

CEO'S RECOMMENDATIONS FOR ONTARIO'S 10-YEAR CAPITAL INFRASTRUCTURE PLAN

By Barry Steinberg, P.Eng., and Saskia Martini-Wong

In spring 2010, then Energy and Infrastructure Minister Brad Duguid announced he would consult various stakeholders about the province's proposed 10-year Capital Infrastructure Plan and approached Consulting Engineers of Ontario (CEO) to participate in the consultation process. CEO gladly complied, providing a detailed response supporting the government's long-term infrastructure planning objectives. CEO added that such a plan must be a "living" document—that it should be reviewed regularly and have the flexibility to respond to changing circumstances.

DEFINING INFRASTRUCTURE

In its submission, CEO separated infrastructure into two categories—core infrastructure and social infrastructure. Core infrastructure directly affects economic activity and growth and provides life essentials, such as water. Examples of core infrastructure include roads and bridges, power distribution networks,

and water mains and sewer systems. Social infrastructure, which enhances a standard of living or lifestyle, includes community centres, sports facilities and parks.

Much of the province's core infrastructure is nearing the end of its design life or in drastic need of repair and maintenance. Safe and reliable infrastructure in Ontario requires investment, but investment in new assets must be

balanced by reinvestment in Ontario's aging stock of infrastructure.

KEY AREAS OF THE PLAN

Although there will always be competing interests for public infrastructure spending, CEO recommends the province of Ontario focus on four areas of infrastructure development in its long-term infrastructure plan:

1. transportation (all modes) and public transit;
2. water conservation, treatment and re-use;
3. power transmission and distribution; and
4. health facilities.

TRANSPORTATION AND TRANSIT

"With the state of a region's infrastructure weighing more heavily on location of highly mobile business and individuals, a deteriorating capital stock will increasingly cut into gains in productivity and living standards." (*Mind the Gap: Finding the Money to Upgrade Canada's Aging Public Infrastructure*, TD Financial Group, 2004)

This means Ontario must improve and maintain its transportation corridors to and from the US and access to its north. Ontario must improve and maintain these corridors to ensure it remains competitive internationally and domestically and is able to provide a high quality of life to all its residents, regardless of where they live.

Further recommendations include the coordination of the Growth Plan for the Greater Golden Horseshoe, 2006 with the Metrolinx Regional Transportation Plan, along with the procurement by Metrolinx of all transit



vehicles for Greater Golden Horseshoe municipalities. CEO calls for transportation and public transit to account for at least 35 per cent of the 10-year infrastructure budget and strongly recommends the province continue to press Ottawa to contribute to transit funding in major urban centres.

To lessen our dependence on cars, transportation spending must also allocate resources for public transit systems. In *ReNew Ontario 2005-2010*, a \$30 billion five-year infrastructure plan, the government of Ontario and its partners committed to allocate \$11.4 billion, or 38 per cent of the \$30 billion, for transit and transportation improvements. CEO believes that Ontario should commit the same proportional level of funding for transportation and transit in its 10-year Capital Infrastructure Plan.

WATER CONSERVATION, TREATMENT AND RE-USE

CEO recommends that investment proportional to \$40 billion over 15 years should be allotted for water conservation, treatment and re-use. As well, it supports full metering of consumer water use, which would result in payment of the full cost of services consumed.

According to *Watertight: The case for change in Ontario's water and wastewater sector*, issued in 2005 by the former Ministry of Public Infrastructure Renewal, the province had an estimated \$72 billion in water and wastewater assets (\$20 billion in treatment plants and the rest in distribution and collection systems). The report indicated that over the next 15 years, an estimated \$30 billion to \$40 billion was needed for new water infrastructure investment and repair of existing systems. Approximately \$25 billion was required for capital renewal (including \$11 billion in deferred maintenance) and \$9 billion for growth.

"Without that level of investment," concludes the report, "there will be more flooding, more damage to roads, more sewage diverted to rivers and lakes during storms, and more boil-water advisories."

The case for needed investment in water and wastewater assets is further supported by a 2006 Statistics Canada study, *The Age of Public Infrastructure in Canada*. The paper reported that of the five components studied—highways and roads, bridges and overpasses, water supply systems, wastewater treatment facilities, and sanitary and storm sewers—wastewater treatment facilities across the country were on average the closest to the end of their

service life. In 2003, the average age of treatment facilities in Canada was 18.3 years, or 63 per cent of their estimated service life.

The study also found that 95 per cent of the total investment in sewer systems between 1997 and 2003 was done at the municipal level. By that time, municipal systems had reached 47 per cent of their useful life, whereas provincial systems serving rural areas had reached 71 per cent of their useful life.

Ontarians must recognize that the full cost of providing water and wastewater services is not reflected in current billing practices. As such, moderating use by implementing metering and having consumers pay a larger portion of the true costs of delivering water is required to sustain this natural resource.

POWER TRANSMISSION AND DISTRIBUTION

While the provincial consultation did not include electrical power infrastructure, CEO felt it was too important to omit. Much of the publicly owned utility equipment is nearing the end of its design life or is in drastic need of maintenance and repair. The aging utility grid is rendering many regions in Ontario vulnerable to power failure. A reliable energy delivery system in Ontario requires ongoing investment, and investment in new sources of power generation must be balanced by reinvesting in the existing transmission and distribution infrastructure.

Therefore, CEO urges the province to focus on the integrity of the transmission and distribution infrastructure through integration of the Ministry of Infrastructure's 10-year Capital Infrastructure Plan with the Ontario Power Authority's Integrated Power Systems Plan.

HEALTH FACILITIES

CEO's key recommendation in this area is to assess the procurement methods for large-scale upgrades and construction of health facilities, to ensure Ontarians receive the best care and level of service for money spent.

According to the Ontario Ministry of Health and Long-Term Care, the population of seniors is expected to double in the next 16 years. With this aging population, it is imperative the province create a long-term plan, including infrastructure requirements, that addresses projected needs. Currently, the Conference Board of Canada estimates that 41 per cent of total program spending is designated for health care, a percentage that is certain to grow as the population ages.

DATABASE OF EXISTING INVENTORY

CEO strongly urges the Ministry of Infrastructure to take the lead in developing and implementing a centralized database of all infrastructure assets, to ensure provincial funding is distributed based on need. The development of this important tool would allow the province to track assets and develop long-term sustainable solutions.

Furthermore, CEO supports provincial assistance to help municipalities develop their own asset management systems to ensure proper planning and budgeting for new infrastructure as well as renovations and repair to existing facilities.

DELIVERY, FINANCE AND MANAGEMENT

Ontario is a large, geographically diverse and socially complex jurisdiction. As a result, it requires a balanced infrastructure approach that uses the most modern delivery methods available, allows the province to maintain its knowledgeable-owner status, and ensures its continued commitment to achieving value for money.

For many years, Ontario dealt only in traditional design-bid-build approaches. Recent successes with both horizontal and vertical infrastructure projects in Ontario and across Canada have proven the value of alternative financing and procurement models, such as public-private partnerships and a variety of design-build strategies. Such approaches can deliver assets quickly, efficiently and with optimal sustainability.

CEO also encourages the Ministry of Infrastructure to look to the strategies undertaken by other ministries and jurisdictions to identify innovative project-delivery models. However, it must be stressed that determining key decision-making criteria for any mechanism is critical to success. The funding and delivery approach must match the size and type of project to which it is being applied.

CEO believes that risk and return will ultimately be the defining infrastructure issue, an area where consulting engineers possess considerable expertise. Infrastructure spending costs billions of dollars annually in Canada, and government will be at a significant disadvantage if it does not take advantage of the consulting engineering sector with its diverse experience and knowledge from working around the world.

SUMMING UP

The Ontario government must focus its 10-year Capital Infrastructure Plan on core infrastructure. The recommended areas of focus will stimulate the economy and improve the social and environmental

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quality of life for all Ontarians. The Conference Board of Canada, in its publication *Lessons From the Recession*, estimates that in an economy performing below potential, every dollar spent on infrastructure can increase real gross domestic product by as much as \$1.20.

As well, the Ontario government must recognize that as levels of immigration rise, so too will the need for new and rehabilitated core infrastructure. Without these improvements, the province will be unable to meet its goal of managing growth and development in a way that supports economic prosperity, protects the environment and promotes a high quality of life. Through the Places to Grow Initiative, a number of regional plans have been developed for areas like the Greater Golden Horseshoe and northern Ontario that will succeed only if there is adequate core infrastructure—roads, water, wastewater, along with electrical transition and distribution systems to support them.

This warning is repeated in *Public Infrastructure Underinvestment: The Risk to Canada's Economic Growth*, a 2010 study commissioned by the Residential and Civil Construction Alliance of Ontario. It recommends stable infrastructure spending to promote stronger economic growth. According to the study, the Canadian economy will lose an estimated annual average increase of 1.1 percentage points of real GDP growth over the next 50 years if underinvestment continues.

Equally, repair and maintenance are critical to core infrastructure. If they are postponed, there is a direct effect on the asset's service life. Maintenance and rehabilitation are also critical to vital infrastructure, such as sewer systems and wastewater treatment plants that are often forgotten as "out of sight, out of mind."

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While it is important for the government to plan for the long term, it is equally important to educate the public on infrastructure. Ontarians need to understand what infrastructure is and the distinction between core and social infrastructure. They must understand that while building a new community centre will certainly create jobs and provide value to communities, the current core infrastructure, including the invisible core infrastructure, should be a priority for any successful long-term infrastructure plan.

GOVERNMENT'S RESPONSE

One week after CEO submitted its recommendations to Minister Duguid, a cabinet shuffle resulted in a split of the Ministry of Energy and Infrastructure, and Bob Chiarelli was appointed the new minister of infrastructure. However, on October 25, CEO met with Stephen Young, senior policy advisor, and Paul West, chief of staff in the new ministry, to discuss CEO's recommendations.

CEO also met for 90 minutes on October 19 with Minister Chiarelli as part of the Construction and Design Alliance of Ontario (CDAO).

Summing up, CEO is confident the minister is seriously considering both CEO's and CDAO's comments and recommendations.

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Barry Steinberg, P.Eng., is president, and Saskia Martini-Wong is the manager of operations and corporate service at Consulting Engineers of Ontario.

EDUCATION KEY TO SUPPORTING FIELD OF NANOTECHNOLOGY

By Michael Benedict



John Yeow, PhD, P.Eng.

WHEN IT COMES to understanding the daunting complexities of nanotechnology, according to John Yeow, PhD, P.Eng., a general rule prevails—the more one learns, the more supportive one becomes of this cutting-edge science.

“Educating the public is extremely important,” says Yeow, a systems design engineer at the University of Waterloo and Canada research chair in micro/nano devices.

Concerned about a negative public reaction akin to the one that has scuttled some initiatives in the field of genetically modified organisms, Yeow is a proselytizer for the positives of nanotechnology. “As people become more knowledgeable, they become more supportive,” he says of his field.

Yeow brought his positive message recently to a policy engagement series luncheon sponsored by the Ontario Centre for Engineering and Public Policy.

“The public is already forming its opinion on nanotechnology,” he told some 75 senior provincial officials, academic and business people, many of them engineers.

According to a 2008 survey, about half (49 per cent) of the people who had “heard a lot” about nanotechnology believed the benefits outweighed the risks, such as the uncertainty about possible environmental damage. Just 8 per cent felt the risks outweighed the benefits, with 10 per cent “not sure.” But among those who had “heard nothing” about nanotechnology, only 8 per cent felt the benefits outweighed the risks, with 5 per cent feeling the risks outweighed the benefits and two-thirds (65 per cent) unsure.

Nanotechnology involves working with materials that are on the nano-scale—one billionth of a metre. But for Yeow, the work is defined by more than the infinitesimal size of the particles involved. “What really characterizes nanotechnology is managing the phenomena that are demonstrated at that level,” he says.

For his part, Yeow is breaking through barriers in nano-biotechnology, an emerging hybrid discipline that integrates nanotechnology with biomedical engineering. At the University of Waterloo, he’s helping to develop a miniaturized X-ray machine with carbon nano-tubes as the electron source, which could eventually replace traditional radiation therapy.

Present-day X-ray equipment delivers large doses of radiation to kill cancer cells or shrink tumours. However, the radiation often produces collateral damage as it penetrates healthy tissues to reach the cancer and can kill neighbouring healthy cells. With the miniaturized nano X-ray machine, radiation can be delivered with more precision to attack the cancer. “It will deliver the right dose to the right place,” says Yeow.

Yeow’s prototype is now being tested at the Princess Margaret Hospital in Toronto and could be in operation in several years.

For engineers, Yeow says, nanotechnology represents almost endless opportunities. “It will have an impact across the board,” he adds. “The first stage of nanotechnology was understanding material properties—that was mostly a chemistry issue. Now, the next plateau is for engineers to see what can be done with those properties.

“This is only the start,” Yeow says. “The market will be huge.”

For more information on the policy engagement series luncheons, visit members.peo.on.ca/index.cfm/ci_id/38188/la_id/1.htm.

Michael Benedict, of MCB Strategies, offers writing, editing and consulting services to not-for-profit and for-profit clients.



KEEPING DRINKING WATER SAFE AND ECONOMICALLY SUSTAINABLE

By Ketra A. Schmitt and Ryan S.D. Calder

DELIVERING POTABLE WATER to citizens is an essential role of government. In Canada, this responsibility is shared among federal, provincial and municipal governments, with a federal role that often serves in an advisory capacity. While Canadian drinking water is generally of a very high quality, emerging contaminants such as disinfection by-products and nano-materials threaten its safety. Historically, federal and provincial water policies have been reactive, responding in a piecemeal way to emerging threats and scientific advances. The Canadian Federal Water Policy calls for more anticipatory, comprehensive and efficient water policy (Environment Canada, 1987), but this has largely failed to happen. With a few tragic exceptions, current Canadian water policy does deliver safe water to the public. However, the slow reaction time and lack of legal force behind drinking water guidelines at the federal level may leave Canadian water supplies vulnerable to emerging contaminants.

Canada has 9 per cent (Environment Canada, 1987) of the world’s fresh water, but the more appropriate figure to consider is Canada’s level of renewable supply, which is about 6.5 per cent of the world’s supply. Since only 40 per cent of this water is accessible to population centres, the actual amount of water available to Canadians is 2.6 per cent of the world’s supply (Sprague,

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2006). Canada does have enough water, but the popular perception of its water wealth is overblown and dangerous for policy considerations. Still, the biggest issue facing Canadian water supply is quality, not quantity. In this regard, Canada faces the same drinking water challenge as much of the developed world: Can the technology that is increasing the number of potential drinking water contaminants keep pace with our ability to detect and remove them?

At the same time that technological advances cause potential complications, science and water policy coexist in an important feedback loop. A change in our understanding of a contaminant's toxicity or an increased ability to detect a contaminant at low levels often leads to a drinking water policy response. Drinking water policies and regulators play a leading role in setting scientific research priorities. As each side is spurred on by the other, the landscape of drinking water policy and science grows more complex and more costly. This approach has mostly worked for us so far; our water is generally safe, and water treatment costs are not yet overwhelming municipal budgets. Unfortunately, the rate of change in emerging contaminants and increasing toxicological knowledge (and the need for subsequent research) means that our current approach is unlikely to continue to keep us safe at a reasonable cost.

Take for example perchlorate, a widely dispersed contaminant with a clear toxicological effect, but not a clear safe dose. Lower detection limits allowed the extent of contamination to be realized and created a research need for identifying health effects at lower exposure levels. While Health Canada's more flexible regulatory guideline system has allowed a guideline to be produced for perchlorate, the US Environmental Protection Agency (EPA) has been mired in both scientific and political controversy and eventually decided not to issue a drinking water rule. Much of the debate on perchlorate could have been circumvented by structuring a forward-looking science policy approach focused on identifying potential contaminants and responding to those threats quickly. Without consideration of the interaction of science and policy—treating them as a unit in an explicitly identified regulatory framework—we will be stuck in this pattern, unable to move forward with a rational, predictive drinking water policy.

DRINKING WATER LANDSCAPE

The current water delivery paradigm consists of underground pipes providing highly purified potable water, of which just 5 per cent is consumed by humans (Natural Resources Canada, 2009). While roughly half of municipal water is used in homes, the top residential water uses are bathing, toilets and laundry (Environment Canada, 2001). Only 10 per cent is used for cooking, and even less is consumed.

Water distribution infrastructure stretches back to the early 1800s. While components have been updated throughout the intervening 200 years, water's physical delivery has remained the same, leading to corrosion, water loss, contaminant leakage into the environment and, with chlorination technology, the inclusion of disinfection by-products. While the advent of hygienic public water supplies is universally hailed as one of the modern miracles of public health, delivery of high-quality water supplies via a system of underground pipes might not be the obvious choice if water systems were introduced today, particularly in view of the popularity of alternative water-supply systems, such as bottled water, home water purification systems, rainwater catchment systems, and grey

water re-use systems. New delivery systems may also include distributed water treatment systems, desalination systems, or point-of-use water treatment, thereby avoiding potential post-treatment contamination.

The fact that traditional systems continue to be built even in new developments may have more to do with the concept of infrastructure as destiny. In other words, some large-scale infrastructure choices have permanent impacts on communities, spaces and technology.

In 1987, the federal government created a water policy designed to safeguard water resources of all kinds. The new policy highlighted the need for increased coordination and co-operation with the provinces, the need for considering the life cycle of potential contaminants, as well as the need for water policy to be effective, efficient and anticipatory, rather than reactive to emerging threats. Fifteen years later, Quebec developed its own policy, echoing the need for co-operation with neighbouring states and provinces, as well as the need to implement the precautionary principle in dealing with emerging water threats (Government of Quebec, 2002).

More recently, Ontario's *Water Opportunities and Water Conservation Act, 2010* specifically addresses the need for innovative solutions to water issues in the province.

Canadian drinking water policy is unique among most of the industrialized world in that the federal government has no legal power to enforce water contaminant limits. Thus, Canada's water policy has been augmented by provincial water policies.

Current strategies to address issues of drinking water quality and availability include adapting new treatment technologies as well as new approaches to policy and delivery. Policy solutions include adopting the precautionary principle, such as the European Union's Regulation for Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), which requires that chemicals be proven safe before use. Chemical alternatives analysis uses a decision-making framework and focuses on products throughout their life cycle, forcing end-users to evaluate multiple input needs and trade-offs associated with those choices. In contrast, the US EPA employs the more traditional "safe until proven otherwise" approach.

Available treatment technologies vary widely in cost and level of cleanliness delivered. Each, from basic filtration, flocculation and chlorination technologies, to sophisticated reverse osmosis and ultraviolet (UV) light treatment, has

specific risks and benefits. For example, chlorination technologies are cost-effective and widely used, but disinfection by-products impose risks on users. UV and reverse osmosis methods deliver highly purified water free of by-products (at a high cost), but do not provide resistance to post-treatment contamination.

POLICY AND TOXICOLOGY BACKGROUND

What drives water policy regulation? Is there likely to be more and more regulation as science advances? If so, is the current method of supplying drinking water the most economical, long-term approach? While actors in both drinking water science and drinking water policy study and react to the other in the context of a conventional water distribution infrastructure, there has been very little study of the overall landscape, implications for the future, or alternatives to the current infrastructure-oriented model. Substantial investments in public drinking water quality when only a tiny portion of that water is used for human consumption may be an indicator that our infrastructure-oriented approach is not in our long-term best interests.

Current water policies derive from the ad hoc relationship between drinking water science and specific measures to keep water safe. They are the result of discrete public health discoveries and the ensuing patchwork of policy fixes. The current scientific and regulatory landscape has thus been carved out in a piecemeal way with little effort at predicting costs and benefits beyond the horizon of a particular issue. Furthermore, substantial lags exist between the discovery of new water quality challenges and appropriate policy responses, for example, in addressing disinfection by-products, chemical mixtures and nano-materials. And technology-based responses tend to default to the existing water distribution infrastructure, missing creative opportunities for improving overall efficacy and efficiency.

A technology policy perspective can make for better drinking water policy through an improved understanding of the drivers and outcomes of regulatory change. In particular, such an approach can help us understand how different regulatory constructs respond to emerging drinking water challenges and assess the efficacy and efficiency of current water distribution technology alternatives. The results can help policy-makers adopt more effective and efficient drinking water policy.

Insights into the regulatory drivers of such policies are crucial to understanding the cur-

rent regulatory framework and how it deals with unanticipated challenges. Only then can it be compared with alternative water delivery and regulatory systems to predict their success. While alternative water delivery systems are often viewed as solutions for low water-availability issues, they need to be considered as potential solutions for reducing drinking water costs and risks in conventional settings as well. An ability to expect the unexpected will be the defining characteristic of a successful holistic and predictive scientific-regulatory framework for drinking water.

Significant academic and government resources have been devoted to creating and evaluating the impacts of individual water regulations. Conversely, little research exists to assess the drivers and outcomes of water quality regulations as a whole. A look back at the environmental movement demonstrates that it has succeeded in triggering new regulations over time, but the specific determinants of environmental regulation have not been widely treated as an academic subject and, as such, are not well understood.

Further, we don't understand with any certainty how these regulations actually protect public health, due to the lack of information about contaminant toxicity at very low doses. An increased understanding of the public health benefits of advances in detection and treatment technology can help regulatory decision-making become more responsive to emerging threats.

Our understanding of the toxicology of drinking water contaminants is in rapid evolution. Identification of new exposure pathways and the increased ability to detect contaminants at low levels can lead to new regulations. Take the case of arsenic, whose safe regulatory level in Canada and the US as a result of new testing was lowered in 2006 to 10 micrograms/litre from 50 micrograms/litre (Health Canada, 2010; EPA, 2001).

Emerging contaminants can be defined as "chemicals or materials that have evolving science (e.g. beryllium); new or unknown exposure pathways (e.g. trichloroethylene and nano-materials); and new detection capabilities (e.g. perchlorate) that can be reasonably anticipated to lead to regulatory changes" (Cunniff and Asiello, 2009). Other definitions of emerging contaminants exist, but there has been little research to determine what drives regulatory action. Much of the existing literature focuses on the role of quantitative risk assessment (Cothorn and Marcus, 1984).

However, statistical analysis has been used in reviewing EPA decision-making in pesticide regulation and corporate influence through comments on proposed new administrative rules. For our part, we have begun to examine the drivers of regulatory change by evaluating the role of detection ability in prompting new drinking-water regulations (Calder and Schmitt, 2010). We are also in the process of assessing the regulatory significance of uncertainty in the toxicological model (our knowledge of the dose-response relationship between exposure and disease based on animal studies) in cancer estimates. We hypothesize that model uncertainty may play a large role in determining the regulatory level for contaminants in opposite ways, by leading to more stringent standards and by delaying the decision to regulate. Other important drivers of drinking water policy include: comprehensive approaches in which emerging issues are treated as a connected system, as called for in Canada's water policy; life cycle-based approaches that evaluate a product's potential environmental and human health, as well as social and

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economic impacts throughout their life cycle; the precautionary principle, which requires that products are proven safe, rather than waiting for products to be demonstrated to be unsafe; anticipatory approaches that seek to identify and appropriately address emerging issues before problems become entrenched; and the polluter pays principle, which shifts the burden of environmental damage onto polluters.

Clearly, understanding these drivers is the first step to ensuring that contaminants are being regulated to the appropriate level. This is crucial to good governance—excessive regulation causes an unnecessary burden on industry, while insufficient regulation can cause human health and environmental harm. Once we understand what drives regulation, we can consider the impacts of regulation and begin crafting better drinking water policies.

CHOOSING THE RIGHT TOOLKIT

Existing policies can only be improved once we understand the impact of the current policy landscape. Evaluating the impacts of a regulatory and infrastructure system as pervasive as drinking water delivery requires robust and flexible methodologies. Cost-benefit analysis is one such analytical technique, widely used in fields as disparate as health-care delivery, education and transportation. Broad analyses and frameworks exist for establishing the costs and benefits of large-scale water systems, sanitation projects, and source water delivery (Baffoe-Bonnie, 2007; Hutton et al., 2007). Regulatory impact assessment determines how well regulations do the job they were designed to do. We are currently addressing the impact of regulatory structure by developing a comparative study of water regulations in Canada and other nations, assessing the risks and benefits in sub-national regulation.

More than the right methodology is necessary to develop an effective anticipatory policy solution. A water delivery framework and a realistic understanding of human behaviour are also required.

Drinking water clearly requires both a solid scientific understanding of water delivery as a system and social science training in policy and human behaviour.

SPECIFIC RESEARCH RECOMMENDATIONS

Addressing Canada's drinking water delivery first requires a theoretical understanding of the water regulatory system as it pertains to water quality and distribution. That understanding is needed to develop an anticipatory framework to better address new regulatory challenges in a more comprehensive manner. Such a new framework requires a coherent set of measures to assess regulatory and water delivery systems and that these measures be tested against existing and novel water distribution systems. Specifically, research is needed to:

1. identify the drivers of drinking water regulation and characterize how they influence drinking water policy;
2. evaluate the outcomes of different regulatory constructs for influencing drinking water quality and distribution; and
3. assess and recommend technology policy scenarios for successful delivery of drinking water, where success is measured in effectiveness, efficiency and adaptability.

With a few exceptions, Canadian water delivery systems work well, delivering high-quality water to the vast majority of citizens. While the current

regulatory and infrastructure framework is successful, advances in science and technology are already beginning to alter this reality, both by making us more aware of (and able to remove) existing water contaminants and by contributing to increased and more sophisticated contaminants. Our current infrastructure and regulatory approach cannot serve our drinking water needs forever. Our increasing ability to identify, understand and treat emerging contaminants will necessarily lead to increased water treatment cost in the short run. In the long run, it is not clear that our current infrastructure approach can provide water that satisfies the public's desire for quality. Σ

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Ketra Schmitt is an assistant professor in the Centre for Technology, Innovation and Society (general studies unit) of Concordia University's engineering and computer science department. Ryan Calder is a graduate student in the department of building, civil and environmental engineering at Concordia University.