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CLIMATE CHANGE TEAM

PAYING FOR URBAN INFRASTRUCTURE ADAPTATION IN CANADA

An Analysis of Existing and Potential Economic Instruments for Local Governments

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PAYING FOR URBAN INFRASTRUCTURE ADAPTATION IN CANADA:
An Analysis of Existing and Potential Economic Instruments for Local Governments

by ACT (Adaptation to Climate Change Team)
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CONTENTS

LIST OF ACRONYMS

AR5	Fifth Assessment Report of the Intergovernmental Panel on Climate Change
BGI	Blue Green Infrastructure
CCA	Climate Change Adaptation
CAC	Community Amenity Contributions
CO2	Carbon Dioxide
CoV	City of Vancouver
CVRD	Cowichan Valley Regional District
GHG	Greenhouse Gas
DCC	Development Cost Charges
DFAA	Disaster Financial Assistance Arrangements
FAR	Floor Area Ratio
FEMA	Federal Emergency Management Agency
GMF	Green Municipal Fund
IBC	Insurance Bureau of Canada
ICLEI	Local Governments for Sustainability
IPCC	Intergovernmental Panel on Climate Change
LIC	Local Improvement Charge
NDMP	National Disaster Mitigation Program
NRTEE	National Roundtable on the Environment and the Economy
FCM	Federation of Canadian Municipalities
OECD	Organization for Economic Cooperation and Development
P3	Public Private Partnership
PPM	Parts Per Million
ROI	Return on Investment
TIF	Tax Increment Financing

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EXECUTIVE SUMMARY

As global climate change advances, Canada's climate is also changing. The scientific community has warned that the world is committed to further changes in climate, regardless of future greenhouse gas emission (GHG) scenarios. While mitigating emissions remains necessary to avoid catastrophic change, adaptation to the risks posed by climate change is key to minimizing their impacts.

A number of lessons are emerging from the worldwide experience with adaptation in recent decades:

First, while adaptation can contribute to the welfare of current and future populations, the potential for adaptation, as well as constraints and limits to adaptation, varies among sectors, regions, communities, and ecosystems. Hence, it is now recognized that no single approach for reducing climate change risks is appropriate across all geographical settings.

Second, while engineered and technological options are often necessary to reduce the risks of climate change impacts, there is increasing recognition that, in order to limit the impacts and the costs of projected climate change, adaptation needs to become embedded in medium- and long-term planning processes at all levels of government.

Finally, and perhaps most importantly for the purpose of this report, it is increasingly recognized that cost-effective adaptation takes place at different levels of government, including local governments.

As is the case in many other countries in the Western hemisphere, local governments in Canada have a significant role to play in minimizing the impacts of climate change on their population, economy, and fiscal budgets. Simultaneously, local governments typically experience limited capacity, expertise, and limited financial resources.

In the absence of adaptation, estimates indicate that climate change may cost the people of Canada approximately $5 billion per year by 2020, and between $21-$43 billion by 2050 (NRTEE, 2011). These rising costs are already becoming evident. Local governments must therefore develop a clear understanding of anticipated climate change impacts in order to analyze the costs of inaction. This involves assessing geographical areas, sectors and populations at risk from climate hazards, characterizing expected damages, and identifying infrastructure, people, businesses, etc., that may be at risk. It is important that all costs associated with extreme weather events are calculated, including socio-economic impacts such as loss of production, unemployment from destroyed or

bankrupt businesses, loss of biodiversity and green infrastructure, loss of housing price value, lost tax revenue, etc.

Unless comprehensive understanding is created based upon the estimated costs of inaction, the design of solutions will be skewed and risk placing disproportionate pressure on isolated parts of local governments' areas of responsibility.

This report examines a number of instruments that local governments in Canada may use to generate revenues in support of adaptation in general, and in support of the development of climate resilient infrastructure in particular. The report also examines instruments aimed at incentivizing behavioural changes at local levels that may reduce the need for public investments in adaptation, and could thereby reduce the need to generate revenues in support of such investments. The most effective combination of incentives and investments is likely to vary across local governments.

There are numerous policies and instruments available to local governments to increase investment in climate change adaptation infrastructure. A review of the literature suggests the following three over-arching messages:

First, public sector financing of adaptation infrastructure may require giving lower levels of government greater access to public sources of revenue.

Second, it is clear that public sector financing will not be sufficient to fund all climate change adaptation measures at local levels, especially where local levels of government are already facing infrastructure deficit.

Third, gaining public buy-in is a key factor in any infrastructure adaptation project.

The report distinguishes between tools for financing and tools for funding climate change adaptation infrastructure: *Financing* refers to securing capital for a project in advance, whereas *funding* infrastructure refers to repaying or saving for payment of the up-front capital costs. *Funding* also includes the operation and maintenance of infrastructure. Examples of tools include: borrowing, reserve funds, green and climate bonds, tax increment financing (TIF), user fees, development cost charges (DCCs), local improvement charges (LICs), tax levies, inter-government grants, Gas Tax Grants, public-private partnerships (P3s), incentive programs, density bonuses, and land trusts. All tools

are evaluated through a framework to enable systematic, evidence-based assessment of the different options.

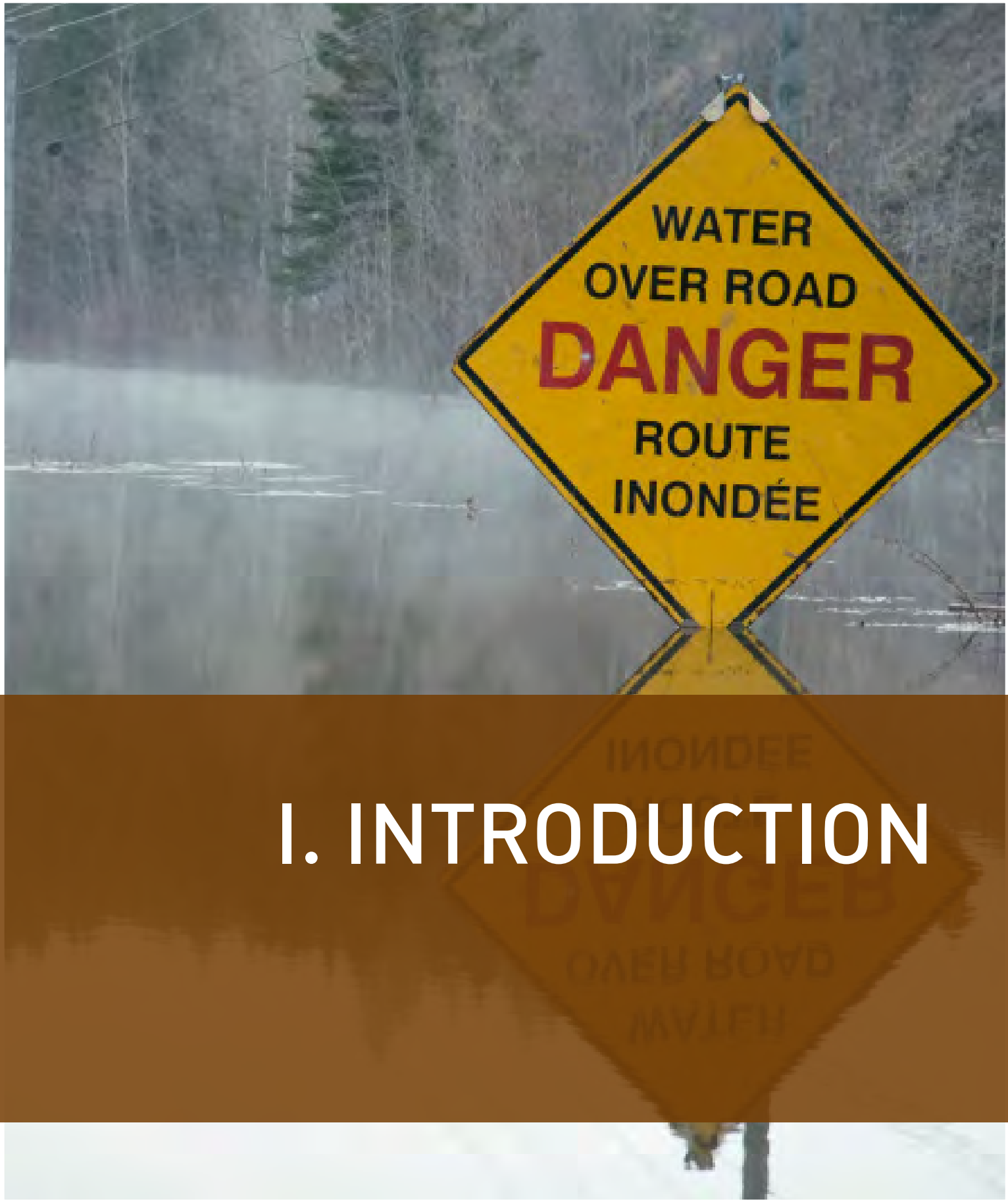
We present two sets of recommendations: for local governments, and for other levels of government.

FOR LOCAL GOVERNMENTS, IT IS RECOMMENDED TO:

- Include adaptation in long-term strategic planning using downscaled climate change projections.
- Reduce incremental costs associated with climate change by incorporating adaptation actions into existing municipal processes (e.g., into infrastructure maintenance and replacement programs, or in updates of community plans).
- Act strategically and be creative with the current tools available.

FOR OTHER LEVELS OF GOVERNMENT, IT IS RECOMMENDED TO:

- Reduce barriers for local governments to borrow or issue bonds for resilient or adaptation projects.
- Remove barriers and incentivize public-private partnerships for resilient or adaptation projects.
- Assess the continued appropriateness of the existing provincially administered Disaster Financial Assistance (DFA) funding formulas in light of increase flood-related damage due to climate change.
- Explore opportunities to link mitigation and adaptation projects.
- Provide regulatory support for an overland flood insurance program.



I. INTRODUCTION

Over the 20th century, average temperatures in Canada have increased by 1.5°C, precipitation patterns have changed, floods have increased in both frequency and intensity, and sea level has risen. As noted in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC 2014), the world is committed to further significant changes in climate even if strong mitigation

efforts were to rapidly take place. Across general circulation models, climate change projections until approximately 2050 remain nearly identical regardless of GHG emissions scenarios in coming decades.

> ***First,*** while adaptation can contribute to the welfare of current and future populations, the potential for adaptation, as well as constraints and limits to adaptation, varies among sectors, regions, communities, and ecosystems. Hence, it is now recognized that no single approach for reducing climate change risks is appropriate across all geographical settings as well as socio-economic characteristics of impacted populations.
>
> ***Second,*** while engineered and technological options are often necessary to reduce the risks of climate change impacts, there is increasing recognition that, in order to limit the impacts and the costs of projected climate change, adaptation needs to become embedded in medium- and long-term planning processes at all levels of government.
>
> ***Finally,*** and perhaps most importantly for the purpose of this report, it is increasingly recognized that cost-effective adaptation takes place at different levels of government, including local governments.

Adaptation aims to reduce the risks of climate change impacts. A number of lessons are emerging from the worldwide experience with adaptation in recent decades:

> National governments can coordinate adaptation efforts of local and sub-national governments, for example by protecting vulnerable groups, supporting economic diversification, and providing information, policy and legal frameworks, and financial support. Local governments and the private sector are increasingly recognized as critical to progress in adaptation, given their roles in scaling up adaptation of communities, households, and civil society and in managing risk information and financing. (IPCC, 2014, p.116)

The various levels of government experience different strengths and limitations in tackling climate change. At the local level, limited financial and human resources remain a common constraint.

The purpose of this research is to explore existing economic instruments currently in use in the Canadian public sector and ways these instruments might be modified and applied to finance adaptation measures in Canada, especially in the local government context. In doing so, the report looks at approaches currently in use in other OECD countries (see Appendix 1 for detailed examples), and new approaches that can be modified or utilized for adaptation. The outcomes of this review are applied to the City of Vancouver (CoV), with the goal of helping the city adopt economic instruments that promote adaptation within the urban environment.

The Cowichan Valley Regional District (CVRD) joined the project as a partner representing a contrasting mix of rural, resource and peri-urban communities. These results are also included in our analysis, and a customized report was developed for direct delivery to the CVRD. However, the national scope of this report did not allow in-depth analysis for the wide variety of municipal regulations across Canada's provinces, and this is recommended as an option for future research.

The research proceeded in three stages:

First, we conducted desktop research in the areas of municipal finance, climate change adaptation infrastructure, and intergovernmental infrastructure financing. In the process, we explored the potential of innovative financing options, including green bonds and climate bonds.

Each tool identified was evaluated based on seven objectives and 12 criteria developed from a review of literature and interviews with key experts including academics, city planners, and municipal financial officers. A scale of high, medium or low was used to rank each tool, based on its ability to achieve the goals and objectives reflected in the chosen categories and reflecting how tools score in comparison to others. Table 6 illustrates the evaluation criteria and ranking. The tools were evaluated in a table format (see Appendix 6 for detailed results), and each result was colour-coded to indicate how the tool ranked in each criterion section.

The criteria we employ are qualitative and subjective, but by providing a common basis for understanding what it would take to achieve a particular level of score for each category, it is possible to analyze the potential success of each tool.

Second, feasibility studies with the CoV and the CVRD assessed whether each tool

has practical applicability to the financing of adaptation infrastructure projects in those jurisdictions.

Third, the results were compiled in order to share our findings on the tools currently in use in Canada, or that have potential for use in financing urban infrastructure adaptation.

The report is structured as follows: In the next section (II), we briefly review global and Canadian-specific climate change literature. Issues pertaining specifically to adaptation and the role of resilient infrastructure are discussed in Section III. Section IV discusses paying for adaptation in the Canadian context and provides a summary of the tool evaluation criteria, research results, and best practices. The tools are examined in detail from section V to VII: Section V explores internal financing and funding tools, Section VI discusses external revenue sources, and Section VII discusses innovative instruments. Section VIII explores the role of insurance and disaster financial assistance in incentivizing adaptation infrastructure. Section IX briefly examines considerations for planning adaptation infrastructure, followed by recommendations, areas for further research, and conclusions in Section X.

II. CANADIAN CLIMATE CHANGE CONTEXT

II.1. A "Commitment" to Global Climate Change

Global and regional data records show that land surface air temperatures and sea surface temperatures have both increased in the course of the last century. Records also show that the maximum and minimum temperatures over land have increased since the mid 20th century, and that each of the past three decades has been warmer

than any previous decade in recorded history (IPCC, 2014). Reductions in the volume of glaciers and ice sheets, combined with thermal expansion of the oceans, have led to a rise in global mean sea level.[1] Records show that the rate at which global mean sea level is rising has increased from 1.7 millimeters per year (mm/y) over the period 1901-2010 to approximately 3.2 mm/y over the period 1993-2010.

Looking to the future, the IPCC's AR5 report confirms many findings of earlier assessment reports: we can expect further increases in temperature, further rise in sea levels, and greater frequency and/or higher intensity of extreme weather events.

AR5 reasserts the fact that near-term warming from past emissions is unavoidable: barring major volcanic eruptions and significant changes in solar irradiation, global mean surface temperature for the period 2016-2035 is likely to be 1-1.5°C above the average temperature observed over the period 1850-1900.[2] Mitigation actions, even if strong and immediate, do not produce different climate change outcomes for the next 30 years or so.

Similarly, while there remains uncertainty as to the extent of sea level rise, (AR5 reports average sea level rise projections ranging from approximately 0.4-0.7 meters, with a maximum rise of 0.98 meters, by 2100), there remains no uncertainty as to the nature of the change: sea level will continue to rise for the forthcoming decades, if not centuries (Levermann et al., 2013; Meehl et al., 2012). This is generally referred to as the earth's "commitment to climate change." Plattner et al. (2008) and Solomon et al. (2009) show that increases in atmospheric temperature resulting from increased CO_2 concentration

1 Domingues et al. (2008) estimate that thermal ocean expansion has contributed to approx. 40% of observed sea level rise over the period 1961-2003, with the melting of glaciers and ice caps contributing 35%, and large polar ice sheets of Greenland and Antarctica contributing approximately 25%. IPCC (2013) projects thermal expansion to be the single largest contributor to sea level rise in the 21st century. However, as warming continues, melting and dynamic changes in the Greenland and Antarctic ice sheets are projected to become dominant contributors to sea level rise (Hanna et al., 2013; King et al., 2012; Nick et al., 2013 and Rignot et al., 2011).

2 Important sources of uncertainty with respect to projected global mean temperatures pertain to the future role of land and oceans in acting as carbon sinks (Canadell et al., 2007), as well as the possible release of large quantities of methane, a more potent GHG than CO2, from thawing permafrost (DeConto et al., 2012). Climate sensitivity – the estimated change in global equilibrium mean surface temperature as a response to changes in radiative forcing following a doubling of atmospheric concentration of carbon dioxide – remains a critical source of uncertainty when projecting future global temperatures (Rogelj et al., 2012; Rohling et al., 2012).

are largely irreversible up to 1,000 years after emissions cease.

While a global temperature increase of 2°C has been defined as "dangerous anthropogenic interference" with climate systems, the likelihood of limiting global warming to less than 2°C is considered to be very small as it would require immediate and deep cuts in global emissions (UNFCCC, 2009a).

It is generally estimated that achieving such a targeted limit on the increase in global temperature will require stabilizing GHG concentrations at less than 450 parts per million (ppm) of carbon dioxide equivalent (CO_2eq) (IPCC, 2007).[3] It is worth noting that the atmospheric concentration of carbon dioxide (CO_2) increased by 2.10 ppm in 2011 (Blunden & Arndt, 2012), and exceeded 400 ppm for the first time since instrumental records began. Signatories to the Copenhagen Accord at the UNFCCC's Convention of Parties held in Copenhagen in 2009 recognized that achieving such stabilization would require large reductions in CO_2 emissions:

> We agree that deep cuts in global emissions are required according to science, and as documented by the IPCC Fourth Assessment Report, with a view to reduce global emissions so as to hold the increase in global temperature below 2 degrees Celsius, and take action to meet this objective consistent with science and on the basis of equity. (UNFCCC, 2009b)

Ramanathan and Xu (2010) estimate that, if CO_2 emissions were to peak in 2015 and remain at that level until 2100, then the atmospheric concentration of CO_2 would exceed 550 ppm by 2100. The authors estimate that maintaining GHG concentrations at less than 450 ppm requires a reduction in emissions in the range of 50% by 2050, and 80% before 2100. As pointed out by numerous authors (e.g., Kharecha & Hansen (2008), Matthews

3 "Ppm" (parts per million) is the standard measure of GHG concentrations in the atmosphere. There are numerous GHGs. The three most potent gases are carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O), each of which has a different global warming potential. Methane has 25 times the global warming potential of CO2, nitrous oxide 298 times. CO2 equivalent represents the concentration of CO2 alone that would give an equivalent radiative forcing to that provided by a basket of anthropogenic GHGs. Despite the greater warming potential of CH4 and N2O, CO2 remains by far the largest contributor to global warming as a result of being discharged in the atmosphere in much larger quantities.

& Caldeira (2008), Lackner et al. (2012)), not only would emissions from coal have to cease by 2050, but emissions from all other fossil fuels would also have to be significantly reduced. Beyond 2050, CO_2 emissions would have to continue to fall and approach zero by 2100 in order to achieve the required stabilization of CO_2 concentration.

Nordhaus (2010), Rogelj et al. (2012) and numerous other studies now conclude that it is unlikely that the Copenhagen temperature target of 2°C will be attained, even if countries meet their ambitious (but voluntary) objectives under the Accord. Joshi et al. (2011) estimate that, in higher GHG emission scenarios, the global average 2°C warming threshold is likely to be crossed by 2060. Peters et al. (2013) note that the latest CO2 emissions continue to track the high end of emission scenarios and that a shift to a 2°C pathway requires immediate significant and sustained global mitigation, with a probable reliance on net negative emissions in the longer term.

"While a global temperature increase of 2°C has been defined as "dangerous anthropogenic interference" with climate systems, the likelihood of limiting global warming to less than 2°C is considered to be very small as it would require immediate and deep cuts in global emissions.

A recent World Bank report notes that, without further commitments and action to reduce GHG emissions, the world is likely to warm by more than 3°C (World Bank, 2012). The same report notes that "present emission trends put the world plausibly on a path toward 4°C warming within the century."

Smith et al. (2011) argue that, given the likelihood of exceeding 2°C and reaching an increase of 4°C, adaptation to climate change "needs to be re-conceptualized away from the incremental handling of residual risk to preparing for continuous (and potentially transformational) adaptation."

Crucial to understanding the nature and extent of the adaptation challenge is recognition of the projected significant increase in energy demand over the period 2010-2035. Primary energy consumption from OECD and non-OECD countries is expected to increase by approximately 45% and 220% respectively. Furthermore, by 2035, approximately 80% of total energy demand will continue to be supplied by fossil fuels, only slightly down from 84% in 2005 despite rapid increases in both nuclear and renewable sources of energy (IEA, 2011). World oil production capacity alone is projected to increase from the existing 93 million barrels per day (mbd) to approximately 110 mbd by 2020 (Maugeri, 2012). As a result, annual global CO_2 emissions are projected to increase from approximately 33 million metric tons in 2010 to 43 million tons in 2035 (IEA, 2011). A large share of this increase is projected to take place in non-OECD countries.

Hence, far from stabilizing GHG emissions at any given level sufficient to avoid dangerous interference with climate systems, concentrations of GHG emissions are projected to continue to increase well into the first half of the 21st century.

As a result, while mitigation must remain an important objective to avoid catastrophic climate change, there is significant empirical evidence to support a strong emphasis on adaptation.

II.2 Climate Change in Canada

Along with global climate change, Canada's climate is changing, with observed shifts in air temperature, precipitation, snow and ice cover and other indicators. Further changes in climate are inevitable (Warren et al., 2014, Table 1).

As a result of its significant impacts, the damages caused by climate change are also increasingly becoming evident. Estimates by Swiss Re (2014) show that global annual insured losses due to extreme weather events (especially extreme precipitation) have increased from around $6 billion in the 1980s to around $30 billion in the 2000s. In the US, the Federal Emergency Management Agency (FEMA) estimates that 20-25% of flood-related insurance claims stem from stormwater damages (2011), and correspond to an annual minimum loss of $250 million.

The costs of climate change are also becoming evident in Canada. The Insurance

Table 1: Observed and Projected Climate Changes in Canada

CLIMATE SYSTEM	OBSERVED TRENDS	PROJECTED TRENDS
Temperature	The annual average surface air temperature over the Canadian landmass has warmed by 1.5°C over the period 1950-2010. The frequency of warm days has increased, while the frequency of cold nights has decreased since 1950.	Increases in the frequency and magnitude of unusually warm days and nights and decreases for unusually cold days and nights are projected to occur throughout the 21st century. The length, frequency and/or intensity of warm spells, including heat waves, are projected to increase over most land areas, including Canada. Rare heat extremes are currently projected to become more frequent. For example, a one-in-20-year day of extreme heat is projected to become about a one-in-five year event throughout most of Canada by mid-century.
Precipitation	Canada has generally become wetter in recent decades. In several regions of southern Canada, there has been a shift in precipitation type, with decreasing snowfall and increasing rainfall.	More frequent heavy precipitation events are projected, with an associated increased risk of flooding. Historically rare extreme precipitation events are projected to become about twice as frequent by mid-century over most of Canada.
Permafrost	Permafrost temperatures at numerous borehole sites across Canada have increased over the past two to three decades.	Warming of the permafrost is projected to continue at rates surpassing those observed in records to date. However, low average temperatures of much of the permafrost in the Arctic mean it will take decades to centuries for colder permafrost to completely thaw.

Ocean	Relative sea level rise of over three mm/y has been observed on the coastline of Atlantic Canada and the Beaufort Sea coast, with lower amounts along Pacific coastlines. Long-term changes in ocean temperature (increasing), salinity (variable sign), and acidity (increasing) have been observed in all three of Canada's oceans. Long-term decreases in subsurface dissolved oxygen levels have also been observed in the Atlantic and Pacific oceans off Canada.	Estimates of the magnitude of future changes in global sea level by the year 2100 range from a few tens of centimeters to more than a meter. BC provincial government projects 1.2 meters of SLR by 2100. Patterns of change along Canadian coastlines will continue to be influenced by land uplift and subsidence as well as by changes in the oceans. Sea-level rise will continue to be enhanced in regions where the land is subsiding, and sea level is likely to continue to fall in regions where the land is rapidly rising. Regions where the land is slowly rising may experience a transition from sea level fall to sea level rise.
Sea ice	End-of-summer minimum ice extent has declined at a rate of 13% per decade from 1979-2012, while maximum winter sea ice extent has declined at a rate of 2.6% per decade.	A nearly ice-free summer is considered a strong possibility for the Arctic Ocean by the middle of the century, although summer sea ice may persist longer in the Canadian Arctic Archipelago region.

SOURCE: ADAPTED FROM WARREN ET AL. (2014)

Bureau of Canada (IBC) calculated the trend in catastrophic losses related to extreme weather events over the last 30 years (Figure 1) and found that, on average, annual losses were "stable" at $400 million a year in the period 1983-2008. Over the last five years, however, annual losses have surged to above $1 billion in insurable damages (Table 2). It should be noted that these numbers do not include damages from residential overland flooding.

Figure 1: Catastrophic Losses in Canada 1983-2013

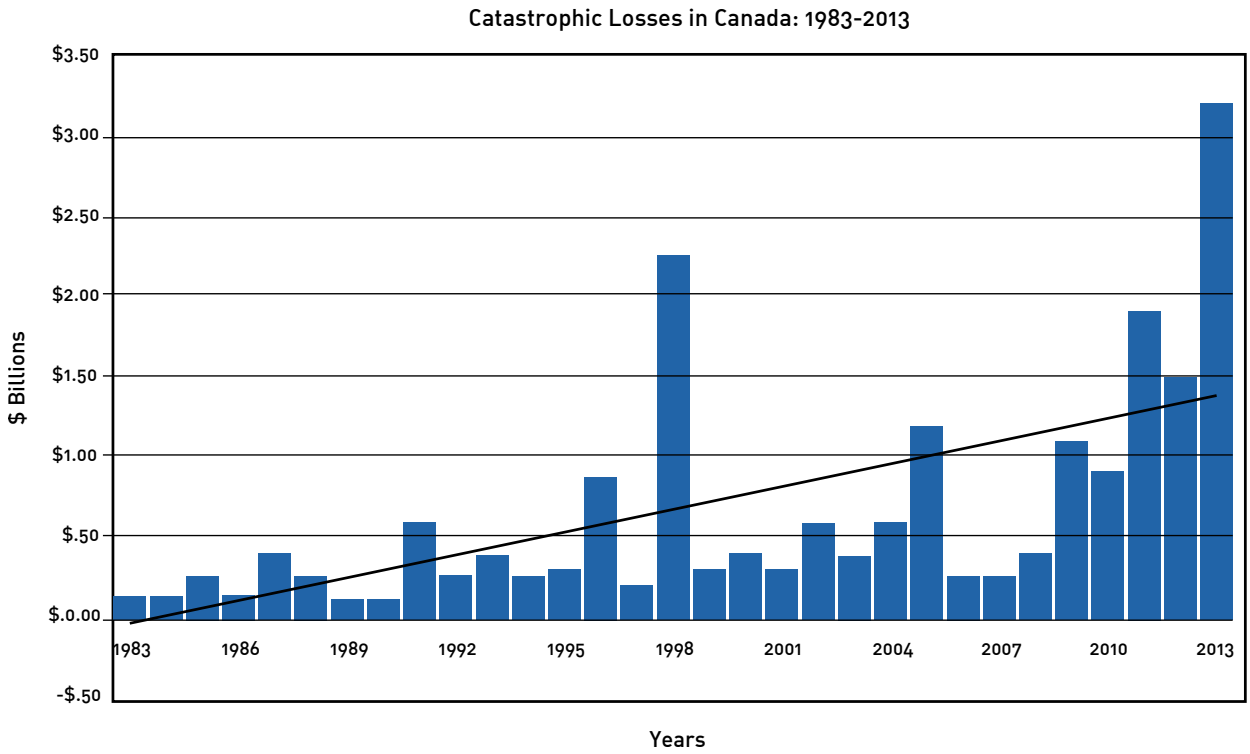


Table 2: Insured Costs of Selected Weather-Related Disasters in Canada

DATE	LOCATION	CLIMATE HAZARD	EST. COSTS ($ MIL)	INFRASTRUCTURE DAMAGE
June 2013	Alberta	Heavy rains	$1,743	Major power outages. Damage to major roads, including forced closure of the Trans-Canada highway and rail lines.
July 2013	Ontario	Heavy rains	$944	Private property damaged. Forced closure and damage to the subway system.
August 2012	Alberta	Heavy rains, hail, winds	$530	Hail damage to buildings. Ripped sidings from buildings and residences. Basement flooding.
May 2011	Alberta	Wildfire	$742	12,055 evacuees. 450 properties destroyed and 84 damaged.
June 2010	Alberta and Sask	Heavy rains	$956	Portion of Trans-Canada highway washed out. 2,065 people evacuated from their homes.
June-July 2009	Ontario and Quebec	Heavy rains	$228	Damaged roads and bridges. Flooded basements. 50 houses in Notre-Dame-des-Prairies flooded. Major street collapse.

August 2005	Southern Ontario	Wind/rainstorm	$625	Collapse of Finch Avenue (major thoroughfare). Damage to two high-pressure gas mains, and a portable water main. Damage to telephone, hydro and cable service lines.
June 2005	Southern Alberta	Flooding	>$400	Sewer backup. Roads, parks, sewers, bridges, buildings, agriculture affected.

SOURCE: ADAPTED FROM ALEXANDER & MCDONALD (2014)

In the absence of adaptation, it has been estimated that climate change may cost Canadians approximately $5 billion per year by 2020, and between $21-$43 billion by 2050 (NRTEE, 2011). As we have noted and demonstrated, these rising costs are already evident.

III. ADAPTATION TO CLIMATE CHANGE

III.1 The Cost of Adaptation

Recent years have witnessed development of a large number of studies and reports providing estimates of the economic costs of both climate change and the costs of the actions required for adaptation, which are generally presented as the investment necessary to restore an estimated baseline reference of development.

A 2010 World Bank study represents an influential example of such studies at the global level, with estimates of the global annual cost of adaptation ranging between $70-$100 billion up to 2050 (in 2005 prices).[1] Following a similar methodology, annual adaptation costs have been estimated to reach approximately $40 billion in Asia and the Pacific over the period 2010-2050. The Asia Development Bank (ADB) (2009, 2013b, 2014b) and Westphal et al. (2013) represent other examples of such analysis at the regional level. Parry et al. (2009) note the vast discrepancy in methods, as well as in geographical and sectorial coverage, across the existing set of analyses, resulting in a large range of estimates of the economic costs of climate change and of adaptation.

The above studies and numerous others present estimates of adaptation costs at the global, regional, or national levels. However, only a few studies have examined adaptation issues at local and municipal levels.

III.2 Adaptation and Climate Resilience at the Local Government Level

The impacts of a changing climate are already leading local governments around the world to take action on adaptation to emerging hazards. Many local governments around the world and in Canada have already begun taking action to reduce vulnerability to the effects of climate change.

Table 3 identifies common climate triggers in Canada, related hazards, local responses to mitigate the impacts of those hazards, and case study examples of cities that have implemented one or more of the identified responses. “Climate trigger” refers to the impacts or effects of climate change that produce environmental or social hazards that require infrastructure responses at the local scale. “Climate hazard” refers to impacts that have the potential to negatively affect human populations. “Reponses” refers to specific infrastructure measures that reduce damage resulting from these hazards, and may provide dual mitigation and adaptation benefits. Last, Table 3 identifies selected cities that

1 UNFCCC (2009b) also.

have implemented the responses identified in the table; these case studies are examined in more detail throughout the report.

Table 3: Canadian Climate Change Triggers, Hazards, Responses, and Global Case Studies

CLIMATE TRIGGERS	HAZARDS	RESPONSE	CASE STUDY
Hotter, drier summers, and heat waves	Health and safety impacts to vulnerable populations, water supply shortages, shortened lifecycle of transportation infrastructure, increased risk of forest fires	Green/cool roofs Urban forests Flexible pavement	Toronto Edmonton Quebec
Increased intensity and frequency of heavy rain events	Surface water flooding, sewer backups and overflows, landslides	Permeable pavement Separated sewers Natural wetland preservation	Kitchener/Waterloo Vancouver Copenhagen Toronto (Corktown Commons)
Sea level rise and increased storm surges	Increased flooding in coastal areas, coastal property damage/ loss, increased shoreline erosion	Sea walls Dikes Near-shore buffer areas	Netherlands New York
Extreme storms	Increased ice storms, hurricanes, hail, windstorms, and tornadoes	Window protection on buildings Back-up power	Florida Toronto

Permafrost degradation	Ground and slope instability and buckling, reduced strength and reliability of physical infrastructure	Vulnerability mapping of current infrastructure built on permafrost Ongoing monitoring of road infrastructure	Northwest Territories

SOURCE: ADAPTED FROM: BIZIKOVA ET AL. (2008); BOYLE ET AL. (2013); NORTHWEST TERRITORIES (2008); AND RICHARDSON, G. R. A. (2010).

III.3 Canadian Infrastructure Deficit

It is widely acknowledged that Canadian municipalities face a major infrastructure deficit (Hanniman, 2013; FCM, 2012; Mirza & Haider, 2003). This significant long-term deficit in infrastructure improvements has left systems vulnerable. For example, in some areas of the country, the current storm and sanitary sewer infrastructure is simply unable to handle the increasing frequency and severity of rain events.

The Canadian Infrastructure Report Card[2] is an assessment of the condition of municipal infrastructure between 2009 and 2010 that analyzed responses from 123 municipalities across all provinces and extrapolated the results to create a national picture (Félio, 2012). The full report card examines four primary asset categories of municipal infrastructure: (1) drinking water systems; (2) wastewater infrastructure; (3) stormwater networks, and (4) roads. Overall, the report card ratings for the four asset categories show that, on average,

2 Report created by Félio (2012) for the Canadian Society for Civil Engineering (CSCE), the Canadian Public Works Association (CPWA), the Canadian Construction Association (CCA) and the Federation of Canadian Municipalities (FCM).

30% of municipal infrastructure ranks between "fair" and "very poor." The replacement cost of these assets alone totals $171.8 billion nationally, or $13,000 per Canadian household (Félio, 2012).

The Canadian Infrastructure Report Card findings examine infrastructure service life under current practices (investment, operations, maintenance). However, the report fails to analyze the implications of future climate change projections or incorporate issues associated with projected climate change impacts. Issues such as increased extreme weather events exceeding system capacity will further shorten infrastructure lifespans, suggesting that the deficit may in fact be even more profound.

III.4 The Economic Case for Adaptation

The need to build a detailed business case when working to build resilience is important to local governments as they are pressured on many sides to be as cost-effective as possible, providing the highest amount of services for the least amount of taxes. Local governments must ask: Do we spend our money in a cost-effective manner? The business case therefore becomes an important tool, as economics is a question of prioritizing scarce resources and, by designing for multiple benefactors, local governments can create value through smart investments.

Local governments must have a clear understanding of the anticipated climate change impacts to analyze the costs of inaction. This involves assessing geographical areas at risk from climate hazards, understanding expected damages, and identifying infrastructure, housing, businesses, etc. that may be affected. ICLEI Canada (Local Governments for Sustainability) provides a framework that local governments can use to carry out this assessment: the Building Adaptive and Resilient Cities (BARC) tool. In addition, it is important that all costs associated with extreme weather events are calculated, including socio-economic impacts such as loss of production, supply chain interruption, unemployment from destroyed or bankrupt businesses, loss of biodiversity and green infrastructure, loss of housing price value, lost tax revenue, etc. Unless a full understanding is created based upon the costs of inaction, the design of the solutions will be skewed and will tend to favour isolated parts of local governments' areas of responsibility.

Based upon this detailed understanding of the costs of inaction, local governments can create impact assessments to identify benefits to each sector that may experience losses due to extreme weather events. Adaptation solutions can then be prioritized in a cost-benefit analysis, which will show where the local government can achieve the best return on investment for stakeholders.

Thinking through investments from a strategic and holistic perspective will aid local governments in minimizing and sharing the costs of construction, as well as increasing benefits.

Once local governments have established a comprehensive estimate of the costs and benefits to specific sectors, they have a business case to present to stakeholders who may benefit from the actions, and therefore may have an interest in becoming co-financiers of the solution. For example, in terms of extreme precipitation management, developers

may see advantages in the use of integrated blue-green resilient solutions that provide attractive green neighbourhoods, rather than an underground piped solution that does not provide any visible benefit. This approach considers the benefit to the physical, social, and cultural capital of the neighbourhood. Renovation of city streets geared to adaptation can be done in concert with other maintenance work or installation of fibre optics, district heating, gas pipes, or other large infrastructure, thus allowing the local government to share costs between departments and save capital, as well as minimize disruption to traffic flow and noise pollution from construction.

Thinking through investments from such a strategic and holistic perspective will aid local governments in minimizing and sharing the costs of construction, as well as increasing benefits.

Once having identified the costs, benefits and appropriate stakeholders, as well as the financial instruments that will be most beneficial to the project, planning financing for the project can proceed. It is clear that the cost of doing nothing is severe and desperately needs to be managed (City of Vancouver, 2012); where no action has yet been taken, the risks urgently need to be evaluated. However, we must ask whether the benefits of adapting will outweigh the costs required.

In the following section, we highlight cases from around the world in which adaptation has been either started or is fully implemented. We also briefly illustrate some benefits of adapting to a changing climate that may not be obvious at first glance.

III.5 Cost/Benefit Considerations

The simplest way to demonstrate the benefits of climate change adaptation is to measure whether the direct investment costs are outweighed by the projected prevented damages. The economic benefits of these prevented damages can be compared to the capital, operational and maintenance costs of the adaptation measure. Swiss Re published a report in 2009[3] on the economics of climate change adaptation called “Shaping Climate-

3 Together with the Climate Works Foundation, Global Environment Facility, the European Commission, McKinsey & Co., The Rockefeller Foundation, and Standard Chartered.

Resilient Development: A Framework for Decision-Making," which outlines a cost=benefit analysis for eight case studies showing that the benefits outweigh the costs (Swiss Re et al., 2009). In Florida, for instance, flooding from hurricanes currently poses the risk of an annual loss of $17 billion[4] that is expected to increase to $30-$33 billion by 2030. These figures take into account damages from windstorms, storm surges, rainstorms, increasing economic growth, and a changing climate. Interestingly, the measures with the lowest cost-benefit ratio are the measures that handle water through natural blue-green infrastructure (BGI) elements, whereas more expensive measures fall within the classic grey infrastructure investments.

The City of Copenhagen has developed measures to adapt to increasing precipitation in what they called their Cloudburst Adaptation Plan, which outlines how avoided damages exceed the cost of adaptation, but only up to a certain point (Copenhagen, 2013). Following the same procedure as Swiss Re, the cost-benefit analysis by Copenhagen shows that it is only economically viable to prevent a certain amount of damages; in response, Copenhagen has settled for a security level that can prevent damages from a 100-year event. This conclusion was reached by analysing the cost of initiatives to prevent damages at certain security levels, compared with estimated costs of prevented damages up to a 400-year event. The results showed that, as the level of security increases, so does the cost of adaptation. When the cost of adapting becomes higher than the prevented damages, the incentive to act is reduced.

Copenhagen found that the total benefit to society of the BGI-based solution that it selected was $90 million more than that of the grey infrastructure solutions, partly due to the lower cost of BGI, but not entirely. The total socio- and environmental-economic benefits of Master Plan (MP) 1 were conservatively estimated at $300 million (Leonardsen, 2013). Table 4 below shows estimates from the socio-economic costs and benefits for MP1 and MP2, as analyzed in Copenhagen's Cloudburst Adaptation Plan.

4 2008 dollars

Table 4: Socio-economic Costs and Benefits of MP1 and MP2 (NPV million EUR)

ITEMS	MP1 (BGI)	MP2 (GREY INFRASTRUCTURE)
Air pollution	22	21
Real estate taxes	42	42
Insurance damages	320	349
Real estate value	151	150
Renewal/upgrade savings	96	96
Municipal investment	-75	-71
Utilities investment	-260	-368
Municipal operational costs	-96	-72
Utilities operational costs	-58	-68
Total Benefit	142	78

SOURCE: LEONARDSEN (2013)

III.6 Value of Blue Green Infrastructure (BGI)

Infrastructure renewal and upgrades, and new development, are all key actions for cities adapting to climate change (American Rivers, 2012). However, using BGI provides additional benefits, for instance:

- Lower capital, operational and maintenance costs by as much as 75%
- Fewer land acquisitions due to smaller footprint

- Reduction in energy demand in buildings through use of green roofs; cooling effect of trees on neighbourhoods
- Cleaner environment
- Enhanced biodiversity

The City of Virginia's 33,640-acre park system illustrates the enormous added value of BGI, as it is estimated to provide a total of $700 million per year in benefits to society, of which stormwater management cost represents less than one percent (Trust for Public Land, 2011). Likewise, research in cities such as Philadelphia and Denver shows that stormwater management is low on the total contribution of BGI to the social and environmental economics of society (Trust for Public Land, 2008, 2010). Overall, the total annual benefit of BGI in these cities was found to be in the range of $500-2,000 million.

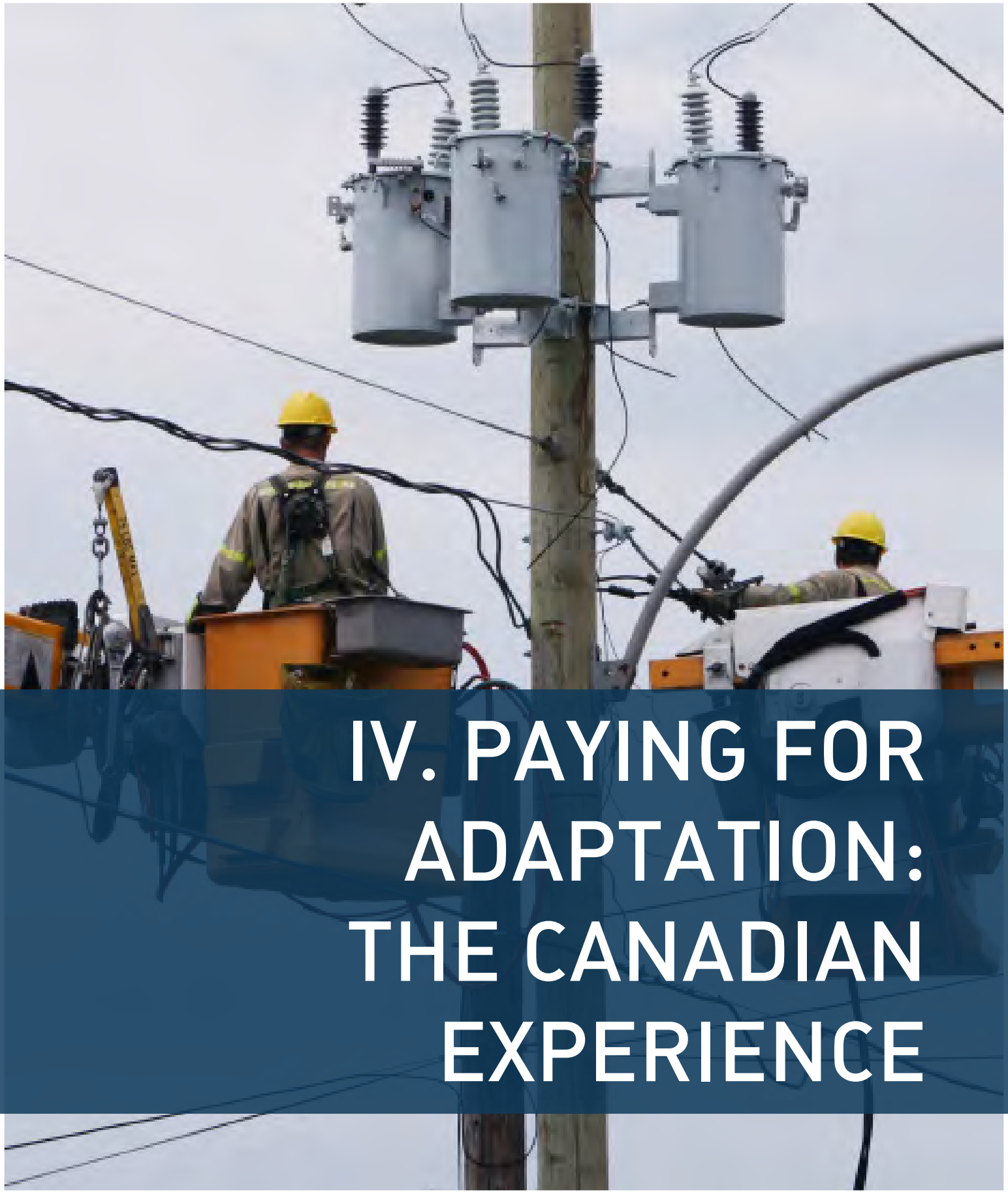
International engineering consulting firm ARUP has identified 24 additional social and environmental benefits of BGI, categorized into three groups: environmental, economic and social, with each group containing eight benefits (Table 5). In relation to health care costs, for instance, ARUP indicates that green spaces deliver social and health benefits of up to £1.44 billion per year for the UK economy. It also found that people living in close proximity to green areas (e.g., trees on streets or in parks) reported lower levels of mental distress and had a higher degree of life satisfaction compared to people living in areas without greenery (ARUP, 2014).

There are therefore demonstrable benefits from investing in BGI. However, there is a need to develop a business case to identify who benefits, and showcase how blue/green climate change resilient infrastructure is beneficial, not only in preventing damages, but also in improving the liveability of a region.

Table 5: Environmental, Economic and Social Benefits of BGI-based Adaptation at Local Levels

ENVIRONMENTAL BENEFITS	ECONOMIC BENEFITS	SOCIAL BENEFITS
Improved visual amenity	Increased property prices	Encouraging physical activity
Enhanced urban microclimate	Increased land values	Improved childhood development
Improved air quality	Faster property sales	Improved mental health
Reduced flood risk	Encouraging inward investment	Faster hospital recovery rates
Better water quality	Reduced energy costs	Improved mental health
Improved biodiversity	Improved chances of gaining planning permission	Improved workplace productivity
Reduced ambient noise	Improved tourist and recreation facilities	Increasing social cohesion
Reduced CO2 concentration	Lower healthcare costs	Reduction in crime

SOURCE: ARUP (2014)



IV. PAYING FOR ADAPTATION: THE CANADIAN EXPERIENCE

Planning for resilient infrastructure at local levels offers innovative opportunities for climate change adaptation. Local governments typically have authority over the selection of infrastructure projects made at the municipal level, as well as over land use decisions, which may in turn determine infrastructure needs and associated investment requirements. Hence, assessing the needs for infrastructure and its

financing should be connected to long-term land use planning, and should take place in that context.

Simultaneously, local governments are typically confronted with a severe deficit of infrastructure financing. Planning payment for climate change adaptation investments may therefore require consideration of new financing options. According to a recent survey of 468 cities in OECD and non-OECD countries, most cities (approximately 60%) do not receive any external financial support for their adaptation actions; 24% identify the national level of governments as the most common source of financial support for adaptation; and 8% report support from private foundations and non-profit organizations (Carmin et al., 2012).

A 2014 survey of 481 local governments across Canada found that all of Canada's larger cities (those with populations greater than 500,000) are engaged in adaptation planning. However, smaller communities were in general less likely to be planning for adaptation; in fact, despite widespread experience with severe weather, many Canadian communities are not yet planning for adaptation (NMAP, 2014).

A 2010 survey found that the costs of adaptation were "the most significant barrier to taking climate change into account in decision making" for over half of municipal government respondents (Environics Research Group, 2010). In the academic literature on climate change action in Canada, limited financial resources are often cited as one of the principal barriers to adaptation (Amundsen et al., 2010; Burch, 2010). As indicated in Appendix 4, the costing and financing of climate change action plans at local levels appear to be significant barriers, as these have rarely been implemented to date.

Numerous policies and instruments are available to local governments that wish to increase investment in climate resilient infrastructure, however. A review of the literature suggests the following three overall messages:

First, public sector financing of resilient infrastructure may require giving lower levels of government greater access to public sources of revenue. This may be achieved by expanding taxation authority in order to increase autonomous sources of revenue. Simultaneously, transfer programs from national or provincial to local governments could be designed to incentivize investments in climate change adaptation in general, and climate resilient infrastructure in particular. A variety of states in Brazil, Germany and India,

for example, have introduced environmental criteria to allocate state tax shares to local governments. Alternatively, national government can facilitate access to municipal green bonds through tax exemptions and subsidies.

Second, it is clear that public sector financing will not be sufficient to fund all climate change adaptation measures at local levels, especially where local levels of government are already facing infrastructure deficit. In this regard, private sector investment will be required. A key role of national governments is to ensure that policies are conducive to, and incentives are compatible with, the creation of a suitable environment for private investment in resilient urban infrastructure.

Third, gaining public buy-in is a key aspect for any resilient infrastructure project. Local council ultimately approves most local funding, which relies on local votes; therefore, having public buy-in and support for adaptation is critical, regardless of the financing approach.

IV.1 Finance Tools

Our study examines 18 finance tools, listed below, that have the potential to address adaptation infrastructure finance challenges. The tools were evaluated using the criteria presented in Table 6, and are explained in detail in sections V-VII, including an explanation of each tool, the benefits and limitations of its use, the implementation or design of the tool, applicability to adaptation infrastructure, case studies, and a summary of the feasibility of its use by the CoV and CVRD.

INTERNAL REVENUE

- **Financing**
- Borrowing
- Reserve Funds
- Climate/Green Bonds
- Tax Increment Fiancing
- **Funding**
- Property Taxes
- Tax Levy
- Local Improvement Charge (LIC)
- User Fees
- Development Cost Charges

EXTERNAL REVENUE

- Federal Gas Tax
- Intergovernmental Grants
- Public-Private Partnerships (P3)
- CARIP Grant (BC Only)
- Carbon Fund

INNOVATIVE PROGRAMS

- Local Incentives and Rebates
- LIC Financing
- Density for Benefit Agreements
- Natural Area Tax Exemption

IV.2 Tool Evaluation Methodology

Each tool was evaluated based upon seven objectives and 12 criteria. A scale of high, medium and low was used to rank each tool, based on its deemed ability to achieve the

goals and objectives reflected in the chosen categories. Table 6 illustrates the criteria and ranking used to evaluate each tool. The rating reflects how the tool scores in comparison to the others. The tools were evaluated in a table format (see Appendix 6) and each result was colour-coded to indicate how the tool ranked in each criterion section.

Table 6: Evaluation Chart: Objectives and Criteria

OBJECTIVE	CRITERIA	LOW	MEDIUM	HIGH
Effectiveness	Potential capital raised: How much capital will the mechanism raise?	< $300,000	$300,000-$1 million	>$1 million
	Long term funding	One time amount.	2-10 years.	Long-term funding.
	Risk dispersion: Where does the risk fall?	Risk dispersion is assessed on the basis of a qualitative discussion.		
Ease of implementation	Authority/jurisdiction: Does the local government have the legislative authority/ jurisdiction?	The tool requires new provincial legislation to enable local governments to use it.	The tool requires the approval of Mayor and Council and the provincial government.	No need for assistance or approval.
	Administrative time and resources: Does the municipality have the resources and expertise to implement this measure?	High expertise needed and resources intensive.	Moderately difficult to implement.	Easy to implement.
	Existence of a Canadian model: Is there a Canadian case of this mechanism that can be used as a model?	No.	< 5 cases	> 5 cases

Public acceptance	Accountability: Is there a clear link between the tool and the project?	No clear link between tool and project.	Less defined link between tool and project.	Clear link between tool and project.
	Communicability: How complex is the mechanism to explain?	Very complex and difficult to communicate.	Moderately complex.	Simple and easy to communicate.
Equity	Benefits-received principle: Are the payers also those who benefit?	Charge is not related to service received.	Charge based on access.	Charge is based on use.
	Equity: Will any group be unfairly burdened?	Some groups are unfairly burdened by charge.	Yes. But actions can be taken to reduce burden.	No groups are unfairly burdened.
	Intergenerational equity: Is there fairness in timing of costs and benefits?	Charges will fall disproportionately on the present or future generation.	Charges are moderately distributed across generations.	Charges are fairly distributed across generations.
Flexibility	Flexibility of tool: Can the tool be adapted to suit changing project needs or other projects?	No flexibility.	Moderate limitations.	No limitations.
Incidence	Incidence: Who bears the final burden of the charge?	Incidence is assessed on the basis on a qualitative discussion.		
Political will	Political will: To what extent is there political will to legislate or require action?	Political will is assessed on the basis on a qualitative discussion.		

The rating given to each tool reflects how the tool performs in relative comparison to the others. The categories are qualitative and subjective criteria, but by providing a common basis for understanding what it would take to achieve a particular level of score for each category, it is possible to analyze the potential success of each tool with less variability in results.

IV.3 Summary of Results

Table 7: Summary of Evaluation

OBJECTIVE	EFFECTIVENESS		EASE OF IMPLEMENTATION			PUBLIC ACCEPTANCE		EQUITY			FLEXIBILITY
Criteria	Potential Capital	Long Term	Authority	Expertise/ Resources	Canadian Model	Account-ability	Ease of Comm	Benefits Received	Ver-tical	Inter-gen	Flexibility
TOOL											
Borrow	High	Low	Med.	High	Med.	N/A*	Med.	N/A	N/A	High	Med.
Reserve Fund	High	High	High	High	High	N/A	High	Low	N/A	Low	Med.
Green/Cli-mate Bond	High	Low	Low	Med.	Low	N/A	Med.	N/A	N/A	High	Med.
TIF	High	Med.	Low	Low	Low	Med.	Low	High	Med.	Med.	Med.
Property Tax	High	High	High	High	High	Med.	Med.	N/A	Med.	N/A	High
Tax Levy	High	Med.	High	High	High	High	Med.	Med.	Low	N/A	Med.
LIC	Low	Med.	High	Med.	High	High	High	High	Low	High	Med.
User Fee	High	High	High	Low	High	Med.	Med.	High	Low	Med.	Med.
DCC	Low	Low	High	High	High	High	High	High	Med.	Med.	Low
Gas Tax	High	High	High	High	High	Low	Med	Low	High	Low	High
Inter'gov Grant	High	Low	High	High	High	N/A	High	Med.	N/A	N/A	Med.
P3	High	Med.	Med.	Low	Med.	Med.	Med.	Med.	Low	Med.	Med.
CARIP (BC Only)	Low	High	High	High	High	Low	Med.	Med.	High	High	High
Carbon Fund (BC e.g.)	Low	High	High	Med.	Med.	High	Med.	High	High	N/A	High
Local Incentives	N/A	N/A	High	Med.	High	Low	High	N/A	N/A	N/A	N/A
LIC Financing	Low	Low	Low	Med.	Med.	Med.	Low	High	Med.	High	Low
Density Bonus	N/A	N/A	High	High	High	High	Med.	High	N/A	N/A	Med.
Land Trust	N/A	N/A	High	High	Med.	High	Med.	High	High	High	Low

* N/A INDICATES NOT MEASURABLE. RISK DISPERSION, INCIDENCE AND POLITICAL WILL ARE NOT INCLUDED IN THIS TABLE AS THEY WERE ANSWERED QUALITATIVELY. FULL ASSESSMENTS CAN BE FOUND IN APPENDIX 6.

IV.4 Evaluation Criteria and Best Practice Tools

Effectiveness

It is widely noted in the literature that there is a need for reliable, predictable, and dedicated funding to support multi-year infrastructure investment strategies. In addition, maintenance and upgrades are a crucial aspect of infrastructure resilience. Each financial tool is assessed in terms of its capacity to provide sufficient upfront capital for resilient infrastructure projects and/or provide sustainable funding for the operation, maintenance, and upgrading of such projects, if needed.

The tools that we found to be the most effective are financing tools, traditional property tax, and outside revenue streams. This in part reflects the difficulty local governments face in attempting to access new sources of revenue, such as charging fees for a new service previously included in property tax. Tools that fall in the category of "innovative programs" are the least effective by this measure, because they do not generate new revenue, but instead provide cost saving opportunities for the local government.

Two relatively untested but promising tools are green bonds and public private partnerships (P3s). Both tools have the ability to capitalize on private investment to help raise the large sums of capital that may be required for large adaptation projects.

Ease of Implementation

We evaluate each financial tool based on the administrative burden associated with its implementation, and whether or not local governments have the legislative authority to implement it. A financial tool facing high legislative barriers is less likely to be used. Similarly, a tool requiring significant resources and expertise is less likely to be adopted or, if adopted, is less likely to be effectively implemented.

In the Canadian context, it is important to note that local governments receive their power and authority from provincial statutes (such as Ontario's Municipal Act, Alberta's Municipal Government Act, and BC's Local Government Act). Moreover, some municipalities have special charters giving them slightly different levels of authority (such as the cities

of Vancouver and Winnipeg). In addition to municipal acts, other specific statutes and regulations provide further powers to local governments (Thompson & Bevan, 2010). Therefore, there is significant variation in powers of local government over property taxation, fees and other financial mechanisms. In this regard, the possibility of learning from existing Canadian experience with a selected financial tool may be an important feature of financial planning. Lessons learned from implementation experiences by other municipalities may aid in the analysis of appropriateness of each tool for specific needs of each situation and location.

Tools that are already widely used in Canada, for example, reserve funds, tax levies, and intergovernmental grants, scored highest in this category. There may be a trade off between ease of implementation and flexible use, however, as it can be difficult to be innovative with existing tools. Finally, ease of implementation is a category that can be improved upon through changes in legislation or collaboration with other levels of government or outside consultation.

Public Acceptance

For a funding mechanism to be successful, it is necessary to establish "buy-in" from the public. To establish buy-in, a tool should be both accountable and communicable. *Accountability* requires that the design of the financial instrument be clear to taxpayers and that the link between the beneficiaries of a government service and payment for that service be tight (Kitchen, 2006). *Communicability* refers to how easy it is to communicate how the tool works to the public. There can be a trade-off between the two, as highly accountable mechanisms may be complex and therefore more difficult to communicate.

Some of the case studies reviewed in this report indicate the importance of public acceptance, as certain user fees and tax levy initiatives were not implemented due lack of public support. Public acceptance hinges more on communicability than accountability. The tools that are reported as the easiest to communicate are reserve funds, local improvements charges, development costs charges, intergovernmental grants, and local incentives.

Equity

Equity is evaluated through the distribution of the burden of financial instruments. Three principles are used:

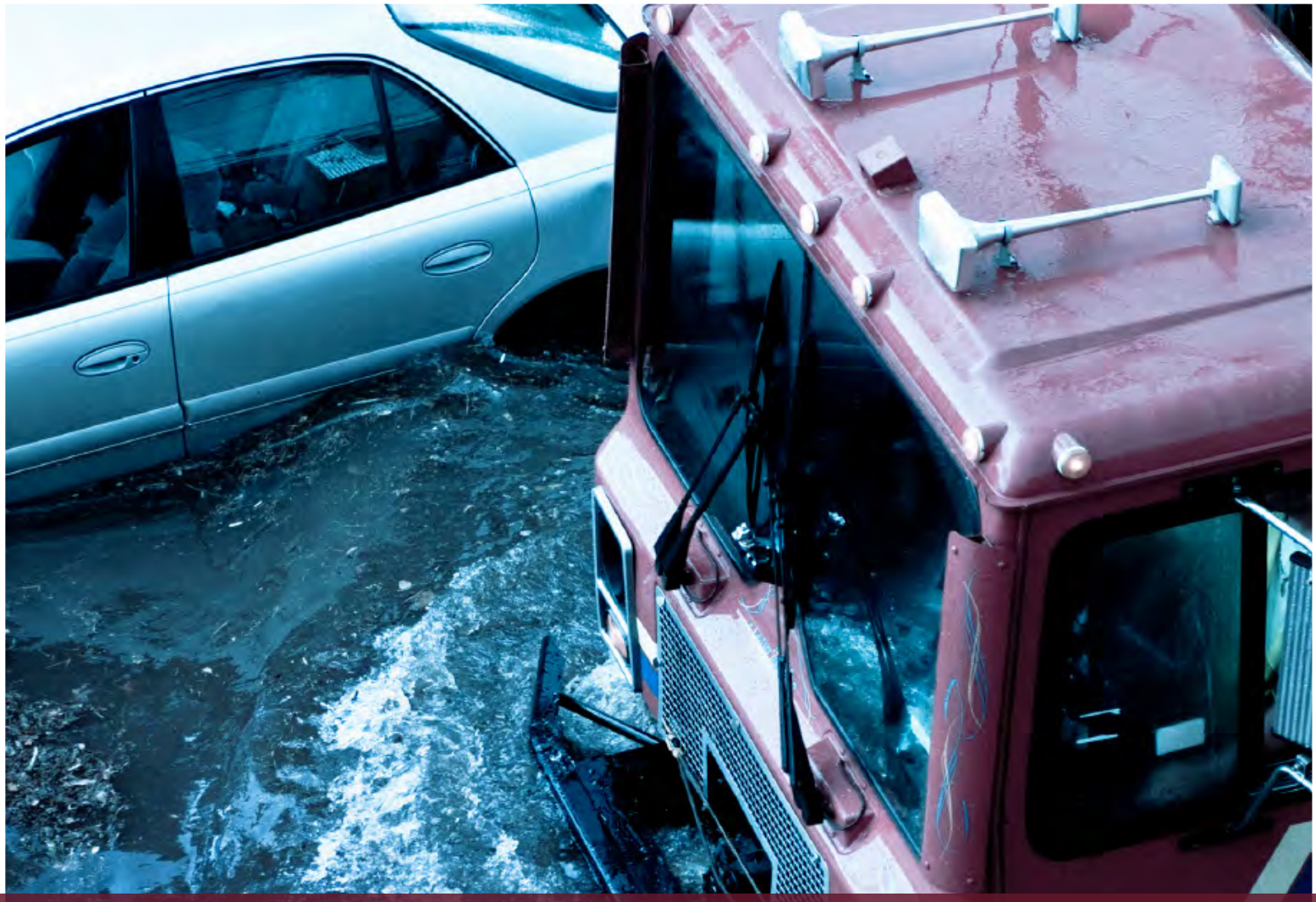
1. The benefits principle states that the extent of taxes paid by individuals should be reflective of the extent of the benefits received.
2. The ability-to-pay principle states that the extent of taxes paid by individuals should be reflective of their financial capacity to pay.
3. While equity may be examined across groups within a given generation, it may also be examined across generations, as a financial instrument may shift financial burdens from current to future generations.

Given the long-term nature of climate impacts, borrowing, green/climate bonds, and tax increment financing score well in this category because they amortize costs into the future. Local improvement charges, user fees, and development cost charges are seen as fair because they connect the cost of a service to the user. Tools that connect the fee to services are particularly interesting because they can be linked to incentive programs to impact individual behaviour.

Flexibility

Flexibility refers to the ability of a financial instrument to adapt to changing needs or to different socio-economic conditions. Most tools have some degree of flexibility to meet changing circumstances; however, once funds are secured through a certain mechanism, it is often difficult to change how the funds will be spent.

Finally, ***risk dispersion, incidence***, and ***political will*** were assessed qualitatively for each tool. The results of the assessment are presented in Appendix 6.



V. INTERNAL SOURCES FOR ADAPTATION INVESTMENTS AT THE LOCAL LEVEL

Internal sources are revenues that can be raised by local governments themselves. This distinguishes them from revenue sources that depend on other levels of government or private stakeholders. Traditionally, most revenues available at local levels are obtained from internal sources, with property taxation and fees for municipal services contributing most to total revenues (FCM, 2012).

This section explores financial tools that local governments feasibly have the legislative authority to use. As noted, the power of a local government to implement the tools evaluated depends on both jurisdiction and the instrument; while all the tools listed in this section have been used in Canada, there is a large national variance in local government powers over property taxation, fees and other financial mechanisms.

Local governments are already paying for adaptation projects through general revenue sources by integrating adaptation measures into existing capital improvement projects and operating budgets, or utilizing tax revenues. The value of this approach is its administrative simplicity; however, it requires competing against other programs and projects.

Adaptation projects are often viewed as additional or unnecessary costs, despite evidence that preparation and planning ahead of a disaster greatly reduces the costs and suffering incurred both during and after a disaster (NRTEE, 2011). There must therefore be interest in and support for initiatives before adaptation projects can be incorporated into capital plans and financed through general revenue streams. For example, a 2014 study of British Columbia's flood policy highlighted the fact that local governments need a better understanding of local risks, cost-benefit, and/or the effectiveness of various adaptation options before moving forward with investments (Arlington Group, 2014).

Therefore, all internal revenue options require time to actively communicate the risks and benefits with the public and politicians in order to be successful. Informing key audiences about vulnerabilities, risks, and potential projects that can help to mitigate such issues is an important investment for any local government. In addition, involving many local departments in adaptation planning to overcome the silo effect is a strong way to improve knowledge and raise the visibility of the issue, and consequently increase the chances of general revenue being available for adaptation projects.

This section provides a distinction between *financing* climate adaptation infrastructure (Section V.1), and *funding* climate adaptation infrastructure (Section V.2). *Financing* refers to securing capital for a project in advance, whereas *funding* infrastructure refers to repaying or saving for payment of the up-front capital costs, as well as the operation and maintenance of new infrastructure.

Within the categories of financing and funding, we have further sub-divided the tools

into conventional and innovative tools. Financial tools have been classified as innovative if (1) they are not used widely in Canada; or (2) if already being used, could nonetheless be used in a new way to make them more appropriate to fund resilient infrastructure investments.

V.1 Conventional Financing

Financing refers to securing up-front capital for a project. The overall goal when financing a project is to smooth the tax impact over a period of time. This section explores the ways conventional forms of financing could be applied to adaptation infrastructure projects, and examines selected innovative approaches to financing.

Borrowing

Municipalities may borrow money to finance the front-end costs of all types of new infrastructure. Municipalities borrow money long-term through loans from other levels of government (Capital Asset Programs) or issuing bonds or debentures (see Table 9 for Canadian examples).[1] Borrowing has benefits and limitations (Table 8).

1 Bonds and debentures differ in that bonds are secured by a specific physical asset, and debentures are secured by the issuer's promise to pay the interest plus loan principal

Table 8: Benefits and Limitations of Borrowing

BENEFITS	LIMITATIONS
Immediate financing	Risk associated with changes in credit conditions
	Credit conditions depend on credit ratings
15-50 year repayment period, matching the lifespan of the infrastructure	Local governments locked into spending patterns
Current credit market offers low interest rates	Must have secure revenue streams to repay borrowing
Intergenerational equity	May require public approval
Relatively low risk	Provincial regulations restrict debt levels
	More expensive than grants
	Federal loans require provincial approval

In every province, legislation outlines the rules for how municipalities may borrow money (see Appendix 2). In most instances, a local finance board, or the provincial ministry governing local governments, approves the municipality's request to borrow money. In addition, provincial regulation requires an authorization for the debt through a borrowing by-law, which stipulates the purpose and the terms for the borrowing. Depending on the amount and purpose, the council may be required to advertise the borrowing to the public, informing them of when and where the council will approve the debt. Occasionally, public consent may be required via a referendum.

Table 9: Major Municipal Bonds Issued in Canada (2012)

ISSUER	SIZE (MILLION)	TERM
Municipal Finance Authority, BC	$220	5-year
	$165	10-year
	$125	10-year
City of Montreal	$210	10-year
	$165	20-year
City of Ottawa	$175	30-year
Region of Peel	$300	30-year
City of Toronto	$300	30-year
	$300	10-year
TransLink	$150	40-year
	$100	40-year
CoV	$120	40-year
City of Winnipeg	$75	40-year
	$50	40-year
Region of York	$250	20-year
	$150	20-year

SOURCE: HANNIMAN (2013)

Most provinces have a Municipal Finance Authority that issues bonds for municipalities. These bonds are guaranteed by the provincial government, which helps to both secure low interest rates and maintain high credit ratings for Canadian municipalities. In 2012, annual interest rates on 10-year municipal bonds were just over 3% (Hanniman, 2013). The federal government makes loans to municipalities (and provinces) to assist with municipal capital works projects, which are repaid over a 15-50 year period with interest.

Debt repayment includes repayment of the initial sum borrowed plus interest; interest rates offered by finance authorities are usually lower than those offered by banks. The repayment of borrowed funds comes from operating revenues such as taxation and user fees. Water and wastewater assets are the most common types of infrastructure financed by borrowing, followed by major roadways, bridges, municipal buildings and facilities, and public transit (Ploeg, 2006).

Design

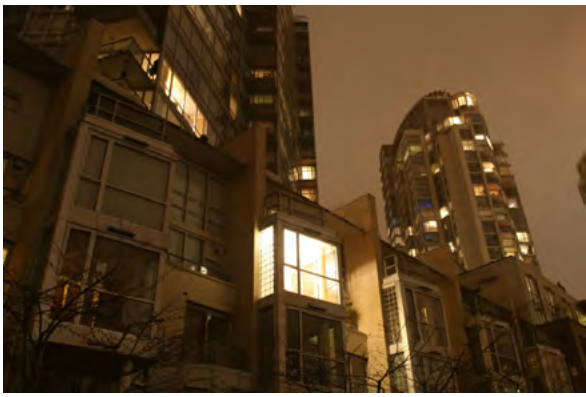
Provincial legislation dictates the process of municipal borrowing and stipulates types of long-term borrowing options: loans, debentures, or bonds. There are two types of bonds issued in Canada: serial and bullet bonds. Serial bonds mature in instalments, whereas bullet bonds are repaid on the maturity date (Hanniman, 2013). In 2012, the issuance of bullet and serial bonds was almost equal, at $2.9 billion and $3.1 billion, respectively. To encourage private investment in public infrastructure, the US offers tax-free municipal bonds; however, these are not available in Canada.

Application to Climate Change Adaptation

Borrowing offers one way of synchronizing the costs and benefits of an infrastructure project over the lifetime of the asset. For example, revitalizing a stormwater management system will have benefits over several years. If a local government borrows funds for a specific project, it will work out a repayment scheme that ensures beneficiaries of the infrastructure are contributing to the repayment. Municipalities have many mechanisms available for recouping up-front costs of infrastructure; however, a combination of mechanisms may be required, as provincial regulation may limit the use of such funds. For instance, in BC, a local government may not use development cost charges (DCCs)

for the interest portion of debt repayment unless authorized to do so; however, it may have an additional agreement with a developer to recover the interest portion of the debt repayment.

Feasibility[2]



Borrowing money is a standard procedure for local governments in BC. The ground truthing research showed that all participants were familiar with the process and the limits of borrowing money. For instance, it was clear to all municipal participants that they were able to borrow up to 25% of sustainable controllable revenue without approval from the province. Some participants thought that borrowing money for adaptation infrastructure to reduce vulnerability would be appropriate as a way to finance the project as long as the asset would last for more than ten years. Alternatively, some participants expressed that it was unlikely that they would borrow money for adaptation infrastructure because their government did not have a culture of borrowing money, and they did not see this changing in the future. Uncertainty also remains as to the long-term sustainability of revenue sources for long-term repayment. The likelihood of a local government borrowing money for adaptation infrastructure projects relates to its size, and that particular government's culture regarding borrowing money in general.

Reserve Funds

Financing capital projects through funds set aside for capital spending is the reverse of financing through borrowing. Instead of borrowing to finance capital expenditures and paying off the debt in the future, a reserve fund saves current revenue for a future specific project. A portion of current revenue is set aside in a special account or accounts, and

2 See Appendix 3 for details of this discussion with the CoV and CVRD.

allowed to accumulate until it satisfies the financial requirement of a specific capital project. Reserve funds can be obligatory or discretionary (Kitchen, 2003). An obligatory reserve is created if a statute requires that monies are kept separate from general revenue.

Application to Climate Change Adaptation

Reserve funds are a way to proactively plan for future expenses. In this sense, they match up well with climate change adaptation goals. A potentially creative way to use reserve funds for adaptation projects that combine mitigation and adaptation goals would be to create an "energy savings" fund. This would involve first installing energy retrofits in government buildings, which could be funded by capital from an intergovernmental grant such as the Green Municipal Fund. Once the energy retrofits result in cost-savings on energy use, these savings could be put into a reserve for adaptation projects.

Benefits

The use of reserve funds may increase funds available to local government without increasing taxation, as they are earmarking existing revenues. Reserves also play a key role in the planning and development of future infrastructure projects. In addition, as priorities shift, reserves can potentially be used for different projects than the original intent.

Limitations

Capital reserves and reserve funds cannot be viewed as a sustainable or ongoing source of funding for infrastructure without deciding how to increase the size of the reserves themselves. Furthermore, to the extent that the creation of reserve funds diverts scarce fiscal resources, it may require identification of additional sources of revenue, potentially contradicting its benefit. Reserves also have the potential to decrease in value over time due to inflation. Finally, they can violate the principle of intergenerational equity, because current users and current taxpayers pay for capital that future generations will use.

Feasibility

In general, it was noted that reserve funds work best for big projects that require a large capital investment, as one can use reserves to save enough capital for such projects to be built all at once. Reserves could work well for climate change adaptation projects because not all response actions need to happen today. The CoV offered the idea that, even if a reserve was not explicitly for a climate change adaptation project, it could be used for something along the same theme. For example, a reserve fund for public art could be used to pay for an art project that raises awareness about a climate change impact. Therefore, depending on the municipality's resources, they might potentially have some reserves now that could be used under the climate change banner. The CoV also explained that one of the disadvantages of reserve funds is that other projects may arise that require immediate use of the capital. Another disadvantage is that purchasing power may decrease with time unless assets are invested and yield returns at least at the rate of inflation. In practical terms, it was noted that, in order to create a reserve fund for an adaptation project, one would need a determined council and a clear need to find a financing source for the reserve.

V.2 Innovative Financing

Green Bonds and Climate Bonds

Green bonds are debt instruments that raise capital for projects with a specific environmental purpose (Sustainable Prosperity, 2012). Environmental purposes may include water and land pollution reduction, energy efficiency upgrades, and climate change adaptation or mitigation projects (Webb & Jackson, 2014). Most green bonds are treasury-style retail bonds, which have a fixed rate of interest and are redeemable in full on maturity. However, there is no standard format for green bonds, which can make it difficult to estimate demand (TD Economics, 2014).

Climate bonds are a new asset class within the existing bond market. Governments or corporate entities issue climate bonds to raise capital for "environmental" projects, for instance "to raise finance for investments in emission reduction or climate change adaptation" (Mackenzie & Ascui, 2009).

Design

The design of green bonds and climate bonds is similar to regular bonds; they are only distinguishable by the type of projects they finance. The Climate Bond Initiative, an organization working to develop an international climate bond standard, categorizes green bonds as a type of climate bond. International certification and disclosure standards enable green and climate bonds to be recognized as investments in sustainability (Webb & Jackson, 2014). Green bonds have been successfully used in the US, where the federal government works with municipalities to financially support municipal bonds with tax exemptions and subsidies. This federal-municipal coordination relieves some financial risk associated with bonds and thus attracts investors. However, Canada has yet to use this approach to incentivize green bonds.

Application to Climate Change Adaptation

Green bonds have the potential to raise money for public infrastructure projects with long

amortization horizons, such as adaptation projects, which could overcome the political/economic preference for short-term planning (Lanz, 2014). In general, investors tend to make decisions based primarily on anticipated quarterly and annual performance. Similarly, policymakers typically focus their agenda on policies that improve the likelihood of re-election in a political cycle that is usually four years or less. In contrast to this favouring of short-term results, large-scale infrastructure investments generally do not generate financial rewards in the short term. This prevalence of short-term thinking constrains the scale of green infrastructure investment, whose financial benefits may not be apparent for several years or decades. As green bonds can have maturities of 10-, 20-, and 30-plus years, these debt instruments could enable issuers to raise capital for investments in large-scale green infrastructure projects whose benefits accrue over a longer time horizon and whose costs can be amortized over a lifetime.

Green bonds therefore differ in the type of risk assessments and interest rates applied to standard issue bonds. Several financial experts, among them the Executive Vice Chairman and Managing Director at Credit Suisse, Mark Burrows, have spoken openly on the need for more standardized evaluation methods and certifications for green bonds in order to promote their use.

In general, green bonds to date have financed climate mitigation actions such as energy efficiency, wind, solar and hydropower, infrastructure upgrades, and depending on the definition of “green,” nuclear energy. However, transportation remains the largest market share with 75%. The international market for new issues of green bonds in 2013 reached $11 billion, and $16 billion in 2014, with more than $350 billion of green bonds outstanding. Most bonds are issued in the AAA debt category and are therefore considered stable and secure investments that are suitable for large money funds such as pension funds, which need long-term payout to match their obligations (HSBC, 2013).

Benefits

Green and climate bonds have the potential to attract private investors who are concerned

with the ecological integrity of their investments, and who may be willing to receive a lower rate of return on an investment that meets social and environmental requirements.

Limitations

Green bonds are relatively new and no Canadian municipality has issued one yet. Municipal debt-servicing limits set by provincial legislation (in BC, 25% of the operating budget) may act as a barrier for municipal governments interested in issuing a green or climate bond for a large infrastructure project as it may exceed these limits.

Canadian Case Studies

Ontario is the first province to issue green bonds, designed to raise capital for infrastructure projects such as public transit. Translink, the transport authority in Metro Vancouver, has issued low interest bonds with specific environmental benefits, but has not labeled them "green" (Lanz, 2014). Most recently, the North Island Hospitals Project on Vancouver Island, BC was the first Public Private Partnership (P3) in Canada to issue a green bond, which raised $231.5 million in debt financing with a term of 32.3 years at 4.394%.

Feasibility

As noted, issuing green bonds is a relatively new approach, and only a limited number have been issued in Canada to date. Due to the limited experience of issuing green bonds in Canada, the local governments interviewed for this study said that they were interested in learning more about the logistics of issuing green bonds as a means for raising capital for adaptation projects.

An obstacle frequently mentioned by the local governments was their debt-servicing limit. Municipalities in Canada have limited allowable debt and require voter approval to exceed this limit. Public support for exceeding borrowing limits for adaptation infrastructure will vary across the country and will likely be related to whether or not an extreme weather event caused major property damage in the past. If the local government is averse to additional debt, senior managers may not approve borrowing for adaptation projects. If green bonds are included in municipal debt limits, municipalities will be less interested

in using them to finance resilient infrastructure projects; however, if a senior government issues green bonds on behalf of the municipality, they may provide an innovative financing option for local governments to use to reach resilient infrastructure goals.

Tax Increment Financing (TIF)

Tax increment financing (TIF) is the practice of financing capital projects through the increase in property tax revenues that new development projects may generate. This increase in tax is known as the tax increment. The insertion of new amenities, services, or, for instance, the revitalization of a brown field in an existing neighbourhood, will tend to augment property values and consequently raise property tax revenues (Box 1).

BOX 1. CORKTOWN COMMONS

Corktown Commons is a multi-use park in Toronto that eliminates flood risk for 210 hectares of real estate, including a portion of the financial district, and creates accessible green space within a 7.3-hectare park (FCM 2014). While federal and provincial funding financed this park, it is an example of the kind of innovative infrastructure that could use TIF to secure finance. The park is both a piece of resilient infrastructure, as it is a flood protection landform, and a brown field redevelopment, as it has turned a previously unsightly area into a recreation area.

Design

Cities designate a TIF area for capital improvements and then earmark any future growth in property taxes to pay for investments in infrastructure and other economic development initiatives. The current property tax revenue in the area is set as the baseline property tax level. When the project is complete, the municipality dedicates the tax increment above the baseline level towards repaying the loans made to finance the capital improvements, ending essentially when loans made at the beginning of the project are repaid. At this

point, the entire property tax revenue (baseline plus increment) goes to the municipality's general fund, thereby increasing its tax base (Pacewicz, 2012).

Application to Climate Change Adaptation

A potential method of financing adaptation is through innovative mechanisms that capture the value of each project. TIF, similar to green bonds, has the potential to capture this value, and incent investments for projects that do not traditionally have a return.

Benefits

TIF is a self-funding mechanism, not a tax increase, because the additional revenues come from an increased tax base (Ploeg, 2006). It is also well designed for the renewal and replacement of existing infrastructure, which is often difficult to finance.

Limitations

TIF is relatively new in Canada, and has not yet been used to finance adaptation infrastructure. As there is very limited practical experience with this financing tool in Canada, it will be more difficult to implement and might have a higher administrative cost. TIF can also be financially risky if not done correctly, or if the market conditions change drastically. A TIF loan is backed by the understanding that the investment will improve land value, therefore increasing the price of real estate and property tax revenue. However, real estate prices are dependent on many larger macroeconomic factors and can fluctuate in unplanned ways. TIF could therefore create major liability for a municipality if anticipated revenue increases do not materialize.

In addition, there may be concerns with redistribution impacts from this kind of finance structure because there is a loss of revenue from the general tax base when repaying the loan. This might be perceived as future taxpayers paying for present development through a loss of general revenue.

Canadian Case Studies

TIF was first introduced in California in 1952 and since then has spread to almost all US states. In Canada, TIF is a much newer instrument and its use is not nearly as widespread. Only Alberta, Manitoba, and recently Ontario, have authorized the use of TIF. In Ontario, there are plans to use TIF to finance new transit, but this is currently a topic of political debate (Alcoba, 2014).

Feasibility Study

None of the local governments interviewed are currently using TIF because it is not legal in BC. However, if the legal issues could be overcome, there was consensus among participants that it could only be attempted if the municipality, and not the province, did property assessments. Otherwise, there is too much risk involved.

V.3 Conventional Funding

Funding infrastructure refers to repaying or saving for up-front capital costs. Funding also includes the operation and maintenance of new infrastructure.

Taxation is the most common form of centralized funding. Local governments in Canada rely on property tax as their base tax, and have the additional ability to tax special charges and levies. The charges and levies that would be well matched to provide funding for adaptation infrastructure have been identified as a general tax levy and local improvement charges.

User fees are also widely used by local governments and are generally based on the user's consumption of, or reliance on, the service.

Funding from taxation and user fees falls on a benefit-pay spectrum: the link between a charge and a benefit. At the broad end of the spectrum is property tax, and the most direct link is user fees.

Development cost charges (DCCs) and community amenity charges (CACs) are levies placed on developers, and represent additional sources of funding available to local governments.

After a flooding event, a stormwater management levy could gain more public support than in a period with no problems.

Property Taxes

Property taxation is the primary source of revenue for local governments. The Federation of Canadian Municipalities (FCM) reports that 50% of Canadian municipal revenue comes from property taxes (2012). Local governments are granted this taxation authority through province-specific provincial statutes.

In general, property taxes pay for local government administration, staffing, debt servicing, leases, and the costs of providing services to the community (BC Ministry of CSCD, 2014). Property taxes are calculated using the market value, or an assessment of land value and the municipal tax rate. Tax rates can differ between municipalities and may vary depending on the type of property. Municipalities set their annual tax rates based on the revenue needs set out in their financial plan. It is important to note that revenues from property taxes are shared between local and provincial governments, as a significant

share of what local governments collect flows to the province to fund education programs. Hence, local governments may not have complete control over the rate, nor over the total amount raised.

Application to Climate Change Adaptation

For climate change adaptation, an important obstacle to using general property tax revenue is that adaptation projects will need to compete with everything else on the municipal agenda. When choosing what capital works to finance from a pool of payments, there is often a preference for high priority projects with immediate payoff. Projects with longer-term horizons, such as adaptation infrastructure, are therefore at risk of being delayed due to insufficient funding sources or more urgently needed infrastructure projects.

Benefits

Property tax provides stable, citywide funding that requires low administrative effort. It is visible and transparent, resulting in a high level of accountability.

Limitations

Currently, municipalities collect eight cents of every tax dollar collected in Canada. There is consensus in the literature that attempting to close the infrastructure-funding gap with traditional sources such as the general property tax is both unrealistic and unsustainable (Ploeg, 2006; FCM, 2002/2012). One of the limitations of the property tax is that it is a relatively narrow tax base that is linked to property ownership, and therefore to real estate values. Its growth can be more unreliable in mirroring general economic growth than an income or sales tax because real estate values are slower to shift. In addition, property tax only generates revenue after a development is built. Therefore, it does not provide funding for investments that are proactively needed to support new development. Finally, property tax does not capture value from those who are passing through a municipality and using its infrastructure, but paying property tax elsewhere.

Feasibility Study

Property taxation was not part of the feasibility study, as all local governments are already utilizing this tool.

Tax Levy

A specialized tax levy is similar to the general property tax, but differs in that it collects revenue to support a distinct project. Specialized levies generate more funding for a municipality to cover a new service not traditionally covered by the general tax base, and that may be difficult to fund through user pay options.

Design

A levy can be set up either for an infinite period or for a specific time horizon. For example, a levy collected to fund a specific project should end when the project is complete. Levies can face trade-offs when choosing how specific the use of funds will be, e.g. between the benefits of increased flexibility from a broad goal, and public support for easily identifiable results (FCM, 2002).

Application for Climate Change Adaptation

A special levy could be set up to fund overall improvements in an existing system, or to fund the building of new risk reduction infrastructure. Levies usually garner the public support they require after an extreme weather event when public awareness is high. For example, after a flooding event, a stormwater management levy could potentially gain more support from the public than in a period with no tangible problems.

Benefits

Levies are not a new tool for municipalities, are not complicated to explain or administer, and can raise a lot of capital for a project. Special levies can be used to build reserve funds and are a good source of prospective funding for major projects.

Limitations

Levies involve a large public engagement program to be successful. There is a higher standard of accountability with a special levy, and a municipality must make sure it communicates exactly what the levy is to be used for to the public (Box 2). The parameters for use, including restrictions, must be established before implementing a levy. A significant limitation of this tool is that only a small number of "special" levies are practical in a municipality, otherwise they would overwhelm the tax base.

Canadian Case Studies

Flood-affected areas such as Regina, Edmonton, Strathcona County, Calgary, Hamilton and London all have a flat fee attached to their property tax or water bill with the specific purpose of funding stormwater upgrades. Winnipeg also has specific sewer and water renewal levies.

BOX 2. UNSUCCESSFUL LEVY – TORONTO

In January 2014, a bill was put forward in the City of Toronto to increase residential taxes by 0.5% and non-residential taxes by 0.167%, to increase the operating budget by $12.2 million. The rationale behind this tax levy was: "To have a strategy to fund the City's one-third share of the two extreme weather events in 2013, and to increase extreme weather reserve levels, which will better position the City to respond to future extreme weather events" (City of Toronto, 2014). However, the political position among Toronto voters was against raising taxes, so this proposed levy was not adopted.

BOX 3: SANITARY SEWER RESERVE FUND IN PETERBOROUGH (ONTARIO)

The City of Peterborough, Ontario is vulnerable to flooding due to its hydrogeology and location on the Otonabee River. Current damages associated with flooding are caused by a combination of extreme rainfall events, meagre storm sewer capacity, ineffective overland flow routes, and infiltration of storm water into the sanitary system (Rodgers & Behan, 2012). Peterborough experienced consecutive extreme rainfall events in 2002 and 2004 that caused extreme levels of damage, precipitating the need to upgrade vulnerable infrastructure. The municipality has created a master plan for managing stormwater, which requires $5 million annually to finance improvements (CAP, 2013). Currently, $2.5 million is committed from existing property tax, with the other half coming from the Sanitary Sewer Reserve Fund (SSRF), a new levy appearing on residential water bills. In addition, the municipal operating budget was increased to maintain sewers using the new SSRF funds.

Challenges

Several projects exceed the annual funding and must be stretched over longer terms than planned, and because the projects are financed using tax dollars they are dependent on a continued public commitment. Following the damages from two recent flooding events, residents were distrustful of the municipal government. Impatience from the public was and continues to be an issue for municipal staff who encounter resistance from neighbourhood groups and individual residents. This condition is exacerbated by the fact that much of the retrofit work is conducted underground and it is therefore difficult to convince residents that change is occurring.

SOURCE: RODGERS AND BEHAN (2012)

Feasibility

All participating municipalities had previously administered a special tax levy, and saw it as a feasible option to finance different adaption projects. Parkland acquisition and funding for the Shawnigan Basin Society to work on watershed management presents one example of a project funded by tax levies in the CVRD. However, concerns were also raised over issues of jurisdiction, especially with regard to infrastructure projects that have the potential to protect an area larger than the jurisdiction of the local government. While a local tax levy is possible, it would be necessary to justify why that specific municipality is paying for the improvement. While the CoV has used them, it has not been done recently. In general, tax levies seemed to be of more interest to smaller municipalities.

V.4 Innovative Funding

Local Improvement Charges (LICs)

The concept of Local Improvement Charges (LICs) was discussed earlier in the context of debt financing. LICs can also be used for funding purposes.

LICs raise funds for a project in a specific geographic area, such as a neighbourhood. The charge is levied against properties to recoup the costs of an improvement that specifically benefits those properties. LICs are levied against properties within an area, and are then used to fund borrowing undertaken to finance local infrastructure improvements (Ploeg, 2006). In general, the owner of the property has the option to pay the local improvement charge in one lump sum payment or in instalments over a period of time. If these charges are not paid, the government may place a lien on the property. LICs are calculated in a variety of ways, such as frontage charges or zone assessments. The method of calculating the charge will depend on the project being funded. Typically, the LIC will require local approval before being charged to property owners. In certain cases, LICs are imposed based on the request of a group of property owners.

Application to Climate Change Adaptation

LICs are well suited to local improvements that have users who visibly benefit. They are

ideal for projects such as sewer and sidewalk upgrades in a specific neighbourhood. In addition to being a traditional funding mechanism, the legislative framework of LICs permits municipalities to implement innovative financing programs. It has been proposed that LICs could fund capital investments on private property within a home or building, acting as a loan to the property owner and using the property tax system to recover the loan (Persram, 2011). We examine the use of LICs as a financing model in Section VII, comparing pilot programs in Vancouver, Nelson, Toronto, and Halifax.

Benefits

LICs work well for renewal, rehabilitation and replacement projects, which are often not prioritized for funding because they get pushed behind more politically popular projects. By clearly linking the charges to the project, LICs can be a useful tool for funding maintenance projects, such as updating a street's drainage system.

Due to the clear link between charges and benefits, LICs tend to be more politically acceptable than a general property tax increase or general tax levy. A municipality can generally spread the cost of a local improvement over several years to minimize the annual payment property owners have to make. If a property owner sells their property before the local improvement charges are fully paid off, the new owner assumes responsibility for making the remaining payments.

Limitations

LICs can be costly to administer, as they require local approval, background work, analysis, special studies, extensive checking, record keeping, account management, and detailed reporting. One limitation is that projects must involve enough upfront costs to make administration worthwhile, as it can be more costly than the funds raised.

In addition, a clear connection between increased charges and increased benefit needs to be established, which can be difficult. LICs can also raise questions about public goods and levels of responsibility. For example, should a waterfront community be charged a LIC to pay for infrastructure that gives increased protection from coastal surges? On one

hand, they are the group that would receive the most benefits (and be the worst off with the status quo); on the other hand, increased coastal protection would benefit the city, region, province, and nation as a whole. Such questions must be carefully considered and justified before a LIC is levied; likewise, the issue of project size. When charging an LIC, there is a trade-off between the size of the local area and the amount of capital that can be raised. LICs are only levied once a year, therefore if an area is small and specific, there is a limit to how much capital can be raised for the project.

Feasibility

Participants generally agreed that LICs are a reasonable tool for localized adaptation infrastructure (Box 4). One of the biggest drawbacks to choosing this tool would be consideration of shared resources, and the need to clearly designate who benefits and who pays.

All local governments we spoke to have used this tool at some point. Smaller municipalities had used the tool recently, and specifically for projects like sidewalk improvements. The CoV noted that this tool has been used more frequently in the past than it is now. It must get votes and approval to be put into place, which requires significant effort.

BOX 4. LICS IN WHITEHORSE (YUKON TERRITORY) & SURREY DRAINAGE TAX

Whitehorse uses LICs to finance neighbourhood-wide subsurface improvements, including sanitary and storm sewer services. Once the scope and cost of a project are determined, a vote is held with the affected property owners. If more than 50% of benefitting property owners object the project will be cancelled. Projects are approved or cancelled on a neighbourhood, rather than street-by-street, basis (Whitehorse Planning Services, 2014).

Project implementation occurs through a cost-sharing arrangement between the City and property owners. For example: (1) For subsurface works, the City pays for water and sewer upgrades located in the rights-of-way (which include roads, boulevards, and lanes); and (2), for bleeder systems, the City pays for the replacement of water services on private property leading up to the home; the replacement of plumbing inside the home is at the expense of the property owner.

Another advantage of LIC projects is that the opportunity exists for private property owners to upgrade sewer lines on their property in order to take advantage of the trench-work carried out and paid for by the City.

Surrey Drainage Tax

The drainage tax is a charge that has been used to fund drainage services in Surrey, BC since April 2002. The long-term aim for the tax is to convert it into a charge based on parcel size and land use, closer to a user-pay system.

Some of the difficulties faced in implementation were: (1) Difficult to charge based on direct usage because many of the costs are from infrastructure maintenance; and (2), similarly, to assign costs to the level of drainage service specific properties receive would be costly, difficult, and liable to create as many inequities as it attempts to solve.

User Fees

User fees recover the costs of using municipal property or services. A utility user fee model facilitates the collection of fees for a specified service, and that service is managed separately from other municipal services. These fees are usually collected on a user-pay basis so that the costs are borne specifically by those who benefit from the utility's service. In general, user fee revenue can only be used for the purpose of maintaining and upgrading that specific service. A user fee model provides a stable funding source directly connected to infrastructure use, but the building costs must be front-ended, often through borrowed funds.

Application to Climate Change Adaptation: Stormwater Management Systems

A user fee model is limited in its application. However, "there is an emerging approach to apply a utility model to stormwater management services, in recognition of the substantial costs for stormwater-related capital works and the operating costs of the capital infrastructure" (FCM, 2002).

Updating and improving stormwater management systems can have multiple adaptation benefits. Depending on the way the system is managed, it can reduce the expected increase in runoff created by extreme weather events, and can expand the supply of water during dry periods (Porter-Bopp et al., 2011). Other OECD countries are using this tool as a way to finance and fund adaptation investments.

There is a variety of ways to calculate user fees for stormwater, ranging from a simple flat fee to a more complex impervious area measurement. There is a trade-off between the accuracy of the rate charged and complexity in its administration (Gregory, 2012). Depending on the chosen rate structure, a municipality can develop different programs to motivate private adaptation measures. In addition, a user-pay model raises awareness about best practices in stormwater management, which can have additional environmental benefits.

Benefits

One advantage of this tool is that it secures a revenue stream for the service. Any surplus or reserve funds generated by the user fee must be re-purposed for projects that are directly related to the utility, which is a way of guaranteeing that longer-term adaptation projects are not consistently pushed behind projects with shorter-term gains.

Another advantage of user fees is that they can be tailored to encourage certain behaviours, such as resource conservation, which can reduce the overall costs of services (e.g. increasing impervious pavement) (FCM, 2002; Ploeg, 2006; Kitchen, 2003). In the context of adapting infrastructure, encouraging certain behaviours has benefits beyond cost savings because it can promote environmentally-friendly practices that have multiple advantages. One example of this is stormwater utility fees, which have been used to create credit or rebate programs as discussed in Table 10 below. On a larger scale, charging a

fee for service raises awareness about that service, and can work to help shift mindsets about the importance of water conservation, for instance.

Many of the benefits of switching to a utility user fee model are related to the efficiency gains that come from charging based on individual use. “When user fees are in play, individuals will consume only an amount for which they are willing to pay” (Ploeg, 2006). Utility models can therefore allocate costs for services more accurately to the users and present those costs in a transparent fashion. This tool can potentially offer a more equitable and fair alternative to other financing mechanisms, such as broad property tax-based charges (FCM, 2002).

Limitations

User fees can only be used for specific municipal services, such as water, sewer, stormwater and garbage. While transportation infrastructure can be funded through user fees, it is not included in the utility model because the term “utility” typically applies to services related to individual properties (FCM, 2002). Due to the limitations on their use, innovations in the implementation of utility models are likely to arise in the way fees are applied to these services, rather than through the application of this method to new utilities (FCM, 2002).

Another limitation of a utility model is a loss of distributional equity. Although a utility model can promote horizontal equity (an alignment of payment and benefits), it does not coincide with vertical equity. That is to say, user fees of any kind are by nature regressive as they take a larger portion of lower-income individuals’ or households’ income.

Canadian Examples

Table 10 compares Canadian municipalities that are either currently using, or in the process of setting up, a utility model to fund stormwater management regimes. While the uptake of this model in Canadian cities is limited, it is important to note that it is very popular in American cities. Portland, Oregon has used a specific utility to manage stormwater since 1977 and its model is prominently mentioned in the literature as a best practice (FCM, 2003; Golan & Corbett, 2011; Porter-Bopp et al., 2011). In Canada, the experiences of the cities of Prince George and Victoria offer lessons of interest (Box 5).

BOX 5. UTILITY MODELS IN PRINCE GEORGE AND VICTORIA

Both Prince George and Victoria recently attempted to implement a stormwater utility fee. The Prince George project has been put on hold due to public opposition, while the Victoria project is slated for implementation in 2015.

Prince George lessons learned:

- The proposed tiered flat-rate system is too complicated.
- Other utility costs are also increasing = tax fatigue.
- Critical to carry out public education before public consultation; municipal staff were asked to condense timelines and the education piece fell through.
- Rural vs. urban knowledge gap.

City of Victoria lessons learned:

- Spend time learning from others who have already done it.
- Get management and council endorsement early on; do not waste resources if no support.
- Be prepared for a long haul.
- Get other departments involved.
- Look for champions inside/outside of organization.
- Conduct meaningful public engagement: discussions with stakeholders and the public significantly influenced the final design of the program.
- Make sure the program is fair and understandable.
- Build a compelling case: be able to explain it to someone who is not involved.
- Secure adequate resources.
- Make sure technology systems can keep up – e.g. do billing online and keep it green.
- In a municipal context: think of everyone it affects internally and do not assume everyone knows what you are doing.

Table 10: Municipal Utility Model Case Studies

MUNICIPALITY AND YEAR IMPLEMENTED	RATE METHOD / REVENUE EARNED	CREDIT SYSTEM IN PLACE?
Regina, 1992	Flat fee based on property size. The fee for drainage is a daily fee applied to total property size in increments of 2,000 m2.	No.
Edmonton, 2003	Charges based on impervious surface area and development intensity factor. Considerations in the calculation of rates include: (1) Area of property: lot size in square metres; (2) Development intensity: the measure of the portion of lot being utilized for its intended development; and (3) Run-off coefficient: the permeability of a surface.	Yes. An opportunity for qualifying customers to receive a credit on their monthly land drainage utility bill. Customers must demonstrate that they contribute significantly less stormwater discharge per property area to the City's land drainage systems than other similarly zoned properties.
Halifax, 2013	An annual charge based on property class.	No. Programs considered but not yet in place (Halifax Water, 2013).
Kitchener / Waterloo, 2010	Charges calculated based on impervious surface area.	Yes. Property owner can receive up to 45% off of the stormwater portion of the utility bill based on the amount of stormwater diverted from the municipal system. Approved stormwater management practices include rain barrels, cisterns, infiltration galleries, rain gardens, permeable pavement (City of Kitchener, 2014).

Prince George, on hold	The model will be a tiered flat rate funding model. Charges would be based on a property's zoning classification (e.g. residential/commercial).	No. This program has been put on hold (see Box 5).
Victoria, 2015	Charges calculated based on impervious surface area. Other activities taking place on the property that would affect the quality of the stormwater are also taken into consideration. The City uses Geographic Information System (GIS) technology, aerial photography and building plans to measure impervious surfaces on individual properties. Properties will not be metered for stormwater flows.	This program is still in development and has not been finalized. The City of Victoria website states that a credit program is being developed that will allow property owners to apply for a rainwater management credit that would be applied to their annual stormwater utility bill (City of Victoria, 2014).

Feasibility

Many of the local governments interviewed were highly interested in this tool. One participant thought it would be a useful tool for their municipality and feasible to implement. Alternatively, one participant did not agree with the concept of charging a user fee for stormwater, as user fees should be based on use and the choice to use, which is not the case with stormwater.

One of the concerns raised by participants was the difficulty in calculating user fees. In addition, it may be simpler in a more rural area because it would be easier to comparatively describe the benefits to land owners. In general, it was noted that a switch to user fees would need a large public engagement piece.

Development Cost Charges (DCCS)

Development cost charges (DCCs) are one-time charges levied on new developments to help recover the costs associated with growth (Bevan, 2010). DCCs are an instrument that

cities use to ensure that the obligations of the city to deliver certain civil services are met, and that the costs of installation are clear and transparent for the city and the developer.

There are two main approaches to the development of a DCC rate structure: municipality-wide or area-specific. Under the municipality-wide charge structure, the same DCC rate applies to a particular type of land use throughout the municipality regardless of the location of the development. This approach assumes that similar land uses generate a similar capital cost burden, and should therefore be treated equally. The area-specific charge refers to assigning different rates to the same class of land development depending on factors such as geography, zoning, or certain infrastructure needs. This type of DCC structure can encourage a compact nodal development or infill, in keeping with the official land development planning and transportation demand management goals of the municipality.

Implementation

In general, DCCs are established in order to build or expand facilities that are associated with the following services: (1) roads and highways; (2) sewage treatment; (3) water services; (4) drainage; (5) parkland acquisition and improvement (BC Ministry of Municipal Affairs, 2000).

In BC, community amenity contributions (CACs) can be charged as well. CACs are similar to DCCs but they can also be used to fund soft services, such as: (1) park space; (2) libraries; (3) childcare facilities; (4) community centres; (5) transportation services; (6) cultural facilities; (7) neighbourhood houses (CoV, 2014).

Application for Climate Change Adaptation

DCCs have the potential to fund some types of adaptation infrastructure. They can secure funds for a public capital project, or serve as incentive for developers to include specific infrastructure designs in new developments. Alternatively, DCCs can be waived if construction meets certain standards. However, waiving DCCs means reduced revenue for local governments, which may be an unpopular option as these charges are monies that local governments levy on new developments to help recover some of the capital costs resulting from development (Curran, 2010).

Benefits

DCCs can be a dependable cost-recovery tool for new development, and can be very effective when combined with other sources of funding. Provinces that already have legislation in place governing the use of DCCs experience little administrative complexity associated with this measure. Beyond being a cost recovery tool, DCCs provide the ability to strategically shape the extent and location of development in a municipality.

Limitations

While DCCs are a good way to share the costs of new infrastructure, they are a one-time fee and do not cover operation and future maintenance costs. In addition, there can be political costs in establishing development fees in the form of pushback from developers. DCCs also have the potential to distort development decisions, and may be unpopular in municipalities that are trying to attract growth. DCCs tend to be common in urban municipalities that are experiencing growth, and used much less frequently in smaller, rural, and slow-growing urban municipalities (FCM, 2012). DCCs can also potentially influence housing affordability. In BC, impact on affordability is one of the criteria for determining DCCs (CMHC, 2005).

Canadian Examples

Many cities use development charges to fund the building of new drainage infrastructure that will service new developments. BC, Alberta, Ontario, Nova Scotia and Halifax all levy DCCs to pay for water, drainage, and sewers. In addition, Nova Scotia and Halifax include stormwater in their legislation governing the use of DCCs (Baumeister, 2012). Halifax received negative press when they raised DCCs to include stormwater, but the increase remained. The City of Penticton, BC passed a bylaw in 2010 allowing DCCs to be reduced by 50% if developments achieve a score of 40 or higher on a sustainability checklist that includes items such as permeable surfaces, on-site stormwater retention, drought resistant shrubs, and green roofs.

Feasibility

The general theme emerging from discussions around DCCs are that they are widely used by larger municipalities, but are a less valuable tool for smaller municipalities. DCCs and CACs are both extensively used in the CoV, where it was agreed that they are feasible tools for adaptation purposes, such as:

- Incenting development in a specific area
- Increasing park space
- Expanding stormwater management systems

The CoV indicated that it would consider using DCC rebates, but has not yet done so. It was suggested that instead of creating a rebate system, it would be more efficient to issue grants for development that matched specific goals.

VI. EXTERNAL SOURCES OF REVENUE FOR INFRASTRUCTURE ADAPTATION

As discussed in the previous section, the current sources of revenue available to local governments in Canada are inadequate to raise the kind of capital that will be needed to invest in adaptation projects and upgrades. This section examines revenue streams that local governments can access, but that are not within their jurisdiction.

VI.1 Conventional Sources

Conventional streams are defined as sources of revenue that municipalities are already accessing.

The Federal Gas Tax Fund

Tax revenue sharing refers to an arrangement under which federal or provincial government transfers a portion of the revenue collected from a specific federal or provincial tax to a local government (Ploeg, 2006). The federal gas tax is an example of tax revenue sharing: funds from the Federal Fuel Excise Tax are transferred into the Gas Tax Fund (GTF), which is then distributed to the provinces.

Federal gas tax funding is provided twice a year as an upfront payment to provinces and territories. The provinces and territories then pass this funding to municipalities to pay for infrastructure needs. In most provincial agreements, the allocation of funds to municipalities is on a per-capita entitlement basis, with small adjustments to guarantee that smaller communities receive a base amount. These allocations are subject to change as new census data becomes available. Municipalities can pool, bank and borrow against this funding, giving the funds financial flexibility (Infrastructure Canada, 2014). The requirements for investing or borrowing against the funds differ by province.

Application to Climate Change Adaptation

Originally, gas tax funding did not target areas specifically related to climate adaptation, but as of April 1, 2014 project eligibility was expanded to specifically include disaster mitigation in the form of infrastructure that reduces or eliminates long-term impacts and risks associated with natural disasters.

Many provincial governments require local governments to develop and implement Integrated Community Sustainability Plans (ICSPs) in order to receive their gas tax transfers; however, in most provinces there is no requirement to incorporate climate adaptation measures as part of an ICSP, with the exception of Nova Scotia (CAP, 2012). Nova Scotia stands alone in its recent initiative to include climate change adaptation as a requirement to access gas tax funding (Nova Scotia Infrastructure, 2014).

Many municipalities use their gas tax allocation for projects that have resiliency aspects. For example, Quebec City used $10 million from the Federal Gas Tax fund to restore the Cyrille-Delage Dam. The dam is now better equipped to deal with flooding, as the retaining wall and banked edge were reinforced and new valve chambers controlling water flow were added. Drinking-water supply pipes were also repaired and replaced as part of the project (Infrastructure Canada, 2014).

Table 11 compares provincial allocations and adaptation requirements:

Table 11: Provincial Gas Tax Allocations and Adaptation Requirements

JURISDICTION	GTF ALLOCATION	ADAPTATION SPECIFIC REQUIREMENT?
Newfoundland and Labrador	$155,298,000	ICSP requirements but no mention of climate change.
Prince Edward Island	$78,000,000	No.
Nova Scotia	$276,776,000	Nova Scotia: "As a requirement for the 2010-14 Federal Gas Tax Extension Agreement and the Municipal Funding Agreements (MFAs), municipalities will be required to prepare and submit to Service Nova Scotia and Municipal Relations (SNSMR) a Municipal Climate Change Action Plan (MCCAP) by December 31, 2013. The MCCAP will be an amendment to the Integrated Community Sustainability Plans (ICSP), and will focus on both climate change adaptation and mitigation (Nova Scotia Infrastructure, 2014).
New Brunswick	$225,276,000	No requirement, but will need to fill out a capital investment plan to demonstrate how the funds will be used.
Quebec	$2,382,738,000	No.
Ontario	$3,873,735,000	No, need to complete an asset management plan.
Manitoba	$340,448,000	No.

Saskatchewan	$292,707,000	No.
Alberta	$1,084,983,000	Requires an ICSP, but vague specifications.
British Columbia	$1,317,040,000	Administered by UBCM, requires an ICSP but not adaptation-specific. Some municipalities have included adaptation in their ICSP.
Yukon	$78,000,000	The development of an Integrated Community Sustainability Plan is a pre-requisite to drawing down funds for infrastructure projects under the GTF.
Northwest Territories	$78,000,000	Requires an ICSP but no mention of adaptation.
Nunavut	$78,000,000	No.
First Nations	$138,999,000	No.
TOTAL	$10,400,000,000	

Benefits

Gas tax allocation amounts are usually specified in a legislated formula; this ensures consistent and predictable streams of revenue, which differentiates this funding from possibly unpredictable or insufficient grants.

With the passage of Bill C-13, Keeping Canada's Economy and Jobs Growing Act, the federal GTF became protected in legislation as a permanent annual source of infrastructure funding for Canada's municipalities at $2 billion per year (AMO, 2014). While this funding has been set up to be permanent, it is still subject to program and political changes.

Limitations

There are competing demands for GTF use within local governments, as these monies are used to finance all critical infrastructure upgrades. However, there may be opportunities to reform the Federal Fuel Excise Tax (Box 6).

BOX 6. REFORMING THE FEDERAL FUEL EXCISE TAX?

There is room to reform the federal Fuel Excise Tax to make it both more economically efficient and improve its effectiveness in pursuing environmental objectives. While a full analysis of the tax is beyond the scope of this research, it is possible to suggest the expansion of the tax to other fuels to reduce the emissions of green house gases (GHGs). By taxing GHG emissions, the funds would have a more robust link to funding adaptation infrastructure.

The federal Fuel Excise tax was introduced in 1975, and applies to fuels used in vehicles. The original purpose of this tax was to curb reliance on imported oil, and has become an important source of federal revenue, raising $5.1 billion in 2006-2007 (Mintz & Olewiler, 2008). However, the original purpose of this tax is now obsolete. Both the federal and provincial governments have the power to impose environmental taxes. Provinces are making strides with environmental taxes (such as BC's carbon tax); however, the federal government has no equivalent tax to reduce GHG emissions. As the federal Fuel Excise Tax is already in place and used to fund infrastructure, it is a logical area to consider for reform and broaden to reflect more known environmental impacts. However, consultation and cooperation with the provinces is key in moving forward with fuel tax reform to ensure there is no overlap, nor adverse impacts on competitiveness.

Feasibility

All local governments involved are already using their gas tax fund, and many depend on it. The CVRD, in particular, depends heavily on gas tax funds. The CoV has used gas tax funds for early stages of its adaptation projects.

Intergovernmental Grants

Government grants are economic awards made by federal and provincial government to eligible grantees. Usually, grants help fund a specific program, project, or outcome that serves the public. Recipients do not repay grants, but may be required to report on the project's progress. The federal government has numerous grant opportunities available throughout various departments. The most relevant to adaptation infrastructure are from the Infrastructure Canada Program (ICP), which aims to enhance infrastructure in both urban and rural communities in Canada. The involvement of municipal governments is key to its success.

Infrastructure Canada prioritizes projects in three areas of national importance: a stronger economy; a cleaner environment; and strong and prosperous communities. Infrastructure Canada grants currently include four major funds:

1. The new Building Canada Fund, which consists of the National Infrastructure Component and the Provincial-Territorial Infrastructure Component;
2. The Green Infrastructure Fund, which prioritizes new or rehabilitation-oriented infrastructure projects in the following categories: wastewater infrastructure, green energy generation and transmission; solid waste; and carbon transmission and storage;
3. The Gas Tax Fund; and
4. The Green Municipal Fund, which can offer federal grants in support of environmental projects in general, including adaptation (see Box 7).

BOX 7. GREEN MUNICIPAL FUND (GMF)

The GMF is a perpetual endowment fund established via a $550 million endowment from the Government of Canada. This fund allows the Federation of Canadian Municipalities (FCM) to fund municipal environmental initiatives through the GMF. The fund has yearly maximums for grants and loans to ensure prudent management of green infrastructure funding, and funds plans, studies and projects in five sectors of municipal activity: brownfields, energy, transportation, waste, and water.

Municipal plans eligible for GMF funding include "sustainable neighbourhood action plans, community brownfield action plans and GHG reduction plans" (FCM, 2014). Municipal studies eligible for GMF funding include technical and financial feasibility studies, as well as field tests of small-scale municipal environmental projects. If eligible, plans, feasibility studies, and field tests may receive a grant covering up to 50% of eligible costs, to a maximum of $175,000 (FCM, 2014).

In addition to grants, the FCM offers below-market loans in combination with grants to finance municipal capital projects, which may receive up to 80% of eligible costs, with a maximum loan of $10 million and a grant of up to 20% of the loan, capped at $1 million (FCM, 2014).

Design

Local government projects within provinces bear up to 33.33% of the total costs of the project, with the local, provincial, and federal governments each contributing one third of the funding. Major highways or public transit projects owned by a province may receive up to 50% of total eligible costs. Public-private partnerships and for-profit sector projects may receive up to 25% of total eligible project costs. Territories may receive up to 75% of total eligible project costs.

Application to Climate Change Adaptation

The federal government recognizes the value of resilient infrastructure when it comes to ensuring public safety, protecting public and private property, and enhancing economic security, during and after extreme weather events. Depending on the nature of the adaptation infrastructure project, it may be eligible for federal funding through the new Building Canada Fund – National Infrastructure Component. One of the eligible categories for funding through this fund is disaster mitigation. Eligible projects include: "Construction, modification, reinforcement or relocation of public infrastructure that protects from, prevents, reduces the impact and/or likelihood of, or mitigates the potential damage resulting from natural hazards, including impacts or events related to climate change" (Infrastructure Canada, 2014, p.17). Not all projects will be eligible for this type of funding: ineligible projects include normal routine, maintenance, and operational work. Further research is required by the local government to determine if a project is eligible.

Benefits

From the point of view of local governments, federal grants are often a preferred form of funding because they are a consistent source of external revenue.

Limitations

While grants may be preferred, adaptation projects need to compete with other basic infrastructure projects, such as major roads, airports, and public transit.

Canadian Examples

Town of Richmond Hill:

Climate change projections for the Town of Richmond Hill show an increase of 52mm in average annual precipitation by 2050. Due to Richmond Hill's vulnerable geography, this expected trend in precipitation levels might cause additional flood risks. Richmond Hill has established a ten-year Capital Plan for stormwater management upgrades, which ranked areas vulnerable to flooding.

The Pioneer Park Stormwater Management Facility ranked first in priority as a flood-vulnerable area.

To mitigate this vulnerability, Richmond Hill incorporated flood protection into stormwater management plans, improved the hydrological functions of Pioneer Park, included wetland and fish habitat protection in new plans, and utilized green technology to improve water quality, as well as make operations and maintenance more efficient (CAP, 2012).

The total cost of the project was estimated to reach $6.3 million. The funding was provided as follows:

1. Municipal: Town of Richmond Hill SWM 10-Year Capital Plan, $2.925 million
2. Provincial: Ontario Municipal Infrastructure Investment Initiative, $2.25 million
3. Federal: Gas Tax Fund, $1.125 million

Cowichan Valley Regional District (CVRD):

The CVRD and its member municipalities have expanded and rehabilitated a diking system to increase safety and mitigate flood events occurring in the regional centre. In 2009, this area experienced a severe flood event that affected 273 people and cost $1.5 million in damages. The new system is designed for a 1:200 year flood return period that incorporates climate-induced increases to flood levels within the river and marine environment, and includes consideration of projected increases in precipitation. In addition, the new flood protection area provides multiple benefits to the community, including an active transportation trail, habitat for species at risk, and 35,500m^3 of new fish habitat (CVRD, 2014).

The total cost of the project is $13.4 million provided through a partnership between federal, provincial and local government funds, with a ratio of roughly one third each.

BOX 8. PROVINCIAL FUNDING

In recent years, adaptation has gained prominence on the political agenda and almost all provinces now have an adaptation strategy. However, in most cases these plans are still in early stages and have yet to be tied to budgets and definitive policy. This means that funding for climate change adaptation projects is still limited. Appendix 5 presents an overview of key provincial adaptation policies and funding frameworks. While there is additional provincial planning and funding for various sectors (such as natural resources and agriculture), this overview is focused on climate resilience of the built environment).

Quebec is one of the provinces with the most substantial funds dedicated to adaptation projects, with $55 million from 2006-2013, and over $180 million from carbon pricing revenues outlined in the 2013-2020 plan (Boyle et al., 2013). This provincial money is a one-time investment, meaning the municipality is responsible for the cost of maintenance over time as well as a portion of the total initial budget.

Sept-Îles, a coastal municipality in Eastern Quebec, was approved for $6 million to rebuild sandbanks to adapt to rising sea levels. However, Sept-Îles still needed to raise $2 million for initial costs and enough to cover maintenance. The local government decided to use a tax levy to raise the needed funds, but could not obtain public support. This was in part due to the levy being applied to all residents, while only the oceanfront property owners would directly benefit. Sept-Îles ended up declining the provincial funds, as the local government did not have a means of acquiring their required portion (Arlington Group et al., 2014).

Feasibility Study

Local governments depend on grants to help undertake projects that they could not achieve using taxpayer money alone. The local governments interviewed all shared anecdotal evidence about projects they funded through intergovernmental grants. The most noted obstacle to receiving intergovernmental grants is the time and money

associated with the application process. One local government interviewed shared that a recent application for a multi-million dollar grant cost upwards of $500,000 in staff time, engineers, and consultant fees.

One criticism mentioned by several governments interviewed was that, due to the restrictions for receiving the grant, the type of infrastructure project pursued by the local government is dictated more by what the federal government will help pay for, rather than what is most needed by the local government. As local governments in Canada look to make progress in the area of adaptation infrastructure, the limitations of intergovernmental grants may hinder local governments moving forward in this area.

VI.2 Innovative External Revenue Sources

As local governments have many competing priorities and limited funds to carry out all of their responsibilities, it is necessary to examine potential new or innovative revenue streams. The options presented below are possible funding sources, recognizing that they describe a diversion from the status quo for local governments and require significant discussion at all levels of government before they could be utilized. In sum, creative and innovative funding options for adaptation projects may have potential for future use, but they will require strong political will to implement.

Public-Private Partnerships (P3s)

A public-private partnership (P3) is a contractual agreement between the public and private sector, where the private sector provides a project or service while assuming some operational or financial risk (Hanniman, 2013). In the local government context, a municipality may collaborate with a private company on delivery of a specific infrastructure project or package of services. For example, a private company will build a transit line or a hospital, provide capital financing, and often include private operation and maintenance services for a set period of time (FCM, 2002). P3s are an interesting financial tool because they allow the local government to maintain ownership of an infrastructure asset, while transferring a portion of the associated project risks and maintenance – as well as the benefits – to private sector partners.

Although there is wide variation in the structure of P3s, they generally include one or

more of the following features (Kitchen, 2006):

1. The private sector operates the facility for a fee, while the public sector retains responsibility for capital costs.
2. The private sector leases or purchases the facility from the public sector, operates the facility, and charges user fees to the public sector.
3. The private sector builds or develops a new facility, or enlarges or renovates an existing facility, and operates it for a number of years before transferring ownership to the public sector.
4. The private sector builds and operates the facility and is responsible for capital financing, while the public sector regulates and controls the operation.

Application to Climate Change Adaptation

The current structure of P3s works for projects with traditional returns on investment, such as facilities that can be funded through user fees. However, there is a possibility that CCA could be integrated into current classic infrastructure projects, if done holistically.

The private sector is motivated by profit, which means they are unlikely to invest in a project if there is insufficient return on investment (ROI). Adaptation addresses the loss of value as the result of climate change, while P3s are usually utilized in cases where there is the creation of additional values, meaning it can be contradictory for the private sector to fund adaptation.

P3s are suited for infrastructure projects that create a revenue source for the private partner, such as public transit infrastructure. Integrating adaptation infrastructure into other infrastructure projects, such as residential development projects, could facilitate the applicability of P3s for CCA. For instance, P3s become particularly interesting when a socio-economic business case for CCA exists. Several studies show that BGI has a positive effect on real estate prices (Leonardsen, 2013) due to improved quality of life and neighbourhood attractiveness; it may therefore be possible to engage non-traditional private investors, e.g., real estate funds, pension funds or other large capital funds.

Benefits

P3s are an attractive option for large infrastructure projects because financial risk management incentivizes private partners to complete projects on time and on budget. In addition, projects can be completed faster than scheduled to avoid increased debt load and capitalize on private sector expertise.

It can also be argued that, because the private sector operates in a competitive environment, it is more innovative in infrastructure design, construction, and facility management when compared with the public sector (Kitchen, 2006), potentially leading to innovative project design and optimized facility operation.

Limitations

The successful management of any form of P3 scheme requires a high level of financial expertise and oversight (Craft et al., 2012).

Examples

While examples exist in other countries (Box 9), there are no Canadian examples to date of P3s being used for infrastructure adaptation.

BOX 9. PRIVATE ADAPTATION: THAMES WATER, LONDON, UK

Thames Water is a privately owned utility company that currently provides 76% of the water supply to the population of Greater London. It is the UK's largest water and sewage company, and is currently adapting operations by putting new design standards in place to prevent sewer flooding, improving water efficiency, and working with stakeholders to determine how to maintain service levels as climate impacts occur (Nitken et al., 2009).

Business Case

As the successful operation of Thames Water depends on the natural environment, the impacts of climate change will be felt in all aspects of its business. Therefore, Thames Water is adapting to the impacts of climate change as part of its core business and risk management strategies. It is cost-effective for Thames Water to proactively address issues related to climate changes and make appropriate investments, rather than responding after impacts have occurred (UNFCC, 2014).

Feasibility

None of the local governments we spoke to had administered P3s. The general consensus was that they are very complex legal agreements, and are only worth doing if a project is worth over $60 million. There was also difficulty envisioning what kind of adaptation project would fit the characteristics of a P3, such as identifying initiatives that would be large enough to justify this approach.

The smaller municipalities had no interest in P3s and did not see themselves feasibly ever doing one. The CoV, while it did not have a project in mind, could imagine a P3 being possible and the CVRD is exploring future options.

Carbon Fund (BC Only)

One hundred and eighty-two of the 190 communities in BC signed the BC Climate Action Charter, voluntarily committing to carbon neutral operations by 2012. Signatories achieve carbon neutrality[1] by measuring total corporate GHG emissions; reducing emissions where possible; balancing unavoidable emissions by purchasing carbon offsets; or investing in local community-based GHG reduction projects (Government of BC, 2014). Corporate emissions refer to the emissions associated with government services, such as building energy use, fleet vehicles, and some contracted services. The yearly level of emissions determines the amount of carbon offsets the local government is required to purchase to claim neutrality. Some municipalities in BC have established a carbon fund to redirect money from purchasing carbon offsets to fund GHG reduction projects that will have local impact. The price of carbon in BC is currently set at $30/ton.

Design

A carbon fund functions in essentially the same way as a reserve fund, with the key difference being that funds collected must be used for mitigation or adaptation projects.

Application to Climate Change Adaptation

Currently, local governments with an established carbon fund use the fund primarily to finance GHG reduction projects. Many climate change mitigation and adaptation strategies are complementary; therefore, supporting adaptation actions with money from a carbon fund is possible if the project combines mitigation and adaptation actions. Examples of combined actions include green infrastructure, power system resilience, sustainable

1 In this context, “carbon neutral” refers to zero net release of GHG emissions into the atmosphere due to government operations.

transportation, water and energy conservation, and building weatherization (Winkelman and Udvarady, 2013). Alternatively, local governments could extend this policy to explicitly allow the carbon fund to finance adaptation actions.

Benefits

A key benefit is that local governments have control of how the funds are used, and they may collect interest on money held in a carbon fund.

Limitations

Revenue collected may not cover the cost of large infrastructure projects.

Canadian Case Studies

The District of Saanich, BC decided to create the Saanich Carbon Fund instead of using taxpayer money to purchase offsets. Currently, the fund finances corporate GHG reduction projects, such as solar hot water, geo-exchange, photovoltaic systems and carbon sequestration within Saanich. The District of Saanich's website outlines the principles of the Carbon Fund:

1. Reduction of GHG emissions is the first priority, with the ultimate goal of reducing the carbon footprint to the lowest possible level using currently available technology.
2. The carbon fund will respect the principle of "additionality," which means that these funds will only be used for GHG-reducing projects that would not normally be undertaken as part of the municipality's capital expenditure plan.
3. Priority for project funding from the fund will be given to those projects that have the highest and most immediate impact on GHG emissions, e.g., replacing fossil fuel use such as natural gas water heating at a municipal pool with solar hot water.
4. Projects funded by the Carbon Fund will be located within the boundaries of the

District of Saanich, preferably on municipal or public lands.

5. Each year, Saanich's GHG inventory is updated by Saanich or Capital Regional District staff in order to reflect actual GHG emissions for that year.

Subject to the size of Saanich's remaining carbon footprint, as expressed in tons of GHG (equivalents), a dollar amount equal to the prevailing market value of a ton of carbon will be set aside in the annual financial plan for inclusion in the Carbon Fund (District of Saanich, 2012).

Feasibility Study

All the local governments interviewed are capable of creating a carbon fund; however, interest in doing so varied. Of the local governments that were uninterested, two were able to claim carbon neutrality without purchasing carbon offsets, and one purchased a relatively low amount of offsets from a local offset provider. One local government was interested in the idea but identified the cost of verifying the offsets from corporate GHG reduction projects as a potential obstacle, as the cost of verification by a third party would likely exceed the cost of the project.

The results of our feasibility study revealed that a carbon fund is useful for a local government that possesses the need to purchase a significant number of offsets, the political will to support local projects, and the administrative capacity to run mitigation and adaptation projects. As local governments improve the energy efficiency of corporate operations, the number of offsets purchased will decrease. Without purchasing a significant

number of offsets (more than $10,000), the administrative costs of running an internal program may exceed the amount collected yearly in the carbon fund.

Climate Action Revenue Incentive Program (CARIP) Grant (BC Only)

The CARIP grant is a conditional economic incentive provided by the Province of BC to Local Government Charter signatories. The amount of the grant is equivalent to 100% of the carbon tax paid by the local government, so the grant program acts as a reimbursement to the local government of the carbon tax paid. The intention behind the grant is for the local government to use the grant to further reduce GHG emissions; however, there are no stipulations on how the money is to be used by the local government. This flexibility allows the local government to use the grant on anything, including adaptation responses they deem a priority. A requirement of the program is that local governments must announce the actions they are taking to achieve carbon neutrality through their CARIP public reports.

Design

The CARIP grant is a tax reimbursement for local governments that meet certain requirements. In 2012, the total amount reimbursed to local governments from the CARIP grant was $5 million (BC Ministry of CSCD, 2012).

Application to Climate Change Adaptation

As there are no stipulations for how the CARIP grant is used, the local government may apply the grant to climate adaptation actions. Climate change adaptation projects can be combined with, or help contribute to, GHG emissions reduction through, e.g., increased green spaces to uptake GHGs, green transportation routes for bicycles, etc. In many cases, the amount the government receives through the CARIP grant is minimal in comparison to adaptation project implementation costs; however, grants could contribute to a long-term infrastructure fund or be used for adaptation planning.

Benefits

This tool represents a dependable source of revenue and there do not appear to be constraints on how resources may be used.

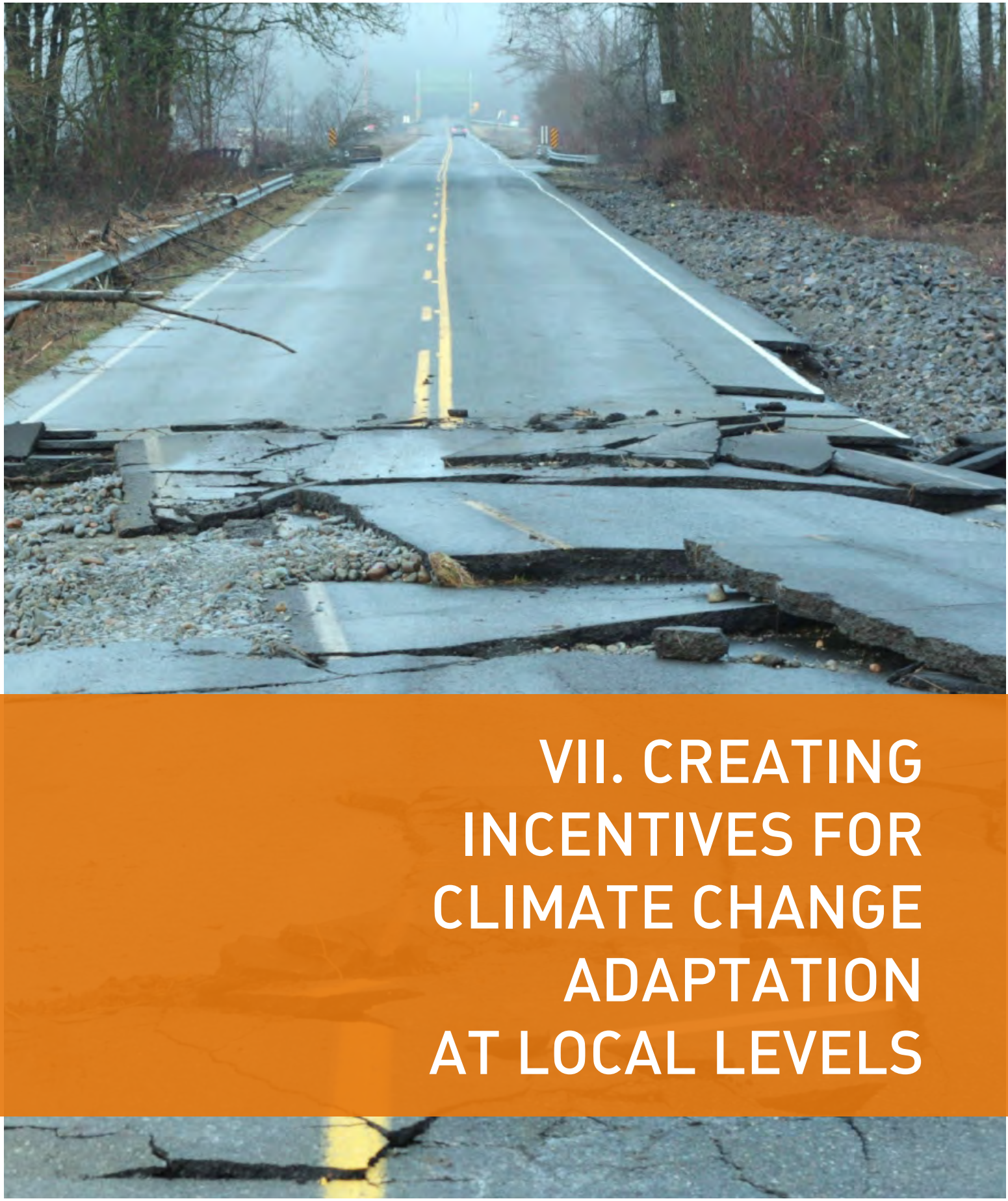
Limitations

Political will is required to use the money for adaptation responses.

Feasibility Study

The local governments interviewed all receive the CARIP grant. A common theme amongst interviewees is using the CARIP grant to support existing environmental initiatives, or to purchase offsets required to claim carbon neutrality. For the smaller municipalities interviewed, the amount of the CARIP grant closely matched the cost of the offsets they purchased each year. However, the CoV and the CVRD do not purchase offsets, but use the revenue to broadly support the government's community environmental initiatives.

The CARIP grant has the potential to be used for adaptation responses if the response is incorporated into the realm of projects the grant is already supporting. Given the fiscal constraints of local governments, it may prove challenging to divert CARIP funding to an adaptation response if doing so would undermine existing programs.



VII. CREATING INCENTIVES FOR CLIMATE CHANGE ADAPTATION AT LOCAL LEVELS

A number of instruments may be used to create incentives for climate change adaptation at local levels. While these instruments are not a source of fiscal revenues to local governments, their aim is to reduce the need for public investment in adaptation infrastructure.

Local Financial Incentives and Rebates

A local government may offer local residents incentives to encourage a certain type of construction, appliance, or behaviour. Incentives include municipal property tax exemptions and rebates for purchased items that achieve specified goals, such as energy or water savings.

As incentives and rebates are not a source of funding, local governments may consider using this tool in combination with a cost-recovery program, such as a stormwater levy, to encourage adaptive behaviour. For example, if a new levy charged homeowners based on the extent of impervious surfaces on their property, homeowners could have that levy reduced by meeting certain criteria, such as having a green roof, rain barrels, pervious cement, etc. The levy in and of itself creates an incentive to have onsite stormwater management measures, but rebates create extra incentive to take action, as they assist homeowners to overcome financial barriers to taking adaptive actions. As policies change to meet adaptation standards, local governments may increase public acceptance of policy changes if they provide homeowners with financial support to meet new guidelines.

Incentives are not limited to the property level and can come from all levels of government in many forms. For the purposes of this report, this section on incentives and rebates focuses on the local level.[1]

Design

The design of a rebate or financial incentive program will largely depend on the adaptation goal of local government. As the goal of the program is to incent an action, the incentive must be large enough to capture a portion of the population that would have not otherwise taken such an action. Many local governments have experienced success with rebates

1 For more information on Canadian financial incentives, please visit Natural Resources Canada's website on the subject: http://www.nrcan.gc.ca/energy/funding/efficiency/4947.

coupled with local policy changes such as green roof by-laws (City of Toronto) and water utility cost increases (Town of Cochrane).

Depending on the incentive, the local government may be required to provide upfront funding for a rebate program or forego collecting associated property tax revenue. The structure of financing for such incentives must be clarified in the design phase.

Application to Climate Change Adaptation

Incentives and rebates can be a good way of encouraging small-scale adaptation projects as well as providing a source of public education. However, they are not a funding source per se, because they take revenue away from municipalities instead of providing it. A way around this would be if the local government taxes a new service, for example stormwater management. The local government could waive some or all of the tax if certain measures were taken, which could be promoted via rebates.

Local governments may view rebates and incentives as an alternative funding source, because providing incentives to the public might cost less than paying for the cost of implementing certain actions themselves.

Benefits

Incentive and rebate programs have the potential to encourage actions that might not otherwise happen. Such programs can reach private homeowners in ways traditional financing tools cannot. Such programs also allow the individual responsible and benefiting from the assets to pay for a majority of the cost of the action.

Limitations

Incentives and rebate programs cost local governments money, although they can be an effective means to ease public resistance to policy or by-law changes. In addition, rebate programs focused on water or energy conservation have been criticized for not actually creating additional savings because those purchasing new appliances would likely have chosen high efficiency models regardless of the rebate due to updated product lines (Brennear, Lee & Taylor, 2013).

Case Study Examples

In 2009, the City of Toronto implemented the Eco-Roof Incentive Program as a key element of the City's Climate Change Action Plan, coupled with a green roof bylaw. The incentive program provides a subsidy for green roof construction in buildings that do not fall under the bylaw.

Toronto provides the following Eco-Roof incentives:

- Eligible green roof projects will receive $75 per square metre up to a maximum of $100,000.
- Eligible cool roof projects will receive $2-5 per square metre up to a maximum of $50,000.
    - Cool roofs with a coating applied over an existing roof are eligible for $2 per square metre.
    - Cool roofs with new membranes are eligible for $5 per square metre.

The Town of Cochrane, a municipality just outside Calgary, Alberta, offers numerous rebates to its citizens. The program was initially implemented to assist residents to become more water efficient, as the municipality was increasing water utility costs. Rebates focus on water conservation and include incentives for mulch, fescue, rain barrels, climate-based irrigation, and high-efficiency toilets and washing machines. Cochrane is an excellent example of a small municipality using rebates to incentivize individual actions to achieve municipal water conservation goals.

There is a provision in British Columbia's Community Charter for "revitalization tax exemptions," which refers to property tax exemptions that can be applied to environmental revitalization projects such as the use of "green" approaches to management of stormwater drainage (BC Ministry of Community Service, 2008). Section 396E of the Vancouver Charter allows for the same type of tax exemptions.

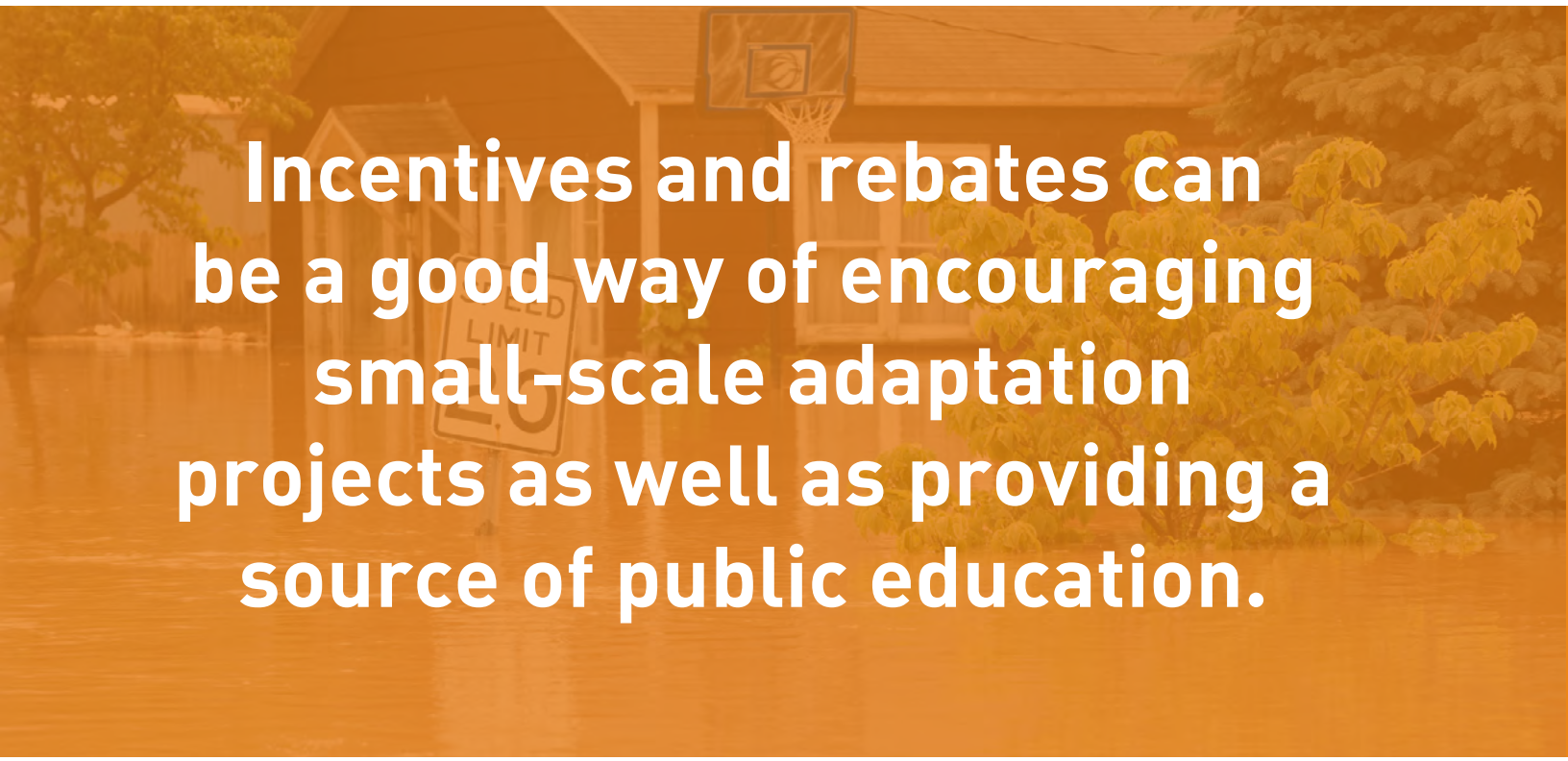
Feasibility Study

Local governments in Canada are already utilizing household incentive and rebate programs to meet community policy goals. The local governments interviewed felt that

use of a similar program to reach adaptation goals was feasible; however, they have yet to identify a project suitable for a rebate or incentive program. Obstacles discussed included the high administrative costs of running such a program in small municipalities, as well as the need to identify appropriate projects that could align the local government's adaptation goals with an appropriate incentive or rebate.

Local Improvement Charge (LIC) Financing

Local Improvement Charge (LIC) financing consists of offering a specific bond to investors and using the proceeds to loan residents capital towards a housing retrofit. The bond issued is low risk because the repayment is tied to property ownership. Homeowners repay the loan over the assigned term (typically 15 or 20 years) via an annual assessment on their property tax bill. One of the most notable characteristics of LIC financing is that the loan is attached to the property rather than an individual. LIC financing programs are very popular in the US, where they go by the name of PACE (property assessed clean



energy). Traditionally, PACE programs are used for energy retrofits, but can be used to finance resiliency upgrades as well (Box 10). This model of financing has not received the same level of uptake in Canada.

BOX 10. PROPERTY ASSESSED CLEAN ENERGY (PACE) IN THE U.S.

PACE programs have been very popular and successful in the US, with nearly 500 municipalities setting up programs (Klimovich et al., 2014). However, as of July 2012, the Federal Housing Finance Authority (FHFA) objected to local governments holding the first lien on PACE homes, ensuring the repayment of public funds if the home goes into foreclosure. The reasoning behind this objection is that it can pose significant risk to the mortgage financier. This objection has stopped existing PACE residential programs and halted the development of dozens of others nationwide (Sustainable Cities Institute, 2014). The development and implementation of residential PACE programs continues to be on hold until the rulemaking process is complete. The rulemaking does not affect commercial PACE programs, which continue to be established in communities nationwide.

With that said, there has been recent innovation in the US connecting PACE models to resiliency upgrades. The PACE program in Florida can fund wind mitigation improvements such as: strengthen roof deck attachments; a secondary water barrier to prevent water intrusion; wind-resistant shingles; gable-end bracing; reinforced roof-to-wall connections; storm shutters; and opening protections. The cost savings with these upgrades come from property insurance premium reductions (Florida PACE, 2014).

The Pembina Institute has completed a report examining the costs associated with setting up a LIC financing program (Peters et al., 2005). Identified costs include:

1. Interest on capital expenditures – the municipality will need to have funds available to pay for improvements as they are completed and approved.

2. Staff transactions – municipal staff need to devote time to establishing the initial program parameters, dealing with contractors and property owners for LIC financing requests and approvals, and tracking LIC financing payments.
3. Council transactions – in addition to approving the initial program launch, municipal councils are typically responsible for approving all LIC financing in the form of a bylaw.
4. Advertising – to facilitate adoption of the program by building owners, the municipality will need to promote the program.
5. Contractor certification – the municipality will need to have a list of certified contractors for property owners to approach when making improvements.

Application for Climate Change Adaptation

LIC financing has found some applications for climate change adaptation (see Table 12). LIC financing could be used to loan residents funds for resiliency upgrades, such as backwater valves to lower the risk of flooding, or wind-resilient windows. One of the reasons PACE financing has been successful for clean energy is because the cost savings in energy use are often higher than the loan repayments. This financing model could be easily extended to fund infrastructure such as green roofs, as they are improvements that have adaptive benefits as well as energy savings on heating and cooling. In addition, as the repayment of the loan is tied to a property and not a person, it aligns the long-term benefits associated with adaptation retrofits.

Benefits

Financing can be made available to property owners of all incomes and mortgage amounts, including those that might need to pay premium interest rates to obtain a loan from a private lender. In addition, LIC financing may be more attractive to owners who intend to sell the property in the near term, and might otherwise be unwilling to make a large investment in a retrofit. The reason for this is that the LIC financing debt is tied to the property, not to the property owner, and the new owner upon transfer of the property assumes any outstanding debt. Municipalities are protected from default by the property lien attached to LIC financing, so they are able to offer financing at lower interest rates than other financing options (Environmental Commissioner of Ontario, 2012).

Limitations

This type of funding is currently limited to individual home retrofits, and is not appropriate for financing large projects. In addition, PACE has been focused on energy retrofits because these measures save money and help to repay their investors, while other adaptation measures, such as flood proofing, may not generate revenue. Improperly structuring LIC financing-related liabilities can pose a threat to a municipality's finances. For example, if LIC financing bonds are structured as a "general obligation" of the municipality, then the debt might create a direct liability to the municipality's general fund, count against its debt limit, and/or impact its credit rating (Sustainable Cities Institute, 2014).

Feasibility

The participants had mixed views on LIC financing. While some thought it was an interesting idea with potential, others felt that issuing loans was beyond the role of municipalities. The municipalities that showed interest estimated that the biggest challenge would be making the business case and securing buy-in from the community. It would also not be possible for a municipality to go into debt to float the loan. One idea was that the municipalities show support for the program, but have it administered by a financial institution. Participants generally agreed that an advantage of promoting this kind of program included raising the level of awareness about individual actions that property owners could take in order to make their home more resilient to the impacts of climate change.

Table 12: Selected Canadian Examples of LIC Financing

PROGRAM NAME	UPTAKE AND COSTS	FINANCING MODEL AND EXPERIENCE
Halifax Solar City **Approved by Council December 2012**	By February 2014, 250 homes participating in the program $8.3 million	Turnkey financing. In this model, municipalities opt to provide an exclusive source of funding. Advantages: Funding immediately available for projects; simple model. Disadvantages: Can deprive building owners of choice, and the fees and administrative costs may not be as transparent as in markets with open market competition.
Vancouver HELP **Approved November 2011**	Program was unsuccessful	Participating homeowners to have an "energy audit" by federally licensed auditors, who would recommend the best methods for reducing the home's carbon footprint. Homeowners could then select from a list of pre-approved contractors and apply for up to $10,000 in financing from Vancity Credit Union, the City's partner. The amount was calculated after equipment rebates had been applied from partner utility companies, including Fortis BC and BC Hydro. The 10-year VanCity loan, with a fixed interest rate of 4.5%, would be collected through the city's annual property tax bill. Limited intake because (1) Dropping energy rates in Vancouver; (2) misjudged interest rates, and (3) people were not used to the city functioning as a financing institution.
Ontario CHEERIO	Pilot projects underway	Will differ depending on municipality, but loans will come from Infrastructure Ontario.

Nelson EcoSave program. **Pilot program in April 2012**	The pilot phase of the EcoSave program was two years long.	Loans made through Nelson Hydro. During the pilot phase, 431 people registered with the program, 309 participants completed a pre-retrofit energy assessment and 107 participants completed a post-retrofit assessment, meaning they made upgrades of some kind to their home. Maximum loan amount is $16,000. Choice of 5- or 10-year term (5-year renewal date). 3.5% fixed interest rate (interest rate subject to change at the beginning of each year). $100 processing fee charged each time funds are dispersed to the participant.

Density for Benefit Agreements (Bonuses/Transfers)

Zoning bylaws stipulate the allowable Floor Area Ratio (FAR) a developer can include in a development. Density bonuses permit an increase in the FAR in exchange for a defined amenity or housing need (Bevan, 2010). Amenities and housing needs commonly exchanged include parks, heritage preservation, affordable housing, and green infrastructure. In theory, the additional density creates an uplift, or additional profit, for the developer. The uplift does not belong solely to the developer, who exchanges amenities or cash with the municipality for the opportunity to earn higher profits. The municipality must establish the density bonuses through zoning bylaws that set out the specific conditions needed in order for a development to receive the increased FAR (Government of BC, 2014).

Density for benefit agreements are commonly used in large municipalities in Canada; however, they are not a common practice in smaller municipalities, which typically develop at slower rates and thus often cannot exploit the same opportunities the market provides to larger municipalities.

Design

Density for benefit agreements are used by many local governments across Canada

and the US, and follow a simple design process. In most instances, the benefits are predetermined. In most regions, the distribution of density bonuses is done in a systematic way following provincially legislated rules. In large municipalities, such as Vancouver and Toronto, the process is *ad hoc*, i.e., the benefits secured are negotiated on a case-by-case basis.

Application to Climate Change Adaptation

Density bonuses may provide an incentive for developers to include resilient infrastructure such as green roofs, cool roofs, and onsite stormwater management infrastructure in exchange for more floor space, more housing units, and taller buildings (Government of BC, 2014). Alternatively, an adaptation-oriented density bonus program could be designed to allow developers to contribute to an adaptation fund in lieu of building resilient infrastructure on their property in exchange for a density bonus.

In Vancouver, density transfers are used to maintain the historical integrity of a neighbourhood. The aim is to balance the need to maintain heritage buildings with the need to increase density of an area. In some circumstances, adding density is restricted by the heritage building bylaws. To address this issue, the City has established areas that are density "donor sites" and density "receiver sites," which allow developers to transfer bonus density to other sites that have more development potential. Density transfers could be used to incent more development in areas that are less vulnerable to climate change impacts by transferring density out of at risk areas (donor sites) to low risk areas (receiver sites).

Benefit

The developer receives increased FAR in an area not previously zoned for that density and the local governments receive amenities that help achieve planning and policy objectives. When amenities are more appropriately located elsewhere, developers may provide cash-in-lieu that can be used by the municipality to build elsewhere.

Limitations

Density for Benefit Agreements are limited to site-by-site basis and are most suitable for areas with strong housing markets, high land values, and artificially constrained development capacity (Puget Sound Regional Council, 2008). The program is an unreliable source of revenue/amenities. The infrastructure traded for density must bear direct relation to new development.

Canadian Case Study

UniverCity at Simon Fraser Unversity on Burnaby Mountain, BC offers a Green Building Bonus to incent developers to exceed the community's existing Green Building Requirements. Developers receive up to 10% additional density in exchange for including optional features, such as enhanced stormwater management practices, including green roofs, interflow zones, detention trenches, deep soil planters, cisterns, etc. (SFU Community Trust, 2013).

UniverCity developers receive up to 10% additional density in exchange for including optional features, such as enhanced stormwater management practices

Feasibility Study

Density for benefit agreements are commonly used in larger municipalities across Canada. The CoV currently uses them to develop additional amenities for communities. Those in existence do not yet include climate change adaptation responses, but when the City decides such actions are necessary, such agreements may provide a viable tool with which to implement responses at the individual property level. The smaller municipalities interviewed were limited in how much bonus in density they can approve due to small property sizes, which do not allow for increased density as they are constrained by other by-laws such as parking restrictions. Density transfers are also difficult for them as the land base they can draw upon is limited and therefore cannot accommodate donor and receiver sites.

This tool tends to work well if market rents, home prices, and/or land values are high, and land is scarce.

Natural Area Tax Exemption

Natural area tax exemptions incentivize the protection of natural areas on private property in exchange for a property tax exemption for the land protected. The aim of such programs is to alleviate pressure on property owners to develop land that holds ecological value. This program places the protected land into a covenant, which is a long-term, legally binding, protective agreement. Future landowners must abide by covenant regulations. A covenant is not a land acquisition tool, however, as property ownership and rights remain with the property owner.

Currently, property tax exemptions available in Canada vary from 65-100% for the portion of land protected. In addition to helping private landowners, these exemptions also help charitable, non-governmental land trusts cover the carrying costs of accumulated land holdings.

Design

Determine lands and features that are eligible for the program. The Natural Area Protection Tax Exemption Program (NAPTEP) in the Gulf Islands has specific criteria, for instance:

- Areas relatively undisturbed by human activity that house important ecosystems such as forests over 80 years old, woodlands, water features, sparsely vegetated natural areas, coastal bluffs, etc.
- Areas relatively undisturbed by human activity that are key habitat for rare native plant species or plant communities.
- Areas that are critical habitat for native animal species in relation to breeding, rearing, feeding or staging.
- Special geological features (Government of BC, 2008).

The NAPTEP has a two-phase application process. Phase 1 determines the eligibility of the property for the program. Once deemed eligible, Phase 2 registers a NAPTEP covenant on the property title and issues the property owners a Natural Area Exemption Certificate. Other design criteria to consider include:

- Legal advice for developing and amending the covenant
- Tax and financial advice for reviewing your situation to ensure the program is right for you
- A survey of the proposed covenant area(s)
- A report on the current state of the covenant area and its ecosystems prepared by an approved environmental professional
- Covenant registration costs
- A voluntary endowment to cover future monitoring costs that is eligible for a charitable receipt (Government of BC, 2008)

Application to Climate Change Adaptation

As the value of blue-green infrastructure (BGI) for adaptation becomes clearer to local governments, maintaining and protecting ecologically-rich areas may become more economically beneficial. For instance, areas that capture and hold excess rainwater during large rain events may be more economical to protect than construction of new stormwater infrastructure to address projected extreme storm events. Protecting natural areas by providing property owners with a tax exemption may provide an economically viable solution to achieving ecosystem maintenance goals.

Benefits

Natural Area Tax Exemptions support the maintenance of ecosystems that provide adaptation measures for a region or specific site without local government needing to purchase land. The tool is simple to implement and has low administrative costs.

Limitations

Natural Area Tax Exemptions may not be beneficial for smaller properties, as the tax exemption may be less than the administrative fees. In addition, there are many property types (agricultural and forest land) with other eligible tax exemptions; only residential properties are eligible for property tax exemptions. Similarly, property taxes are a large source of revenue for local governments; this tax exemption will lower the amount of property tax collected. Last, covenants are permanent, thus actions of future property owners are restricted. Violation of the covenant at any time may result in penalties such as repayment of all past tax exemptions plus interest, as well as fines for each infraction.

Canadian Case Studies

Table 13: Canadian Natural Area Tax Exemption Case Studies

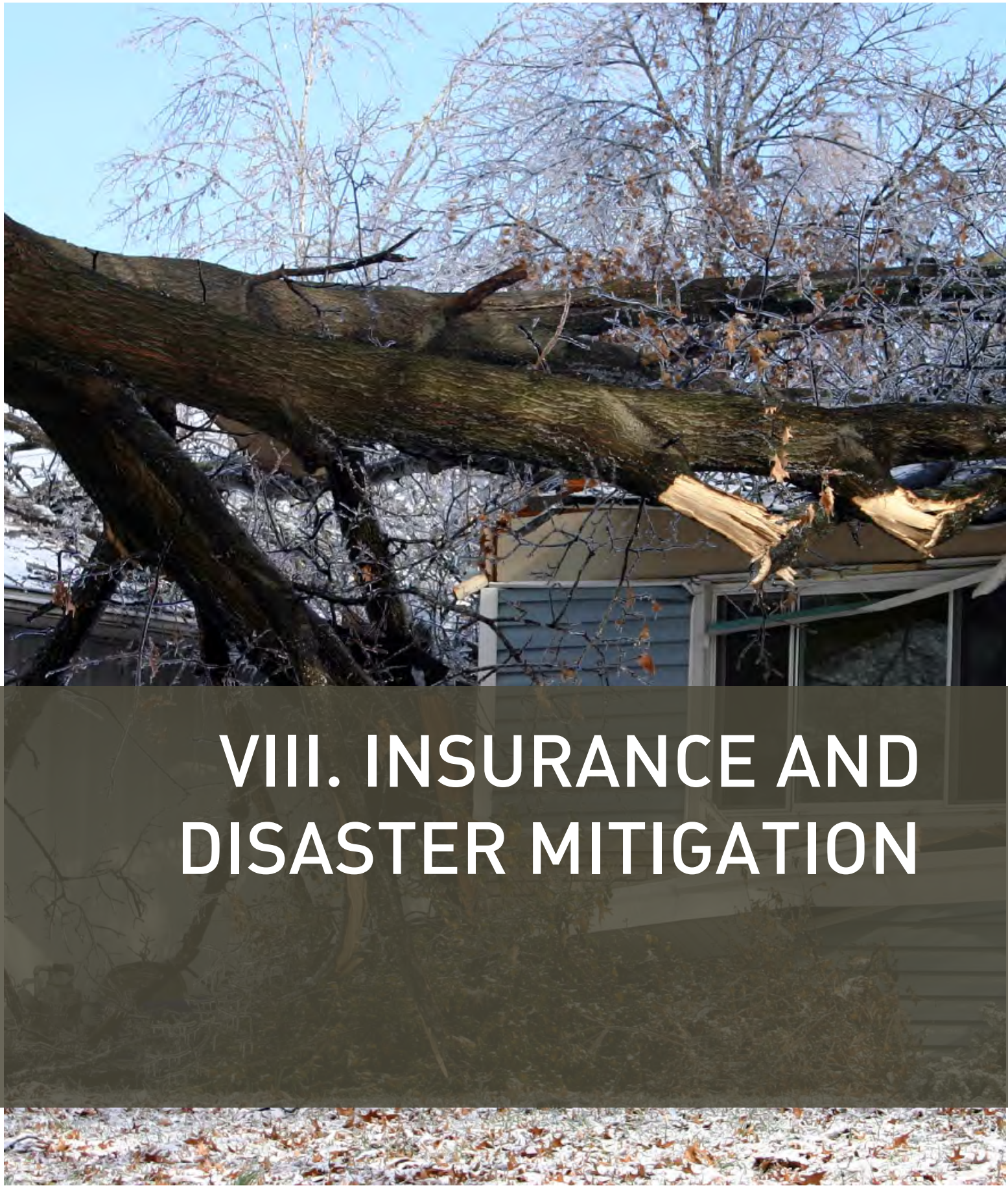
PROGRAM	REQUIREMENTS	ELIGIBLE LAND
Ontario's Conservation Land Tax Incentive Program (CLTIP)	• Land must meet eligibility requirements and be 1/5 of a hectare (1/2 acre) or larger in size (Ontario 2014) • Property owners must commit to protecting the designated portion of your property and allow Ministry of Natural Resources and Forestry staff to inspect it if requested (Ontario 2014)	• Provincially significant wetlands • Provincially significant areas of natural and scientific interest (lands with significant geological and biological features) • Niagara Escarpment natural area (lands in a natural state and associated stream valleys, wetlands and forests that are relatively undisturbed) • Habitats of endangered species, where specific guidelines for the CLTIP have been developed • Community Conservation Lands (restricted to non-profit charitable conservation organizations and conservation authorities)" (Ontario 2014)
Nova Scotia's Conservation Property Tax Exemption (Nova Scotia, 2014)	• All land owners, including non-governmental, charitable conservation land trusts • Province compensates municipality for lost revenue	• Land owned or held for the primary protection of biodiversity and natural processes • Industrial and commercial practices are prohibited on the land • Designated ecological site or wilderness area

Canada's Natural Area Conservation Program (NACP) (Environment Canada, 2013)	• Helps non-profit and non-governmental conservation organization purchase and protect sensitive ecosystems, habitat and wildlife • Federal government matches funding to purchase land	• Significant national or provincial land • Habitat for species at risk or migratory birds • Land providing or enhancing corridors between National Parks, National Wildlife Areas, or Migratory Bird Sanctuaries *** The federal government also provides tax benefits to landowners who donate land to create enhance wildlife habitats or ecologically sensitive areas through the Ecological Gifts Program

Feasibility Study

The municipalities interviewed had the ability to implement tax rebate programs; however, they outlined several obstacles to using this tool for adaptation purposes. For instance, they have not identified, or do not have, natural areas within their boundaries that can act as adaptation infrastructure. Without intact natural areas on private property providing this service, the tool is not applicable. The second obstacle identified was that providing a property tax rebate would require the municipality to raise property taxes overall to compensate, which would likely prove politically difficult without an extreme weather event occurring first to drive home the risk to property owners.

Furthermore, despite expressing interest and having the land area appropriate for utilizing this tool, the CVRD does not have the authority to provide property tax exemptions, because they collect their portion of property tax from the municipalities and the province, not from property owners directly. As a result, this tool is not applicable at the regional level. The Islands Trust is able to utilize this tool because their Letters Patent are different than those of the regional districts. Amending the Letters Patent for regional governments in BC would be required for this tool to be applicable.



VIII. INSURANCE AND DISASTER MITIGATION

Greater effort on the part of households and companies to protect themselves against climate-related adverse events is warranted. Two areas that merit further research are: additional insurance instruments provided by the private sector, and reform policies surrounding disaster relief. Private insurance instruments may have potential to be structured to provide incentives for property owners to invest in adaptation.

This would shift the burden from the public to private sector, hence reducing the need for public financing and funding. Restructuring of federal disaster relief in coordination with the availability of private insurance would reinforce positive incentives to adapt.

These two areas were not evaluated through the framework or ground-truthing because they are not within municipal jurisdiction and require action from other levels of government to implement.

Insurance

Insurance is an agreement in which, for a payment (a premium), one party (the insurer) agrees to pay to the other (the insured) a defined amount if a specific loss occurs (Sandink & McGillivray, 2014). Insurance companies measure and put a price on individual risks, such as the risk of property damage from an extreme weather event, and charge the insured a premium to secure them against the loss. The insurer sets its premiums based on expected losses from the covered properties. Risks that are difficult to diversify across premium holders if the adverse event is catastrophic (e.g., major earthquakes, floods) will be more expensive. Similarly, events that are catastrophic but affect only a small number of parties (e.g., rare fatal diseases) are also difficult and expensive to insure. Finally, if the likelihood of an extreme adverse event is difficult to quantify, insurance is more challenging to provide. All these situations can apply in the case of climate change.

Property and casualty insurance are the most vulnerable sectors to the impacts of climate change. In the past 30 years, the cost of claim payouts due to extreme weather events has increased 15-fold (IBC, 2014). In addition, 2013 was the fifth year in a row that insured losses from extreme weather events was near or above $1.5 billion in Canada. Insured losses in 2013 alone were over $3 billion (IBC, 2014).

These high numbers cannot be attributed solely to a changing climate, as cities are also becoming larger, attracting more people, and requiring more infrastructure. However, the increasing variability and intensity of weather is felt by the insurance industry in Canada and abroad. Therefore, the insurance industry has a strong incentive to structure their products to keep them actuarially sound and avoid payouts they do not have sufficient reserves to cover.

How is insurance already involved?

The insurance sector in Canada is currently investing in research. For example, the property and casualty insurance sector established the Institute for Catastrophic Loss Reduction, a research institute focused on climate change adaptation and disaster risk management. A recent report written for insurance company The Co-operators by members of the Institute (Thistlethwaite & Feltmate, 2013) explore the challenges of providing overland flood insurance to property owners, a topic noted below. The Insurance Bureau of Canada (IBC) is also undertaking a national survey of floodplain mapping in Canada.

How could insurance be involved more?

Insurance could be involved in the financing of adaptation infrastructure both through funding from government insurance operations and through incentive programs.

1. Directly invest in municipal/provincial adaptation projects

This would involve targeted investment for projects that lower a community's risk of damages. For example, the Insurance Corporation of British Columbia (ICBC), a provincial government entity, launched a road improvement program in 1989 and since then has invested over $100 million in projects across BC. In 2011, ICBC invested approximately $4 million in projects in the Lower Mainland and $6.5 million in 283 projects across the province, all aimed at improving road safety. The rationale for this funding is that "...fewer crashes mean fewer injuries and wrecked cars, and fewer insurance claims" (ICBC, 2014).

2. Offer a premium discount for adaptation actions

This could involve charging lower premiums for households or communities that have adopted best practices when it comes to adaptation. In the US, for example, the Community Rating System (CRS) is a voluntary program administered by the Federal Emergency Management Agency (FEMA) that provides incentives for communities and individual homeowners to go beyond the requirements of the National Flood Insurance Program (NFIP) and invest in further floodplain management measures,

elevation of structures or other flood-proofing measures. Depending on the measures that are implemented, premiums can be reduced by up to 45%.

Overland flood insurance in Canada

A stipulation of both of the options stated above is that insurance companies will need to include the hazard in their portfolio. Overland flooding, which is one of the largest climate impacts felt in Canada, is not currently an insurable hazard for residential buildings. However, this could change, as the federal Economic Action Plan 2014 *"...proposes to consult with the insurance industry, provinces and territories to explore options for a national approach to residential flood insurance" (Canada's Economic Action Plan, 2014).*

Thistlethwaite and Feltmate (2013) interviewed CEOs at insurance companies accounting for over half of the property insurance business in Canada and attributed the lack of overland flood insurance in Canada to four main obstacles:

1. Adverse selection reduces the ability of Canadian insurers to write a viable policy;
2. Data gaps exist for flood risk exposure and government and consumer preferences;
3. Demand for coverage has been low, likely in part due to the expectation that government programs will provide relief in the event of a significant flood; and
4. There is skepticism that governments will assist by implementing policies to mitigate exposure in high-risk areas.

The federal government can assist in the creation of a market for overland insurance. For instance:

1. The development of flood maps is a vital input into assessing risk, and these need to be up-to-date and publicly available. It is recommended that flood map risk data be aggregated into a central open database at the provincial or federal level, to improve government and homeowner decision-making towards mitigation by raising awareness of flood exposure.
2. More research on systems that strive to charge risk-adjusted rates, such as Australia or Germany, could help clarify whether incentives are strong enough to encourage mitigation.

The demand for overland insurance is linked to access to government revenues for post-disaster compensation. Therefore, a potential method of both encouraging a shift of the financial burden to individuals and reducing the impact of disasters on taxpayers would be to reform current federal disaster financial assistance formulas. This is elaborated in the section below.

National Disaster Mitigation Strategy

An evaluation of the current national disaster mitigation regime in Canada is an important aspect of climate change adaptation funding. Disaster mitigation and climate change adaptation follow the same procedure, i.e., applying risk management principles to identify risks and vulnerabilities, and have the same desired outcome, i.e., increasing resilience to future hazard events. Canada's National Disaster Mitigation Strategy (NDMS) was developed in 1998, and further in 2002, as a result of countrywide consultations

facilitated by the national agency responsible for emergency management, now represented by Public Safety Canada (PSC) and the Insurance Bureau of Canada (IBC) (Sandink & McGillivray, 2014). These discussions took place as a response to the significant damages and subsequent payout caused by the 1996 Saguenay River flood, the 1997 Red River flood, and the 1998 eastern Canada ice storm (Sandink et al., 2010). Priorities that emerged from the discussions included support for initiatives occurring at the municipal and provincial level, pre-disaster mitigation planning, and incorporation of disaster mitigation into disaster relief funding (Hwacha, 2005). In January 2008, Public Safety Canada released Canada's National Disaster Mitigation Strategy in conjunction with revised Disaster Financial Assistance Arrangements (DFAA) guidelines.

National disaster assistance programs can play a positive or negative role in local government adaptation investments for the following reasons:

- Positively, assistance for disaster mitigation measures from higher levels of government can increase the ability of local governments to implement adaptation measures.
- Negatively, the existence of, and reliance on government disaster assistance programs can serve to deter investment in disaster mitigation, as "moral hazard" decreases the willingness of individuals and communities to mitigate risk (ICBC, 2014).

Therefore, depending on their structure, national disaster assistance programs can either work to deter local government adaptation investments or to enhance them. Historically, disaster management at the national level in Canada has focused on the reactive aspects of disaster management, including response and recovery, rather than proactive disaster mitigation and prevention (Henstra & McBean, 2005). However, there have been some recent developments that demonstrate a shift towards a more proactive approach. The latest development is that the federal Economic Action Plan 2014 proposed $200 million over five years, starting in 2015–16, to "...better protect Canadians and their homes through a National Disaster Mitigation Program (NDMP). This program will support investments in structural mitigation measures, such as infrastructure to control floods that can reduce the impact of severe natural disasters. The costs of projects will be shared with provinces and territories" (Government of Canada Economic Action Plan, 2014).

Despite the program's intention to build safer and more resilient communities, the funding available through the NDMP may prove insufficient. For example, estimated costs to increase the size of the Red River floodway protecting Winnipeg are over $1 billion and the FCM, in its 2012 report on infrastructure, estimated that replacement costs for Canada's sewer and stormwater infrastructure would cost almost $55 billion. Provincial governments will need to be strategic in how they allocate the limited funds from the NDMP to local governments.

Disaster mitigation planning might be improved in Canada in two ways:

1. Develop a program for pre-disaster mitigation. It is possible that the proposed National Disaster Mitigation Program may fill this role, but this is difficult to assess at this time. The program should ideally have a financial commitment better matched to the costs associated with mitigation projects, as described above.

2. Better incorporate post-disaster mitigation in the DFAA following the American model. The current mitigation enhancement criteria under the program are very limited. In a 2011 audit of the program, it was recommended that it consider more of a balance between short-term (response/recovery) and long-term (prevention/mitigation) objectives (PSC, 2014). An examination of the US Federal Emergency Management Agency (FEMA) grants demonstrates the potential variety possible in mitigation assistance programs.

BOX 11. FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) GRANTS

The Success of Mitigation Grants

Mitigation grant programs have had positive results in the US. A cost-benefit analysis done in 2005 by the Multi-Hazard Mitigation Council found that "a dollar spent on mitigation saves society an average of $4" (MHMC, 2005). The study estimated that the societal benefits from the FEMA mitigation grants during the period studied (1993-2003) had a discounted present value of $14 billion, compared to the $3.5 billion value of the grants themselves. In addition, the study found that the FEMA grants often lead to non-federally funded mitigation activities (MHMC, 2005).

The following table provides a summary of FEMA grants, and examines whether funding is available before a disaster has occurred (proactive), and if the grant is dependent on the National Flood Insurance Program (NFIP) being in place.

PROGRAM	DESCRIPTION	PROACTIVE?	DEPENDENT ON NFIP?
Hazard Mitigation Grant Program	Provides assistance for the implementation of mitigation measures during the disaster recovery phase; grant pays up to 75% of eligible project costs.	✗	✗
Pre-Disaster Mitigation	Provides assistance for mitigation planning and implementation of mitigation projects before a disaster occurs; grant pays up to 75% of eligible project costs. Small and impoverished communities can receive 90% federal cost-share.	✓	✗
Flood Mitigation Assistance	Provides assistance for reduction or elimination of long-term flood risk for structures insured under (NFIP); grant pays up to 75% of eligible project costs. 90% available if previous mitigation measures implemented.	✓	✓
Repetitive Flood Claims	Provides assistance for reduction or elimination of long-term flood risk to structures insured under NFIP and that have received one or more NFIP payouts; grant pays up to 100% of eligible project costs.	✗	✓
Severe Repetitive Loss	Provides assistance for reduction or elimination of long-term flood risk damage to residential structures insured under the NFIP that have experienced severe repetitive losses; grant pays up to 75% of eligible project costs. 90% available if previous mitigation measures implemented.	✗	✓

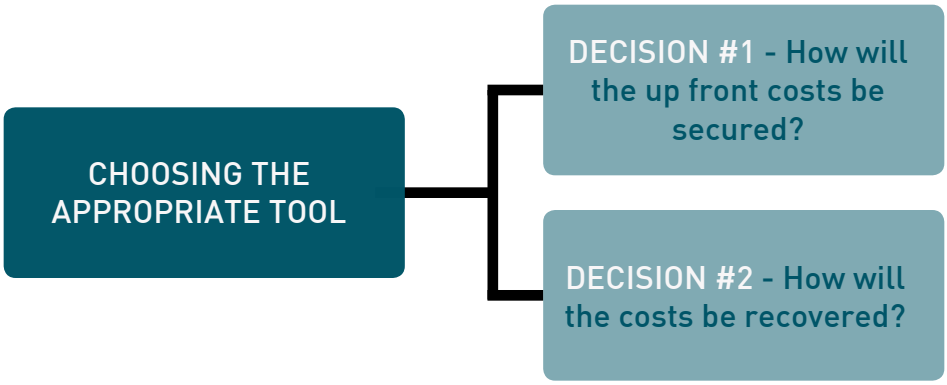
IX. INFRASTRUCTURE ADAPTATION PLANNING CONSIDERATIONS

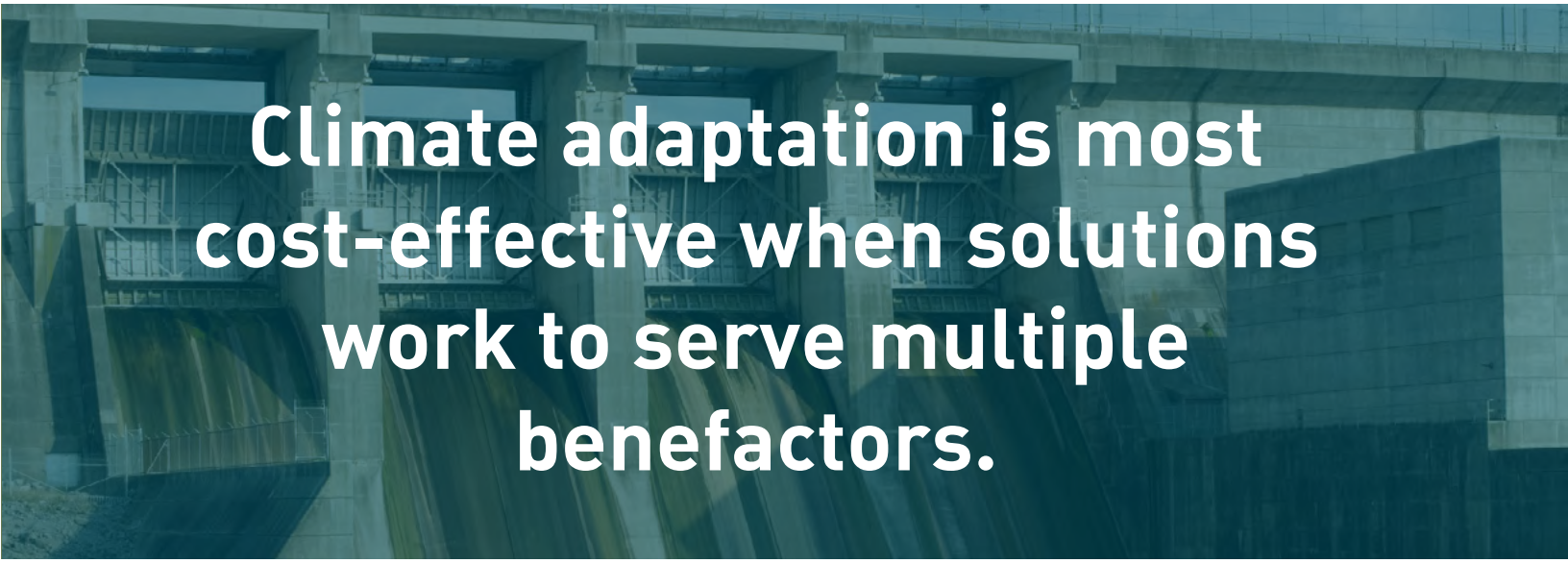
Climate adaptation is an opportunity to drive sustainable development by combining synergies between local governments, private partners and local residents. ICLEI Canada (Local Governments for Sustainability) has created a four step approach for local governments developing adaptation plans in its Building Adaptive and Resilient Cities (BARC) tool:

1. Identify the anticipated challenges related to climate change.
2. Identify and map major impacts to infrastructure, buildings and risk areas.
3. Develop actions to respond to these challenges and impacts and prioritize based on risk analysis and estimated effectiveness.
4. These three steps produce a climate adaptation plan, which is then to be implemented in step four.

ICLEI encourages cities to continuously re-evaluate their analysis of climate impacts and adaptation actions. This process has been used by hundreds of cities around the world, including many in Canada. By following ICLEI's approach, local governments develop an understanding of the regional and infrastructure challenges they face. Going forward, it may take more effort to develop the complex thinking required to understand that adaptation presents an opportunity to combine public sector services with city development, local needs and wishes, business development, and many more factors. Climate adaptation is most cost-effective when solutions work to serve multiple benefactors, as opposed to simply representing a change in infrastructure standards. A combination of BGI and grey infrastructure provides the most resilient infrastructure and cost-effective solutions.

Given the wide variety in both tools and types of adaptation infrastructure, no single tool will address all finance needs. Instead, tools must be evaluated on a project-to-project basis. Depending on the nature of the project and the services it provides, tools vary in their applicability. To identify the best financial tool for different types of adaptation projects, the financial requirements of infrastructure must be identified.





Climate adaptation is most cost-effective when solutions work to serve multiple benefactors.

Decision #1: How will up-front costs be secured?

This decision is focused on choosing a *financing* tool. Infrastructure characteristics that need to be considered when choosing an appropriate tool are:

Project size: The size of a project will affect everything from the need for feasibility studies and environmental assessments to the size and sophistication of the construction crews needed to complete the project, which impact the amount of capital needed.

Up-front costs: Large and complex infrastructure projects can have high up-front costs, such as costs associated with planning for a new floodway.

Construction timeframe: Some projects can spread over several years and multiple budget cycles. When combined with high up-front costs, this can mean committing a large sum of money for an extended period of time without receiving any offsetting revenue during the construction and start-up phases.

The criterion in the evaluation framework used in this report relevant to this decision point is that of effectiveness, which ranks how much revenue a tool can raise, for how long, and how financial risk is dispersed.

Decision #2 - How will the costs be recovered?

This decision is focused on choosing a *funding* tool. Infrastructure characteristics that need to be considered when choosing an appropriate tool are:

Revenue generating: Jurisdictions must assess whether the services associated with a project will produce revenue so that it is self-funding (marketable), or whether it must be supported by government involvement through a tax subsidy (non-marketable).

New construction or renewal: New construction is often easier to accomplish than renewing existing systems, as the public understands the need for new services to accommodate growth. Therefore, the criteria of public acceptability and political will should be considered.

Long or short asset life: Lifespan of a project can vary according to asset type, connecting to the criteria of effectiveness.

Community wide or localized: Some municipal infrastructure assets provide services to all residents, whereas other infrastructure serves a selected geographical portion of the city. The criteria of public acceptance and equity fit this characteristic.

Broad or particular usage: It is important to know how and to what extent different groups will use an infrastructure asset. For example, will an infrastructure asset be used by all residents equally, regardless of socio-economic status? This again fits the criteria of equity.

Table 14 combines the results from the ground-truthing study and the desktop research to illustrate the most appropriate infrastructure project(s) for each financing tool, including: new projects, existing infrastructure upgrades, maintenance and operations, and community-wide projects. Depending on the nature of the project and the services it provides, financing tools vary in their applicability. Double check marks (✓✓) indicate the tool is recommended for that type of project; one check mark (✓) indicates the tool is applicable in certain circumstances, and a cross (✗) indicates the tool is not applicable.

Table 14: Tools Matched to Infrastructure

TOOL		NEW INFRA-STRUCTURE	UPGRADES	OPERATIONS AND MAINTENANCE	COMMUNITY -WIDE INFRASTRUC-TURE
Internal financing sources	Borrowing	✓✓	✓	✗	✓✓
	Reserve Funds	✓	✓	✗	✓
	Green/ Climate Bonds	✓✓	✓	✗	✓✓
	Tax Increment Financing	✓	✓	✗	✗
Internal funding sources	Property Tax	✓✓	✓✓	✓✓	✓✓
	Tax Levy	✓	✓	✓	✓
	LIC	✓	✓✓	✗	✗
	User Fees	✓	✓✓	✓✓	✗
	DCCs	✓	✓	✗	✗

External sources	Gas Tax Grant	✓✓	✓✓	✓	✓✓
	Intergov't Grants	✓✓	✓	✗	✓
	P3	✓✓	✓	✓	✓
	CARIP Grant	✓	✓	✓	✓
	Carbon Fund	✓	✓	✓	✓✓
Incentives	Local Rebates	✓	✓	✗	✗
	LIC Financing	✗	✓	✗	✗
	Density Bonus/ Transfer	✓	✓	✗	✗
	Land Trusts	✗	✗	✓	✗

New Infrastructure

Almost all tools can be used for new infrastructure, with the exception of some innovative sources. Tools that are able to raise large amounts of capital all ranked highly. Borrowing and green bonds are the most promising internal financing sources, as they allow local governments to attain large sums of capital. However, smaller municipalities are limited in their ability to borrow or issue bonds based on current legislative requirements, which suggests that current borrowing regulation may be an obstacle for maximizing the potential of this tool. Other promising sources are intergovernmental grants and P3s.

Upgrades

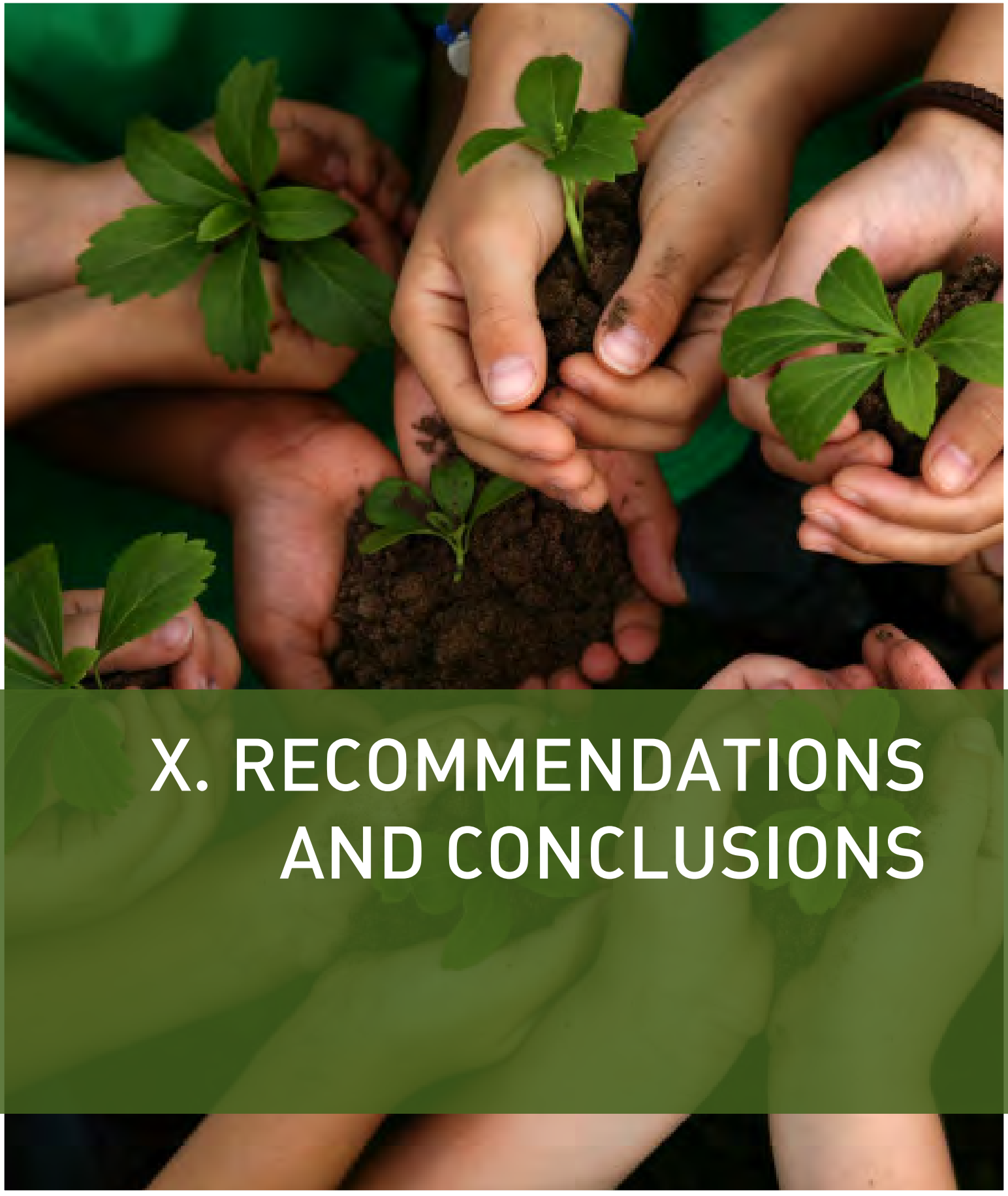
Upgrades can potentially carry high costs, depending on the size of a project. However, unlike new infrastructure, they may not lend themselves well to political buy-in or public acceptance, as they are less exciting than new projects. Therefore, tools that depend on high public acceptance or political will may be less suitable. Tools that work well are user fees, LICs and the Gas Tax Fund.

Operations and Maintenance

Any tool that provides a one-time sum is not well suited for long-term operations and maintenance. However, tools that create consistent monetary streams are well suited for upgrades, such as user fees.

Community-wide infrastructure

Infrastructure that has the potential to benefit all residents of a community is best matched to tools that do not link a fee to a service or area. Therefore, tools that create more general-use funds are the best fit, such as borrowing, green bonds, the Gas Tax Fund and carbon funds.



X. RECOMMENDATIONS AND CONCLUSIONS

Two sets of recommendations are presented, the first for local governments, and the second for federal and provincial levels of government. These recommendations are presented as potential avenues of exploration, and will benefit from further discussions with national, provincial, and local stakeholders that are beyond the scope of this report.

These conclusions should therefore be revised according to the outcomes of such discussions as a component of future research activities.

RECOMMENDATIONS FOR LOCAL GOVERNMENTS

1. Include adaptation into long-term strategic planning using downscaled climate change projections.

Vulnerability mapping and downscaled climate change projections should be the first step in adaptation planning. This planning then results in clear priorities for action and enables decision makers to effectively target limited resources.

Tools such as the Pacific Climate Impacts Consortium's online Plan2Adapt and Regional Analysis Tool may be used to identify climate variability and projected changes in specific regions in BC. However, local governments should not be left to individually engage in projections of climate change and sea-level rise. Economies of scale indicate that it would be more cost-effective for projection studies to be undertaken by higher levels of government, and that each local government should then plan using the resulting, consistent set of climate change projections.

Long-term strategic planning includes the following components:

- Take stock of climate projections for specific region or local area and the associated uncertainty;
- Assess what is currently at risk and what will be at risk in the future and consider infrastructure lifespans;
- Calculate costs and benefits of different options;
- Invest first in no regrets or low regret adaptation, i.e., options that will pay off regardless of climate change, as well as in measures for which there are large and known co-benefits including mitigation benefits;

- Assess sources of funding most applicable to issue at hand; and finally,
- Secure funding.

In addition to these steps, climate change projections should be incorporated into development plans to ensure current decisions will not bring high costs later.

2. Reduce incremental climate change costs by incorporating adaptation actions into existing municipal processes.

Local governments can save money by incorporating adaptation actions in regular infrastructure upgrading cycles. Research shows that smaller adaptation actions do not always require new funding mechanisms if projects are integrated into existing planning practices. Potential cost savings from matching adaptation actions to infrastructure upgrades highlight the importance of research into levels of risk and regional climate change scenarios. For example, up-to-date vulnerability and risk mapping will help local governments integrate climate change adaptation into daily business. This integrated approach to adaptation planning enables local governments to be proactive rather than being only reactive to crises or funding opportunities.

3. Be strategic and creative with current tools available.

Many existing tools are applicable to adaptation projects; however, innovation may be required to enable them to fund or incentivize adaptation actions. For example, local governments could reduce DCCs in exchange for on-site stormwater retention.

RECOMMENDATIONS FOR FEDERAL AND PROVINCIAL LEVELS OF GOVERNMENT

1. Reduce barriers for local governments to borrow or issue bonds for resilient or adaptation projects.

Debt financing at local levels appears to be a promising instrument for support of public funding of adaptation infrastructure. However, legislative and other barriers, such as a lack of standards for green/climate bonds,' may prevent local governments from accessing this source of capital for adaptation-specific projects.

2. Remove barriers and incentivize public-private partnerships for climate resilient infrastructure.

Regardless of the nature of public sources of revenue to fund climate adaptation infrastructure, relying solely on such sources would not be an efficient use of limited resources. The private sector has a key role to play in ensuring climate resilience and must be incentivized to do so.

3. Assess the continued appropriateness of the existing provincially-administered federal Disaster Financial Assistance (DFA) funding formulas, in light of projected flood-related damage increases due to climate change.

Each province has discretion in its DFA regulation, despite it being a federally-regulated program. There is potential for DFA to be allocated in such a way that incentivizes individual responsibility and adaptation actions, as demonstrated by the changes made by the Government of Alberta after the 2013 summer floods. Albertan recipients are now only eligible for funding in the flood fringe zone if they have met provincial flood-proofing requirements. Such stipulations can both encourage individual action, and lessen the financial burden on federal and provincial governments to provide post-disaster financial aid.

4. Explore opportunities to link mitigation and adaptation projects.

Opportunities to create closer links between revenues generated via

economic instruments targeting the mitigation of GHGs in Canada (such as carbon taxes) and the funding of adaptation actions at local levels should be examined by both the federal and provincial government.

5. Provide regulatory support for an overland flood insurance program.

As indicated earlier, Canada is unique among developed countries in that the private sector does not provide overland flood insurance to residential buildings. Such programs have been successful in transferring flood risk from the public sector to the private sector. For transparency purposes, an important step in setting up such program would be the creation of a national index for flood risk and mapping to support sellers and buyers of insurance.

AREAS FOR FURTHER RESEARCH AND NEXT STEPS

1. Conduct cost-benefit analysis of different adaptation measures & costs of inaction.

While there is a lot of interest in using cost/benefit analysis as a guide for decision making and the selection of adaptation actions in Canada, this tool has yet to be widely applied. There is an opportunity to research best practice methods for local governments to conduct cost/benefit analyses and calculate the costs of inaction, as well as produce a guiding document in order to ensure that assessments are consistent across the country. ACT plans to proceed with this work in 2015-2016.

2. Comparatively evaluate existing infrastructure grant schemes to identify overlap and underutilized funding opportunities for adaptation infrastructure projects.

There are numerous granting opportunities available to local governments for infrastructure projects, such as the recently announced National Disaster Mitigation Program; however, due to the complex application process and project requirements, local governments may miss opportunities to take advantage of this tool. An assessment of all infrastructure grant options may

identify opportunities to improve inefficiencies in the current system.

3. Increase opportunities/create a mechanism for intergovernmental collaboration on climate change adaptation and its funding sources.

A broader national conversation is required amongst all levels of government in Canada, as well as stakeholders from industry, NGOs and community leaders, to establish perceptions of risk, cost and responsibility in the context of projected climate change impacts. As we have noted, the costs of damages associated with climate change, in particular flooding, are already evident in Canada; however, there is a dearth of resources – both data and financial – available for effective decision-making. Rather than proceed with a vast patchwork of mismatched responses, or continue to struggle to pay for resources that would be more economically developed by centralized government bodies, an enhanced national discussion could help to reveal appropriate roles and responsibilities for a variety of Canadian jurisdictions and authorities. Such an undertaking would be challenging, but the rewards would outweigh the effort involved.

4. Research the cost effectiveness of using regulatory instruments as an economic tool for climate change adaptation.

Incorporating adaptation actions into land-use planning is a tool that was not examined in detail in this report due to its focus on financial mechanisms. However, there are many potential ways that adaptation can be incorporated into land-use planning to prevent or lower public costs in the long run. For example, it is possible to use zoning bylaws to designate construction requirements for different levels of flood risk. The CoV, for instance, recently raised their flood construction levels to account for sea level rise and coastal flooding. In addition, the City of Richmond requires developers along diked areas to upgrade dikes to new seismic standards as a condition of rezoning approval. Building codes have incorporated new resiliency requirements in other jurisdictions, such as the US and the UK.

CONCLUSIONS

First, public sector financing of adaptation infrastructure may require giving local levels of government greater access to public sources of revenue. This may be achieved by expanding taxation authority in order to increase autonomous sources of revenue. Simultaneously, transfer programs from national or provincial to local governments could be designed to incentivize investments in climate change adaptation in general, and climate resilient infrastructure in particular.

Second, it is clear that public sector financing will not be sufficient to fund all climate change adaptation measures at local levels, especially where local levels of government are already facing infrastructure deficit. In this regard, private sector investment will be required. A key role of the federal government is to ensure that policies are conducive to, and incentives are compatible with, the creation of a suitable environment for private investment in resilient urban infrastructure.

Third, gaining public-buy in is a key aspect of any adaptation infrastructure project. Raising public awareness about climate change impacts and the need for adaptation is critical, as the local councils that ultimately approve most funding rely on local votes. Therefore having public buy-in on adaptation is critical, regardless of the financing approach.

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APPENDIX I: ADAPTATION EXPERIENCE IN OECD COUNTRIES

Super Levee Financing in Japan

In Japan, half of the population is located in areas that have a high risk of flooding; most major metropolitan areas are located in low-lying deltas. One solution to this problem is the design and construction of "super levees."

Japan's three tiers of government share the administrative and financial responsibilities for flood mitigation work. For the largest (Class 1) rivers, the national government contributes 50% of the costs of construction, while the prefecture, or municipal government level, contributes the remaining 50%. For medium-sized (Class 2) rivers, the national government contributes between 40-50% of the costs, and two-thirds of the cost for smaller municipal rivers.

Funding for local government public works projects includes the national government contribution of 40%, borrowing (20%), and local tax revenues and general purpose grants (30%). General purpose grants, or Local Allocation Tax grants, are paid by the national government to prefectural and municipal governments to ensure basic local needs are met; river management is considered a basic local need. Debt repayment for river management projects is also considered a basic local need.

Japan relies on private investment in infrastructure to help finance public projects that governments cannot afford. The national government is currently in the process of selling the operational rights to one of the country's largest airports. Moreover, it is considering selling rights to highways and sewage plants. Super levees can also be financed through private infrastructure investment, because they create a new development once completed.

Dutch Delta Program

In Holland, flooding from the sea or from rivers/canals is seen as a national issue as water is considered a collective responsibility. The Dutch spend nearly $1 billion a year on disaster prevention and infrastructure maintenance.

The "Delta Fund" is intended to ensure that the country is safe from flooding and has a sustainable supply of fresh water. The program has a long-term focus, wherein measures taken in the short term are designed to include the capacity to adapt to long-term changes and withstand extreme situations.

Each year, $800 million is set aside in the Delta Fund to be invested in the construction, improvement, management, and maintenance of dikes, or in sand deposits along the coast line. Money is also set aside for feasibility studies investigating which measures need to be taken. The funding from the government comes from taxes paid by inhabitants and landowners to the Regional Water Authorities.

Additional examples of financial and fiscal instruments designed to address the topic of climate change are presented in Table A1:1 below:

Table A1:1: Financial/Fiscal Instruments to Support Climate Change Plans in OECD Countries

CITY	FINANCIAL / FISCAL INSTRUMENTS
Paris	• Innovative financial partnerships needed between national, regional and local governments in renovation of buildings. Involve banks for attractive interest rates and adjust loan repayment charges to the cost effectiveness of the energy-saving work. • Voluntary fund to finance sustainable development projects in tourism. • Total cost-based accounting method. • Tax credit in property tax for energy-saving renovations. • Energy-saving certificates or projects buying emission reductions and selling on • International carbon market. • Discount rates in parking tariffs for small and electric vehicles. • Shifting burden to eco-taxes. • Tariff-based incentives for waste recycling. • Fines for energy suppliers that do not save energy.
Mexico	• Additional resources based on sales of GHG emission reduction credits.

London	• Introduce carbon pricing; host carbon-trading markets. • Carbon pricing for transport: charge cars to enter in the central business area on the basis of their carbon emission levels. • Become world leader in financial development on climate change: carbon emission trading, green funds, pricing climate change risks, financing climate change research. • Lobby the national government to change vehicle charges in different Vehicle Excise Duty bands. • Support borough-based carbon pricing initiatives: permit-parking charges on the basis of CO2-emissions.
Tokyo	• Climate Change Fund. • Examine the introduction of Energy Efficiency Promotion Tax System.
Philadelphia	• Systems benefit charge for demand side management programs by local utilities. • Update pricing of parking.
Austin	• Development of carbon offset credits.
Portland	• Public utility charges funding energy conservation programs. • Support extension of the State Business Energy Tax Credit.
Los Angeles	• Increase of LA Department of Water and Power rebates for energy efficient investment by customers.

San Francisco	• Expand transportation impact fee assessment to all the downtown commercial space. • Increase Gas Tax. • Investigate congestion pricing and cordon tolls. • Consider charging market rates for parking permits; differentiate parking rates based on vehicle size. • Collecting parking lot taxes from hotels. • Differentiate vehicle registration fees based on vehicle size or emissions. • Promote bridge toll waivers for alternative fuel vehicles. • Commuter tax benefit programs for city and county employees. • Reduce city permit fees for solar energy. • Provide differentiated rates for waste recycling.
Seattle	• Road pricing. • Parking tax: implementation and increase. • Consider open-space impact fee.
Stockholm	• Congestion charge.

SOURCE: OECD (2010)

APPENDIX II: PROVINCIAL BORROWING LEGISLATION AND REGULATIONS IN CANADA

Table A2:1 Provincial Borrowing Legislation and Regulations in Canada

PROVINCE & TERRITORIES	PROVINCIAL REGULATION FOR LOCAL GOVERNMENT BORROWING	PROVINCIAL FINANCE AUTHORITY
Alberta	The Local Authorities Board oversees borrowing that exceeds the regulated level of indebtedness (1.5 times municipal revenue) and the permissible level of debt service (25% of revenue). Borrowing must be authorized with a borrowing bylaw and the bylaw must be advertised (unless the borrowing term is less than three years). "According to the Municipal Government Act and the Debt Limit Regulation (AR255/2000), total debt cannot exceed two times the total revenue (roughly $5 billion)." Relevant Legislation: Municipal Government Act.	Alberta Capital Finance Authority
British Columbia	The Municipal Finance Authority (MFA) borrows on behalf of municipalities (except Vancouver). Long-term borrowing requires both provincial approval and two-thirds council majority (and possibility a referendum). Relevant Legislation: The Community Charter Part 6: Financial Management, the Local Government Act Division 5: Financial Operations. Section 822 of LGA refers to short-term capital borrowing (five years or less). The Municipal Finance Authority Act.	Municipal Finance Authority of BC
Manitoba	Borrowing must be authorized by bylaw and the expenditure must be approved in the capital budget. Public notice must be given before approving the bylaw (notice may not be needed for projects already announced in a local improvement plan). The Municipal Board must approve borrowing before third reading of the bylaw. Relevant Legislation: Municipal Government Act.	

Nova Scotia	Minister approves borrowing and borrowing limits. Villages and service commission must receive approval from electors before borrowing. Relevant Legislation: Municipal Government Act and Municipal Finance Corporation Act.	Nova Scotia Municipal Finance Corporation
New Brunswick	The Municipal Capital Borrowing Board approves municipal capital borrowing. The Board will determine what information the municipality needs to make public in regards to the borrowing application. Required to have a sinking fund associated with issuance of debenture. Relevant Legislation: Municipal Capital Borrowing Act and Municipal Debentures Act.	New Brunswick Municipal Finance Corporation
Newfoundland & Labrador	The Minister must approve municipal borrowing. Relevant Legislation: Municipalities Act.	Newfoundland & Labrador Municipal Finance Corporation
Ontario	The Ontario Municipal Board (OMB) and Ministry of Municipal Affairs regulate the indebtedness and general financial affairs of municipalities. Relevant Legislation: Municipal Act.	Ontario Strategic Infrastructure Financing Authority
Quebec	Municipal borrowing requires either voter approval or provincial approval (except Montreal and Quebec City) and foreign currency borrowing is controlled by the province. Relevant Legislation: Municipal Code of Quebec	
Saskatchewan	If borrowing exceeds the debt limit, is not repayable within three years, and not secured with debentures of the municipality, then the Saskatchewan Municipal Board approves borrowing and a borrowing bylaw is required. Voters may also be required to approve the borrowing. Relevant Legislation: Municipalities Act.	Municipal Financing Corporation of Saskatchewan

Yukon	Borrowing is authorized by bylaw. The Minister must approve borrowing that exceeds three percent to of the current assessed value of all real property in the municipality that is subject to property taxes or grants. The Minister may require a referendum to approve borrowing. Relevant Legislation: Municipal Act.	

APPENDIX III: GROUND-TRUTHING RESULTS WITH THE COV AND THE CVRD

Ground-truthing took place in two areas of BC: the CoV and the CVRD. The researchers ground-truthed the findings with municipal and regional finance experts, as well as climate change planners from both regions. Participants were selected based on their expertise and experience in the field. Project partners helped to expand the participant pool by introducing the researchers to colleagues in the region with experience in municipal finance, climate change planning, municipal or regional governance, and provincial municipal financial regulation.

Table A3.1: Characteristics of Ground-truthing Participants

CHARACTERISTICS	THE COV	THE CVRD
Level of Government	Municipal	Regional Government providing regional service to nine electoral areas and four municipalities (City of Duncan, Town of Ladysmith, District of North Cowichan, and Town of Lake Cowichan).
Population	603,502 (Statscan, 2014)	80,332 (Statscan, 2012)
Geographical Size	114.97 km2 (Statscan, 2014)	3,473.12 km2 (Statscan, 2013)
Climate Change Impacts	Increase in average annual precipitation with a decrease in the summer Increase in average annual temperature with most notable change in night-time lows Rising sea level Increase in extreme events	Increased fall, winter, spring precipitation Decrease in summer precipitation and snow inputs with increased threat of drought Increase in average annual temperature Increase storm and precipitation-driven floods Rising sea level More frequent extreme weather events Summer wildfire conditions increasing

Important Economic Sectors	Education Financial Services Information technologies Life Sciences Film and TV	Agriculture Tourism Forestry Fisheries
Legislation	The Vancouver Charter	Local Government Act Community Charter
Total Taxes Collected	$1,222,345,000 (BC Ministry of CSCD, 2012)	$47,191,419 (combined total for City of Duncan, Town of Ladysmith, District of North Cowichan, and Town of Lake Cowichan) (BC Ministry of CSCD, 2012). In addition, 2013 statement of accounts reports $63,513,061 of CVRD revenue.
Developer Contributions	$96,068,000 (BC Ministry of CSCD, 2012)	$3,088,336 (combined total for City of Duncan, Town of Ladysmith, District of North Cowichan, and Town of Lake Cowichan) (BC Ministry of CSCD, 2012).

Discussions with the CoV and CVRD indicate the following:

- Participants had a general knowledge of climate change hazards in their respective regions and acknowledged that these were under consideration for future planning strategies. They were particularly interested in options to finance resiliency investments, as they could foresee funding being a challenge for them in implementing plans in the future.
- Every participant was acutely aware of the financing constraints and opportunities available to them. One notable difference was that the larger municipalities had increased legal flexibility to incorporate resiliency investments into capital planning documents.

- Smaller municipalities were more inclined to use specialized taxation instruments, whereas larger municipalities had more legal options to place resiliency investment charges on developers.
- There was general sensitivity amongst participants towards tools that had been rarely used in Canada, such as green bonds (see Section V). While municipalities were interested in new financing tools, they had difficulty definitively stating if they would be useful for particular projects. In addition, in some circumstances, they were able to identify legislative barriers to using such tools in BC.
- Participants shared concern about issues of jurisdiction and how to spread the costs of resiliency investments designed to respond to climate change hazards that span jurisdictional boundaries.
- Participants expressed initial resistance when talking about using a service fee or charge to fund adaptation projects. However, when given a concrete example, such as charging for stormwater management, participants could easily understand how such a service fee or charge was appropriate as a financing tool.

Notes from the ground-truthing discussions are presented below in Table A3.2:

Table A3.2: Outcomes of Discussion

TOOLS		COV	CVRD
Internal Financing	Borrowing	The CoV has a program for borrowing money in place. The City has previously borrowed money to finance infrastructure projects and may consider the tool for future resiliency investments; however, the City would only consider borrowing money for large- or medium-sized projects where the asset will last more than 10 years.	Although participating municipalities have the ability to borrow money through the provincial municipal finance authority, they do not borrow money frequently. Noted obstacles include the time associated with the borrowing process and the debt limit. Requires bylaw approval.

	Reserve Funds	Reserve funds are a good alternative to borrowing as they allow the City to save money and only move forward on a project once adequate funding is in place. Money is “reserved” for a particular type of project and may not be easily accessible. In some instances, the time it takes to save money for a large project may exceed the need or desire for that particular infrastructure. In such circumstances, adaptation planners may need to apply an adaptation lens to the intended project to be able to access money in some reserve funds.	Reserve funds are commonly used by participating municipalities. However, the purpose the money is being reserved for must be viewed as important by taxpayers and often does not raise a lot of capital. Funds cannot be raised without specific and bounded approval by the electorate.
	Green Bonds & Climate Bonds	The City has never issued a green bond but knows they are commonly used in the US. Noted obstacles are debt limits and needing voter approval for taking on significant debt. Participants were unsure if current political climate would provide necessary support to issue a green bond.	Participating municipalities had never issued bonds before and expressed apprehension to taking on debt as it is likely a bond, green or not, would exceed debt limits, especially for smaller local governments. Despite these challenges, the municipalities expressed interest in learning more about green bonds as a potential financing tool in the future.
	Tax Increment Financing	The City has not used this tool and is not considering using it in the future, as not all climate change responses will necessarily increase property value. Furthermore, the province is responsible for property assessments, so the City cannot guarantee a return on the investment. Finally, changes in the market mean this tool is not a reliable source of financing.	The participating municipalities are not considering this tool because the province is responsible for property assessments, which means this tool cannot guarantee a return on investment.

Internal Funding	User Fees	The CoV is currently charging a stormwater utility fee via the water utility fee. This fee is not based on use, as it is difficult to calculate user fees for stormwater infrastructure. The City has not yet considered changing to a user fee model for stormwater management infrastructure but may consider such a model for a resiliency investment if an appropriate project is identified in the future.	Participating municipalities are not currently charging user fees specifically for resilient infrastructure and found it conceptually difficult to consider adaptation services in the same context as a typical service that provides immediate benefits. Interest in this tool increased after researchers provided examples of how other municipalities in Canada are using it; however, communicating the tool to the public and attaining public support was identified as an obstacle. Participants noted that implementing a parcel tax or LIC might be a more appropriate tool for achieving similar objectives.
	DCCs and CACs	The City currently collects DCCs and CACs from eligible development projects. DCCs and CACs are limited by legislation and can only be charged for specific projects, for instance, asset replacement and renewal are not eligible. For certain projects, DCCs could be used if the resilient infrastructure standards were incorporated into infrastructure upgrading projects.	Regional governments do not charge DCCs but may ask developers for amenities. Participating municipalities collect DCCs for appropriate developments; however, the amount of development in the municipalities tends to be small and therefore DCCs are not a reliable source of revenue for implementation of resiliency investments. CACs are not currently being charged to finance resilient infrastructure.
	LIC	It was unknown if this tool has been used by the City previously but could be useful for appropriate resilient infrastructure.	Participating municipalities have used this tool. This tool can be complicated when the benefits provided by the infrastructure span multiple jurisdictions.

	Tax Levy	The City is not currently using this tool. In terms of adaptation, it could potentially be used for stormwater management but any other project would require a more localized source of funding.	All participating municipalities have used or are using this tool. One participant had recently imposed a levy to raise funds for ecological governance of a watershed.
External Sources	Intergovernmental Grants	The City uses grants; however, the grant application process is extensive and often very costly. Intergovernmental grants are used when infrastructure projects are large and tax revenue is insufficient for funding.	Participating municipalities and the CVRD depend on intergovernmental grants to complete infrastructure projects that could not be achieved using tax income alone. In regards to adaptation, it may currently be difficult to justify diverting limited resources to mitigate the likelihood of future property damage. In these circumstances, grants are the most appropriate source of funding.
	CARIP Grant	The City is currently using their CARIP grant to support the Greenest City 2020 Action Plan, which focuses on the following areas: green economy, climate leadership, green buildings, green transportation, zero waste, access to nature, lighter footprint, clean air, clean water, local food (City of Vancouver, 2011).	The CVRD uses the CARIP grant to support and upgrade sustainability services and systems. Most recently, the CARIP grant is supporting an energy efficiency program. Both municipal participants use the CARIP grant to purchase offsets to achieve carbon neutral operations. They purchase the offsets from a local offset provider: Cowichan Energy Alternatives. They expressed interest in learning more about putting the money into a "Carbon Fund" to support local or corporate resilience initiatives.
	P3s	The City has never used a P3 to finance a project. The process is complex and is only applicable to extremely large projects. Currently, the City cannot imagine an adaptation project that would be suitable for a P3 partnership.	Have not done a P3 because there has not been any project that is eligible for the program yet. However, future development projects may offer such opportunity.

Innovative programs	Local Improvement Charge Financing	The City has tried to implement a program for energy efficiency using this tool but uptake in the program was low. Despite past experience, with the right project and high buy-in from the community, the City believed this tool could work to incent homeowners to invest in resiliency upgrades at the individual property level.	The participating municipalities raised concerns about this tool's use. The most significant obstacle was questioning whether or not it was appropriate for municipalities to be in the business of issuing loans for private property upgrades. Another significant obstacle was the fact that municipalities are not legally allowed to issue these types of loans. Despite these issues, one participant felt it was likely that the municipality would support a program of this nature if a financial institution implemented it.
	Density Bonus Transfer	City of Vancouver representatives thought this tool may prove appropriate for adaptation in areas where they wanted to build something, or leave a certain setback, over and above the existing building code.	Participating municipalities have used this tool to a limited degree. They were not confident this tool would be useful to meet resilient investment goals, as the land base is too small to provide enticing bonuses and because they are restricted by other rules, such as providing adequate parking for residents. At the regional level, the CVRD thought this tool might be useful to move pre-approved density zoning out of sensitive watersheds
Local	Rebates	The CoV supports rebate programs for energy efficiency for single family and multi-family residences, but has not explored rebates that could be linked to resiliency.	This tool is currently used in the participating municipalities to incent use of water efficient appliances, fixtures, and practices. If a suitable resiliency project would benefit from this tool, the participating municipalities have the ability and interest to use it. This could also be expanded from the Islands Trust NAPTEP model to incent the protection of green infrastructure.

	Land Trusts	The City has never used this tool and was not confident that it would ever be useful, partly because most undeveloped land is already protected as parkland.	Regional governments in BC are not able to give rebates on property taxes. Participating municipalities have the ability to implement this tool but expressed reservations about its applicability as the land base is small and it would be difficult to justify taking away tax revenue that the municipality depends on. In addition, participants could not identify an appropriate area that would provide ecosystem benefits to address climate change and warrant a tax rebate for its protection.

APPENDIX IV: MUNICIPAL ADAPTATION PLANS

Please note: Regional and watershed plans, as well as local adaptation case studies, are not included in this list. Adaptation actions were identified for numerous municipalities in Canada; however, without publicly available adaptation plans, those actions were not included in the list. Adaptation actions not identified in this list may be examined in other areas of the report, such as the City of Toronto's Green Roof bylaw.

Table A4:1 Municipal Adaptation Plans

NAME, LOCATION, DATE	HIGHLIGHTS	ESTIMATED COSTS AND SOURCES OF FUNDING
ATLANTIC CANADA		
Climate Change Adaptation Plan for Stratford, P.E.I. 2010.	Focus: Coastal erosion, coastal sea level rise, storm surge and flood, as well as changes in precipitation events. Future costs associated with property damage resulting from climate change impacts were identified throughout the document. Implementation of the plan focuses on changes to policies and standards.	**Plan Development:** **Cost:** Not identified **Funding:** NRCan as part of Mainstreaming Climate Change Tools For The Professional Planning Community project. **Plan Implementation:** **Cost:** Not estimated **Funding:** Not addressed

Climate Change Adaptation and Flood Management Strategy. Moncton, NB. June 2013.	Focus: Flooding, changes in temperature and precipitation, sea level rise, extreme weather events. The plan identifies adaptation strategies and actions, as well as ways to increase the adaptive capacity of both the Corporation and community.	**Plan Implementation:** **Cost:** "Staff time" is identified often for cost; however, some actions have figures, such as the cost to develop an Urban Forest Management Plan is identified as $250,000; research for floodplain best practices $7,500; and a Sewer System Review and Plan is $6 million. **Funding:** Funding climate change adaptation is a key consideration. Recommendations include: · A yearly assessment of external climate change adaptation funding options; · Continued funding of the back-water valve replacement program (100 valves per year); · Capital budget adjustment to anticipate increased stormwater management requirements (i.e. implementation of zero-net policy & increased maintenance of stormwater infrastructure such as ponds); and · Yearly adjustments to proposed capital budget for climate change adaptation related items, based on recommendation of Climate Change Action Committee and available external grants.

Climate Change Adaptation Action Plan for Glace Bay, Nova Scotia. 2010	Focus: Coastal erosion, sea level rise and storm surge, coastal development, and loss of natural resources. Strategies identified include: education and capacity building, vulnerability study and risk assessment, protect key infrastructure, develop new rules and regulations, overcome adaptation barriers, provide incentives and economic support.	**Plan Development:** **Cost:** Not estimated **Funding:** NRCan under the Mainstreaming Climate Change Tools For The Professional Planning Community program **Plan Implementation:** Funding identified as a barrier to implementation. Page 12 of the plan states; "Funding from different sources needs to be determined and organizations need to be approached with proposals for implementation of actions on a realistic time schedule." A recommended action on pg. 23 states "Seek various sources, allocate budget and attempt to secure adequate financial resources to cover the CCI (climate change impacts) incentives."
Climate Adaptation Plan or Glenburnie – Birchy Head – Shoal Brook, Newfoundland. Volume 1 background report and Volume 2: Adaptations and Strategies. 2010	Focus: Coastal flood, coastal erosion, debris flows, groundwater issues, infrastructure damage, road safety, changing community traditions, environmentally sensitive areas, Recommended adaptation action areas include: environmental, infrastructure, economic, cultural and traditional, governance, and capacity building.	**Plan Development:** **Cost:** Not estimated **Funding:** NRCan as part of Mainstreaming Climate Change Tools For The Professional Planning Community project. **Plan Implementation:** The plan does not address costs or funding for implementation but states on pg. 7; "Take advantage of external programs, funding and research projects to assist with adaptation."

BRITISH COLUMBIA		
City of North Vancouver Climate Change Adaptation Plan. October 2013.	Focus: Flooding and inundation of coastal, creek, and low lying lands due to more intense precipitation and sea level rise, infrastructure not well adapted to future climate within its lifespan, direct health and safety effects, major transportation disruptions due to flooding of transit hubs.	**Plan Implementation:** **Cost:** Not estimated **Funding:** identified next steps include finding new funding mechanisms as well as investigate external funding opportunities such as CARIP, FCM Green Municipal Fund.
Community Climate Change Adaptation Strategy. Prince George. 2009	Adaptation is incorporated into the City's "myPG" sustainability plan and will be incorporated into the new OCP. Areas of focus are forest, flooding, transportation, precipitation, freeze-thaw and sensitive ecosystems.	**Plan Implementation:** **Cost:** Total cost of implementing the strategy is not estimated; however, the costs associated with flood damage are identified as $35 million. **Funding:** Lack of funding was identified numerous times throughout the document and summarized in the introduction, which states on pg.6; "In order to support this continued work the City should seek funding opportunities, grants, and (new and continued) partnerships."
City of Vancouver. Climate Change Adaptation Strategy. 2012.	Areas of concern: Increase intensity and frequency of heavy rain events, sea level rise, extreme weather, increased temperatures, over land flooding, health impacts from extreme heat.	**Plan Implementation:** **Cost:** Not estimated **Funding:** The plan discussed funding throughout the document but, in most cases, it is not secured for implementation of adaptation actions. The plan does identify the source as either the capital or operating budget.

Coomunities Adapting to Climate Change Initiatives: City of Rossland. 2009	Part of a regional strategy led by the Columbia Basin Trust. Areas of focus are infrastructure, water, energy, and food.	**Plan Development:** **Cost:** Total budget for the plan $47, 258.52. **Funding:** Funded by NRCan and the City. **Plan Implementation:** **Cost:** Total costs are not estimated but the plan categorizes costs of actions as High – < $50,000; Medium –$10,00 to $50,000; Low –> $10,000 but exact figures were not identified. **Funding:** "The potential costs of implementing and potential funding sources…especially grant funding" was identified as a priority action on pg. 60. Potential funding sources were identified as the City, Sustainability Commission, grants, Columbia Basin Trust Watersmart.
Climate Change Adaptation Plan, District of Saanich, 2011	The areas of focus are ecosystems and urban forests; infrastructure; transportation and mobility; buildings; agriculture and food security; energy supply; economic development; health; land-use; and emergency response.	**Plan Development:** **Cost:** $60,000 **Funding:** Sources of funding: Gas Tax Funding, Natural Resources Canada and District of Saanich. **Plan Implementation:** **Cost:** Not estimated **Funding:** Saanich identifies funding as a limitation to implementing actions; however, actions "will be integrated into municipal departmental plans where funding commitments are tied into the Saanich budgeting process."

Communities Adapting to Climate Change Initiative: City of Castlegar. 2009	Main concerns: Water resources; local food and agriculture; and municipal stormwater system. The municipality used the results of the report to update the OCP.	**Plan Development:** **Cost:** $59,832.35 **Funding** 964 in-kind City staff hours. 141 in-kind volunteer hours. **Plan Implementation:** **Cost:** Total costs are not estimated but the plan categorizes costs of actions as high – < $50,000; Medium –$10,00 to $50,000; Low –> $10,000 but exact figures were not identified. **Funding:** addressed throughout the document
City of Surrey Climate Adaptation Strategy. 2013	Focus: Flood management and drainage, infrastructure, ecosystems and natural areas, urban trees and landscaping, agriculture and food security, human health and safety, linkages between adaption and mitigation.	**Plan Implementation:** **Cost:** total cost was not estimated but individual actions were represented using the following ranges: $<$75,000; $$ $75 - 300,000; $$$ $300-500,000; $$$$ $500,000 - $1 million; $$$$$>$1 million. **Funding:** Not addressed
The Cariboo-Chilcotin Climate Change Adaptation Strategy, Cariboo Regional District (CRD). 2009-2012.	Led by the Fraser Basin Council: Regional scale, focus on local government and services; this strategy will be rolled into a larger regional growth strategy.	**Plan Development:** **Cost:** $45,000 **Funding:** From CRD and NRCan **Plan Implementation:** **Cost:** Not estimated **Funding:** Funding challenges identified related to providing services related to climate change.

Red Deer Climate Change Adaptation And Mitigation Plan Part One. 2014	Assistance from ICLEI, integrate this plan in to other planning documents. Part one of the report focuses on business continuity planning, development and planning standards, stormwater design, parks role in adaptation, as well as operations and service levels. Part two of the report is still in development and will provide prioritization and implementation strategies.	**Plan Development:** **Cost:** $30,000 not including staff time **Funding:** City of Red Deer **Plan Implementation:** **Cost:** Not estimated **Funding:** Not addressed The cost and funding of implementation may be addressed in part two of the plan.
QUEBEC		
Urban Heat Islands: A Climate Change Adaptation Strategy for Montreal. December 14, 2007.	Focus: Risk assessment for urban heat island effect and adaptation strategies.	**Plan Implementation:** **Cost:** The total cost of actions is not estimated but individual actions are ranked as low, medium or high. No figure is attributed to the ranking. **Funding:** Nominally addressed on pg. 48: “A combination of incentives and assessments may be used for funding.”
Quebec City’s Environmental Services Adaptation Plan. 2014	Focus: Air, soil, water quality, wastewater, stormwater, landfill sites, and urban forests.	**Plan Implementation:** **Cost:** Not estimated **Funding:** Not addressed

NUNAVUT		
Climate Adaptation Action Plan for Cambridge Bay. 2010	Focus: The community process for developing the plan, climate change impact assessment, and an adaptive capacity assessment.	**Plan Implementation:** **Cost:** Not estimated but large costs associated with climate change impacts are identified throughout the report. **Funding:** Identified as a challenge on pg. 45: "However, the challenge will be securing the necessary funding in order to increase adaptive capacity and implement adaptation projects within communities such as Cambridge Bay."
Climate Change Adaptation Action Plan For Iqaluit. 2010	Focus: Climate change impacts and adaptation actions focused on buildings, roads, water supply system, wastewater treatment system, waste disposal system.	**Plan Implementation:** **Cost:** Not estimated **Funding:** Not addressed
Climate Change Adaptation Action Plan for Hamlet of Arviat. 2010.	Focus: Research and community engagement activities on climate change impacts such as weather, wildlife, sea ice, vegetation. Other areas explored impacts to hunting and trapping, water levels, housing, infrastructure, and health.	**Plan Implementation:** **Cost:** Not estimated **Funding:** Securing funding is identified as a next step on pg.15.

APPENDIX V: PROVINCIAL ADAPTATION STRATEGIES AND FUNDING FRAMEWORKS

Table A5:1 Provincial Adaptation Strategies and Funding Frameworks

PROVINCE	PROVINCIAL ADAPTATION STRATEGY	FUNDING
British Columbia	Preparing for Climate Change: British Columbia's Climate Change Adaptation Strategy (2010)	• $10.7 million from the Natural Resources Canada Regional Adaptation Collaborative program. • $95.8 million to establish the Pacific Institute for Climate Solutions to assess, develop and promote viable emission reduction and adaptation options as inputs to policy.
Alberta	Climate Change Adaptation Framework Manual (2010)	N/A
Saskatchewan	Bill 126: The Management and Reduction of Greenhouses Gases and Adaptation to Climate Change	The bill does not explicitly fund adaptation projects, but did fund "Saskadapt.ca" which deals with climate change impacts and adaptation. Go Green Fund. The Emergency Flood Damage Reduction Program.
Manitoba	The Climate Change and Emissions Reductions Act (2008); Kyoto and Beyond - Manitoba's Green Future (2008)	Manitoba Climate Change Action Fund.
Ontario	Adaptation Strategy and Action Plan (2011-2014)	No specific funding sources linked to the adaptation plan.

Quebec	2006-2012 Climate Change Action Plan Government Strategy for Climate Change Adaptation (2013-2020)	As of 2012, $55 million will have been invested to support municipalities for climate change risk mitigation. 2013-2020 plan commits $120 million to reduce vulnerability and improve community adaptive capacity, $45 million for adaptation research, and $11.5 million to strengthening the durability and safety of buildings. This funding will principally come from carbon pricing revenues.
Nova Scotia	Towards a Greener Future: Nova Scotia's Climate Change Plan (2009)	Climate change adaptation fund, which in 2012-2014 has $25,000 to support community projects. Due to its modest size, this fund is more focused on research then infrastructure.
New Brunswick	Climate Change Action Plan (2007- 2012)	Environmental Trust Fund projects.
Prince Edward Island	PEI & Climate Change: A Strategy for Reducing the Impacts of Global Warming (2008)	In 2008, the Government of Canada provided $15 million in funding for Prince Edward Island as part of the Clean Air and Climate Change Fund. PEI will use revenues from wind development initiatives and invest them to fund provincial government climate change activities and associated research initiatives.
Newfoundland and Labrador	Charting Our Course: Climate Change Action Plan (2011)	Plan includes a number of adaptation investments, including $700,000 over three years to establish flood-risk mapping and alert systems, as well as a coastal erosion monitoring and mapping program.
Northwest Territories & Yukon	Pan-Territorial Adaptation Strategy (2011)	$20.02 million from Aboriginal Affairs and Northern Development Canada (AANDC)'s Climate Adaptation and Resilience Program for Aboriginals and Northerners.

Nunavut	Climate Change Adaptation Planning: A Nunavut Toolkit	Funding from AANDC.

APPENDIX VI: DETAILED EVALUATION OF FINANCIAL INSTRUMENTS

Borrowing

OBJECTIVE	CRITERIA	ANALYSIS
Effectiveness	Potential capital raised	**HIGH:** The amount of capital raised will vary depending on the project but can range from $100,000 to $300 million. The amount will depend on the debt-servicing amount the local government may take on and relates to the amount required for infrastructure project. Approval from the province and voters may be required to exceed borrowing limits.
	Long term funding	**LOW:** Individual transactions are one-time injections of capital.
	Risk dispersion	Local and provincial government.
Ease of implementation	Authority	**MEDIUM:** Provincial legislation stipulates how much can be borrowed with provincial and public approval. Local governments do not require public approval when they borrow money for a legislated infrastructure project.
	Expertise and resources	**HIGH:** Local governments have the appropriate staff to work with local financing authorities.
	Existence of a Canadian model	**MEDIUM:** Each province has a legislated process for local governments to borrow money; however, there is no example yet of a municipality in Canada borrowing money to finance climate change adaptation infrastructure.
Public acceptance	Accountability	**Not measurable:** Depends on the cost recovery tool.
	Ease of communication	**MEDIUM:** Communicating the principals of borrowing is easy; however, justifying the need to borrow money may pose difficulties, especially how the loan will be repaid.
Equity	Benefits received	**Not measurable:** Dependent on the cost recovery tool.
	Vertical equity	**Not measurable:** Dependent on the cost recovery tool.
	Intergen. equity	**HIGH:** Adaptation infrastructure addresses long-term vulnerability and will be protecting assets over the long run; therefore, borrowing money with a long-term repayment plan shares the costs amongst those benefiting from the infrastructure in the future as well as the present.

Flexibility	Flexibility	**MEDIUM:** Province-specific, but legislation consistently requires that borrowed money be used only for the purpose/project that it was borrowed for, which is typically outlined in the borrowing bylaw.
Incidence	Incidence	Cost of repaying borrowed money falls to tax payers through property tax and user fees.
Political will	Political will	Political will to borrow money varies across municipalities. Some city councils are extremely risk adverse and do not borrow money, whereas other municipalities in the country borrow money to finance infrastructure frequently. Other difficulties of public acceptance and feasibility apply. Provincial legislation restricts municipal ability to have a deficit budget.

Reserves

OBJECTIVE	CRITERIA	ANALYSIS
Effectiveness	Potential capital raised	**HIGH:** Reserves can raise as much money as is required for the project.
	Long term funding	**HIGH:** Can be long-term, but the reserve will need to be continually filled.
	Risk dispersion	Local government
Ease of implementation	Authority	**HIGH:** Most local governments have the ability to create reserve funds.
	Expertise and resources	**HIGH:** Not difficult to administer.
	Existence of a Canadian model	**HIGH:** It is common for local governments in Canada to create reserve funds for specific projects.
Public acceptance	Accountability	**Not measurable:** Dependent on the tool used to create reserves.
	Ease of communication	**HIGH:** Reserve funds are easy to communicate to the public.
Equity	Benefits received	**LOW:** No, there may not be connection between the charge and project funded.
	Vertical equity	**Not measurable:** Case dependent, not really applicable as reserves are a method of financing not funding.
	Intergen. equity	**LOW:** Reserves, financed from general taxes, tend to violate the principle of intergenerational equity because current users and current taxpayers pay for capital that future generations will use.

Flexibility	Flexibility	**MEDIUM:** Reserve funds can be created for any type of project; however, once money is allocated, there are some limitations in trying to
Incidence	Incidence	Taxpayers
Political will	Political will	Case specific

Green/Climate Bonds

OBJECTIVE	CRITERIA	ANALYSIS
Effectiveness	Potential capital raised	**HIGH:** Bonds can raise significant capital; a green bond issued in Canada raised $231.5 million.
	Long term funding	**LOW:** Individual transactions are one-time injections of capital.
	Risk dispersion	Local and provincial government
Ease of implementation	Authority	**LOW:** Local governments in Canada cannot incur long-term debt without provincial approval.
	Expertise and resources	**MEDIUM:** Local governments may have financial officers on staff familiar with the process of working with the local financing authority or provincial ministry to issue a bond (if provincial legislation allows local governments to issue bonds).
	Existence of a Canadian model	**LOW:** there is no example yet of a local government issuing a green bond to finance climate change adaptation infrastructure.
Public acceptance	Accountability	**Not measurable:** Dependent on the cost recovery tool.
	Ease of communication	**MEDIUM:** Easy to communicate the tool, however, may be difficult to communicate the merits of borrowing money for a particular project.
Equity	Benefits received	**Not measurable:** Dependent on the cost recovery tool.
	Vertical equity	**Not measurable:** Dependent on the cost recovery tool.
	Intergen. equity	**HIGH:** Bonds are repaid over a long time period which allows for future generations to contribute to the repayment.

Flexibility	Flexibility	**MEDIUM:** Provincial legislation requires that when a municipality borrows money, it must authorize this through a bylaw. As part of the regulation, it is usually required to spend the money borrowed only on the project described in the bylaw. Projects could be city-wide infrastructure upgrades or a site-specific project.
Incidence	Incidence	Money repaid by taxes or user fees.
Political will	Political will	To be assessed on a case-by-case basis.

Tax Increment Financing (TIF)

OBJECTIVE	CRITERIA	ANALYSIS
Effectiveness	Potential capital raised	**HIGH:** In the US, bonds are issued based upon a portion of the assumed increase in tax revenues. For example, if a new development expects a $5,000,000 annual tax increase, then a $25,000,000 bond could be issued. Assuming the project successfully increases tax revenues, a portion of the revenue will repay the bond and a portion is dedicated to other public purposes.
	Long term funding	**MEDIUM:** It can be a stable long-term source of funding if property values and tax rates are stable.
	Risk dispersion	TIF is financed through a municipal bond that must be repaid over time. If the tax revenues from the area do not increase as planned, the municipality will be responsible for making up any deficit. It is therefore important that municipalities ensure that the assumptions and projections behind the establishment of a TIF are realistic.
Ease of implementation	Authority-jurisdiction	**LOW:** Provincial enabling legislation is required in Canada. Currently: Manitoba: •Legislation 2008 Ontario: •Tax Increment Equivalent Grants (TIEG) •TIF Legislation: Pilot Studies Alberta •Community Revitalization Levy
	Expertise and resources	**LOW:** Jurisdiction dependent.
	Existence of a Canadian model	**LOW:** Only used in Winnipeg and Calgary. Has been used and studied extensively in the US.

Public acceptance	Accountability	**MEDIUM:** Area specific. Important to use the "only if" principle, which is that development will only occur with subsidies and not without.
	Ease of communication	**LOW:** Important to communicate that municipality (local government) is not increasing taxes, but that the housing market is increasing values due to increased area benefits, which in turn increases tax payments.
Equity	Benefits received	**HIGH:** Not an increase in tax for everyone but a healthier tax based stemming from improvements.
	Vertical equity	**MEDIUM:** There can be concerns, as future taxpayers are losing out on general revenue that is going to repay TIF loan.
	Intergen. equity	**MEDIUM:** There can be concerns, as future taxpayers are losing out on general revenue that is going to repay TIF loan.
Flexibility	Flexibility	**MEDIUM:** Case-dependent. Funds are project-specific, and area specific (limited to special designated areas). Because of risk involved, better to limit to smaller and medium-sized projects
Incidence	Incidence	The general tax base.
Political will	Political will	Can be very politically popular because it is a self-financing mechanism and does not draw from other capital expenditures or necessitate a tax increase. Needs to be well designed to ensure it will never draw from general tax base to prevent bond default.

Property Tax

OBJECTIVE	CRITERIA	ANALYSIS
Effectiveness	Potential capital raised	**HIGH:** In 2008, property tax accounted for 50% of Canadian local governments total revenue, at $36,519 million.
	Long term funding	**High:** Permanent funding source but adaptation projects will need to compete with everything else on the municipal agenda.
	Risk dispersion	Local government
Ease of implementation	Authority	**HIGH:** Yes, all local governments collect property tax in some form.
	Expertise and resources	**HIGH:** Yes, see above.
	Existence of a Canadian model	**HIGH:** Yes
Public acceptance	Accountability	**MEDIUM:** Property tax is general revenue, so it goes to a variety of projects, including public infrastructure improvements.
	Ease of communication	**MEDIUM:** Project dependent – will need to make a strong case for raising the tax. The municipality will likely require voter approval to raise taxes for a specific project.
Equity	Benefits received	**Not measurable:** Project dependent – if the project will benefit the whole municipality, then yes.
	Vertical equity	**MEDIUM:** On the one hand, property tax is a flat tax that does not change in percentage, whether you have a $10,000 home or a $10,000,000 home. As such, an increase of 2% will affect homes differently as the value of the house determines the total tax amount. However, low-income families will most likely live in lower cost housing, and therefore will contribute a lower amount.
	Intergen. equity	**Not measurable:** Intergenerational equity will vary between project types

Flexibility	Flexibility	**HIGH:** There is high flexibility in the use of funds.
Incidence	Incidence	Taxpayers
Political will	Political will	In general, political will is low as raising taxes is unpopular. However, it is context dependent.

Tax Levy

OBJECTIVE	CRITERIA	ANALYSIS
Effectiveness	Potential capital raised	**HIGH:** Will depend on the tax base, but can raise >$1 million.
	Long term funding	**MEDIUM:** Depending on the structure of the levy, can be general and long-term, or project specific.
	Risk dispersion	Local government.
Ease of implementation	Authority-jurisdiction	**HIGH:** Local governments have the authority but will need to pass a by-law to approve new levy.
	Expertise and resources	**HIGH:** Local governments have the expertise but will need to devote time and resources to consultation, administration and reporting.
	Existence of a Canadian model	**HIGH:** Yes, multiple case studies. For examples refer to page 39.
Public acceptance	Accountability	**HIGH:** A well-designed levy will have a clear link between the charge and the project.
	Ease of communication	**MEDIUM:** Will need a strong public communication piece to be accepted by the public. The more specific the project, the easier to communicate. There is a trade-off between flexibility of what the funds can be used for and communicability of levy.
Equity	Benefits received	**MEDIUM:** Not as specific as other funding mechanisms (such as user fees), which directly align costs to benefits.
	Vertical equity	**LOW:** General tax levies are a regressive tax, as they take an equal amount of money independent of a households overall income.
	Intergen. equity	**Not measurable:** Intergenerational equity will vary between project types

Flexibility	Flexibility	**MEDIUM:** The funds can earn interest, and the levy amount can be modified on an annual basis, depending on how it has been set up. To gain public buy-in, project-specific levies do bet-
Incidence	Incidence	Tax payer
Political will	Political will	Often low political will because increasing taxes is not popular.

Local Improvement Charge (LIC)

OBJECTIVE	CRITERIA	ANALYSIS
Effectiveness	Potential capital raised	**LOW:** For example, in Whitehorse, Yukon, a unit price is applied to a property's frontage on a per-meter basis. The charge in 2012 was $571/metre. Improvements included curbs, gutters, and sidewalks.
	Long term funding	**MEDIUM:** No, project specific. The charges can be levied annually on the property tax bill.
	Risk dispersion	Local government
Ease of implementation	Authority-jurisdiction	**HIGH:** The way a LIC can be used is outlined in provincial statutes governing municipal powers. It varies by province, but the basic distinctions are: Flexible definition: Municipalities are free to decide what kinds of projects fit the definition (British Columbia, Alberta, Quebec, Newfoundland, Labrador and the Yukon). Limited definition with some flexibility (Saskatchewan, Manitoba, Prince Edward Island, Ontario). Explicit definition of LIC (New Brunswick, Nova Scotia).
	Expertise and resources	**MEDIUM:** LICs require local approval, background work, analysis, special studies, extensive checking, record keeping, account management, and detailed reporting. Therefore the projects being funded need to be large enough to offset the effort and costs involved.
	Existence of a Canadian model	**HIGH:** Yes, all provincial legislation allows for the administration of a type of LIC.
Public acceptance	Accountability	**HIGH:** In general, more acceptable then general property tax because it is easy to see what the funding is being used for. In some cases, property owners request a LIC.
	Ease of communication	**HIGH:** It is necessary to establish a clear connection between increase charges and increase benefit.

Equity	Benefits received	**HIGH:** The concept of LICs is that those who will benefit from the improvement are directly paying for it.
	Vertical equity	**LOW:** Lower income neighbourhoods will not be able to fund improvements in the same way as higher income neighbourhoods.
	Intergen. equity	**HIGH:** Generally charges match with use but can be project dependent. LICs work best for upgrades and renewal, and projects that have fast completion dates.
Flexibility	Flexibility	**MEDIUM:** No, the funds need to be used for the project. In general, once an LIC is levied there is little flexibility regarding what the funds can be used for.
Incidence	Incidence	The property owners in the LIC designated area will pay the final incidence of the charge.
Political will	Political will	Generally high

User Fees

OBJECTIVE	CRITERIA	ANALYSIS
Effectiveness	Potential capital raised	**HIGH:** Depends on the rate set for the fee. The fee should be calculated to cover capital, operational, and maintenance costs.
	Long term funding	**HIGH:** Raises a predictable and dependable amount of annual revenue dedicated to the service, and no competition with other governmental services for general revenues.
	Risk dispersion	Local government
Ease of implementation	Authority-jurisdiction	**HIGH:** Depends on the province but generally within municipal authority. There is an established precedent for utility models in Canada.
	Expertise and resources	**LOW:** Developing a utility model from scratch has large up-front administrative costs and requires financing (through borrowing or reserve funds). Time and expertise for research into appropriate methods along with revenue estimates, planning, consultations and the development of legal ordinances would be required.
	Existence of a Canadian model	**HIGH:** Six Canadian examples, explained further in Table 12.
Public acceptance	Accountability	**MEDIUM:** The major difficulty in applying the utility model approach is public acceptance in areas where services are being delivered at rates subsidized by the general tax base. A switch to a utility model is a large change that will require extensive public consultation.
	Ease of communication	**MEDIUM:** A utility approach is relatively easy to explain and the issues of equitable payments assist in communicating the idea. However, it can be difficult to communicate why a utility has been set up for something that was previously included in the general property tax.
Equity	Benefits received	**HIGH:** Depending on the rate structure, utility fees can be very specific in linking a service to a charge.
	Vertical equity	**LOW:** Utility fees are regressive, that is, they absorb a higher percentage of lower income individuals' or households' income when compared with higher income individuals or households.
	Intergen. equity	**MEDIUM:** Yes, rates are charged to cover the cost of service.

Flexibility	Flexibility	**MEDIUM:** The tool is flexible. The funds raised can earn interest but they need to be used for the utility. The rate structure can be modified and/or raised to meet changing needs. There are a limited number of municipal services that can be equitably managed on a user-fee basis (water, sewer, storm water and garbage). Therefore, user fees are limited to certain projects.
Incidence	Incidence	Taxpayers.
Political will	Political will	To be assessed on a case-by-case basis.

Development Cost Charges (DCCs)

OBJECTIVE	CRITERIA	ANALYSIS
Effectiveness	Potential capital raised	**LOW:** There are regional and provincial variations in the amount of capital a DCC can raise. In Vancouver, BC a DCC is $944 per single-family residential development.
	Long term funding	**LOW:** No, DCCs are a one-time fee and can therefore not be classified as long term funding.
	Risk dispersion	Local government and developers
Ease of implementation	Authority-jurisdiction	**HIGH:** The ability for each municipality to set development fees is established in the local government act. Ontario, BC, Alberta, Saskatchewan, Nova Scotia, and the Halifax Regional Municipality all have legislation permitting municipalities to levy charges, however this is not the case for all municipalities (FCM 2012). Quebec, notably, does not charge DCCs.
	Expertise and resources	**HIGH:** Yes, if the legislation is already in place.
	Existence of a Canadian model	**HIGH:** Yes
Public acceptance	Accountability	**HIGH:** Benefits must have a clear relation to the development. Generally, DCCs are supported by the public, unless it appears as if they are favouring certain areas or raising the cost of housing.
	Ease of communication	**HIGH:** The goals of this mechanism are transparent and simple to explain.
Equity	Benefits received	**HIGH:** The charges are used to fund infrastructure projects that will be used by the new residents of the development.
	Vertical equity	**MEDIUM:** DCCs may have social equity ramifications, as they can affect the availability of low- to moderate-income housing and consequently the ability of lower-income residents to live in better-serviced parts of the community.
	Intergen. equity	**MEDIUM:** Need to consider equity between existing taxpayers and developers or newcomers attracted by development.

Flexibility	Flexibility	**LOW:** DCCs can only be used for projects directly related to the costs associated with new growth.
Incidence	Incidence	The developer, and consequently the buyer of new housing.
Political will	Political will	Politicians may be reluctant to charge different rates in different areas for fear of being seen as favouring certain areas or constituents over others.

Federal Gas Tax Fund

OBJECTIVE	CRITERIA	ANALYSIS
Effectiveness	Potential capital raised	**HIGH:** The amount each province receives can be found in Table 13.
	Long term funding	**HIGH:** In its current form it is a dedicated funding source.
	Risk dispersion	Local government
Ease of implementation	Authority	**HIGH:** Have control over how the funds are used but not over the amount received.
	Expertise and resources	**HIGH:** Yes, it is stable annual funding that local governments are accustomed to receiving and administering.
	Existence of a Canadian model	**HIGH:** Currently every province receives a portion of this fund.
Public acceptance	Accountability	**LOW:** In its current form, no. However, possible to reform the Fuel Excise Tax to create a link between GHG emissions and adaptation projects.
	Ease of communication	**MEDIUM:** Simple to communicate, but will need to explain why adaptation is being prioritized over other infrastructure projects.
Equity	Benefits received	**LOW:** As a grant from another level of government, there is not a clear link between those paying the charge and those receiving the service.
	Vertical equity	**HIGH:** No groups will be disadvantaged from this charge
	Intergen. equity	**LOW:** There may be no, or very limited, long-term social equity in this type of financing since taxpayers contributing to costs of infrastructure assets are not necessarily those who will use it and benefit directly from them.

Flexibility	Flexibility	**HIGH:** Yes, the funds are very flexible as they can be used as capital finance, or operational funding. Furthermore the funds
Incidence	Incidence	The taxpayers bear the direct financial burden through fuel use, and indirectly through paying a higher price for products that incorporate the cost of the tax.
Political will	Political will	High

Federal Grants

OBJECTIVE	CRITERIA	ANALYSIS
Effectiveness	Potential capital raised	**HIGH:** Capital raised varies between projects but typically range between $300,000 to $100 million.
	Long term funding	**LOW:** Grants are a one-time amount.
	Risk dispersion	The risk is shared between all participating levels of government.
Ease of implementation	Authority	**HIGH:** The local government has the authority to request a grant from other levels of government.
	Expertise and resources	**HIGH:** The federal grant proposal must be coordinated with the provincial government. The local government should have the resources and expertise to submit a proposal. Cost will vary depending on the project details and the cost of developing a business case.
	Existence of a Canadian model	**HIGH:** Grants are frequently used for financing infrastructure.
Public acceptance	Accountability	**Not measurable:** Assessed on a case-by-case basis.
	Ease of communication	**HIGH:** Borrowing is easy to communicate to the public; however, the cost-recovery process may prove more difficult.
Equity	Benefits received	**MEDIUM:** Those paying federal taxes may or may not directly benefit from federally funded infrastructure projects.
	Vertical equity	**Not measurable:** Will vary depending on the project
	Intergen. equity	**Not measurable:** Will vary depending on the project
Flexibility	Flexibility	**MEDIUM:** Funding may only be used for the project it was approved for but there is wide variety of projects that may be eligible for grants.
Incidence	Incidence	Tax payers.
Political will	Political will	Yes, grants are a favoured tool for financing infrastructure.

Public Private Partnerships (P3s)

OBJECTIVE	CRITERIA	ANALYSIS
Effectiveness	Potential capital raised	**HIGH:** P3s will reduce the amount of upfront capital required of the local government; however, the annual service payment still needs to be considered and procurement costs can be high.
	Long term funding	**MEDIUM:** A P3 can supply funding for maintenance if it is structured to span the lifecycle of the asset.
	Risk dispersion	A critical issue in the design of a P3 is the sharing of risk, which depends on a partnership's structure. The greater the private sector's share, the greater the expected rate of return. In principle, the party best able to deal with each type of risk at the least cost should bear that risk (TD, 2006). For example, the risk of cost over-runs, scheduling delays, and service demand should be borne by the private sector. The risks associated with changes in environmental taxation regulation and legislation should be assumed by the local government (Kitchen, 2006).
Ease of implementation	Authority	**MEDIUM:** Relevant Municipal Acts, which differ by province, will govern the authority of a municipal administration to enter into a P3 contract. Each municipality will need to understand its legislative restrictions, such as how its procurement policies are constrained by provincial laws/regulations, and what can be provided by the private sector without regulatory change.
	Expertise and resources	**LOW:** BC, Ontario, Quebec and New Brunswick have P3 agencies, and Alberta has a P3 division within its treasury board. These agencies are set up to help municipal P3 procurement. It can be resource-intensive to set up a P3, which are complex projects with complicated and technically sophisticated procurement procedures.
	Existence of a Canadian model	**MEDIUM:** As of November 2011, there are 150 municipal P3s in Canada. However, there are no examples linked to resilient infrastructure.

Public acceptance	Accountability	**MEDIUM:** The link between the tool and the project may not be clearly defined depending on the structure of the P3.
	Ease of communication	**MEDIUM:** Requires a shift in thinking about the role of the public sector. Public consultations should begin during the planning phase, and include open public meetings where procuring agency can articulate the project's purpose, costs, and progress made.
Equity	Benefits received	**MEDIUM:** Rates are charged to cover the cost of service.
	Vertical equity	**LOW:** Users pay the same amount for service (unless the local government subsidies service for certain groups).
	Intergen. equity	**MEDIUM:** Rates are charged to cover the cost of service.
Flexibility	Flexibility	**MEDIUM:** P3s are project specific. In addition, they are more appropriate for larger projects. Infrastructure Ontario notes projects over $20 million are more suitable; "Larger projects have a greater potential to generate the efficiency gains needed to offset the fixed costs incurred by the public and private partners during the development and procurement phases" (39).
Incidence	Incidence	In a traditional model, P3s operate with an ROI so those paying for the service bear the final burden but also share the returns.
Political will	Political will	Potential for resistance from public-sector unions (Kitchen, 2006) as can be seen as "privatization by stealth" (Ploeg, 2007).

CARIP Grant (BC Only)

OBJECTIVE	CRITERIA	ANALYSIS
Effectiveness	Potential capital raised	**LOW:** Local governments in BC receive a CARIP grant in the range of $5,000 to $40,000.
	Long term funding	**HIGH:** Local governments will remain eligible for this grant for as long as the carbon tax is in place and the provincial government is offering the grant.
	Risk dispersion	Local government
Ease of implementation	Authority	**HIGH:** All local governments in BC that are Climate Action Charter signatories and are working towards carbon neutrality are eligible for the grant.
	Expertise and resources	**HIGH:** Local governments are already receiving the CARIP grant.
	Existence of a Canadian model	**HIGH:** Many local governments in BC are receiving the CARIP Grant.
Public acceptance	Accountability	**LOW:** The CARIP Grant has no limitations on how it can be used.
	Ease of communication	**MEDIUM:** The Ministry of Community, Sport, and Cultural Development currently lists projects funded by the CARIP grant on their website but it may be complex to communicate the funding mechanism to the public.
Equity	Benefits received	**MEDIUM:** Yes, the CARIP grant is a reimbursement of carbon tax paid by the local government and the grant is reimbursed for the exact amount paid by the local government.
	Vertical equity	**HIGH:** No groups will be unfairly burdened.
	Intergen. equity	**HIGH:** Depends on how and when the money is spent but most likely to be used the year it is received.
Flexibility	Flexibility	**HIGH:** The CARIP grant may be used at the discretion of the local government.
Incidence	Incidence	Tax payers
Political will	Political will	Political will to use the CARIP grant for adaptation response projects will depend on a case-by-case basis.

Carbon Fund (BC Example)

OBJECTIVE	CRITERIA	ANALYSIS
Effectiveness	Potential capital raised	**LOW:** Capital raised will be equivalent to the number of unavoidable corporate municipal emissions per tonne multiplied by the price of carbon tonne.
	Long term funding	**HIGH:** A carbon fund would collect money annually.
	Risk dispersion	Local government.
Ease of implementation	Authority	**HIGH:** The Climate Action Charter gives local governments the necessary authority.
	Expertise and resources	**MEDIUM:** Local governments in BC have the resources and expertise to implement this measure. The size of the local government may affect the ability to easily run the program. The most time-intensive aspect is managing the fund and establishing projects that it can fund or contribute funding to.
	Existence of a Canadian model	**MEDIUM:** Less than five examples in BC.
Public acceptance	Accountability	**HIGH:** Funds are collected for mitigation and adaptation projects.
	Ease of communication	**MEDIUM:** The mechanism is simple in BC, but may be more complicated in other provinces where the public sector is not legislated to be carbon neutral. Having a provincially established price on carbon reduces complexity.
Equity	Benefits received	**HIGH:** Yes, locally-paid taxes will be used for local projects.
	Vertical equity	**HIGH:** Money is collected from tax revenues and is incorporated into the operating budget.
	Intergen. equity	**Not measurable:** Depends on how and when the revenue is used in the community.
Flexibility	Flexibility	**HIGH:** Funds should be able to earn interest and adaptable in that the fund can be used on a variety of projects (local governments discretion).
Incidence	Incidence	Tax payers
Political will	Political will	Must be assessed on a case-by-case basis.

Local Incentives

OBJECTIVE	CRITERIA	ANALYSIS
Effectiveness	Potential capital raised	**Not measurable:** Capital is not raised with this tool but is used to encourage private actions to achieve adaptation goals and can result in local governments saving money.
	Long term funding	**Not measurable:** See above.
	Risk dispersion	Local government
Ease of implementation	Authority	**HIGH:** Local governments have the authority to implement a rebate or incentive program. Program funding will likely require Council's approval.
	Expertise and resources	**MEDIUM:** Depending on the size of the local government, designing and implementing a program should be feasible. If resources are limited, a new staff position may be required to design and implement the program.
	Existence of a Canadian model	**HIGH:** Examples exist at every level of government.
Public acceptance	Accountability	**LOW:** Capital to develop the program may come from different sources.
	Ease of communication	**HIGH:** Simple mechanism, easy to communicate when requirements for receiving incentives are simple.
Equity	Benefits received	**Not measurable:** Case-by-case basis. Ideally, those paying for the program have access to receiving the incentives.
	Vertical equity	Depends on the program.
	Intergen. equity	Depends on the program.
Flexibility	Flexibility	Assessed on a case-by-case basis.
Incidence	Incidence	Tax payers, unless new revenue source is used to establish the program.
Political will	Political will	High when mandate and financial resources align.

Local Improvement Charge Financing

OBJECTIVE	CRITERIA	ANALYSIS
Effectiveness	Potential capital raised	**LOW:** The potential capital raised varies greatly; however, when taken on a per home basis, the CoV was able to provide a loan of up to $10,000 per homeowner. For the Halifax program, total costs per home are typically $6,500-$7,900 for materials and installation, plus financing costs.
	Long term funding	**LOW:** Loans are a one time amount tied to individual properties with the retrofit.
	Risk dispersion	Improperly structuring PACE-related liabilities can pose a threat to a municipality's finances. For example, if PACE bonds are structured as a "general obligation" of the municipality, then the debt might create a direct liability to the municipality's general fund, count against its debt limit, and/or impact its credit rating.
Ease of implementation	Authority	**LOW:** Dependent on legislation for LICs and municipalities' debt limit.
	Expertise and resources	**MEDIUM:** Total costs depend on the size and scope of the program and generally include start-up costs, initial expenses, and ongoing costs. For each category, costs include municipal personnel time for overseeing the program, fees paid to third parties, and marketing expenses. A municipality can recover program administration costs through application fees, a fee added to the project cost, an increased interest rate, and other sources (e.g., the general fund and grants).
	Existence of a Canadian model	**MEDIUM:** There have been four pilot programs in Canada; the one in Vancouver was not successful. These programs are compared in Table 12.
Public acceptance	Accountability	**MEDIUM:** The program requires high public uptake to be cost-effective. As it is optional, participants can chose if they want to participate or not. The program could be seen as an inefficient use of public funds if there is low uptake.
	Ease of communication	**LOW:** The structure of the program can be confusing, as the public is not accustomed to municipalities issuing loans.

Equity	Benefits received	**HIGH:** Only those property owners who opt in pay for the program and only the current owner of an improved or retrofit-
	Vertical equity	**MEDIUM:** This tool could have positive or negative consequences depending on uptake and structure. The potential negatives are: only those who have the ability to pay will be interested by the program, especially if there is little ROI, and may only appeal to those who would undergo retrofitting regardless of program. Potential positive: the program makes loans available to those with lower credit ratings who may not be able to receive a loan in other circumstances.
	Intergen. equity	**HIGH:** The loan is tied to the property; therefore, the resident living in the property will be paying part of the amortized cost.
Flexibility	Flexibility	**LOW:** LIC loans only fund private adaptation, so in its current form this tool is not appropriate for large scale projects.
Incidence	Incidence	The homeowner, and the municipality if the homeowner defaults on their debt.
Political will	Political will	Case dependent

Density for Benefit Agreements (Bonuses/Transfers)

OBJECTIVE	CRITERIA	ANALYSIS
Effectiveness	Potential capital raised	**Not measurable:** This tool does not raise capital but incents developers to include specific amenities into their project.
	Long term funding	**Not measurable:** Density bonuses are negotiated once per development.
	Risk dispersion	On the developer.
Ease of implementation	Authority	**HIGH:** Local governments may authorize density bonuses/transfer through bylaws.
	Expertise and resources	**HIGH:** Zoning and density bylaws are authorized by the local government. Administrative costs are the time need to issue and negotiate the rezoning application. Public consultation may be required.
	Existence of a Canadian model	**HIGH:** There are more than five local government examples, such as CoV and City of Toronto.
Public acceptance	Accountability	**HIGH:** Benefits must have a clear relation to the development (Moore, 2013).
	Ease of communication	**MEDIUM:** Easy to communicate with developers as they are already familiar with this tool; however, as the negotiations of density bonuses are not a transparent process, it may be difficult to communicate to the public (Moore, 2013).
Equity	Benefits received	**HIGH:** The benefits of density bonuses will be transferred to the purchasers of the housing, who will benefit, e.g. from green infrastructure.
	Vertical equity	**Not measurable:** Depends on the project and the size of the density. bonus.
	Intergen. equity	**Not measurable:** Depends on the project and the size of the density. bonus.
Flexibility	Flexibility	**MEDIUM:** Amenities are negotiated between the developer and the local government so there is some flexibility in what the developer may agree to provide; however, amenities must have a direct relationship to the development.
Incidence	Incidence	The developer, who in effect transfers it to the real estate purchaser.
Political will	Political will	Political will is not a limiting factor.

Natural Area Tax Exemption

OBJECTIVE	CRITERIA	ANALYSIS
Effectiveness	Potential capital raised	**Not measurable:** This tool does not raise capital but incents the protection and maintenance of natural areas with societal, cultural, or environmental value.
	Long term funding	Not measurable, see above.
	Risk dispersion	Not measurable, see above.
Ease of implementation	Authority	**HIGH:** Local governments authorize property tax exemptions.
	Expertise and resources	**HIGH:** Tax exemptions are already part of the property tax process. Administrative costs are charged to the property owners as an application fee. For example, NAPTEP charges an application fee for each phase. Phase one fee is $275 and phase two fee is $175.
	Existence of a Canadian model	**MEDIUM:** Case studies are examined in Table 13.
Public acceptance	Accountability	**HIGH:** Property owners are compensated for maintaining ecologically important areas that have a larger societal benefit.
	Ease of communication	**MEDIUM:** The mechanism is simple to communicate; however, the process varies depending on the size of the property and complexity of the covenant, which may make communicating the process to participants more difficult.
Equity	Benefits received	**HIGH:** What is lost in general revenue by the tax exemptions must be made up from other property tax collected. The result is that those benefiting from the protected areas are also balancing out the costs of providing the exemption.
	Vertical equity	**HIGH:** No group will be unfairly burdened.
	Intergen. equity	**HIGH:** The covenant is permanent, therefore generations will benefit long-term and the property owners will continue to receive the tax exemption.
Flexibility	Flexibility	**LOW:** In its current form there is no flexibility.
Incidence	Incidence	Local tax payers
Political will	Political will	Assess on case-by-case basis.

APPENDIX VII: GROUND-TRUTHING PROCEDURE AND INTERVIEW QUESTIONS

Ground-truthing participants received a project summary, meeting agenda, and question guide via email prior to the interview. The question guide was used to assist the participants through the questions and topics of interest. The questions were answered to the best of the participants' ability and not every tool was addressed, as what tools were discussed was at the discretion of the participant. The results of the discussion were summarized and consolidated in the *feasibility* section of each tool explanation.

Ground-truthing participants received the following:

Project Summary:

With support from Natural Resources Canada, Simon Fraser University's Adaptation to Climate Change Team is researching possible finance tools available to local governments in Canada to finance and implement climate change adaptation (CCA) measures for nfrastructure. The tools identified below are the results of a literature review informing the larger study that aims to identify different finance tools available in Canada for infrastructure adaptation. The goal of these interviews is to conduct a feasibility study with project partners (CVRD and CoV) to determine if the tools identified have the potential to either directly finance adaptation, or catalyze adaptation measures.

The tools listed below focus on financing infrastructure that aims to reduce a region's vulnerability to extreme weather events caused by climate change. The requirements of CCA can be broken into four different stages that need financing:

1. **Identify** the impacts of climate change through research
2. **Develop adaptation plans** and **communicate** those plans to the appropriate people
3. **Implement** adaptation plans at various scales
4. **Maintain** the integrity of the adaptation plans and associated infrastructure

The primary focus of this research is the last two stages: Implementing and maintaining adaptation measures. This focus is on these areas because implementation and maintenance are the most difficult to finance. Many Canadian municipalities already have adaptation plans in place but require stable sources of funding before moving forward with infrastructure projects.

Table A8:1 Interview Agenda

TIME (MINS)	ACTION ITEM
5	Introduce researchers, interviewees, and present project, hand out consent form
55	Discussion around finance tools and evaluations. Fill in table below, ask clarifying questions relating to specific tools
20	Brainstorm other finance tools that we have missed, discuss the role of insurance and private companies, as well as other levels of government
10	Final comments and next steps

Discussion questions:

1. Are you using this tool currently and for what purpose?
2. Is this tool applicable for meeting adaptation needs?
3. Does your experience/understanding of the tool align with our evaluation?
4. What other information would you like to know about the tool?

Table A8:2 Interview Question Guide

TOOL	ABILITY?	INTEREST?	OBSTACLES?	RATING
INTERNAL SOURCES				
Borrowing				
Reserve Funds				
Green/Climate Bonds				
TIF				

User Fees				
DCCs				
LIC				
Parcel Tax				
Tax Levy				
EXTERNAL SOURCES				
Intergovernmental Grants				
Gas Tax Fund				
CARIP Grant				
Carbon Fund				
PPPs				
CREATING INCENTIVES				
LIC Financing				
DCC Rebates				
Local Incentives and Rebates				
Land Trusts				

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