Montreal Economic Institute Research Papers

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Freshwater exports for the development of Quebec's blue gold

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Montreal Economic Institute
Ideas for a More Prosperous Nation

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Table of contents

Executive Summary

Fresh water is a product whose relative economic value has risen substantially and will keep rising in the coming years. It has become a growing source of wealth and an increasingly worthwhile investment opportunity. Without better management of this resource, the emergence of water distress can be expected in many highly populated areas of the world.

This study aims to present a general portrait of the possibilities open to Quebec in selling and exporting fresh water, to assess Quebec's competitive advantage and potential in this regard and to define the role and responsibilities that the existence of this potential imposes.

The planet's inventory of water consists 97% of salt water, and more than two-thirds of the rest is difficult or impossible to reach because it is trapped in polar icecaps, glaciers or deep rock. Thus, less than 1% of the water inventory exists in the form of accessible fresh water. Each year, agriculture consumes nearly 70% of accessible fresh water, industry consumes another 20%, and the remaining 10% goes to local or municipal use for domestic consumption and other direct uses. In the past century, annual use of fresh water has risen twice as quickly as population. Canada constitutes an important renewable freshwater reserve in the world with 100 000 m^3 annually per inhabitant and 130 000 m^3 in Québec compared to less than 10 000 m^3 for the United States.

The commercial value of water and the profitability of investing in the infrastructure needed to commercialize it will be determined, when all is said and done, by the cost of desalinating sea water. This will be the most likely and most realistic alternative to long-distance imports. Interest in desalination has grown constantly over the last 50 years. Desalination costs may drop as higher-performance technologies are developed, but despite advances in technology, desalinated water remains expensive and is very sensitive to increases in energy costs and environmental regulation. The equivalent annual cost of desalination is estimated now at a minimum of \$0.65 per m^3.

Transferring water between watersheds is not a recent phenomenon: it has existed for thousands of years. The ancient Egyptians and Romans build impressive aqueducts and dams, some of which still stand today. In the 10th century, the French diverted the Satis River to the town of Douai and diverted the Scarpe River to make it navigable. Today, in the face of shortages, water transfer projects are often presented as an inevitable solution to the problems caused by growth in demand for potable water, and they can also be seen from the perspective of economic development.

A number of projects have been adopted in the past, and others are currently under study to meet problems of potable water scarcity. These projects involve building large dams, as well as immense aqueducts or pumping stations, for water to be sent from places where it is abundant to areas where demand exceeds the natural supply. Transport by floating bags or membranes, a technology which is less expensive and less risky, seems to be on the verge of commercial viability. The process for assessing and adopting such projects must be based on technical feasibility, economic justification, social value, fairness, environmental impacts and legal integrity.

But why do these projects stir up such opposition from various groups in society? Water clearly is a resource that is essential to life, and turning it into a business may arouse fears that it could one day be overexploited. But these fears can be calmed if a legal and regulatory framework is established. Regardless of the fuss, it is not necessary to prohibit trade in water. If parts of the world were to suffer from serious water distress, they will have to be supplied with fresh water, which is just as important to life there as it is in regions that are well supplied with water. Moreover, determining a competitive price for water could be a major incentive for more efficient and economical use of water both in areas where it is abundant and in regions where it is especially scarce, for water suppliers and users alike. Of course, pricing must effectively be competitive.

It is true that NAFTA could create new constraints and impose them on us if fresh water were to be sold commercially. But such constraints would be likely to push the trade partners into developing and adopting water management models that are more efficient and thus socially more acceptable. The constraints of national treatment, reciprocity and protection of foreign investments in international trade agreements create wealth and well-being for societies on a worldwide basis by forcing companies to innovate, increase their productivity and become more competitive, as well as by limiting the discretionary, distortion-creating power of governments, especially through price and market manipulation.

Quebec must reflect on the role it could play were markets for water to be created as a preferred means of meeting the imminent necessity of sharing water resources through trade with people elsewhere on the North American continent and eventually around the world. If the province exported, for example, 10% of its one trillion m^3 of its renewable fresh water per year at a price of \$0.65 per m^3, this would generate \$65 billion in gross annual income. Even if only 10% of this amount is collected in royalties, and even if the technological, economic and environmental difficulties to be overcome are substantial, the amounts involved are considerable.

Quebec must be imaginative in exploiting its water resources. Implementing its freshwater export potential and protecting the environment will pose great challenges, but the biggest danger on the horizon would be to get cold feet in designing and implementing the governance mechanisms for the major infrastructure projects that will be needed for this exploitation.

Introduction: background and issues

Fresh water is a product whose relative economic value has risen substantially and will keep rising in the coming years. It has become a growing source of wealth and an increasingly worthwhile investment opportunity. The reason is simple: as with other natural resources, world consumption of fresh water is growing rapidly, requiring the deployment of ever more costly reserves and procedures for water purification and wastewater treatment. We appear headed for a rather orderly creation of markets for water, first regionally and then on a continental and, eventually, planetary level, with the potential to lead to large-scale transfers of this essential resource.

Without better management of this resource, the emergence of water distress can be expected in many highly populated areas of the world. The United Nations estimates that only a few countries, including Canada, will not be suffering from water stress in 2025 (UN, 2000).

In June 2008, three events reminded us that Quebec cannot avoid looking seriously at its freshwater resources for very much longer. First, Quebec's minister of Sustainable Development, Environment and Parks submitted legislation (Bill 92) affirming the collective nature of water resources and aiming to strengthen protection of these resources, thereby ensuring some control over pollution of rivers and lakes and over water use. The bill sets out the user-pay principle, which seems to leave the door partly open to a system of water royalties, mainly for institutional, agricultural, commercial and industrial users.

These developments are not spelled out clearly in the proposed bill, but there is reason to think that the principle of resources being collective in character, something to be protected and preserved sustainably, together with the user-pay principle and the idea of royalties, indicates an intention to attach greater value to these freshwater resources. To achieve this, citizens, institutions, farmers, businesses and industries will have to be brought to use resources responsibly for the greater well-being of the entire population.

The best way to reach this goal is to inform citizens as water users, along with future operators of freshwater supply services, commercial and industrial water providers and wastewater treatment operators, of water's value and thus of its cost. To convey this information and encourage users and operators to make efficient use of available resources, they will have to be informed of the price of a litre of water and thus of its opportunity cost, meaning the value of this litre of water in its best alternative use. This suggests, in a somewhat distant future, establishing markets for water where buyers and sellers will be called upon to exchange large quantities of water based on competitive prices that can send the correct scarcity signals to users and suppliers alike.

The second event was the Great Lakes Conference held in Toronto in April 2008. Milton Clark, the senior health and science adviser to the U.S. Environmental Protection Agency (EPA), stated that we are headed toward large-scale water wars. Lee Fisher, Ohio's lieutenant governor, said at the same conference that, within 10 years, the states bordering on the Great Lakes could start selling water to neighbouring states in the south, although he later retracted this remark and said he had misspoken (CBC, April 24, 2008)!

The third event was a speech by Angel Gurría, secretary general of the Organization for Economic Cooperation and Development (OECD) at the Conference of Montreal in June 2008, in which he said: "Water is managed contrary to common sense, and its use today is not viable. […] All countries – OECD and developing countries alike – need to introduce policy reforms and scale up best practices to avoid dire consequences. […] We need to attract them [private investors] back to the sector rather than chase them away. As with climate change, energy and all the rest, most investment will have to come from the private sector. […] Water is scarce. […] Through a suitable mechanism for establishing prices, you obtain better allocation and better use for everyone." (*Le Devoir*, June 11, 2008).

These three events should sound the alert. The purpose of this paper is specifically to suggest that Quebec take the initiative and step into the forefront as a manager of freshwater resources. This study aims to present a general portrait of the possibilities open to Quebec in selling and exporting fresh water. In other words, our goal is to assess if it is possible to benefit sustainably from Quebec's competitive advantage in fresh water. To this end, we shall allude to the various market mechanisms that can be considered and to the basic conditions for these markets to ensure efficient resource allocation.

More comprehensive studies on the hydrological particularities of the Quebec context, on the various features and details of markets for water, and on measures or technologies for shipping water for export will be needed if Quebec is to take advantage of the opportunities that could arise for exporting water at the national, continental or world levels. There will have to be particular concern regarding water collection points – ideally, though not exclusively, at the mouths of rivers to avoid disturbing lake and river ecosystems – and also regarding techniques for transfer and shipment. We will return to this briefly further on, but it is not this paper's main focus. Our aim is rather to emphasize Quebec's extraordinary potential, the role and responsibilities that the existence of this potential imposes on Quebec, and the fact that responsible exploitation of these water resources is becoming a continental and even planetary matter and could thus represent a major opportunity for development and wealth creation.

It is important to keep in mind the three interrelated issues we are looking at here: first, flawed water management in Quebec (and North America generally) resulting from inappropriate charges for water resources and leading to unbridled waste by agriculture and heavy industry, among other users; next, Quebec's outstanding potential in water resources, only a tiny fraction of which is used or exploited, thus representing a loss of potential wealth; and finally the chance to develop in Quebec a state-of-the-art industry and advanced expertise in water services and to export these services abroad. These issues can be dealt with independently or jointly. The approach taken here is to look at them jointly as three aspects of the same program for bringing optimal value to Quebec's water resources.

A warning is required here. Matters related to development of Quebec's water resources can easily inflame passions. As much as possible, we shall attempt here to present the issues and challenges posed by developing water resources while remaining aware of the diametrically opposed opinions and visions that clash continually on these topics.

A few very important facts

The planet's inventory of water consists 97% of salt water, and more than two-thirds of the rest is difficult or impossible to reach because it is trapped in polar icecaps, glaciers or deep rock. Thus, less than 1% of the water inventory exists in the form of accessible fresh water.

Each year, agriculture consumes nearly 70% of accessible fresh water, industry consumes another 20%, and the remaining 10% goes to local or municipal use for domestic consumption and other direct uses (Rain Bird Corporation, 2003). In the past century, annual use of fresh water has risen twice as quickly as population. A predictable result is that the value of water has climbed and will keep climbing, continuously and substantially. Furthermore, the government sector remains today the main direct supplier of consumed water: 65% in Europe, 85% in the United States, 95% in Asia and nearly 100% in Canada.

Renewable freshwater reserves in Canada and Quebec

Canada has the world's greatest renewable freshwater reserves, with 9% of world inventory, or 100,000 cubic metres (m^3) annually per inhabitant (FAO).[1] Quebec is especially rich in water resources. With 3% of world reserves (CRECQ, 2001) or 130,000 m^3 annually per inhabitant, it has a relatively large share of the planet's freshwater reserves. Also, the province's topography is such that it is endowed with an impressive number of lakes and rivers. Because of its climate, evaporation rates are relatively low. Also, Quebec accounts for just 0.1% of world population.

The wealth of lakes and rivers is not synonymous with an endless renewable supply of potable water. If a lake's water is drained continuously, it will end up drying out. Lake water is thus not always renewable. Since the aim is not to empty Quebec's lakes and rivers but rather to determine whether it is possible to benefit sustainably from Quebec's competitive advantage in fresh water, it is imperative to define clearly what is meant by the term "renewable resource" so as to produce a realistic picture of the quantity of water available for the purposes of eventual export.

The World Resources Institute defines renewable fresh water as fresh water that is replaced entirely each year by rain and snow and that flows through rivers and various waterways to empty into the ocean (Sprague, 2002). According to the OECD, *total renewable water resources* correspond to the net result of the amount of precipitation minus evapotranspiration (internal resources) plus the contribution of water flows from neighbouring countries, including the underground flow of surface water (OECD, 2006). This definition ignores any storage effect and represents the maximum quantity of fresh water available on average each year. Thus, sustainable use of these renewable resources for purposes of exploitation or export would have very little impact on Quebec's freshwater reserves.

Canada has more than 3,000 cubic kilometres (km^3) of renewable water per year on its territory (FAO; UN, *Environment Statistics*; Allard, 1997). According to the UN, the quantity of renewable water in Canada is 11 times greater than in the United States. In terms of renewable fresh water, Canada can call upon 109,000 m^3 annually per inhabitant compared to 9,800 in the United States (TED, 1999). In Quebec, renewable water is around 1,000 km^3 a year (CRECQ, 2001).

1. The difficulty in measuring freshwater reserves, consumption and withdrawals means that evaluations may vary by source. But the orders of magnitude remain the same.

A portion of this quantity of renewable water infiltrates deep into the subsoil, filling all pores, fissures and ground fractures with water. Quebec has abundant high-quality groundwater. According to the Department of the Environment and Wildlife, Quebec's inventory of groundwater reserves stands at 2,000 km^3, and these reserves are fed by flows of about 15 km^3 of precipitation per year, of which 0.43 km^3 is effectively collected. This represents just a fraction (0.3%) of availability of renewable resources (Arcand *et al.*, 2002). In fact, the total volume of groundwater collected annually in Quebec for all uses, whether domestic or industrial, comes to just 3% of the natural recharge in inhabited areas. This suggests that 97% of the natural recharge remains unused and pours into rivers, seas and oceans. It is obviously used by marine ecosystems, but the water, whether or not it is collected, stored and used, always ends up flowing into seas and oceans.

The Department of the Environment and Wildlife says that, if Quebec alone provided the world's entire production of bottled water (154 billion litres in 2004, according to World Water (2007)), this would represent less than 1.04% of the precipitation that recharges the groundwater layers in Quebec's inhabited areas.

In other words, the volume of *renewable* fresh water in Quebec represents 130,000 m^3 per inhabitant per year, or eight times more than the average volume of renewable fresh water per inhabitant on the planet and 13 times more than in the United States. Overall, this represents nearly a trillion cubic metres of renewable fresh water per year. Quebec uses only 0.5% of its available renewable fresh water, compared to 18.9% in the United States (Latraverse, 1997).

The value of water

The commercial value of water and the profitability of investing in the infrastructure needed to commercialize it will be determined, when all is said and done, by the cost of desalinating sea water. This will be the most likely and most realistic alternative to long-distance imports. A region or country in water distress and able to get sea water could build a desalination plant and produce the fresh water its populace requires. Interest in desalination has grown constantly over the last 50 years. In both economic and technical terms, its feasibility is improving thanks to new and more efficient technologies. In 2005, there existed more than 10,402 desalination units in the world producing 35.6 million m^3 of water a year (WWF, 2007), an appreciable quantity but far less than what is needed. According to the OECD, "these processes use high amounts of energy and discharge concentrated brine effluents that can impact adversely on ecosystems. […] Currently there are more than 7,500 such plants worldwide, 60% of them in the Middle East. [At] a plant for a medium-sized city, such as Santa Barbara (United States) … unit costs are of the order of US$1 per cubic metre of water produced … which is up to ten times the cost from other sources." (Ashley and Cashman, 2006).

Desalination costs may drop as higher-performance membrane technologies are developed, allowing for greater efficiency, especially in the reverse osmosis process.[2] But, despite advances in technology, desalinated water remains expensive and is very sensitive to increases in energy costs and environmental regulation (Larbi Bouguerra, 2005). In effect, desalination creates a number of environmental problems. It causes

2. Reverse osmosis is a purification system for water that contains dissolved material. It uses a very fine filtration system that lets only water molecules pass through. As an example, let us take water that includes solutes, especially salt. If two solutions with different concentrations are placed on each side of a filtering membrane, the water goes through it until the concentrations are balanced: this is the phenomenon of osmosis. By applying hydrostatic pressure (50 to 80 bars), the osmotic pressure is exceeded and the water is forced to go through the membrane in one direction, providing on one side for a greater volume (about 70% starting from ocean water) of water with solutes that are more dilute (thus purer water) and, on the other side, a smaller volume of more concentrated water that serves as a piston. This process was first used by the U.S. Navy to provide potable water to submariners. It is used today on an industrial scale for water purification and desalination of sea water.

substantial greenhouse gas releases because of the fact that it is a highly energy-intensive technology. In addition, plants have to be built on coastal lands that are often ecologically fragile and very expensive. Finally, the impact on local marine ecosystems of taking large quantities of sea water may be problematic, and briny releases from desalination plants also pose serious ecological problems since these releases consist of a concentrate of all substances found in sea water and not retained, in addition to the various chemical substances added in the treatment process (Klymchuk, 2008). Discharging these materials into the ocean, if they are not sufficiently diluted, may modify the natural system of water flows, increase the level of salinity, degrade water quality and disturb ecosystems (IOWater, 1998).

The equivalent annual cost of desalination is estimated now at a minimum of \$0.65 per m^3 in California (Rain Bird Corporation, 2003) and at Tampa Bay in Florida, which in 2006 became the first large U.S. urban area to adopt desalination as a source of potable water (Klymchuk, 2008).

Technologies and options allowing for water shipment

The idea of selling fresh water to the United States is far from new. The call for bulk water exports from Canada to the United States goes back to the 1960s, specifically to the signing of the Columbia River Treaty between Canada and the United States in 1961 (Clarke, 2008).

Historically, techniques for moving water relied on building aqueducts or canals. As noted by Lasserre (2005a, pp. 3-4), "the industrial revolution, by developing far more efficient construction techniques but also extensive energy needs, provided for projects of a new magnitude to be built: the movement of large volumes over great distances exceeding hundreds of kilometres." The author continues by giving a partial list some 70 works providing for bulk water transfers, including some with a transfer capacity of many thousands of millions of cubic metres per year. Examples of this have taken shape in the United States but also in Canada, Central Asia, India, China and Italy. These projects were seen as powerful economic levers to which public authorities were sensitive and even favourable.

Today, diversions via aqueducts or canals have been supplemented by other techniques for water exports. Each of them has advantages but also limits. We will look at the most important of them.

Bulk water transfers

Transferring water between watersheds is not a recent phenomenon: it has existed for thousands of years. The ancient Egyptians and Romans build impressive aqueducts and dams, some of which still stand today. In the 10th century, the French diverted the Satis River to the town of Douai and diverted the Scarpe River to make it navigable.

Today, in the face of shortages, water transfer projects are often presented as an inevitable solution to the problems caused by growth in demand for potable water, and they can also be seen from the perspective of economic development. A number of projects have been adopted in the past, and others are currently under study to meet problems of potable water scarcity. These projects involve building large dams, as well as immense aqueducts or pumping stations, for water to be sent from places where it is abundant to areas where demand exceeds the natural supply. This apparently simple technical solution is characterized, however, by high costs that make projects financially risky, and also by major social and environmental impacts.

The process for assessing and adopting such projects is the same as for any other large-scale infrastructure investment. Projects are judged according to criteria of technical feasibility, economic justification, social value, fairness, environmental impacts and legal integrity. The many examples of bulk transfers enable us today to identify the shortcomings of previous projects so that the negative consequences can be better controlled.

Exporting by tanker ship

Although some attempts have been made and some contracts signed, no company is currently exporting water commercially in large tanker ships. However, small tankers are used regularly to export water over short distances.

Tankers can be modified to transport large quantities of water over long distances. This practice is used intermittently in Japan, Taiwan, Korea, some Greek Islands and the Bahamas in emergencies (Lasserre, 2005b). This technology has even been used at time of war. During the Gulf War, U.S. troops were supplied with water from Turkey. Examples of exports over long periods also exist, but such situations are exceptional.

In Canada, a number of projects have been drawn up in recent years to use tankers for exports. Nova Group Ltd. planned to export three billion litres of water from Lake Superior to various Asian markets. After approving the project, Ontario withdrew the permit it had issued, fearing it would create a precedent enabling U.S. companies to take water from the Great Lakes. The McCurdy Group planned to export 52 billion litres taken from Lake Gisborne, in Newfoundland (Mayrand *et al.*, 2002), but the project was abandoned when a feasibility study showed the project might not be financially feasible (Government of Newfoundland and Labrador, 2001).

At present, the costs of long-distance shipment by tanker make this option disadvantageous, especially when compared to other options such as desalination. On the other hand, this option should not necessarily be rejected. The price of water simply has to go high enough for such projects to become profitable.

Exporting by floating membrane

One of the most promising techniques for transporting water, from a commercial standpoint, is to use floating bags or membranes. This technology seems to be on the verge of commercial viability: it may be feasible and profitable in just a few years to transport water over long distances using these bags.

This technology has many advantages over competing technologies. The greatest advantages stem from the fact that this option is more economical, faster to adopt and environmentally safer. In addition, floating membranes require less capital investment and have much lower operating costs than the main alternatives such as desalination, waterway diversions or pipelines. Compared to desalination, this technique is not only much less expensive to adopt but also releases far less greenhouse gas (Edmonds, 2007).

Two North American companies, California-based Spragg Waterbags and Calgary-based Medusa Corporation, are pursuing efforts to show that export projects using floating membrane can be viable and competitive. The cost of making the bags varies between \$125,000 and \$275,000 (Lasserre, 2005b), far less than tankers, and their upkeep is less costly. In this case, investment in ships is limited to tugs. But water bags do have a drawback, which is that they need infrastructure for filling and pumping, the scope of which is proportionate to the volume of water shipped.

It is obvious that exporting water by floating bags or membranes, tanker trucks or tanker ships is not a solution that will easily eliminate the problems linked to growth in world demand for potable water. On the other hand, this approach would enable immediate assistance in emergencies and would help urban zones in dry areas get supplies from nearby regions. Recent developments in these export technologies, along with anticipated innovations, illustrate clearly the type of creative solutions that can be developed when needs are recognized, especially if researchers and entrepreneurs are put to work.

A history of water export projects in Canada

In Canada, some large-scale projects were studied in the 1960s. These projects covered some of the main water basins in Canada and the United States. Among them was the Great Recycling and Northern Development project, better known by the name GRAND Canal, which involved Quebec more particularly. This project consisted of building a dam separating the southern part of James Bay from Hudson Bay, thereby converting James Bay into a freshwater lake by relying on the many rivers that flow into it. This water could then have been pumped south for human use with power from Quebec's hydroelectric plants.

Similarly, the North American Water and Power Alliance (NAWAPA) suggested diverting 308 billion m^3 of water per year from Canada and Alaska to the United States and Mexico. This project was developed in 1964 by a California company, but for political and financial reasons it was never adopted.

Probably because of the costs and the difficulties involved in exporting water by diversion or bypass, and with water shortages imminent in the United States, other projects have been dreamed up by various promoters. In the early 1980s, projects for export by tanker ship were drawn up, especially in British Columbia (Ross, 1999). Six Canadian companies obtained permits to export 55.5 million m^3 of water annually. These companies were planning to move this water in tankers to distant markets such as Saudi Arabia. Because of widespread opposition, the government withdrew the export permits. The main criticisms were that the environmental impacts had not been assessed correctly, that the permits had been granted at very low prices, and that the exporters were not assuming the full cost of the deal.

Various projects were also proposed in Quebec. For example, in 1985 a company called Canwex 2000 International suggested exporting excess potable water from water purification installations in Sept-Îles (Ross, 1999), using tanker ships. According to the promoters, the company could have shipped one-and-a half billion litres of fresh water per month to the United Arab Emirates.

In 1998, Nova Group Ltd. obtained authorization from the Ontario government to export 600 million litres of water a year from Lake Superior. Protests in both Canada and the United States followed this announcement, and in 1999 the Ontario government was forced to withdraw the permits previously awarded to the company and to prohibit bulk water exports.

A recent study explores the possibility of building a pipeline from northern Manitoba to the United States border to supply the south-western states (Klymchuk, 2008). The sale of just 1% of the fresh water pouring from Manitoba's territory into James Bay and Hudson Bay could generate an annual profit of US$1.33 billion and make Manitoba a "rich" province in Canada with no significant measurable effect on the system's ecology.

At present, the issue of bulk water exports in North America remains a rather explosive subject of debate. In 2004, Thomas Mulcair, then Quebec's minister of the Environment, had to confront the wrath of public opinion, of the official opposition and of part of his own government when he edged open the door to bulk water exports, casting doubt on a major element in the *Quebec Water Policy* of that era.

The main conditions for exporting water

But why do these projects stir up such opposition from various groups in society? Water clearly is a resource that is essential to life, and turning it into a business may arouse fears that it could one day be overexploited. But these fears can be calmed if a legal and regulatory framework is established. Regardless of the fuss, it is not necessary to prohibit trade in water. If parts of the world were to suffer from serious water distress, they will have to be supplied with fresh water, which is just as important to life there as it is in regions that are well supplied with water. Moreover, determining a competitive price for water could be a major incentive for more efficient and economical use of water both in areas where it is abundant and in regions where it is especially scarce, for water suppliers and users alike. Again, pricing must effectively be competitive and kept independent from monopoly power. A parallel can be drawn here with the establishment of market mechanisms and competitive pricing in the matter of greenhouse gases, with carbon exchange, carbon taxes and emission quota systems accompanied by cap-and-trade mechanisms that have already been well tested for sulphur dioxide emissions. Furthermore, selling and exporting fresh water must be assessed like all other projects, with explanations of their advantages and costs and of their options and risks.

Three main premises underlie the arguments in favour of water export projects. First, it is important to emphasize that bulk water transfers already exist in North America, in Canada especially. This is something Canadian public opinion is often unaware of. It is not the United States that has diverted the largest quantities of water: Canada comes first by far in the volume of water transferred (Lasserre, 2005b). Moreover, Canada already exports municipal water from British Columbia to Point Roberts in Washington state, and from Coutts, Alberta, to Sweetgrass, Montana. But these arrangements are viewed more as friendly agreements for the efficient provision of municipal services than as water exports.

Second, water is abundant and underused in Canada, with a substantial surplus. For example, the total volume of groundwater collected annually in Quebec for all uses (domestic and industrial) comes to only 3% of the natural recharge in inhabited areas. Thus, 97% of the natural recharge goes unused and flows into rivers, seas and oceans. This natural recharge should be put to better use and should lead to consideration by researchers and entrepreneurs in the search for clean, environmentally sound procedures that can generate a substantial premium. There is no reason to believe that prohibiting renewable freshwater exports, the zero solution, is what should really be sought. According to a study from the Policy Research Initiative:

"The amount of water that can be removed by a tanker is small relative to the amount of water available – a large tanker load would be about one day's flow of a small river. For example, the all-time minimum flow recorded for Manitoba's Burntwood River is over 200,000 m^3 per day, and Quebec's Rivière aux Outardes has a minimum daily flow of over 900,000 m^3 per day. A large river, such as the Niagara, has a minimum flow greater than 350,000,000 m^3 per day, and, even on a bad day, could fill more than 700 of the largest super-tankers. Therefore, provided the source is selected with moderate care, the taking of the water by itself need not pose any environmental threat." (PRI, 2005b, p. 3).Third, it is commonly admitted that the United States, or at least some areas of the country, like many other regions of the world, will soon be facing a water crisis, and this will create a demand that Canada can turn to profit. An opening to trade in fresh water, with prices set competitively, would promote innovation in technologies for collection, transfer and use as well as more efficient residential, commercial and industrial consumption.

In addition to sociological and political constraints, certain economic characteristics of water may explain the relatively slow development of markets for water (Howitt and Hansen, 2005). First, water has several characteristics that are associated with public services: the cleanliness of rivers and lakes is essentially public, and their exploitation in a particular spot is likely to create impacts on the downstream population, leading to a potential source of conflict if the market mechanisms ensuring balanced compensation for the negative effects on the people living there are not yet operational and functional. Second, fluctuations in water supply can result in the market occasionally narrowing, in other words having relatively few buyers, relatively few sellers, or both at the same time. Finally, water transfers often involve substantial costs and risks as well as major public sector investments in infrastructure for water retention and shipment, requiring an adequate regulatory environment.

Even in the presence of interested buyers and sellers, markets for permanent rights over fresh water are not often sanctioned by the authorities because they lead to substantial benefits for various population segments, for example on employment in sectors that have traditionally benefited from the absence of markets for water and thus of competitive pricing for its use. Agriculture is an example that often comes up in this regard, but other industries that are major users of nearly-free or unmetered water could also be affected.

The technical and financial constraints associated with the trade in fresh water, as well as the possible presence of alternatives at comparable cost in domestic markets, are factors holding back the development of a structured market for fresh water at the world level. It is certainly possible to consider managing domestic demand better, for example with more efficient pricing for consumption and other commercial and industrial uses of water, such as agriculture, but these considerations, despite an obviously vast potential when differences in freshwater use in various countries or regions are taken into account, are not reason enough to ignore the hardships some regions will face in the near future. There have already been many cases listed of potable water exports to communities or businesses that have no valid alternatives at comparable cost but that do have the financial resources to pay the costs of buying and shipping the resource.

The development of markets for water, especially for export purposes, poses problems both in their conception and in their regulation (legal framework). Some of these problems come up in a report from the Public Research Initiative (PRI, 2005a, p. 19):

"We need to better understand what specific objectives water markets can foster most efficiently, and in what context given the existence of other management regimes. Markets reduce state responsibility for prices and allocation, and may thus be more politically acceptable than direct intervention in some circumstances. At the same time, the state has to intervene to ensure environmental or other social goals are met, for example by determining the total amount of water that can be part of trading."

But again, these difficulties are more an opportunity to show imagination in finding solutions to the challenges they pose.

To alleviate resistance to the international trade in water, it is imperative for the potential gains from this trade to be reflected more effectively in pricing. Some analysts hold the view that, to make this pricing more interesting and representative of the value of water, there is a need to implement policies that could enable individuals, in addition to government authorities, to benefit directly from these gains and thus to cope with the opportunity cost of not exporting water (Anderson and Landry, 2001).

For example, a company in British Columbia, Global Water Corporation, has signed an agreement with the town of Sitka, in Alaska, giving the town the right (but not the obligation) to export up to 18,500 m^3 of water annually for the next 30 years. The agreement stipulates that the Canadian firm will pay the town $25,000 a year for the first five years and $75,000 for the subsequent years. In addition, the town will receive royalties based on an ascending scale per gallon when the water is exported. Despite some fears within the community, the fact remains that the project has the support of a majority of inhabitants. In the town's latest referendum on this topic, they backed the project by a ratio of three to one (Anderson and Landry, 2001).

Canada's obligations under the NAFTA

Beyond the reasons blocking the development of markets for water mentioned in the previous paragraphs, one of the main objections in Canada from opponents of exports is that any bulk water export project would create a legal precedent that would later be difficult to challenge. For the moment, water in its natural state (in lakes and rivers) is not subject to NAFTA obligations. The terms of trade agreements apply only insofar as water is viewed as merchandise. Water becomes a *product* when it is collected, stored, bottled or conditioned. Once water becomes a form of merchandise, three major issues arise: national treatment, proportionality and investors' rights.

The North American Free Trade Agreement stipulates that "each Party shall accord national treatment to the goods of another Party in accordance with Article III of the General Agreement on Tariffs and Trade" (Article 301). The concept of national treatment means that American and Mexican companies must be treated the same as Canadian companies regarding access to products and markets. In the field of water exports, this implies that, if water were viewed as merchandise and exports were begun to the United States, it would become impossible for Canadian authorities to reduce or suspend exports unless it also reduced access to products and markets by Canadian companies. If the government decides to give import or export permits to Canadian businesses, it cannot refuse a permit to an American or Mexican business. Canada would thus lose a certain degree of autonomy with respect to management of the resource.

NAFTA further stipulates that the signatory governments can impose restrictions on the export of a product only if "the restriction does not reduce the proportion of the total export shipments of the specific good made available to that other Party relative to the total supply of that good of the Party maintaining the restriction" (Article 315). In other words, were bulk exports of Canadian fresh water to start up, the United States would see itself to some extent as owners of a right over Canadian water resources. The volumes exported could be reduced only if water were rationed proportionately or similarly for Canadian businesses and consumers. Moreover, the export price could be reduced or raised only if the domestic price changed similarly.

It is true that NAFTA could create new constraints and impose them on us if fresh water were to be sold commercially. But such constraints would be likely to push the trade partners into developing and adopting water management models that are more efficient and thus socially more acceptable. The fact that electricity produced by Quebec's hydroelectric plants can be exported is a potential impetus for seeking to be more efficient and effective in producing, transporting and consuming electricity. Why would it not be the same for renewable fresh water? The constraints imposed on the various member countries of the World Trade Organization by international trade and investment agreements are substantial, although no country has expressed the desire to withdraw from the WTO. On the contrary, countries that were not members have sought and applied pressure to get in and become subject to the constraints of national treatment, reciprocity and protection of foreign investments. Apart from the farming sector and its lobby groups, very few industries are fighting for trade to be tightened. The reason is obvious: the rules and constraints of international trade create wealth and well-being for societies on a worldwide basis by forcing companies to innovate, increase their productivity and become more competitive, as well as by limiting the discretionary, distortion-creating power of governments, especially through price and market manipulation.

In addition, according to jurists with the Great Lakes Joint Commission, "the provisions of the NAFTA and the WTO agreements do not prevent Canada and the United States from taking measures to protect their water resources and preserve the integrity of the Great Lakes Basin ecosystem where there is no discrimination by decision-makers against individuals from other countries in the application of those measures," and "NAFTA and the WTO agreements do not constrain or affect the right of a government to decide whether or not it will allow natural resources within its jurisdiction to be exploited and, if a natural resource is allowed to be exploited, the pace and manner of such exploitation" (Johansen, 2001).

Since 1999, the bulk removal of water, including removal for export, from major Canadian water basins has been prohibited following adoption of a strategy aimed at protecting Canadian waters. This strategy reaffirmed the federal government's long-standing position against bulk water removal and was consistent with the 1993 statement of the NAFTA countries that, "unless water in any form has entered into commerce and become a good or product, it is not covered by the provisions of any trade agreement including the NAFTA" (Johansen, 2001). Accordingly, Canada's federal government seeks to focus its approach on protecting water in its natural state to make it a resource management and environmental issue rather than a trade matter.

Despite the federal government's intention to prohibit water exports, it nonetheless remains the case that the provinces have primary responsibility for managing water on their territory, whereas the federal government has responsibility for boundary waters within the limits set out by the *International Boundary Waters Treaty* of 1909.

In Quebec, the *Water Resources Preservation Act* prohibits water taken in Quebec from being transferred outside the province. The act applies to surface water and to groundwater. The Quebec government nonetheless reserves the right to deviate from the law in certain cases such as: 1) the production of electric energy, 2) the marketing of water for human consumption, if it is bottled in Quebec in containers of 20 litres or less, 3) the supply of potable water to establishments or dwellings located in a border zone, and 4) the supply of vehicles (Joint International Commission, 2000). It is also possible, in emergencies, for humanitarian reasons or for any other reason considered to be in the public interest, to lift the prohibition on water taken in Quebec being transferred outside the province.

A few examples of water transfer agreements

As we have mentioned previously, there already exist several examples of water being transferred beyond national boundaries, but these cases remain isolated, and such transfers often respond to particular crises. These transfers, usually by tanker truck, are very expensive and are not normally seen as a viable long-term solution. However, proposals for large-scale, long-term international water transfer projects are viewed increasingly as a solution to water shortages in several parts of the world, essentially for deviations by means of canals. Here are several examples.

Lesotho and South Africa

Water transfer between Lesotho and South Africa (intra-basin) has been in place since 1998 and is seen as the first major transfer at the international level. The main aim of the project is to transfer water from the mountains of the Kingdom of Lesotho to the industrial heartland of South Africa (Gauteng province). The Lesotho Highlands Water Project (LHWP) also includes a hydroelectric component for Lesotho.

This ambitious four-phase project is intended to transfer 2.2 billion m^3 a year to South Africa by 2020. The first phase, begun in 1989, was fully completed in 2004. The agreement between Lesotho and South Africa stipulates that the latter is responsible for the costs related to water transfer, regardless of whether the work is located in Lesotho or in South Africa. These costs account for 95% of the project's total cost. Lesotho is responsible for the costs linked to hydroelectric generation on its territory, accounting for the remaining 5% of the project's total cost. The agreement states that South Africa agrees to share the net benefit with Lesotho, by means of royalty payments shared between Lesotho (56%) and South Africa (44%).

The particularity of this agreement lies in the fact that these two countries do not view water as merchandise. They consider that it is not the water itself that is exported or marketed (usually arising from an approached based on rights or permits). Instead, it is the "economic spin-offs" from the common exploitation of the waterway that are shared.

This project may be quite interesting because it brings into play mechanisms that are analogous to market mechanisms without making water the object of a transaction between buyer and seller. Beyond the fact that this is a water transfer model, it is a worthwhile example of cooperation based on needs and on common management rather than on an approach based on exports as such or on usage rights. Moreover, financing of the infrastructure work needed to implement this cooperation is done in a way analogous to what would emerge from market mechanisms.

Israel and Turkey

The recent agreement between Israel and Turkey on the transfer of water from the Manavgat River also represents a turning point in international water management. This treaty, signed on March 25, 2004, is the first international agreement for the systematic sale of bulk water from one country to another. Turkey and Israel agreed to the export of 50 million m^3 of water a year from the Manavgat River in Turkey for 20 years. The agreement sets out in the longer term the building of a channel that could substantially increase possibilities for water exports from Turkey. An author (Ganem, 2005, p. 188) wrote on this subject:

"Turkey's Manavgat waters lie at the centre of this regional cooperation project. Israel is thus the first buyer of Turkish water resources. […]

The water resources of countries in the region are expected to decrease considerably in the near future [...] whereas consumers and their needs will undergo a large increase. [...] Turkey could benefit from this and fulfil an essential role in resolving this problem even partially, thereby enhancing its place in the concert of Middle East nations. The Israel-Turkey cooperation model is creating imitators, and Lybia, upon announcement of the 'water rapprochement' between the partners, said it was interested [in importing Turkish water]. Today, this perspective is taking shape, and Turkey is preparing to improve its facilities on the Manavgat River. While these facilities provide now for the export of 180 million m^3 of water, the river's capacities are enormous, and better installations could multiply the quantity of exportable water."

France and Spain

A major project for transferring water from the Rhône between France and Spain is current under study. This project has been promoted since 1995 by the French company BRL, which holds a concession from the French government and a right to Rhône water up to 2056. It calls for the construction of an underground channel 330 km long, intended to transfer 15 m^3 a second (1.3 million m^3 a day) from Arles in France to Barcelona in Spain. One especially interesting aspect of this project is that it is presented as an act of European solidarity. It would in fact be the first link in a future pan-European network for managing and transferring water.

Considering the sizable freshwater requirements for consumption, agriculture and industry, as well as the growing number of large-scale water transfer projects on the international scene it seems reasonable to expect that such transfers will develop further in the near future.

Intra-national transfers

In addition to growth in international transfer projects, there already exist a considerable number of intra-national transfers. Some countries have even established national markets for the exchange of water permits.

The western states in the United States have markets for freshwater resource exploitation permits that are among the most efficient and best organized in the world. Colorado, for example, has one of the most active markets. Tens of thousands of acre-feet of water[3] are exchanged annually through private, voluntary transactions. Benefits go to those who ensure sustainable development and higher-value use of the resource on these markets. In recent years, the market has grown significantly, providing a reliable source of water for farmers and for residents of Denver, Fort Collins and Colorado Springs. California, for its part, is poised to catapult to the top rank of water markets following a single agreement for the transfer of over 250,000 acre-feet (or 106 million m^3) of water from the Imperial Irrigation District, one of the country's richest farming areas, to the city of San Diego. The various parties are currently negotiating details of the agreement.

As for Australia, it has the longest and most extensive experience in inter-regional water trading (Craik, 2006). In the 1970s, the states in the Murray-Darling basin conducted a vast reform in the management of their water resources. In the first 10 years after the reform, the trading of permits spread widely among all states in the basin. Meanwhile, water shortage problems continued to grow in the rest of the country. This situation led to expansion of the market, with permits then becoming exchangeable between all the states in the country. The first water transfer from one state to another took

3. An acre-foot of water is a measure of the quantity of water that would fill a basin an acre in area to a depth of one foot; 1 acre-foot = 1,233 m^3 = 325,851 U.S. gallons. One megalitre = one million litres = 1,000 m^3 = 0.81 acre-foot.

place in 1992 in the form of a five-year lease for the transfer of nearly 10 million m^3 a year of water from a river in New South Wales to a cotton farm in the south of the country, Since that first initiative, inter-regional trade in Australia has continued to develop.

In 1998, a pilot project was presented to allow trading in permanent water use permits within the Murray-Darling basin. The project is led by the Murray-Darling Basin Commission, which coordinates all administrative and legal procedures between the participating states. Implementing permanent permits avoids the complications that can result from permit trading involving different legal rights and restrictions. These reforms led to the trading of more than 3.43 million m^3 of water between the three states taking part in this pilot project. The Murray-Darling Basin Commission notes that most water transfers take place between users for whom water has a low marginal value and other users for whom water has a high marginal value such as horticultural or wine-growing businesses. The pilot project was so successful, within a relatively short period, the Commission is considering various strategies that would extend this model to other parts of the country.[4]

Changes in the trading of water use permits could serve as an example for the United States, Canada and Mexico. Instituting a tripartite commission (like the Murray-Darling Basin Commission) would provide a single political authority that could specify or suggest a definition of property rights or rights to removal and use and ensure their application, set out the details for transfers and eventually promote adequate legislation for water use in a given watershed. This type of organization could take several forms, but at a minimum it would harmonize water use rights, making them transmittable and enforceable throughout North America.

4. Similar institution changes – the creation of markets, transferable rights, and royalties – are also under study in New Zealand (Martel, 2006).

Conclusion, analysis and recommendations

In conclusion, we should recall some parameters and estimates of the potential scope of a well planned program for bringing value to our freshwater resources.

As mentioned in the introduction, water is becoming a precious product, a source of wealth and a major investment opportunity. Demographic growth and agricultural development have caused substantial pressure on water resources as on other natural resources. World consumption is rising rapidly and has required putting increasingly expensive potable water reserves into production. Sooner or later, these pressures will bring about a reasonably orderly creation of markets for water, first on a regional basis and then, in the not too distant future, on a continental and eventually planet-wide basis to increase effectiveness and efficiency in the supply and consumption of fresh water and potable water, by means including large-scale transfers of this essential resource.

Less than 1% of the water on our planet exists in the form of accessible fresh water. Agriculture consumes nearly 70% of the accessible fresh water and industry another 20%, with the rest used for consumption. The use of fresh water and its sectoral allocation, along with its ubiquitous waste, stem from pricing rules that are not only obsolete but above all unsustainable because they create considerable inefficiency and inefficacy while the great majority of human beings and inhabited regions are already suffering from water distress.

Quebec has on its territory 3% of the world's renewable fresh water but represents just one-tenth of one per cent of the world's population. This represents a thousand billion m^3 a year, eight times more on a per-capita basis than the average worldwide volume and 13 times that of the United States. Quebec can use only a very small percentage (less than 1%) of its available fresh water and should seriously consider the best way to manage and exploit it. The ever-increasing value of this resource may soon become too high for Quebec to go it alone in its exploitation. It seems highly probable that the pressures to share this fresh water with neighbours both near and far will keep growing. Sharing must mean trading.

The challenges of sustainable inter-regional development

The anomalies, inefficiencies and inefficacies currently found in the water sector are due to a number of causes. First is inequality in the natural geographic allocation of freshwater resources. Next are phenomena linked to demography: high world population growth, significant differences in population growth rates at the regional level, and strong growth in worldwide per-capita water consumption caused in part by industrial development. Finally comes the inefficiency of current regulation and controls instituted by governments, first and foremost the traditionally inadequate pricing of water, both for potable water supply services and for wastewater treatment. We should also mention the direct and indirect subsidies provided by governments, especially to agriculture and the oil industry, which artificially swell demand for water. Charges for water, when they exist, are based most often on a highly flawed calculation of operating costs and are diluted in municipal taxes with no direct link to actual consumption levels rather than being based on the opportunity cost and thus on the resource's value in its best alternative use. For the best outcome, the correction of anomalies, inefficiencies and inefficacies that are particular to the freshwater sector should be accompanied by similar corrections in other areas of the economy.

Despite the official talk of desired goals for sustainable development, it must be said that actual policies have not always contributed to the long-term preservation of freshwater resources or to enhancement of their value. Freshwater use, both sectoral and territorial, largely reflects pricing rules that are not only obsolete and based on principles that have very little to do with exploiting or conserving the resource but that, more than anything else, are becoming ever less acceptable or ethical because they lead to sharp gaps in the relative consumption of the resource. These differences in consumption are not based on a competitive valuation. It is inevitable that the competitive price of fresh water will vary from one region to the next, with problems such as transportation preventing perfect price harmonization at the inter-regional or international level. If prices differ, consumption can also be expected to differ. It will also differ if prices are the same because of other characteristics such as geography, climate and living standards. But the current differences seem to go well beyond what could result from this sort of partial harmonization, with Quebec and Canada generally being areas where per-capita freshwater use is among the highest in the world – double the level in France, three times as high as in Norway or China, four times Switzerland's level and five times that of Denmark or Israel.[5]

As water resources begin to run short in many parts of the world, Quebec has such resources in abundance. Water is worth too much for us to let ourselves keep using it with relative inefficiency. This situation cannot last very long, and international pressure is likely to intensify. Quebec must take the initiative and prepare to exploit its water resources rationally and responsibly with a view to wealth creation based on sharing it and thus trading it.

Considering the perspective of what water shortages in some parts of the world could produce, Quebec must reflect on the role it could play were markets for water to be created. Quebec must act and start looking seriously into the possibility of helping set up markets for water as a preferred means of meeting the imminent necessity of sharing water resources through trade with people elsewhere on the North American continent and eventually around the world. The idea is not to start granting exploitation and export permits now but rather to study the various mechanisms and potential examples of markets. The organization, operation, advantages and disadvantages of the various exploitation models must be analyzed, and there is also a need to devise the laws and regulations that must be instituted to ensure the adequate functioning of these markets. In addition, major modifications to water pricing, for residential, commercial, agricultural and industrial consumers alike, are within our reach. A new pricing system would produce behaviour more in line with developing our freshwater resources in a perspective of wealth creation for all of society.[6]

Trading water and pricing it competitively are the most effective means of bringing more value to our water resources. Determining a competitive price for water is also a way to ensure the efficient and equitable sharing of the resource among the various types of users – residential, commercial, agricultural and industrial. Selling water can finance the investments needed to ensure efficiency in use of the resource. Making it marketable would also force inefficient users to find the capital needed to improve their activities, change their behaviour or modify their actions.

5. According to FAO data for 2006, available at http://www.fao.org/nr/water/aquastat/dbases/index.stm and http://www.fao.org/nr/water/aquastat/data/query/index.html.

6. The Task Force on Fees for Public Services (Montmarquette *et al.*, 2008) came out in defence of this.

However, for markets to be able to function optimally, governments must set clear rules that reflect economic and environmental realities. Regulations must be more supple and flexible: they need to safeguard legitimate regional environmental interest while not unduly blocking trade in water.

Quebec's enormous potential

It is hard to come up with exact figures on Quebec's potential for freshwater exports, for two key reasons. One is that, at present, there exists no complete register of the quantity of water in Quebec. To make up for this shortcoming, Line Beauchamp, Quebec's minister of Sustainable Development, Environment and Parks, proposes creating a Quebec Water Knowledge Bureau (MDDEP, 2008). This initiative would help identify more precisely the quantity and quality of the resource on Quebec territory. Also, it is hard to establish or estimate precisely the price at which water will be exchanged over the next 25 years, even though we already have a cautious estimate ($0.65 per m^3 for desalinated water).

Nonetheless, some specialists have attempted to estimate the benefits that would result from the various scenarios. One of them suggests exporting floodwaters (a renewable resource), intercepting these waters above the falls just south of Matagami before they flow toward James Bay and diverting them to the U.S. market through a series of dikes, canals and pumping stations on various rivers in Quebec, including the Ottawa River. This project would allow for the shipment of 800 m^3 of water per second to the Great Lakes for transfer to the United States. At $0.65 per m^3, the project would generate more than $16 billion in annual income.

Markets for water and thus its export, handled with transparency, flexibility and solid regulation, could improve substantially the way water is managed and used in Quebec. This could create strong incentives for conserving water and would allow for the fair and efficient reallocation of available water to meet our needs. It would also promote innovations and changes in behaviour that would help reduce our consumption considerably without harming our living standards.

Companies in Quebec, with its per-capital potable water reserves that are among the highest in the world, have been almost absent from the international scene both in the supply of potable water to communities and in wastewater treatment. Up to now, the abundance of freshwater resources, along with technological constraints and restrictions on its trade, has resulted in our showing little concern for conserving or developing water. The abundance of our reserves and the limited possibilities of exploiting them have made us poor managers in a certain sense. But this environment is changing quickly, and we need to be prepared now to develop leading expertise in freshwater conservation and commercialization.

Developing and marketing this expertise requires a strategic plan to enable Quebec to become a water management leader. Such a plan involves not only essential collaboration between the public and private sectors but also investment in scientific fields (technology, economics, biology, computer science, etc.) likely to enhance the effectiveness of water management by shaping efficient markets or equivalent mechanisms, both internally – within municipalities, within Quebec as a whole in a given watershed or between watersheds – and externally – between Canadian provinces and between Quebec and the United States or other countries. The huge investments that will be needed worldwide to ensure water supply, wastewater treatment and systematic recycling amount to very large sums, around $180 billion a year up to 2025 (Ashley and Cashman, 2006). Quebec could be in the forefront, helping bring to fruition this vast water infrastructure development effort, and it could benefit from it enormously.

The respective roles of the public and private sectors

The great financial potential of these markets could attract new private-sector investment. But despite these advantages, developing and establishing this type of market presents a certain number of challenges. The success of these markets relies in the end on the legislative framework and the ability of government to establish clearly defined and transferable water use rights that would provide incentives for conservation of the resource and thus for sustainable development.

The government must set out the regulatory framework for the trade in water, sharing of the advantages and costs, and granting of rights to various players. These user rights, which may be limited in quantity over time and space, must make their owners or concession-holders sensitive to the benefits and costs associated with the various uses of water under their governance.

These restrictions must be accompanied by realistic pricing that would encourage consumers and other users to apply the resource responsibly and producing companies to ensure a stable supply. The absence of prices and markets, a ubiquitous situation today in Quebec, leads to waste, makes for development of a less efficient economy and keeps people in the dark as to the value of this resource, thereby holding back fulfilment of a substantial potential for wealth creation.

Two observations already seem beyond question: in all likelihood, Quebec's water export potential is considerable, and harmonious development of this sector will require collaboration between the public and private sectors with clearly defined roles for each of them to maximize effectiveness (fulfilling goals successfully) and efficiency (doing so at the lowest cost). It is precisely because this resource is essentially a collective resource that its development must be watched over. For this to occur, an enlightened partnership between the public and private sectors is desirable.

Wealth and drawers of water

If Quebec exported, for example, 10% of its one trillion m^3 of its renewable fresh water per year at a price of \$0.65 per m^3, this would generate \$65 billion in gross annual income. Even if only 10% of this amount is collected in royalties, and even if the technological, economic and environmental difficulties to be overcome are substantial, the amounts involved are considerable. It is our duty, as exceptionally well endowed holders of freshwater resources, to study realistically and openly the various options regarding their development.

Some will argue, perhaps correctly, that the United States, our natural market and the most profitable outlet for our fresh water, is a very poor manager of its own freshwater resources and that for this reason we should not sell them our water. Meanwhile, it seems others would favour our exporting water to the countries that are the poorest and most deficient in water resources as a form of international assistance. The way to cut this Gordian knot of "dubious" but wealthy consumers and "virtuous" but poor and deficit-ridden consumers is to sell our water to the former and devote part of the profits from the operation to potable water supply operations (digging wells and recovering rainwater) among the latter, a potential annual transfer of billions of dollars. Thus, Quebec water exports would go *indirectly* to the chosen countries without having to consider the feasibility of the transfer in question.

Quebec must be imaginative in exploiting its water resources. Implementing Quebec's freshwater export potential and protecting the environment will pose great challenges, but the biggest danger on the horizon is that Quebec could get cold feet in designing and implementing the governance mechanisms for the major infrastructure projects that will be needed for this exploitation.

Quebec must take the initiative and prepare to exploit this resource rationally with a view to wealth creation based on sharing it and thus trading it. Quebec should act now with the aim of becoming a leader in water trading and eventually in the management not only of water resources themselves but also of potable water supply and wastewater treatment. It must not hesitate to go well beyond statements of intention, and it must avoid the temptation of a policy of isolation.

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Biography

Marcel Boyer, vice president and chief economist of the Montreal Economic Institute, is one of Canada's best known economists. He holds a Ph.D. in economics from Carnegie Mellon University and teaches at the economics department of the University of Montreal, where he currently occupies the Bell Canada Chair in industrial economics. He is also a fellow of the Center for Interuniversity Research and Analysis on Organizations (CIRANO) and sits on the board of the Quebec agency for public-private partnerships. In 2002, he obtained the Marcel Vincent Prize awarded by the Association francophone pour le savoir (ACFAS) for the exceptional quality of his work in social science. He was elected to the Royal Society of Canada and has served as president of the Canadian Economics Association and of the Société canadienne de science économique.

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