New Economy Infrastructure

The federal government has initiated an ambitious new infrastructure program, with an emphasis on investments that will help Canada's economy transition to a low-carbon, climate resilient future. The government will need to develop new criteria to govern all infrastructure investments if its objectives are to be met.

While some will advocate a business-as-usual or incremental approach to the federal infrastructure program, we firmly believe there are tremendous economic, social, and environmental opportunities associated with a transformational approach that draws on existing tools and decision-making models. This approach starts with lifecycle costing analysis, to enable better decisions that compare the relative cost and carbon impacts of various design and material combinations for any given project. This would, in turn, result in more cost-effective infrastructure decisions, a lower carbon footprint, increased productivity,[i] and other economic benefits for the Canadian economy.

We propose that a three-screen approach be a mandatory requirement for all infrastructure investments:

1. Full economic lifecycle cost assessment

Remarkably, many government infrastructure projects fail to consider full lifecycle costs. For example, one of the largest government infrastructure costs is roads and highways. Yet many RFPs for such projects do not weigh normal maintenance costs (i.e. how often the road will have to be "shaved and paved" through its life span) or how traffic patterns, climatic stresses or other factors might contribute to the lifecycle cost of a given project. When comprehensive lifecycle costing is required, governments generally opt for more resilient surfaces, such as rigid concrete pavements rather than asphalt. The result is lower costs to government, and also to the economy as a whole, as disruptive construction on these roads occurs far less often.[ii]

Lifecycle costing should also consider the impacts of climate change and more extreme weather. An approach that integrates natural infrastructure (wetlands, sloughs/swales, trees) with built infrastructure can mitigate the impact and cost of extreme weather such as flood and storm waters. And infrastructure built to accommodate uncertainty with respect to a future of changing and more extreme weather could save governments billions in repair and re-building costs. MIT, the Institute of Catastrophic Loss Reduction, and Engineers Canada, among others, are developing important tools to help decision makers integrate these considerations into the lifecycle costing of buildings and infrastructure investments.

2. Full carbon cost assessment

Accounting for carbon in any given infrastructure project demands we consider:

a) embodied carbon - carbon emitted as a result of material production, construction processes and waste;
b) operational carbon – carbon emitted as a result of the functional use and maintenance of a project over its useful life, including how emissions are impacted by design considerations;
c) end of life carbon – carbon emitted as a result decommissioning, reuse, recycling and/or disposal; and

d) carbon sequestered – through the restoration and enhancement of natural features (e.g. wetlands, sloughs, swales, buffers) for water quality and flood/storm water mitigation.

The relative magnitude and timing of emissions is also important. For example, efforts to reduce embodied emissions have an immediate climate mitigation effect, while operational emissions, though often far more significant in terms of total volume, return benefits over time. End of life emission reduction efforts may not return climate benefits for many years or decades. Full lifecycle carbon accounting can minimize the climate impacts at each phase of a project's life.

3. "Best Available Solutions" assessment

Based on the Alternative Land Use Services model, project proponents should be required to undertake an analysis of whether the need associated with the infrastructure project can be met through a different type of infrastructure that performs better under one or both of the first two screens, using the analysis of a qualified expert. To name just a few examples drawn from recent government procurements:

- An energy storage system would be a more cost-effective and less polluting option for back-up power than a diesel generating plant. Storage may offer similar types of savings as an alternative to building new transmission.
- The cost of a water treatment facility may be reduced or avoided by employing less expensive natural infrastructure, such as maintaining wetlands upstream or paying farmers to use less polluting land management practices.[iii] There are similar examples in the area of flood mitigation.[iv]
- A concrete culvert under a major arterial roadway may have a more expensive capital first cost than a thermoplastic or corrugated steel conduit, but a concrete pipeline system offers resilience to human-made catastrophes and extreme weather events.

Implementation

While there is now an abundance of lifecycle data and tools, a lack of consistency in boundaries, methodologies and robustness can impede credible full lifecycle carbon assessments and sow confusion in the marketplace. With the exception of pavements, where the choice of materials and designs are relatively limited, there currently exist no robust yet accessible tools to properly inform an integrated design and decision protocol for minimizing carbon in infrastructure projects.

These challenges could be overcome with a modest investment to integrate, refine and standardize a lifecycle carbon platform and fill in remaining lifecycle inventory information gaps. Work underway at MIT, the Athena Sustainable Materials Institute, the Risk Sciences Institute, among others, is already helping to amass lifecycle costing data and tools, making it easier to accommodate uncertainty around the impacts of any given project.

This integrated approach should also take into account the need for increased resilience in infrastructure as a result of climate change. New studies from MIT show that failing to accurately value the risk to infrastructure from disasters (including, for example, more extreme weather) can have a dramatic impact on the lifecycle carbon performance of a given project (e.g. if it requires premature replacement or repairs).[v]

In terms of process for incorporating the three screens, the assessment should generally be undertaken through the Asset Management Plan process, according to consistent methodology that draws on the above-mentioned sources. Assistance to undertake the three-screen assessment should be provided by the federal government, particularly for smaller municipalities. In addition, there may be less of an analytical requirement for smaller projects (e.g. under $2 million), although for some categories, smaller projects could simply follow simpler template methodology based on other similar types of projects.

This proposal has been endorsed by:

Analytica Advisors
ALUS Canada
ArcTern Ventures
Building Owners and Managers Association of Greater Toronto Area (BOMA Toronto)
The Cement Association of Canada
City of Vancouver
Clean Energy Canada
Ecology Action Centre
EllisDon Corporation
Environmental Defence
Evergreen
Insurance Bureau of Canada
Intact Centre on Climate Adaptation, University of Waterloo
MaRS Cleantech Venture Services
NRStor

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[i] See Bak, Céline, *Growth, Innovation and COP21: The Case for New Investment in Innovative* Infrastructure.
[ii] As a side benefit, environmental impacts also tend to be greatly reduced when full lifecycle costing is employed. In the case of roads, rigid concrete pavements require 66% less energy 73% less aggregate to build and maintain, contain less "embodied carbon" and improve vehicle fuel efficiency by up to 7%. They also reduce lighting costs by 24% and mitigate the urban heat island effect. See http://www.athenasmi.org/wp-content/uploads/2012/01/Athena_Update_Report_LCA_PCCP_vs_HMA_Final_Document_Sept_2006.pdf, and https://cshub.mit.edu/results/pavements.
[iii] For example, in 2010, Halifax Water avoided a $150,000 upgrade at the Middle Musquodoboit Water Treatment Plant (built in 2009-2010 for $2.2M) by working with a farmer. The farmer is compensated $300 on an annual basis for modifying agricultural practices and for maintaining a wider riparian buffer. According to a World Resources Institution study, 6 U.S. cities saved 60% on water infrastructure by integrating natural and built infrastructure. New York City invested worked with the agricultural community to protect water quality rather than spend $6-8B on a new filtration system with annual costs of $300M. The rate of return on the natural infrastructure investment was between 90 to 170%. An added benefit was the injection of $100M per year into the rural parts of the watershed: World Resources Institute: *Natural Infrastructure: Investing in Forested Landscapes for Source Water Protection in the United States*, 2013.
[iv] See *Ibid*; Ducks Unlimited Canada, *Wetlands Working: Flood Mitigation in the Bow River Basin*; and Olewiler, Nancy, *The Value of Natural Capital in Settled Areas of Canada*, Ducks Unlimited Canada and the Nature Conservancy of Canada, 2004.
[v] https://cshub.mit.edu/sites/default/files/documents/Research%20Brief%20August%202014-final.pdf