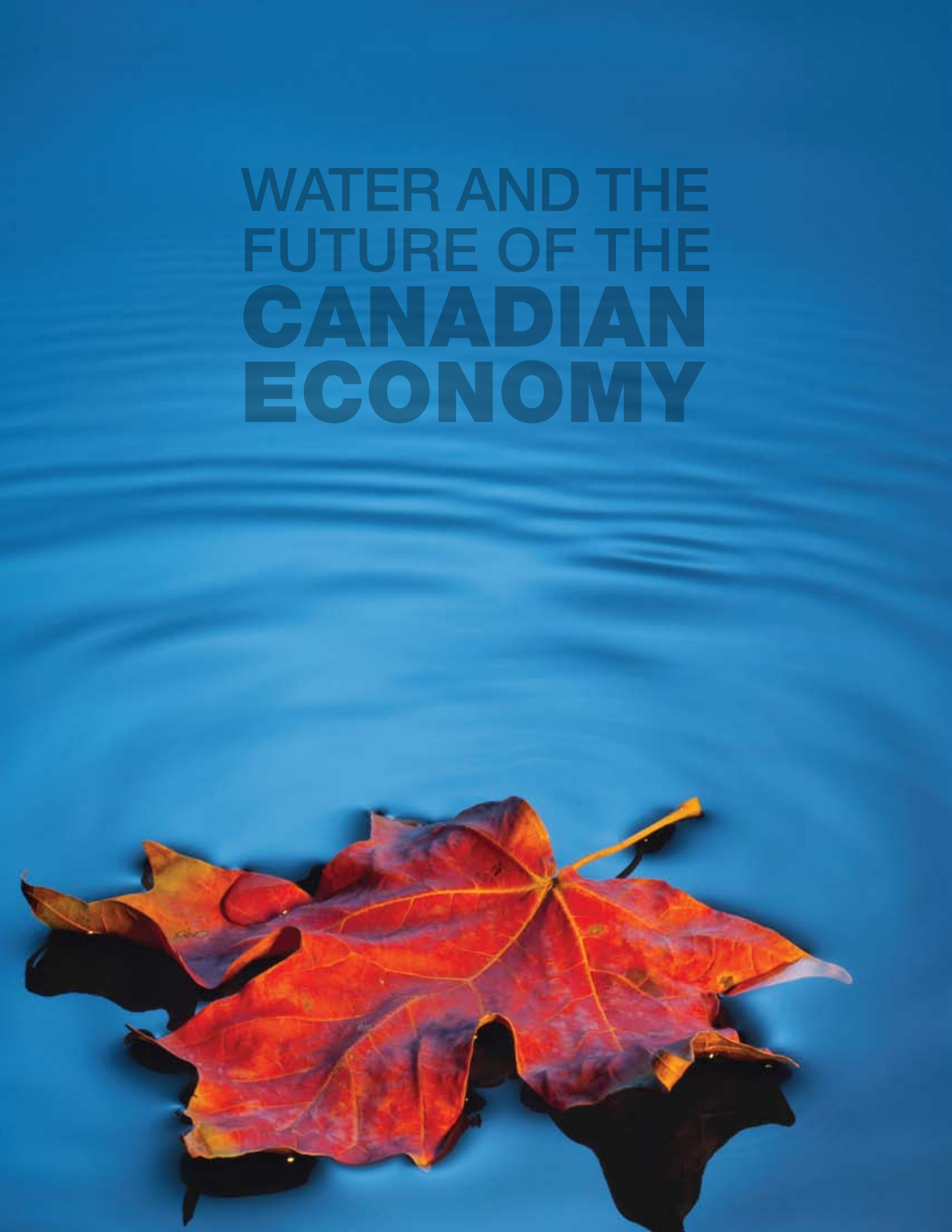
WATER AND THE FUTURE OF THE CANADIAN ECONOMY



Water and the Future of the Canadian Economy

Welcome message: The Innovolve Group Inc.

Anthony M. Watanabe, Ph.D.
President & CEO
The Innovolve Group Inc.

Following on the heels of the inaugural Canadian Water Summit, held on June 17, 2010 in Toronto, I am pleased to present *Water and the Future of the Canadian Economy*. More than a recap of Summit discussions, this report is designed to establish a series of direct and indisputable links between water and Canada's productivity, competitiveness and, ultimately, our prosperity in this century and beyond.

For the reader who has already spent years working to valorize water, you may recognize some of your efforts in this document. As a society, we have long known why this natural wonder is precious from an environmental perspective, although our pricing mechanisms and behaviour often tell a different story. With this report, we have endeavored to demonstrate why this most valuable resource should also be considered through an economic lens. Indeed, such use of market mechanisms to drive environmental progress speaks to the very ethos of The Innovolve Group since our inception.

As always, no analysis of such a complex issue can ever pretend to be exhaustive, nor should it be static. The purpose, on the contrary, is to incite dialogue – dialogue which is dynamic in its process and meaningful in its impact. As such, not only do we welcome your feedback on this study, but we have built in opportunities for you to share it, both through our cross-Canada Roadshow in the Fall of 2010 and the next Canadian Water Summit in the Spring of 2011.

Let the conversation continue.

Industry perspective: RBC

RBC Blue Water Project™

As the presenting sponsor of the inaugural Canadian Water Summit, RBC is pleased to continue our involvement by supporting the production of this Report, *Water and the Future of the Canadian Economy*. We view both the Summit and Report as critical inputs to an important dialogue about the contribution water makes to Canada's prosperity.

Even though Canada is considered a water-rich nation, we're not immune to impacts of the water challenges being experienced both here and elsewhere in the world. Since launching the RBC Blue Water Project in 2007, we have learned that Canadians tend to be unaware of, or undervalue the worth of water. We're doing our part to try to help change that.

As a financial services company, we see both risk and opportunity in water. We need to understand when and how our clients' businesses might be constrained by water issues, in sectors such as food and beverage, manufacturing, utilities and power-generation. We also anticipate that consumers, industry and governments will become more interested in water efficiency, especially as energy costs continue to rise, and as a result we expect to see exciting business opportunities for Canadian companies in the water-tech sector.

Since 2007, through the RBC Blue Water Project, we've pledged over $24 million to more than 285 organizations worldwide that protect watersheds and provide or ensure access to clean drinking water. We are committed to promoting responsible water use with our employees and clients through education and awareness programs; and we anticipate the growth of North American businesses that develop and commercialize innovative solutions to the water issues facing the world.

We enjoyed connecting with you at the Summit, and look forward to seeing you again next year.

Shari Austin
Vice President, Corporate Citizenship
RBC

Industry perspective: Molson Coors

Molson Coors has over 200 years of brewing heritage in Canada, beginning when John Molson built his brewery on the banks of the St. Lawrence River in Montreal. The location was chosen largely due to the availability of a reliable fresh water source. Our reliance on and respect for water persists across Molson Coors' global breweries today – remaining a core driver of business strategy and employee and community outreach.

In addition to recognizing that water can have direct and indirect impacts on businesses and their broader supply chains, Molson Coors also believes that Canada has the potential to become a global water leader and can attract businesses on the merits of water availability, supportive infrastructure and sound integrated stakeholder engagement.

In addition to supporting the inaugural Canadian Water Summit, Molson Coors is a leading sponsor and endorser of such water stewardship initiatives as the 2009 Circle of Blue/Globescan Survey, which confirmed that water is the number one environmental concern globally among the public. Molson Coors is also a signatory and endorser of the United Nations Global Compact's CEO Water Mandate, a lead sponsor and signatory of the Carbon Disclosure Project's Water Disclosure Initiative, and is heavily engaged with the Beverage Industry Environmental Roundtable that is bringing together leading global beverage companies to define a common framework for stewardship, drive continuous improvement across the industry, and inform public policy.

The need for fresh and sustainable water will be one of the major drivers in the future of local and global economies, where wisdom, diligence and leadership from a diverse group of stakeholders will be required to sustain the needs of communities around the world. Like many of the voices captured in this report, we at Molson Coors are actively participating and seeking partners in this journey.

Michael Glade

Director, Water Resources and Real Estate
Molson Coors
Brewing Company

Industry perspective: Veolia Water Solutions & Technologies

Klaus Andersen

Senior Executive Vice President and Chief Operating Officer
Veolia Water Solutions
& Technologies

Veolia Water Solutions & Technologies (VWS) is responding to the growing demand for environmentally conscious and innovative water technologies and solutions that meet the diverse needs of both industry and municipalities. With rich perspective on the resource efficiency and sustainability pressures driving Canada's diverse economic actors, VWS is committed to staying at the leading edge of sustainable offerings.

Veolia's integrated water solutions include resource-efficient technology to improve operations, reduce costs, decrease dependency on limited resources, and comply with current and anticipated regulations. Today, internal efforts such as our carbon footprint reduction program are helping to drive innovation and accelerate the development of clean technologies for water treatment. Anticipating future needs, Veolia's R&D efforts are geared towards delivering neutral or positive energy solutions, and migrating toward green chemicals and water-footprint-efficient technologies with high recovery rates.

With more than 60 years of presence in Canada, VWS is committed to preserving and enhancing Canadian water resources by developing innovative, environmentally conscious water technologies and solutions. Veolia Water Solutions & Technologies will continue to maximize financial benefits for our customers worldwide, while contributing to the broader mission of positioning Canada for water leadership outlined in this report.

Independent advisor perspective: NRTEE

National Round Table on the Environment and the Economy | Table ronde nationale sur l'environnement et l'économie

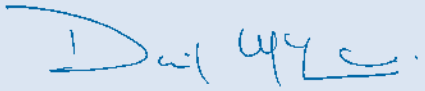
David McLaughlin

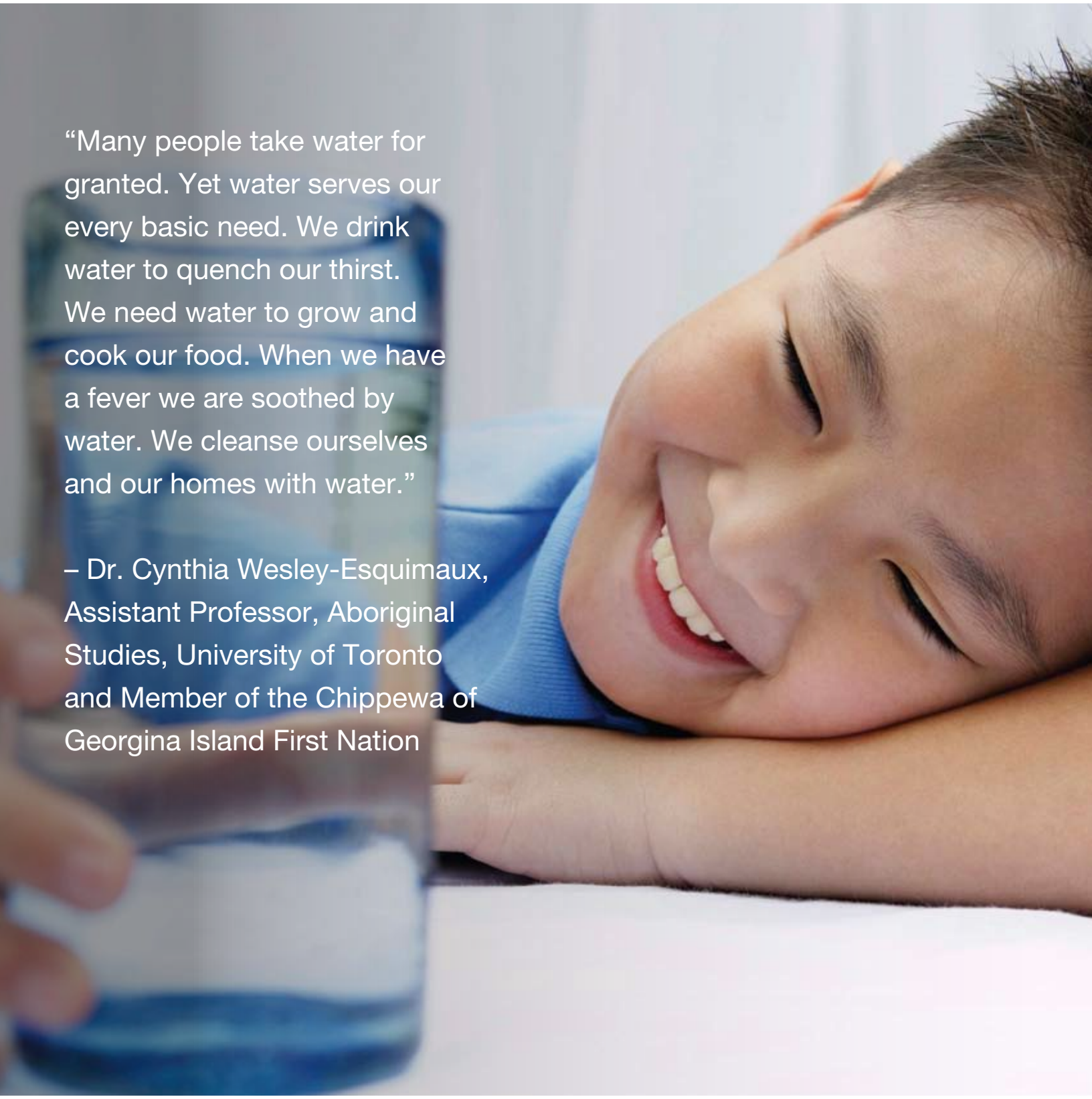
President and CEO
National Roundtable on the Environment and the Economy

As a sponsor of the Canadian Water Summit, the National Round Table on the Environment and the Economy (NRTEE) is proud to have launched "*Changing Currents: Water Sustainability and the Future of Canada's Natural Resource Sectors*" at this inaugural event. Changing Currents is the result of more than a year of research and engagement with the country's foremost experts on water management and policy, and collaboration with key industry representatives and associations. So it is fitting that we share our findings at an event which brought together many of the country's leading water practitioners and innovators.

The NRTEE believes that water will continue to have critical implications for Canada's prosperity, as well as for the operation and growth of the natural resource sectors. The anticipated growth of the sectors will also likely heighten existing pressures on water availability and quality. In the absence of accurate, comprehensive, and integrated water use data and information, we are ill-equipped to make decisions about water use and policy implementation to the benefit of the environment and the economy. And while water governance is central to the solutions required, Canada must improve the current approach to reflect present and future realities of greater uncertainty due to climate change, competing uses and our knowledge of ecosystem requirements.

Over the next year, the NRTEE will continue to provide insight and policy advice to governments on a concerted, strategic approach to water governance and management. Building on the partnerships fostered through our work, we will continue to underpin the economic importance of water to the agriculture, forestry, mining, and energy sectors. Our second report will provide recommendations to governments on the transition needed to achieve effective, efficient and equitable water use by the natural resource sectors. The foundations of this transition will be in improved approaches to water allocation, policy instruments, governance mechanisms, and water use information.





"Many people take water for granted. Yet water serves our every basic need. We drink water to quench our thirst. We need water to grow and cook our food. When we have a fever we are soothed by water. We cleanse ourselves and our homes with water."

– Dr. Cynthia Wesley-Esquimaux, Assistant Professor, Aboriginal Studies, University of Toronto and Member of the Chippewa of Georgina Island First Nation

Executive summary

Making the most out of our liquid assets

New supply and demand issues are giving rise to heightened awareness of the 'water economy.' This report attempts to stimulate and clarify conversations around critical intersections between water and the Canadian economy – areas that demand proactive management in order to minimize our exposure to water risks while seizing opportunities in the burgeoning water sector. By consolidating the ideas of leading thinkers across diverse areas of water research, the Report aims to:

1. Build understanding around the central role water plays throughout the Canadian economy, with a view to improving how management of this vital resource can enhance national productivity and competitiveness;

2. Bridge the gap between research, policy and management practices to help diverse economic actors find a common platform for collaboration; and,

3. Highlight strategic areas where creative, proactive intervention can position Canada as a progressive and influential voice for addressing water issues within and outside our borders.

Managing supply and demand

Managing the appropriate use, long-term availability, and the equitable distribution of water is emerging as a major political and economic theme. Several drivers have been cited as key contributors to water stress, including population growth, intensified agriculture and natural resource use, urbanization impacts, industrial growth, infrastructure needs, and climate change impacts. Given the complex interaction between social, economic and environmental factors underlying water issues, scarcity is more often caused by the nature of demand and/or the inappropriate allocation of water, rather than by total availability alone. This suggests that water scarcity may be more akin to a governance failure than a pure resource crisis, implying that such crisis can be resolved through better management, stronger governance and smarter financial investiture.

Satisfying our thirst

Water permeates the entire Canadian economy, whether used for generating electricity, raising crops, developing the oil sands, producing forest products, or manufacturing consumer goods. As such, the concept of water risk – both direct and indirect – applies to all government, industry and business stakeholders. Companies in sectors such as food and beverage or water-intensive manufacturing face direct challenges with respect to sourcing water of sufficient quality and quantity. Other sectors are indirectly affected. In the financial services sector, for example, firms are beginning to pay closer attention to how clients manage their own water risks.

Water risks also go hand in hand with energy challenges – at times producing unintended consequences owed to the complex relationship between water, energy and climate change. The positive underlying story is that, generally, management or technology improvements to water productivity or efficiency can cut across all industry and commercial value chains. These can include improvements in agricultural practices (such as less water intensive crops, automated irrigation and crop yield enhancing technologies), industrial practices (for example, optimizing inputs for power production and other heavy water use industrial processes), or municipal/domestic infrastructure (as in appropriate price signals and fee structures, or improved water treatment and distribution productivity). As part of Canada's adaptation to our new water reality, concepts such as the 'water-energy nexus,' 'virtual water' and 'water footprinting' are emerging as planning considerations for a diverse range of stakeholders.

Canada's water management web

While business will play a primary role in defining water management practices, government is ultimately responsible for establishing the frameworks that will enable optimal water management practices to blossom. The varying water allocation frameworks currently in place across the country often present unclear priorities for allocation and use, demonstrate rigidity in the face of uncertainty and change, and provide limited support for water conservation and efficiency.

Furthermore, factors such as the structure of municipal funding, cost of running and maintaining facilities, and increasing urbanization across Canada are exacerbating underlying problems. As management complexity increases and the demand for water becomes more urgent, clarity over allocations and the flexibility to accommodate change and shifting priorities will become paramount. Such a view toward planning and decision-making can result in exciting opportunities for collaboration between government, industry and communities – a movement that is already afoot in several provinces.

Meeting the market through Canadian water innovation

Today's water industry includes the full continuum of companies involved in enabling conveyance, collection, distribution, treatment, disposal, and increasingly, reuse of water resources. Currently valued at US$400 billion and projected to reach approximately US$1 trillion in ten years, the global water industry presents significant opportunities for Canadian companies. Canadian water sector firms maintain a technical lead in such areas as purification, membranes and hydrogeology, and have substantial expertise in traditional water services like consulting, engineering, quality analysis and construction. Such expertise can find a home in familiar export markets such as the United States – the world's largest market for water treatment equipment – as well as in fast-growing economies in Asia and Latin America, where daunting infrastructure needs are demanding innovative solutions.

To take advantage of these opportunities, Canada must overcome challenges with respect to commercial scale, regional intelligence and market access. Whether firms scale up to provide complete solutions or take a 'global value chain' approach toward inserting themselves into the broader supply chain of larger companies or government buyers, greater attention is required among policymakers, businesses and investors to ensure Canadian enterprises can participate meaningfully in the global marketplace.

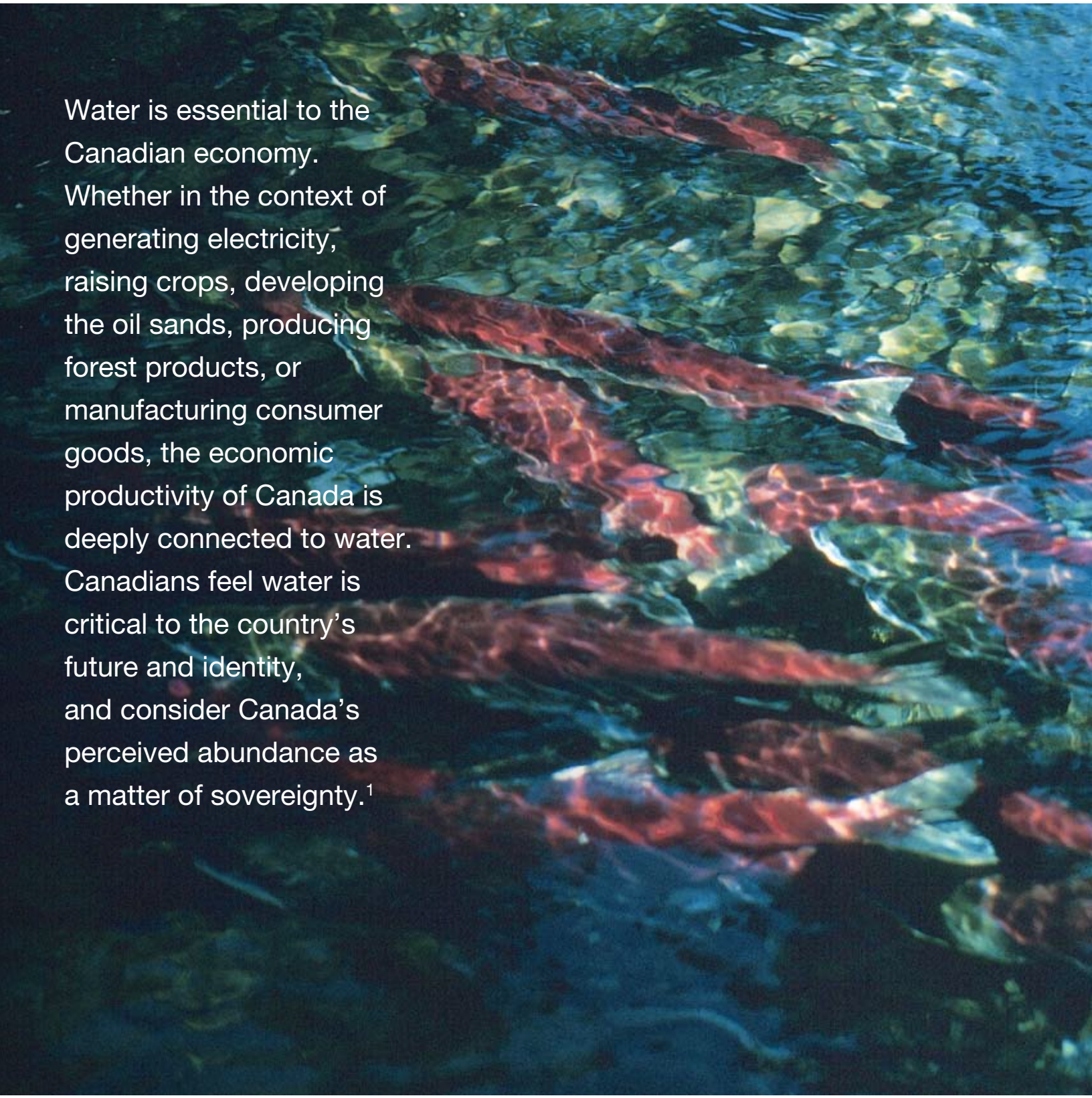
Designing our water future

Our global inter-dependency means that within a generation Canadians could be exposed to significant domestic and international water threats. Diverse stakeholders are growing aware of their shared exposure to water risk, whether surfacing through physical risk to business operations from supply losses or pollution, increased expenditure on energy to secure water for citizens, or losses from sub-optimal water distribution networks. Fortunately, the realization that water sustainability is often more a question of mismanagement than absolute scarcity suggests that informed, corrective measures can be effectively employed to avert water crisis.

Canada has the innovation track record and technical capacity to become an effective force for change, and there is growing recognition that a purposeful approach to harnessing our water assets can create both immediate and long-term benefits for the economy. Targeting improved water management in key industrial sectors and urban centres will not only boost national productivity, but also sprout technologies and business models that are better able to compete for high value opportunities in the global water market. Ultimately, success will be measured by whether Canada can assemble a healthy 'ecosystem' of policies and activities to meet opportunities along the entire water value chain. Such an ecosystem will need to encompass improved regulatory frameworks, effective information flows and incentives, better reporting standards, strong demonstration projects, successful patents, and new collaborative business models.

In attempting to clarify and stimulate conversation around critical intersections between water and the Canadian economy, we invite readers to continue exploring collaborative approaches toward mobilizing our entrepreneurial, political and societal energy around a vision for Canada that enhances our productivity, competitiveness and influence over water resiliency around the globe.

Aerial view of water impoundment in Canada (Jupiterimages)



Water is essential to the Canadian economy. Whether in the context of generating electricity, raising crops, developing the oil sands, producing forest products, or manufacturing consumer goods, the economic productivity of Canada is deeply connected to water. Canadians feel water is critical to the country's future and identity, and consider Canada's perceived abundance as a matter of sovereignty.[1]

Sockeye salmon in the Adams River, British Columbia, Canada (© Getty Images)

Below the surface

Making the most out of our liquid assets

Canada has plentiful freshwater, long coastlines, and large energy resources, however, there is some question – and increasingly, concern – as to whether our prolific use of water is sustainable. In the language of economics, some have argued that we have reached a point where we are 'drawing down the capital of our water assets, versus simply living off the interest.'[2] New supply and demand issues are giving rise to heightened awareness of the 'water economy,' as well as presenting corresponding responsibilities and opportunities to meet international water pressures that could threaten our integrated global economy.

In Canada, our water dialogue is punctuated by apprehension with current regimes surrounding water management, concerns around the lack of information needed to adequately manage and monitor resources, and debate with respect to the judicial allocation of water for society, industry, and ecosystems.[3] Climate change adds further complexity, as ensuing shifts in weather patterns may mean that prevailing assumptions about water flows currently governing policy and planning approaches are becoming increasingly less relevant.[4]

In this report, we have attempted to consolidate the ideas of leading thinkers across diverse areas of research, reframing salient themes most relevant to business, planning and policy actors who will ultimately be charged with managing the complex relationship between water and the Canadian economy. The Report aims to:

1. Build understanding around the central role water plays throughout the Canadian economy, with a view to improving how management of this vital resource can enhance national productivity and competitiveness;

2. Bridge the gap between research, policy and management practices to help diverse economic actors find a common platform for collaboration; and,

3. Highlight strategic areas where creative, proactive intervention can position Canada as a progressive and influential voice for addressing water issues within and outside our borders.

These aspects are to be explored with the understanding that ecosystem consideration is an important foundation for water sustainability. Freshwater, after all, plays an integral role in providing essential ecosystem services for civilization, such as drinking water, recreation and nutrient cycling.

Canada's water balance sheet

Water permeates across our economy: at times directly and at times indirectly. While not meant to be an exhaustive inventory, looking at key aspects of our 'water reality' through the lens of financial 'assets' and 'liabilities' can help frame the complex relationship we have with water, as well as highlight the many responsibilities and opportunities that flow from how we choose to manage this precious resource.

** Amounts in this report are presented in Canadian dollars unless otherwise stated.*

assets as·set ***n.*** Tangible or intangible economic resources that are capable of being owned or controlled to produce value and that is held to have positive economic value.

Assets

Cash and cash equivalents

- **> $1 billion** – the combined acquisition price for two world-class Canadian water technology companies – ZENON Environmental (acquired by General Electric for $760 million) and Trojan Technologies (acquired by Danaher for $246 million)
- **$7.5-$23 billion** – Water's measurable contribution to the Canadian economy annually, as estimated by Environment Canada
- **> US$1 trillion** – value that the global water industry is projected to reach by 2020 – an industry already valued at US$400 billion annually today, as estimated by LUX Research

Inventories

- **9%** – Canada's approximate share of the world's renewable water supply, as estimated by Environment Canada
- **891,863 km²** – amount of space (about 9% of Canada's total area) covered by the nation's freshwater lakes, ponds and rivers, as estimated by Natural Resources Canada

Property, plant and equipment

- **> 4,000** – the number of municipal water treatment plants that treat drinking water taken from lakes, rivers and groundwater sources in Canada
- **570 facilities**, **3 million people** – the scope of the Ontario Clean Water Agency (OCWA) – one of the largest individual operators of water and wastewater facilities in North America

Intangible assets

- **19 years** – the average age of cleantech companies in Quebec (Canada's national average is 14 years), which in addition to having a mature cleantech industry is home to more water companies than any other province[5]
- **19** – the number of water-related organizations including universities, research centres and national water institutes in Ontario alone, providing a foundation for a broad range of leading water expertise[6]
- **#1** – Canada's rank for having the soundest financial system according to the World Economic Forum – four Canadian banks now rank among the Top 10 largest banks in North America by market value
- **30** - the number of portfolio companies being supported by specialized Canadian water investors, XPV Capital Corporation and Emerald Technology Ventures as of October 2010

Investments

- **> $52M** – the amount Sustainable Development Technology Canada (SDTC) has invested in clean water, which has leveraged additional funds of $142M[7]
- **"British Columbia Water Act"** – the new Act that is seeing British Columbia strengthen its commitment to protect stream health and aquatic environments, improve water governance arrangements, introduce more flexibility and efficiency in the water allocation system, and regulate ground water use in priority areas[8]
- **"Bill 72"** – the official name of Ontario's Water Opportunities and Water Conservation Act, which provides a world-class platform to promote the development and sales of new technologies and services for water conservation and treatment

liabilities li·a·bil·i·ty *n. pl.* An obligation of an entity arising from past transactions or events, the settlement of which may result in the transfer or use of assets, provision of services or other yielding of economic benefits in the future.

Liabilities

Accounts payable

- **$18.2 billion** – the estimated cumulative drop in GDP from six major Canadian droughts between 1984-2002, according to Environment Canada and Natural Resources Canada
- **20%** – the percentage of all municipal drinking water lost to leaks, as reported by the Federation of Canadian Municipalities

Current liabilities

- **BC's Okanagan Valley and Southern Alberta, Saskatchewan and Manitoba** – farming-intensive regions where water supply and/or quality problems are being reported by community leaders, according to Agriculture and Agri-Food Canada
- **Approx. 50%** – according to the Insurance Bureau of Canada, the share of homeowner claims related to water damage (from infrastructure, extreme weather, appliance failure etc.), overtaking fire as the leading cause of losses

Long-term liabilities

- **$80-$90 billion** – the estimated cost to upgrade Canada's water infrastructure over a ten-year period, as reported by Infrastructure Canada in 2004
- **2 out of 3** – the share of the world's countries that could be 'water-stressed' by 2025, according to the United Nations

Contingent liabilities

- **15th out of 16** – Canada's rank among 16 peer countries according to a Conference Board of Canada study which shows Canada's water consumption to be more than double its peer average
- **50%** – the amount that domestic water consumption can increase during the summer months when people water their lawns and gardens, according to Environment Canada[9]
- **3.25 billion litres per day** – the amount of untreated sewage dumped into our waters by 21 cities across the country, as reported by the Sierra Legal Defence Fund

Mega trends shaping the water dialogue

Around the world, managing the appropriate use, long-term availability, and the equitable distribution of water is emerging as a major political and economic theme. Several trends have been cited as factors that both frame and compound current questions in water management, including:

Population growth and water needs. By 2020, the UN estimates that water use will need to increase by 40% to support the food requirements of 7.5 billion people.[10] Population growth is largely occurring in regions with precarious water resources and by 2025, 80% of the world's population is expected to be living in dry, or drought-prone, regions.[11]

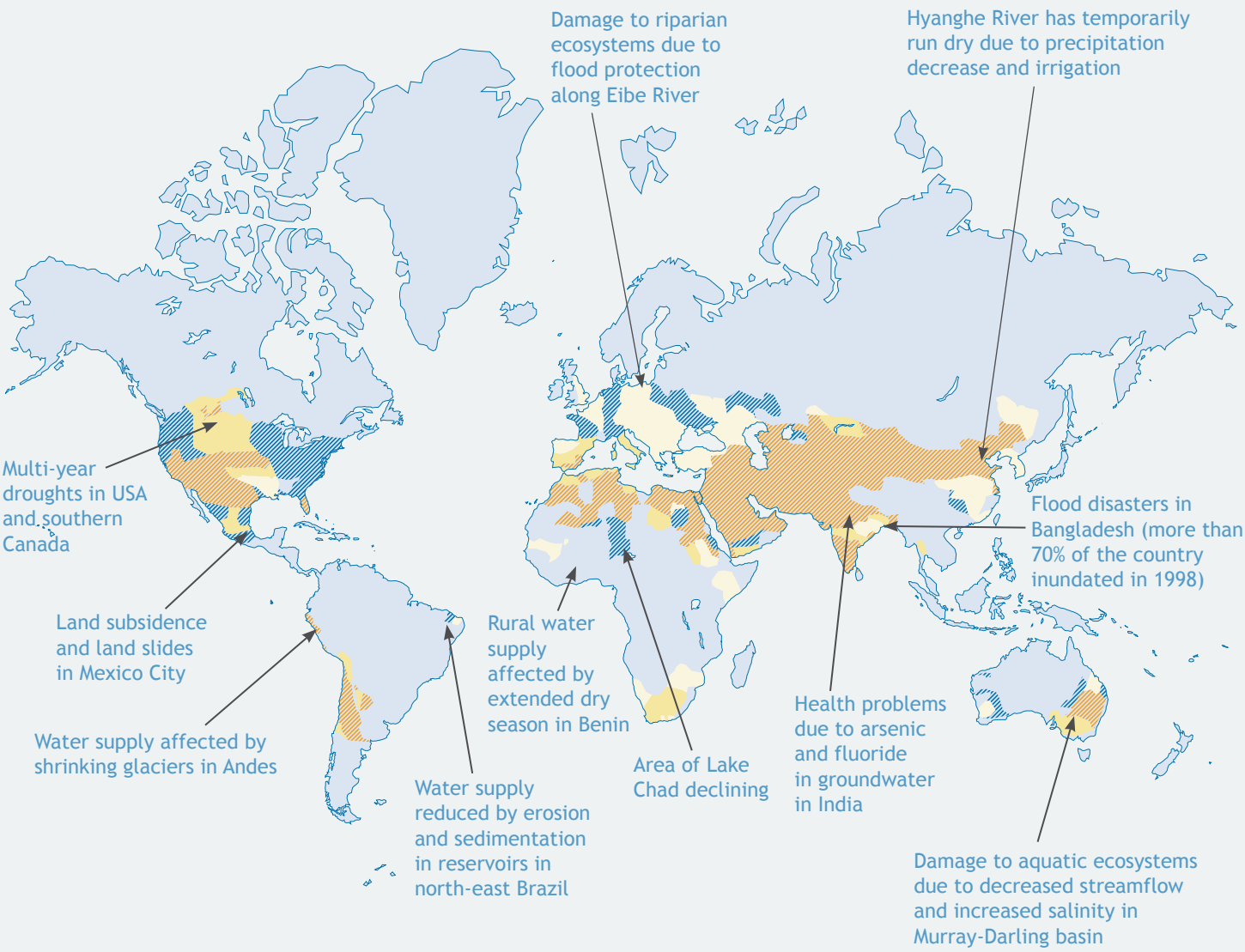
Agriculture and natural resources. Agriculture has a voracious appetite for water, the bulk of which is used for intensive irrigation.[12] Demand for agricultural water in places like India has led to seawater intrusion by as much as 7 km inland. It is expected that these pressures will only mount with population growth and as diets change in favour of more water-intensive food products.[13]

Urbanization. By 2030, it is expected that 60% of the world's population will live in cities. Domestic water use in urban areas typically outpaces that of rural counterparts, putting significant strain on already overburdened water infrastructure. Shanghai, for example, uses fives times more water per capita than surrounding regions.[14] In China, 400 of the country's 660 cities lack sufficient water supplies and 110 suffer from serious shortages.[15]

Industrial growth. Industry faces a future where water demand will grow, availability will decline, and treatment requirements will likely increase. Estimates indicate that every US$1 million increase in GDP per year will require an additional 22,000 cubic metres of water.[16] Over time large industrial users will be facing simultaneous water and energy strains as even more energy inputs will be needed to address water availability and pollution abatement.[17]

Infrastructure needs. Over the next 25 years, global water infrastructure requirements are estimated to reach $22.61 trillion, including over $9 trillion in Asia and nearly $5 trillion in Latin America.[18] This invites an opportunity to not just 'fix' or rebuild existing infrastructure, but to do it 'better and smarter, adding intelligence and instrumentation' that can help reduce losses from both built and natural systems.[19]

Climate change. The International Panel on Climate Change has identified several areas of concern when it comes to the impacts of climate change, which include but are not limited to droughts, land subsidence, and flooding, extreme events which are further compounded by the increasing vulnerability of aquatic ecosystems **(see Figure 1)**. Globally, fish stocks in lakes and rivers have declined by 30% since 1970 and an alarming number of the world's great rivers no longer reach the sea.[20, 21]



Source: Morrison, J., et. al., Water Scarcity and Climate Change: Growing Risks for Businesses and Investors (CERES, 2009).

Figure 1 - Global freshwater resource risks

The question of whether water is a basic 'human right' (as defined as safety, sufficiency, transparency, physical accessibility, and responsibility) or a 'commodity' in need of a market is a binary question that is not easily answered. Instead, such debates can be highly political and emotionally charged. Many believe that water is the same as food, a staple of life whose price should be controlled by market forces. Others believe water is like air: abundant, open to abuse and free to all. The truth is that water is somewhere between the two—free but costly to distribute and process.

— IBM (Water: A Global Innovation Outlook Report)

What is at risk?

The United Nations has defined water scarcity as 'the point at which the aggregate impact of all users impinges upon the supply or quality of water under prevailing institutional arrangements to the extent that the demand by all sectors, including the environment, cannot be satisfied fully.'[22]

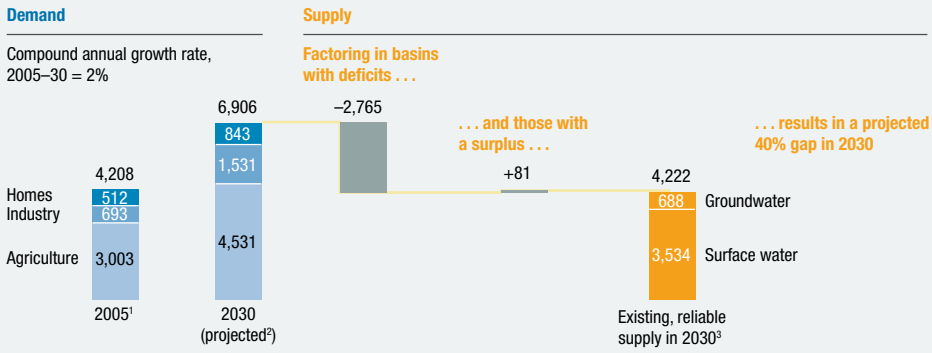
This definition is both globally and regionally applicable, as it implies that, in practice, water scarcity is more often caused by the *nature* of the demand and/or the inappropriate allocation of water, rather than by *total availability* alone. Water scarcity, therefore, 'normally arises due to a complex interaction of social, economic and environmental factors… making it seldom the product of solely lack of precipitation.' This suggests that water scarcity may be more akin to a governance failure than a pure resource crisis, implying that such crisis can be resolved through better management, stronger governance and smarter financial investiture.[23]

While it is certain the gap between supply and demand *will* (and must) be closed, the question is how. Although technical innovation is helping, it is not keeping pace with demand growth – the world's population is climbing by about 80 million people per year, which is increasing freshwater demand by approximately 64 billion cubic metres per year **(see Figure 2)**.[24]

Given our historical predilections, will the water economy land on solutions that are environmentally sustainable and economically viable?[25] The answer to this question will hinge on the collective efforts of diverse stakeholders who must work to bridge an increasingly complex global supply and demand gap.

Exhibit: **Running on empty**

By 2030, water supplies will satisfy only 60 percent of global demand on average.



[1] Based on inputs from International Food Policy Research Institute (IFPRI)

[2] Based on frozen-technology scenario and no increase in water efficiency after 2010; figures do not sum to total, because of rounding.

[3] Supply at 90% reliability, including infrastructure investments scheduled and funded through 2010; supply in 2005 is 4,081 billion cubic meters per year, projected improvements in technology and infrastructure brings 2030 total to 4,866 billion cubic meters per year; net of environmental requirements.

Source: IFPRI; McKinsey analysis

Figure 2 - Aggregated global supply gap[26]

***Analysis conducted by McKinsey & Company** suggests that water supplies will only meet 60% of global demand by 2030, assuming no increase in efficiency beyond 2010. Factoring in projections in supply-side technology and infrastructure improvements raises this figure to 70%, which still falls short of bridging the estimated 2% compound annual growth rate in forecasted demand.*

Athabasca River Bridge and Moberly flats Jasper National Park (© Getty Images)

The Athabasca River – Regional Issue, Global Resonance

Did you know? In recent decades, mean annual temperatures have been increasing over the Athabasca River basin and the Great Lakes-St. Lawrence River regions. River flows and lake levels have diminished as a result of warmer temperatures, and for the Athabasca, from the retreat of glaciers in the headwaters. Some climate models predict that minimum flows in the Athabasca could diminish by 7-10%. Such a decline may make flows insufficient to satisfy the needs of oil sands production, as well as other industrial, commercial, agricultural, municipal and environmental users, including the biologically-rich Peace Athabasca Delta.[27]

Did you know? At 441 million m^3 of water per year, oil sands mining activities are eligible for approximately 80% of all licensed water-use (2005 data) in the Athabasca River basin, although the cumulative amount of water that the oil sands mines withdraw is currently less than the total amount they are licensed to take.[28] Other industrial and commercial users are authorized for approximately 20% of licensed water-use, while agricultural and municipal allocations account for about 1.5%.[29]

Energy demands and oil sands production in Canada are expected to continue to rise. Oil sand production is forecast to increase by at least 50% by 2013, with implications for water availability, quality, ecosystems, and groundwater.[30] According to Natural Resources Canada, future production from planned mining projects may increase water withdrawal to 529 million cubic metres (3.3 billion barrels) per year.[31]

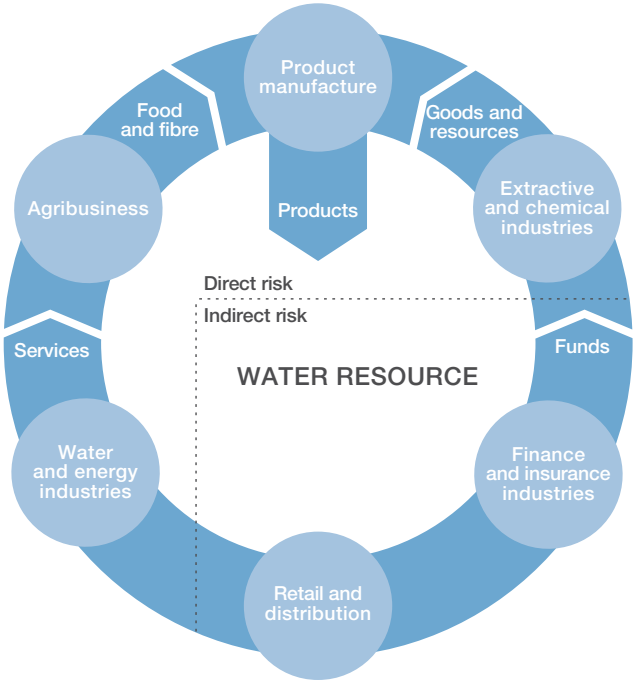
Did you know? Originating in Jasper National Park, the Athabasca River provides habitat for over 30 of Alberta's 59 fish species. As it flows northeast, the river provides the largest direct inflow of fresh water into the Peace-Athabasca Delta. The Peace-Athabasca Delta is one of the world's largest freshwater deltas and is an important part of Wood Buffalo National Park, a UNESCO World Heritage Site.[32]

Water scarcity can be defined as ‘the point at which the aggregate impact of all users impinges upon the supply or quality of water under prevailing institutional arrangements to the extent that the demand by all sectors cannot be satisfied fully’. Further upstream resides the concept of ‘water risk’, which refers to those potential disruptions, costs, revenue losses, or growth constraints that can ensue due to a lack of water, poor water quality, or from using water inefficiently. Looking deeper into the data allows us to develop a more complete picture of the specific actors impacted by our growing thirst for water.

Satisfying our thirst

Water permeates the entire Canadian economy, whether it is used for generating electricity, raising crops, developing the oil sands, producing forest products, or manufacturing consumer goods. The concept of water risk thereby applies to all government, industry and business stakeholders. All groups rely on sound water management principles to ensure respective risks are mitigated, whether these apply to water conveyance, water quality inputs, manufacturing processes, or other activities.

The relationship between business and water risks can be described as both direct and indirect **(see Figure 3)**. The type of industry or business will determine the level and exposure to risk and the appropriate response, but in general, numerous sectors around the world are facing challenges and uncertainties due to the increasing scarcity of water.[33] Companies in sectors such as food and beverage or water-intensive manufacturing (as is the case with semiconductors), face direct challenges with respect to sourcing water of sufficient quality and quantity, while other sectors are indirectly affected. Financial services institutions, for example, are beginning to pay closer attention to how clients manage their water risks.[34]



Source: Lloyd's 360 Risk Insight, WWF. Global Water Scarcity – Risks and Challenges for Business (2010).

Figure 3 - Direct and indirect water risk

Who's thirsty?[35]

Industry is often said to have 'big water' needs when compared to the relatively nominal consumption resulting from domestic and household use, or 'small water'.[36] In Canada, the natural resource sectors have the most significant influence on water, as they are responsible for 84% of '*gross water use*' (the total volume withdrawn from water bodies) and '*water consumption*' (water that is withdrawn and not returned to a water body after use). This is notable given that the natural resource sectors account for approximately 12.5% of Canada's GDP, are projected to grow by 50%-65% by 2030, and underpin the major functions of the Canadian economy (i.e. through the production of electricity, fuel, and food).

Due to irrigation requirements, agriculture is the largest water *consumer* and second largest water *user* of all the natural resource sectors (making up an estimated 66% of national water consumption and 10% of gross use). This is only expected to increase with growing demand for food and water-intensive food products like meat and biofuels. These trends will be further complicated by questions regarding how well the sector will adapt to climate change impacts such as reduced spring run-off and prolonged drought, or address large-scale impacts on water quality and ecosystems – as is the case with Intensive Livestock Operations (ILOs) and their impact on regional water quality.[37]

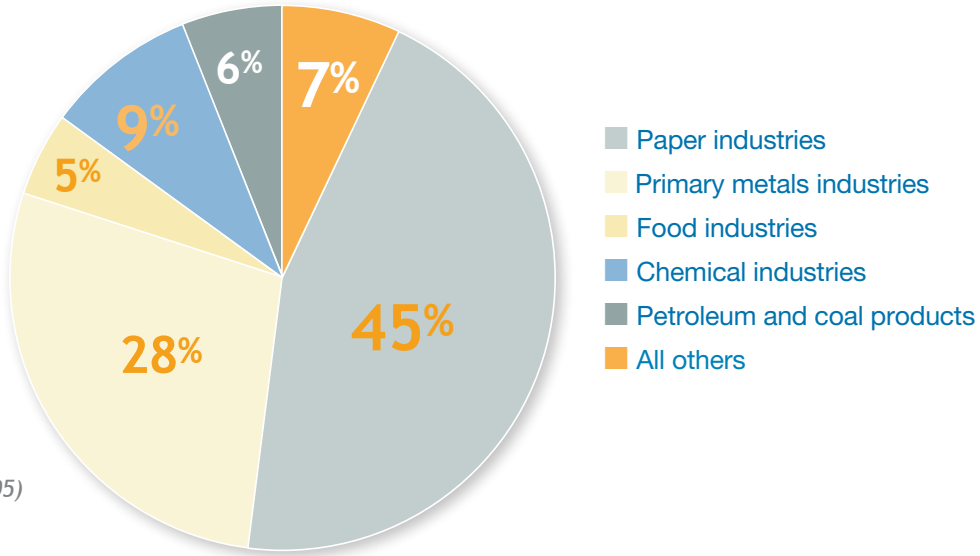


Figure 4 - Water intake for manufacturing industry (2005)

Source: Industrial Water Users (StatsCan, 2005).

Intense debate over the energy and water intensity of crops is already occurring in other countries. Analysts predict that by 2025, 55% of the world's population will depend on food imports as a result of insufficient domestic water – a requirement that some believe will result in a major reconfiguration of international trade, and one that has further implications for Canada's agricultural sector and its water use.[38] For example, in response to the rising awareness of the massive scale of the food security problem in dry regions, policymakers are exploring importing 'virtual water' by importing food grown in less drought-prone regions.[39]

The electricity sector also has a significant effect on water in Canada – thermal power alone accounts for 64% of national gross water use and 12% of consumptive use. In addition to the water used in hydroelectricity generation, fossil and nuclear power generation also depend heavily on water for cooling processes. Key issues for this sector include understanding how climate change will affect future electricity generation profiles (as in how climate will affect hydroelectricity capacity through its effect on water quantity[40]), as well as how the sector's relationship to ecosystems, water availability, and quality will continue to be managed as energy demand increases. In particular, the inextricable relationship of energy and water is growing more apparent as flash points between energy needs, water needs, and ecosystem impacts converge.

The oil and gas sector is a relatively small user of water overall, but the strong growth expected for this sector will have regional water impacts. Approximately 75% of Canadian oil and gas production occurs in Alberta, where production currently consumes 7% of Alberta's total water allocations (in comparison, irrigation for agriculture in the province accounts for nearly 60-65% of water consumed, on average).[41] Oil sands production is expected to increase by 50% by 2013, meaning that managing priorities for water withdrawals, water quality, ecosystems, and groundwater resources will continue to be a challenge. Further downstream, water could also become a bottleneck for the development of alternate energy technologies. For example, the Canadian oil sands have a 1 to 5 petroleum production-to-water ratio, while coal-to-methanol processes have an approximate ratio of 1 to 18.[42]

While forestry does not contribute significantly to overall water use, water availability is vital to production. A related sector, pulp and paper, can also have effects on water quality and ecosystems through mill effluent. Canada's forests play a crucial role in influencing the quality and quantity of water, signifying that our limited present-day understanding of forest-water interactions is a potential area of concern. As a sign of heightened attention to this reality, it is expected that companies will soon be placing increased demand for water reporting on forest products through CSR principles.[43]

Another ‘footprint’ to make sense of

While industry’s experience with ‘carbon footprinting’ provides instructive lessons, accounting for water involves a whole new set of charms and challenges that demand careful consideration. Led by a coalition of scientists, companies and development agencies, an international movement has emerged under the banner of the Water Footprint Network to help corporations and governments measure and manage water use. This said, and as a Wall Street Journal article recently highlighted, the emerging world of ‘water footprints’ and ‘virtual water’ is still very much evolving:[44]

Striking numbers. This wave of ‘virtual water’ research has produced embedded water estimates for a wide variety of products: cup of coffee (35 gallons); cotton T-shirt (700 gallons); a typical hamburger (630 gallons) etc.

Context matters. Experts acknowledge that the accuracy and usefulness of water footprints can depend heavily on where and how products are made. In addition, there can be considerable variability in the timing, quality and location of water being restored to aquifers. For example, oranges grown in Brazil might have a higher water footprint than oranges from Spain, but the Brazilian orange might be a better choice because of the country’s rainy climate.

Methodology crux. Tallying the water footprints of manufactured goods can be tenuous since no clear standards exist. Some companies only measure water that is used in factory operations while others count the volume used to grow ingredients in their supply chains. Still others account for end-use consumption by consumers.

Enter the ‘water offset’. Models are emerging for ‘water offset’ projects, which will allow heavy water users to soften their impact by funding water sanitation and conservation projects. PepsiCo recently piloted a program to help rice farmers cultivating 4,000 acres in India switch from flood irrigation to direct seeding – a planting method that requires less water and makes crops more resilient to drought.

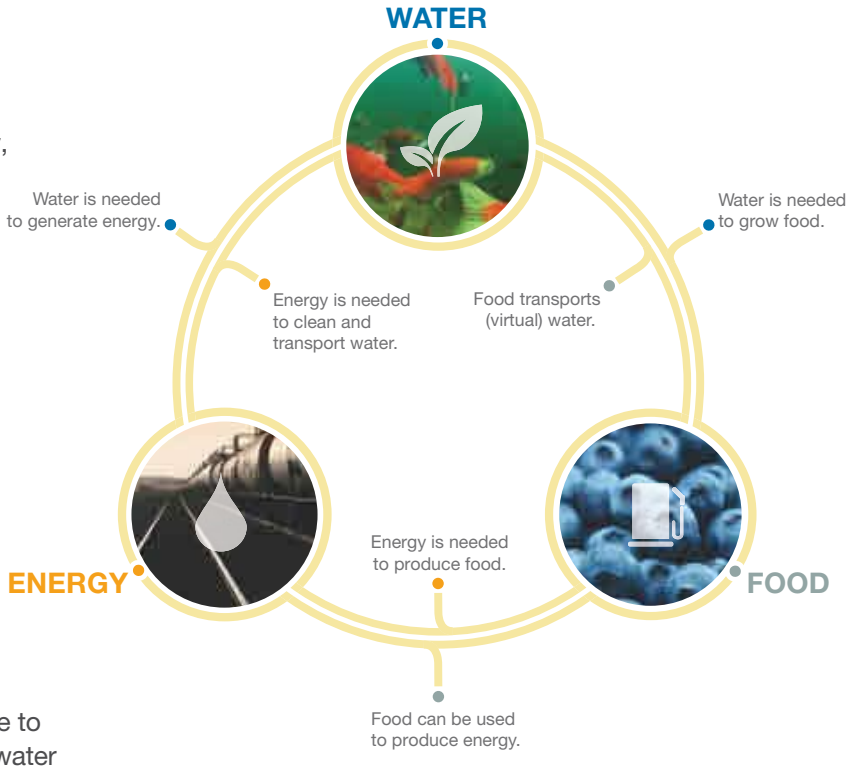
At 3% of national consumption, the mining sector is not a significant user or consumer of water but its activities can have harmful impacts on ecosystems and water quality if not managed properly. Further, climate change impacts are important for management and future design of mines, particularly in the North.

As illustrated in **Figure 4**, leading industries for *water intake*[45] (the amount withdrawn from the source for a particular activity over a specific period of time) among Canadian manufacturers include Paper, Primary Metals, Chemical, Petroleum and Coal, and Food. Within each segment, conversations are already underway with respect to how businesses are responding to sector-specific sustainability risks and opportunities. Increasingly, water is becoming a prominent point of conversation, and is sparking fresh thinking around water management approaches and new concepts.

The water-energy nexus

An important issue for water management, industry, and government is the relationship between water and energy, or the 'water-energy nexus.' When it comes to industrial production, water is needed to produce energy, and conversely, energy is needed to produce useable or potable water. Indeed, research suggests that a main driver for organizations to optimize water is to achieve corresponding financial savings from energy use reductions.

Feedback loops between such critical areas as energy, water and food, however, can put various priorities in conflict. For instance, shifting to renewable biofuels like corn-based ethanol, can have unintended impacts on both water and food availability. The United Nations estimates that if all national plans and policies to increase biofuels were to be implemented, an additional 180km^3 of irrigated water would be required over and above the 44km^3 (or 2% of irrigated water) currently used to grow crops for energy.[46] Furthermore, since many biofuel crops are also key food staples, competition for commodity supplies can displace food availability or increase food costs.



Source: Water: A Global Innovation Outlook Report (IBM, 2009).

Figure 5 - A delicate balance

The nexus between water and energy, and between water quantity and quality, is especially prominent for nations that have a powerful claim on future economic development. For example, the nexus between water and energy in China could have a destabilizing effect on the entire global economy. The energy intensity and cost of water provision is increasing rapidly as the transportation requirements of water increase across the country, and as energy-intensive water treatment becomes more widely used in the delivery of potable water. Wastewater sanitation is also expected to be a significant growth area and consumer of energy.[47] Running parallel to these needs is China's hydroelectric power production, of which water is a critical component.[48]

Climate change is also often linked to discussions about the water-energy nexus due to the greenhouse gas emissions that result from energy production and the impacts that occur on water resources as a result of climate change. This has been referred to as the water-energy-climate change feedback loop, and it has profound implications for both business and for government.

Water adaptation under way

Already, Canadian industry is recognizing the important role that water plays in its long-term viability, and is taking important steps towards building sector-specific responses. **(See page 26)**

Water flowing through James Bay dam (© Getty Images)

Formulating a response

The natural resources sector – as a significant water user and consumer – has challenges to consider and overcome, as does industry in general. These challenges go hand in hand with energy challenges, and at times may produce unintended consequences. For instance, industry faces a potential spiraling challenge of declining water availability and increasing pollution control requirements, and addressing both requires energy – which, in turn – has its own environmental and economic implications. These issues are particularly relevant to large industrial users such as metals, mining, petroleum, and energy companies.

The positive underlying story is that, generally, management or technology improvements to water productivity or efficiency can cut across all industry and commercial value chains. These can include improvements in agricultural practices (such as less water intensive crops, automated irrigation and crop yield enhancing technologies), industrial practices (for example, optimizing inputs for power production and other heavy water use industrial processes), or municipal/domestic infrastructure (as in appropriate price signals and fee structures, or improved water treatment and distribution productivity).[49]

Water adaptation under way		
Forestry	273,700 Jobs[50]	*In an act of voluntary transparency, the forestry sector is working to develop quantitative profiles of water uses by forest products in Canadian operations.* According to the National Council for Air and Stream Improvement, of the water used in forestry manufacturing processes, about 93% is obtained from surface or groundwater sources and 88% is returned directly to surface waters following treatment. About 11% of water used is converted into water vapour through manufacturing and wastewater treatment processes, and about 1% is imparted to products or solid residuals.
Oil & Gas	230,000 Jobs[51]	*The oil and gas sector has partnered with the Alberta government to invest in furthering shared innovation and in technology for increased water efficiency.* The Alberta government is implementing a series of strategies to carry out this mission – from the Provincial Energy Strategy, Climate Change Strategy, and the oil sands strategic plan (Responsible Actions). These activities are designed to bolster investment in research, development, demonstration and deployment of sustainable and clean energy technologies.[52]
Mining	363,000 Jobs[53]	*The mining sector is developing methods for integrating water use and efficiency into its sustainability reporting standards.* The mining industry is involved in a number of initiatives aimed at improving its water management, including the Water Footprint Network, Global Reporting Initiative (GRI) Water Protocol, and the Mining Association of Canada's 'Toward Sustainable Mining' initiative. [54]
Agriculture	300,400 Jobs[55]	*In Southwestern Ontario, agricultural producers have mobilized with public authorities to engage the public on allocation decisions during seasonal drought.* Agricultural producers, local water managers and government representatives have partnered to develop a framework for participatory water management to ensure fair sharing and maintenance of flows for ecosystem services. A key element of the framework is the farmer-led Irrigation Advisory Committee, which lays the groundwork for two-way communication between water managers and irrigators, communication and mediation of conflicts between irrigators, and the education of irrigators.[56]
Food & Beverage	244,800 Jobs[57]	*Food and beverage companies are applying eco-industrial approaches around the Toronto Pearson Airport district as part of the Region's efforts to become an internationally-recognized 'eco-business zone.'* The food and beverage industry is a key constituent of Partners in Project Green – a project dedicated to producing environmental and economic benefits for companies through new forms of collaboration. Under the leadership of the Greater Toronto Airports Authority (GTAA) and Toronto and Region Conservation (TRCA), the Pearson Eco-Business Zone is helping companies reduce their water footprints through investments in water efficient fixtures, wastewater recycling, green site development and rainwater harvesting.

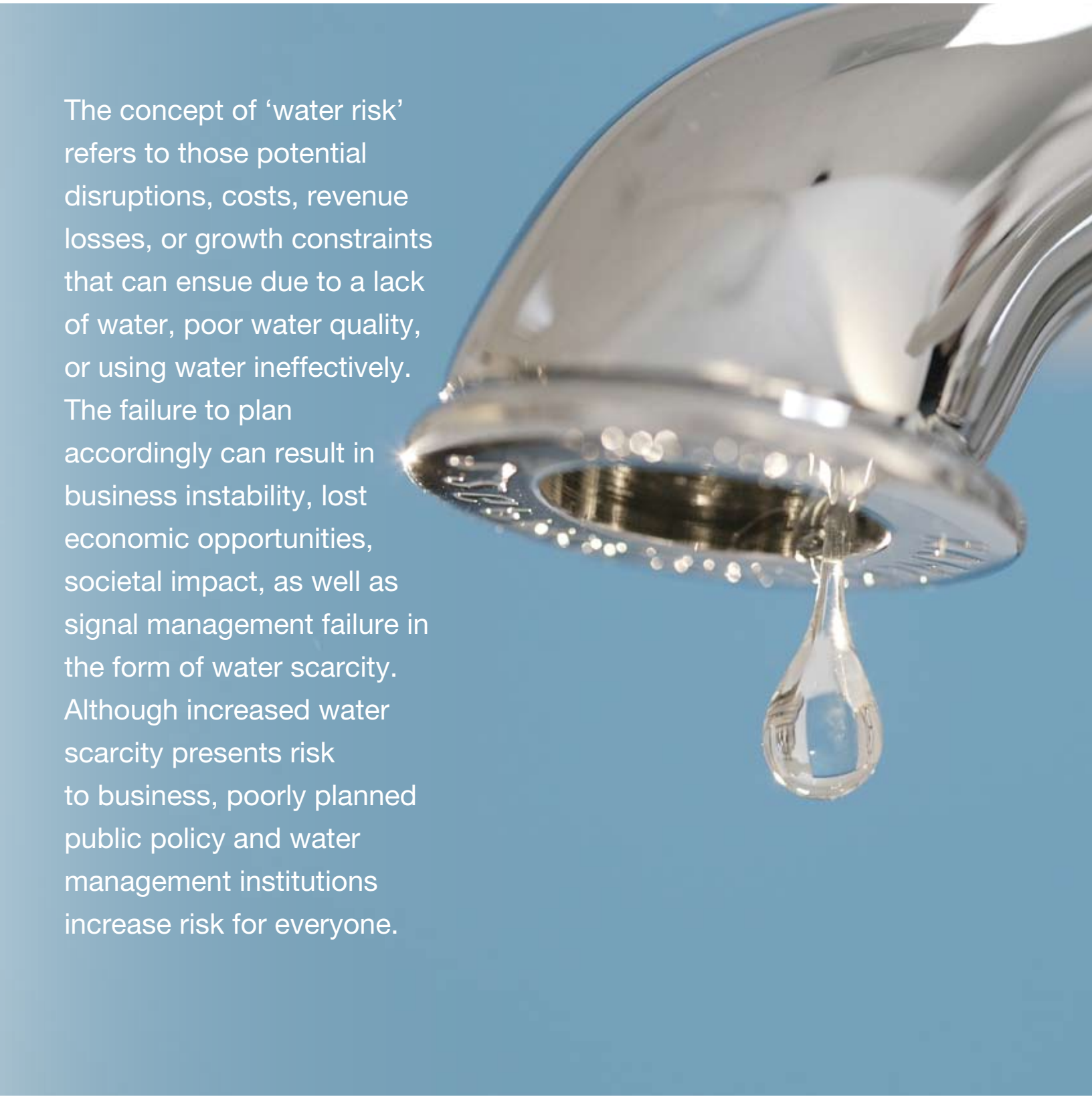
Mixing water and oil

From both environmental and economic perspectives, there is a tendency to draw comparisons between water and petroleum. While water and petroleum resources may be comparable in their complex interaction with the environment and the economy, important differences must be considered. For example, unlike petroleum products, in many instances, no suitable substitutes exist for water. What other distinctions need to be factored into water management approaches?

Iceberg splitting off coast of Newfoundland (© Getty Images)

	Like	Unlike
Consumption	Water is a critical ingredient and production input for a wide variety of goods and services that contribute to measurable GDP growth.	Water is governed by a hydrological cycle that affords a constant supply – albeit in variable flows, forms, quality and locations that may significantly alter its utility. Further, unlike petroleum, which is chemically converted into other substances when consumed, water simply changes states or is transferred between varying locations.
Public Awareness	Public awareness of water sustainability is increasingly driving public discourse, policy and business management practices, augmented in part by the growing number of severe water-related crises capturing attention globally.	
Business Readiness	Much like petroleum's associated GHG impacts, water is becoming subject to increasingly comprehensive accounting, disclosure, and reporting norms.	
Regionality	Water can be transported across great distances and transformed into different states. The economic and environmental expense of such activity is increasingly figuring into business planning and policy.	Unlike petroleum, which has largely universal environmental implications, water issues are highly regional – dictated by the complex interplay between such factors as the timing and quality of water withdrawals and returns, and competition among local users.
Market Integration	Like many goods and activities related to petroleum, imperfect pricing instruments and complex subsidy and tax frameworks can cloud the 'true value' of water.	Well-established market frameworks do not exist to govern the price of, supply of or demand for water globally.
Regulation & Public Policy	Significant differences exist between the approaches taken by federal, provincial and municipal authorities in managing water resources. The resulting policy patchwork can result in increased costs for businesses operating in multiple jurisdictions.	Water is a tangible and largely known compound – regulations and management frameworks have been with us for millennia and we have frequently found ways to collaborate and share water resources without conflict.[58]
Bonds		Societies around the world generally maintain a different emotional, cultural and often spiritual bond with water that shapes values towards and management approaches for water.

The concept of ‘water risk’ refers to those potential disruptions, costs, revenue losses, or growth constraints that can ensue due to a lack of water, poor water quality, or using water ineffectively. The failure to plan accordingly can result in business instability, lost economic opportunities, societal impact, as well as signal management failure in the form of water scarcity. Although increased water scarcity presents risk to business, poorly planned public policy and water management institutions increase risk for everyone.



Managing the flow

3

Canada's water management web[59]

Any discussion of water risk cannot occur independently of the policy and planning context for water management. When it comes to water allocation, Canada's provinces and territories hold prime accountability according to frameworks based on either prior allocation (First in Time, First in Right), riparian rights (in terms of access to water based on adjacent ownership or occupation of land), or statutory regulation (Civic Law principles).[60] According to research by Brandes and Maas, these systems have three major shortcomings in that they all have unclear priorities for allocation and use, demonstrate rigidity in the face of uncertainty and change, and provide limited support for water conservation and efficiency.[61]

Specifically, while many provincial policies recognize the importance of maintaining ecosystem integrity, allocation systems neither clearly identify when ecosystem purposes should have priority over extractive human uses, nor recommend criteria to evaluate how trade-offs should be made among conflicting interests. Further, these frameworks have been considered too rigid to adapt to and meet increasingly complex social, economic, and environmental demands, and have been said to poorly reflect the true economic and social value of water, thereby undermining opportunities for greater efficiency and conservation.[62]

Uncertainty, inflexibility, and inefficiency have ripple effects on robust social planning, industry longevity, and ecosystem needs. It has been suggested that 'the primary concern for water allocation systems in the 21st century will not be permitting the extraction of more water, but rather directing available water to its most socially valuable uses.' As our world becomes more complex and the demand for water more urgent, clarity in allocation and the flexibility to accommodate change and shifting priorities will become paramount. Such a view toward planning and decision-making can result in exciting opportunities for collaboration between government, industry and communities.

As an initial response to these challenges, governments have begun to modify or supplement their allocation systems. For instance, faced with serious water shortages in the southern part of the province, Alberta has undertaken a review of its water allocation management system. This will allow government, industry, and the public to explore options to better meet future water needs and support regional outcomes. Similar initiatives that assess and improve existing allocation systems are being contemplated in other provinces such as British Columbia, which will do much to improve the information flow and resulting management of these critical freshwater sources.

Water issues as diverse as our nation

Atlantic Canada

- Runoff and contamination from intensive agri-chemicals use is polluting surface and groundwater.[63]
- The Region faces receding water tables, and rising costs of water and wastewater treatment.[64]
- Poor water quality threatens aquatic life and the fishing industry that comes with it.[65]
- Climate change-related weather events are resulting in saltwater intrusion into aquifers.[66]

Central Canada

- The Great Lakes Basin (surrounded by 40 million people) faces growing demand from industry, power plants, farms and urban sprawl – as such, integrated watershed planning and aging infrastructure are chief concerns in Ontario and Quebec.
- In Montreal, 40% of potable water is lost in transportation due to leaky and deteriorating pipes.[67]
- Blue-green algae plague many lakes across Quebec.
- Trans-boundary issues remain a high priority in the St. Lawrence River and the Great Lakes Basin, which is shared between Ontario, Quebec and eight American states.[68]

Prairies

- A booming population has put pressure on the supply of water in southern Alberta.[69]
- Extreme weather patterns such as severe droughts and floods are affecting the Prairies.
- Eutrophication has caused record growth of algae blooms in Lake Winnipeg.
- Water rights transfers across the Region present further environmental threats and management challenges.[70]

Pacific Coast

- Low snowpack levels are reducing stream flows and forcing municipalities to consider water restrictions.[71]
- Eutrophication is a growing problem in the densely populated lower Fraser River Basin, which is seeing high levels of agricultural runoff and municipal wastewater discharge.[72]
- The use of pesticides in orchards and vineyards and fertilization of crops under irrigation are damaging ecological systems in the south-central valleys of BC.[73]

Northern Regions

- Despite recent improvements, First Nations communities face ongoing challenges regarding access to safe drinking water and wastewater treatment.
- Canada is likely to experience warming at twice the global average in the next Century, with northern regions experiencing the greatest increases.[74]
- Changes in permafrost may have significant implications for public infrastructure, including wastewater treatment and distribution, buildings and transportation access routes.[75]

The Catch-22 of Canadian water infrastructure

Unlike electricity or natural gas that can be widely distributed, water is very much a localized resource when it comes to conveyance to the end user, making it one of the world's few natural monopolies.[76] This means that although provincial and territorial governments have primary jurisdiction over water allocation, most of the operational aspects of water management are delegated to our municipal governments.

According to a recent report by the Conference Board of Canada, the bulk of water and wastewater infrastructure assets owned and maintained by municipal governments were built between the 1950s and 1970s and are due for replacement.[77] The high cost of water infrastructure, in combination with habitually low water pricing, means that fewer revenues are generated by water utilities compared to other utilities. In Canada, this has resulted in situations where insufficient funds exist to cover the costs of maintaining and replacing infrastructure, implementing necessary system upgrades, or to even replenish reserve funds.[78]

Several other factors conspire to exacerbate this problem, including the structure of municipal funding, the cost of running and maintaining facilities, and increasing urbanization in Canada. Many Canadian municipalities have inadequate funding as provincial legislation limits their ability to spend and raise revenues. Between 1995 and 2002 for example, local government revenues increased 14% compared to provincial revenue increases of 30%, and federal government revenue increases of 38%.[79] This limits the investiture local governments can make into facilities, which as mentioned, is sizeable compared to other utilities.

Energy costs add another large burden to the overall cost for water and wastewater treatment, distribution, and collection. For many municipalities, which are the prime owners of these facilities, water and wastewater divisions can consume 25-40% of municipal electrical bills.[80] In Ontario for example, such plants account for an estimated 1.5-2% of Ontario's total electrical load.[81] Costs can also vary significantly based on factors such as where water sources are located and how far water needs to travel.[82]

As is explored further in the section to follow, low pricing for water has important implications as well. The 'ripple effect' of inexpensive water provision is several-fold. Overall, water service providers (and taxpayers) experience higher operating costs due to the need to pump and treat water regardless of how effectively it is used, along with:

- Additional energy costs for excess water treatment, pumping and heating.
- Higher sewer flows and unnecessary treatment and disposal costs.
- Peaking factors, which refers to the point at which water use is greatest during the year. These volumes can be very high in regions where there is little incentive to moderate consumption. The result is that infrastructure can be oversized to meet excess demand, which in turn inflates the cost of infrastructure.

In Canada, senior levels of government periodically inject large amounts of subsidy funding into infrastructure renewal, or such costs may be subsidized at the local level through property taxes, reserves, or other sources. In the absence of more optimal approaches to water management, however, such investments can still lead to the same overbuilt, expensive, and at times wasteful conclusions.[83] In short, our current approach to water system planning is not yet environmentally nor economically sophisticated, and results in further overbuilt systems and increased waste – hence, the Catch-22 of Canada's water infrastructure. These observations highlight the need to explore regulatory frameworks that reward innovation in water management.

Managing the Great Lakes

The Great Lakes region offers insight into a dynamic range of water management issues, many of which are consistent with water management discussions happening around the world.

On Governance. The 1972 Great Lakes Water Quality Agreement between the US and Canada stated a shared commitment to restore and maintain the chemical, physical and biological integrity of the Great Lakes Basin ecosystem. In 2007, the two federal governments completed a comprehensive review of the Agreement and concluded it was no longer able to address current threats to Great Lakes water quality, prompting the need for new amendments.

Existing Diversions in the Great Lakes Basin

Source: Chamberlain, A., Great Lakes Legal Tools – Charts, Charters and Compacts, prepared for June 17, 2010, Canadian Water Summit, Toronto.

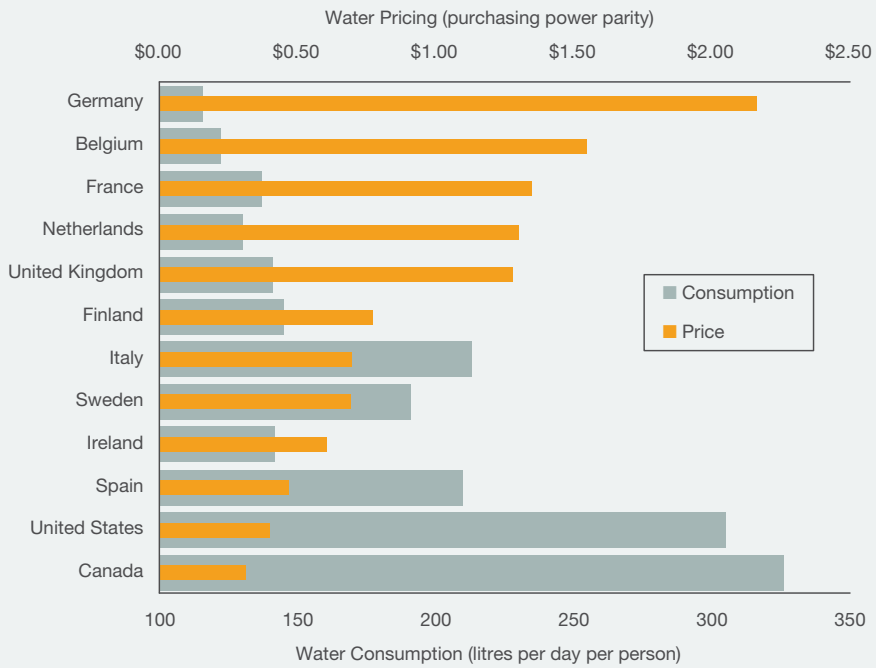
On Change. The Great Lakes have earned dubious association with the concept of 'death by a 1000 straws,' as the many diversions out of the Basin have resulted in a net loss of water from the system over time. Despite the seeming immensity of freshwater the Lakes hold, decreasing depth has commercial significance in terms of impacts on shipping and trade in the region.

On Opportunism. Aside from the opportunity to expand human habitability in the Great Lakes region, the possibility of attracting vulnerable industries dependent on fresh water resources has been a controversial topic of late. The City of Milwaukee, located on Lake Michigan, has recently rejected considering a block tariff for water pricing, which would have raised prices for high-volume users and encouraged conservation. The City is considering increasing water use because of its spare infrastructure capacity and ample supply. As a City utility manager explains, 'Milwaukee could double its customer base without having to build new facilities, and as there's no capital cost to avoid by increasing water use… why not attract industry looking for cheaper water?'[84]

What should water cost?

Many municipalities currently do not capture the real cost of providing and maintaining water and wastewater services. Low water fees are further undercut by flat rate pricing fee structures, or even declining block rates as volume use increases.[85] In contrast, conservation rate structures are designed to account for the volume of water used and are typically referred to as volume-based pricing. In Canada, approximately 75% of Canadian households are on volume-based pricing, and the remainder is on flat water rates.[86] The effect of fee structures on water use is simple yet startling: the average Canadian household on a flat rate system uses an average of 467 litres per person per day, compared to the 266 litres used on a volumetric charging system – a 43% variance.

Despite the fact that the majority of Canadians do pay volumetric-based prices, experts still consider fees too low to provide the pricing signals necessary to trigger significant water conservation. Appropriate fee structures and pricing signals have profound impacts on the perception and the ultimate quantity of the water consumed by end-users, as can be seen by the patterns of pricing and consumption illustrated in **Figure 6**. For example, the Pacific Institute reckons that by merely using current water-saving practices (i.e. no technological breakthroughs), California, a water-poor state, could meet all of its needs for decades to come without using a drop more.



Source: 2030 Water Resources Group, Charting Our Water Future - Economic Frameworks to inform Decision-making (McKinsey, 2010).

Figure 6 - Water price and consumption in selected countries

Formulating a response

Most of today's water utility delivery systems are predicated on a strong regulatory framework, inexpensive water pricing, and limited use of conservation oriented fees or fee structures. This model is also compounded by allocation systems that are unclear and need to better account for how water should be used and prioritized across the country. Our current water management context has major bearing on the sustainability of how we allocate and manage water resources in Canada, and presently does injustice to the value of conservation by industry and the Canadian public. Optimizing supply and demand, and accounting for multiple perspectives to broker new governance models will become increasingly critical both at home and abroad, given the estimated gaps in supply and demand facing many regions of the world.

The preceding sections have illustrated that business has a major role to play in helping to implement better management, but ultimately government is responsible for putting in place the frameworks that will enable optimal water management practices to blossom.[87] Both government and business are growing more aware of their shared exposure to water risk, whether it surfaces through physical risk to business operations from supply losses or pollution, increased expenditure on energy to secure water for citizens, or losses from sub-optimal water distribution networks.

Although there is no one-size-fits-all approach to improving water management, a greater emphasis on knowledge transfer, better and more transparent guiding frameworks, leveraged funding through private-public partnerships, and updated economic incentives, are means through which more effective water usage can be achieved. Public-private partnerships, for example, can help expose collaborators to sophisticated methods of planning and financing infrastructure, and ultimately can contribute more creativity, technology and expertise in the financing and delivery of public services. Furthermore, opportunities exist for financial institutions and municipal policy makers to forge new operating norms that reduce the risk of new technology adoption, helping to unleash the full potential of municipalities to serve as positive catalysts for water sustainability.

Public-private partnerships for water sustainability

Public-private partnerships can play an effective role in delivering innovative water management solutions to municipalities, as well as create scale opportunities that help Canadian companies trial or refine technologies that can effectively make their way into export markets.

Okotoks, Alberta – *Giving biosolids a (second) chance…*

In Okotoks, Alberta, biosolids resulting from treatment in the town's wastewater treatment plant are being disinfected and composted in-house and turned into a high quality product that is finding a second life in municipal landscaping applications. Under a public-private partnership, EPCOR Utilities has assumed responsibility for a recent $11.2 million upgrade to the Okotoks wastewater treatment plant, as well as ongoing responsibility for water and waste treatment system operations, and maintenance and enhancement of the composting process. The plant employs several advanced technologies, including biological nutrient removal, fine particulate filtering, and ultraviolet disinfection.[88]

Halifax, Nova Scotia – *Beyond plugging leaks…*

In 2007, the Halifax Regional Municipality (HRM) transferred responsibility of its wastewater and storm water assets to the Halifax Regional Water Commission ('Halifax Water'), becoming the first-ever regulated water, wastewater and storm water utility in Canada. Halifax Water is an autonomous, self-financed utility that was already responsible for a fully metered water utility providing drinking water and fire protection services to Halifax customers. This asset management approach facilitates the delivery of water services in an integrated, cost effective, and environmentally sound manner. Halifax Water is positioning itself to meet long-term regulatory requirements facing municipalities across Canada, and is sharing its recognized leadership in water loss control by working with cities like Montreal to tackle leakage issues.[89]

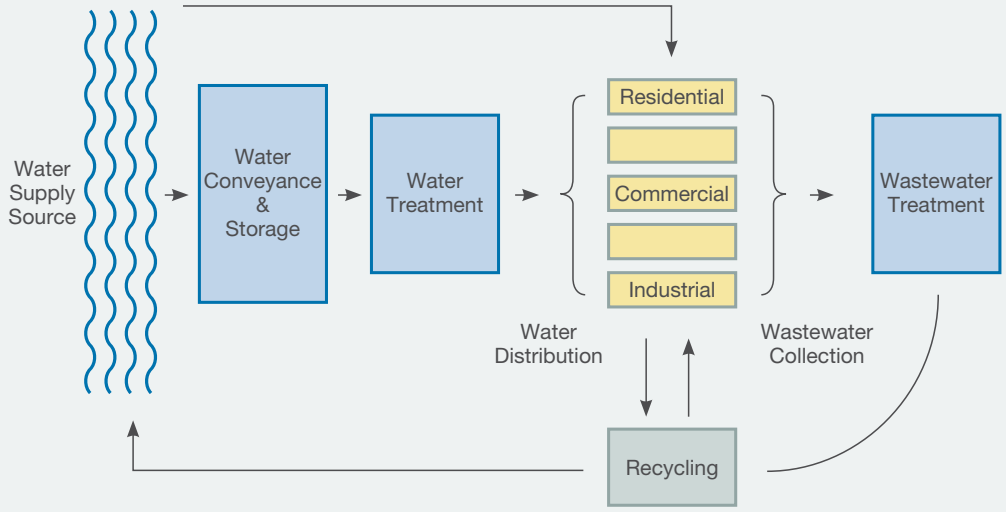
The water industry's reach includes water utilities that provide drinking water and wastewater services to end-users, and the myriad of companies providing supporting technologies, services and products to municipalities and industries alike. With proven knowledge and technological capacity to excel, Canadian companies are actively defining the role they will play in shaping this dynamic sector.

Canada's water industry

4

The water value chain

The term 'hydrocommerce' has been employed to describe the 'full continuum of companies involved in the distribution of clean water for economic and social benefit,' specifically, products and services enabling conveyance, collection, distribution, treatment, disposal, and increasingly, reuse of water resources.[90]



The water industry comprises companies providing products and services toward the collection, conveyance, treatment, and monitoring/ analysis of water and wastewater for residential, commercial, industrial, and agricultural uses.

Source: Maxwell, S., Dickenson, M., The Case for Water Investing 2010 – Value and Opportunity in Any Economic Environment (Summit Global Management Inc., 2010).

Figure 7 - The water value chain

In addition to maintaining a technical lead in such areas as purification, membranes and hydrogeology, Canada has substantial expertise in traditional water services like consulting, engineering, quality analysis and construction. In fact, with 400 to 600 firms active in this space, domestic expertise is much more extensive in services than on the technology supply side, where about 100 firms specialize in new technology. Notably, the bulk of these latter firms are small to medium-sized enterprise (SMEs).[91]

Canadian innovation in the water value chain

	Water services	Water treatment	Distribution	Management	Wastewater treatment
Key Technologies	• Engineering & consulting • Quality analysis • Infrastructure construction & rehabilitation • Water analytics	• Ozone disinfection • Ultraviolet (UV) disinfection • Micro-filtration/ultra-filtration • Reverse osmosis • Ion exchange • Electro-dialysis • Desalination • Other technologies (e.g. Coagulation, flocculation and clarification)	• Automated systems & instrumentation to monitor/control pollution • Products to optimize management & operation of water/ wastewater treatment & conveyance infrastructure • Transmission and usage efficiency metering & system management	• Water information systems & software • Agricultural efficiency technologies • Quality enhancement, filtration & desalination • Biosolid utilization (e.g. Waste-to-energy)	• Wastewater-to-product & recycling technologies • Residential & industrial grey water treatment • Anaerobic and aerobic sludge digestion • Nitrification & denitrification systems • Enhanced biological phosphorus removal

Canadian Innovators

Water services

EnviroTower Inc.

Toronto's EnviroTower provides an integrated cooling tower water management system that replaces traditional chemical treatment approaches and results in decreased maintenance costs and reduced wastewater discharge of hazardous chemicals.

- EnviroTower's solution leverages a patented treatment and remote monitoring system, which is supported by a comprehensive service program that helps customers maximize returns on investment
- EnviroTower's solution has been proven in use in hotels, hospitals, office buildings, and retail store locations

Water treatment

Saltworks Technologies Inc.

Vancouver's Saltworks technologies is pioneering an approach that harnesses renewable energy sources such as dryness in the atmosphere or heat from the sun to provide low cost water desalination.

- Saltworks' process uses up to 80% less electrical/mechanical energy relative to leading desalination technologies
- Applications for Saltworks' technology include producing drinking water for communities and municipalities, irrigation water for agriculture, and process water for industry

Distribution

Echologics Engineering

Toronto's Echologics Engineering provides non-intrusive acoustic technology for highly accurate leak detection in water pipe networks.

- Developed in collaboration with Researchers at the National Research Council of Canada, Echologics' test method evaluates pipe wall thickness and accurately locates leaks without the need to dig
- Echologics has conducted successful pilot projects with leading municipal water networks in Chicago, Las Vegas, and London (UK)

Management

BioteQ

Vancouver's BioteQ applies innovative technologies and operating expertise to solve challenging water treatment problems in the resource and power generation industries by converting waste into a useful resource.

- The outputs of BioteQ's unique processes are by-products that can be sold to offset the cost of water treatment, and clean water that meets strict water quality criteria
- BioteQ has been named one of Canada's Top 50 Most Socially Responsible Corporations by Jantzi Research and Maclean's

Wastewater treatment

Xogen Technologies Inc.

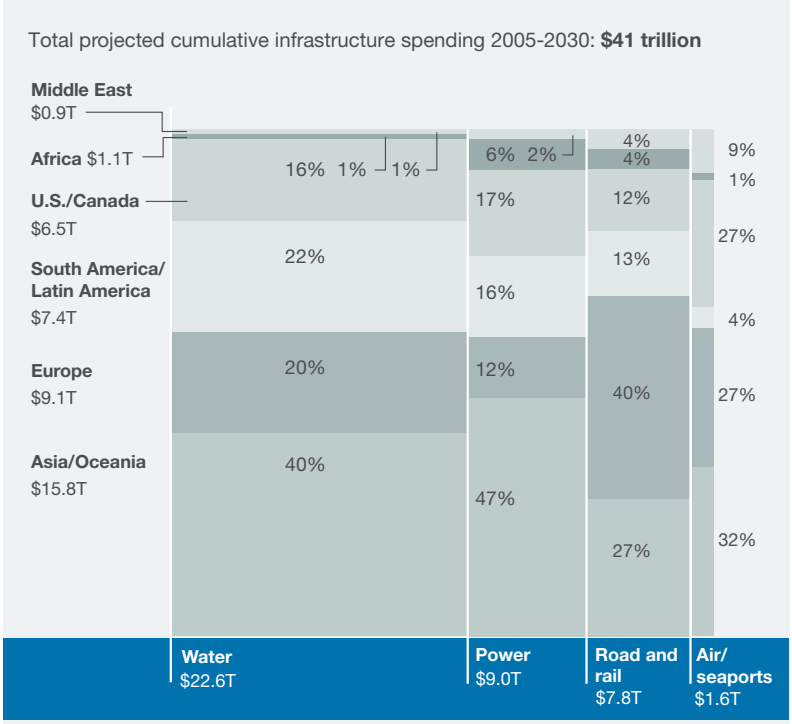
Orangeville's Xogen's patented technology treats raw wastewater using an electrolytic process that eliminates biosolids and requires a much smaller footprint than conventional treatment approaches.

- Xogen's process produces a mixture of hydrogen and oxygen gas by-product that can be used to generate energy through combustion or a fuel cell
- Aided by funding from SDTC, a pilot project is underway to refine Xogen's technology for commercial use in both Canadian and international markets

The global water opportunity

This US$400 billion water industry is expected to become a significant global growth area and is projected to reach approximately US$1 trillion in ten years. Much of this growth is expected to revolve around meeting the daunting infrastructure needs of the world's fastest growing economies. In a study of global water trends commissioned by The 2030 Water Resources Group – a coalition comprised of the International Finance Corporation, McKinsey & Company and leading multinational companies – demand for water is projected to rise dramatically in the coming decades. By 2030, the global demand for infrastructure is expected to reach US$41 trillion. Approximately half of this will go towards water infrastructure, with fully 60% of spending concentrated in Asia and South America alone **(see Figure 8)**.[92] Municipal and domestic demand is projected to grow significantly across all emerging markets.[93]

In spite of opportunities in emerging markets, Canada need only look south to its largest trading partner for opportunities for water sector companies. According to a 2003 report from the US Government Accountability Office, at least 36 states expect to face water shortages within the next five years.[94] Already, the US represents the largest market for water treatment equipment. Given existing cultural kinship, trade access and comparable infrastructure and technology needs, Canada would do well to find ways to better service this large, familiar market.



Source: Booz Allen Hamilton, Global Infrastructure Partners, World Energy Outlook, OECD, Boeing, Drewry Shipping Consultants, US Department of Transportation.

Figure 8: Water to dominate global infrastructure spending

Demand management thinking

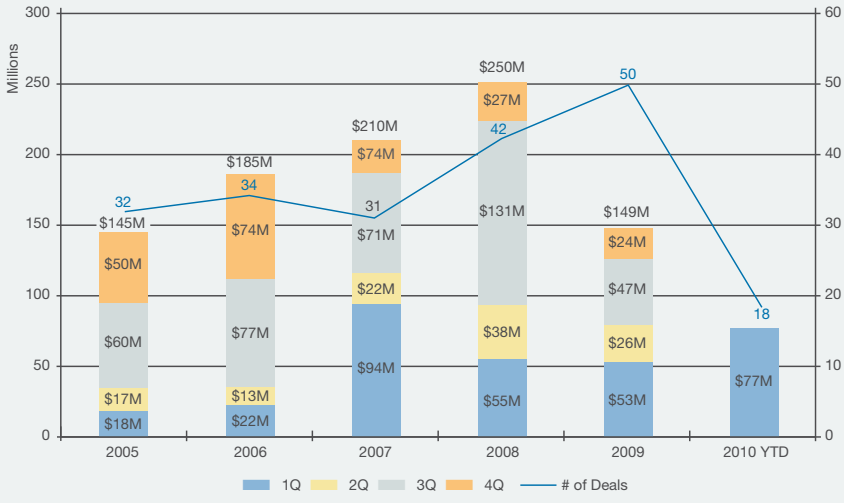
The principles of organizing and optimizing physical infrastructure for delivering and managing water are changing, bringing about new questions and new solutions. Traditionally, water infrastructure investment has focused on expanding the supply of water, however the imperative to better understand and reduce water use has elevated interest in demand management technologies. Demand management includes strategies to reduce overall water consumption, peaking, loss, or waste, as well as to increase the recycling and reuse of water resources.[95] Ultimately, water stakeholders are looking for ways to extend life, improve capacity and optimize distribution, suggesting that 'smart' technologies designed to satisfy these needs will be well positioned to succeed.[96]

The desire to do things differently is giving rise to concepts such as 'demand destruction,' which seeks to reduce or destroy the costs of energy or chemicals in the water system. Planners are rethinking wastewater-to-product opportunities, and even reconsidering the composition of basic infrastructure.[97] Stormwater management practitioners, for example, have found themselves giving increasing credence to rainwater harvesting, green roofs, topsoil permeability, and new ways of approaching roadway and pavement reconfiguration.[98]

Riding the investment wave

Such trends are borne out by recent investment patterns in water. The Cleantech Group notes a trend towards backing energy efficient treatment technologies aimed at improving the productivity of water treatment and distribution, as well as onsite wastewater treatment technologies that facilitate water reuse. Notably, whereas later-stage venture capital deals are typically the order of the day, a recent surge in early-stage activity suggests an encouraging trend towards heightening entrepreneurship and innovation in the water sector. As depicted in **Figure 9**, while venture investment in water (as with other sectors) declined in 2009, venture financing looks to be gaining momentum in the early stages of 2010.[99]

Another investment pattern is linked with the sizeable opportunity in information technology and water resource services, which is being regarded as an underdeveloped niche with significant global potential. As outlined in previous sections, the virtual flow of water through global and regional trade and the knowledge required to manage and map these dynamics is becoming increasingly salient. Water-scarce countries and regions are already making policy decisions based on the trade-offs between the water intensity of domestic production vs. purchasing water 'virtually' by importing products. Saudi Arabia, for example, has chosen to de-subsidize water use and instead use the water of Pakistan embedded in food grown specifically for Saudi Arabian consumption, as costs to pump and desalinate the huge amounts required to meet domestic food needs extend into the billions of dollars.[100]



Source: Javier, M., The State of Water Innovation (Cleantech Group, 2010).

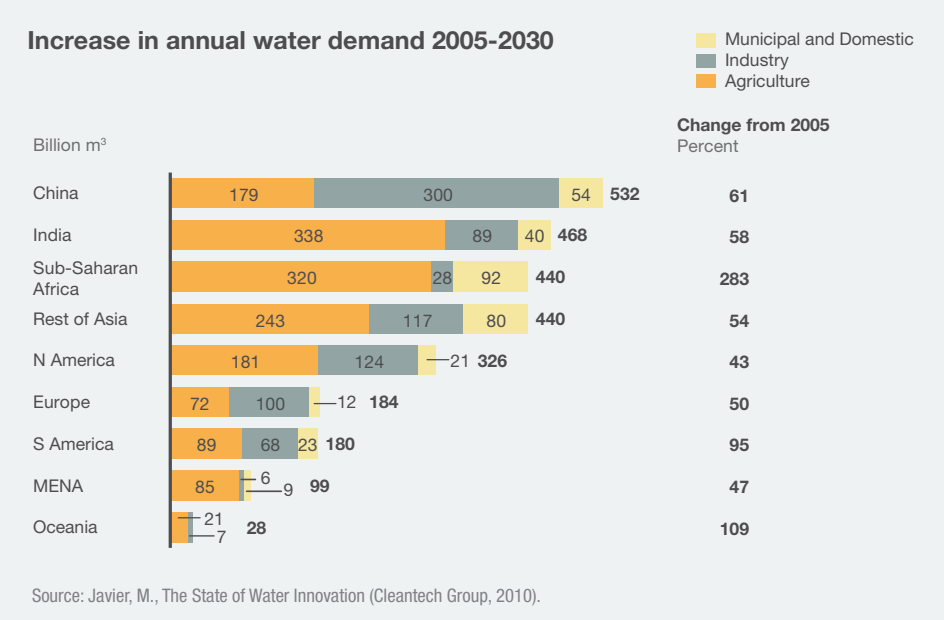
Figure 9: Venture investments in water

Positioning the Canadian water sector for global impact

Looking outside our borders paints a compelling picture of opportunities for Canadian technology and expertise to meet the world's growing thirst for water solutions. In 2008, the Conference Board of Canada identified three promising pathways for Canadian expertise: clean energy technologies, regenerative medicine, and the growing industry in water management. The report authors concluded that water technologies should focus on quality enhancement, filtration, desalination, transmission and usage efficiency, metering, and system management. Canadian strengths in these areas include anaerobic treatment of sludge from municipal and high-strength industrial wastewater, treatment of biosolids resulting from the wastewater treatment process, and desalination techniques for purifying seawater, brackish water and wastewater.

Canada's technology portfolio already includes a number of water purification and quality management technologies, including ultraviolet disinfection and membrane technology, water information systems, and infrastructure maintenance solutions. Three of this country's most noteworthy representatives include ZENON Environmental with its membrane technology for water and wastewater treatment, Trojan Technologies and its ultraviolet water treatment solutions, and Glegg Industries, which provides industrial pure water systems to energy, electronics and pharmaceutical industries. All three companies have since been sold to large US multinationals, leaving Canada with more than 2,000 employees possessing 25-plus years of experience in the water industry.[101] In addition, Canada is home to specialized water investors such as XPV Capital Corporation, Emerald Technology Ventures and Sustainable Development Technology Canada, which have all played important roles in the development of successful water companies.

Canada also has demonstrated excellence in complementary information technology spheres, particularly in the southern Ontario/ Waterloo region, which is also home to renowned groundwater specialists, hydrologists, and water research centres. As demand heats up for services that require the backing of sophisticated monitoring, measurement and analytical capabilities, consideration could be given to how homegrown IT expertise can be leveraged in conjunction with water research excellence to deliver value-added water services. Already, IT industry stalwarts like Intel, IBM and SAP are mobilizing resources to service the water sector.



Source: Javier, M., The State of Water Innovation (Cleantech Group, 2010).

Figure 10 - Increase in annual water demand 2005-2030

"Technology is a global business. Customers across the world want the best products they can buy regardless of the country in which the products were designed and manufactured. Any Canadian company competing in the clean technology marketplace will inevitably, if not already, compete with companies from the US, the European Union, Australia, and increasingly China, Korea, and India."

— 2009 OCETA SDTC Cleantech Growth & Go-to-Market Report

Challenges to Canadian growth

According to the Conference Board of Canada, industry fragmentation is a factor that affects Canada's commercial capacity to excel in the water technology sphere. Most firms in the Canadian water sector operate as suppliers of specialized technologies to municipalities, which as discussed earlier, manage water requirements on a local basis. This specialized deployment structure does not encourage expansion, meaning that few, if any large companies in Canada are yet operating at the commercial scale necessary to participate meaningfully in the global water market. On a related theme, industry observers have also noted a slow-down in mobilizing high profile demonstration projects, which have historically played an important role in lending credibility to and ultimately helping to secure export opportunities for innovative Canadian water technologies.[102]

Earlier in the innovation chain, Canadian technology development is hampered by the shortage of risk capital and investment funding. According to the Cleantech Group, in 2009 there was not a single water start-up company funded by a venture capital company in Canada. This is in contrast to other countries, which are providing support at all stages of the innovation and commercialization pathway, and in so doing, fortifying their homegrown assets and innovation capacity. For instance, nearly 50% of all water related patents are currently being filed in Asia (Singapore, Korea, China, India, Japan etc.), and all five IPOs filed to date in 2010 are Chinese companies.[103] It has also been noted that the lack of a cohesive water sector voice is limiting creation of a world-class water sector in Canada.

Inexpensive water provision can also play a negative role, falling prey to the law of unintended consequences. Principally, basic economics dictates that when resources are scarce, or when input costs are higher, firms have greater incentive to economize and innovate. The absence of this cost driver stymies the development and application of new technologies domestically, thereby limiting opportunities for Canadian companies to ready technologies that may be attractive to buyers in major markets where supply or cost incentives are currently driving demand for water management solutions.[104]

Investing in water leadership

In light of the world's growing thirst for water, nations around the world are positioning themselves as leaders by actively developing and exporting water technologies and solutions.

Germany – *Innovation fueled by public-private partnerships…*

According to 2003 OECD figures, water technologies were Germany's 2nd largest export, and German components for water and wastewater engineering had approximately 16.5% of the world market share – second behind the United States.[105] In 2008, the German Water Partnership (GWP) was created as a joint initiative between the public and private sectors to promote the German water industry. Among its 273 members, the GWP includes five federal government ministries and a wide range of non-government organizations, water associations, scientific and research institutions, engineers and consultants.

Singapore – *A small nation with big global water aspirations…*

Singapore has aggressively positioned itself to be a leader in environmental and water sectors. Under its Ministry of Environment and Water Resources, Singapore established the Environment and Water Industry Development Council, with the goal of becoming "the global environment and water hub for business, investment, research and technology." According to the Singapore Economic Development Board, by 2015 the environment and water sector is estimated to contribute US$1.7 billion to Singapore's GDP and employ over 11,000 people. During the 2010 Singapore International Water Week, an annual conference held in Singapore for the water industry, over US$2.8 billion in deals were secured during the event. Furthermore, while listing a relatively small number of companies, 13 of the 27 cleantech companies on the Singapore Exchange (SGX) operate in the water sector.[106]

Israel – *Where scarcity makes for abundant innovation…*

Israel's regional water scarcity has stimulated the development of advanced water technologies. Added support for the Israeli water industry came in 2006 with the launch of the Novel Efficiency Water Technologies program (NEWTech), which supports Israeli water and energy technologies locally and internationally. There are currently over 150 companies involved in Israel's water sector, according to the NEWTech member listings. Government and private sector funding has allowed NEWTech to establish technology incubators for different technologies, including water. In total, these incubators have brought in over US$750 million in private investment.[107] According to an estimate by the Cleantech Group, the Israeli water technology market is expected to export US$2.5 billion of water technology abroad by 2011. The water industry has also been assisted by WATEC – a NEWTech-orchestrated international exhibition and conference promoting water and environmental technologies that attracted over 20,000 attendees in 2009.

Netherlands – *Cultivating infrastructure expertise that can be exported…*

Local infrastructure has been an important stimulus for the Netherland's foray into the water sector. In 2007, the Dutch parliament approved a 100-year infrastructure plan to extend its coastline, reinforce dikes and build more storm barriers. The government is also exploring the possibility of creating floating communities that could rise above flood levels, as well as lowering and removing some dikes to return land to the water. This US$1.5 billion a year plan is laying a framework for the Dutch to future-proof their economy, increase their capacity in water technology development, and grow their expertise in the nascent water service sector. The Dutch are already building a global export industry around advising other low-lying jurisdictions on flood control and rising sea levels. Increasingly unpredictable weather patterns around the world will only increase the need for these kinds of services.

Thinking big, in more ways than one

Global trends point to great opportunities for Canadian companies in the water sector. However, entry into overseas markets need not follow identical paths. On the one hand, overseas buyers are seeking complete solutions – that is, companies that are able to build, operate and provide complete water facilities or systems. On the other hand, opportunities exist for firms to strategically insert themselves into the broader supply chain of large companies or government buyers seeking to bolster their water capabilities. Often referred to as the 'global value chain' approach, this entry strategy could manifest through such diverse approaches as Selling, Offshoring, Outsourcing, Direct Investment Abroad, Foreign Direct Investment or Joint Ventures and Strategic Relationships.[108] If Canadian companies intend to be influential players on the global water innovation and technology commercialization stage, the implications of these contrasting approaches will require closer attention by policymakers, businesses and investors alike.

Spotlight: scaling up approach

In a study of how to achieve innovation-based global success, the Conference Board of Canada concluded that without a significant increase in the size and capabilities of Canadian firms in collaborative ventures between companies or with governments, companies will be limited in their ability to participate in the global water market. Yet, natural strengths exist in primary sectors like agriculture, mining, or oil extraction, where improvements in water efficiency and productivity has enhanced competitiveness in these sectors, and also has created leadership opportunities in such growth areas as industrial water reuse.[109]

The Conference Board of Canada also suggests that a national approach to water infrastructure management could accelerate the development of a Canadian firm or cluster of interconnected firms to address Canadian wastewater treatment needs en route to developing companies and technologies poised for global success.[110] In this regard, public-private partnership models could provide innovative vehicles for creating scale opportunities that help Canadian companies trial or refine technologies that can be subsequently brought into export markets.

Canadians at work:

GLV Inc., headquartered in Montreal, Quebec has grown to become a leading global provider of technological solutions used in water treatment, recycling and purification, as well as in pulp and paper production – operating in 30 countries with the support of 1,500 employees. Organized under two primary groups, Water Treatment and Pulp and Paper, GLV has expanded through company acquisitions that seek to strengthen its technology portfolio and brand names. Targeting growth markets such as China, India, Australia, the Middle East and Russia, the company's global strategy includes:[111]

1. **Building a comprehensive technology portfolio:** GLV's Water Treatment Group provides comprehensive solutions for the filtration, clarification, treatment and purification of water that will either be returned into the environment, or re-used in various industrial processes and domestic purposes.
2. **Increasing after-market business:** GLV positions itself to build on original equipment sales through profitable aftermarket opportunities such as quality spare parts and optimization services.
3. **Improving operational efficiency:** GLV continuously reviews possibilities for improving efficiency by outsourcing component fabrication to regions with competitive manufacturing cost, such as China and India.

Spotlight:
Global Value Chain (GVC) approach

Ramping up to compete by sheer operational scale alone may not be an accessible strategy for many Canadian water sector companies. Fortunately, today's integrated global economy is presenting alternative routes to capitalize on overseas opportunities. For instance, Foreign Affairs and International Trade Canada is putting greater focus on the 'global value chain' approach to business, which offers a way for firms to deliver greater value to their customers through reduced costs and increased product and service quality. By focusing on what they do best, and using strategic relationships with other partner firms to fill in the gaps, companies are able to strengthen their competitive advantage in ways which would not have otherwise been possible.[112]

On a related theme, Nicholas Parker of the Cleantech Group explains, "who we play with and who we partner with needs to be determined... we need to figure out how we are complementary to the major players out there."[113] To effectively leverage this approach, Canadian companies must be clear about the distinctive, value-adding competencies they can contribute to the larger global value chain for water solutions – and in doing so – overcome barriers that currently pose a challenge for Canadian firms eying a share of the global prize.

Canadians at work:

Quebec City's H2O Innovation, designs, produces, and integrates custom-built water treatment systems for a wide variety of municipal and industrial applications. H2O Innovation systems have supported water reclamation and wastewater treatment in the municipal, commercial, institutional, industrial, oil and gas, mining and energy markets. With a focus on the higher value-added technology and process engineering segments, H2O Innovation has built a keen understanding of market issues and is seizing global opportunities through such strategies as:

1. **Pursuing complementary acquisitions:** Having completed and successfully integrated nine acquisitions in its 10-year history, H2O Innovation searches for opportunities that bring complementary know-how and technologies in-house.
2. **Forging strategic partnerships and alliances:** H2O Innovation seeks to establish partnerships and strategic alliances to penetrate new market segments. For example, it formed H2O Innovation India Ltd., a joint venture based in Mumbai, India to serve the fast-growing local Indian market for industrial and institutional water treatment. Furthermore, H2O Innovation actively forges partnerships with specialized distributors around the world.
3. **Maintaining a distributed manufacturing network:** In addition to its Indian joint venture, H2O Innovation houses approximately 90 employees in eight offices and three manufacturing plants across Canada and the United States.

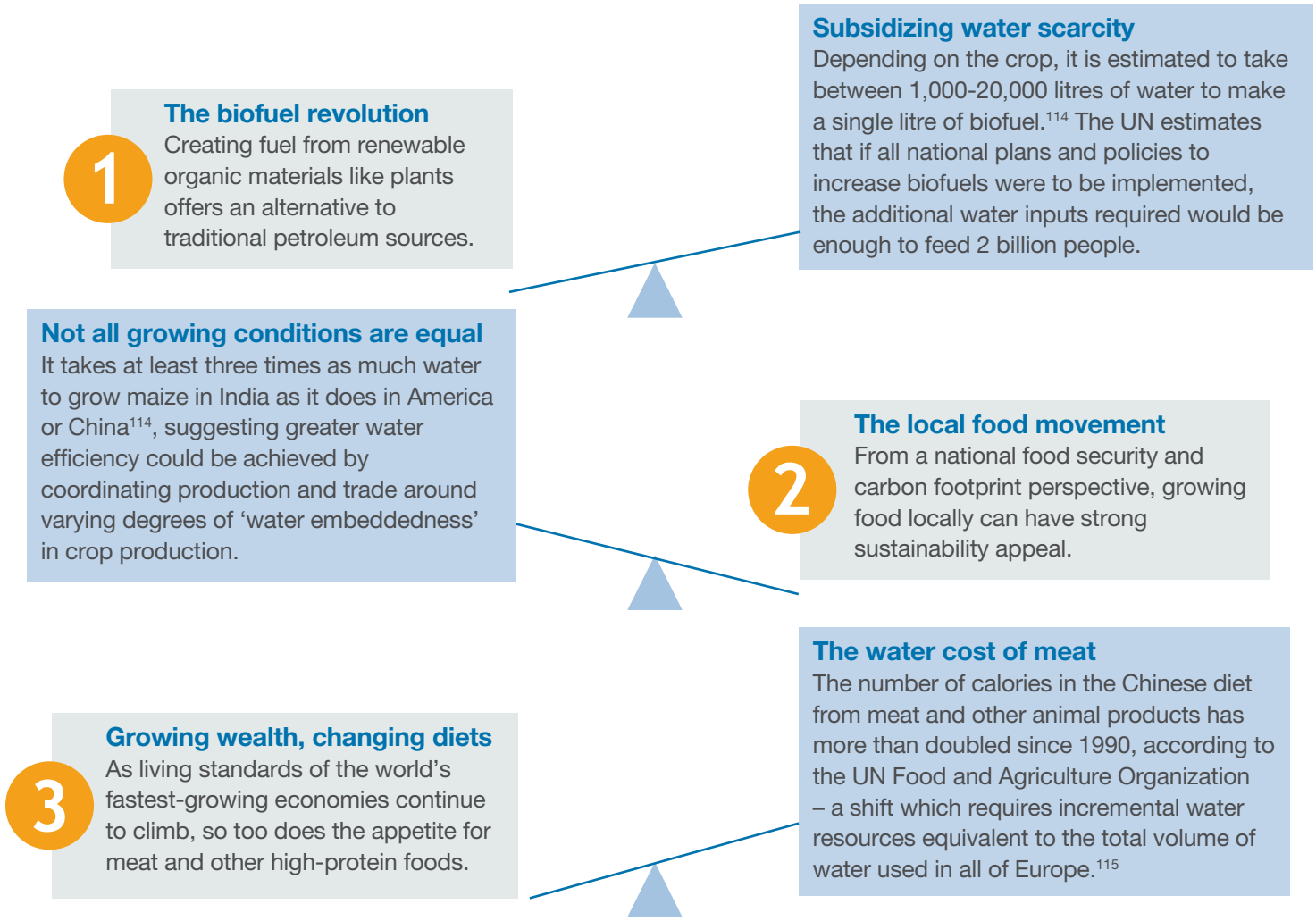
Flowing through the nation's rivers, crops, turbines, products, and quite literally through the veins of every Canadian – water is deeply embedded within our national identity and economy. Our growing awareness of water issues can at times serve as an uncomfortable reminder of how business operations, compliance costs, energy expenditures and infrastructure integrity can fall victim to water risk. Fortunately, amidst this confluence of water threats lies a silver lining. The realization that water sustainability is often more a question of mismanagement than absolute scarcity suggests that informed, corrective measures can, and indeed have been shown to avert water crisis.

Shifting currents

5

The great balancing act

There is growing recognition that positive societal advancements may also produce negative, albeit unintended consequences for water. Recognition of these relationships is not meant to paralyze action or innovation. Rather, it underscores the importance of an integrated approach to meeting our inter-connected web of sustainability challenges, which in many cases will require spanning national boundaries.



Future proofing with benefits

Our global inter-dependency means that within a generation Canadians could be exposed to significant domestic and international water threats. That is of course unless we recognize these threats early and respond proactively. What forward-looking scenarios might we encounter based on our greater understanding of water's embeddedness across the global economy? More importantly, what assumptions about water need to be challenged and how might we formulate strategic responses that not only help to avert serious impacts on the Canadian economy, but also serve to elevate Canada's political and cultural influence over water issues the world-over?

Designing our water future

Myth	Future scenario	Observations	Potential strategic response
1. Water is Always in Season. Canada's plentiful freshwater resources means that we will not be impacted by the same supply shocks as arid regions around the world – especially when it comes to our food supply.	**Global Food Chain Shocks Cause Ripple Effect that Raises Cost of Living.** As 12% of Canada's total water footprint (the water required to produce the goods and services we consume) is embedded in agricultural goods derived from foreign water resources, Canadians are not immune to global supply shocks.[116] With agriculture being the largest user of water globally, increased competition for water to meet population growth may drive up commodity prices across the food value chain and beyond.	Roughly 70% of the water used globally is for agriculture, as much as 90% in developing countries where populations are growing fastest.[117]	**Align our foreign aid, capacity building and water R&D agendas to support water threats in strategic regions most closely linked to Canadian food security, and integrate 'water intensity' considerations into agricultural and trade policy.**
2. Water, Water Everywhere and More than Enough to Drink. With more than our fair share of the world's freshwater sources, Canadians will always have access to a plentiful supply of drinking water.	**Available Water to Canadians Dries Up with Melting Icecaps.** Postcard perfect images of our snow-capped mountains and lakes might make the prospect of local drinking water shortages seem unfathomable. However, our reliance on the natural water storage capacity from glacier and snowcap melting, means that permanent changes to freezing and thawing cycles being exacerbated by climate change could threaten our drinking water supply.	Many western Canadian rivers that are currently experiencing increased flow from glacial melt, are already showing evidence of decline.[118] As glacier melting increases, British Columbia is expected to face increasing water shortages and the drought frequency is expected to double by 2050.[119]	**Ensure Canada's climate change adaptation approach includes consideration of water-related risk.**

Myth	Future scenario	Observations	Potential strategic response
3. Water is Practically Free. Water will continue to be cheap and readily available for the foreseeable future.	**Water-Intensive Industries Shocked by Input Costs.** With growing recognition that we have taken reliable and inexpensive water sources for granted, a shift toward 'full-cost' pricing and more stringent regulations governing access to and management of water assets could raise input prices across the economic value chain, putting water-intensive sectors at special risk.	The price of water in Canada is one of the lowest in the developed world, and per-capita consumption levels are one of the highest.[120]	**Target investment in efficiency innovations and management best practices for strategic, water-intensive sectors such as agriculture, food and beverage, mining and the oil sands.**
4. Crops Need Watering, Not the Industries of Tomorrow. High-tech sectors we increasingly depend on for economic growth do not face the same water pressures as traditional agriculture.	**Water Vulnerability within High-Tech Industries has Cascading Effect Across the Economy.** A wide range of advanced industries – from electric power, biotechnology, pharmaceuticals, IT and its supporting metals/mining supply chain – rely on water for material processing, cooling, washing and cleaning. As such, operational disruptions from water shortages or rising water prices could trigger financial loss and instability across a wide range of technology sectors.	Intel estimates each chip requires 45 litres of water to manufacture.[121] 11 of the world's 14 largest semiconductor factories are in the Asia-Pacific region, where water quality risks are especially severe.[122]	**Invest in developing centres of excellence and export markets for efficient manufacturing technologies to help Canadian and overseas manufacturers shield themselves from water risk.**
5. Promoting Density around Cities is a Good Thing for the Environment. Cities are the engines of economic growth in our knowledge-based economy and are poised to serve the workforce of the future.	**Strain on Aging Urban Infrastructure Puts Public Coffers on the Brink.** Canada's major cities are developing into 'city-region states' with unprecedented infrastructure needs, yet have inadequate fiscal and policy tools to meet the needs of growing populations.	Canada's 27 census metropolitan areas (>100,000 citizens) are home to two-thirds of the nation's total population.[123] Every year, Ontario water main breaks alone cost $40 million and result in a loss of 40% of purified water produced.[124]	**Align cross-jurisdictional funding and property tax/ development fee structures to more appropriately reflect Canada's urbanization patterns and impacts on water infrastructure sustainability.**

Myth	Future scenario	Observations	Potential strategic response
6. Taking Manufacturing Abroad is a Timeless Cost-Reduction Strategy. To stay competitive, Canadian companies can take advantage of lower labour, environmental and regulatory costs-of-doing-business abroad.	**Canadian Companies Going Abroad Face New and Complex Water-Related Pressures.** Companies doing business abroad will encounter new and/or heightened physical, reputational and regulatory management challenges, ranging from more stringent regulation governing wastewater treatment, to increased pre-treatment costs, increased employee health costs, and greater responsibility for financing community water infrastructure and watershed restoration.	20% of Canada's total water footprint (the water required to produce the goods and services we consume) falls outside of the country.[125]	**Through strengthened bi-lateral partnerships, work closely with regions of strategic importance to meet local infrastructure needs, while garnering preferred trade status by enhancing the capacity and reputation of Canadian multi-nationals for implementing progressive water management practices.**
7. Markets will Self-Correct to Manage Future Water Risks. Market forces will act to moderate water risk through price signals, improved information disclosure and shareholder pressure.	**Water Risk Slows Innovation and Efficient Flow of Capital.** Just as markets are coping with climate-related risk, information gaps and investor uncertainty around water could stymie the flow of capital and spread planning uncertainty throughout the market.	The Insurance Bureau of Canada reports that water damage causes about $1.3 billion a year (as of 2008) in insured losses, overtaking fire as the leading cause of damages to homes in Canada.[126]	**Key government departments at all levels to support domestic and international initiatives aimed at improving water disclosure practices, data collection and economic modeling that improves the relevance and quality of information available to market actors.**
8. Canadian Technology will Save the Day. Canadian technology can be at the forefront of alleviating health, social and environmental risks associated with water stress.	**High-Technology Solutions Meet Barriers to Adoption.** While Canadian research institutions and cleantech companies may be developing innovative solutions, large-scale global penetration is not being achieved owed to the relatively small scale of Canadian industry, as well as under-developed understanding of or influence over the 'local context' within which water solutions must be implemented.	As of June 2010, Clean Technology Issuers on the Toronto Stock Exchange contributed a combined market capitalization of $20.2 billion – just a small fraction of the $1.8 trillion value of listed companies in total.	**Invest in creating a vibrant water technology sector through industry clusters and consortium models that enable Canadian companies to operate at a meaningful scale – leveraging flagship municipal infrastructure projects to demonstrate capabilities.**

Myth	Future scenario	Observations	Potential strategic response
9. The Future of Power Politics will Continue to be Anchored in Energy Issues. 'Soft assets' like water are not 'serious' political and economic power brokers.	**Water Eclipses Energy Security as Dominant Geopolitical Driver.** Recognizing the potential for water stress to create social, environmental and political instability around the world, G20 nations will shift their attention toward issues like water scarcity and access to safe drinking water. As water-related conflict and hardship intensifies in water-vulnerable nations, Canada may also be compelled to accommodate a new wave of 'water refugees.'	According to National Geographic, nearly a billion people have no access to clean water, and 3.3 million people die from water-related health problems each year. Between 1948–1999, 87% of conflictive events were related to water quantity and infrastructure.[127]	**Assert Canada's diplomatic and humanitarian leadership by making global water security a dominant foreign policy platform, supported by strategic aid and trade relationships that leverage Canadian technologies and best practice to meet international water challenges.**

Productivity today, competitiveness tomorrow

This report has attempted to stimulate and clarify conversations around the critical intersections between water and the Canadian economy – areas that demand proactive management in order to minimize our exposure to water risks while seizing opportunities in the burgeoning water sector. Whether focusing attention on advancing efficiency, embedding water considerations into business strategy and economic policies, or targeting region and sector-specific threats to water security being exacerbated by climate change, Canadians are not alone in the race to find answers. In fact, a number of forward-thinking nations are already hard at work creating market and policy conditions that, by design, will engender economic returns.

Fortunately, Canada has the innovation track record and technical capacity to become an effective voice at the table. A purposeful approach to harnessing our water assets can create both immediate and long-term benefits for the Canadian economy. Since many of Canada's dominant industries – along with the cities that serve as its economic engines – are highly dependent upon stable water supplies, improved water management could boost national productivity. Looking ahead, the stronger technologies and business models that sprout from local water innovation, could better position Canadian enterprises to compete for high value opportunities in the global water market.

Through this lens, success will be measured by whether Canada can assemble a healthy 'ecosystem' of policies and activities to meet opportunities along the entire water value chain. Such an ecosystem will need to encompass improved regulatory frameworks, effective information flows and incentives, better reporting standards, strong demonstration projects, successful patents, and collaborative business models that facilitate access to global markets. The question that will continue to be explored as we move beyond these pages is whether Canada will seize this critical opportunity to shape the direction and force of the currents propelling us forward.

Let us continue to ask how we might mobilize entrepreneurial, political and societal energy around a vision for the nation that meets our needs at home, while augmenting our influence over water resiliency around the globe. At stake in this fluid conversation is the long-term productivity, competitiveness and integrity of our nation.

Key water terms

Carbon Disclosure Project (CDP) Water Disclosure[128]

The CDP Water Disclosure initiative was launched in April 2010 with the support of 137 investor signatories with combined assets of $16 trillion. The Water Disclosure initiative aims to provide water-related risk and opportunity data from corporations to the world investment community. Covering water management, risks, opportunities, linkages with carbon/energy, and water accounting, the associated questionnaire targets companies in water-intensive sectors such as Oil and Gas, Agriculture, Energy and Mining and Metals.

Ecosystem Services[129, 130]

Ecosystem services have no standardized definition, but are broadly regarded as 'the benefits of nature to households, communities, and economies.' Twenty-four specific ecosystem services were identified and assessed by the Millennium Ecosystem Assessment, a 2005 UN-sponsored report designed to assess the state of the world's ecosystems. Notably, among these 24 services, three areas are currently receiving the most interest worldwide: climate change mitigation, watershed services and biodiversity conservation.

Freshwater Ecosystem Service Valuation[131, 132]

Ecosystem service valuation accounts for the benefits ('services') that different ecosystems provide by placing a monetary value on the service. Freshwater ecosystem service valuation places a monetary value on the goods and services freshwater ecosystems provide such as drinking water, recreation and nutrient cycling. Freshwater ecosystem service valuation studies in Canada have been conducted in the boreal forest, the Mackenzie River watershed, Lake Simcoe Basin, and in several urban areas.

Global Reporting Initiative (GRI)[133]

The GRI is a widely used reporting framework that promotes transparent and reliable sustainability information sharing through sustainability reporting guidelines that can be used by a variety of organizations. GRI guidelines outline the types of information organizations should provide to stakeholders under the categories of Environment, Economics, Human Rights, Labour Practices/Decent Work, Product Responsibility, and Society. The most recent version of the Guideline was published in 2006 and is known as the G3 Guidelines.

GRI Water Performance Indicators[134]

Several indicators about water performance are included in the GRI G3 Guidelines. Water indicators are located under the Environment category of the Guidelines, and suggest that organizations should report on: EN8 - Total water withdrawal by source (Core); EN9 - Water sources significantly affect by withdrawal of water (Additional); EN10 - Percentage and total volume of water recycled and reused (Additional); EN21 - Total water discharge by quality and destination (Core); and, EN25 - Identity, size, protected status, and biodiversity value of water bodies and related habitats significantly affect by the reporting (Additional).

Hydrological Cycle[135]

The hydrological cycle refers to the natural system that circulates water molecules, which are moved through a series of natural processes including evaporation, transpiration, precipitation, condensation, percolation, and runoff. When water is heated by the sun it turns to vapour, evaporates and later falls as precipitation in the form of rain, snow, sleet, hail and fog. Water vapour is also emitted by plant leaves through a process known as transpiration. When the water vapour cools, it condenses to form clouds and can either turn into a liquid or solid (ice, hail, snow) depending on temperature and later falls as precipitation. When precipitation falls on land, it has the ability to move through soil and rocks and percolate (infiltrates) into groundwater systems. Water can be returned to surface water systems such as streams, rivers and lakes through runoff.

Integrated Resource Management (IRM)[136]

Integrated resource management is an approach to planning and decision-making that promotes the use of environmental, economic, social and policy considerations to ensure resources are used efficiently and sustainably. Sustainable long-term benefits should accrue to society by using IRM when planning projects that will make use of natural resources.

Integrated Water Management[137]

A framework for water-related decisions and actions that considers not only company requirements but also the needs and interests of impacted stakeholders and the natural environment.

United Nations CEO Water Mandate[138]

Launched in July 2007, the CEO Water Mandate is a public-private initiative designed to assist companies in the development, implementation and disclosure of water sustainability policies and practices. Participation in the CEO Water Mandate is restricted to existing corporate endorsers of the UN Global Compact.

Virtual Water (Embedded Water)[139]

Water used in the production of goods and services is referred to as 'virtual water' contained in the good or service. The concept of virtual water is important for understanding how global trade might be influenced by water scarcity or water abundance. When a country exports goods and services, it is exporting virtual water to another country. Countries with scarce water supplies may decide to focus on producing goods and services that require less water, and therefore, protect water supplies from being sent abroad.

Water Footprinting

Tightly linked to the concept of virtual water is the practice of 'water footprinting.' This methodology for determining the total water impact of a nation, business or individual has the potential to increase accountability for responsible water use. Water footprinting consists of estimating the direct and indirect water consumed and/or polluted per unit of time, taking into account blue water (freshwater), green water (evaporated water) and greywater (polluted water) for each footprint. Proponents of the idea recommend that the footprint consist of the operational water footprint (water consumed during production and manufacturing) as well as the supply-chain water footprint (including water impacts related to disposal of or pollution resulting from the end product). It is a comprehensive calculation that would have to be supported by careful measurement of a company's consumption and discharge, including metering and real-time monitoring.

Blue Water Footprint[140]

Volume of surface and groundwater consumed as a result of the production of a good or service. Specifically, it is the amount of water abstracted from ground or surface water that does not return to the catchment from which it was withdrawn. Consumption refers to the volume of freshwater used and then evaporated or incorporated into a product. It also includes water abstracted from surface or groundwater in a catchment and returned to another catchment or the sea.

Green Water Footprint[141]

The volume of rainwater consumed during the production process. This is particularly relevant for agricultural and forestry products (products based on crops or wood), where it refers to the total rainwater evapotranspiration (from fields and plantations) plus the water incorporated into the harvested crop or wood.

Grey Water Footprint[142]

The grey water footprint of a product is an indicator of freshwater pollution that can be associated with the production of a product over its full supply chain. It is defined as the volume of freshwater that is required to assimilate the load of pollutants based on existing ambient water quality standards. It is calculated as the volume of water that is required to dilute pollutants to such an extent that the quality of the water remains above agreed water quality standards.

Water Neutral Offset Calculator[143]

The 'water neutral' concept was conceived by Pancho Ndebele at the 2002 Johannesburg World Summit for Sustainable Development. A water neutral calculator is a science-based individual water footprint calculator that quantifies the volume of water used to produce goods used by a traveler visiting another country on a daily basis while on holiday or business. The calculator is linked to a tool that calculates the offset price necessary for each unit of water consumed.

Wastewater-to-Product

A practice by which useful products are being derived from wastewater streams, such as fertilizers, biogases, biofuels and plastics that, for example, can be extracted from wastewater treatment processes. In addition to improving the quality of water released back into the environment, recovery and refinement of useful elements from wastewater streams can produce products with monetary value.

Water-Energy Nexus[144]

Water used to produce energy and the energy used to provide water-related services is known as the Water-Energy Nexus. For example, water is necessary for producing electricity in Canada, through hydro-power or through the cooling of thermal energy plants. Energy, in turn, is required to treat water for human consumption, for heating water for steam or hot water production, and pumping water from source to consumption.

WBCSD Global Water Tool[145]

The WBCSD's Global Water Tool, launched at the 2007 World Water Week in Stockholm, and updated in 2009 for the 5th World Water Forum in Istanbul, is a free and easy-to-use tool for companies and organizations to map their water use and assess risks relative to their global operations and supply chains.

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