Canada 2030: Scan of Emerging Issues

Infrastructure

Introduction

The purpose of this foresight scan is to explore a number of key plausible changes that could affect infrastructure – and infrastructure investments – over the next 10-15 years. The rise of virtual work, online consumption, and decentralized local production could reshape how and where people want to work and the kinds of infrastructure needed to support their choices. At the same time, technologies like self-driving vehicles, 3D printing, the Internet of Things (IoT), Artificial Intelligence (A.I.), robotics and automation, virtual reality, and renewables and energy storage are all changing the possibilities for infrastructure. In the context of these and other changes (e.g. climate change and an aging population), it is important to consider a range of possibilities for how tomorrow's infrastructure may differ from what is currently expected. This can help stimulate reflection and inform current decisions about infrastructure investments and reduce the risk of stranded and underutilized infrastructure in the future.

Definition – For this project, infrastructure[1] refers to the structures, systems, and facilities serving a region, a country, a city or other space (physical and virtual). It includes 4 broad areas:
- **built environment** (residential, industrial and commercial buildings);
- **transportation** (personal, public and commercial including all modes: road, rail, air, sea);
- **energy** (sources, storage and delivery); and
- **digital** (telecommunications, data centres and the services participating in the digital space).

What is changing?

The insights below represent Policy Horizons Canada's initial scans of plausible disruptive changes with implications for infrastructure. They draw on previous foresight studies in areas such as the future of energy, work, technology and the digital economy.

Personalized Mobility as the New Mass Transit

Electric self-driving vehicles could enable a range of convenient and affordable personalized mobility options that make fixed-route mass transit models relatively undesirable. Over the next 10-15 years, the plans of Google, Apple, Tesla, Uber, Lyft and others to introduce self-driving cars, ride-sharing and door-to-door services at affordable prices, could rapidly attract mass transit users and upset current transportation and road infrastructure. In this context, fixed-route mass transit models (such as light rail, buses and dedicated bus lanes) may become increasingly risky investments.

Emerging "Urban" Electric Grids

Increasing demand for electricity coupled with emerging sources of electricity production and storage could require new (smart, decentralized) approaches to managing the urban power grid. Over the next 10 to 15 years, cities' power sources may shift to incorporate much higher levels of renewable energy. A growing digital economy powered exclusively by electricity, coupled with a rapid transition from fossil fuel to electric fuel for transportation and housing could substantially increase the demand for electricity in urban areas. At the same time, declining costs of decentralized and distributed energy systems could reinforce urban energy security and pave the way for cities to reach their climate change targets. The installation of in-home batteries and renewable energy sources (solar or wind power) on private homes, public buildings and infrastructure facilities (such as warehouses and factories), and the use of vehicle-to-grid technology could eliminate concerns over managing peak demand and allow power exchanges between households. This shift may increase pressure on centralized power utility companies to adopt a business model focused on decentralized energy systems with multiple owners.

"Virtual Transportation" of Goods

Local production could reduce the need for national and global freight transportation infrastructure. The digital economy is redefining global supply chains and reducing the importance of low-cost labour as a factor in determining the location of manufacturing and production. A range of existing and emerging technologies are making it cheaper to relocate production nearer to customers, thereby reducing delivery times and costs. Additive manufacturing (i.e. '3D Printing') technologies will produce increasingly complex, customizable products containing multiple materials at local print shops and eventually in the home. Low-cost, polyvalent robots will enable efficient small-scale assembly, packaging, and delivery. Automated solar powered vertical farms could enable efficient urban agriculture. Synthetic biology and the circular economy could enable local production and recycling of raw materials. Over the next 10 to 15 years, these easily deployable and decentralized technologies could play a growing role in local production in cities and reduce the need for extensive import and export infrastructure.

Digital Infrastructure

Leading-edge digital infrastructure could become the key determinant of economic competitiveness and social wellbeing, requiring new approaches by governments to address market failures. A wide number of cities around the globe have already begun to implement plans to supply free Internet in public spaces. Over the next decade we are likely to see a debate on whether the Internet should be considered a public good, given that it is becoming an ever more essential part of daily life, our means of communication and a tool for public service delivery. In the future, access to low-cost broadband Internet may become a way to counter social and regional inequality, and to ensure economic competitiveness. Through the Internet of Things (IoT), more and more companies are planning to use smart and connected products to collect and commercialize big data. For cities and governments, the integration of IoT-connected sensors into physical infrastructure could help to improve water management systems, coordinate urban mobility, and collect data on air quality or noise levels. Leveraging big data from urban areas could also be useful to police departments and other security organizations to improve their "predictive policing" capabilities.

From Corporate Seats to Digital Workers

As work becomes virtual, cities and communities may need to attract residents based on quality of life rather than jobs, requiring new priorities in urban development and infrastructure investment. For decades, factors such as quality of jobs, local business development, business tourism, philanthropic gains, corporate and international organizations' seats have been an important source of economic growth for cities. North American city centers have been planned to welcome skyscrapers and commercial spaces for daily professional workers. For competition reasons, many companies could soon instead establish their corporate headquarters in the virtual world and start to employ predominantly remote workers from all around the world. [2] As more digital workers show up to work online, city policies based on attracting physical office infrastructure may be less effective. The potential lack of workers in city centers may also force a review of urban planning and an opportunity to transform downtown into an attractive space for "resident workers" to live (and spend).

Infrastructure In a Post Oil and Gas Economy

With the transition to an electricity-based economy, many existing and planned infrastructure projects related to extraction, transportation, refining and delivery of oil and gas may become obsolete and require significant shifts in government funding. While the contemporary industrial economy has been largely built on low-cost access to fossil fuel resources, the adoption of carbon emission reduction targets, the rising electricity demands of the digital economy, and low-cost electricity production from renewable sources could all lead to a faster than expected shift away from reliance on fossil fuels.[3] Many components of the fossil fuel infrastructure have implications for government funding and regulation, from the building of pipelines to the safe decommissioning of refineries and service stations and minimizing the risk of contaminated brownfield sites that limit future infrastructure development. In addition, fewer internal combustion engines on our roads may affect the liquidity of the Gas Tax Fund that is considered a predictable, long-term, stable funding for Canadian municipalities to help them build and revitalize their local public infrastructure. This may require governments to explore alternative sources of revenue.

Access is the New Ownership

A growing preference to access rather than own goods could have implications for the design and use of urban infrastructure. An increasing number of consumers are re-thinking the value of ownership. Whether borrowing goods, renting homes and clothes or car-sharing, the concept of ownership, which has always been regarded as a sign of prosperity, is increasingly being called into question, and not only among younger generations. The emerging consensus seems to be that ownership is more expensive than simply accessing goods via the sharing economy. Major actors in this business have already understood that to succeed they need to target the ownership market rather than just the existing service industry. According to John Zimmer of the car-sharing service Uber, "We didn't get into this to replace taxis. That's just a $12 billion market in the U.S. We want to create an alternative to car ownership, which is a $2.15 trillion market in the U.S. alone." The transition to a peer-to-peer or sharing-based economic model could require existing infrastructures to be redesigned or repurposed to accommodate mobility sharing initiatives as well as work-space sharing in urban areas. Growing virtual work and e-consumption may also force decision-makers to rethink urban zoning to enable flexible repurposing of empty office and retail spaces.

What else is changing?

Horizons is exploring additional topics to consider for this study. For now, this includes the following:

Self-funding Infrastructure
New technologies including ubiquitous sensors and micropayments could enable seamless use-based payments and other innovations in infrastructure funding.

New Approaches in Affordable housing
Advances in telepresence and self-driving vehicles, changing preferences in living patterns, cheap building technologies and emerging business models that enable space sharing could all help create new opportunities for governments to provide or enable affordable housing options at a time when incomes and government revenues could be in decline.

Small Town Urbanization
Virtual work, declining employment and incomes, shifting leisure preferences, security concerns, and reduced transportation costs could potentially result in more people in Canada choosing to live in small towns rather than large cities – with significant implications for long term infrastructure planning. This could affect current assumptions about large infrastructure deployment in urban areas and increase the risks of stranded infrastructure assets.

Cyber Security and Infrastructure
As all modern infrastructure becomes 'smart' to achieve much needed efficiencies, cyber security could become a key infrastructure challenge, with important cross-cutting implications for policy-makers across various fields including infrastructure, public and national safety, economic development and privacy.

How Horizons is Contributing to the Dialogue

A foresight study led by Policy Horizons Canada is exploring plausible futures for Canada over the next 10-15 years in the area of infrastructure.

The exercise is exploring questions such as:
• What disruptions are likely to impact our future investments in infrastructure?
• What could infrastructure requirements look like in Canada in 2030?
• What challenges and opportunities could these disruptions create for Canada?

With the active participation of experts from governmental and other organizations, the exercise is identifying the key factors driving disruptive change, exploring plausible futures in the form of scenarios, and identifying key emerging policy challenges and opportunities.

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Notes

1. Note: the focus of this study is primarily on built environment, transportation, energy and digital infrastructure. It does not include other areas that are sometimes grouped under government infrastructure spending such as Green infrastructure (e.g. waste water treatment plants), and Social infrastructure (e.g. child care and health centres, culture and recreation, and social investments in communities).
2. Policy Horizons Canada, *Canada and the Changing Nature of Work*, May 2016, http://horizons.gc.ca/sites/default/files/Publication-alt-format/2016-0265-eng.pdf.
3. Policy Horizons Canada, *Canada in a Changing Global Energy Landscape*, June 2016, http://horizons.gc.ca/sites/default/files/Publication-alt-format/2016-0266-eng_0.pdf.