Evolving infrastructure innovation

Our world will effectively be rebuilt over the next two decades, and transformative change is required in how cities are constructed, energy is generated and consumed, goods and people are transported, and how the expanding urban footprint is sustainably managed, argues **Gregory J. Smith**, chief executive of InstarAGF

INFRASTRUCTURE IS A story of evolution in response to emerging needs and shifting patterns of use, urbanisation, new technologies and climate change, and physical surroundings – all of which pose significant and costly challenges for infrastructure development and resiliency.

According to the Global Commission on the Economy and Climate, around $90 trillion of infrastructure investments will be required globally over the next 15 years, nearly twice the scale of the current stock. This means that investment in infrastructure will need to soar from $3.4 trillion annually to $6 trillion.

Meeting this need will require some old habits to be broken; namely, the tendency to build new and costly infrastructure. In many instances, retrofitting, refurbishing and reusing existing infrastructure – and making it more environmentally friendly – can be more affordable and deliver greater long-term benefits.

The adaptive reuse of our existing infrastructure is fundamentally the product of intersecting trends such as urbanisation and technology and government demand for private sector capital and expertise to address burgeoning infrastructure needs. Indeed, the infrastructure deficit we face in North America is large and growing – estimated at nearly $3.6 trillion in the US and up to C$570 billion ($449 billion; €386 billion) in Canada. This deficit is due to chronic underinvestment, but also in part to a prioritisation of new projects over care and proper maintenance for existing infrastructure, which contributes to a higher-cost, lower-return system of investment.

Fundamentally, the extent to which this decay can be reversed will depend on the ability of governments and investors to rethink how to innovate the design and delivery of our critical infrastructure. And the urgency of this crisis is such that there is neither the time nor the money to produce all the infrastructure North America needs through conventional or large-scale engineering solutions. While some new infrastructure is unquestionably required, there is a need to adapt and make smarter use of that which exists. We must also look for opportunities to embed technologies and apply other 'future-proofing' techniques to make our infrastructure more resilient, intelligent and geared towards the holistic economic, social and environmental outcomes our communities are seeking to achieve.

With the bulk of North America's infrastructure investment needs residing at the level of municipalities, universities, schools and hospitals, otherwise known as 'MUSH' institutions, the challenge of how to tackle infrastructure decline while channelling and balancing urban growth and prosperity is very much local in scope. Indeed,

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ageing or deteriorated urban infrastructure represents a significant opportunity for reinvention, reinvigoration and regeneration of community wealth and quality of life. And investing in sustainable infrastructure is the growth story of the future. For all these reasons, adaptive reuse of infrastructure is becoming a trend in and of itself.

BETTER MANAGING INFRASTRUCTURE CAPACITY

A key element of retrofitting and refurbishing infrastructure relates to incremental investments to better manage demand and enhance capacity. Much existing infrastructure, such as roads, transit and electricity generation, is designed to meet peak demand. Rather than building new infrastructure to increase capacity as demand for such services continues to grow, focusing money and strategies on smoothing out such peaks can help to get more out of existing infrastructure and improve asset utilisation rates.

Using electricity as an example, such strategies could include digital tools for customers to better manage their energy-use patterns, predictive energy monitors and pricing incentives along with an array of new technologies such as battery storage, microgrids, smart grids and analytics software that are shifting the old boundaries of the power and utilities industry. Overall, North America's electrical system is decades old and largely dependent on equipment that is reaching the end of its useful life. Such grid modernisations can preserve the safety and reliability of this infrastructure, lower costs for consumers, and ensure the system is managed more efficiently and sustainably. Earlier this year, the World Economic Forum estimated that the asset utilisation rate of the US electricity system remains below 60 percent, and that more than $2.4 trillion of value could be realised by the transformation of electricity over the next 10 years.

The Chelsea High Line: New York's innovative $270m rehabilitation project has resulted in an estimated $2bn in new economic activity and boosted the local tax base by $900m

ADVANCING ENVIRONMENTAL AND ECONOMIC SUSTAINABILITY

The adaptive reuse of existing infrastructure delivers quantifiable environmental and economic benefits. Reusing a building such as a school, for example, typically offers greater savings than demolition and new construction. According to the Preservation Green Lab of the National Trust for Historic Preservation, it can take between 10 and 80 years for a new energy-efficient building to overcome – through efficient operations – the climate-change impacts created by its construction. Most building types in different climates will require 20 to 30 years to compensate for the initial carbon footprint from construction.

Reusing existing buildings is also good for the economy and for the community: in the US, the rehabilitation of old buildings has a 30-year track record of creating 2 million jobs and generating more than $90 billion in private investment.

Sustainability also refers to improving the ability of infrastructure to withstand or adapt to climate change, whether it is floods affecting management and roads systems, degradation that threatens the integrity of building structures, more extreme weather events submerging coastlines, or the disruption of essential services.

Climate change considerations need to be integrated more deeply into infrastructure decision-making, design and maintenance, and adaptive measures established to strengthen the resiliency of existing assets. For example, the impact of Hurricane Sandy in 2012 prompted The New York City Housing Authority to think innovatively about rebuilding affected housing in a manner that enhances the physical and environmental soundness of critical infrastructure while improving the social and economic wellbeing of the community. Several of NYCHA's housing developments, many of which suffered severe flooding and were stranded for days without power, heat and hot water, now have electrical systems that are housed in elevated and flood-proofed structures. In addition, some of NYCHA's buildings will be powered by permanent, full-load generators in case of power outages.

Both the Canadian and US economies are already feeling the effects of climate change, with financial and quality-of-life impacts that are likely to grow materially over the next five to 25 years and affect the future performance of today's infrastructure investment decisions. The retrofit, refurbishment and reuse of existing infrastructure to new, higher and greener standards takes on new significance – and urgency – within this risk profile.

BRINGING INNOVATION TO OLD INFRASTRUCTURE

The adaptive reuse of existing infrastructure also helps communities to facilitate and manage the land use and resource intensification that accompanies urbanisation. The poor use of land and associated infrastructure overlay – or lack thereof – in many North American cities carries a huge economic, environmental and social cost.

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With creativity and vision, communities can turn legacy assets into infrastructure that supports innovation and growth. Some of these opportunities are predominantly social or green in scope, such as the Chelsea High Line project in New York City, which redesigned an abandoned railway and industrial site into a living system and new public space that contributes to a stronger sense of place. This $270 million rehabilitation has resulted in an estimated $2 billion in new economic activity and boosted the local tax base by approximately $900 million, while inspiring comparable reuse projects elsewhere in North America and internationally.

Other types of adaptive reuse opportunities are more hidden from view but no less important to economic development and community sustainability. In Canada, the federal government operates one of the continent's largest public sector district energy systems in Ottawa, with six central heating and cooling plants and five distribution networks servicing about 80 federal buildings and three privately owned buildings. With the assets reaching the end of their useful lives and using outdated technologies, the government is exploring partnering with the private sector to finance the modernisation and expansion of this critical district energy system, effectively turning a cost centre into an asset that drives greater electricity stability, waste reduction, climate mitigation and local jobs, while helping to stimulate Canada's clean tech sector. Notably, this project is expected to help the government meet its goal of reducing greenhouse emissions in its own operations by 40 percent by 2030.

CREATING RESILIENT URBAN ENVIRONMENTS

Infrastructure is the pivotal enabling force of any community with the power to meet the existing and future challenges presented by urbanisation, population growth, and technological and climate change. It is more than merely physical assets, encompassing both knowledge and institutions as well. This holistic quality gives infrastructure the unique ability to underpin the way a community functions, and to foster equitable, inclusive and sustainable development.

In that sense, the infrastructure we build in some ways ends up building us. The retrofitting, refurbishing and reuse of existing infrastructure delivers some very tangible outcomes: communities that are reimagined, restored, and, ultimately, reinvigorated. By that measure, the future of our cities will be defined in equal parts by what we refuse to tear down and the breadth of our vision of what it is possible to achieve. ■