Leadership in Sustainable Infrastructure

Leadership en Infrastructures Durables

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ENGINEERING SUSTAINABLE COMMUNITIES

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Though strategic and innovative infrastructure design is an important factor in achieving environmental, social and economic sustainability, the term 'Sustainable Infrastructure' is ambiguous. The common definition of sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. However, societal and environmental problems are complex and intractable, and the solution will vary depending on many factors, including location, population, density, resources, local government, etc. The risk of climate change should be integrated into development programmes, such as a sustainability assessment tool that is truly universal. It has been recognized that a common rating system will be a key element in addressing many questions. As designers, constructors, consumers, and community members, we must ask ourselves: how to design for sustainability, what sustainable infrastructure is, how to get sustainable designs into project specifications, how to overcome lowest capital cost requirements, and how the cost will be justified. A variety of tools and rating systems are already in place to provide guidance to stakeholders to achieve sustainable development; however, these tools can be consolidated into one holistic rating system, with the purpose of addressing the full range of environmental, social and economic impacts to support practitioners to incorporate sustainability in design, construction and operations.

1 Introduction

Civil engineers in Canada are charged, legally and ethically, with holding paramount in everything they engineer, the protection of the environment and the welfare of the public, even before their own self-interests and those of their clients. Yet, our professional engineering livelihood is assailed by clients, public pressures, and considerations to business competitiveness that pressure us to compromise our legal, ethical, and even moral, requirements and values. How do engineers strike a balance between these competing priorities, our legal obligations, and self-moral principles, while maintaining a professional reputation? One approach that has been adopted by the American Society of Civil Engineers, and will shortly become an ISO standard, is to use sustainability indices such as the Envision rating system. It allows for a neutral third party, with peer-reviewed and science-based tools, to conduct an independent audit of proposed engineering projects, policy analyses, and/or designs. It then gives a rating that is comparable industry-wide, with identified ways to improve the sustainability rating. Is this tool appropriate for Canada, for Canadian society, for our colleagues in the Canadian Society for Civil Engineers (CSCE)? An initiative has been launched recently by CSCE headquarters to consult members across Canada in this regard. The purpose of this paper is to review the issues surrounding possible sustainability assessment tools for Canadian civil engineers, and to make recommendations for future considerations.

2 Addressing the Impacts of Climate Change

The impacts of climate change are difficult to predict accurately, and any strategy for mitigation and/or adaptation should be as flexible as possible in order to respond to new information. Governments should integrate mitigation and adaptation strategies into their project development but may require support to overcome technical capacity constraints. The best way for governments to accelerate adaptation is to promote strategic project development. If individuals and communities are empowered by development and rendered less vulnerable overall, they will be better able to adapt to changes in their environment. Improving disaster preparedness and management will not only save lives, but will also promote early and cost effective adaptation to climate change risk.

Canada's commitment to the Paris Agreement was ratified in December 2015, less than a year after the Paris climate conference (COP21), when Prime Minister, Justin Trudeau, announced a 'floor' carbon price of $10 a tonne in 2018, rising by $10 each year to $50 per tonne by 2022.

To stay in line with commitment to COP21, which aims to achieve a legally binding and universal agreement on climate change with the goal of keeping global warming below 2 °C, government can make long-term infrastructure more resilient through building codes and regulations, land-use zoning, river management, and warning systems.

Integrating adaptation into development policy and process through national economic planning and budgetary processes is an important first step towards effective adaptation. The budget is an important process for identifying and funding development priorities. Adaptive activities should be integrated into the budget framework and relevant sectoral priorities to help ensure necessary actions receive adequate funding over the long term and are balanced against other competing priorities.

The Government of Canada renewed and expanded its focus on adaptation by investing $148.8 million over five years in ten adaptation programs and adopting the Federal Adaptation Policy Framework (2011) to help bring climate change issues into the mainstream of federal decision-making. The figure below compares the federal spending on adaptation programs in 2007 and 2011.

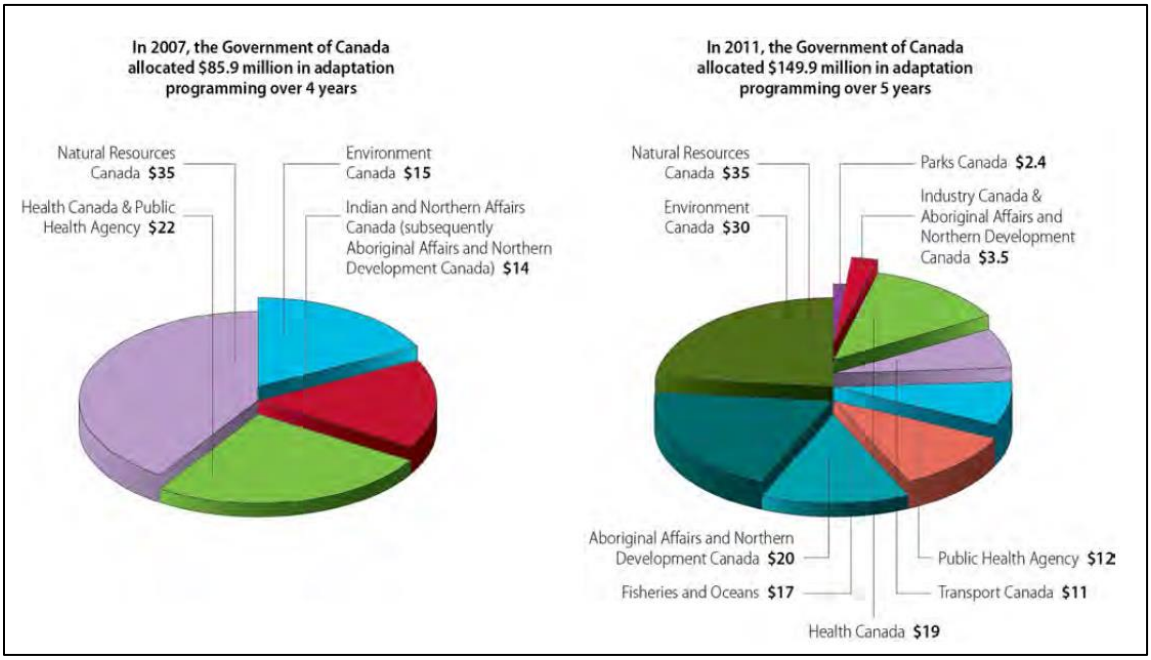

Figure 1: Evolution of federal spending on adaptation programs (Data from: Environment Canada, 2013; CNW, 2007)

Impacts on health are increasingly evident as the climate continues to change. Adaptation is needed to reduce growing risks to vulnerable populations and communities. Successful adaptation requires intersectoral collaboration (e.g. health, environment, planning, transport, and infrastructure) to monitor and surveillance climate change health outcomes, address root causes that limit preparedness (e.g. poverty), identify vulnerable populations, reduce uncertainty through increased research on impacts, educate the public and decision makers about potential disasters and benefits of preparedness, and finance needed measures.

3 Cost Benefit Analysis and Asset Risk Management

The insurance industry is well placed to enhance efforts to manage climate risks, and a project under the Economic Working Group led by the Insurance Bureau of Canada is quantifying the economic cost.

Insurance is an area closely related to disaster preparedness – an area in which climate-change considerations reinforce what governments should already be doing on developmental grounds. Well-functioning insurance markets share risk across individuals, regions, and countries, to reduce the welfare effect of negative shocks of all types, whether they are climate-related or not. Risk-based insurance schemes can also reduce the costs of climate change by encouraging good risk-management behaviours. For example, by providing incentives to meet standards on building design and construction, they encourage action to reduce risk. In addition, by providing information through its measurement and pricing of climate risk, insurance may also act as a catalyst for autonomous adaptation. With the expected increase in climate-related shocks, governments now have even more reason to promote well-functioning insurance markets. Figures 2 and 3 show the impacts of climate change across the country, and examples of insured losses from extreme weather events, respectively.

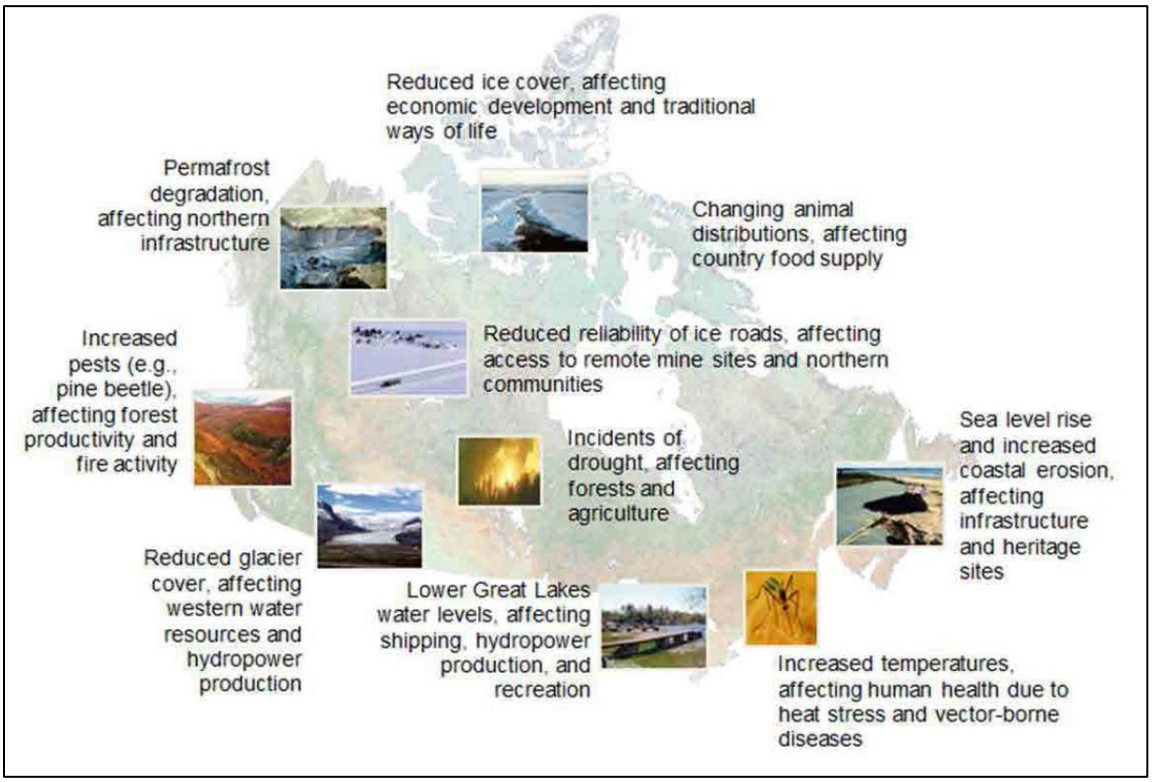

Figure 2: Examples of Climate Change Impacts

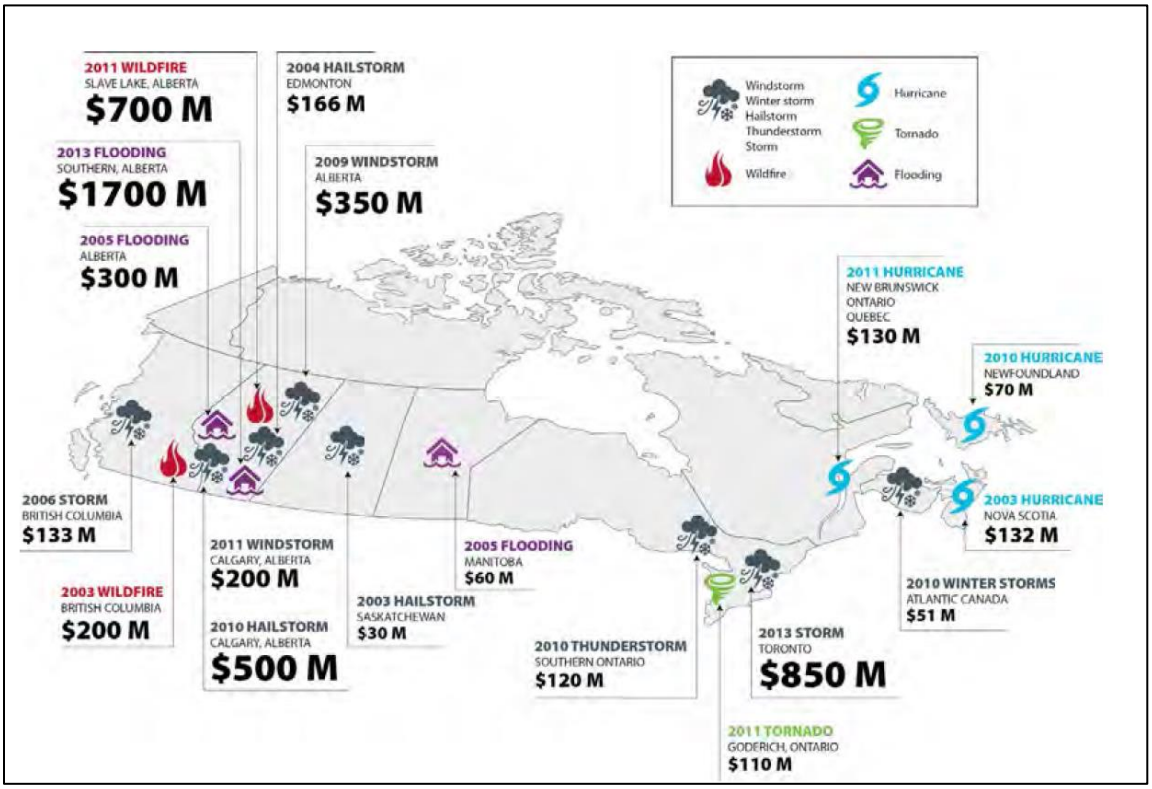

Figure 3: Examples of Insured Losses from Extreme Weather Events in Canada

4 Rating Systems for Developing Sustainable Communities

As facilitators, government agencies are responsible for removing barriers and creating incentives so that people and organizations across society are more inclined to proactively adapt. Government agencies are responsible for adjusting policy, programming and operational decisions to account for a changing climate.

Regulatory measures may be appropriate instead of, or complementary to, tax or trading instruments. These measures can also be more effective in stimulating competition and innovation by signaling policy intensions and reducing uncertainty while supporting the market for outputs of technological advances. These measures can also promote efficiency through strategic coordination of key markets, for example by reducing long-run transport demand through integrated land-use planning and infrastructure development.

A significant challenge lies with local politicians. It is difficult for a politician to justify spending taxpayers' money on incremental social or environmental benefits, if the more sustainable option is also more expensive than the basic solution. Although a cost benefit analysis (CBA) can help when it comes to infrastructure decisions, it tends to overlook a project's social and environmental benefits. What is needed is a true triple-bottom-line (TBL) analysis.

As mentioned, there are a number of rating tools that can be utilized throughout the planning & design, construction, operation & maintenance, and deconstruction & decommissioning phases of a projects' life cycle. Amongst some of these tools are the Institute for Sustainable Infrastructure Envision™, the Canadian Healthy Development Index (HDI) and the Dutch Sustainable Transport Safety (STS) system.

Envision is broken down into five categories: quality of life, leadership, resource allocation, natural world, and climate & risk. The categories are further broken down into sub-categories, each with a number of

different credits that can be referenced to guide decision makers into reaching one of five levels of achievement in their project (i.e. Improved, Enhanced, Superior, Conserving, and Restorative).

The Healthy Development Index focuses on guiding designers to shape communities to make active transportation possible, convenient and preferred in order to hardwire physical activity into daily lives and significantly improve public health by fostering physical activity. This tool is divided into seven built environment elements: density, service proximity, land use mix, street connectivity, road network and sidewalk characteristics, parking, and aesthetics and human scale.

Currently, designers of transportation systems focus on crash reduction and the elimination of death and serious injury. The Dutch Sustainable Transport Safety system can be used to help designers by providing a set of guiding principles based on scientific theories and research methods that have arisen from disciplines including psychology, biomechanics and traffic engineering. These principles include: functionality of roads, homogeneity of mass and/or speed and direction; predictability of road course and road user behaviour by a recognizable road design, forgiveness of the environment and road users, and state of awareness by the road user.

Barriers that once stood in the way of calculating the value of social or environmental benefits are continuing to break down. The tools to analyze standard social and environmental input values means TBL analysis is now feasible for most infrastructure project. As shown in Figure 1, The Government of Canada has expanded its focus on federal adaptation programs. Greater efforts have been taken by public health and emergency management officials and non-governmental organizations to better prepare Canadians for climate change impacts on health. Analysts can use the TBL approach to rank infrastructure investment options and politicians can allocate public funds to infrastructure projects, starting with the projects that have the highest net present value or return on investment.

Each of the tools mentioned above encompass a vast amount of details to support designers, constructors, consumers and community members, yet there are still some missing components that can further strengthen these tools. Gaps and opportunities are continuing to appear as these tools are used more frequently. To simplify the process, these tools should be integrated with each other to create one holistic rating system that will also support TBL CBA and risk assessment. Additionally, integration of major contributing factors unique to Canada such as consultation with First Nations, cold region issues (i.e. permafrost degradation), social issues, geography and politics, will truly enable the development sustainable communities.

5 Conclusion

Well-functioning infrastructure and systems are critical to Canada’s economic, social and environmental well-being. All sectors depend upon reliable access to clean water, effective stormwater maintenance, effective treatment of wastewater and a safe and efficient transportation network. A changing climate presents risks to these services in several ways. Extreme events emerge as the key concern, with numerous examples of heavy precipitation overloading stormwater-handling capacity and disrupting transportation corridors. However, slower-onset changes such as higher temperatures, sea level rise, permafrost thaw and declining lake levels are also important factors to consider in infrastructure design, operation and maintenance. The focus for both water and transportation has been on risks, with limited attention given to potential opportunities. Future adaptation will involve further technological advancements and incorporation of climate change into design standards and maintenance practices. Fundamental research is underway to inform these developments. The application of a holistic rating tool for designers will be a key element in engineering truly sustainable communities.

6 Acknowledgements

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