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***Municipal Infrastructure
Market Report***

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STEP

Saskatchewan's economy depends on its ability to compete in the global market. Exports across Canada and internationally account for over two-thirds of annual GDP, and one-third of the province's jobs. Increasing exports creates economic activity, wealth and jobs for Saskatchewan people.

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Executive Summary

“Sustainable infrastructure refers to water, sewer, roads, bridges, remediation and other infrastructure systems that meet the needs of current and future generations in a socially, economically, and environmentally viable manner.”

Infrastructure is a critical component of a society's development. Nations around the world rely on an extensive network of interlinked infrastructure systems to meet the ever increasing needs of their citizens and businesses. From enabling international trade and ensuring that people can move to and from work, to protecting the health and well-being of people through providing access to and distribution of clean water as well as distribution and disposal of sewage, infrastructure maintenance, development and innovation affects all members and groups within society.

While the cause and effect relationship between infrastructure and societal development is not always incontrovertible, it is clear that developed nations have more developed systems of infrastructure than less developed nations. Nations that have invested in infrastructure realize tremendous economic benefits for their businesses and citizens arising from their investments.

The Government of Canada and governments around the world have fully recognized that a fundamental requirement to maintaining an advanced society and ensuring a foundation is laid to achieve international competitiveness as a society is through sustainable infrastructure development and maintenance. In 2007, the Federal Government of Canada introduced the *Building Canada* infrastructure plan, a comprehensive plan that would see \$33 billion invested in infrastructure projects across Canada between 2007 and 2014. In addition, on January 27th, 2009, the Canadian federal government also introduced their annual budget under the title of *Canada's Economic Action Plan*. This plan outlines Canada's two-year \$52 billion stimulus package response to the recent financial crisis. The plan is designed to spur growth and mitigate Canada's exposure to the global financial crisis through targeted financial stimulus spending. The plan introduced \$12 billion in new stimulus funding for infrastructure investment over two years. Building upon the seven-year, \$33 billion public infrastructure spending plan outlined under *Building Canada*. Beyond Canada, governments around the world are realizing the power behind investing in infrastructure to boost economic strength. Together, world governments are projected to invest a total of \$1.05 trillion in annual infrastructure investment, with total infrastructure investment worldwide estimated to equal \$25 - \$30 trillion over the next 20 years.¹

¹ Tal, Benjamin. *Occasional Report #66: Capitalizing on the Upcoming Infrastructure Stimulus* CIBC World Markets. 26 Jan. 2009. 4 Feb. 2010. <http://research.cibcwm.com/economic_public/download/occrept66.pdf>

While economic stimulus spending has injected urgently needed investment into Canada and the world's infrastructure inventory, more funding is desperately required. As revenues are squeezed, governments at all levels across Canada are feeling the pressure to present and maintain balanced budgets. To achieve this governments have been deferring infrastructure upgrades and maintenance by shifting the responsibility and expense of infrastructure from federal and provincial governments to municipalities. The deferring of investment and responsibility has resulted in a municipal infrastructure deficit, the amount of funding required to bring municipal infrastructure to an acceptable level, in Canada the municipal infrastructure deficit has reached an estimated \$123 billion.² Of this, Canada's local governments are faced with an estimated \$64 billion deficit that is growing at a rate of \$2.1 billion per year.³ This is major, considering that in 2007, the value of public infrastructure related to transportation, water and wastewater management in Canada was estimated to be \$286.2 billion (approximately 80% of the total public engineered infrastructure in Canada).⁴ When one takes into account the additional investment needed for new infrastructure and upgrading requirements, Canada's total infrastructure deficit could be approximately \$350 - \$400 billion.⁵ Across the border the situation is not much brighter. In the United States (U.S.), the American Society of Engineers estimates that USD \$2.2 trillion needs to be invested over the next five years to bring U.S. infrastructure to a "good condition."⁶ Over the next two decades, infrastructure investments globally are estimated to reach \$25 - \$30 trillion.⁷ World-wide, infrastructure is at a critical point and considering the real and economic costs associated with infrastructure failure governments cannot continue to ignore and defer investment in this area.

Although infrastructure around the world is in a critical state, there is reason for governments in Canada and Saskatchewan to be hopeful. While the current infrastructure deficit in Canada represents an impediment to future growth, it also represents an opportunity. As current infrastructure nears the end of its useful life there is an opportunity for countries and governments to replace old, inefficient infrastructure, with sustainable, green infrastructure. Saskatchewan is in a prime position to take advantage of this opportunity.

As a home to a world-class cluster of industry, government and academic leaders in the research and development of cutting-edge technology, processes and knowledge in the field of sustainable municipal infrastructure, Saskatchewan is positioned to lead the way in sustainable municipal infrastructure development and adoption. Saskatchewan's sustainable municipal infrastructure cluster is comprised of a

² Mirza, Saeed. *Danger Ahead: The Coming Collapse of Canada's Municipal Infrastructure* Federation of Canadian Municipalities. Nov. 2007. 20 Jan. 2010. <<http://www.fcm.ca/CMFiles/mdeficit1OPT-792008-3425.pdf>>

³ *State of the World: FIDIC Infrastructure Report 2009* International Federation of Consulting Engineers. 2009.

⁴ Gaudreault, Valerie; Gagnon, Mychele; Overton, Donald. *Age of Public Infrastructure: A Provincial Perspective* Statistics Canada. 11 Dec. 2009. 2 Feb. 2010. <<http://www.statcan.gc.ca/pub/11-621-m/11-621-m2008067-eng.htm>>

⁵ *For the Record: Canadian Infrastructure Crisis Still Critical* The Canadian Council for Public-Private Partnerships. Mar. 2009. 8 Feb. 2010. <http://www.pppcouncil.ca/pdf/mirza_032009.pdf>

⁶ *2009 Report Card for America's Infrastructure* American Society of Civil Engineers. 25 Mar. 2009. 22 Jan. 2010. <http://www.infrastructurereportcard.org/sites/default/files/RC2009_full_report.pdf>

⁷ Tal, Benjamin. *Occasional Report #66: Capitalizing on the Upcoming Stimulus* CIBC World Markets. 26 Jan. 2009. 20 Jan. 2010. <http://research.cibcwm.com/economic_public/download/occrept66.pdf>

number of stakeholders, including: municipalities, research organizations, and several industry leading businesses. At the center of the cluster in Saskatchewan is Communities of Tomorrow, a public private partnership that was created to bring together key players and build partnerships to create sustainable communities. The organization acts as a catalyst for the development of a cluster of companies, researchers, municipalities and investors in the field of innovative and sustainable municipal infrastructure. By facilitating collaboration between leaders from these different fields, Communities of Tomorrow is developing Canada's first Municipal Innovation Network to position Saskatchewan to become a world-wide center of excellence in the field of sustainable municipal infrastructure.

Throughout this report municipal infrastructure in Canada will be focused on with some attention paid to infrastructure in other areas of the world. The report is primarily focused on three broad categories of infrastructure that municipal governments are heavily involved with, including:

1. Water and Wastewater

- This category includes infrastructure related to the supply and distribution of water, water treatment and waste water management. This includes such infrastructure as: pumping stations, piping and water filtration facilities.

2. Transportation

- This category encompasses: all types of roads, sidewalks, recreational paths, overpasses and bridges, as well as services related to the maintenance of those infrastructures.

3. Waste Management

- This category includes services and infrastructure required to transport, manage and dispose of existing and new waste produced within municipalities, towns and cities.

Of these three broad categories, the first two categories, water and wastewater treatment and transportation, combined, account for 80% of all engineered infrastructures owned by Canadian government entities.⁸

State of Municipal Infrastructure

Municipal infrastructure can be characterized as the lifeblood of the world's economy. The human body relies on a healthy flow of blood to keep all the components of the body working together and properly. So is true that the world economies rely on infrastructure to properly function and grow. Spending on

⁸ Gaudreault, Valerie; Lemire, Patrick. *The Age of Public Infrastructure* Statistics Canada. 11 Dec. 2009. 2 Feb. 2010. <<http://www.statcan.gc.ca/pub/11-621-m/11-621-m2006035-eng.htm>>

infrastructure represents a major expenditure for world governments. In Western Canada alone, the major prairie cities spend approximately \$9.3 billion annually to operate and maintain their cities, with over 60% (\$5.8 billion) of their budget dedicated to maintaining, establishing and operating local infrastructure. In Regina and Saskatoon alone, infrastructure spending, including both operating expenses and capital costs, totalled \$483 million in 2008.⁹ Infrastructure spending at the local level has a significant impact on local economies as it encourages job creation and provides the necessary framework for increased opportunities related to local economic development. However, maintaining and establishing complex systems of infrastructure requires ongoing maintenance and represents an active asset as well as a liability for local economies. In recent decades the state of municipal infrastructure has fallen victim to neglect and has been in decline. Much of the world's infrastructure is in a deteriorated state and in need of repair or replacement. The shortfall in investment in the maintenance and upgrading of infrastructure is often referred to as the infrastructure deficit or infrastructure gap.

Over the last few decades the infrastructure deficit across North America has been growing. In Canada, the municipal infrastructure deficit, the amount of funding required to bring municipal infrastructure to an acceptable level, has reached an estimated \$123 billion.¹⁰ Of this, Canada's local governments are faced with an estimated \$64 billion deficit that is growing at a rate of \$2.1 billion per year.¹¹ This is a major concern for governments and citizens, considering that in 2007, the value of public infrastructure related to transportation, water and wastewater management in Canada was estimated to be \$286.2 billion (approximately 80% of the total public engineered infrastructure in Canada).¹² When one takes into account the additional investment needed for new infrastructure and upgrading requirements, Canada's total infrastructure deficit could reach levels of approximately \$350 - \$400 billion.¹³ Across the border the situation is not much better. In the United States (U.S.), the American Society of Civil Engineers (ASCE) estimates that USD \$2.2 trillion needs to be invested over the next five years to bring U.S. infrastructure to a "good condition." On the ASCE's annual report card, in 2009, infrastructure in the U.S. received a grade of "D" or "Poor."¹⁴ Considering that a nation's economic prosperity is impacted by the state of their network of infrastructure, reducing the infrastructure deficit in Canada and the U.S. should be a priority among all levels of government. When looking at the entire world over the next two decades,

⁹ Wandzura, Dorian. *Municipal Innovation Network: A Strategy Developed in Collaboration with Communities of Tomorrow* Communities of Tomorrow. July 2009.

¹⁰ Mirza, Saeed. *Danger Ahead: The Coming Collapse of Canada's Municipal Infrastructure* Federation of Canadian Municipalities. Nov. 2007. 20 Jan. 2010. <<http://www.fcm.ca/CMFiles/mdeficit1OPT-792008-3425.pdf>>

¹¹ *State of the World: FIDIC Infrastructure Report 2009* International Federation of Consulting Engineers. 2009.

¹² Gaudreault, Valerie; Gagnon, Mychele; Overton, Donald. *Age of Public Infrastructure: A Provincial Perspective* Statistics Canada. 11 Dec. 2009. 2 Feb. 2010. <<http://www.statcan.gc.ca/pub/11-621-m/11-621-m2008067-eng.htm>>

¹³ *For the Record: Canadian Infrastructure Crisis Still Critical* The Canadian Council for Public-Private Partnerships. Mar. 2009. 8 Feb. 2010. <http://www.pppcouncil.ca/pdf/mirza_032009.pdf>

¹⁴ *2009 Report Card for America's Infrastructure* American Society of Civil Engineers. 25 Mar. 2009. 22 Jan. 2010. <http://www.infrastructurereportcard.org/sites/default/files/RC2009_full_report.pdf>

infrastructure investments globally are estimated to reach \$25 - \$30 trillion, a truly staggering and troubling number.¹⁵

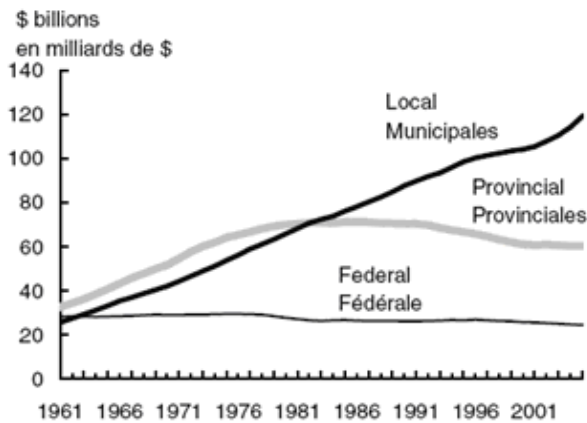
In Canada, the majority of infrastructure was built before the 1970's, leaving the country in the position of having over 50% of its infrastructure at the end of its operating life. Over the last 30-40 years there has been minimal investment in the maintenance and replacement of infrastructure, with one study indicating that between 1978 and 2000 new investment in infrastructure averaged only 0.1% per year during that time frame.¹⁶ This same study noted that investment in infrastructure did increase between 2000 and 2003. However, the study concluded that the majority of the increase in investment can be attributed to the result of rapid urbanization, with little of the increased funding being directed towards maintenance, replacement and upgrading of existing infrastructure, a key element in reducing the overall infrastructure deficit in Canada.

In addition to the slow down in infrastructure investment, much of the ownership and responsibility of infrastructure has been shifted to municipal governments. From 1961-2001 federal ownership of infrastructure remained relatively flat and provincial ownership increased slightly. In contrast, in that same time period, municipal ownership of infrastructure increased dramatically. This can largely be attributed to economic and political forces. Investment in infrastructure surged in the 60's and 70's, largely fuelled by the increasing appetite and demographic explosion driven by the baby boomer generation. As the baby boomer generation came to age and subsequently had fewer children than their own generation, federal and provincial government budgets were squeezed. As a mechanism for delivering a balanced budget, federal and provincial governments reduced ownership, investment and responsibility for infrastructure and shifted the onus on infrastructure to municipal governments. This trend was magnified by the subsequent recessions of the 80's and 90's. As cash strapped municipal governments stretched their limited resources to meet the immediate needs of their local citizens and federal and provincial governments reduced funding in infrastructure to balance budgets, infrastructure across Canada started to age and the infrastructure deficit began to grow.

¹⁵ Tal, Benjamin. *Occasional Report #66: Capitalizing on the Upcoming Stimulus* CIBC World Markets. 26 Jan. 2009. 20 Jan. 2010. <http://research.cibcwm.com/economic_public/download/occrept66.pdf>

¹⁶ Mirza, Saeed. *Danger Ahead: The Coming Collapse of Canada's Municipal Infrastructure* Federation of Canadian Municipalities. Nov. 2007. 20 Jan. 2010. <<http://www.fcm.ca//CMFiles/mdeficit1OPT-792008-3425.pdf>>

Figure 1: Stock of Infrastructure Capital, by Level of Government (1997 constant CAD dollars)



Source: *Canadian Economic Observer* Statistics Canada. Sep. 2007. 13 Feb. 2010. <<http://www.statcan.gc.ca/pub/11-010-x/11-010-x2007009-eng.pdf>>

Over the last decade infrastructure investment has somewhat rebounded, especially with the recent inclusion of investment in infrastructure as a primary economic stimulus measure by the Canadian and world governments. However, when it comes to infrastructure investment, especially in Canada, the majority of new investment is directed towards the establishment of new infrastructure. Upgrading and maintenance of existing infrastructure receives only a small share of the overall investment. This has resulted in a cycle where new infrastructure is invested in, which subsequently reduces the average overall age of infrastructure, while older infrastructure continues to degrade. While in 2007 the average age of public infrastructure in Canada was 16.3 years¹⁷ (Figure 3), in 2003, over 59% of infrastructure in Canada was over 40 years old (Figure 2).

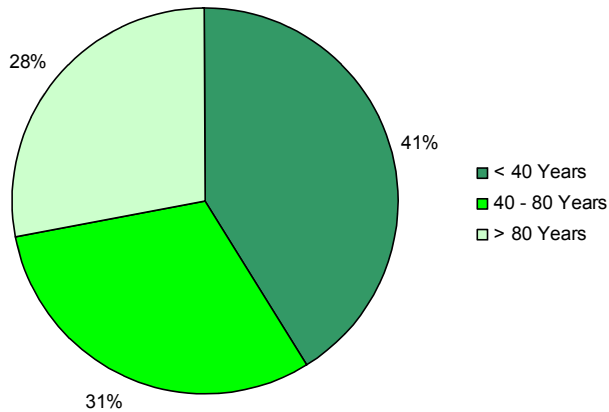
In summary, one can identify several factors that have directly contributed to the growth of the infrastructure deficit in Canada. These factors include:

- Inflation and subsequent interest rate increases during the 1970's and 1980's in Canada;
- Decreases in proportional infrastructure investment from federal and provincial governments in infrastructure and increased investment requirements from municipal governments;
- Demographic and economic factors.

In order to get a better understanding of the state of municipal infrastructure in Canada one needs to look at the three major areas of municipal infrastructure individually, water and wastewater, transportation and waste management.

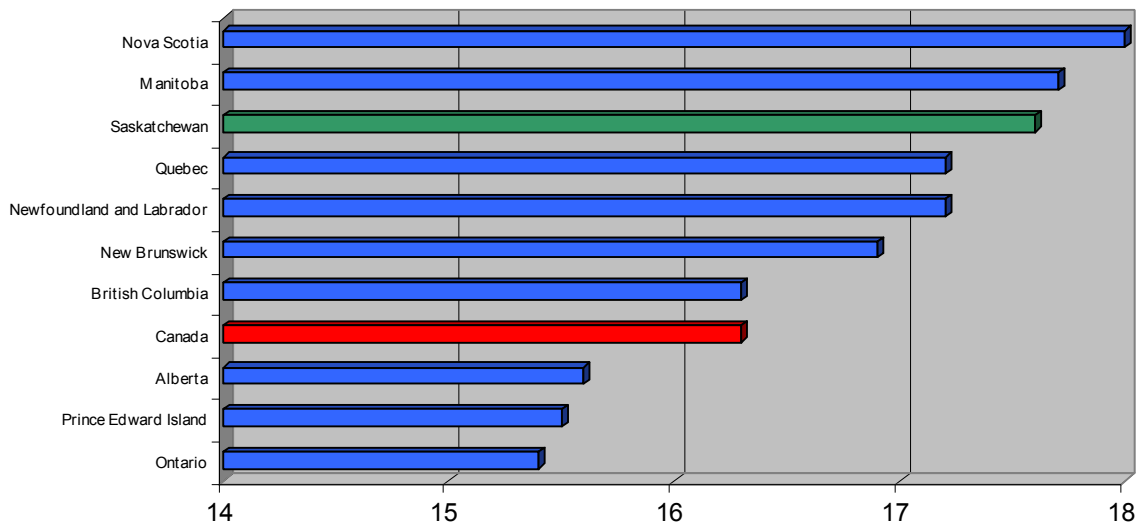
¹⁷ Gagnon, Mychele; Gaudreault, Valerie; Overton, Donald. *Age of Public Infrastructure: A Provincial Perspective* Statistics Canada: Investment and Capital Stock Division. 12 Nov. 2009. 16 Feb. 2010. <<http://www.statcan.gc.ca/pub/11-621-m/11-621-m2008067-eng.htm>>

Figure 2: Age of Canadian Infrastructure



Source: *Civil Infrastructure Systems Technology Road Map 2003-2013* Engineers Canada. 2003. 20 Jan. 2010.
<http://www.engineerscanada.ca/e/files/TRMReporteng.pdf>

Figure 3: Average Age of Public Infrastructure in Canada by Province (2007, Years)



Source: *Table 1: Average age of public infrastructure by province and type of infrastructure, 2007* Statistics Canada, special tabulation, Investment and Capital Stock Division. 11 Dec. 2009. 4 Feb. 2010. <http://www.statcan.gc.ca/pub/11-621-m/2008067/tables/5002061-eng.htm>

Water and Wastewater

Water is arguably the most important resource in the world. Every municipality, province, state and country across the world depends on a clean, available and sustainable supply of water in order to ensure that the health and economic well-being of its citizens and businesses is maintained. While water is

considered to be a partially-renewable resource, overconsumption and haphazard usage is imposing pressures on current resources and depleting water resources to a point where future demand requirements will outpace available supply in many regions. Current overconsumption and unsustainable usage of water resources occurs for a number of reasons, including unsustainable irrigation and industrial practices, climate change, increased population and the growing trend towards urban population concentration. Current examples of unsustainable consumption of water resources are being experienced in North Africa, Middle-East and parts of Central Asia. In addition, excessive usage is also found in South Korea, several countries throughout Europe and regions of North America.¹⁸

Currently, agricultural usage accounts for approximately 75% of global water consumption. Remaining resources are primarily used for industrial purposes (20%), with 5% used for domestic purposes such as human consumption.¹⁹ In Canada, one study estimated that 30% of Canada's total infrastructure network is comprised of water and wastewater systems and equipment. That same study further estimated, as of 2007, that a combined investment of \$77.6 billion worth of upgrading and maintenance investment was required for Canada's water and wastewater infrastructure.²⁰ Beyond Canada, it is estimated that worldwide USD \$150 billion is annually spent on wastewater treatment and this is expected to surpass USD \$240 billion by 2016.²¹

In North America the major causes of water stress and issues with municipal water infrastructure are related to aging infrastructure and climate change. Conversely the major issues facing developing countries are generally focused on availability and access to clean water and adequate sanitation. Canada is currently facing a \$31 billion water infrastructure deficit.²² In 2007, water infrastructure in Canada was worth \$56.3 billion (CAD \$32.3 billion in water infrastructure and CAD \$24 billion in wastewater treatment infrastructure). Additionally, in 2007, the average age of public water infrastructure and wastewater treatment infrastructure in Canada was 15.1 years and 17.6 years, respectively. A study conducted by Statistics Canada found that, in 2007, wastewater facilities and sewer systems in Canada had reached 63% and 53%, respectively, of their useful life.²³ Saskatchewan has the fifth oldest average age of public water infrastructure in Canada, behind Prince Edward Island (PEI), Quebec, New Brunswick

¹⁸ "Vital Water Graphics: An Overview of the State of the World's Fresh and Marine Waters – 2nd Edition: Excessive withdrawal of renewable water resources." *United Nations Environment Programme* 2008. 28 Jul. 2009. <<http://www.unep.org/dewa/vitalwater/article81.html>>

¹⁹ "Vital Water Graphics: An Overview of the State of the World's Fresh and Marine Waters – 2nd Edition." *United Nations Environment Programme* 2008. 28 Jul. 2009. <<http://www.unep.org/dewa/vitalwater/article186.html>>

²⁰ Mirza, Saeed; Sipos, Cristian. *Canada's infrastructure deficit a sad legacy for future generations* Municipal Leader. Winter 2009. 1 Feb. 2009. <<http://www.amm.mb.ca/PDF/Magazine/Winter2009/SR-legacy.pdf>>

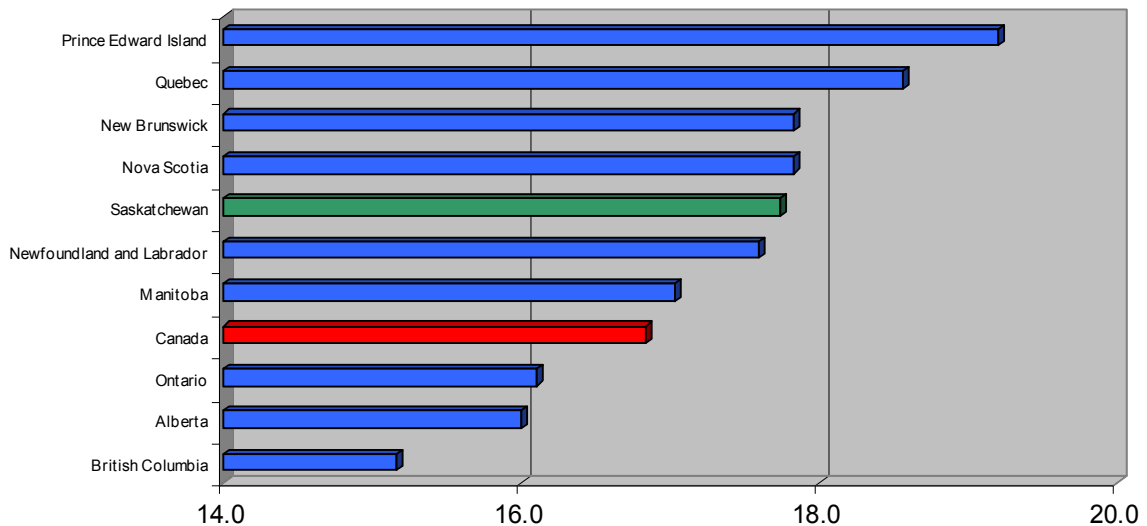
²¹ Wild, Daniel; Francke, Carl-Johan; Menzli, Pierin; Schon, Urs. "SAM Study: Water: A Market of the Future." *Sustainable Asset Management Group* Dec. 2007. 4 Aug. 2009. <http://www.sam-group.com/downloads/studies/waterstudy_e.pdf>

²² Mirza, Saeed. *Danger Ahead: The Coming Collapse of Canada's Municipal Infrastructure* Federation of Canadian Municipalities. Nov. 2007. 20 Jan. 2010. <<http://www.fcm.ca/CMFiles/mdeficit1OPT-792008-3425.pdf>>

²³ *Table 1: Average age of public infrastructure by province and type of infrastructure, 2007* Statistics Canada, special tabulation, Investment and Capital Stock Division. 11 Dec. 2009. 4 Feb. 2010. <<http://www.statcan.gc.ca/pub/11-621-m/2008067/tables/5002061-eng.htm>>

and Nova Scotia. In 2007, the average age of public water infrastructure, consisting of water supply systems, waste water treatment and sewer systems, in Saskatchewan was 17.6 years (Figure 4).

Figure 4: Average Age of Public Water Infrastructure in Canada by Province (2007, Years)

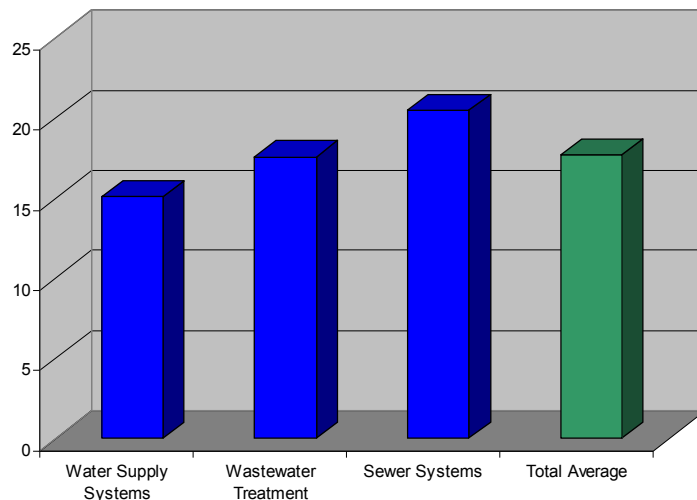


Source: Table 1: Average age of public infrastructure by province and type of infrastructure, 2007 Statistics Canada, special tabulation, Investment and Capital Stock Division. 11 Dec. 2009. 4 Feb. 2010. <<http://www.statcan.gc.ca/pub/11-621-m/2008067/tables/5002061-eng.htm>>

When looking at each of the public systems that make up public water infrastructure in Saskatchewan the water supply system is the youngest, having an average age of 15.1 years in 2007. This figure has been reduced substantially as a result increases in investment beginning in 1982, when the average age of the water supply system infrastructure was 21.6 years. Sewer system infrastructure in Saskatchewan is the oldest with an average age of 20.5 years, the second oldest in Canada behind Newfoundland and Labrador.²⁴

²⁴ Gagnon, Mychele; Gaudreault, Valerie; Overton, Donald. *Age of Public Infrastructure: A Provincial Perspective* Statistics Canada: Investment and Capital Stock Division. 12 Nov. 2009. 16 Feb. 2010. <<http://www.statcan.gc.ca/pub/11-621-m/11-621-m2008067-eng.htm>>

Figure 5: Average Age of Public Water Infrastructure in Saskatchewan (2007, Years)



Source: *Table 1: Average age of public infrastructure by province and type of infrastructure, 2007* Statistics Canada, special tabulation, Investment and Capital Stock Division. 11 Dec. 2009. 4 Feb. 2010. <<http://www.statcan.gc.ca/pub/11-621-m/2008067/tables/5002061-eng.htm>>

Transportation

Transportation infrastructure is comprised of roads, sidewalks, recreation pathways, bridges and overpasses and the support services required for these systems. These support services often consist of road maintenance and snow removal. Transportation infrastructure allows for the efficient and effective flow of goods and people from one region to another. It enables national and international commerce to occur and is a foundation of capitalist society.

One study estimated that transportation infrastructure comprises 55% of Canada's total infrastructure system. The road system alone in Canada, including bridges and overpasses, comprise roughly 40% of all government owned infrastructure.²⁵ This study also estimated, in 2007, that a combined investment of \$50.2 billion in transportation infrastructure upgrading and new infrastructure is required in Canada.²⁶ A study conducted by Statistics Canada found that in 2003, bridges and roads and highways in Canada had reached 57% and 53%, respectively, of their useful life.²⁷ The average age of public transportation infrastructure (highways, roads, bridges and overpasses) in Saskatchewan was 20 years in 2007, the third oldest amongst Canadian provinces (Figure 6). While government investment in roads increased

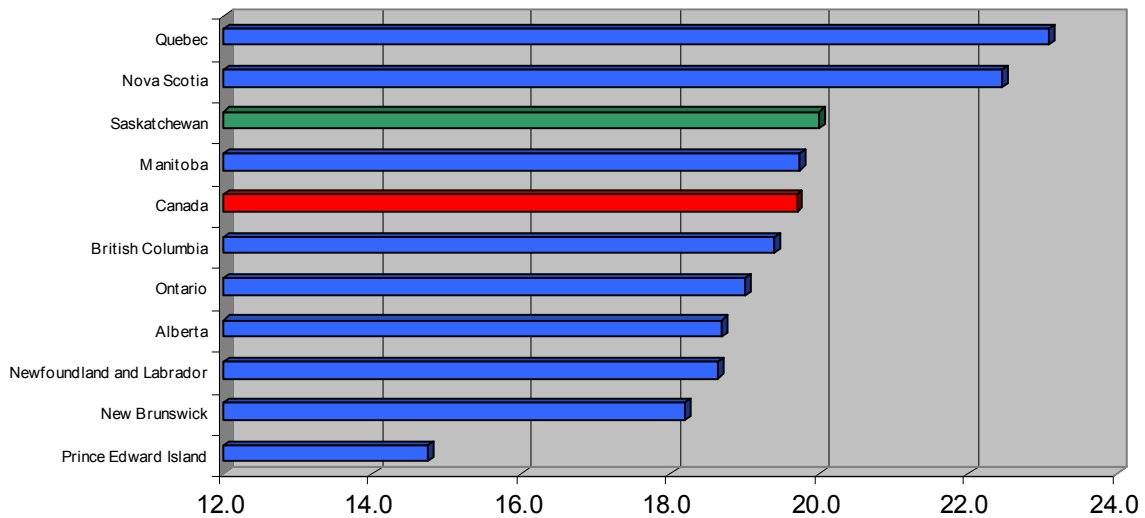
²⁵ *Canadian Economic Observer* Statistics Canada. Sep. 2007. 13 Feb. 2010. <<http://www.statcan.gc.ca/pub/11-010-x/11-010-x2007009-eng.pdf>>

²⁶ Mirza, Saeed; Sipos, Cristian. *Canada's infrastructure deficit a sad legacy for future generations* Municipal Leader. Winter 2009. 1 Feb. 2009. <<http://www.amm.mb.ca/PDF/Magazine/Winter2009/SR-legacy.pdf>>

²⁷ Gagnon, Mychele; Gaudreault, Valerie; Overton, Donald. *Age of Public Infrastructure: A Provincial Perspective* Statistics Canada: Investment and Capital Stock Division. 12 Nov. 2009. 16 Feb. 2010. <<http://www.statcan.gc.ca/pub/11-621-m/11-621-m2008067-eng.htm>>

from roughly \$4.3 billion in 1998 to \$7.3 billion in 2005,²⁸ this achieved little compared to the estimated \$50 billion in investment required.

Figure 6: Average Age of Public Transportation Infrastructure in Canada by Province (2007, Years)



Source: Table 1: Average age of public infrastructure by province and type of infrastructure, 2007 Statistics Canada, special tabulation, Investment and Capital Stock Division. 11 Dec. 2009. 4 Feb. 2010. <<http://www.statcan.gc.ca/pub/11-621-m/2008067/tables/5002061-eng.htm>>

Waste Management

Waste management is a key component of a healthy and advanced infrastructure system. Whether one is looking at garbage or commercial and industrial waste, one of the fundamental challenges for municipal governments is how they can increase their capacity and ability to redirect waste from traditional storage and disposal options to a point where the waste can become an active asset through the utilization of reuse or recycling technologies and techniques. This track of thinking is often referred to as incorporating the three R's into waste management, *Reduce, Reuse and Recycle*.

In Canada alone it is estimated that there are over 10,000 landfill sites, both open and closed.²⁹ Landfills are primarily comprised of two types: municipal solid waste (MSW) and forestry landfills. Most municipal landfills are publicly operated, while the majority of forestry landfills are privately operated. In addition to

²⁸ *Canadian Economic Observer* Statistics Canada. Sep. 2007. 13 Feb. 2010. <<http://www.statcan.gc.ca/pub/11-010-x/11-010-x2007009-eng.pdf>>

²⁹ *Factsheet 8 – Waste: 1990 – 2000* Environment Canada. 16 Feb. 2010 16 Feb. 2010. <http://www.ec.gc.ca/pdb/ghq/inventory_report/1990_00_factsheet/fs8_e.cfm#anchor3>

MSW landfills many municipalities in Canada utilize waste incineration to reduce the amount of waste that makes it to landfills. The most recent *Waste Management Industry Survey* conducted by Statistics Canada, found that in 2006 the average Canadian produced over 1,000 kgs of waste. Of this amount approximately 78% of the waste ended up in landfills or was incinerated and approximately 22% was diverted away from landfills and incineration. In general, the amount of waste a given region accumulates is primarily driven by population growth, increased economic activity and rising incomes.³⁰

For municipal governments, the majority of expenses related to waste management are comprised of collection and transportation expenses, followed by the expenses related to the operation of recycling and disposal facilities. From 2004 to 2006 in Canada, municipal waste operating expenditures increased by roughly \$200 million. While expenses have increased, in 2006 Saskatchewan maintained one of the lowest waste management expenditures per capita in the country. However, during this same time period Saskatchewan also diverted the least waste of any Canadian province away from landfills.³¹

Why Governments and Citizens Should Care About the Infrastructure Deficit?

Throughout this report thus far we have discussed the reasons to why infrastructure is vitally important to all economies around the world. From enabling commercial and international trade, tourism and individual accessibility to providing critical employment, we can all agree infrastructure is critically important to a country's economic well-being. As important a role as infrastructure plays in the Canadian and world economy, it is vitally important that this infrastructure is maintained and upgraded, but what happens if nations continue to allow their infrastructure to degrade?

Infrastructure failure due to lack of maintenance, upgrading and replacement can cause significant financial, economic and health damage. An infrastructure deficit is a tell tale sign that work and investment need to happen. If one considers that Canada's total infrastructure deficit has reached an estimated \$123 billion, it is not surprising that from time to time major infrastructure failures occur throughout Canada, causing significant real and economic damage.³²

In May 2000 in the town of Walkerton, Ontario, a breakout of *Escherichia coli* (*E. coli*) contaminated the town's water system. Of the town's population of approximately 4,800, more than 2,300 people became ill and seven people died. The contamination of Walkerton's water supply was deemed to have occurred

³⁰ *Waste Management Industry Survey: Business and Government Sectors* Statistics Canada. 2006. 16 Feb. 2010. <<http://www.statcan.gc.ca/pub/16f0023x/16f0023x2006001-eng.pdf>>

³¹ *Waste Management Industry Survey: Business and Government Sectors* Statistics Canada. 2006. 16 Feb. 2010. <<http://www.statcan.gc.ca/pub/16f0023x/16f0023x2006001-eng.pdf>>

³² Mirza, Saeed. *Danger Ahead: The Coming Collapse of Canada's Municipal Infrastructure* Federation of Canadian Municipalities. Nov. 2007. 20 Jan. 2010. <<http://www.fcm.ca//CMFiles/mdeficit1OPT-792008-3425.pdf>>

due to contamination from manure run off from a farm located near one of the town's wells. Investigations into the contamination found that insufficient monitoring, training and expertise with regards to proper chlorination and monitoring of the contaminated well were to blame for the tragedy. In addition, provincial monitoring safeguards also failed to catch the subsequent contaminations. Within *Part One of the Report of the Walkerton Inquiry from the Ontario Attorney General*, one of the items highlighted was that, in 1996 due to budgetary constraints, the Provincial Government of Ontario discontinued government laboratory testing for municipalities and reduced overall budgets and staffing.³³ This made it less likely that the proper authorities would have caught the improper operating practices that lead to this tragedy. A combination of mismanagement and inadequate resource allocation lead to this tragedy, which resulted in significant human suffering and the tragic deaths of seven people. One estimate puts the economic cost of this tragedy at \$64.5 million.³⁴

More recently in September of 2006 the de la Concorde overpass in Laval, near Montreal, Quebec, suddenly collapsed killing five people and closing down a critical transportation link for approximately five weeks. The City of Laval estimated the direct financial costs of this tragedy to be \$1.2 million.³⁵ A subsequent inquiry lead to the direct cause of the collapse of the overpass, which was roughly halfway through its useful life, as being the result of negligence during initial construction of the bridge and lapses in the managing and inspection of the overpass.³⁶

The two above examples illustrate just how important continual investment and funding in infrastructure is to Canada and its citizens and how severe the damage and costs can be as a result of failure of infrastructure and inadequate funding for inspections, upgrades and maintenance. These examples highlight the need to reduce the infrastructure deficit in Canada and the call for governments to focus on infrastructure. It is nearly impossible for governments to solve this problem alone. By bringing together both the public and private sector to deal with the current state of infrastructure in Canada, we can be sure that both parties involved will get a "foot in the game." This will ensure that Canada's infrastructure system is safe, efficient and reliable, thereby paving the way to a prosperous future.

³³ Dennis, O'Connor. *Part One: A Summary – Report of the Walkerton Inquiry: The Events of May 2000 and Related Issues* Ontario Ministry of the Attorney General. 2002. 14 Feb. 2010.

<http://www.attorneygeneral.ius.gov.on.ca/english/about/pubs/walkerton/part1/WI_Summary.pdf>

³⁴ *Canada's worst-ever E. coli contamination* CBC News Online. 20 Dec. 2004. <<http://www.cbc.ca/news/background/walkerton/>>

³⁵ *Laval bills Quebec for overpass collapse costs* The Gazette (Montreal). 14 Nov. 2006. 14 Feb. 2010.

<<http://www.canada.com/montrealgazette/news/montreal/story.html?id=0157a1cd-73c2-4bc0-97b4-a7a7d6b7a63e>>

³⁶ *Commission of Inquiry into the Collapse of a Portion of the de la Concorde Overpass Report* Commission of Inquiry into the Collapse of a Portion of the de la Concorde Overpass. 2007. 14 Feb. 2010.

<http://www.cevc.gouv.qc.ca/UserFiles/File/Rapport/report_eng.pdf>

Drivers of Municipal Infrastructure Investment

Investments in infrastructure, like any other investments, are driven by the incentives offered to those investing. Local and national governments invest into infrastructure because they have direct incentive to do so. This may take the form of ensuring their local citizens are provided with safe and reliable roads, drinking water, etc. It may also be related to ensuring that they are elected in the next election or reducing the liability of failing infrastructure. In Canada, many of the periods of increased investment in infrastructure from government can be attributed back to significant international and national events, including Expo and the Olympics games in Montreal, Calgary and Vancouver.³⁷ These events require significant infrastructure upgrades to handle the influx of visitors during the events. In addition the world's eyes are on these locations and it is generally in government's best interests to look as good as possible.

In addition to world focused events, there are a number of factors that have a direct influence on infrastructure investments. A number of studies have been completed which identify factors that influence infrastructure requirements and investment.^{38 39} These factors include:

- Demographics
- Geography
- Local needs
- Economics
- Speed of change
- Globalization
- Increasing governance
- Communications revolution
- Environmental pressures/sustainability
- New technologies
- Urbanization
- Water
- Climate change
- Pandemics

Many of the above factors are influencers of the type of infrastructure needed to be adopted and are better indicators of future areas of investment in infrastructure, rather than indicators of the amount of investment required. Influencers of the type of infrastructure to be adopted include: speed of change,

³⁷ Canadian Economic Observer Statistics Canada. Sep. 2007. 13 Feb. 2010. <<http://www.statcan.gc.ca/pub/11-010-x/11-010-x2007009-eng.pdf>>

³⁸ Mirza, Saeed. *Danger Ahead: The Coming Collapse of Canada's Municipal Infrastructure Federation of Canadian Municipalities*. Nov. 2007. 20 Jan. 2010. <<http://www.fcm.ca/CMFiles/mdeficit1OPT-792008-3425.pdf>>

³⁹ *State of the World: FIDIC Infrastructure Report 2009* International Federation of Consulting Engineers. 2009.

communications revolution, environmental pressures/sustainability, increasing governance, new technologies, climate change and frequency of pandemics. The other factors identified are influencers of the quantity of infrastructure and infrastructure investment. These factors include: demographics/urbanization, geography, economics, climate change and globalization. In order to better understand what drives the amount of investment in public infrastructure we need to discuss each one of the following factors individually: demographics and urbanization, geography, economics, climate change and globalization.

Demographics and Urbanization

In Canada and around the world, rural populations have been migrating to urban settings at record pace. This trend is referred to as urbanization. Since 1950 rural populations have been shrinking across the world, while urban populations have been increasing. According to the *United Nations World Urbanization Prospectus (UNUP): The 2007 Revision* in 2005, 48.6% of the world's population lived in an urban setting. By 2050, this figure is expected to increase to 69.6%. This trend is expected to be magnified in lesser developed regions, which still support a significant rural population, and minimized among developed regions, which already have a significant % of their population living in urban settings.⁴⁰

In Canada, prior to the Second World War, just over half of the population was concentrated in urban centers. According to the *United Nations (UN) World Urbanizations Prospects 2007* in 2005, 80.1% of the population of Canada was living in an urban area and by 2020 this is only expected to increase to 82.9% and to 87.9% by 2050.⁴¹ Contrast this to the developing nation of China, which in 2005 had 40.4% of its population concentrated in urban settings. The UN forecasts China's urban population to reach 53.2% by 2020 an increased of 31.7%.⁴²

⁴⁰ *World Urbanization Prospects: The 2007 Revision Population Database* United Nations 2008. 12 Feb. 2010.

<<http://esa.un.org/unup/>>

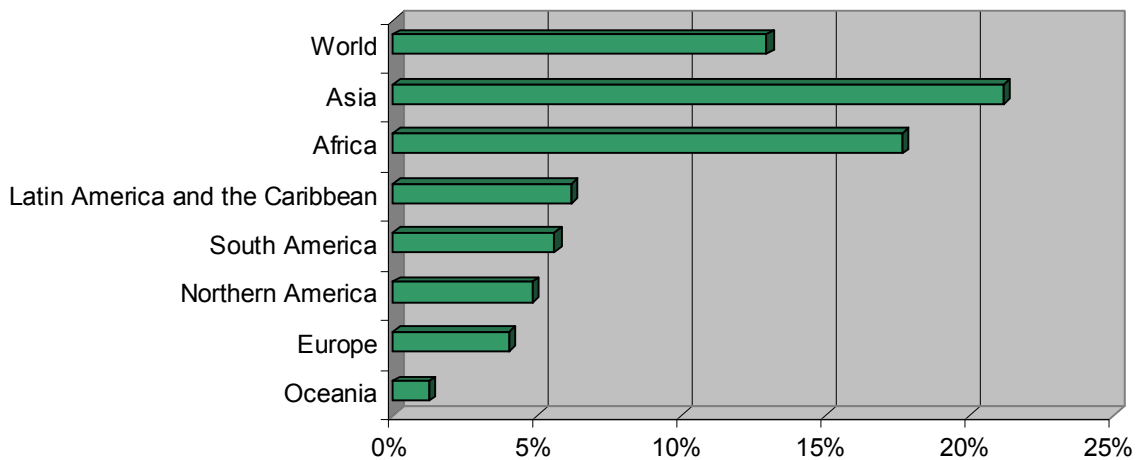
⁴¹ *World Urbanization Prospects: The 2007 Revision Population Database* United Nations 2008. 12 Feb. 2010.

<<http://esa.un.org/unup/>>

⁴² *World Urbanization Prospects: The 2007 Revision Population Database* United Nations Population Division. 2 Feb. 2010.

<<http://esa.un.org/unup/index.asp?panel=3>>

Figure 7: Forecasted % Growth in Urbanization by Region (2005-2020)



Source: *World Urbanization Prospects: The 2007 Revision Population Database*. United Nations Population Division. 2 Feb. 2010. <http://esa.un.org/unup/index.asp?panel=3>

This growing trend of migration from rural to urban populations imposes a number of pressures on existing and future infrastructure systems. In terms of rural infrastructure, urbanization is quietly eroding the tax base required to fund infrastructure maintenance and upgrades and reducing the economic viability of maintaining significant rural populations in developed countries. Many areas of Canada have seen farming communities become desolate and city populations surge, this carries with it challenges for the distribution of investment in public infrastructure in rural areas.

In addition to urbanization, demographics play an important role with respect to municipal infrastructure investment. In Canada, investment in infrastructure surged in the 60's and 70's, largely as a result of the baby boomer generation coming to age. The influx of population brought with it tremendous economic growth, which required and facilitated an increase in infrastructure investment. As the baby boomer generation grew older and had fewer children than their parents, the economy eventually slowed down from its feverish pace. Thus investment in infrastructure slowed and declined throughout the 80's and 90's. This slowdown happened to coincide with much of the infrastructure that was built in the 60's and 70's reaching the end of its useful life. While investment, somewhat recovered in the 2000's. The demographics of this situation are at least partly responsible for the infrastructure deficit that Canada is faced with.

Geography

The geographic composition of a region plays a critical role in the amount and type of infrastructure investment required. Different geographic regions require different mixes of infrastructure. The United Arab Emirates (UAE), for example, are one of the largest per capita consumers of fresh water in the world

and with little in the way of fresh water resources, rely heavily on commercial desalination to meet their fresh water needs. On the other hand, municipalities in Manitoba, Canada, along the fresh water Red River, must make significant investments in infrastructure to mitigate the damages caused by seasonal flooding.

In Saskatchewan, a rich prairie region where agriculture plays a significant role in the provincial economy, the maintenance of municipal infrastructure is critical. In Saskatchewan there is a total 160,000 km of road surface, of which 26,000 kms of it is provincial highways.⁴³ The extensive road network is required so that local agricultural producers, located across an immense geographic area, can get their product to central rail lines or highways. Regardless of the type of geography, each comes with their own challenges and requirements. For some regions this may represent a greater need for investment in public infrastructure than others.

Economics

Of course a discussion of the drivers of investment cannot be had without making mention of the economic forces behind investment in infrastructure. In the short-term there are strong economic incentives for municipal, provincial, state and federal governments to invest in infrastructure. Namely this comes in the form of job creation. The estimates of the ratio between amount invested and jobs created differ. The Canadian Construction Association (CCA) estimates that for every \$1 billion invested in the new economic stimulus package on infrastructure an average of 8,800 jobs⁴⁴ are created, while the Alliance for American Manufacturing estimates that 18,000 new jobs are created for every USD \$1 billion in new infrastructure investment.⁴⁵ Regardless of the exact figure, governments across the world generally agree that new investment in infrastructure equals a significant increase in new jobs, namely construction positions and positions in companies that provide services and products to the construction industry.

The benefits of investment in municipal infrastructure are not limited to the short-term alone. By creating and maintaining a network of reliable infrastructure commerce is able to be conducted efficiently and profitably within and across borders. This enables economic growth resulting in job creation; individual, local and national wealth, as well as creating a situation that fosters long-term growth and prosperity. When traveling within lesser developed regions and developed regions, one of the main differences that is easily identifiable and undeniable, is the difference between the infrastructure systems of the two regions. More developed societies often have developed systems of infrastructure, while lesser

⁴³ *Common Questions* Government of Saskatchewan: Highways and Infrastructure. 2007. 13 Feb. 2010.

<<http://www.highways.gov.sk.ca/common-questions/>>

⁴⁴ Ferreira, Bill. *Budget 2009 Gets High Marks From The Canadian Construction Association – Every \$1B in Investment Means 11,500 Jobs Across Canada* Canadian Construction Association. 27 Jan. 2009. 14 Feb. 2010. <http://www.cca-acc.com/news/mediareleases/2009/Budget_2009_e.asp>

⁴⁵ *Infrastructure Investment Best Way to Create Jobs* Alliance for American Manufacturing. 13 Feb. 2010. <<http://www.americanmanufacturing.org/infrastructure-investment/>>

developed nations often lack the adequate systems of infrastructure required to maintain basic health and sanitary requirements for their populations. The short- and long-term benefits of investment in infrastructure are clear, however without the necessary investment in the maintenance of that infrastructure, the benefits will be limited to the short-term.

Climate Change

Climate change, defined by the Intergovernmental Panel on Climate Change (IPCC) as: “a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer,” is a phenomenon that is currently being realized around the world in the form of global warming.⁴⁶ Global warming describes an increase in the average air and ocean temperatures. While the effects of global warming are currently being felt across the globe, those effects are not fully understood or agreed upon.

The potential impacts of climate change differ across countries and regions. Some regions are more susceptible to the potential impacts of climate change than others. However, no region is immune from these potential impacts. The potential impacts of climate change also widely vary within regions. There is some consensus that global warming will increase the severity of weather patterns across the world, thereby increasing the severity of the effects of those weather patterns. This may be represented in the form of more severe and extended periods of droughts and floods, deforestation, melting of glaciers and ice sheets and increased temperatures in the summer months resulting in a multitude of impacts, ranging from increased exposure to smog in urban areas to greater instances of heat related health problems.

The conundrum of climate change, as it relates to municipal infrastructure (mainly water infrastructure) and the world, is that climate change is expected to have the most severe impact on those regions that are currently experiencing population growth, which also consist of some the poorest countries in the world. Combine these two variables together and the resulting situation is one where the regions that are the least economically, politically and technologically equipped to deal with climate change, experience the worst of the problem, intensifying the resulting outcomes and impacts to those region.

In terms of infrastructure, climate change represents a significant challenge for many parts of the world. In terms of Least Developed Countries (LDCs), of which many currently lack the most basic infrastructure, it means that further stresses will be imposed upon the establishment of basic infrastructure. Climate change represents a significant barrier to countries with significant existing barriers.

⁴⁶ Bates, Bryson; Kundzewicz, Zbigniew; Wu, Shaohong; Palutikof, Jean. “Climate Change and Water: IPCC Technical Paper VI.” *Intergovernmental Panel on Climate Change* Jun. 2008. 29 Jul. 2009. <<http://www.ipcc.ch/pdf/technical-papers/climate-change-water-en.pdf>>

With regards to developed and developing nations, climate change will further stress aging national infrastructure stocks and compound the size of infrastructure deficits world-wide. In Canada, if climate-change induced extreme weather patterns are realized, great strain will be placed on current infrastructure. Increased funding will need to be allocated to maintain current infrastructure, which will divert funding away from the establishment of new infrastructure and upgrading of existing infrastructure. New technology that focuses on sustainability will need to be focused on by municipal governments in regions that are prone to the effects of climate change.

Globalization

Globalization, referring to the integration of societies across the globe, has undoubtedly changed the way in which people everywhere live their lives. Having begun with the simple trading of commodities and passage of knowledge, recent advances in technology and logistics have ushered in an era of unprecedented global integration. It is now possible for people to travel, with relative ease, to most locations around the world. In addition, with the general overall reductions in trade barriers and investment barriers, global commerce and exporting are now considered the norm of all business and is no longer confined to the biggest, richest corporations.

This recent expansion of globalization cannot be the product of advances in technology and the reduction of trade and investment barriers alone. A complex and reliable network of critical communications and logistical infrastructure needed to be in place. Airports, marine ports, canals, pipelines, roads, highways, bridges, information technology and telecommunication networks all around the world enable global commerce as we know it today. This system of infrastructure is always moving economies towards becoming further integrated everyday. One needs to not look further than the introduction of the Euro or the recent global financial crisis to bear witness to just how integrated the world economy has become. As the globe and the nations that comprise it become further entwined, the need for expansion and maintenance to the current infrastructure network that enables this whole process becomes clear. While the recent financial crisis has dampened global trade in recent times, over the long-term one can expect international trade to strengthen and grow. This will require significant investment in road networks, port capacities and communications networks.

Current Market and Investment Trends in Infrastructure

Since the beginning of the recent financial crisis, infrastructure has been a featured story on many news casts and top of mind for many politicians. Whether one is talking about the benefits of infrastructure investment or the current state of infrastructure in Canada, infrastructure is a hot topic. There is common agreement that a strong network of infrastructure is a fundamental component to a healthy economy and

that investment in this network is a key to emerging from the recent recession with a stronger, healthier economy.

Within the recent push for greater infrastructure investment there is a strong emphasis on investing and adopting sustainable municipal infrastructure. The impacts of climate change and the growing public push towards sustainable living are contributing to this growing trend. The Government of Canada has taken a lead in this area. Under *Canada's Economic Action Plan*, the federal government introduced \$1 billion in funding over five years to create the Green Infrastructure Fund (GIF). The GIF is directed to the development of sustainable infrastructure, which includes: green energy generation, development and upgrading of waste water treatment systems and innovative solid waste management projects.⁴⁷ As governments focus on ensuring that our infrastructure system is both sustainable and environmentally friendly, the need to consult with and have collaboration between government, industry and academia intensifies.

In order to better understand the current market and trends in investment around infrastructure we should consider each of the areas of focus within this report, water and wastewater, transportation and waste management, individually.

Water and Wastewater

In Canada and around the world there are two emerging areas of focus in water infrastructure. One focuses on technologies and processes that increase the supply of useable water and the other that focuses on decreasing demand for water. Both of these emerging areas focus on sustainable options for infrastructure. On the demand side municipal governments are increasingly pressured to implement strategies that focus on reducing overall water consumption from all levels, whether that is from industry, commerce or individual citizens. In addition, municipal governments will increasingly be required to address water shortage issues in drier regions and utilize innovative processes and technologies that increase the supply of useable water.

An additional concern for municipal governments in Canada and around many parts of the world is that municipal water infrastructure is aging and there will be demand for the repair and replacement of water distribution, storage and treatment infrastructure. Piping, reservoirs and water treatment facilities will need to be upgraded, repaired and replaced. There is a strong push towards the development and installation of advanced infrastructure that will increase the efficiency of traditional distribution methods, including new "smart" piping technology that uses technology to identify the location and size of current leaks, without a need to dig up the leaky pipe.

⁴⁷ *Green Infrastructure Fund* Infrastructure Canada. 4 Feb. 2009. 14 Feb. 2010. <<http://www.buildingcanada-chantierscanada.gc.ca/creating-creation/gif-fiv-eng.html>>

With regards to trends in the supply of water the current focus is on increasing the supply of useable water. Around the world the supply side trends that are currently receiving the most attention include, but are not limited to: desalination, rainwater catchment and treatment and advanced technologies that focus on water and wastewater treatment.

As far as Canada is concerned the number one growing area of focus for municipal governments is water and wastewater treatment. In Canada, following the Walkerton tragedy, public awareness and concern with the quality of municipal drinking water increased significantly. In addition, the recent expansion and growth of activity in the Alberta oil sands has put a spotlight on water resources and their efficient use, as energy production from oil sands requires tremendous water resources. Across the world there a number of factors driving change in the water treatment sector. In addition to these drivers there are a number of restraining factors that look to block this change. The following drivers and constraints were identified for the water and waste water treatment global market⁴⁸:

Drivers:

- Rising water quality requirements
- Affordable solutions of rising global population
- Smaller foot-print, waste minimization/recycling and resource recovery
- Intrinsic link to energy markets
- Economic benefits
- Low carbon

Restraints:

- Lack of consistent water policies
- Global economic slow-down
- Lack of green focus in emerging markets
- Political risk delaying projects in less stable regions
- Financing bottlenecks for large projects as well as in emerging markets

As governments push for greater environmental responsibility, accountability and sustainability, both municipal governments and private enterprise will need to partner, reassess and evolve their current water infrastructure and usage to reflect this. Many of the drivers and restraints cited above will have direct and immediate impacts on municipal governments across Canada. Sectors, including the energy and agricultural sectors, which require significant water resources, will increasingly look to municipal

⁴⁸ Royan, Fredrick. "Water Sector Outlook for 2009: Sustainable Water & Wastewater Treatment Technologies Strongly Benefit from Economic Downturn." *Frost & Sullivan Webinar*. 4 Jun. 2009.

governments to tackle these issues head on and provide policy and regulatory oversight. One thing that is clear though is that neither private business nor government can do this alone, a collaborative approach is required.

Beyond drinking water, wastewater treatment is a growing area of focus for municipal governments. One estimate indicates that worldwide USD \$150 billion is annually spent on wastewater treatment and this is expected to surpass USD \$240 billion by 2016.⁴⁹ There is a strong push for governments and industry to reuse and recycle wastewater. Meaning there will be a strong focus on investments and actions from local governments to repair, upgrade and replace existing systems as they come to the end of their useful life with new systems that are both effective and efficient in their energy usage.

Other Trends in the Water Sector

Many local governments around the world are looking for solutions to increase their supply of useable water. This trend will only further increase as more regions around the world experience increasing periods of water stress. One area being considered is the reuse or recycling of greywater for irrigation purposes. Greywater is wastewater that is not sewage, and is generally generated from residential sources not involved with sanitation. Recycled greywater is primarily being utilized for irrigation purposes. To date, the reuse and recycling of greywater has been limited to residential usage in areas experiencing significant water stress. A number of factors work against widespread usage of greywater. For example: greywater easily degrades into blackwater (sewage) in a short period of time, resulting in an increase of health risks associated with using the water. However, if current water stresses are magnified around the world it is reasonable to assume that further adoption of this technology in certain parts of the world may increase over time.

Municipal governments around the world are also considering the harvesting of rainwater as another method of increasing the useable supply of water. Rainwater harvesting, involves the collection of rainwater for the purposes of distribution for human consumption and/or irrigation. The collection of rainwater has been around for centuries with some evidence dating the practice in China back 6,000 years.⁵⁰ Recently rainwater harvesting has gained momentum due to its inherently low price and the lack of treatment required. There are several examples of municipal utilization of rainwater catchment for irrigation purposes. To date, municipal government utilization of rainwater harvesting has been limited to usage on large municipal complexes, such as arenas, for irrigation of nearby grounds. In Tucson, Arizona, the local government has recently enacted an ordinance requiring all new commercial building

⁴⁹ Wild, Daniel; Francke, Carl-Johan; Menzli, Pierin; Schon, Urs. "SAM Study: Water: A Market of the Future." *Sustainable Asset Management Group* Dec. 2007. 4 Aug. 2009. <http://www.sam-group.com/downloads/studies/waterstudy_e.pdf>

⁵⁰ "The Texas Manual on Rainwater Harvesting: Third Edition." *Texas Water Development Board* 2005. 7 Aug. 2009. <http://www.ircsa.org/factsheets/RainwaterHarvestingManual_3rdedition.pdf>

projects to incorporate rainwater catchment systems to meet 50% of their landscape irrigation requirements.⁵¹

The above example demonstrates the increasing requirement of local governments to take proactive roles with regards to policies, regulations and investment in the water sector. New, innovative strategies will need to be considered and adopted by municipal governments. It will be imperative that government, at all levels, be involved in research into new technologies. By collaborating with private industry, local governments around the world can work towards implementing sustainable water practices. In addition to taking a lead in ensuring an adequate supply of clean water exists, local governments will increasingly be required to implement policies and designate funding towards the reduction of water usage from their citizens as well as the commercial and industrial sectors. This may include the implementation of advertising initiatives aimed at efficient water usage in areas that have significant drought or water shortage risks.

Transportation

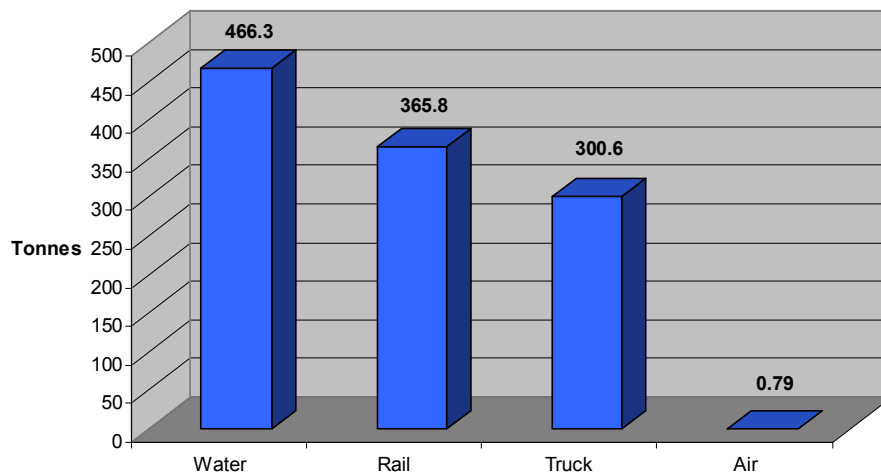
Transportation is the largest and most expensive component of municipal infrastructure in Canada and the world. Transportation infrastructure is comprised of roads, sidewalks, recreation pathways, bridges and overpasses and the support services required for these systems. These support services often consist of road maintenance and snow removal. Transportation infrastructure is also comprised of ports, canals, airports, inland ports, rail lines, subways and other capital that enables transportation of goods and people. In 2006, 1.132 billion tonnes of goods were shipped in Canada, primarily by water, rail and truck. While water and rail comprise the majority of commercial transportation of goods in Canada, trucking as a transportation option has grown substantially in the last 15-20 years. Between 1989 and 2006, the amount of tonnes of goods moved by truck grew 59%.⁵² The growth in the usage of trucking has been primarily driven by the advent of “just-in-time” delivery.

⁵¹ Cutright, Elizabeth. “A First for Rainwater Harvesting.” *Water Efficiency* 6 Jul. 2009. 7 Aug. 2009.

<http://www.waterefficiency.net/blogs/we-editors-blog/a-first-for-rainwater-harvesting-56867.aspx>

⁵² *Human Activity and the Environment: Annual Statistics* Statistics Canada. 2009. 15 Feb. 2010. <<http://www.statcan.gc.ca/pub/16-201-x/16-201-x2009000-eng.pdf>>

Figure 8: Freight Shipped in Canada by Method of Transportation (2006, Million Tonnes)



Source: *Human Activity and the Environment: Annual Statistics* Statistics Canada. 2009. 15 Feb. 2010.

<http://www.statcan.gc.ca/pub/16-201-x/16-201-x2009000-eng.pdf>

In addition to the increase in usage of trucking for commercial goods transportation, the number of vehicles in the country has also increased over the last decade. In 2008, over 21 million vehicles were registered in Canada, up 20% from 1999.⁵³ Considering these statistics it is not surprising that transportation infrastructure plays an important role within the trend towards creating and maintaining sustainable municipal infrastructure. Ensuring that goods and people can flow efficiently and effectively from one point to another with minimal environmental impact is a key goal for those concerned with transportation infrastructure. Transportation infrastructure investment is generally the largest single category of infrastructure investment for Canadian cities. However this cost is justified. In 2007 one estimate placed the cost of traffic congestion in major urban centres in Canada at \$3.7 billion in lost economic activity alone.⁵⁴

Beyond congestion issues, traditional fossil fuel-based transportation is a major contributor to air pollution and the increasing concentration of greenhouse gases in the atmosphere. With the recent advancement in the understanding of the adverse health and environmental effects of utilizing fossil fuel-based transportation sources, many governments around the world are developing and implementing plans to adopt more sustainable transportation solutions. While governments around the world currently recognize the harmful effects, on the environment and the health of a population, from the usage of fossil fuel-based

⁵³ *Human Activity and the Environment: Annual Statistics* Statistics Canada. 2009. 15 Feb. 2010. <http://www.statcan.gc.ca/pub/16-201-x/16-201-x2009000-eng.pdf>

⁵⁴ Cannon, Lawrence. *Speaking Notes for the Honourable Lawrence Cannon Minister of Transport, Infrastructure and Communities* Infrastructure Canada. 1 Feb. 2007. 14 Feb. 2010. <http://www.infc.gc.ca/media/speeches-discours/20070201-eng.html>

transportation by governments, most efforts by governments have focused on the creation of fossil fuel-efficient transportation methods, rather than alternatives to these traditional technologies.

Canada's greenhouse gas emissions are among the highest in the world and account for over 2% of the world's greenhouse gas emissions.⁵⁵ This is staggering, considering Canada only accounts for approximately 0.5% of the world's population (2009 est.).⁵⁶ In 2007, the Government of Canada committed themselves to reducing total greenhouse gas emission 20% by 2020, relative to 2006.⁵⁷ The Government of Canada is currently focusing their efforts around the environmental sustainability of transportation through regulating vehicle and engine emissions, promoting sustainable transportation options and using efficient land usage to promote efficient transportation practices.⁵⁸

Sustainable Transportation Options

There is currently a strong push among municipal governments to adopt more environmentally friendly transportation alternatives. Many municipalities across Canada are in the process of transferring their fleet of vehicles from traditional gasoline fuelled vehicles to vehicles and buses that run off of environmentally friendly alternative fuels, including ethanol, natural gas, electric, hybrid and bio-diesel. At the present time Canada's transportation and public transit infrastructure is aging, with Saskatchewan having the third oldest average age of transportation infrastructure in the country.⁵⁹ While this does raise some concerns, considering the municipal deficit in Canada is substantial, it also represents an opportunity for Canada. As transit infrastructure ages and government fleets near the end of their useful life, governments at all levels can choose and are choosing to adopt sustainable transportation alternatives.

In addition to adopting environmentally friendly vehicles it will be important for governments to invest in and provide reliable public transit. In 2006, 73% of Canadian workers were driving personal vehicles to work as the driver and only 8% were passengers in vehicles. 11% of people utilized public transit, while 8% of people utilized other methods.⁶⁰ In 2005, it cost Canada \$4.2 billion dollars to operate the public transit system, of which revenues (primarily from transit fares) covered \$2.6 billion dollars of the cost. This left a tab of approximately \$1.6 billion for Canadian municipal governments to cover.⁶¹ It will be important

⁵⁵ *Regulatory Framework for Air Emissions* Government of Canada. 2007. 14 Feb. 2010. <http://www.ec.gc.ca/doc/media/m_124/report_eng.pdf>

⁵⁶ CIA World Fact Book: <https://www.cia.gov/library/publications/the-world-factbook/>

⁵⁷ *Regulatory Framework for Air Emissions* Government of Canada. 2007. 14 Feb. 2010. <http://www.ec.gc.ca/doc/media/m_124/report_eng.pdf>

⁵⁸ *Transportation* Environment Canada. 10 Mar. 2007. 14 Feb. 2010. <http://www.ec.gc.ca/cleanair-airpur/Pollution_Sources/Transportation-WS800CCAF9-0_En.htm>

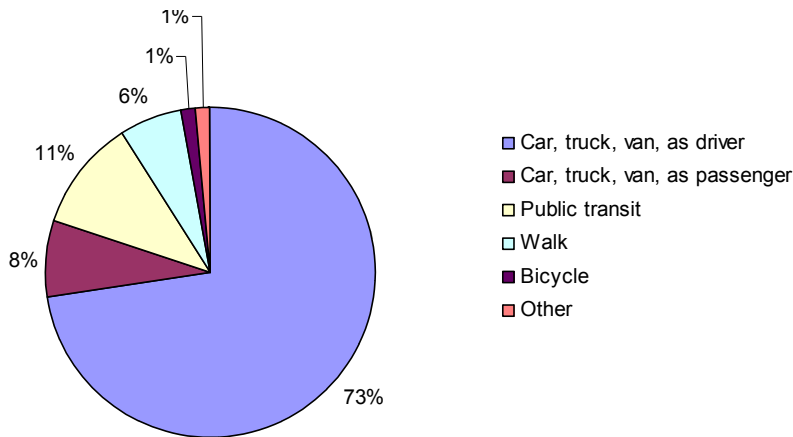
⁵⁹ *Table 1: Average age of public infrastructure by province and type of infrastructure, 2007* Statistics Canada, special tabulation, Investment and Capital Stock Division. 11 Dec. 2009. 4 Feb. 2010. <<http://www.statcan.gc.ca/pub/11-621-m/2008067/tables/5002061-eng.htm>>

⁶⁰ *Human Activity and the Environment: Annual Statistics* Statistics Canada. 2009. 15 Feb. 2010. <<http://www.statcan.gc.ca/pub/16-201-x/16-201-x2009000-eng.pdf>>

⁶¹ *National Transit Strategy* Federation of Canadian Municipalities Big City Mayor's Caucus. 5 Mar. 2007. 15 Feb. 2010. <<http://www.fcm.ca/CMFiles/transitsub1LUT-8282008-1885.pdf>>

in the future, especially for smaller communities, that provincial and federal governments help fund public transit costs.

Figure 9: Usual Mode of Transportation for Travel to Work in Canada (2006, % of Workers)



Source: *Human Activity and the Environment: Annual Statistics* Statistics Canada. 2009. 15 Feb. 2010.
<<http://www.statcan.gc.ca/pub/16-201-x/16-201-x2009000-eng.pdf>>

Waste Management

Sustainable waste management practices are the foundation to maintaining public health and a healthy ecosystem. Whether we are talking about municipal solid waste (MSW), recycling, hazardous waste or medical and infectious waste, one of the fundamental challenges within waste management is how nations can increase their capacity and ability to redirect waste from traditional storage and disposal options to a point where that waste can become an active asset through the utilization of reuse or recycling technologies and techniques.

Traditional waste has several negative impacts on our environment, including⁶²:

- Pollution of ground and surface waters from leachates (landfill drainage);
- Air pollution, including greenhouse gases;
- Long-term soil pollution;
- Noise, odour, optical and other nuisances;
- Loss of resources and associated impacts from production of virgin materials.

⁶² Frás, Karolina. *PowerPoint Presentation: Waste Management in the European Union: State of play and the new Waste Directive* International Conference in Municipal Waste Technologies and Strategies. 6 Oct. 2008. 15 Feb. 2010.
<<http://colloque2008.cmm.gc.ca/presentations/fras.pdf>>

As Canada and the world move forward it will be necessary that local, provincial, state and federal governments implement strategies, policies and investments that increase the utilization of waste products and decrease the residuals and negative impacts created from traditional landfilling and incineration. It will also be important that local governments shape public policy with the mindset of preventing the creation of waste in the first place. Local governments can achieve this by directing policies and research towards technologies and processes that⁶³:

- Promote alternative uses of traditional waste products, including using MSW to create energy;
- Implementing commercial and industrial standards that minimize the amount of waste produced;
- Provide funding and policies that stimulate the amount of waste that is recycled.

It will be important that local governments partner with private business and research centers across the country in the adoption of sustainable approaches to waste management and policy implementation. The City of Edmonton recently entered into a public-private partnership to succeed at doing just that.

Waste to Energy

In an effort to fully utilize the waste produced by the City of Edmonton, Alberta the city began construction in September of 2009 of a municipal-solid-waste to ethanol facility that will utilize the municipal solid waste produced by the city to produce methanol and cellulosic ethanol. The \$70 million project, that is an alternative to traditional landfilling, will produce 26 million litres of ethanol per year and allow the city to increase their waste diversion rate to 90%. This project is a public-private collaboration between the City of Edmonton, Government of Alberta and Enerkem Greenfield Alberta Biofuels. The waste used for this project will consist of the waste residue left over after recycling and composting have been factored, waste that previously would have been destined for the local landfill. In total this project is expected to reduce Alberta's carbon footprint by 6 million tonnes over 25 years and lower the demand for traditional landfilling. The project demonstrates the importance of viewing municipal waste as an opportunity rather than a cost. It is also important to note that only through private-public collaboration and cooperation could such a project reach the commercialization stage.⁶⁴

⁶³ Fras, Karolina. *PowerPoint Presentation: Waste Management in the European Union: State of play and the new Waste Directive* International Conference in Municipal Waste Technologies and Strategies. 6 Oct. 2008. 15 Feb. 2010.

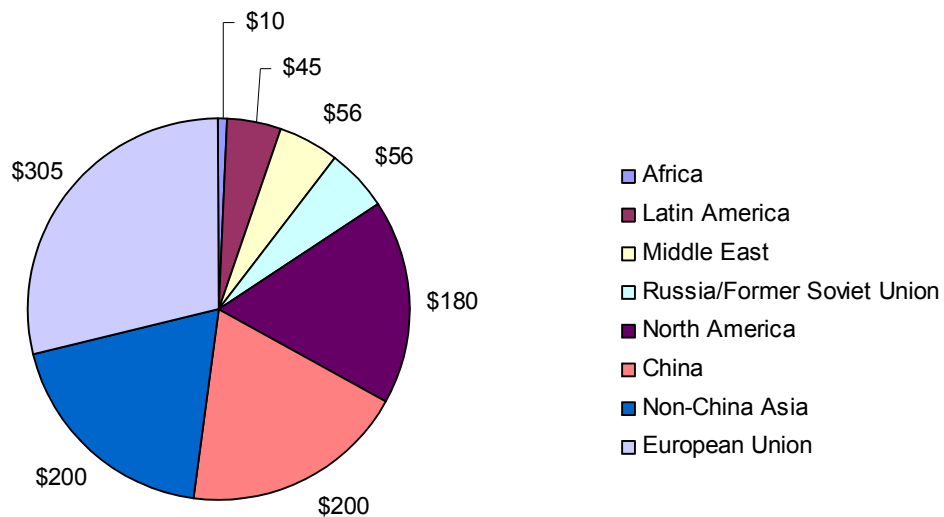
<<http://colloque2008.cmm.gc.ca/presentations/fras.pdf>>

⁶⁴ *Project Description: Overview of the Edmonton Waste-to-Biofuels project* Edmonton Waste-to-Biofuels Project. 2010. 15 Feb. 2010. <http://www.edmontonbiofuels.ca/projets.htm?yams_lang=en>

Impact of Stimulus Spending on Municipal Infrastructure

The great recession, referring to the housing crisis of 2007 which transformed into the financial crisis that is continuing today, has spurred tremendous investment in municipal infrastructure from governments around the globe. Having recognized the importance of infrastructure as a foundation and catalyst of economic prosperity, world governments are projected to invest a total of \$1.05 trillion in annual infrastructure investment, with total infrastructure investment worldwide estimated to equal \$25 - \$30 trillion over the next 20 years.⁶⁵ The bulk of this investment will be located in North America, European Union and Asia (Figure 10).

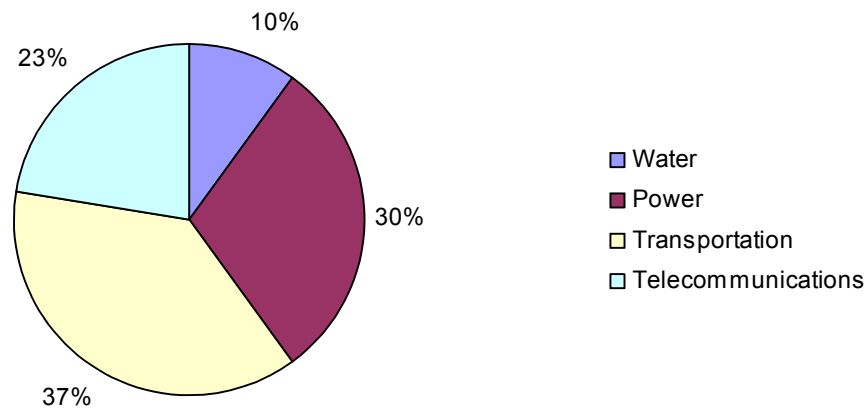
Figure 10: Projected Annual Global Infrastructure Investment (CAD \$Billions)



Source: Tal, Benjamin. *Occasional Report #66: Capitalizing on the Upcoming Infrastructure Stimulus* CIBC World Markets. 26 Jan. 2009. 4 Feb. 2010. <http://research.cibcwm.com/economic_public/download/occrept66.pdf>

⁶⁵ Tal, Benjamin. *Occasional Report #66: Capitalizing on the Upcoming Infrastructure Stimulus* CIBC World Markets. 26 Jan. 2009. 4 Feb. 2010. <http://research.cibcwm.com/economic_public/download/occrept66.pdf>

Figure 11: % of Projected Annual Global Infrastructure Investment Worldwide by Type of Infrastructure



Source: Tal, Benjamin. *Occasional Report #66: Capitalizing on the Upcoming Infrastructure Stimulus* CIBC World Markets. 26 Jan. 2009. 4 Feb. 2010. <http://research.cibcwm.com/economic_public/download/occrept66.pdf>

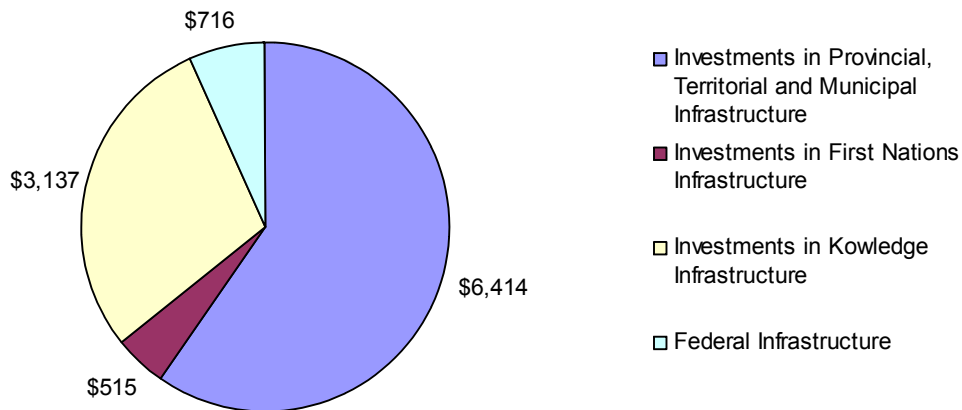
On January 27th, 2009, the Canadian federal government introduced their annual Budget under the title of *Canada's Economic Action Plan*. *Canada's Economic Action Plan* outlines Canada's two-year, \$52 billion stimulus package response to the recent financial crisis. The plan is designed to spur growth and mitigate Canada's exposure to the global financial crisis through targeted financial stimulus spending. The plan introduced \$12 billion in new stimulus funding for infrastructure investment over two years. Building upon a seven-year, \$33 billion public infrastructure spending plan that was introduced in 2007's Budget.

Canada's Economic Action Plan focuses investment on four categories of infrastructure⁶⁶:

- Provincial, territorial and municipal infrastructure;
- First Nations infrastructure;
- Knowledge infrastructure;
- Federal infrastructure.

⁶⁶ Flaherty, James. *Canada's Economic Action Plan: A First Report to Canadians* Government of Canada, Department of Finance. Mar. 2009. 8 Feb. 2010. <http://www.actionplan.gc.ca/grfx/docs/ecoplan_e.pdf>

Figure 12: Immediate Spending to Build Infrastructure outlined under Canada's Economic Action Plan (2009-11, CAD \$Billions)



Source: Flaherty, James. *Canada's Economic Action Plan: A First Report to Canadians: Table 4.5: Immediate Action to Build Infrastructure* Government of Canada, Department of Finance. Mar. 2009. 8 Feb. 2010.

<http://www.actionplan.gc.ca/grfx/docs/ecoplan_e.pdf>

Of the four areas of focused investment outlined in Canada's plan, investment in provincial, territorial and municipal infrastructure represents nearly 60% of all initial infrastructure stimulus spending by the Federal Government of Canada. Additionally, this spending is intended to be matched by local governments, increasing the total spending in this category to just under \$13 billion. According to the most recent update, the stimulus funding has been committed to over 6,700 provincial, territorial and municipal infrastructure projects.⁶⁷

It is important to recognize that infrastructure investment as economic stimulus is not wasted money. It is a catalyst that can spur growth and reinvigorate an economy. A recent study from the Federation of Canadian Municipalities (FCM) found that, in 2008, for every \$1 billion spent on infrastructure the real economy should increase by 0.13% or approximately \$1.3 billion. Additionally an investment of \$1 billion in new infrastructure should create an average of 8,800 jobs between 2009-12, mostly in the construction industry, but also benefitting several industries providing supplies and services to the construction industry.⁶⁸

Since the implementation of the *Canadian Economic Action Plan*, the Canadian economy has shown signs of economic recovery. Employment gains have been witnessed over four of the last six months and

⁶⁷ *Canada's Economic Action Plan: A Fourth Report to Canadians* Government of Canada. Dec. 2009. 8 Feb. 2010. <http://www.actionplan.gc.ca/grfx/docs/4threport/CAPDEC2009_eng.pdf>

⁶⁸ Sonnen, Carl. *Municipal Infrastructure: Macroeconomic Impacts of Spending on Level-of-Government Financing* Federation of Canadian Municipalities. 31 May 2008. 16 Feb. 2010. <<http://www.fcm.ca/CMFiles/Final%20Informetrica1LUG-5312008-7682.pdf>>

real gross domestic product (GDP) increased in the 2nd and 3rd quarters of 2009. While much of this growth can be attributed to the impact of the stimulus spending in Canada, it is positive news and may indicate that our economy is moving towards more positive, yet subdued, economic growth in the years ahead. At the moment the Canadian government is focused on moving the country away from a reliance on stimulus spending to a more sustainable economy.

Other countries around the world have also included aggressive investment in infrastructure as a key element in the implementation and success of their stimulus actions. The United States' primary stimulus activity came in the *American Recovery and Reinvestment Act of 2009*. Through this act, the Government of the United States provided USD \$787 billion in stimulus spending. Of this, USD \$111 billion was directed to infrastructure and science funding.⁶⁹ In 2008, China announced that approximately USD \$586 billion would be invested in infrastructure over the next two years as part of their economic stimulus plan.⁷⁰

With the huge one-time injection of investment in infrastructure brought on by economic stimulus spending. Governments in Canada, and around the world, have signalled their dedication to infrastructure as a key component to growing and sustaining national economic prosperity. While the investments in infrastructure within these plans are welcomed by local governments around the world, it is still important to understand that to maintain economic growth and prosperity, constant investment in infrastructure maintenance, repair and replacement is required.

Saskatchewan's Advantage and Opportunity

Earlier in this report emphasis was placed on Canada's growing infrastructure deficit and the annual cost of maintaining, operating and constructing infrastructure was noted to be approximately \$5.8 billion among major Western Canadian cities. If local Canadian cities were able to reduce their annual infrastructure spending by 1%, through advancements and innovations related to sustainable municipal infrastructure, they would be able to reduce their costs by \$58 million every year. If one assumes that the average useful life of most infrastructure is between 30 and 40 years, than one can extrapolate the above figure and estimate that advancements in technology and innovation related to infrastructure could potentially save major Western Canadian cities between \$1.7 and \$2.3 billion in costs over the life of municipal infrastructure.

⁶⁹ *Where is your money going?* Recovery.org. 8 Jul. 2009. <<http://www.recovery.gov/?q=content/investments>>

⁷⁰ Barboza, David. *China Unveils Sweeping Plan for Economy* The New York Times. 9 Nov. 2008. 8 Feb. 2010. <<http://www.nytimes.com/2008/11/10/world/asia/10china.htm>>

Currently, the Province of Saskatchewan is positioned to be a catalyst in Canada for sustainable municipal infrastructure research and leadership. There are over 250 firms in Saskatchewan involved in infrastructure, construction and the environmental sector. Of these 250 firms, 60 of them are involved in clusters in Saskatchewan.⁷¹ Saskatchewan is home to a diversity of leading associations, academic and research centres and private enterprises that are working towards developing sustainable municipal infrastructure policies and technologies. Saskatchewan is taking a lead in this field and has established an organization, Communities of Tomorrow, to act as an industry catalyst to ensure that the province is a world leader in innovation and advancement in the field of sustainable municipal infrastructure.

Communities of Tomorrow

Communities of Tomorrow is a public-private partnership with the mission of making Saskatchewan a global leader in the field of innovative sustainable municipal infrastructure.

Communities of Tomorrow works with industry, municipalities and researchers to find innovative solutions to infrastructure challenges. Capitalizing on the trillion-dollar global infrastructure market, Communities of Tomorrow assists in the development of more cost-effective, longer-lasting and environmentally friendly infrastructure products and services, in turn creating jobs, growing businesses and generating economic activity for Saskatchewan.

Their strategic focus is on the areas of water, roads and transportation, and remediation. Communities of Tomorrow operates with four core business strategies:

Technology Innovation Brokerage and Facilitation

Communities of Tomorrow builds partnerships between the key sectors: municipalities, industry, and researchers. They seek to discover needs and match them with suppliers and assist in the development of products and services from concept to field-testing to commercialization, as well as the development of innovative solutions and best practices.

Funding

Communities of Tomorrow provides project funding to assist companies, municipalities, and researchers to prove out and demonstrate innovative technologies and processes. Over 100 projects have previously received funding.

⁷¹ Regina – Sustainable Infrastructure Cluster Fact Sheet National Research Council Canada. 22 Sep. 2009. 17 Feb. 2010. <<http://www.nrc-cnrc.gc.ca/eng/clusters/factsheets/regina.html>>

Capacity Building

Communities of Tomorrow is assisting industry and municipalities to develop expertise and create capacity, and as a result become innovative leaders in the infrastructure sector.

Economic Development

Communities of Tomorrow works with industry players, associations, regional economic development authorities, and other stakeholders to create economic development in the private sector. Communities of Tomorrow focuses on the expansion of existing enterprises and the creation of new enterprises to drive economic growth and maximize return on investment in innovation.

Municipal Innovation Network

Communities of Tomorrow is focused on the needs of Saskatchewan municipalities, as the front-line builders and operators of infrastructure systems. Their work is dedicated to finding innovative and sustainable infrastructure products and services that will provide these outcomes:

- Lower ongoing operating costs
- Longer system life
- Reduced maintenance
- Reduced environmental impact

Communities of Tomorrow has been building a network of municipalities, companies, and researchers working in the field of innovative infrastructure. This network will provide a common ground for all municipalities to share problems and solutions, and perhaps generate opportunities for shared use of services or products.

Communities of Tomorrow is engaged in ongoing discussions with SUMA, the City Mayors group, and the Saskatchewan Public Works Association, among others, to further target the needs of municipalities.

In addition to being the home of leading industry and research institutions, Saskatchewan is home to several leading private enterprises in the field of sustainable municipal infrastructure. These companies include, but are not limited to: Mainstream Water Solutions, Droycon Bioconcepts, Pavement Scientific International, Ground Effects Environmental Services, TecWater, AECOM, Clifton and Associates, and many others.

Ground Effect Environmental Services Inc. is one of these leading Saskatchewan firms that are introducing ground breaking technologies into the municipal infrastructure industry and Communities of Tomorrow is helping them along the way. Ground Effects Environmental Service Inc., Communities of Tomorrow, University of Regina and TransGas recently partnered to work towards the commercialization

of a new technology for in-situ desalinization, an electro-kinetic remediation process that removes salt from contaminated soils. The technology represents an environmentally sustainable technology that will help eliminate salt contaminated soils that are generated from the oil and gas industry, dump sites for salt used on winter roads and municipal salt storage yards. This technology does not require any excavation activities. After extensive study and testing, the technology is now ready for commercial use and represents a significant opportunity for a local Saskatchewan company.

By recognizing that advancements at this level can only be made through partnerships and collaboration, Saskatchewan and Canada recognize the importance of creating clusters. By bringing together industry, government and academia, clusters foster growth in scientific and technological innovation. By clustering Saskatchewan is positioning itself as a leader in world-class research and development in the field of sustainable municipal infrastructure. As the infrastructure deficit in Canada continues to pose a significant threat to the country's economic prosperity, it will be vitally important that local governments support collaboration at all levels.

Conclusion - Moving Forward Through Partnership

When considering the impact that municipal infrastructure has on Saskatchewan, Canada and the world the value of infrastructure to communities around the world becomes apparent. Communities across the country rely on municipal governments to ensure the reliability and safety of our infrastructure network. By maintaining wastewater treatment infrastructure local governments ensure the health of their citizens and the through the establishment and maintenance of transportation infrastructure those governments ensure international commerce keeps are economy vibrant and prosperous.

In Canada, demographic challenges and public pressure to maintain balanced budgets have caused provincial and federal governments to shift the responsibility of a large portion of public infrastructure to municipal governments who have limited funds. This has led to an unprecedented infrastructure deficit in Canada. The infrastructure deficit and the aging and degrading of infrastructure pose significant threats to public health and economic prosperity in Canada.

While the threat posed by Canada's infrastructure deficit is immense, Saskatchewan is leading the way in innovative and cutting edge research and commercialization in sustainable municipal infrastructure processes and technologies. The leadership demonstrated by Saskatchewan municipalities will be a critical component in this field. They have the opportunity to collaborate on development of solutions to their own challenges, by becoming part of the emerging Municipal Innovation Network - Canada's first - and by offering their own infrastructure systems as "living labs" for the field-testing of innovative infrastructure developments.

Saskatchewan's sustainable infrastructure cluster is bringing together leading minds from industry, government and academia to come up with solutions and new technology that will reshape the future of infrastructure here at home and around the world. Communities of Tomorrow is facilitating the growth and development of the cluster, and there is a powerful economic incentive for local private enterprise to bring the latest in municipal infrastructure products, technology and innovation to the rest of the world.

With municipalities, private industry, and the research community moving this industry forward together, Saskatchewan is ensuring that future generations will have access to safe, reliable and sustainable infrastructure and that the economic growth benefits of developing that innovative infrastructure will be enjoyed here at home.

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