050*	Manchester *Local Dev. Framework. Core Strategy Dev. Plan*	Ageing Infrastructure
3	Vejle *Vejle Resilience Strategy*	London *City of London Local Plan*	Boston *Resilient Boston*	Digital Infrastructure
4	Thessaloniki *Resilient Thessaloniki: Strategy for 2030*	Birmingham *Birmingham 2026: Our Future Vision*	Helsinki *Helsinki City Plan Vision 2050*	Transit-Oriented Development
5	Birmingham *Birmingham 2026: Our Future Vision*	San Francisco *Resilient San Francisco*	Edmonton *Edmonton Metropolitan Growth Plan*	Infrastructure Demand
6	Boston *Resilient Boston*	Manchester *Local Dev. Framework. Core Strategy Dev. Plan*	Victoria *City of Victoria Official Community Plan*	Inadequate Public Transit
7	Bristol *Bristol Resilience Strategy*	Boulder *Resilient Boulder*	Baltimore *City of Baltimore Master Plan*	Regionalization (Transit)
8	Calgary *Calgary Resilience Strategy*	Mississauga *Our Future Mississauga*	Tokyo *Creating the Future: Long Term Vision*	Cyber Security
9	Christchurch *Resilient Greater Christchurch*	Berkeley *Berkeley Resilience Strategy*	New York City *OneNYC: A Strong and Just City*	Renewable Energy
10	Melbourne, Pittsburgh, Rotterdam, Wellington	Baltimore City of Baltimore Master Plan	Stockholm Stockholm: A Sustainably Growing City	Infrastructure Failure

6.2 Narrowing the Focus: Top Tens

The relevant plans from the 37 precedent cities were identified using three different comparison systems. This was done in order to analyze the strategies of other cities' plans in more detail. The most relevant plans to

Ottawa's context was identified through the process described in **Chapter 3: Methods.** The three variations and the most relevant technological drivers to Ottawa are found in **Table 6 – 1.**

In 'Matching Plan Classification,' several cities' plans were tied for tenth place and were included in the list alphabetically. In the top ten drivers, infrastructure failure was tied with several other technological drivers; however, the importance of infrastructure failure to the City of Ottawa was highlighted during the workshop; therefore, this driver was given priority over the other 'tied' drivers.

Several plans were included in at least two of the three variations; however, none of the plans were included in all three variations. This may be due to the strengths or known expertise a city may have with certain drivers. The plans that have been listed in at least two of the three variations are: Manchester's *Local Development Framework: Core Strategy Development Plan*, Berkeley's *Resilient Berkeley*, Tokyo's *Creating the Future: Long Term Vision*, Baltimore's *City of Baltimore Master Plan*, Helsinki's *Helsinki City Plan Vision 2050*, Birmingham's *Birmingham 2026: Our Future Vision*, and New York City's *OneNYC*. These plans should be considered for further examination.

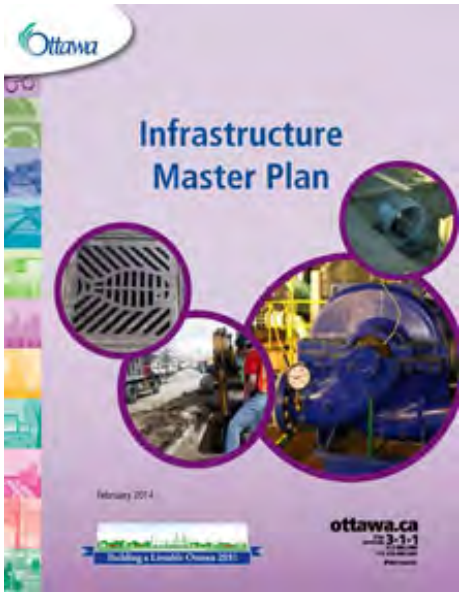
6.3 Integrating Drivers into Ottawa's Planning Regime

The following section summarizes the major drivers identified as being important to Ottawa (**Table 6 – 1**), as well as the City's ability to address these drivers, and the strategies used to address these drivers from the relevant precedent plans.

Infrastructure Demand

The City of Ottawa will experience population growth over the next 50 years, which will lead to more demand for infrastructure to accommodate or to service new households or businesses. The City of Ottawa is responsible for planning and servicing infrastructure, and plays an important role in developing efficient infrastructure. Collaboration with different levels of government may be required to meet the infrastructure demand, depending on the type and location of the infrastructure, including airports, roads, and schools.

Ottawa's *Infrastructure Master Plan* outlines the operation and growth of service infrastructure including water, stormwater and wastewater.[3] Additional plans for infrastructure and services may need to be developed to address this driver. The City must continue to promote intensification and growth in built areas to maximize infrastructure efficiency.



The cover page of Ottawa's Infrastructure Master Plan.

Edmonton's Metropolitan Region Growth Plan has identified the potential lack of adequate infrastructure as an important consideration to the sustainability, competitiveness and future growth of the region. One of the guiding principles for the Plan is to achieve compact growth and to efficiently plan any new infrastructure. The Plan notes that planning for a region is challenging, especially when coordinating with different levels of government and ensuring that infrastructure aligns across the region. The Plan suggests identifying the locations where they may build anticipated infrastructure.[4]

Ageing Infrastructure

A major concern within cities is the deterioration of various forms of infrastructure over time, as well as the limited use of existing and ageing infrastructure. The City of Ottawa's *Infrastructure Master Plan* acknowledges that there has been a shift from supporting service delivery to investing in the rehabilitation of ageing infrastructure.[3] Developing assets for infrastructure rehabilitation and funding is a potential challenge. The City of Ottawa is responsible for infrastructure and may need to develop a strategy or standard of operation for how to update and finance the replacement of ageing infrastructure over the next 50 years.

The City of Berkeley's *Resilience Strategy* notes that funding rehabilitation of ageing infrastructure is a major challenge. To address this driver, Berkeley proposed working with other local governments and organizations to develop a regional infrastructure financing agenda.[5]

The cover page of Berkeley's Resilience Strategy plan.

Failing Infrastructure

Out-of-date technology, infrastructure overload or disruptions due to natural phenomena such as flooding may impact the performance of Ottawa's infrastructure. The issue of failing infrastructure escalates as the population increases, climate change becomes more prevalent and infrastructure becomes outdated. In the next 50 years, the City may need to focus on identifying and rehabilitating failing infrastructure.

The City of Berkeley's *Resilience Strategy* proposes implementing a multi-benefit solution to its infrastructure design. For example, its stormwater management infrastructure will be enhanced to mitigate any failure due to flooding, will serve as a filtration system, and will capture stormwater in case of droughts.[5] A multi-faceted enhancement to the City of Ottawa's infrastructure may be a possible strategy when attempting to mitigate any vulnerabilities associated with failing infrastructure.

Digital Infrastructure

Examples of digital infrastructure include broadband, high-tech zones, fiber optics and wireless connectivity installed throughout a city's infrastructure. Strong digital infrastructure is attractive to businesses and residents alike; however, achieving a fully connected system within both existing and new infrastructures may be challenging. The presence of the federal government in Ottawa poses additional challenges of jurisdiction and potential security risks.

Baltimore's *Comprehensive Master Plan* strategizes the promotion of businesses in the City's Computer, Internet, Data and Software (CIDS) services by using its existing and proposed digital infrastructure. Baltimore aims to develop safe connection areas and wireless zones based on its existing digital infrastructure for both CIDS and residents, and the Plan suggests that this can be achieved through a Master Plan, policy, and franchise agreements.[6]

The cover page of Baltimore's Comprehensive Master Plan.

The City of Ottawa is home to a large high-tech sector that could be used to promote or integrate new technologies into infrastructure. It may also be possible for the City to approve plans, proposals and permits related to digital infrastructure.

Inadequate Public Transit

Public transit services within the City of Ottawa is not yet at the level of service seen in leading European capital cities[7]. The City of Ottawa is responsible for public transportation and may improve its services by implementing new or additional services that can effectively address the areas in the City where services are lacking. Updating or implementing plans and policies related to public transit may be a possible solution for addressing this driver as population grows, the City expands, and transit demand increases.

Boston's Go Boston 2030 resiliency strategy outlines the City's transportation vision which prioritizes the development of predictable

and reliable networks such as walking, driving, transit, and biking. By creating a more reliable transportation network, the City hopes to mitigate any possible extreme weather events in the future and to close social and equity gaps. They propose working with various groups, stakeholders and local municipalities to achieve this; however, they do not provide further detail.[8] Ottawa should consider working with local groups, stakeholders and other interest groups to identify areas with inadequate services.

Transit-Oriented Development

Sustainable travel zones or Transit-Oriented Developments (TODs) are currently being promoted by the City of Ottawa in the *Official Plan* and the *Transportation Master Plan*.[9,10] How TODs are addressed may change over the next 50 years as the economy may fluctuate, housing developments may be altered or businesses may relocate. Scenario plans should consider these possible changes.

Both New York City's *OneNYC* and Baltimore's *Master Plan* include TODs within their respective plans, but New York City's *OneNYC* is more detailed. Under the Housing goal, one of the supporting initiatives of creating more housing is through TOD. There are no specific policies or plans; however, *OneNYC* does make note that these TOD opportunities are subject to feasibility assessments.[11]

The cover page of New York City's OneNYC plan.

Regionalization

Creating a regional transit network in Ottawa is referred to in its *Transportation Master Plan*. Ensuring that commuters have a safe and convenient transit service is an overarching concern.[10] The location of transfer points, intercity connections and how to update roads in a regional context should be considered. A possible challenge with this driver is how to coordinate with other areas such as Gatineau to create a seamless regional transit system.

Helsinki's *City Plan Vision 2050* includes public transportation at the regional level. There is no specific example within this Plan; however, the Plan does state that more steps will be taken to ensure jobs and services are in public transport nodes to build up the region's connectivity.[12]

The cover page of the Greater Helsinki Vision 2050 plan.

Renewable Energy

There are various environmental policies and programs within the City of Ottawa that refer to implementing or developing more renewable energy opportunities. The *Energy Conservation and Demand Management Plan*, for example, refers to incentive programs for renewable energy.[13] This driver may also create an opportunity for the City to reach out to institutions and businesses in the technology sector and environmental fields. The City should consider developing a policy framework or using new technologies to develop different forms of renewable energy.[14]

San Francisco's *Resilient San Francisco* plan does not explain how it will generate more renewable energy beyond its financing programs; however, it did refer to its *0-50-100-Roots* framework.[15] This is a framework developed to achieve 0% waste, 50% sustainable trips, and 100% renewable energy, and protecting green urban spaces and urban forests. This framework has been developed to aggressively challenge climate change impacts through different programs, policies and partnerships.[16] A unique aspect of the 100% renewable energy goal is the renewable energy service, *CleanPowerSF SuperGreen*, which is currently voluntary but invests ratepayer funds into renewable energy infrastructure.[17] Funding is an important characteristic of developing new technologies or renewable energy infrastructure and should be considered in the development of future scenario plans.

Cyber Security

Cyber security is a challenging driver to plan for, especially for Ottawa's multiple levels of government and security concerns. The extent that technology will progress over the next 50 years is unknown, and the ways in which cities mitigate possible damages from cyber-attacks and cyber-terrorism are evolving. However, since the technology sector is one of the main sectors in Ottawa, incentive programs, outreach programs and think-tanks can be developed to address this driver of change.

Cybersecurity. (Credit: Sara Friedan, 2017)

In New York City's *OneNYC* plan, it intends to enhance its cyber security through LinkNYC - a network that includes city structures and public spaces. The City is aware of possible cyber-attacks and plans to

standardize and manage the various networks. This is not clearly explained in the Plan. Considerations such as who would be included in a similar security network or where it would be implemented should be incorporated into scenario plans.[11] With continuous advancements in technology, other possible opportunities and vulnerabilities related to cyber security are still unknown.

Autonomous Vehicles

During the workshop, this driver was discussed in terms of ensuring that autonomous vehicles will not dictate how the City will be developed, or reduce the safety, livability and experience of residents. Finding creative ways to mitigate potential issues, such as safety, need to be considered in the development of scenario plans.

Autonomous vehicles are an example of a future significant technological advance (Credit: Autoevolution, 2016)

Pittsburgh's *ONE PGH: Resilient Pittsburgh* includes a segment on autonomous vehicles, and outlines the platform and governance required to adopt smart infrastructure and transportation technologies. Pittsburgh has a *Smart Transportation Plan* and has developed "Smart Spine" corridors where technology and deployment sensors for autonomous vehicles are fixed to improve safety, mobility and efficiency. The Plan also suggests partnering with the Department of Mobility and Infrastructure, and Microsoft.[18]

Scenario plans are an important way to plan for this driver of change. The shape of areas within a city will determine how this driver will affect the city. The current condition, design, and cost of transportation infrastructure is another important consideration for this driver, and how it may be adapted to integrate autonomous vehicles should be considered when developing scenarios.[19]

Although not all of the effects of autonomous vehicles are known, it is considered a driver of change that may limit the use of cars, reduce sprawl and parking, and encourage more infill development.[19] But as discussed during the workshop, if autonomous cars are a possible driver, they should be allowed in Ottawa in a way that does not negatively affect the City's livability or the public's safety. Other forms of autonomous vehicles beyond personal vehicles should also be considered in scenario plans. With the development of autonomous freight trucks and shuttle buses, suburban neighbourhoods are not the only areas that will be affected.[19] Ottawa's entire urban and rural context needs to be considered as well.

For Consideration in Scenario Plans

Other drivers discussed in the workshop were highlighted but did not make the top ten list. However, technological drivers overlap in many ways. Some additional considerations pertaining to technological drivers are below:

- Artificial intelligence in technology such as Autonomous Vehicles should

be considered for safety and security reasons. For example, if an Autonomous Vehicle or other AI technology is hacked, then what are the security protocols or safety measures?

- Many of the technological drivers have potential effects on economic and demographic drivers. If e-commerce, for example, becomes more prominent, then what jobs and businesses will be affected?
- Will some of these technological drivers create social inequality? Some of the implications of these drivers are unknown, but the accessibility to some technologies, such as autonomous vehicles, may be linked to a certain income bracket.

6.4 Lessons Learned

The technological drivers of change identified in *Framing Our Future* overlap with some of the drivers identified by other city plans. While some of these technological drivers have been identified in precedent plans, the City of Ottawa needs to be cautious in the pursuit of adopting policies, plans, programs and various frameworks to adapt and mitigate these changes. Technology is continuously evolving and some of the current trends explored in this section may not be what actually happens in the next 50 years. The autonomous vehicle driver, for example, should be considered with some skepticism before fully adapting to the trend.

The City's control over each driver varies and is dependent on external influences, including population and climate change. How the City chooses to use technologies depends on what programs, incentives and policies they have in place. The City of Ottawa should look to other city plans, such as those of New York City, Pittsburgh and Edmonton for examples of strategies to manage technological changes. The impact of technological drivers of change on the National Capital Region is uncertain, although there is the possibility that drivers such as regionalization, TOD, and cyber security will supersede any political, geographical or jurisdictional barriers.

The drivers identified in **Table 6 – 2** are those which are most important to building a more resilient Ottawa from a technological perspective; the City must consider these drivers in their development of scenarios for long-range planning purposes. They are listed based on the number of votes they received in the workshop. Each of these drivers can be seen as opportunities (yellow) upon which Ottawa could capitalize, or vulnerabilities (blue) which may cause significant negative effects if proactive strategies are not implemented.

Table 6 – 2 List of technological drivers identified as important to Ottawa's future.

Technological
Autonomous Vehicles
Ageing Infrastructure
Digital Infrastructure
Transit-Oriented Development
Infrastructure Demand
Inadequate Public Transit
Regionalization (Transit)
Cyber Security
Renewable Energy
Infrastructure Failure

Technology Lessons Learned:

- Ottawa has identified that infrastructure failure, social isolation, new forms of crime, health problems, loss of local business opportunities, and employment will affect the City's technological future in *Framing Our Future*.
- Infrastructure demand and the threat of ageing infrastructure are of particular concern as the population increases within the City of Ottawa over the next 50 years. This will lead to more demand for infrastructure to accommodate developments such as new households or businesses. Autonomous vehicles are another driver that may affect Ottawa, and was heavily discussed during the workshop.
- Drivers such as ageing infrastructure, failing infrastructure and infrastructure demand have overlapping characteristics that could be addressed together in the development of scenario plans.
- Long-range plans that are most relevant to Ottawa with respect to technology include Manchester's *Local Development Framework: Core Strategy Development Plan*, Berkeley's *Resilient Berkeley*, Tokyo's *Creating the Future: Long Term Vision*, Baltimore's *City of Baltimore Master Plan*, Helsinki's *Helsinki City Plan Vision 2050*, Birmingham's *Birmingham 2026: Our Future Vision* and New York City's *OneNYC*.
- Technology is continuously evolving, and there is the possibility that drivers such as regionalization, TOD, and cyber security may supersede political, geographical or jurisdictional barriers.

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(Robert Tran)

DRIVERS OF CHANGE: ECONOMIC

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7.1 Overview

The City of Ottawa addressed several drivers of change related to the economy and globalization within *Framing Our Future*. According to *Framing Our Future*, there are many macro-level factors that will create vulnerabilities for both Ottawa and the Canadian economy in general. Economic conditions such as the slow economic recovery from the 2008 financial crisis and the recent US and European debt crises have demonstrated the fragility and inter-connectedness of the current global economy.

The drivers associated with economic change identified in *Framing Our Future* include:

- Resource scarcity;
- Social tensions and economic inequality;
- Unemployment and labour conflicts; and,
- Municipal and energy expenditures.

Labour conflict in California (Credit: Open Democracy, 2001)

The following section briefly summarizes each of these drivers, and also describes important drivers that Ottawa did not consider in *Framing Our Future*, but should have.

Resource Scarcity

Resource scarcity is associated with rising costs and high demand for supply of key natural resources, including fuel, water and food. *Framing Our Future* identifies the following municipal vulnerabilities associated with resource scarcity:

- A rise in petty crime and organized crime, as well as the establishment of black market activity;
- An increase in malnutrition and health issues due to an increase in food prices; and,
- An increase in the cost of living through the increase in fuel costs.[1]

Many city residents depend on vehicle transit for their day-to-day needs, and a spike in fuel prices could leave them without the ability to move around the city. Increased fuel prices could therefore precipitate a need for increased transit services.

Social Tensions and Economic Inequality

There has been an increase in economic inequality throughout North America, stemming from forces such as a lack of jobs and the 2008 global financial crisis. *Framing Our Future* notes that inequality results in more social problems, particularly among those in a lower socio-economic status.[1]

Unemployment and Labour Conflicts

Sudden changes in economic conditions could create high levels of unemployment; this is of concern to Ottawa as it employs a large proportion of workers within the federal government. This has been beneficial to Ottawa in the past, as Ottawa is less affected by economic downturns than other municipalities. However, in the absence of economic diversification in Ottawa, long-term

cuts to federal programs or the movement of government programs to other municipalities could create high levels of unemployment. This unemployment could result in large numbers of people choosing to leave the region for work elsewhere.

Municipal and Energy Expenditures
The continued growth in the City of Ottawa's rural and peripheral areas is more expensive to service than growth within existing urban areas. While the initial capital costs associated with growth may be partially recovered through development charges, infrastructure and service provision is far more efficient and cost-effective in previously developed areas, and the costs to maintain and upgrade this infrastructure may cause increases to property taxes, taking away from spending on health, social, and cultural services. Additionally, as fuel prices rise, households are likely to be forced to spend more on transportation, electricity, and heating. This is associated with the previously mentioned resource scarcity driver.[1] Ottawa identified the above four economic drivers of change in 2012 in the *Framing Our Future* report. Moving forward, updating this list to include important drivers omitted in *Framing Our Future* becomes an important consideration.

There were many significant drivers of change identified in the review of 37 plans that were not included in *Framing Our Future*. This included:

- Industry change, automation, and diversification;
- Resource conservation;
- Employment growth and decline, skills and training development; and,
- Globalization, regionalization, and competition.

Interestingly enough, the municipal and energy expenditures driver is unique to Ottawa, and was not mentioned as a threat in any other plan. However, there are some drivers that were not identified within *Framing Our Future* that were addressed in many of the other scenario plans, specifically relating to globalization, employment and industrial changes. Although each city is unique, and some drivers are more relevant to specific cities, the drivers identified can provide important considerations for Ottawa moving forward.

7.2 Narrowing the Focus: Top Tens

To determine which cities' plans would be most relevant to Ottawa and its economic future, the list of 37 plans was prioritized according to three criteria. This process is outlined in depth within **Section 3: Methods**. These plans can be found in **Table 7 – 1.**

Many of the top drivers selected during the workshop were related to the change in employment sectors. Workshop participants stressed the importance of changing demographics within the employment sector. There is a need for training and skills development as industries become more technologically advanced. Workshop participants indicated that the economic drivers and municipal plans in **Table 7 – 1** were the most important and relevant to the Ottawa context.

Table 7 – 1: Prioritization of Plans Related to Economic Drivers

Rank	Matching Plan Classification	Workshop	Addressed Ottawa's Top 10 Drivers	Top 10 Economic Drivers of Change
1	Chicago Go To 2040: *Comprehensive Regional Plan*	Edmonton *Edmonton Metropolitan Growth Plan*	Edmonton *Edmonton Metropolitan Growth Plan*	Employment Skills/Training
2	New York *OneNYC: A Strong and Just City*	London *City of London Local Plan*	Mexico City *CDMX Resilience Strategy*	Diversification
3	Vejle *Vejle Resilience Strategy*	Stockholm *Stockholm: A Sustainably Growing City*	Mississauga *Our Future Mississauga*	Globalization
4	Thessaloniki *Resilient Thessaloniki: Strategy for 2030*	The Hague *Resilient The Hague*	Calgary *Calgary Resilience Strategy*	Economic Competition
5	Birmingham *Birmingham 2026: Our Future Vision*	Calgary *Calgary Resilience Strategy*	Rotterdam *Resilient Rotterdam*	Automation
6	Boston *Resilient Boston*	Canberra *ACT Planning Strategy*	Melbourne *Resilient Melbourne*	Economic Change
7	Bristol *Bristol Resilience Strategy*	Boulder *Resilient Boulder*	Budapest *Budapest 2030 Long-tern Urban Dev.*	Regionalization
8	Calgary *Calgary Resilience Strategy*	Copenhagen *The Coherent City: Municipal Strategy 2014*	Helsinki *Helsinki City Plan Vision 2050*	Industry Mix Changes
9	Christchurch *Resilient Greater Christchurch*	Pittsburgh *ONE PGH*	Birmingham *Birmingham 2026: Our Future Vision*	Inequality
10	Melbourne, Pittsburgh, Rotterdam, Wellington	Paris, New York, Boston, Mississauga, Birmingham, Melbourne, Berlin	Berlin Urban Development Concept Berlin 2030	Economic Uncertainty

The various criteria used to prioritize the plans of other cities are intended to highlight the plans that are the most important for Ottawa to consider. This was based on the type of planning process used, the expert opinion of workshop participants, and the number of economic drivers considered. Calgary's *Calgary Resilience Strategy* was the only city to appear in all three variations. This indicates that Calgary is likely dealing with similar economic issues and is a good example for Ottawa. Plans such as New York City's *OneNYC*, Pittsburgh's *ONE PGH*, and Edmonton's *Edmonton Metropolitan Growth Plan* are also good examples for Ottawa to consider, as they appear in at least two of the variations.

7.3 Integrating Drivers into Ottawa's Planning Regime

The drivers of change that were identified within the workshop as the most important to Ottawa's economic future include those relating to industry, employment, state of the economy, social tensions and connectivity. There are varying levels of control that the City of Ottawa has over different economic drivers. The City can directly control, influence, or modify the scope and significance of some drivers. Other drivers simply cannot be controlled by the City due to practical or jurisdictional issues. The following section briefly summarizes each of the economic drivers identified as being most important to Ottawa, and outlines strategies other plans are using to address these drivers.

Industry

The three drivers relating to industry that were identified within the long-range plans and workshop include: industrial changes, industrial automation and industrial diversification. Industrial changes relate to the mix of jobs, services, and industries based on changing population and workforce. Industrial automation relates to the transition from traditional services to automated, technological systems. Diversification of industry can foster more opportunities based on a variety of different industries within a city.

Manufacturing plays an integral role in economic growth. (Credit: DEW, 2017)

The City of Ottawa is responsible for promoting industry, such as the ever-growing high-tech sector. Ottawa has commissioned Invest Ottawa, a non-profit agency, to facilitate economic growth and job creation in the City.[2] Ottawa is also responsible for zoning, and may encourage an increase in zoning to allow for more industrial areas. Despite this, Ottawa cannot change the global trends of industry, including the transition to automation.

Pittsburgh's *ONE PGH: Resilient Pittsburgh* addresses multiple drivers that the City of Ottawa has also addressed, including

employment skills and training, economic change, regionalization, and economic uncertainty. Pittsburgh's economy is increasingly reliant on healthcare, education, and technology sectors; however, these sectors are also experiencing rapid changes, and economic uncertainty is of concern.[3]

Employment

Employment skills and training are two drivers that were identified as important within the workshop. Many cities are offering opportunities for people to develop their skills, or 'up-skill' training to encourage more job growth. For example, retiring baby boomers may not want to quit working altogether, but instead change career paths. A shift towards more technologically advanced careers may also require additional training. The City of Ottawa does not have power or authority to address employment skills and training directly; however, they can encourage institutions to increase diversification of training opportunities through the many universities and public colleges found within the City.

The proportion of baby boomers nearing retirement is especially large in Pittsburgh, where 1.2 million workers will need to be hired or 'up-skilled' over the next ten years.[3] *ONE PGH: Resilient Pittsburgh* outlines the many city-sponsored activities in place to promote skills and training for the ageing population, including technical training programs sponsored by industries anticipating workforce transition.[3] New York City's *OneNYC* plans to foster job growth and build an inclusive workforce by focusing investment in training in high-growth industries.[4]

State of the Economy

The two drivers that were addressed in the workshop relating to the state of the economy were economic uncertainty and economic change. Economic change can be either positive or negative for a city, but economic uncertainty may cause undue stress on a city's economy and resources. As Ottawa's industry is based around the high-tech sector and the federal government, lack of diversification may create vulnerabilities that the City cannot address unless scenario plans are created to anticipate different future outcomes.

Calgary's *Resilience Strategy* plan is currently in its preliminary stages, but already there have been efforts to begin implementing resiliency strategies within the City.[5] Calgary is home to the most head offices per capita in Canada, and leads the country in many infrastructure and service areas.[5] Calgary's industry growth is dependent on large economic swings that affect the oil and gas industry. As oil prices fall, job losses have risen, which creates pressure on Calgary's ability to provide services.[5] Calgary is also facing stresses stemming from chronic economic uncertainty given the lack of economic diversification within the City. Ottawa's economy is similar to that of Calgary, as Ottawa also relies on two key sectors – federal government and high-tech. Any shift in government or technological trends may offset the job market. Calgary's *Resilience Strategy* addresses economic stressors through strategic municipal funding allocation.[5] This includes building, updating and maintaining needed infrastructure, optimizing capital investment to create jobs, and attracting and retaining businesses.[5]

Social Tensions

One social tension driver that was identified during the workshop was economic inequality. As of 2010, approximately 15% of Ottawa residents live on low income.[6] Ottawa can strive towards poverty reduction and help people achieve greater self-sufficiency through social programs. This includes employment skills and training, language training, career counselling, and affordable housing in complete communities.[6] There have been some efforts where the City has tried to mitigate economic inequality, such as through the *10 Year Housing & Homelessness Plan*, which integrates a housing system that aligns assets, funding, services, supports, policies and programs to respond to citizens' needs.[7]

Ottawa's plan aims to address homeless in the city. (Credit: Ottawa Citizen, n.d.)

Economic inequality is addressed by both Ottawa and Calgary. Calgary's *Resilience Strategy* outlines a need for social cohesion, as it is an important prerequisite for successful responses to other prioritized stresses and shocks.[5] There are a number of ways in which Calgary is addressing this; one method is through adequate affordable housing.[5] In 2015, Calgary established a one-time *Community Economic Resiliency Fund* dedicated to initiatives boosting Calgary's economic development and improving affordable housing opportunities for residents.[5] This, and the 2016 *Foundations for Home – Calgary's Corporate Affordable Housing Strategy 2016-2025*, has helped to create a more resilient housing system for Calgary.[8]

Like many cities in North America, Pittsburgh is dealing with rising housing prices, energy costs and the threat of gentrification.[3] To mitigate this risk, an Affordable Housing Task Force was created to allocate funds to improve the quality of existing and ageing housing within Pittsburgh.[3]

Poverty in New York. (Credit: The National Herald, 2014)

New York City has a high poverty rate and income inequality is growing.[4] To meet the needs of the City's growing population at a time of rising economic costs, *OneNYC* plans to implement a program aimed at creating and preserving affordable housing.[4] By establishing a *Mandatory Inclusionary Housing Program*, the City can promote economic diversity and affordable housing development. New York City will also aim to maximize the use of city-owned land for new, affordable housing.[4]

New York City's *OneNYC* plan also outlines *Career Pathways* program, created to develop bridging programs to help New Yorkers obtain the academic credentials, experience, and technical skills required to secure entry-level work and advance into skilled training.[4] This will help alleviate social tensions, and will support the creation of, and training for jobs. Additional employment programs include the *Career Pathways Construction Industry Partnership*, which will expand construction training and employment opportunities for traditionally underrepresented New Yorkers, and the strengthening and expansion of Career and Technical Education programs at colleges.[4]

Connectivity

The workshop identified drivers related to global connectivity including globalization, regionalization and economic competition. Globalization creates strategies and broadens the client base to a global level. Similarly, regionalization creates strategies and broadens client base at a regional level. The City of Ottawa must be considerate of regionalization, as it works alongside surrounding municipalities with regards to its public services, including transit. OC Transpo, which is run by the City of Ottawa, crosses provincial and municipal boundaries into Gatineau, Québec. However, since globalization and regionalization are such broad drivers of change, there is very little the City of Ottawa can do to directly address them. Economic competition focuses on strengthening a city's economy based on the threat of another city. The City of Ottawa and the surrounding high-tech companies are attracting talent through Invest Ottawa's *Work in Ottawa* campaign, which aims to draw workers from across North America.[2] Like Ottawa, New York City's *OneNYC* plan is aiming to look at the City through a regional lens, working closely with neighbouring municipalities on issues including transportation, housing, and jobs.[4] By collaborating with regional municipalities and housing agencies on shared priorities, New York City can establish a network that can address regional and long-range planning issues.[4] These efforts, however, are very broad, and *OneNYC* does not necessarily provide adequate detail on how regionalization – or globalization – will be addressed.

Edmonton was identified in the workshop as a city that is closely linked to Ottawa. Edmonton is a region that has grown predominantly in the form of low-density satellite communities around a central city core with energy as the primary regional economic driver.[9] Edmonton's *Metropolitan Region Growth Plan* outlines how inadequate services such as transit, infrastructure and housing are impeding competitiveness of the city.[9] Edmonton will address economic competitiveness through identifying and enhancing regional assets, supporting regional economic development initiatives, and attracting investment, businesses and workers by sustaining a high quality of life within Edmonton.[9] By increasing housing diversity to include market affordable housing near major employment areas, Edmonton will be able to promote livability and prosperity to outsiders.[9] Although Edmonton's *Metropolitan Region Growth Plan* identifies plans to address economic competitiveness, it is broad and does not provide much detail. If Ottawa is looking to other city plans to find

strategies for drivers of change, it may be beneficial to look at plans with concrete examples, rather than high-level actions.

To compete on a global scale, New York City's *OneNYC* has created plans to support their core industries and foster an innovative economy. This is to be fostered through increasing capacity for employment space in Central Business Districts and investing in specialized space for creative firms.[4] The City will support small business growth by simplifying and reducing the regulatory regime through an initiative called *Small Business First*.[4]

As with the majority of plans reviewed, Pittsburgh's *ONE PGH* plans to address economic competition through promoting innovation and incubation of new technologies and businesses.[3] The *Roadmap for Inclusive Innovation* program within the City promotes a number of initiatives for up-and-coming businesses.[3] The City's *Welcoming Pittsburgh* program aims to attract newcomers as well as improving the lives of long-term residents through social cohesion, connectivity and investing in upgrading infrastructure.[3]

The cover page of Pittsburgh's ONEPGH Plan

7.4 Lessons Learned

Ottawa's current long-range growth strategy, *Framing Our Future*, identifies a number of economic drivers that were also identified during the review of long-range city plans from around the world. Despite this, Ottawa has failed to address some of the most important economic drivers of change that may affect the city over the next 50 years in its long-range plan, including globalization, employment training and industrial changes. Ottawa will need to re-examine the current economic landscape, as well as forecast for the future to understand the City's economic threats and vulnerabilities. Through researching and identifying similarities within other cities' long- range plans, Ottawa may find some transferrable strategies to address certain economic drivers. By ensuring that its economic plans and programs embrace a range of uncertainty, Ottawa can prepare-for future scenarios.

The drivers identified in **Table 7 – 2** are those which are most important to building a more resilient Ottawa from an economic perspective; the City must consider these drivers in their development of scenarios for long-range planning purposes. They are listed in descending order of the number of votes they received in the workshop. Each of these drivers can be seen as opportunities (yellow) upon which Ottawa could capitalize, or vulnerabilities (blue) which may cause significant negative effects if proactive strategies are not implemented.

Table 7 – 2: List of economic drivers identified as important to Ottawa's future.

Economic
Employment Skills/Training
Diversification
Globalization
Economic Competition
Automation
Economic Change
Regionalization
Industry Mix Changes
Inequality
Economic Uncertainty

Economic Lessons Learned:

- Ottawa has identified resource scarcity, social tensions and economic inequality, unemployment and labour conflicts, and municipal and energy expenditures as the drivers that will affect the City's economic future.
- any of the key economic drivers selected during the workshop were related to the change in employment sectors, including employment growth and decline, skills and training development.
- Long-range plans that are most relevant to Ottawa with respect to economic drivers of change include Calgary's *Calgary Resilience Strategy*, New York City's *OneNYC*, Pittsburgh's *ONE PGH*, and Edmonton's *Edmonton Metropolitan Growth Plan*.
- By identifying gaps within Ottawa's current long-range growth strategy, it was made clear the City will need to continually re-examine the current economic landscape, as well as forecast for the future in order to understand the City's economic threats and vulnerabilities.

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CONCLUSIONS AND RECOMENDATIONS

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CONCLUSIONS

This report examines the process and purpose of scenario planning, identifies drivers of future change, and explores their relevance to the City of Ottawa. It provides an overview of the literature available regarding scenario planning in the context of urban planning. The literature compiled for this report was created through the examination of academic literature and provides insight into how to define scenario planning, and how to create and evaluate scenario plans. It also outlines a classification system that can be used to comprehend the scenario planning process.

By looking at a variety of cities around the world, an extensive catalogue of drivers of change has been identified. This should be used to understand what primary issues other major cities have identified while planning for their long-term resilience. It is not limited to issues of importance to Ottawa, nor does it identify any drivers that are singularly unique to Ottawa's context. However, by providing a wide array of cities with a broad range of issues, it should be a comprehensive representation of the possible drivers of change.

While examining academic literature and city plans is important, there is no specific literature that examines Ottawa, or another city that matches Ottawa's exact context. Long-range planning is unique to the specific geographic, political, environmental, social, economic, and technological context to which it is applied. The long-range planning project for Ottawa must ensure it adequately captures the unique circumstances of the region, and the drivers of change that are present.

With this in mind, the following conclusions have been made regarding scenario planning in the City of Ottawa context:

1. **Scenario planning is a valuable tool for building resilience.**

Traditional planning typically involves the extrapolation of historical trends to plan for a single likely future. However, the future is highly uncertain, and planning for current trends can only reinforce the continuation of these trends.

The academic literature has shown the benefit of using scenario planning methods. Conventional thinking usually only envisions one scenario, whereas scenario planning explores multiple alternatives.[1] When a set of alternative scenarios is prepared by a diverse set of stakeholders, the resulting scenarios contain different futures reflecting different assumptions about the future. In this sense, scenario planning is powerful tool for organizational learning and option exploration; it forces stakeholders to appreciate diverse perspectives, and to critically think about the consequences of different planning strategies.[2]

Scenario development is also a beneficial process as it allows stakeholders to explore the interrelations between key drivers of change, policy responses, and resulting spatial and temporal consequences.[3] Bringing together stakeholders to think about different combinations and permutations of events and processes for alternative futures is a valuable exercise, even if no plan is developed.[4] This collaborative exploration of alternative

futures, and of policy choices for alternative futures, is a useful forum to explore different pathways for city resilience.

This means that even if alternative futures are not completely accurate, scenario planning is still useful. By having stakeholders collaborate to imagine multiple futures and plan for changes in these scenarios, a city can prepare itself for a wide range of possible changes, rather than a singular forecast. This strengthens a city's capacity to respond to stresses and shocks.

2. **Consider the 41 drivers identified in Table 5 – 1 in Ottawa's scenario development process.**

The *Framing Our Future* initiative failed to identify several significant drivers of change likely to affect Ottawa's future resiliency. The drivers identified in **Table 8 – 1**, as a result of the analysis conducted in this report, are those which are most important to building a more resilient Ottawa. The City should consider these drivers in their development of scenarios for long-range planning purposes. They are listed based on the priority they received in the workshop. Each of these drivers can be seen as opportunities upon which Ottawa could capitalize, or vulnerabilities which may cause significant negative effects to Ottawa if they are not planned for. The vulnerabilities tend to be more prevalent in the environmental and demographic categories, whereas the technological and economic categories have more opportunities.

3. **Respect relationships between drivers in scenario development.**

The drivers of change which will affect Ottawa's future are heavily interrelated. When combining drivers to form alternative scenarios, planners must take a holistic, comprehensive approach where these interrelationships are respected. Despite organizing drivers into environmental, demographic, technological, or economic categories for this report, most drivers spill over into other categories. Trends in any category will be affected by trends among other drivers.

For example, the effects of climate change, such as sea level rise in low-lying areas, will catalyze a 'climate migration' to more climate change resilient areas. The underlying links between different drivers must be considered.

Calgary's *#ResilienceYYC* workshops identified the unique link between the economy and the energy sector. The transition to renewable energy is an environmental and technological driver of change. However, as the Calgary economy is heavily dependent on the energy sector, the transition to renewable energy will also have a profound impact on its economy, making it an economic driver of change as well.

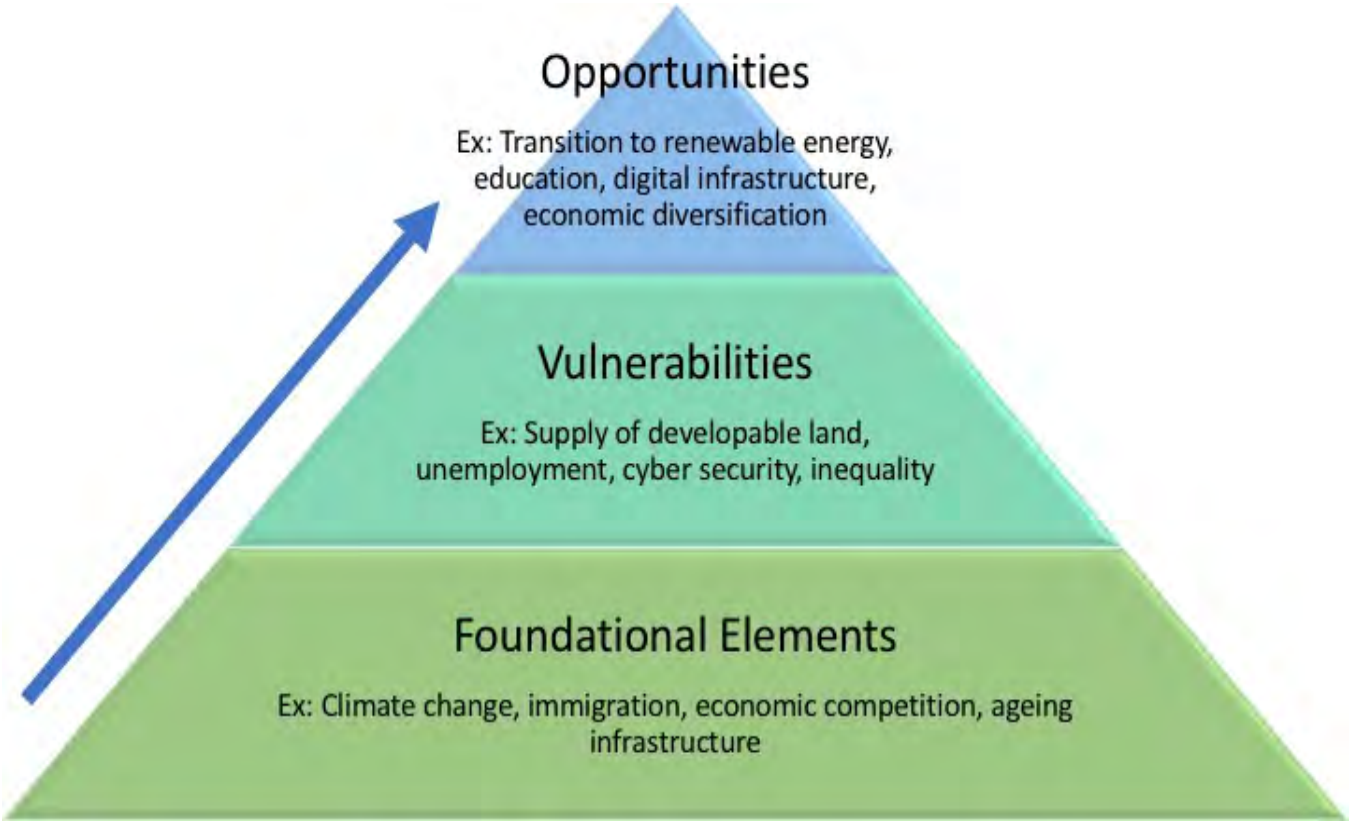
Table 8 – 1: List of drivers identified as important to Ottawa's future. Organized based on their ranking in the workshop, in top-down order of importance. Classified as opportunities (yellow) or vulnerabilities (blue).

Environmental	Demographic	Technological	Economic
Floods	Immigration	Autonomous Vehicles	Employment Skills/Training
Transition to Renewable Energy	Population Growth	Ageing Infrastructure	Diversification
Supply of Developable Land	Ageing Population	Digital Infrastructure	Globalization
Extreme Storms	Housing	Transit-Oriented Development	Economic Competition
Demand for Power	Shifts in the Labour Market	Infrastructure Demand	Automation
Increase in Rainfall Intensity	Social Mobility	Inadequate Public Transit	Economic Change
Urban Heat Islands	Placemaking	Regionalization (Transit)	Regionalization
Wastewater Capacity	Unemployment	Cyber Security	Industry Mix Changes
Damage to Natural Areas	Retention	Renewable Energy	Inequality
Warmer Temperatures	Education	Infrastructure Failure	Economic Uncertainty
Decreased Air Quality			

4. **Consider Ottawa's varying degree of control over drivers of change in scenario development.**

Due to practical or jurisdictional issues, Ottawa does not have direct control over all the drivers of change which may affect its future. In some situations, the City cannot directly predict how a driver will change and develop, but it can implement proactive strategies to mitigate and adapt to the drivers' projected impacts. This may also work with other jurisdictions; Ottawa may partner with stakeholders to promote and advocate for potential adaptation strategies. Limits to the City's ability to control future drivers should be considered in future scenario development.

Figure 8 – 1: Layers of Scenario Construction



5. **A multi-layered approach should be taken when building scenarios.**

Foundational Elements

When building scenarios, there are certain foundational elements that any proposed scenario must include. In the case of long-range urban planning, there are assumptions that will remain present in any scenario. These are things that the City of Ottawa has no control over, and will occur regardless of the City's actions. These must be factored into Ottawa's scenario planning, because the City will inevitability be required to respond to them.

Despite the certainty that these foundational elements will occur, their duration or potential scale is unknown. For example, climate change, immigration levels, and economic competition all have elements of uncertainty to their scale and duration, regardless of the certainty that they will occur. Variations such as these should be factored into scenarios.

Vulnerabilities

Threats that are not foundational elements should be considered next when building scenarios. Drivers categorized as threats could have a significant negative influence on the City if left unaddressed. These drivers should be examined for the scope of the threat that they pose on the City, and the City's ability to address them when creating future scenarios.

Opportunities

Opportunities are the final layer when building scenarios. Rather than dealing with threats, planning for opportunities offers the

City of Ottawa the ability to take a proactive approach and adapt to future changes that will benefit the City. Opportunities are two-sided; they have a tremendous ability to solve issues, but if not harnessed properly, they could pose threats themselves. Opportunities are the least urgent element to anticipate for in long-range planning, but they can be beneficial if planned for appropriately.

6. **Develop scenarios in a collaborative process involving diverse stakeholders.**

Ottawa will conduct a city-led, participatory, joint fact finding, comprehensive, and explorative scenario planning process as outlined in **Section 1: Introduction**. Rather than preparing different scenarios and then presenting them to stakeholders and the public for feedback, the public and stakeholders should be involved from the beginning of the process and actively participate in scenario development.

The review of academic literature for best practices in scenario development led to the identification of five scenario planning initiatives: *Envision Utah*, *Metropolitan Washington DC Council of Governors Region Forward 2050*, *Maryland Scenario Project*, *Valley Futures Project*, and *Västerås, Sweden*. All of these scenario planning initiatives were identified as having excellent scenario development processes.[5,3,4] Based on the type of scenario planning process Ottawa wishes to develop, best practices from these five planning initiatives were combined to yield the following recommended scenario development process:

A) Scoping: Identification of stakeholders who should be involved in the scenario development process, definition of roles and responsibilities, and definition of the geographic and temporal scope of the project.

B) Stakeholder and Residents' Values Analysis: Consult and engage with residents to determine their most fundamental values for the future, while ensuring demographic representation of respondents. This will provide insight on what residents feel is essential to their quality of life, which must be maintained in the future. It will also act as evaluation criteria for alternative scenarios to be compared. The results of this analysis will be combined with the list of drivers outside of Ottawa's control, to form a consistent list of future drivers of change that will not differ across scenarios.

C) Develop a Baseline Scenario: Based on current development trends, develop a future 'business as usual' scenario. This acts as a control by which alternative scenarios may be compared.

D) Stakeholder and Public Education Campaign: This will educate residents on the scenario development process, the baseline scenario, and related consequences.

E) Workshops: Conduct a series of multi-day workshops involving stakeholders and the public. Following an initial background presentation, divide the workshop into groups of approximately ten people from diverse backgrounds. Emphasize to each group that the purpose of the scenario development process is to break with

convention, avoid extrapolation from current trends, and question assumptions in order to consider a wide range of potential futures. Provide each group with a list of drivers that the City of Ottawa can influence, and have each group complete the following tasks:

(i) Brainstorm three different 'futures' in each of the following categories: environmental, technological, economic, and demographic. List the future state of each 'influenceable' driver for each alternative future.

(ii) Combine different features from each category into three to five comprehensive future scenarios. Ensure that the combinations of different futures from different categories respect interrelationships between categories. This should allow for the development of 'explorative' scenarios, which do more than simply project future trends.

(iii) Map the different scenarios onto a land use map with the help of a neutral facilitator, and refine the future scenarios as needed.

F) Scenario Development:

(i) Prepare and publicly publish digital Geographic Information System (GIS) versions of the maps created in the workshops. This allows the public to see what was generated at the workshops, and how the workshop results were integrated into final scenarios.

(ii) Based on workshop results, have planners develop up to five alternative scenarios. List how each 'changeable' driver would appear under each scenario. Provide these scenarios to key stakeholders for comment and revision.

(iii) Input these revised scenarios into scenario planning software like the *Envision Tomorrow* platform. This platform allows for the calculation of future quality of life indicators such as housing affordability, air quality, and jobs-to-housing ratio for each scenario, allowing the public to understand and compare the outcomes of different approaches to future growth and development.[7]

G) Scenario Evaluation: Solicit public feedback on the different scenarios through public meetings and online scenarios.

7. Develop a mechanism for multi-jurisdictional cooperation to address drivers of change.

The National Capital Region is unique in terms of the multitude of municipal, provincial and federal stakeholders present within the Region.

It is bisected by the Ottawa River, which acts as the boundary between the provincial authorities of Ontario and Québec, and the municipal jurisdictions of Ottawa and Gatineau. As the seat of Canada's capital, federal agencies also have special jurisdiction, foremost among them the National Capital Commission (NCC). This creates a fractured array of actors with different powers, abilities, and knowledge.

Many of the issues affecting Ottawa's future are regional in nature and are not limited to a single geographic area, jurisdiction, or singular authority, but transcend political boundaries. For example, both Ottawa and

Gatineau draw their municipal drinking water from the Ottawa River, and both dispose of their wastewater into the Ottawa River. Planning for the current and future health of the river will inevitably require cooperation between the two municipalities.

Proactively planning for the future should consider different mechanisms for integrated joint planning and collaboration on regional issues. This does not necessarily require a radically new model for governance. An enhanced inclusion of relevant regional bodies in the planning process could achieve this integration. This would require an intensive form of meaningful participation. The typology (see **Section 2: Planning Concepts**) of future planning projects would need to include these stakeholders in "joint fact finding." For this type of regional planning to be effective, efforts have to go beyond simply informing other bodies or merely seeking feedback, to including a coordinated effort to align plans among each jurisdiction.

This integrated planning does not require the creation of a new special district, or having the government create a comprehensive regional development agency with broader powers than the NCC.[5] If there was a desire to formalize this relationship, it could consist of special agencies created under federal leadership. For example, Washington D.C. has an area transit agency spanning Maryland, Virginia, and the District of Columbia, with cost-sharing mechanisms in place. In Canada, similar transit agencies exist for the Greater Toronto Area and the Vancouver Region in the form of Metrolinx and Translink, respectively.[6] Working on a regional basis allows for cost-sharing, coordination of goals and objectives, and consistency in planning approaches.

8. Ensure future resilience strategies embrace a range of uncertainty.

Future environmental, social, demographic, technological, and economic conditions are uncertain and are subject to change. Any long-range plan or city resilience strategy should embrace a range of uncertainty, and should be regularly reviewed and updated as Ottawa's future vulnerabilities and opportunities are likely to change over time. Strategies developed from scenario planning help to mitigate this uncertainty. There will always be unknowns for which a city cannot specifically plan. Unforeseeable opportunities or vulnerabilities could arise which cannot be anticipated. Ottawa should be sure to regularly update its long-range and resilience plans to ensure that these circumstances are identified as they arise. Cities should remain proactive in addressing any new issues as they are discovered and be prepared to amend strategies to respond to these disruptors, lessons learned from past efforts, and changing circumstances.

For example, NYC updates its resilience strategy every 4 years. It prepared its first resilience strategy, *PlaNYC* in 2007, then updated it in 2011. Then, in 2012, Hurricane Sandy made the city realize its vulnerability to rising sea levels and tropical storms. Consequently, the 2015 update to New York City's resilience strategy, *OneNYC,* made mitigation and adaptation to tropical storms a new and urgent priority.

9. Identify specific strategies to address drivers of change.

Many of the plans reviewed adequately identified drivers of change that could affect their potential future. However, these plans also lacked specific strategies or details for how to address these drivers. A strong resilience plan should identify not only those factors that are driving change, but ensure that detailed, actionable items are identified that can be carried out as a response to those drivers.

Recognizing that long-range plans and resilience plans are often broad, overarching plans, strategies do not necessarily have to be included in this plan. However, a long-range plan should identify where strategies to address the drivers of change are going to be formalized. Without specific strategies that are developed as a result of a long-range planning process, it is unlikely that the values within the plan will be realized.

We felt that Mexico City's *CDMX Resilience Strategy* was strong in this respect, as this plan clearly enumerated issues, initiatives to address issues, the timeline in which the issue would be addressed, and then the funding source and agency responsible for each initiative.

Conclusion

These recommendations are intended to act as a starting point for the City of Ottawa's long-range planning through the development of alternative scenarios. Key drivers, processes for scenario development, and important considerations for the development of long-range resilience strategies have been identified. The future is highly uncertain; however, the development of alternative scenarios to inform long-range and resiliency planning efforts will assist Ottawa in building a more resilient capital in the next half-century.

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APPENDICES

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APPENDIX A:

Precedent Catalogue

Athens

Greece

Athens Resilience Strategy for 2030

POPULATION

664,046

ESTABLISHED

~7000 BCE

NATIONAL CAPITAL?

Yes

WHY CASE STUDY IS APPROPRIATE

The City of Athens, Greece is part of the 100 Resilient Cities Network. It is one of the oldest cities in the world, and is also a national capital. Economic changes have challenged the future for Athens, forcing cuts to social services and increasing unemployment. Along with crumbling infrastructure and running out of resources, the City of Athens created this plan so they would better respond to future crises. Ottawa can look to Athens as an example of poor preparedness for sudden shocks, stressors, and drivers of change. The City funds and hosts a series of innovation forums to give youth the opportunity to share their entrepreneurial ideas. This allows for forward and future-oriented thinking to engage the youth in urban change.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Floods
- Warmer Temps.
- Urban Heat Island
- Waste

DEMOGRAPHIC

- Housing
- Social Tensions
- Inequality
- Unemployment
- Immigration
- Youth Retention

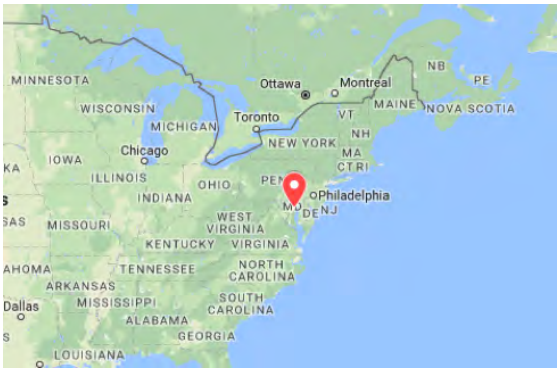
TECH/ECON

- Changing Economy
- Resource Scarcity
- Globalization

Baltimore

United States

City of Baltimore Comprehensive Master Plan: 2007-2012



POPULATION

620,961

ESTABLISHED

1729

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Baltimore, United States is a good precedent for Ottawa to consider in the scenario planning and resiliency process. Within close proximity to a federal capital, the City is not independent from the externalities of Washington D.C. Its top employers are in healthcare and education, and places a high importance on the maintenance of those industries to support job growth. The City of Ottawa can also look to Baltimore for their strategies to foster their current job market with new development and transit to support a desired urban lifestyle. The City has supported the growth of tech industries in their downtown, further fueling a diversified economy and vibrant core area.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Parks Demand
- Watershed Decline

DEMOGRAPHIC

- Population Growth
- House-size Shrink
- Ageing Population

TECH/ECON

- Industry Mix Change
- TOD
- Digital Infrastructure
- New Technology

Bangkok

Thailand

Resilient Bangkok

POPULATION

8,280,925

ESTABLISHED

~1500s

NATIONAL CAPITAL?

Yes

WHY CASE STUDY IS APPROPRIATE

The City of Bangkok, Thailand is part of the 100 Resilient Cities Network. The city attracts in surrounding rural populations, seeking better opportunities and a more urban lifestyle. Ottawa can look to Bangkok on their strategies used to address this population growth pressure from surrounding rural populations. In 2011, they experienced a major flood. This encouraged them to invest in flood management and resilience building to better tackle future shocks and stressors.

The city has engaged in an effort to invest over $72bn in infrastructure. This is attracting new start-up companies and spurring economic benefits into their core area.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Increased Waste
- Air Quality
- Land Demand
- Watershed Decline

DEMOGRAPHIC

- Population Growth
- Social Tensions

TECH/ECON

- Ageing Infrastructure
- Failing Infrastructure

Belgrade

Serbia

City of Belgrade Development Strategy

POPULATION

1,166,763

ESTABLISHED

~7000 BCE

NATIONAL CAPITAL?

Yes

WHY CASE STUDY IS APPROPRIATE

The City of Belgrade, Serbia is part of the 100 Resilient Cities Network. To improve its resiliency, the City is looking to increase economic opportunities and affordable housing for its growing population, and to improve its capacity to utilize critical donations, including food and building materials. Ottawa can look to Belgrade for examples of unique resilient strategies, including mitigation tactics for future shocks and stressors.

The City is investing over $23M into a research and development hub in the City to support job growth in the science, technology, and engineering sectors. This hub will support research and development into creative ways to address future urban changes.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Earthquakes
- Floods
- Landslides
- Land Damage
- Air Quality
- Soil Vulnerability

DEMOGRAPHIC

- Population Growth
- Immigration
- Ageing Population

TECH/ECON

- Industry Mix Change
- Integrated Transit
- New Technology

Berkeley

United States

Berkley Resilience Strategy

POPULATION

121,240

ESTABLISHED

1878

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Berkeley, United States is part of the 100 Resilient Cities Network. Although small, the City is known across the globe as a research and innovation hub. Other California cities look to the City of Berkeley for best practices in hazard mitigation. Ottawa should do the same. Recent efforts include developing the capacity to deliver critical city services for seven days without outside power in the event the region experiences a major outage. As well, Berkeley is working on options for innovative ways to distribute power during other sudden shocks.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Earthquakes
- Wildfires
- Sea Level Rising
- Floods
- Droughts

DEMOGRAPHIC

- Population Growth
- Social Tensions
- Inequality

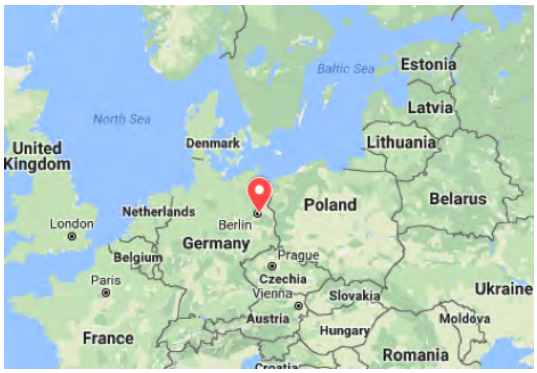
TECH/ECON

- Ageing Infrastructure
- Infrastructure Failure
- Economic Change
- Renewable Energy

Berlin

Germany

Berlin Strategy:
Urban Development Concept 2030



POPULATION

3,670,622

ESTABLISHED

1192

NATIONAL CAPITAL?

Yes

WHY CASE STUDY IS APPROPRIATE

The City of Berlin, Germany has a plan that identifies its strengths, sets out future challenges, and the priorities they have in place for future development. This is an excellent precedent that highlights how other federal capitals in the world engaged with their public to identify how they see the future changing. However, this plan focuses on the physical urban development and its associated changes. Ottawa can exceed this scope, and focus on more than just the physical and tangible elements of the city that will change in the future. This is where demographic, economic, and environmental drivers of change come into play. The Berlin economy is expected to grow faster than anticipated in 2017, and there is an urge for government spend even more.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Warmer Temps.
- Renewable Energy
- Land Demand
- Parks Demand

DEMOGRAPHIC

- Immigration
- Population Growth
- Social Tensions

TECH/ECON

- Economic Competition
- Smart Technology
- Green Technology

Birmingham

United Kingdom

Birmingham 2026: Our Future Vision

POPULATION

1,124,600

ESTABLISHED

1166

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Birmingham, United Kingdom strives to be a global city with a local heart. Their five objectives outlined in their plan are: (1) succeed economically, (2) stay safe in a clean, green city, (3) be heathy, (4) enjoy a high quality of life, and (5) make a contribution. These are great objectives the City of Ottawa can use to frame specific brainstorming activities to create future scenarios. Answer questions like: “how do we succeed economically?”, “what can we do to stay clean, green, and safe?” etc. Birmingham and their university converted an old car dealership into an innovation hub. It is meant to give new business access to expertise and finance for growth.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- More Rainfall
- Warmer Temps.

DEMOGRAPHIC

- Population Growth
- Ageing Population

TECH/ECON

- Global Competition
- Regionalization
- Transit Connectivity
- New Technology

Boston

United States

Resilient Boston

POPULATION

673,184

ESTABLISHED

1629

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Boston, United States is part of the 100 Resilient Cities Network. Much of the City of Boston has prospered, but left many minority communities and populations behind. A lack of affordable housing, fewer educational opportunities, and limited good jobs further divide the City. Ottawa should consider what Boston is doing to attempt to address these issues, as affordability of housing, good education, and job quality will be important fundamentals to Ottawa's future growth.

Boston is ranked as the United States' top city for environmental-based start-up companies. These firms can help address environmental, demographic, and technological/economic drivers of change.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Sea Level Rising
- Warmer Temps.
- Extreme Weather
- Urban Heat Islands
- Floods

DEMOGRAPHIC

- Social Tensions
- Inequality
- Ageing Population
- Housing

TECH/ECON

- Ageing Infrastructure
- Cyber Attacks
- Economic Inequality
- Inadequate Transit

Boulder

United States

City of Boulder Resilience Strategy

POPULATION

108,090

ESTABLISHED

1859

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Boulder, United States is part of the 100 Resilient Cities Network. Ottawa can learn from Boulder's long history of innovation in sustainability and climate change (i.e. tax regulations on open space, green building requirements, and establishment of a carbon tax). Boulder is working closely with the State of Colorado, as flooding and wildfires continue to affect the City. They aim to join this network to "bounce forward" to address the issues before they are problems. To give Boulder an edge on their affordable housing efforts, there is a push to develop much more attached housing units. These units are half of the cost of detached dwellings in the City, which would immediately help with affordability.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Water Supply
- Invasive Species
- Extreme Weather
- Renewable Energy

DEMOGRAPHIC

- Housing
- Affordability

TECH/ECON

- Energy Insecurity
- Infrastructure Failure
- Economic Uncertainty

Bristol

United Kingdom

Bristol Resilience Strategy

POPULATION

454,200

ESTABLISHED

~1000

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Bristol, United Kingdom is part of the 100 Resilient Cities Network. It is the fastest growing city in the United Kingdom. To support the growth, it's investing over $2.7B into new and renewed infrastructure projects. The City has a general resilience framework, where services and governance is decentralized and less prone to cascade failures. It is already the most energy- and waste- efficient cities in the United Kingdom, and aims to improve. The technology sector has increased by over 35% since 2012, however many companies are described as 'disruptive' (i.e. Über and AirBnb). Companies are trying to support and embrace technology, which is backed by the municipality.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Floods
- Air Pollution
- Climate Adaptation
- Sea Level Rising

DEMOGRAPHIC

- Social Mobility
- Housing
- Social Tension

TECH/ECON

- Ageing Infrastructure
- Economic Uncertainty
- Economic Inequality

Budapest

Hungary

Budapest 2030:
Long Term Urban Development

POPULATION

1,759,407

ESTABLISHED

~1

NATIONAL CAPITAL?

Yes

WHY CASE STUDY IS APPROPRIATE

The City of Budapest, Hungary is an international example of another federal capital that identified major drivers of change in their long-term strategic plan. To combat economic uncertainty and improve overall urban resilience, the City is using development and transit to shape the way they want the City to grow. Maintaining and retaining a young population will help with the ageing population, and high density will allow for more housing choice and affordability options. This will be supported by a transition to renewable energy sources, so the City of Budapest will be an attractive and resilient place to live.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Urban Heat Islands
- Renewable Energy

DEMOGRAPHIC

- Housing
- Youth Retention
- Ageing Population

TECH/ECON

- Economic Uncertainty
- TOD
- Integrated Transit
- Green Technology

Calgary

Canada

Calgary Resilience Strategy

POPULATION

1,239,220

ESTABLISHED

1875

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Calgary, Canada is part of the 100 Resilient Cities Network. Calgary is a relatively young city with a vibrant culture and economy. However, similarly to Ottawa, Calgary has a dependency on a single industry for a large portion of jobs – oil. After the market crash in oil, the economy faltered and many jobs were lost. Ottawa can learn from lessons from Calgary, specifically if civil servant jobs were to disappear from the City. The strategies Calgary used to cope with the economic down-swing can be valuable for the City of Ottawa. Population swings in Calgary are predicted to be less volatiles in the next ten years, with about 150,000 people by 2026. Keeping population growth constant takes a lot of coordination and programming to achieve.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Extreme Weather
- Floods
- Droughts

DEMOGRAPHIC

- Immigration
- Ageing Population

TECH/ECON

- Industry Mix Changes

Canberra

Australia

ACT Planning Strategy

POPULATION

303,625

ESTABLISHED

1913

NATIONAL CAPITAL?

Yes

WHY CASE STUDY IS APPROPRIATE

The City of Canberra, Australia is another excellent precedent example for the City of Ottawa. Although it has a smaller population, it is a federal capital with similar stressors that could affect the future City of Ottawa. Canberra is trying to balance the preservation for agricultural and cultural heritage lands with the demand for land for housing. As the City of Ottawa grows, it can look to Canberra for examples and strategies on how to deal with potential fringe development in close proximity to the greenbelt. Similar to plans in Ontario, Australia has future plans to improve connectivity and mobility across the country with a hyper-loop train. This may reduce demands for lands, housing, and infrastructure in the future.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Extreme Weather
- Energy Demand
- Land Demand
- Land Degradation

DEMOGRAOHIC

- Ageing Population
- Housing
- Affordability

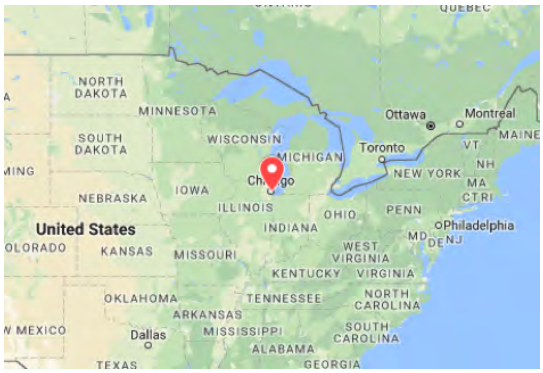
TECH/ECON

- Infrastructure Demand

Chicago

United States

Go to 2040:
Comprehensive Regional Plan



POPULATION

2,704,958

ESTABLISHED

1837

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Chicago, United States is part of the 100 Resilient Cities Network. It is a large cultural and economic center, but faces huge challenges with unequal distribution of resources and access to professional opportunities. It has been working to map and analyze local neighbourhoods with a focus on vulnerable populations. To support and grow its middle class, it has aimed to promote major development in the digital manufacturing sector. To manage ageing infrastructure and inequality to access to services, the City is emphasizing transit-oriented development in suburban areas that complement contemporary planning principles (i.e. commercial building at sidewalk, parking in rear).

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Renewable Energy
- Water Supply
- Land Demand
- Green Retrofitting

DEMOGRAPHIC

- Inequality
- Social Tensions

TECH/ECON

- Ageing Infrastructure
- Transit Demand
- Education/ Training
- Regionalization
- TOD

Christchurch

New Zealand

Resilient Greater Christchurch

POPULATION

367,800

ESTABLISHED

1848

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Christchurch, New Zealand is part of the 100 Resilient Cities Network. After the devastating sudden shock of the 2011 earthquake, the City re-established essential functions quickly, however, downtown rebuilding efforts continue. Ottawa can look to Christchurch for sound disaster management principles. Their economy did not suffer as would be expected due to the location of revenue-generating activities. They developed a grassroots participatory planning process to create a new and improved resilience plan, which was even better for preparing for future to sudden shocks and stressors.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Earthquakes
- Floods
- Sea Level Rising
- Warmer Temps.

DEMOGRAPHIC

- Ageing Population
- Labour Decline
- Social Tensions

TECH/ECON

- Ageing Infrastructure
- Globalization

Copenhagen

Denmark

The Coherent City:
Municipal Planning Strategy 2014

POPULATION

763,908

ESTABLISHED

1254

NATIONAL CAPITAL?

Yes

WHY CASE STUDY IS APPROPRIATE

The City of Copenhagen, Denmark is an example of a progressive city with a plan focused on a number of themes that will address their identified future drivers of change. They aim to meet the preferences of the citizens by creating denser and sustainable developments. These developments will be paired with enhancements to number of jobs supporting the area. All-in-all, the City looks to create a coherent city plan and improve people's quality of life. This is framed around how they see the future of Copenhagen change. As a city that has half of their citizens using bicycles to commute to work, they are using this diverse mode share to combat any potential negative effects autonomous vehicles may have on the City.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Sea Level Rising
- Renewable Energy
- Water Demand
- Land Demand

DEMOGRAPHIC

- Population Growth
- Immigration

TECH/ECON

- Education/ Training
- Transit Demand
- TOD

Edmonton

Canada

Edmonton Metropolitan Growth Plan

POPULATION

932,546

ESTABLISHED

1892

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Edmonton, Canada is a rapidly changing municipality with a focus on fostering economic and technological future changes. Building upon their vast existing public transit infrastructure, they aim to use its growth as a tool to increase economic competitiveness and support new innovative industries. Supporting a multi-modal and integrated transportation network is at the core of their resilient strategy – become a city that is made for people and supports the growth of quality of life. Environmental support, like a transition to the use of renewable energy, will further support these goals.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Watershed Decline
- Agricultural Decline
- Farm Productivity

DEMOGRAPHIC

- Population Growth
- Housing

TECH/ECON

- Economic Competition
- Industry Mix Change
- Economic Diversification
- Renewable Energy
- Public Transit Demand

Glasgow

United Kingdom

Our Resilient Glasgow: A City Strategy

POPULATION

615,070

ESTABLISHED

1175

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Glasgow, United Kingdom is part of the 100 Resilient Cities Network. As part of a grant awarded by the Scottish government, the City has created an initiative called Future City Glasgow. They have developed numerous applications and technologies to collect data for future policy making. Most of the data collection is fostered through the use of personal cellular devices by citizens across the City. It tracks energy use, walking/cycling routes, allows for interactive mapping, and on-demand citizen engagement (see link in endnotes).

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Extreme Weather
- Floods
- New Diseases

DEMOGRAPHIC

- Population Growth
- Education
- Crime
- Resource Scarcity

TECH/ECON

- Smart Technology
- Economic Diversification

Helsinki

Finland

Helsinki City Plan Vision 2050

POPULATION

642,045

ESTABLISHED

1550

NATIONAL CAPITAL?

Yes

WHY CASE STUDY IS APPROPRIATE

Helsinki, Finland is an excellent precedent for the City of Ottawa. It is also a capital with a similar population. Helsinki is known for being a progressive city in terms of urban planning and long-range policy. There are pressures in urban areas for more family sized units, paired with the need for more supply and improved affordability. The City is a good example to consider when building scenarios based on density in the central areas: high density may increase supply and affordability, but requires more transit and creative ways to offer green space. Water and waste management will also be important. Like Canada, the majority of population growth comes from immigration. Helsinki continues to be a major hub of immigration to support the population growth.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Greenspace Demand
- Air Quality Decline
- Water Quality Decline

DEMOGRAPHIC

- Population Growth
- Condo Families
- Housing
- Affordability

TECH/ECON

- New Technology
- Transit Demand
- Globalization
- Regionalization

Istanbul

Turkey

2014-2023 Istanbul Regional Plan

POPULATION

14,804,116

ESTABLISHED

~660 BCE

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Istanbul, Turkey completed this plan and identified their drivers of change with the use of active participation and valuable insights from a wide range of local and national stakeholders. Out of the plan, three major themes were selected: (1) fostering a globally divisive, high value-added, innovative and creative economy, (2) a fair sharing, inclusive, and learning society, and (3) joyful, authentic urban spaces and sustainable environment. These three themes complement the three selected groupings of drivers in this report: environmental, demographic, and technological/economic

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Earthquakes
- Floods
- Water Demand
- Watershed Decline
- Wastewater
- Power Demand
- Food Demand
- Air Quality
- Land Demand

DEMOGRAPHIC

- Education
- Social Tensions
- Population Growth
- Labour Supply

TECH/ECON

- Education/ Training
- Globalization
- Labour Demand

London

United Kingdom

City of London Local Plan

POPULATION

8,787,892

ESTABLISHED

43

NATIONAL CAPITAL?

Yes

WHY CASE STUDY IS APPROPRIATE

The City of London, United Kingdom is part of the 100 Resilient Cities Network. Originally a port city, it has developed into a major cultural and financial center. Real estate prices paired with a lack of affordable housing has made living in London extremely challenging. It also faces issues related to overcrowding, homelessness, and air pollution. Ottawa can look to London as it grows for innovative ideas on how to address population growth, and continue to ensure a standard level of affordability across the city. London is one of the first cities to stop the operation of Über. Revoking their license brought back thousands of taxi-cab drivers into the industry, significantly increasing incomes and supporting their growth.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Floods
- Extreme Weather
- Energy Demand
- Air Quality Decline
- Waste

DEMOGRAPHIC

- Population Growth
- Housing
- Labour Increase

TECH/ECON

- Infrastructure Demand
- Economic Growth
- Green Energy

Manchester

United Kingdom

Local Development Framework:
Core Strategy Development Plan

POPULATION

530,300

ESTABLISHED

1301

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

Manchester is part of the 100 Resilient Cities Network. Similar to Ottawa, Manchester has a unique governance structure. City leadership hopes to grow the urban economy by focusing on employment skills training and the promotion of enterprise culture to challenge social norms that foster dependence. The City faces an environmental challenge in the form of flooding and insufficient infrastructure.

Manchester is proud of its amount of direct foreign investment in their short-term and long-term transportation and infrastructure projects. Having a diversity of funds supporting certain projects decreases the amount of capital the City has to put forward.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Floods
- Urban Heat Island
- Renewable Energy

DEMOGRAPHIC

- Immigration
- Ageing Population

TECH/ECON

- Inadequate Infrastructure
- Inadequate Transit
- Unemployment
- New Technology

Melbourne

Australia

Resilient Melbourne

POPULATION

4,725,316

ESTABLISHED

1835

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Melbourne, Australia is part of the 100 Resilient Cities Network. The City of Melbourne is just over 100,000, but the region surpasses 4 million. This pattern of population and settlement is similar to the City of Ottawa and the surrounding region. Melbourne has undertaken significant work to enhance its resilience, including developing adaptation strategies and plans, establishing networks, developing emergency management plans, and undertaking risk assessments.

Melbourne has identified that their vast variety of wetlands throughout the City are highly contaminated. Without action, they could continue to degrade to a level harmful for humans. They aim to address this issue immediately.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Floods
- Extreme Weather
- Demand for Land
- Water Quality

DEMOGRAPHIC

- Population Growth
- Unemployment
- Social Tensions

TECH/ECON

- Industry Mix Change
- Ageing Infrastructure
- Income Disparity

Mexico City

Mexico

CDMX Resilience Strategy

POPULATION

~21M

ESTABLISHED

1325

NATIONAL CAPITAL?

Yes

WHY CASE STUDY IS APPROPRIATE

Mexico City, Mexico is part of the 100 Resilient Cities Network. Mexico City is one of the world's largest mega-cities, with a large percentage of people living in vulnerable and impoverished conditions. The large, rapid growing population adds to the risk of disaster. The city is susceptible to seismic hazards, as well as flooding and landslides. Although the City is strongly economically divided, it is also a wealthy city. Attempts to reduce inequality and improve social mobility could be noted by Ottawa.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Earthquakes
- Landslides
- Extreme Weather
- Wastewater
- Water Supply

DEMOGRAPHIC

- Social Tensions
- Inequality
- Population Growth

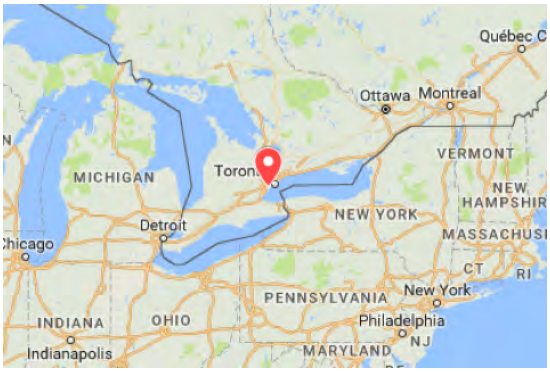
TECH/ECON

- Industry Mix Change
- Economic Change
- Mobility
- Smart Technology

Mississauga

Canada

Our Future Mississauga



POPULATION

721,599

ESTABLISHED

1968

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Mississauga, Canada is a local example of a future strategic plan that identifies specific drivers of change. This plan became the most comprehensive conversation ever held in the City, engaging over 100,000 residents. Ottawa can look to "Our Future Mississauga" for inspiration in the engagement process. The plan identifies a number of drivers of change that affect how they plan for the City's future.

Mississauga improves their resiliency by embracing diversity. By including all groups in every dimension of their community, they can use that diversity as a strength to empower the community to be adaptive to change.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Pollution/Emissions
- Water Quality
- Renewable Energy

DEMOGRAPHIC

- Population Growth
- Unemployment
- Migration/Retention

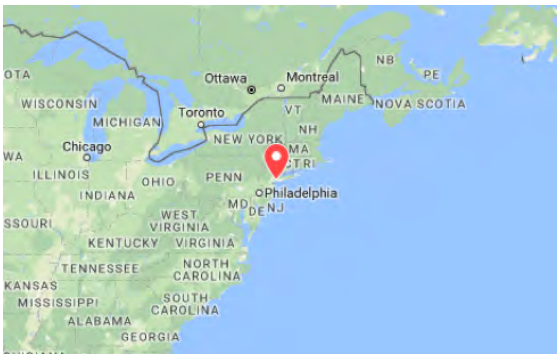
TECH/ECON

- Economic Changes
- Ageing Infrastructure
- Major Industry Change

New York City

United States

One New York:
The Plan for a Strong and Just City



POPULATION

8,537,673

ESTABLISHED

1624

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

New York City, United States is home to more than eight-million people, with nearly 400,000 living in close proximity to vulnerable shoreline at risk of flooding and sea level rising. With ageing building stock and an increasing floodplain, insurance costs are skyrocketing in the City. They are preparing a better plan to improve resilience to predictable and detrimental effects of climate change to the city.

New York had a program that leased cars at sub-prime rates to Uber drivers, but recently stopped it. Like other world cities, the support for Uber is declining. This may be a sign of change that Ottawa may want to consider following. Alternatively, Ottawa should continue to embrace market demand.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Sea Level Rising
- Extreme Weather
- Floods
- Renewable Energy
- Power Demand

DEMOGRAPHIC

- Housing
- Affordability
- Inequality
- Social Tensions
- Poverty
- Population Growth

TECH/ECON

- Transit Demand
- Regionalization
- Industry Mix Change
- Diversification

Paris

France

Paris Adaptation Strategy

POPULATION

2,229,621

ESTABLISHED

~300 BCE

NATIONAL CAPITAL?

Yes

WHY CASE STUDY IS APPROPRIATE

The City of Paris, France is part of the 100 Resilient Cities Network. It is another global center for economic and cultural activity. They have moved towards progressive urban planning, mitigation, and adaptation for climate change. They have also taken steps to improve resilience: a global warming strategy and integration of smart technology. Paris is a global city that Ottawa can look towards to develop methods to tackle shocks and stressors in the future.

A combination of environmental and technological advances within positive energy output buildings have been designed and integrated in a well-known “Smart City” project for Paris (see link in end notes).

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Extreme Weather
- Urban Heat Islands
- Floods
- Agriculture Decline
- Air Quality Decline
- Biodiversity Decline

DEMOGRAPHIC

- Immigration

ENVIRONMENT

- Resource Scarcity
- Energy Demand
- Smart Technology

Pittsburgh

United States

OnePGH: Resilient Pittsburgh

POPULATION

303,625

ESTABLISHED

1758

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Pittsburgh, United States is part of the 100 Resilient Cities Network. The City has emerged as a hub for technology, education, healthcare, and finance. The loss of industrial jobs drove young people away from the City at first, but these new employment sectors and available housing stock may bring young people back. Ottawa can learn from this migration pattern of young professionals. Ottawa has a strong service-based and technology-based economy that can support new graduates looking for work, and also has relatively affordable real estate.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Floods
- More Snow
- Urban Heat Islands
- Air Quality Decline
- Pests

DEMOGRAPHICS

- Social Tensions
- Inequality
- Housing
- Affordability

TECH/ECON

- Ageing Infrastructure
- Labour Decline
- Economic Decline

Rotterdam

Netherlands

Rotterdam Resilience Strategy

POPULATION

623,652

ESTABLISHED

1340

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Rotterdam, Netherlands is part of the 100 Resilient Cities Network. With over 80% of the City below sea level, the City is a key precedent to analyze in regards to integrated water management and innovative climate adaptation. The City aims to be "100% climate-proof" by 2025 – able to continue functioning economically and socially without major disturbance under any extreme weather situation.

This major port City has introduced an industrial automation advancement in container management. A software program can automatically transfer containers from land to ship (or vice-versa) round-the-clock. This allows the City to be even more economically productive.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Floods
- Renewable Energy

DEMOGRAPHIC

- Social Mobility
- Housing
- Education

TECH/ECON

- New Technology
- Smart Technology
- Cyber Resilience
- Industrial Automation

San Francisco

United States

Resilient San Francisco

POPULATION

870,887

ESTABLISHED

1776

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of San Francisco, United States is part of the 100 Resilient Cities Network. It is a major technology and commerce hub with a history of devastating earthquakes and fires. With a diverse population, it has a taken a comprehensive approach to urban resilience strategy, tackling chronic stressors and sudden shocks by creating a municipal plan, but also taking important steps to allow residents to advance their own personal resilience as well. Although Ottawa wants the City to be resilient and sustainable, it starts with the people. If the people become resilient and sustainable, the City will soon follow.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Sea Level Rising
- Extreme Weather
- Earthquakes
- Drought

DEMOGRAPHIC

- Population Growth
- Housing
- Social Tensions
- Affordability

TECH/ECON

- Regionalization
- TOD
- Green Technology
- Digital Infrastructure

Stockholm

Sweden

Stockholm: A Sustainably Growing City

POPULATION

942,370

ESTABLISHED

1252

NATIONAL CAPITAL?

Yes

WHY CASE STUDY IS APPROPRIATE

The City of Stockholm, Sweden has a long-range plan focused around a number of themes: urban growth, transportation, clean and green technology, water, and citizen involvement/engagement. The drivers of change were pulled from these major themes, giving us context behind what kind of stressors and shocks other major international capitals may experience. Ottawa can gain lessons from how Stockholm addresses these major drivers of change.

After the 2008 global economic crisis, Sweden did not follow the same decline like the rest of Europe. They argue it is because of their diverse culture, visionary tech leaders, global-oriented start-ups, and smart policies.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Sea Level Rising
- Heat Waves
- Rainfall Increase
- Energy Demand
- Greenspace Demand

DEMOGRAPHIC

- Population Growth
- Housing
- Affordability

TECH/ECON

- Transit Demand
- Digital Infrastructure
- Smart Technology

The Hague

The Netherlands

The Hague Agenda Setting Workshop

POPULATION

514,861

ESTABLISHED

1230

NATIONAL CAPITAL?

Yes

WHY CASE STUDY IS APPROPRIATE

The Hague, Netherlands is part of the 100 Resilient Cities Network. The City's long-term resilience depends on cyber-security and protecting the home of the international criminal court. They continue to monitor technological developments and new vulnerabilities in its digital infrastructure. Ongoing water management is crucial to address future effects of climate change (i.e. a large artificial sandbank was installed to spread waves and wind naturally along the coast).

The City worked with the Netherlands to invest over €100M into mobility, specifically cycling infrastructure. Without having to rely on the automobile for every daily task, the City can become more resilient and connected.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Coastal Flooding
- Sea Level Rising
- Extreme Rainfall
- Coastal Erosion

DEMOGRAPHIC

- Population Decline
- Ageing Population
- Labour Decline

TECH/ECON

- Failing Infrastructure
- Cyber Attacks

Thessaloniki

Greece

Resilient Thessaloniki:
A Strategy for 2030

POPULATION

325,182

ESTABLISHED

315 BCE

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Thessaloniki, Greece is part of the 100 Resilient Cities Network. With a rich history as a major hub for business, culture, and trade, it is still an active port with a respected university and tourist industry. With the recent economic challenges, the City is increasing their attention to resilience building. Growing unemployment due to a shrinking industrial sector and few young people has led to increased social tensions. They are working with the community, especially the young population, to build trust within their planning process.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Extreme Weather
- Renewable Energy
- Vehicle Use
- Pollution

DEMOGRAPHIC

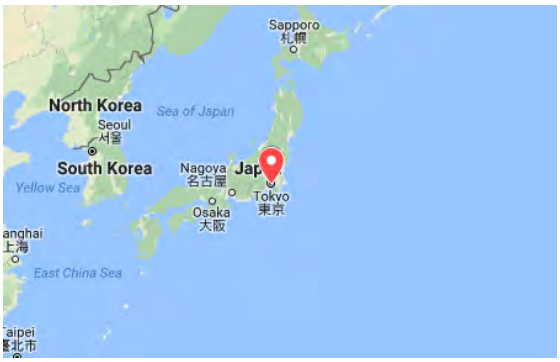
- Ageing Population
- Retention of Youth
- Social Tensions

ENVIRONMENT

- Economic Uncertainty
- Unemployment
- Globalization
- Industry Mix Change

Tokyo

Japan



Creating the Future: Long Term Vision

POPULATION

13,617,445

ESTABLISHED

1175

NATIONAL CAPITAL?

Yes

WHY CASE STUDY IS APPROPRIATE

The City of Tokyo, Japan is an example of a mega-city with a plan to address drivers of change and improve overall resiliency. The City has dealt with major natural disasters and is working hard to combat their externalities. The themes in their plan are focused around the environment, infrastructure, and maintaining a safe and secure community for every citizen.

As the Tokyo 2020 Olympic Games is approaching, the City is developing suitable infrastructure that will effectively serve the future needs of the games, as well as the future needs of the City.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Earthquakes
- Tsunamis
- Storm Surges
- Renewable Energy

DEMOGRAPHIC

- Population Growth
- Housing

TECH/ECON

- Smart Technology
- Globalization

Vejle

Denmark

Vejle Resilience Strategy

POPULATION

111,138

ESTABLISHED

1327

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Vejle, Denmark is part of the 100 Resilient Cities Network. It is one of the most vulnerable areas in Denmark at risk for flooding. A lack of social cohesion is challenge for successful immigration and integration. The City is focused on strengthening social capital to improve everyone's quality of life. The City aims to improve its resilience by re-learning the value of working together, of being responsible for our fellow humans, and for the environment.

Vejle has identified three neighbourhoods as "laboratories" for resilience research, including a waterfront neighbourhood to test storm management and flood mitigation.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Sea Level Rising
- More Rainfall
- Floods

DEMOGRAPHIC

- Immigration
- Social Tension
- Unemployment
- Housing

TECH/ECON

- Infrastructure Demand
- New Technology
- Industry Mix Change

Victoria

Canada

City of Victoria Official Community Plan

POPULATION

85,792

ESTABLISHED

1849

NATIONAL CAPITAL?

No

WHY CASE STUDY IS APPROPRIATE

The City of Victoria, Canada is an excellent example of a provincial capital that has proactively supported and enhanced their education and research sectors. They aim to be hub of research, technology, and innovation in North America, with many local universities and colleges supporting the City. Ottawa can look to Victoria for lessons on how to balance becoming a hub for research and innovation with the affordability and environmental responsibility towards all citizens and newcomers.

Victoria fosters urban resilience in their unique development projects. Dockside Green, for example, is known as one of the most sustainable communities in North America.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Extreme Weather
- Carbon Emissions
- Earthquakes
- Coast Damage
- Food Insecurity

DEMOGRAPHIC

- Ageing Population
- Population Growth
- Affordability
- Housing

TECH/ECON

- Renewable Energy
- Green Technology
- Robotics
- Biomedical Tech.
- Nanotechnology

Wellington

New Zealand

Wellington Resilience Strategy

POPULATION

412,500

ESTABLISHED

1839

NATIONAL CAPITAL?

Yes

WHY CASE STUDY IS APPROPRIATE

The City of Wellington, New Zealand is part of the 100 Resilient Cities Network. Like Ottawa, the federal capital heavily relies on government and professional services as a major component of the labour force. However, due to the position above a major fault line, which increases the risk of earthquake, the City has been reluctant to establish government agencies and local offices there. Ottawa can learn from Wellington's strategy of reaching out to stakeholders at risk of leaving the City with an explanation of their plan and approach to sudden shocks. Using a comprehensive and smart approach to solving pertinent issues can encourage these local groups to stay or return.

IDENTIFIED DRIVERS OF CHANGE

ENVIRONMENT

- Sea Level Rising
- Extreme Weather
- Earthquakes
- Water Supply
- Wastewater
- Land Demand

DEMOGRAPHIC

- Population Growth
- Immigration
- Ageing Population
- Social Tensions

TECH/ECON

- Ageing Infrastructure

ATHENS
http://www.ekathimerini.com/223245/article/ekathimerini/community/greek-french-innovation-network-forum-draws-300-start-ups-and-1500-visitors

BALTIMORE
https://technical.ly/baltimore/2017/11/16/core-tech-downtown-partnership/

BANGKOK
https://www.businessdestinations.com/destinations/bangkok-transforms-into-tech-hub/

BELGRADE
https://seenews.com/news/serbias-govt-to-invest-20-mln-euro-in-three-research-projects-591217

BERLIN
https://www.google.ca/search?biw=1237&bih=723&tbm=nws&ei=Y9cRWtGqFs2kjwOGrqmoBA&q=berlin+economy&oq=berlin+economy&gs_l=psy-ab.3..0.35972.36873.0.37090.7.7.0.0.0.0.171.745.0j6.6.0....0...1.1.64.psy-ab..1.6.744....0.6G43CJlstn8

BIRMINGHAM
http://www.bqlive.co.uk/education-training/2017/10/30/news/birmingham-innovation-centre-builds-up-head-of-steam-28588/

BOSTON
http://dailyfreepress.com/2017/10/18/boston-maintains-top-spot-for-startup-city-environment/

BOULDER
http://www.dailycamera.com/letters/ci_31398624/tom-volckhausen-more-housing-options-needed-boulder

BRISTOL
http://www.southwestbusiness.co.uk/sectors/digital-and-hitech/disruptive-tech--how-these-bristol-businesses-are-transforming-the-economy-17112017101409/

CALGARY
http://calgaryherald.com/news/local-news/steady-decade-forecast-for-calgary-and-region-after-years-of-boom-and-bust

CANBERRA
http://www.heraldsun.com.au/news/plan-to-build-hyperloop-for-highspeed-travel-via-inland-route-to-brisbane/news-story/305306687c43cb9292c13cd0b376828e
COPENHAGEN
https://www.buzzfeed.com/jessesinger/ban-cars?utm_term=.okX4gzr91#.lax5AVadn

GLASGOW
http://futurecity.glasgow.gov.uk/

HELSINKI
http://www.helsinkitimes.fi/finland/finland-news/domestic/13219-immigration-accounts-for-76-ofpopulation-growth-in-finland.html

LONDON
https://www.standard.co.uk/news/london/uber-takes-on-city-banker-as-first-uk-chair-amid-battle-to-keep-london-licence-a3669466.html

MANCHESTER
http://www.finsmes.com/2017/11/manchesters-economy-direct-to-steady-growth-as-foreign-investors-continue-to-fund-in-its-business.html

MELBOURNE
http://www.theage.com.au/victoria/melbournes-toxic-wetlands-20171119-gzobks.html

MISSISSAUGA
https://www.theglobeandmail.com/report-on-business/careers/top-employers/canadas-best-diversity-employers-welcome-new-voices/article34434138/

NEW YORK
https://qz.com/1125601/uber-has-ended-its-subprime-car-leasing-program-for-new-york-drivers/

PARIS
https://www.archdaily.com/585254/vincent-callebaut-s-2050-parisian-vision-of-a-smart-city

ROTTERDAM
https://www.porttechnology.org/news/ect_rotterdam_launches_inland_service

STOCKHOLM
https://techcrunch.com/2016/01/26/sweden-is-a-tech-superstar-from-the-north/

THE HAGUE
http://www.bike-eu.com/industry-retail-organizations/nieuws/2017/11/leading-cycling-nation-continues-to-invest-in-biking-infrastructure-10131929

VEJLE
https://www.theguardian.com/cities/2016/may/19/flood-defence-vejle-denmark-resilience

APPENDIX B:

Annotated Bibliography

Abbott, J. (2005). Understanding and Managing the Unknown: The Nature of Uncertainty in Planning. *Journal of Planning Education and Research, 249*(3), 237-251. Retrieved from https://journals.scholarsportal.info/pdf/0739456x/v24i0003/237_uamtu.xml

Abbott (2005) argues that planning involves understanding and managing uncertainties, and that these uncertainties arise from the environment and the planning process. Understanding these dimensions of uncertainty can provide guidance for planning practice. Abbot (2005) identifies dimensions of uncertainty in planning through both a literature review and case study of a regional growth management strategy in South East Queensland (SEQ), Australia. The literature review outlined five dimensions of uncertainty affecting planning: causal uncertainty, organizational uncertainty, value uncertainty, external uncertainty and chance.
The review of the SEQ 2001 plan shows that environmental uncertainty can lead to the initiation of planning processes and the review of plans and resulting exploration of alternative futures can create or reduce causal, organizational and value uncertainties.

Amer, M., Daim, T. U., & Jetter, A. (2013). A review of scenario planning. *Futures, 46*, 23-40. Retrieved from https://journals.scholarsportal.info/pdf/00163287/v46inone_c/23_arosp.xml

Amer, Daim, and Jetter review various prominent scenario building techniques and argue that scenario planning stimulates strategic thinking and helps to overcome thinking limitations by creating multiple futures. They explain that the consideration of multiple possible future alternatives helps to conduct future planning in a holistic manner, and significantly enhances the ability for planners to deal with uncertainty during decision making processes. In developing scenarios, the authors review existing literature and find there is no precise response to the question of how many future scenarios are optimal in scenario planning, but conclude that 3-5 alternative scenarios are best because it is critical to develop a manageable number of scenarios to best capture the dynamics of the situation and to communicate the core issues effectively. Lastly, Amer, Daim, and Jetter develop a scenario validation criteria that all scenarios should satisfy.

Bartholomew, K. (2007). Land use-transportation scenario planning: Promise and reality. *Transportation, 34*(4), 397-412. Retrieved from https://link-springer-com.proxy.queensu.ca/content/pdf/10.1007%2Fs11116-006-9108-2.pdf

Scenario planning in the land use-transportation field is a technique that promises to provide citizens with opportunities to engage in constructive dialogue about their future communities, and choose appropriate course of actions for the future. A scenario is an "internally consistent view of what the future might turn out to be - not a forecast, but one possible future outcome". A scenario plan utilizes a series of scenarios to gauge possible future conditions (i.e. how do alternative land use futures affect the quality of human and natural environments; how do land use patterns affect transit ridership and the need for highway expansion etc.).

Bishop, P., Hines, A., and Collins, T. (2007). The current state of scenario development: an overview of techniques. *The Journal of Future Studies, Strategic Thinking and Policy, 9*(1), 5-25. Retrieved from http://www.emeraldinsight.com.proxy.queensu.ca/doi/pdfplus/10.1108/14636680710727516

The intent of this paper was to alleviate some of the confusion surrounding scenario development and how to produce scenarios. This was completed through an extensive literature review from a variety of sources and more than one technique was found to develop scenarios. Each of the eight techniques (ex: backcasting, baselines, modeling, etc.) were outlined, compared and analyzed in terms of advantages and disadvantages. It was noted that while the different techniques attempt to outline future scenarios, only some of them use software to craft scenarios. The difference between scenario planning and scenario development was also discussed; scenario planning is a complete study of foresight and is comprehensive, whereas scenario development is more simplistic (one aspect).

Borjeson, L., M. Hojer, K-H. Dreborg, T. Ekvall, G. Fennveden. (2006). Scenario types and techniques: Towards a user's guide. *Futures, 38*(7), 723-739. Retrieved from https://journals-scholarsportal-info.proxy.queensu.ca/pdf/00163287/v38i0007/723_stattaug.xml

In this article, the authors first review 9 existing typologies for scenario planning. Using commonalities in the literature, they then present their own scenario planning typology generally applicable to any form of futures planning. The typology is composed of 3 categories of scenario planning, each of which have their own two subtypes. Predictive scenarios are those analyzing what is likely to happen, as a result of the most likely development or as a result of the outcome of a given event. Explorative scenarios are those detailing what can happen, focusing primarily on internal or external factors, and normative scenarios describe how a particular target can be reached within the existing system of by transforming the existing system structure. The authors then reviewing techniques appropriate to conducting each kind of scenario study. Finally, the authors conclude by classifying each of their scenario types by whether they are qualitative or quantitative, their time frame, the system structure to which they apply, and whether they focus on internal or external factors to assist a scenario practitioner in determining which type of scenario they want or need.

Chakraborty, A., Kaza, N., Knaap, G., & Deal., B. (2011). Robust plans and contingent plans: Scenario planning for an uncertain world. *Journal of the American Planning Association, 77*(3), 251-266. Retrieved from https://journals-scholarsportal-info.proxy.queensu.ca/pdf/01944363/v77i0003/251_rpacp.xml

Chakraborty et al. identify concerns with scenario planning for urban planning including that scenarios often do not anticipate large enough differences from past trends and that too much focus is put on finding a single scenario. Instead, the authors advocate for robust and contingent planning which have scenarios with multiple uncertainties and identify preferred results from among these uncertainties. This is demonstrated by creating examples of robust and contingent plans in the Baltimore-Washington region. The authors call for robust and contingent planning using multiple uncertainties and plans that address the most likely outcomes.

Chakraborty, A. & McMillan, A. (2015). Scenario planning for urban planners. *Journal of the American Planning Association, 81*(1), 18-29. Retrieved from https://journals-scholarsportal-info.proxy.queensu.ca/pdf/01944363/v81i0001/18_spfuptapg.xml

Chakraborty and McMillan attempt to create a typology to classify scenario planning methods in urban planning. By examining existing literature, the authors identify nine components of scenario planning including the organizational structure, the scope, the scenario type, outcome awareness, stakeholder engagement, participation extent, engagement medium, scenario construction and analysis tools, and resources. This typology is then applied to various scenario planning projects and patterns between the typology are examined. This typology is offered to planners to better understand how scenario planning can apply to urban planning, and how it can best be organized and understood for planners.

Corcoran, J., Murray, A. T., & Stimson, R. J. (2011). Spatially disaggregating employment growth estimates. *International Regional Science Review, 34*(2), 138-156. Retrieved from http://journals.sagepub.com.proxy.queensu.ca/doi/abs/10.1177/0160017610386481

Planning for and managing urban growth and development are major issues facing planners and policy makers in achieving a sustainable future for a metropolitan region. Significant impacts are found in metropolitan regions because of jobs-housing imbalances. Such imbalance occurs when residential areas are a considerable distance from locations of employment, and as a result there is a need for substantial commuter travel. This article develops an approach for estimating future jobs by sector in local areas under conditions of growth and change, assuming that commuters will seek greater efficiencies in the journey to work. An optimization modeling approach is proposed to identify scenarios of improved jobs-housing balance. An application is illustrated for the South East Queensland (SEQ) region of Australia.

Deilami, K., & Kamruzzaman, M. (2017). Modelling the urban heat island effect of smart growth policy scenarios in Brisbane. *Land Use Policy, 64*, 38-55. Retrieved from https://ac.els-cdn.com/S0264837716313138/1-s2.0-S0264837716313138-main.pdf?_tid=7204770a-d13e-11e7-9745-00000aab0f27&acdnat=1511545367_10ec88aba601960f147e2fd94b013b6a

Smart growth policy has been identified as a panacea to tackle a range of undesirable outcomes of sprawl development. Various neighbourhood planning concepts have been developed following smart growth principles such as transit oriented development, and infill development. Existing empirical studies, however, do not answer to a key policy question: can smart growth policies reduce the urban heat island (UHI) effect? If so, what type of smart growth policy would be most effective? This research examined the questions by deriving five alternative neighbourhood planning scenarios for Brisbane for 2023: a) business as usual, b) transit oriented development (TOD), c) infill development, d) motorway corridor oriented development, and e) sprawl development. The research utilizes Landsat remote sensing images of 1991, 2004, and 2013 to: first, estimate and validate a Geographically Weighted Regression model in order to identify statistically significant factors influencing the UHI intensities in Brisbane; and second, predict the UHI intensities of the five policy scenarios. Two factors were identified to have significant influence on the UHI intensities in Brisbane: population density, and porosity. Results show that compared to the 2004 and 2013 levels, Brisbane will respectively experience a higher and lower levels of UHI effect in 2023, irrespective of the policy scenarios. On average, the infill development scenario, as a smart growth policy, has a marginally better potential to mitigate the UHI effect in Brisbane in 2023 compared to the sprawl development scenario conditional on the definition applied in this research. The UHI effect would be more equitably balanced spatially under the sprawl development scenario.

Docherty, I. and McKiernan, P. (2008). Scenario Planning for the Edinburgh City Region. *Environment and Planning C: Politics and Space, 26*(5), 982 – 997. Retrieved from http://journals.sagepub.com.proxy.queensu.ca/doi/pdf/10.1068/c0665r

The authors discuss the historical emergence of scenario planning as well as its application in urban planning for analyzing the futures of cities, regions, and countries. Docherty and McKiernan define scenario planning as "a process that combines stories and/or images of plausible future environmental contexts with the practical means of adapting to these possible futures today" (2008, 984). The authors argue that scenario planning is a tool in urban revitalization and repositioning where traditional planning processes and knowledge have restricted and limited creative thinking and new innovative policies. In order to illustrate how scenario planning has been utilized in cities, the authors examine Edinburgh City Region in Scotland where scenario planning was used to: generate new ideas and visions; cultivate engagement with various stakeholders; and encourage discussion on the future of the city for the next two decades.

Durance, P., & Godet, M. (2010). Scenario building: Uses and abuses. *Technological Forecasting & Social Change, 77*(9), 1488-1492. Retrieved from https://ac.els-cdn.com/S0040162510001289/1-s2.0-S0040162510001289-main.pdf?_tid=15db397a-d141-11e7-969e-00000aab0f27&acdnat=1511546493_445a1317c631efcaa2e99653db7481ba

Durance and Godet explain that a scenario is a means to representing a future reality with the aim of clarifying present action in light of possible and desirable futures. A scenario is therefore not an end in itself, but only has meaning as an aid to decision making in so far as it clarifies the consequences of current decisions. In reviewing various approaches to scenario planning, the authors argue that in order for a particular set of hypotheses to be considered a scenario it must satisfy five conditions: pertinence, coherence, likelihood, importance, and transparency. There is no point in forming scenarios if they are not pertinent, coherent, and plausible. Durance and Godet point to the effectiveness of strategic prospective workshops (from the participatory nature of the French 'school' of scenario planning) in meeting their five conditions.

Hoch, C. (2016). Utopia, scenario and plan: A pragmatic integration. *Planning Theory, 15*(1), 6-22. Retrieved from https://journals-scholarsportal-info.proxy.queensu.ca/pdf/14730952/v15i0001/6_usapapi.xml

The concepts utopia, scenario, and plan offer important ways to envision the future.

- Utopia: the perfect, complete place; dramatizes emotional attachment to daily details of a purposeful way of life for a future imagined place.

- Scenario: compares good alternative stories; describes a narrative story about coherent testable accounts of relevant consequences for plausible futures (what might be done in the future to cope with change; futures that are not necessarily desirable or predictable ones)
- Plan: offers useful provisional (i.e. temporary, interim) intentions; compose and compare alternatives to inform practical intentions for choices and decisions for immediate problems we currently face. Enable the ability of professions to make judgments about what to do with the future; assess relative options to current practices and the available competing arguments.

All three help us image how the future consequences of select actions might influence current expectation and hopes.

Khakee, A. (1991). Scenario Construction for Urban Planning. *Omega. 19*(5), 459-469. Retrieved from https://ac.els-cdn.com/030504839190062X/1-s2.0-030504839190062X-main.pdf?_tid=f3d658fe-d141-11e7-9713-00000aacb361&acdnat=1511546873_a73f2b0642044de945531916fcbf352e

Khakee (1991) argues that there is no set of rules for constructing scenarios. Khakee outlines his model for scenario construction, broken down into six stages: selection of the environmental variables, preparation of special background studies, production of quantitative frameworks, enrichment with material from future biographies, assessment of trends, and presentation of alternative urban scenarios. The article presents the case study of Vasteras, Sweden, which constructed scenarios through a participatory approach. The municipality then used these scenarios to develop and implement development strategies. The conclusions from the Vasteras study were divided into three areas: operational, methodological, and perceptual.

Li, S., Li, X., Liu, X., Wu, Z., Ai, B., & Wang, F. (2013). Simulation of spatial population dynamics based on labor economics and multi-agent systems: A case study on a rapidly developing manufacturing metropolis. *International Journal of Geographical Information Science, 27*(12), 2410-2435. Retrieved from https://journals-scholarsportal-info.proxy.queensu.ca/pdf/13658816/v27i0012/2410_sospdboardmm.xml

Spatial population dynamics affects resource allocation in urban planning. Simulation of population dynamics can provide useful information to urban planning for rapidly developing manufacturing metropolises. In such a metropolis with a concentration of immigrant labor forces, individual employment choices could have a significant effect on their residential decisions. There remains a need for an efficient method, which can simulate spatial population dynamics by considering the interactions between employment and residential choices. This article proposes an agent-based model for simulation of spatial population dynamics by addressing the influence of labor market on individual residential decisions. Labor economics theory is incorporated into a multi-agent system in this model. The long-term equilibrium process of labor market is established to define the interactions between labor supply and labor demand. An agent-based approach is adopted to simulate the economic behaviors and residential decisions of population individuals. The residential decisions of individuals would eventually have consequences on spatial population dynamics. The proposed model has been verified by the spatial dynamics simulation (2007 to 2010) of Dongguan, an emerging and renowned manufacturing metropolis in the Pearl River Delta, China. The results indicate that the simulated population size and spatial distribution of each town in Dongguan are close to those obtained from census data. The proposed model is also applied to predict spatial population dynamics based on two economic planning scenarios in Dongguan from 2010 to2015. The predicted results provide insights into the population dynamics of this fast-growing region.

Perveen, S., T. Yigitcanlar, Md. Kamruzaman, & J. Hayes. (2017). Evaluating transport externalities of urban growth: a critical review of scenario-based planning methods. *International Journal of Environmental Science and Technology, 14*(3), 663-678. Retrieved from https://link-springer-com.proxy.queensu.ca/content/pdf/10.1007%2Fs13762-016-1144-7.pdf

Perveen et al. examine the challenges of scenario based evaluation in modelling the transport externalities of urban growth scenarios. They first review 10 methods used to generate scenarios in empirical research, and find that common weaknesses include lack of data, poor coordination of stakeholders, and researcher bias due to conflict of interest or excessive focus on factors relevant to them. They also review the strengths and weaknesses of 12 methods for simulating urban growth, and find that the majority of models fail to adequately account for social and environmental transit-related externalities. They conclude by determining that TRANUS is the most suitable simulation model for assessing the transit impacts of various urban growth scenarios.

Ratcliffe, J., & Krawczyk, E. (2011). Imagineering city futures: The use of prospective through scenarios in urban planning. *Futures, 43*(7), 642-653. Retrieved from https://journals-scholarsportal-info.proxy.queensu.ca/pdf/00163287/v43i0007/642_icftuoptsiup.xml

Ratcliffe and Krawczyk argue that city planners and policy makers lack an effective future-oriented approach to planning. This prevents planners from being able to shape a preferred future condition or anticipate impending change. The authors suggest that the challenges of the future can only be addressed by "Imagineering" the futures of cities. Imagineering is accomplished by applying methods taken from the futures field, which must be applied systematically, rigorously, and most importantly, holistically. Ratcliffe and Krawczyk argue that strategic planning is the link between traditional planning and a futures approach because the 'futurists' responsibility is to help people articulate their dreams, whilst the 'planner's' responsibility is to make those dreams come true. The authors state that there needs to be a major shift in the way planners think, plan, and act in imagining prospects for cities in order to sustain the vitality and viability of cities, and that this shift should be towards a futures-oriented approach.

Reeder, B., & Demiris, G. (2010). Building the PHARAOH framework using scenario-based design: A set of pandemic decision-making scenarios for continuity of operations in a large municipal public health agency. *Journal of Medical Systems, 34*(4), 735-739. Retrieved from https://journals-scholarsportal-info.proxy.queensu.ca/pdf/00163287/v43i0007/642_icftuoptsiup.xml

Continuity of Operations Planning (COOP) is actions taken before, during and after a disaster to maintain the delivery of an organization's essential services. The application of COOP in public health is necessary to save lives and protect population health when disaster strikes. However, COOP decision-making and COOP decision support technology are under-explored in the public health domain. This work approaches the problem of

designing a COOP decision support system for a large municipal public health agency using scenario-based design. Through a series of meetings and informal interviews, we developed a set of 12 scenarios of use for public health decision-making roles during a pandemic. These scenarios were validated as reliable, useful and acceptable by professional public health COOP planners. The results of this work show scenario-based design can be a powerful tool in designing decision support systems for public health leadership information needs during a crisis

Rotmans, J. et al. (2000). Visions for a sustainable Europe. *Futures. 32*(9-10), 809-831. Retrieved from https://journals-scholarsportal-info.proxy.queensu.ca/pdf/00163287/v32i9-10/809_vfase.xml

Rotmans et al. argue that one way to address the concept of a sustainable Europe is through the use of scenarios. They define scenarios as archetypical descriptions of alternative images of the future, and include driving forces, events and actions that lead to future conditions as visualized in images of the future. Rotmans et al. identify a number of deficiencies in current scenario studies and analyze the VISIONS project in Europe. VISIONS aims to develop a range of futures for Europe through integrated scenarios.

Rowland, N.J., & Spaniol, M.J. (2017). Social foundation of scenario planning. *Technological Forecasting and Social Change, 124*, 6-15. Retrieved from https://ac.els-cdn.com/S0040162517301890/1-s2.0-S0040162517301890-main.pdf?_tid=a6af88ac-d146-11e7-861c-00000aacb35f&acdnat=1511548883_76f691155fc8e79ccf5d141c0032824d

Rowland and Spaniol discuss the concerns of models of scenario planning which tend to follow a series of linear or chronological phases or stages, and find that problems emerge when planners must form a theoretical basis for why those practices will work. The authors draw from observations of a planning process with a non-governmental organization in Denmark to better understand the interplay between two phases of a linear model of scenario planning. Drawing on theory from Science and Technology Studies (STS) on knowledge production, Rowland and Spaniol argue that the transition from one phase to the next in linear models of scenario planning is based on social negotiation. The authors argue that this insight has significant practical use for how to transition and manage spaces between phases in scenario planning.

Schoemaker, Paul J.H. (1993). Multiple scenario development: Its conceptual and behavioural foundation. *Strategic Management Journal, 14*(3), 193-213. Retrieved from http://www.sciencedirect.com.proxy.queensu.ca/science/article/pii/S0040162517301890/pdfft?md5=c66b509a02e124c578120be29683c328&pid=1-s2.0-S0040162517301890-main.pdf

This paper explored the historical background of scenario planning predominantly through a business context and offered insight into how to structure the scenario planning process. Schoemaker described scenario planning as a way to identify key uncertainties in the future. He suggests that the scenarios should be developed with the involvement of numerous players and viewpoints, and not be modeled based on best estimates or isolated variables. Schoemaker outlined 10 steps to characterize the scenario planning process (Can't add image but will post on group). Schoemaker also analyzed the psychological impact of scenario planning and how to make it less psychologically threatening. The credibility of the source and content, as well as the way in which it is presented (ex: possibilities rather than firm predictions) limits this psychological threat. Schoemaker ended the paper with several comments and questions, including: How to move from scenarios to strategies, plans and budgets?

Stojanovic, M., Mitkovic, P. & Mitkovic, M. (2014). The scenario method in urban planning. *Facta Universitatis, 12*(1), 81-95. Retrieved from http://casopisi.junis.ni.ac.rs/index.php/FUArchCivEng/article/view/391

Stojanovic et al. summarize the methods of scenario planning and look at how these methods may be applied to urban planning in the future. The authors describe why future approaches, like scenario planning, are important to urban planning. They then describe scenario planning methods including how scenarios differ from forecasting and simulations, how they can be categorized, the number and type of scenarios to use, and how to ensure they are good scenarios. Examples of scenario planning in urban planning are also provided. The future use of scenario planning in urban planning is encouraged to deal with future uncertainty.

Tevis, R.E. (2010). Creating the future: Goal-oriented Scenario Planning. *Futures, 42*(4), 337-344. Retrieved from https://journals-scholarsportal-info.proxy.queensu.ca/pdf/00163287/v42i0004/337_ctfgsp.xml

Organizations use scenario-planning to create a future it reacts to, rather than enact the future it wants. Tevis explains that enactment theory and scenario planning must be put together if the user wants to be able to create a future that it wants. The result is goal-oriented scenario planning, which matches the world an organization wants with the world it expects to see. There are five phases to goal-oriented scenario planning: creating an unconstrained model of what the organization wants to see, determining the actions that need to be taken to make the desired future come to fruition, examining external environment's potential future conditions, understanding the events that will indicate the paths evolving to those future conditions, and then mapping the actions needed against the potential events for analysis and decision possibilities.

Van Notten, Philip W.F. et al. (2003). An updated scenario typology. *Futures, 35*, 423-443. Retrieved from https://journalsscholarsportal-info.proxy.queensu.ca/pdf/00163287/v35i0005/423_aust.xml

This purpose of this paper was to modernize the scenario typology in order for it to apply to modern projects. The paper followed a broad definition of scenarios (i.e. not scenario planning specific definition): descriptions of possible futures that reflect different perspectives on the past, the present and the future. The new typology was created based on three themes: project goal (exploration and decision support), process design (intuitive approach and formal approach) and scenario content (complex and simple). To test the new typology (includes 14 characteristics) for robustness, recent scenario

studies and the VISIONS scenario in Europe were analyzed. It was found that after some minor revisions, the new typology was robust enough to meet modern standards in order to address today's scenarios.

Volkery, A. and Ribeiro, T. (2009). Scenario planning in public policy: Understanding use, impacts and the role of institutional context factors. *Technological Forecasting & Social Change, 76*, 1198-1207. Retrieved from https://journals-scholarsportal-info.proxy.queensu.ca/pdf/00401625/v76i0009/1198_spipputroicf.xml

This paper reviewed evaluative scenario literature and conducted a workshop with environmental scenario practitioners and policy makers to assess its success, impacts, obstacles, etc. Although the paper focused predominantly on the environmental context, the authors looked at a wide range of literature (52) in order to outline a detailed assessment. Scenario planning was described as a way to represent and deal with deep uncertainties and it was acknowledged that its success was contingent on key factors such as societal values and interests, public participation, organizational willingness and the skills and experience of those involved in carrying out the scenario. Overall, it was found that scenario planning is an important tool and while it is difficult to align long-term thinking with strategy and policy-making, its effect and delivery-method should be further evaluated.

Willuweit and O'Sullivan, J. (2013): A decision support tool for sustainable planning of urban water systems: Presenting the dynamic urban water simulation model. *Water Research, 47*(20), 7206-7220. Retrieved from https://journals-scholarsportal-info.proxy.queensu.ca/pdf/00431354/v47i0020/7206_adstfstduwsm.xml

Population growth, urbanization and climate change represent significant pressures on urban water resources, requiring water managers to consider a wider array of management options that account for economic, social and environmental factors. The Dynamic Urban Water Simulation Model (DUWSiM) developed in this study links urban water balance concepts with the land use dynamics model MOLAND and the climate model LARS-WG, providing a platform for long term planning of urban water supply and water demand by analyzing the effects of urbanization scenarios and climatic changes on the urban water cycle. Based on potential urbanization scenarios and their effects on a city's water cycle, DUWSiM provides the functionality for assessing the feasibility of centralized and decentralized water supply and water demand management options based on forecasted water demand, storm water and wastewater generation, whole life cost and energy and potential for water recycling. DUWSiM has been tested using data from Dublin, the capital of Ireland, and it has been shown that the model is able to satisfactorily predict water demand and storm water runoff.

Xiang, W. & Clarke, K. (2003). The use of scenarios in land use planning. *Environment and Planning B: Planning and Design, 30*, 885-909. Retrieved from http://journals.sagepub.com.proxy.queensu.ca/doi/pdf/10.1068/b2945

Xiang and Clarke look at land use development scenarios as a long used method of scenario planning in urban planning and examine how they work and how they can be improved. The article describes how scenarios have a dual function of modeling data and as the raw data for planning. The authors outline the features of a good scenario which include that it be surprising, plausible, have vivid information, as well as having a theme, timeframe, and size that is both effective, as well as safe to use. Scenarios that do not have these features are generally ineffective.

Zapata, M.A. and Kaza, N. (2015). Radical Uncertainty: Scenario Planning for Futures. *Environment and Planning B: Urban Analytics and City Sciencem, 42*(4), 754 – 770. Retrieved from http://journals.sagepub.com.proxy.queensu.ca/doi/pdf/10.1068/b39059

Zapata and Kaza argue that in adopting scenario planning into the urban and regional planning context, planners have neglected the use of multiple scenarios as well as the inclusion of diverse organizations, people, and interests in discussion. The authors draw on four case studies of scenario planning in the United States of America including Envision Utah, Region Forward 2050 (Washington), Maryland Scenario Project, and the Valley Future Project (California). These case studies were analyzed against various categories developed by the authors to assess the use of multiple futures as well as the exploration of diversity of each case study. The authors then provide a comparative analysis of the four scenario planning case studies together based on the measures of multiple futures and diversity.

Zegras, C. & Rayle, L. (2012). Testing the rhetoric: An approach to assess scenario planning's role as a catalyst for urban policy integration. *Futures, 44*, 303-318. Retrieved from https://journals-scholarsportal-info.proxy.queensu.ca/pdf/00163287/v44i0004/303_ttraatacfupi.xml

Zegras and Rayle examine the use of scenario planning as a way to enhance collaboration between various agencies and actors and integration between different types of urban planning. This is done by looking at a case study of scenario planning for urban revitalization in Portuguese cities. It was found that scenario planning increased collaboration through strengthening actor networks, forging a shared understanding of the problem, and helped find common ground between organizations. However, it is unclear whether this enhanced collaboration is different in scenario planning than it would be in any other collaborative planning exercise.

Zegras, C., Sussman, J., and Conklin, C. (2004). Scenario Planning for Strategic Regional Transportation Planning. *Journal of Urban Planning and Development 130*(1), 2 – 13. Retrieved from http://ascelibrary.org.proxy.queensu.ca/doi/pdf/10.1061/%28ASCE%290733-9488%282004%29130%3A1%282%29

The authors examine the application of scenario planning techniques to regional strategic transportation planning and how it can be used to further support and improve on traditional transportation planning processes. Zegras et al. draw upon the work of researchers at the Massachusetts Institute of Technology who applied an eight-step scenario-planning framework to strategic regional transportation planning in Houston, Texas. The authors then evaluate the Houston case study based on the eight-step framework in comparison with other scenario planning case studies, examples from transportation, and scholarly literature.

APPENDIX C:

Plan Classification

Framing Our Future

(National Capital Commission, Ville de Gatineau, City of Ottawa)

1. Organizational Structure
    - **Strong Leader**
        - The plan was organized by and for the City of Ottawa and while the City coordinated with the City of Gatineau and the NCC, the two other agencies did not have a clear leadership role in the process.

2. Scope
    - **Comprehensive**
        - The City of Ottawa looked at a large variety of issues (i.e. sustainability, energy and emissions, and resiliency).

3. Scenario Type
    - **Normative**
        - Participants were involved in developing targets.

4. Outcome
    - Policy Recommendation
        - Outcome will result in discussion related to policy.

5. Stakeholder Engagement
    - Consultation of General Public, Government Agencies, and Stakeholders
        - Included all of the aforementioned groups in the preparation of the plan.

6. Participation Extent
    - **Joint Fact Finding**
        - Participants were included in finding the solutions, targets etc. Was not just informing.

7. Engagement Medium
    - Hybrid
        - Used face-to-face and web based tools.

8. Scenario Construction
    - Qualitative and Computer Modelling
        - Both qualitative methods and computer modelling were used to develop the different scenarios.

9. Resources
    - **Statutory or Recurring**
        - Long-range planning is part of the City of Ottawa's mandate and there will be long-term support for this plan.

Beyond 2036

(City of Ottawa)

1. Organizational Structure
    - **Unitary**
        - The City of Ottawa is responsible for the project and while they do inform other agencies, they are responsible for the process and decisions.

2. Scope
    - **Comprehensive**
        - The plan looks at a large variety of topics, issues, and drivers etc.

3. Scenario Type
    - **Explorative**
        - The plan looks at a variety of options for how the future will unfold in the City of Ottawa.

4. Outcome
    - Policy Recommendation
        - A shared vision will be identified, which will inform policy recommendations.

5. Stakeholder Engagement
    - Consultation of General Public, Government Agencies, and Stakeholders
        - Included all of the aforementioned groups in the preparation of the plan.

6. Participation Extent
    - **Joint Fact Finding**
        - Participants were included in finding the solutions, targets etc. Was not just informing.

7. Engagement Medium
    - Hybrid
        - Used face-to-face and web based tools.

8. Scenario Construction
    - Qualitative
        - This will be the primary method that will be used.

9. Resources
    - **Statutory or Recurring**
        - The plan is intended for long-term use as part of the City of Ottawa's mission and will have long-term support.

The Plan for Canada's Capital: 2017-2067

(The National Capital Commission)

1. Organizational Structure
    - **Strong Leader**
        - Although other groups were involved, it was primarily led by the NCC.

2. Scope
    - **Comprehensive**
        - The NCC looked at a variety of issues (i.e. connectivity, beauty, environment, inclusiveness, economy, etc.)

3. Scenario Type
    - **Normative**
        - The NCC had clearly defined goals at the start of the project.

4. Outcome
    - Policy Recommendation
        - The outcome included specific changes, projects etc.

5. Stakeholder Engagement
    - Consultation of General Public, Government Agencies, and Stakeholders
        - Included all of the aforementioned groups in the preparation of the plan.

6. Participation Extent
    - **Seeking Feedback**
        - The NCC developed the goals/targets and feedback was sought afterwards.

7. Engagement Medium
    - Hybrid
        - Used face-to-face and web based tools.

8. Scenario Construction
    - Qualitative
        - This will be the primary method that will be used.

9. Resources
    - **Statutory or Recurring**
        - The plan was part of the NCC's mandate and long-term support will be provided.

APPENDIX D:
Workshop Materials

Environmental Precedent Cities and Drivers of Change

	Climate Change																Disasters							Water & Wastewater							Energy			Food & Agriculture						Parks & Nature			Other								
	Sea Level Rise	More Frequent/Intense Rainfall	Warmer Temperatures	Heat Waves	Extreme Storms	Increased Storm Surge	Urban Heat Islands	More Frequent/Severe Wind	Increased Carbon Emission	Less Rainfall	Reduction of Aquifer Recharge	Extended Growing Season	Decreasing Soil Moisture Capture	Decreasing River Flows	More Snow	Increasing Erosion	Earthquakes	Floods	Fires	Tsunamis	Landslides	Hurricanes	Droughts	Insecure/Inadequate Water Supply	Increasing Water Demand	Declining Water Quality	Urbanization Impacting Watersheds	Damage to Coastal Environment	Insufficient Wastewater Capacity	Increasing Wastewater Volume	Transition to Renewable Energy	Increasing Demand for Power	Increasing Demand for Heating	Growing Demand for Food	Increasing Food Insecurity	Shrinking Agricultural Areas	Decrease in the Number of Farms	Increasing Farm Productivity	Increasing Food Prices	Increasing Demand for Parks	Increasing Demand for Natural Areas	Damage to Natural Areas	Declining Air Quality	New Pests and Invasive Species	Decreasing Biodiversity	New Patterns of Disease	Increased Demand for Land	Increasing Vulnerability of Soils	Waste Management Logistics	Increased Subsidence	Increased Soild Waste	
Athens			■	■	■		■										■	■																■							■								Athens
Baltimore																											■												■	■									Baltimore
Bangkok																	■	■	■							■				■						■				■			■				■	■	Bangkok
Belgrade																	■	■			■															■					■		■							Belgrade
Berkeley	■																■	■	■				■	■														■											Berkeley
Berlin			■				■																							■									■										Berlin
Birmingham		■	■																																														Birmingham
Boston	■		■		■		■								■			■																														Boston
Boulder																		■	■				■	■							■												■						Boulder
Bristol	■																	■																															Bristol
Budapest							■																							■																			Budapest
Calgary					■													■					■																										Calgary
Canberra			■							■									■				■								■										■								Canberra
Chicago																		■					■	■							■				■					■					■			Chicago
Christchurch	■	■	■			■						■	■	■			■	■	■	■			■																					■		■					Christchurch
Copenhagen	■				■	■																		■							■									■									Copenhagen
Edmonton																											■								■	■	■				■								Edmonton
Glasgow					■													■																											■					Glasgow
Helsinki																																							■			■								Helsinki
Istanbul																	■	■	■					■	■		■	■		■		■								■	■		■						■	Istanbul
London			■				■											■													■											■								London
Manchester		■	■				■			■								■													■																		Manchester
Melbourne	■			■														■	■				■																						■					Melbourne
Mexico City		■	■	■	■			■			■						■	■	■		■		■							■													■						Mexico City
Missisauga									■																	■	■				■																		Missisauga
New York	■	■	■															■				■	■			■					■																		New York
Paris		■	■	■			■											■					■												■									■		■			Paris
Pittsburgh					■		■								■			■			■																											■	Pittsburgh
Rotterdam																		■													■																		Rotterdam
San Francisco	■				■												■						■																										San Francisco
Stockholm	■	■		■								■																				■	■						■	■									Stockholm
The Hague	■	■														■																								■									The Hague
Thessaloniki				■													■	■	■																					■			■						Thessaloniki
Tokyo						■											■			■												■																	Tokyo
Vejle	■	■																■																																Vejle
Victoria								■	■								■											■						■						■									Victoria
Wellington	■	■	■					■									■							■				■												■									Wellington

Demographic Precedent
Cities and Drivers of Change

	Demographic												
	Immigration/Migration	Ageing Population	Shifts in Labour Market	Unemployment	Housing	Social Mobility	Resource Scarcity/Inequality	Population Growth	Retention	Crime	Social Tensions	Placemaking	Education
Athens	■				■						■		
Baltimore		■			■			■					
Bangkok	■							■					
Belgrade		■						■					
Berkeley							■	■			■		■
Berlin					■			■					
Birmingham		■						■					
Boston		■			■	■	■				■		
Boulder					■								
Bristol					■	■							
Budapest		■			■								
Calgary	■	■											
Canberra		■			■								
Chicago						■	■				■	■	
Christchurch	■	■	■		■		■						
Copenhagen			■										■
Edmonton		■		■	■							■	
Glasgow							■	■		■			■
Helsinki					■			■					
Istanbul	■		■	■		■						■	■
London					■	■		■					
Manchester	■	■											
Melbourne		■		■	■		■	■					
Mexico City						■	■	■			■		
Missisauga		■						■	■				
New York	■	■		■	■		■	■				■	
Paris	■												
Pittsburgh							■	■					■
Rotterdam					■	■							■
San Francisco					■	■	■	■					
Stockholm					■			■					
The Hague			■	■									
Thessaloniki	■							■					
Tokyo													
Vejle	■												
Victoria		■			■			■					
Wellington							■	■					

Technological and Economic Precedent Cities and Drivers of Change

Technological

City	Infrastructure: Infrastructure Demand	Infrastructure: Inadequate Infrastructure	Infrastructure: Ageing Infrastructure	Infrastructure: Failing Infrastructure	Infrastructure: Increased Available Infrastructure	Technologies: New Technology	Technologies: Smart Technology	Technologies: Automated Vehicles	Technologies: Digital Infrastructure	Technologies: Biomedical Technology	Technologies: Nanotechnology	Technologies: Disaster Relief	Public Transit: Inadequate Service	Public Transit: Greening Services	Public Transit: Integration	Public Transit: Transit Oriented Development	Public Transit: Diversifying Funding	Public Transit: Regionalization	Public Transit: Increasing Demand	Cyber: Attacks	Cyber: Resiliency	Cyber: Security	Cyber: E-Goverance
Athens																							
Baltimore						X	X		X	X					X	X			X				
Bangkok		X	X																				
Belgrade						X									X				X				X
Berkeley			X	X			X																
Berlin									X														X
Birmingham															X		X		X				
Boston			X										X							X			
Boulder				X																			
Bristol			X																		X	X	
Budapest															X	X			X				
Calgary																							
Canberra	X				X																		
Chicago		X												X					X				
Christchurch			X																				
Copenhagen															X				X				
Edmonton	X				X										X		X	X	X				
Glasgow							X		X														
Helsinki															X	X			X				
Istanbul															X								
London							X																
Manchester		X	X			X							X										
Melbourne			X																				
Mexico City							X		X						X				X				
Missisauga																	X						
New York									X									X					
Paris																							
Pittsburgh			X			X																	
Rotterdam						X	X													X			
San Francisco						X	X						X		X						X		
Stockholm							X		X						X								
The Hague				X																			
Thessaloniki																							
Tokyo						X	X													X	X		
Vejle	X					X	X																
Victoria					X					X	X		X										
Wellington			X																				

Economic

City	Energy: Clean	Energy: Green	Energy: Insecurity	Energy: Renewable	Industry: Mix Changes	Industry: Automation	Industry: Diversification	Resource: Scarcity	Resource: Conservation	Employment: Decrease	Employment: Skills/Training	Employment: Growth	State of Economy: Crisis	State of Economy: Uncertainty	State of Economy: Changes	State of Economy: Diversification	Tension: Inequality	Tension: Poverty	Connectivity: Globalization	Connectivity: Regionalization	Connectivity: Competition	City
Athens								X							X							Athens
Baltimore												X										Baltimore
Bangkok																						Bangkok
Belgrade															X	X						Belgrade
Berkeley		X	X	X											X							Berkeley
Berlin	X		X																		X	Berlin
Birmingham																			X		X	Birmingham
Boston																	X					Boston
Boulder			X								X			X								Boulder
Bristol													X				X					Bristol
Budapest														X					X			Budapest
Calgary													X	X	X				X	X		Calgary
Canberra																						Canberra
Chicago									X			X										Chicago
Christchurch																			X			Christchurch
Copenhagen											X	X							X			Copenhagen
Edmonton	X	X			X		X					X			X	X			X		X	Edmonton
Glasgow																X						Glasgow
Helsinki																			X	X		Helsinki
Istanbul												X							X			Istanbul
London		X										X										London
Manchester												X			X							Manchester
Melbourne															X		X					Melbourne
Mexico City					X		X			X						X			X			Mexico City
Missisauga					X		X								X	X						Missisauga
New York											X	X				X						New York
Paris			X					X														Paris
Pittsburgh										X			X		X							Pittsburgh
Rotterdam						X																Rotterdam
San Francisco		X										X								X		San Francisco
Stockholm	X	X																				Stockholm
The Hague																						The Hague
Thessaloniki													X	X				X				Thessaloniki
Tokyo						X																Tokyo
Vejle																						Vejle
Victoria				X																		Victoria
Wellington												X										Wellington

APPENDIX E:

Ethics

General Research Ethics Board (GREB)

Short Application Form for Course-Based Research

This short application form for course-based research can be used by an instructor once the GREB Instructor Course Based Research Assignment Application Form (in TRAQ) has been ethically cleared by GREB; however it is not mandatory. All documents related to course-based research must be securely stored for five years and may be subject to GREB audit.

1.	**Name of Student and Student Number** Ben McCauley – 20033340; Emily Goldney – 10018284; Taylor Sharpe – 100483340; Sydney Tasfi – 20035593; Robert Tran – 20036459; Jillian Simpson – 10010744; Mark Tanner - 20009622
2.	**Name of Course:** SURP 826 **Professor:** Dr. David Gordon
3.	**Title: of Study:** Ottawa Beyond 2036 **Purpose of Study:** The Ottawa Beyond 2026 research study will undertake a critical review of the City of Ottawa's current growth management principles and practices to ensure that Ottawa remains sustainable and resilient in the face of future change. In 2018, City of Ottawa staff will prepare future scenarios, based upon emerging social-economic trends, technologies, and changing environmental conditions. Our team will identify opportunities, catalogue best practices and make suggestions to improve the city's responsiveness to these trends as inputs to a 2018 scenario building exercise.
4.	**Method of Collecting Data. Check all that apply:** ✓ Interviews (in person, phone, computer)
5.	**Explain your methodology in greater detail:** Stakeholder interviews (i.e. City of Ottawa planners and related staff) will confirm and clarify policy direction from previous long-term planning, such as the 2012 strategic planning document *Sustainability and Resilience Plan.* With confirmed and refined direction from stakeholder engagement, our team will create a series of best practices for input development and creation of scenario plans.
6.	**Provide the number of participants you plan on recruiting for each phase of your study. Indicate the minimum to maximum range of participants for each phase.** Approximately between 5-10 interviewees are expected to participate in our stakeholder interview phase.
7.	**Describe your research participants:** Planners and/or municipal staff, from relevant cities/regions/organizations in the National Capital Region: Ville de Gatineau, City of Ottawa, and the National Capital Commission.

8.	**Please describe any additional ethical considerations that will be needed to address the particular needs of your study participants:** ✓ Procedures for interviews will be laid out in writing, clearly explaining to the interviewees before interviews proceed. It is expected that interviewees will be supplied with the written version of these procedures. ✓ Interviewees will select the location of the interview. ✓ Contact information will be kept confidential, unless we receive explicit permission from the interviewee to publish their identity. ✓ Any recorded contribution, or notes taken, will be used in accordance with the wishes of the interviewee. Permission must be given by the interviewee to publish any of these materials, preferably in writing.
9.	**Are other approvals required (e.g., school board approval, community/institutional approval, multi-jurisdictional approval)?** ✓ No
10.	**Describe procedures for recruiting participants and indicate who will be doing the recruitment. Do the LOI and consent form reflect these procedures?** Recruitment will be done verbally over the telephone or in writing via email. Both the professor and student group will participate in the recruitment process. An agreed upon time, date, and location will be discussed between both parties. This is noted briefly in the letter of information (LOI) and consent form.
11.	**Please describe procedures should someone wish to withdraw and indicate a reasonable timeline for withdrawal. Do the LOI and consent form reflect these procedures?** It is the participant's choice if they would like to participate in the research study. They have the ability to withdraw at any time without consequence. They can also refrain from answering a certain question, but still remain in the study. The research team also has the ability to withdraw you from the study, if the situation arises that warrants a withdrawal. This is noted briefly in the letter of information (LOI) and consent form.
12.	**Are there any risks to your participants? Please note risks must be minimal, i.e., no greater than those experience in everyday life.** ✓ No
13.	**How will you obtain consent?** ✓ Written letter of information with separate written consent form **Please describe consent process:** Free and informed consent is reflected in written consent form. The consent form will be provided to the interviewee in advance of the interview. Before the interview begins, any questions the interviewee may have will be addressed. The interviewee must sign the consent form before the interview begins. The research team will take note if consent is not received from the interviewee in any categories expressed on the consent form.

14.	**Will you be collecting participants' personal identifiable or confidential information? Do the LOI and consent form reflect this collection?** ✓ Yes **If yes, describe how will you protect participants' confidentiality or privacy:** When the interview is complete, an audio recording may be kept to transcribe at a later time. Any audio recordings will be kept in a locked office. Electronic versions of the transcribed interviews will be protected by a password on the team's personal laptop. **If yes, describe who will have access to data containing personally identifiable information.** Only the research team and research supervisor will have access to the recorded interview. **Will information about the participants be obtained from sources other than the participants themselves?** ✓ No
15.	**Will the data be collected and stored in a secure manner (e.g., password protected file; locked office or storage, encryption, etc.)? Do the LOI and consent form reflect these procedures?** ✓ **Yes**
16.	**Attach your supplemental documentation:** ✓ **CORE certificates** ✓ **Letter of Information** ✓ **Consent Form** ✓ **Questionnaires or Surveys** ✓ **Recruitment documents**

Instructor's Decision: Approved _____ **Date** _____

Resubmit _____ **Date** _____

Instructor's Signature _____ **Date** _____

This short application form for course-based research can be used by an instructor once the GREB Instructor Course Based Research Assignment Application Form (in TRAQ) has been ethically cleared by GREB; however it is not mandatory. All documents related to course-based research must be securely stored for five years and may be subject to GREB audit.

Letter of Information for Interview Participants
"Ottawa Beyond 2036 Study"

This letter provides a comprehensive overview of the Master's research project being conducted by Ben McCauley, Mark Tanner, Robert Tran, Emily Goldney, Sydney Tasfi, Taylor Sharpe, and Jillian Simpson (hereafter referred to as the project team) under the supervision of Dr. David Gordon, in the School of Urban and Regional Planning at Queen's University in Kingston, Ontario.

Purpose of the Research Study

The purpose of the research study is to undertake a critical review of the City's current growth management principles and practices to ensure that Ottawa remains sustainable and resilient in the face of future change. In 2018, City staff will prepare future scenarios, based upon emerging social-economic trends, technologies and changing environmental conditions to determine the City's responsiveness to potential future change. The SURP team will identify opportunities, catalogue best practices and make suggestions to improve the city's responsiveness to these trends as input to the 2018 scenario building.

Stakeholder interviews will confirm and clarify policy direction from previous long-term planning such as the 2012 strategic planning document *Sustainability and Resilience Plan*. This plan was developed jointly between the Cities of Ottawa and Gatineau and the National Capital Commission (NCC) as part of an initiative known as "Framing Our Future". The Sustainability and Resilience plan was intended to serve as an overarching strategy plan that would inform various plans and initiatives by the three partners, for example OP reviews and *The Plan for Canada's Capital* (NCC).

With confirmed and refined direction, the SURP team will transition from policy analysis and stakeholder engagement to best practice reviews and inputs for scenario building. The final deliverable for the course will be a report that incorporates the findings of the review of the City's current growth management approach and makes recommendations on the key elements that should form part of a renewed growth management strategy for the City in the 21st century, taking into account the goals of sustainability and resilience that underpinned "Framing our Future."

Procedures & Privacy

Our project team has reached out to you to request an interview opportunity. If you volunteer to take part in this research, you will be asked to take part in one interview with the project team. During this interview you will be asked a set of questions to learn more about your opinions and experiences within the context of Ottawa Beyond 2036. With your permission, the interview will be tape recorded so that it may be transcribed after the interview by the researcher.

The interview will require 30 to 45 minutes to complete and will be administered at a time and place that is most convenient with your schedule. Upon completion of the research, an electronic copy of the report will be provided to any participants that would like one.

When the interview is complete, the audio recording will be kept in a locked office. Electronic versions of the transcribed interviews will be protected by password on the team's personal laptop. Only the research team and research supervisor will have access to the recorded interview. Upon completion of the research, any hard copies of the transcribed or recorded interviews will be destroyed.

Potential Risks & Discomforts

There is minimal risk associated with this study. At any point, if there is a question that you do not wish to answer, you may refrain from responding. Participants may ask to be anonymized within the report and will be referred to simply by their professional title. There are no foreseeable physical or psychological risks associated with this study. At any point, as a participant you have the right to terminate your involvement in the study. If asked, the research team will not use any of the information that you provided in the research.

Potential Benefits

As a participant in this research study, benefits could be direct or indirect. In your professional capacity, this study will give you the opportunity to confirm and clarify policy direction from previous long-term planning, such as the 2012 strategic planning document *Sustainability and Resilience Plan*, developed jointly between the Cities of Ottawa and Gatineau and the National Capital Commission. By developing a better understanding of the current policy context surrounding Ottawa Beyond 2036, we will have a refined direction to create a report incorporating best practices and inputs for future scenario building.

Participation & Withdrawal

It is your choice if you would like to participate in this research study. If you do volunteer in this research study, you have the ability to withdraw at any time without consequence. You can also choose to refrain from answering a certain question, but still remain in the study. The research team also has the ability to withdraw you from the study; if a situation arises that warrants a withdrawal.

Feedback of Results

When the research is complete, the final report will be available through QSpace, the Queen's Research and Learning Repository at https://qspace.library.queensu.ca.

Concerns or Questions

Any questions about study participation may be directed to Ben McCauley, or Dr. David Gordon the research supervisor, or Heather Castleden, Unit REB Chair for the School of Urban and Regional Planning (SURP), Queens University at (613) 533-6000 ext. 77216.

This study has been granted clearance according to the recommended principles of Canadian ethics guidelines, and Queen's policies.

Thank you for your interest in this research study.

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VERBAL CONSENT FORM FOR INTERVIEW PARTICIPANTS

Consent Form
"Ottawa Beyond 2036"

Spoken Script:

You have been asked to participate in a research study conducted by the project team (Ben McCauley, Mark Tanner, Robert Tran, Emily Goldney, Sydney Tasfi, Taylor Sharpe, and Jillian Simpson) from the School of Urban and Regional Planning at Queen's University and supervised by Dr. David Gordon.

1. I have read the Letter of Information understand the information about the study entitled *Ottawa Beyond 2036* and any questions have been answered to my satisfaction.

2. I understand that I will be participating in the study called *Ottawa Beyond 2036*. I understand that this means that I will be asked to engage in an interview that will take approximately thirty to forty-five minutes.

3. I understand that my participation in this study is voluntary and I may withdraw at any time.
   I understand that every effort will be made to maintain the confidentiality of the data now and in the future. Only the researcher will have access to the data. The data may also be published in professional journals or presented at scientific conferences, but any such presentations will be of general findings and will never breach individual confidentiality. Should you be interested, you are entitled to an electronic copy of the findings.

I am aware that if I have any questions, concerns, or complaints, I may contact the researchers Ben McCauley; benjamin.mccauley@queensu.ca; project supervisor, Dr. David Gordon; gordond@queensu.ca; Director at the School of Urban and Regional Planning, or Dr. Heather Castleden for the School of Urban and Regional Planning (SURP), Queens University at (613) 533-6000 ext. 77216.

By verbally consenting, I give permission to be recorded by the researcher with a digital recording device.

By verbally consenting, I request that the final copy of the results be emailed to me at the following address _____.

By verbally consenting, I request to be anonymized and referred only by my professional title. I understand that this may not keep my identity confidential.

By verbally consenting, I agree to be contacted for follow-up questions. I understand that I may decline these requests.

By verbally consenting, I give my consent that the information collected in this study may be used in the future research of the student researcher.

I verbally consent to the above statements and freely consent to participate in this research.

Sample Interview Questions
"Ottawa Beyond 2036"

General Themes & Questions:

1. What is your name and role within your organization?
2. What is your interpretation of the term 'scenario planning'
3. In your opinion, what constitute good elements of a scenario plan/planning process?
4. What criteria would you use to determine if a scenario plan is good or bad? (same question as above but might yield different answer if ask in a different way)
5. Are there any existing scenario planning processes or plans that you admire?
6. What do you think are the benefits of scenario planning in the Ottawa context?
7. What difficulties or barriers do you foresee potentially impeding the scenario planning process in Ottawa?
8. Scenario planning is viewed as an alternative tool to traditional planning techniques and methods by academia, where do you see the use of scenario planning for future planning?

APPENDIX F:

Presentation Questions and Answers

Following the project team's final presentation in Ottawa, ON, on December 13th, 2017, a question and answer period was held to discuss various aspects of the presentation with project stakeholders and industry professionals. The following is a list of questions and comments received, and the answers provided by the project team. It is important to note that no recording device was used. Instead, questions and comments were manually written down with pen and paper, and may not be verbatim of the original questions and and answers.

Q. Was there anything in the long-term plans that talked about how the plans would be implemented? For example, was a hierarchy of plans described? Was there as a cycle for evaluating the plans?

A. One major weakness in many of the long-term plans was a lack of identified strategies for implementing responses to the drivers of change. Few plans identified what other planning documents would be informed by the long-term plan. Some plans did provide specific examples of strategies that could be applied to deal with drivers of change. Examples of these specific strategies have been described in our report.

Q. What are some examples of plans that had a positive future outlook? There are numerous negative aspects of the future, so do any plans turn the negatives into positives?

A. Some plans, like Athens and Thessaloniki, highlighted the economic crisis that has/is occurring in Greece. They talk about the plan as a way to build resilience in case that was to occur again. They frame the crisis as a learning experience. A negative experience that lead to positive outcome – a resilience strategy focused around the economy.

Q. Was there anything in the long-term plans about healthy communities?

A.

1. From an environmental perspective air quality and water quality were both drivers of change that many plans examined which relate to healthy communities. However, these drivers of change were rarely framed explicitly in the context of human health. Primarily, the focus was on improving infrastructure, not dealing with the human health impacts.
2. We did not specifically consider human health as a driver. Human health is not specifically considered a driver of change in and of itself in our report, but health is a consequence of many drivers and is closely linked to many of them, for example, air quality.
3. The core of demographic drivers are people. None of the other drivers would exist without people or a population. That being said, one of the limitations I could identify in a number of plans I reviewed was that there wasn't direct mention of policies for healthy communities – it was often assumed that part of the plan's vision for its people is that the community is healthy.
4. Something we touched on in our faculty presentation at Queen's was the relationship between obesity and technology. This is touched on the technological driver of change section of our report. This has to do with how technology is enabling obesity and health problems, requiring us to move less and exert less effort in simple tasks if technology can replace it.

Q. Was there anything in the long-term plans about food security?

A. Several plans dealt with food security. On the supply side, Edmonton's Metropolitan Growth Plan looked at shrinking agricultural areas, a decrease in the number of farms, and increasing farm productivity and how this would impact the city. Other plans looked at the demand aspects of food security, such as food deserts, and increasing use of foodbanks, like Athens, Victoria, and Chicago.

Q. Were there any examples that inspired or surprised you?

A.

1. It was inspiring to see cities around the world collaborating on long-term planning through the 100 Resilient Cities Network. Frequently cities looked to other cities in their plans when they identified similar issues, and included strategies that the other city had taken. Long-term planning is difficult to grapple with, but a network of cities working together to solve complex problems together is inspirational.
2. Many plans identified baby-boomers and how to create jobs for them as many are not going into retirement. For example, ONE Pittsburgh was really good at outlining programs to upskill/train baby boomers and the older population in terms of technological advances.
3. What really surprised me was the lack of specific strategies that were outlined in many of the plans. Many of them did not go beyond just merely identifying future drivers of change. Without strategies to manage these drivers, it's very challenging for cities to appropriate address these future changes. Pairing strategies with drivers of change is an integral part building a sustainable and resilient city.

Q. Were you able to make connections to SMART city initiatives such as the City of Ottawa?

A. During the workshop, SMART cities were discussed briefly but it was not selected as one of the top ten drivers for the technological driver category. However, in the analysis of precedent plans, several plans such as Rotterdam's Rotterdam Resilience Strategy and Glasgow's Our Resilient Glasgow: A City Strategy referred to SMART cities. In Glasgow's Plan, for example, the city is attempting to enhance the city and ensure that it is more resilient by using open data. Open data is considered an accelerator to innovation and will help to facilitate more economic growth and will be beneficial to the community. In terms of Ottawa, SMART cities is a driver to consider; however, as mentioned in the technological driver section, implementing or adapting to a driver related to technology is difficult when there are jurisdictional barriers or security concerns.

Q. What cities are looking at Autonomous Vehicles?

A. Several plans referred to autonomous vehicles; however, Pittsburgh's ONE PGH was the only plan to specifically address how they would optimize the city in order to implement this driver of change. Pittsburgh is considered the city at the forefront of smart transportation innovation and autonomous vehicles are being tested and developed in the city. Pittsburgh will improve the efficiency and safety of its transportation network and will ensure that there is a connection between major corridors and both primary commercial centres and amenities. It is interesting to see how Pittsburgh is looking at autonomous vehicles in a way that is more positive than negative.

Q. What tone was taken by long term plans? Were they optimistic or pessimistic about the future?

A. It depended on the plan and the specific issue. Environmental issues tended to be seen more negatively, as they were viewed more as challenges due to climate change, or disaster, that the city needed to take a reactive response to. Technological and economic drivers of change were generally seen more positively. More often than not, technological change and the economy were seen as solutions to the problems of the city.

Q. Opinion on the shift towards globalization from nationalism?

A. Fifty percent of the plans were welcoming of globalization, which is good. However, there were a few plans I can think of that saw globalization as a negative. One example is Christchurch, which sees it as a negative impact, as they are struggling with keeping on top of innovative and competitive ventures, especially in such a remote area, where the nearest large scale economic hub is in Asia.

Q. Did you look at population growth with respects to [geographical] boundaries in Ottawa?

A. No we did not consider population growth for different sub-areas in Ottawa. The scope of our project had more to do with how to develop scenario plans for Ottawa as opposed to specific quantitative inputs.

Q. With regards to uncertainty and the 41 drivers as well as Beyond 2036, were the drivers identified as opportunities and vulnerabilities narrative or technical?

A. They were both. However, not all were quantifiable, for example, social tension. Others are and can be put into scenario planning applications, similar to work completed in Envision Utah.

Q. Given the wide nature of cities similar to Ottawa, were there any drivers your discarded or tossed out?

A.

1. We recognize the complexity of this project and how there are so many drivers that may not be relevant to the context of Ottawa. For example, we tossed out sea level rise and tsunamis. The city is not on "the sea", and although we are on a fault line with a risk of earthquake, tsunamis are not a concern.
2. There were a couple of drivers that we did not place as strong of an emphasis on compared to other plans. This was mostly due to geo-political contexts. For example, plans located in regions close to the Middle East or Southern Europe discussed comprehensive refugee policies to deal with the refugee crisis. Plans located in North America also discussed refugee policies but did not frame these policies in the same way. North American plans tied refugee policies into immigration policies and dealt with integration and social and financial support systems. Southern European plans discussed dealing with the massive numbers of refugees flowing into countries and the human rights implications of poor refugee service-delivery.

Q: At what point do cities build on scenarios they don't control versus those they can?

A: Responsible scenario planning inevitably includes scenarios that the local government cannot control, but must plan for to a certain degree. For example, while the City of Ottawa cannot control the number of immigrants moving to the city, or where the immigrants are from, they can certainly influence immigration policy for the city and can design local services and supports that address the needs of newcomers.

Q: To what extent in looking at your plans do they mention the effectiveness of the plans?

A: In the majority of cases the plans we looked at were fairly new so feedback on the effectiveness of the plan's policies were limited. We also noticed that only a handful of plans actually set up a monitoring or evaluation system. More often than not there was no mention of an evaluating system (at least in the case of demographic drivers). Whenever I did come across one it was considered a huge asset to the plan.