ENVIRONMENT AND ELECTRICITY RESTRUCTURING IN NORTH AMERICA

PAPER PRESENTED TO THE NORTH AMERICAN COMMISSION FOR ENVIRONMENTAL COOPERATION

JUNE 2000

TABLE OF CONTENTS

1. INTRODUCTION

The global electricity market is going through a period of profound changes designed primarily to create conditions for greater competition in power generation for the benefit of consumers, and to open up power transmission systems for better integration and more efficient development of markets.

In the United States (U.S.), market restructuring has lowered electricity prices on wholesale markets. However, there has also been a drop in generation reserve margins, leading to price spikes during "peak" periods. This situation is considered transitional. With proper price signals, new generation and transmission projects will get soon in service and will contribute to alleviate the price spikes.

Also in the U.S., the restructuring of retail markets has proven to be slower than anticipated. In fact, the pace of retail access is more noticeable in States where prices of electricity were very high (northeast region), and less in States that already benefit from low cost sources of energy.

Changes in the american industry are encouraging Canadian utilities with low cost electricity to position themselves for new markets. Most Canadian provinces have already announced or implemented important restructuring initiatives, especially Québec, Ontario, Manitoba, Alberta, and British Columbia.

In Québec, the government's Energy Policy (1996) calls on Hydro-Québec (HQ) to help achieve the policy's objective of putting energy to work for Quebecers in accordance with the principles of sustainable development, while taking full advantage of the changes under way in the North American energy industry. HQ Energy Services US inc. (HQUS), a wholly-owned subsidiary of HQ, is currently involved in the Northeastern States markets selling among others the energy produced by HQ. In 1997, HQUS obtained from the Federal Energy Regulatory Commission (FERC) the authorization to sell at market based prices in the wholesale arena.

This paper is the response of HQ to the North American Commission for Environmental Cooperation (CEC) request to contribute at its study on the impacts of electricity restructuring in North America. Summarily, the CEC was established to address regional environmental concerns, help prevent potential trade and environmental conflicts, promote the effective enforcement of environmental laws and encourage a sustainable development based on cooperation and on consistent environmental and economic policies. The present document aims at pointing out, from the HQ and HQ Energy Services US perspective, the impacts of the new regulatory regime ensuing from the electric industry restructuring in the U.S., both at the federal and States level.

As outlined in Section two below, major environmental issues characterize these changes and are of the utmost importance for HQ in terms of commercial threats and opportunities. These issues are raised by the implementation of State restructuring acts, rulemaking orders or policies. They are also anticipated in the US federal bills proposed so far. Section three briefly describes this regulatory background and highlights some examples. Finally, Section four resumes each of the issues listed in Section two, proposes measures that might help to achieve an economic and sustainable electric industry restructuring in North America.

2. ENVIRONMENTAL ISSUES

Industry restructuring in the U.S. could result in increased operation of old coal-fired plants which are less expensive to operate. These plants tend to be substantially more polluting. The U.S. Environmental Protection Agency has so far allowed the existing facilities to operate with significantly higher air emissions rates than new facilities. While EPA intends to implement new rules for sweeping cuts in NO_x emissions by May 1st 2003, owners of coal-fired power plants across the Midwest and Southeast are engaged in a battle to delay the enforcement of these new rules.

When the Clean Air Act was enacted in 1971, it was expected that many older plants would be decommissioned within the short or medium term. Few of the expected decommissionings actually occurred though. On one hand, some observers think that under-utilized capacity in the older coal facilities, especially in the Midwest U.S. could be used under economic pressure. Because of prevailing winds, increased emissions from these facilities would cause adverse impacts in the Northeastern U.S. and in Eastern Canada as well [1]. On the other hand, other analysts consider that several constraints limit the export capacity of coal-fired generators in the Midwest: it appears that excess capacity is available only during night time and weekend hours, that the existing transmission system will not be able to handle additional power transfers, and that high transmission cost would favor more the siting of new combined-cycle gas fired plants close to the Eastern market [2]. Nevertheless, many stakeholders fear that industry restructuring will seriously increase air emissions. Power from older facilities will likely be priced lower and they involve significantly less financial risk than the development of new facilities.

It then makes business sense to move ahead with restructuring in the U.S. with the appropriate environmental safeguards and emissions standards. Otherwise, it could tend to make air quality problems worse. It could also unfairly shift the costs of mitigation among regional economies, and distort the emerging competitive market. Indeed, if there is no proper allocation of pollution costs associated to polluting generation, then that could translate into an unfair competitive advantage. In short, the dirtiest type of power generation would be the least cost power and the ability to pollute would wind up as competitive hedge.

In order to offset market distortions created by the new deregulation on generation, State acts have implemented different market rules. However, unless these rules respect certain criteria, they can also lead to unfair regulations for market participants. HQ is particularly concerned by the following typical issues arising either at the State level or the federal level (given the restructuring bills presented so far) :

- *Renewable Portfolio Standards (RPS)*

RPS consists in the requirement of a minimum percentage of qualifying renewable energy in the retailers' portfolio. We see it as a mechanism to encourage the use and development of sustainable generating resources that, being renewable, help to reduce air pollution. While RPS are precisely designed to include all renewable energy sources, some RPS ignore the merits of hydro generation as an important renewable resource, which contributes to limit the use of fossil fuel fired generation facilities.

HQ believes that RPS should not become market protective instruments for business participants at the expense of consumer interests. Indeed, the true challenge for the RPS is to achieve the development of a renewable energy marketplace at a reasonable cost. It should then help mitigating the price increases expected for electricity (which are likely to double by 2020 if the US attempts to meet its "Kyoto" goal of a 7 % reduction in greenhouse gases are met), and insuring sufficient electricity supply. Consequently, the RPS must recognize hydropower as a viable, low-cost source of renewable power, and let it be fully accounted for within the States portfolios and possibly a national portfolio.

---

[1] National Association of Regulatory Utility Commissioners (NARUC), *Promoting Environmental Quality in a Restructured Electric Industry*, Columbus, Ohio, 1995.
[2] Seiple, Christopher, *"Increased Exports to Northeast Prove a Dubious Proposition"*, in *Public Utilities Fornightly*, July 15, 1997.

To facilitate their implementation and avoid any double accounting of resources, RPS should also be designed to match their requirements with those of other existing information disclosure rules or trading schemes at the regional or international level. The EPA programs for the NO_x and the SO_x and the U.S. "Kyoto" reduction goal are good examples of such integrated mechanisms in a sustainable future perspective. Consistency is critical to the successful implementation of RPS. It helps to create a more certain and robust market.

- ***Reciprocity provisions***

The renewable energy provisions of some of the proposed bills before Congress or those of certain State acts already enacted (New Jersey for instance) could, if not amended, lead to the exclusion of hydroelectricity of Canadian origin, the largest source of Canadian electricity exports to the U.S., from renewable energy standards. Some of those reciprocity requirements would prevent Canadian electricity suppliers from engaging in retail distribution in the United States unless all local distribution facilities owned, controlled or operated in Canada by the electricity supplier (or any affiliate thereof), are subject to open access. Canada-U.S electricity trades are quite significant : in 1999, Canadian electricity exports to the U.S. amounted to about 43 700 GWh for total revenues of 1,9 billion $ CDN. For the same period, the U.S electricity exports to Canada were of 14 600 GWh for total revenues of 387,6 M $ CDN.

It is well established now that free trade is a mean to enhance consumer welfare by way of reciprocal exchange of goods and services. Reciprocity, when used to prevent low-cost producers to compete in the new open market is a barrier to competition and therefore deprives consumers of the true benefits of restructuring. We believe thereby, as Stated by the Ambassador of Canada in the U.S., Mr. Raymond Chrétien, that "...legislation should encourage competition in a non discriminatory manner fully consistent with international trade rules, particularly as the two markets (Canadian and U.S.) restructure at different pace." [3]

At the State level, reciprocity clauses lead to interstate or, when Canadian exports are involved, to foreign barriers. For instance, the "Class II" renewable energy definition provided by the *Electric Discount and Energy Competition Act* of New Jersey illustrates the issue :

"Class II Renewable Energy": *Electric energy produced at a resource recovery facility or hydro power facility, provided that such facility is located where retail competition is permitted and provided further that the Commissioner of Environmental Protection has determined that such facility meets the highest environmental standards and minimizes any impacts to the environment and local communities;* (we underline)

This type of restrictive measures adopted by States under the reasons of environmental or consumer protection leads to clear discrimination against out-of-state producers. In our view, it raises significant U.S. constitutional questions and opens the door to court litigations.

Finally, the fear of market dominance is also frequently at the origin of reciprocity or discriminatory provisions, but we consider that already existing mechanisms can handle such situations. Thus, in most States the Public Utilities Commission have the power to oversee market power situations and order appropriate remedies. The States (and the federal as well) should devise on other means than reciprocity requirements or discriminatory rules to encourage their local industry development.

- ***Trust Funds***

We perceive sometimes a confusion among market participants regarding the respective roles of an RPS and a Trust Fund which is usually associated with a System Benefit Charge (SBC) mechanism.

It should be recognized that, while protecting the environment, RPS is creating a market for both existing and new renewable resources. But its primary goal is not to secure a vibrant market for renewable energy producers regardless

[3] See the letter of Raymond Chrétien to the Honourable Joe Barton, October 22, 1999, **Appendix 1**.

of costs. Its primary goal should be to enhance air quality at the lowest possible cost for consumers, by displacing the use of fossil fuel fired generation.

Conversely, Trust Funds, financed by local consumers through a SBC, should aim at supporting local emerging technologies (e.g. R&D) and helping them to reasonably compete into the transitional market. The confusion between these two incentive mechanisms frequently leads to the exclusion of less expensive renewable energy such as hydropower in order to secure a market for the local renewable generation sources. The cost of RPS is then likely to be higher than necessary for consumers. Furthermore, the renewable technologies market becomes distorted by artificial conditions of entry and goals of restructuring run the risk of not being achieved in a timely and economic manner.

- ***Emission Performance Standards (EPS)***

Some States have adopted standards in order to reduce polluting air emissions within their territory. These standards apply either to generators and to retail suppliers, who have to disclose fuel mix and emissions performance for each generation source. Their fuel mix portfolio is compared to a State's benchmark in tons per MW/h which usually corresponds to the average emissions of the local Pool or control area for each specific pollutant : e.g. SO_2, NO_x, CO_2 and mercury.

The disclosure of information such as power sources and their emissions is a very useful mechanism for consumers when choosing a supplier. However, one problem frequently arises when the EPS ascribe to the electricity imported from a different system (power pool or control area), the average emission attributes of a system of reference (default value), rather than the accurate information when it is available (e.g. Label).

Electricity imported from an identified system should be ascribed this system attributes, and not the average of destination system, or the average of any other. For instance, as actually imposed by the Massachussetts EPS proposal, ascribing the NEPOOL average emission attributes to imported power from HQ which is 93 % hydro, would be discriminatory and commercially harmful.

Incidentally, HQ considers the EPS model rule of the Northeast States for Coordinated Air Use Management (NESCAUM) as a fair design. It allows to assign emissions attributes of the electricity imported from an identified system when the generation information system in use in this power pool is determined as "essentially equivalent" to the one of the destination system. When no essentially equivalent generation information system exists in the source system, the model would assign default emission attributes equivalent to the weighted average emissions of this source system (and not the attributes of any other system). (See **Appendix 2**)

- ***Information disclosure requirements (Labelling)***

Labelling the energy sources is largely adopted by restructuring States as disclosure requirement. A clear and well-understood accounting method is then needed as a baseline. Generators, marketers and consumers are interested in having an accurate description of the fuel-mix and air emissions attributes of their power supply [4], and the actual challenge is to agree on a uniform, neutral (i.e. non-discriminatory) and reliable tracking mechanism. This mechanism is, in our view, the essential condition of success of an healthy renewable energy market.

- ***Trading systems***

Current environmental assessment regimes in North America are not designed to address regional and global challenges in nature (climate change, stratospheric ozone depletion and acid rain). Although it is impossible to

[4] See the HQ label for the 12-month period ending September 30, 1999 at **Appendix 3**

manage these issues at the project level, other types of tools can be implemented at the regional or national level. For example, the sulfur dioxide emission allowance trading system in the U.S. has shown a high rate of environmental efficiency. A similar tool is required for emissions of greenhouse gases, which are currently considered the most serious global environmental issue. As long as there is no formal mechanism to properly address this issue, such as an allowance trading system with a cap on emissions at the North American level, current environmental protection regimes are biased in favor of fossil fuels. In other words, not considering greenhouse gases in these regimes can be considered an "environmental subsidy" to fossil fuels.

Such a trading system could be implemented as well for the RPS. Given discrepancies of these standards between States, demonstration of compliance could be burdensome and costly. For instance, the issue of double accounting cannot be easily resolved without requiring a lot of coordination between all jurisdictions having RPS. Instead, the possible trading of Renewable energy credits (RECs) could then prove to be useful in resolving this issue.

3. THE REGULATORY FRAMEWORK

Restructuring of the electricity sector is under way or completed in most OECD countries as a result of technology development and industrial customer pressure for lower electricity prices in today's more competitive global economy. Other industries, such as natural gas, air transport and telecommunications, led the way in the U.S. in the 1980s and early 1990s. The changes in the U.S. electricity sector were facilitated, in large part, by the Energy Policy Act of 1992 and FERC Orders 888 and 889 of 1996 which provided access to the nationwide transmission system, thus making possible a competitive wholesale market.

3.1 In Canada

Because natural resources are mostly under provincial jurisdiction and because electricity trade is mostly North-South, electricity sector restructuring issues in Canada are addressed almost exclusively at the provincial level. Notably, several provinces (Québec, Ontario, British Columbia) have explicitly indicated in their restructuring plan that environmental protection should be ensured. [5]

In Québec, the wholesale electricity market has been open since May 1, 1997. TransÉnergie, a division of Hydro-Québec (HQ), now operates the transmission system in Québec on a non-discriminatory basis for all North American wholesale customers.

Elsewhere in Canada, only British Columbia and Alberta have opened up their wholesale markets. Alberta is the only province that has opened its retail market, and only partially. As for Ontario, the provincial government plans to open wholesale and retail markets simultaneously by 2001.

3.2 In the United States

At the federal level

In Washington, the politicians are undertaking one of the biggest restructuring the US has ever seen, but seem to have a hard time to reach the needed consensus among them. While FERC orders 888 and 889 aimed at reorganizing transmission in order to open the wholesale market, many States have begun to restructure their retail market. But federal legislation is needed to enable States to implement retail competition effectively (e.g. to modify or repeal outdated federal laws, to cover regional electricity markets, to ensure that the interstate electricity grid is reliable, to establish uniform standards, etc.)

Numerous electricity bills have been introduced at the Congress over the past years, but members of Congress are still debating whether or not the States should be forced to respect minimum restructuring standards. The debate is monopolized by two broad and opposing coalitions, one pushing for rapid introduction of competition, the other arguing for a slower phase-in and cushier terms for the players. Consequently, none of these bills has yet successfully gotten through the legislative process.

While all these bills include provisions that may have direct or indirect impact on the environment, four of them have drawn our attention because of their potential impacts on commerce and trade between Canada and the U.S. In one form or another they should be at the center of intensive discussions during year 2000.

---

[5] See Ministry of Energy, Science and Technology, 1997, *Direction of Change: Charting a Course for Competitive Electricity and Jobs in Ontario*, Toronto, Ontario ; British Columbia Task Force on Electricity Market Reform, 1997, *First Interim Report*, Vancouver, B.C., Ministry of Employment and Investment; Gouvernement du Québec, Ministère des Richesses Naturelles, 1996, *Energy at the Service of Québec. A Sustainable Development Perspective*, Charlesbourg, Québec.

1) The Department of Energy's (DOE) proposal: "Comprehensive Electricity Competition Act" (S1047 and S1048). Introduced in May 1999, it mandates clearly for reciprocity requirements between distribution companies and their affiliates within the U.S. The Bill contains no extra-territorial reciprocity provision.

   On the other hand, the bill would establish a RPS that excludes hydropower and admits only American renewable energy sources.

2) Representatives Largent and Markey's proposal: "Electric consumers' Power to choose Act of 1999" (H.R. 2050). Introduced in June 1999, this proposal would allow reciprocity requirements between States and between Canada and the U.S., referring in particular to the NAFTA "national treatment" principle. The Bill proposes a RPS of 3 % by 2005, excludes hydropower and admits only American renewable energy sources.

3) Representative Barton's proposal: "Electricity Competition and Reliability Act", (H.R. 2944). The initial proposal of this Bill would have imposed reciprocity requirements to the NAFTA members. The potentially damaging impacts of this provision triggered the intervention of the Canadian Ambassador Raymond Chrétien, whose October 22 letter to Representative Joe Barton was raised as one reason to finally drop the reciprocity clause before the Energy and Power Committee. (A copy of Ambassador Chrétien's letter is attached in **Appendix 1**).

Instead of a RPS, the Barton's Bill suggests rather to fund renewable energy producers. The initial proposal of September 24, 1999 would grant a subsidy to "qualified renewable energy facility", e.g. solar, windpower, biomass and geothermal, located in the U.S. During the mark-up period under the Commerce Committee's Energy subcommittee, "small hydroelectric projects" (less-than-30 MW facilities) have been added.

4) The Senator Murkowski proposal : " Electric Power market Competition and Reliability Act, (S. 2098) : The draft copy of Senator Murkowski proposal of 1999 did not impose the opening of retail markets to the States but nonetheless included a reciprocity provision. However, the adoption of the clause is left to each State discretion. It is not clear whether such a clause would apply to Canadian utilities and their affiliates. The draft contains no RPS provision.

At the State level

To date, 25 States have already implemented a law or regulatory policies to restructure their retail market. Among them, 7 States have implemented an RPS. For instance, the following descriptions show how the hydroelectricity status in the portfolio varies from State to State :

- In Maine, the *Act to Restructure the State's Electric Industry* includes hydropower in its portfolio and mandates for a minimum of 30 % of retail sales on an annual basis to be supplied from renewable energy sources. However, its definition limits to 100 MW the eligible hydropower generation facilities. This restriction causes a major problem to HQ who has mainly large unit generating plants whose surpluses are exported in New England.

- In Massachussetts, the portfolio mandated by the *Act relative to restructuring the electric utility industry in the Commonwealth, regulating the provision of electricity and other services, and promoting enhanced consumer protections therein*, provides for two levels of renewable energy sources : a first level establishes the baseline to the RPS requirements that is the actual percentage of kilowatt-hours sales to end-use customers which is derived from existing renewable energy generating sources as to December 31, 1997. The Division of Energy Resource (DOER) is currently establishing the basic percentage to be required by 2003 for retail sales. The result will clarify on its final interpretation of the somewhat ambiguous expression "naturally flowing water and hydroelectric" considered by the Act as a renewable energy source. Notably, the recognition of hydroelectric facilities of all size as qualifying for this definition and the inclusion of the existing long term firm energy contract between HQ and the New England Utilities in the baseline calculation of the existing renewable energy supply in the State is of primary importance for HQ. Starting January 1st, 2003, the portfolio minimum percentage of renewable energy will increase from that baseline with "new renewables" as defined by the law.

The existing renewables start point is critical because the portfolio minimum requirement in 2003 would be of around 13 % renewables instead of 5 % without the HQ contract. Discussions are currently under way trying to clarify the meaning of "naturally flowing water and hydroelectric", and identifying the eligible installations. Unsurprisingly, there are as many interpretations as participants interests.

The second level is composed by the "new" renewable energy sources that represent an increase in generating capacity after December 31, 1997 at an existing facility, or a new renewable energy generating source (as defined by the Act) that begins commercial operation after December 31, 1997. After December 31, 1998, the DOER has discretion to include or not "naturally flowing water and hydroelectric" in the qualifying "new" sources.

- In Connecticut, the RPS implemented by the *Act Concerning Electric Restructuring* divides in two classes. One of these allows for hydroelectricity to be included as a renewable source.

- Equally New Jersey adopted a two tiers RPS in *The Electric discount and energy competition Act*. Hydroelectricity is recognized as renewable in Class two renewable energy, provided though that it is produced from a facility of no more than 30 MW, located where retail market is open to competition. HQ contested strenuously this arbitrary definition as well as its reciprocity provision before the New Jersey Board of Public Utilities.

HQ and HQ Energy Services US intervened before the Regulatory Commissions of all these States to point out discriminatory rules and to call for a truly open and fair competitive renewable energy marketplace. Two important issues were addressed on these occasions: reciprocity requirements and full eligibility of hydropower to RPS.

4. GUIDANCE PRINCIPLES AND PROPOSED REGULATORY MEASURES

In the context of electricity restructuring, many environmental initiatives have been discussed or adopted. This section makes a review of these initiatives, trying to respect the intent of recent restructuring efforts.

4.1 Principles guiding environmental regulation

Environmental protection measures should be designed with the following concerns:

a) The measures must aim at providing **real environmental benefits**, both locally and globally. The reduction of pollution in one area should not be offset by more pollution in another area.

b) The design should consider the **interest of the consumer**. This does not mean choosing the least cost energy option independently of environmental considerations. Air quality is a major concern for consumers, but cost of supply is also a basic concern. Any measure design should try to address both concerns. It means that the environmental strategy should favor "least-cost" options to reduce pollution, therefore achieving environmental objectives at a reasonable cost.

c) Measures should be designed to maintain or establish a "**level playing field**' between entities competing in the same market. This will ensure that the best options are available in each market, no matter if the energy is local or imported. In more extreme terms, it is essential that environmental regulations do not become trade barriers because, in most instances, such trade barriers would limit access to extra-territory renewable resources, prevent the implementation of least-cost measures, increase environmental impacts and create an unfair trading context.

4.2 Principles guiding the assessment of options

When comparing energy options, it is important to consider the following criteria. (For detailed discussion of these issues, see chapter 3 "Comparative environmental analysis of power generation options" in report of the IEA entitled Hydropower and the Environment: Present Context and Guidelines for Future Action, May 2000)

Use life-cycle assessment whenever possible

A life-cycle assessment is an environmental assessment of all of the steps required to create a product. Its goal is to give a complete picture of environmental impacts of products, by including any significant upstream and downstream impact. In the power sector, the assessment should include extraction, processing, transportation of fuels, building of power plants, production of electricity, waste disposal and decommissioning.

It may not always be possible or relevant to produce data with life-cycle assessment. For example, an environmental performance report of an entity may focus only on emissions at plant, because it may be the only portion of the life cycle that a utility has control over.

However, when there are discussions to define "green" power, it is essential to look at the full cycle. Otherwise, the information going to consumers may be misleading. As an example, some recent definitions have included fuel cells as a "green" option. But fuel cells consume hydrogen, which is not a renewable source of energy. If hydrogen is used in large quantities, it will be produced by reformatting natural gas, creating greenhouse gas emissions at a level similar to burning the gas in combustion turbines. Fuel cells are only a conversion process and should not be recognized as a source of "green" energy.

The next page table presents results of life-cycle assessment of generation options (detailed information is available in the previously cited IEA report).

Synthesis of Environmental Parameters for Energy Options

(Life-cycle Assessment)

Electricity Generation Options (classified by level of service)	**Energy Payback Ratio**	**Greenhouse Gas Emissions (kt eq. CO_2/TWh)**	**Land Require-ments** (km^2/TWh/y)	**SO_2 Emissions (t SO_2/TWh)**	**NO_x Emissions (t NO_x/TWh)**	**NMVOC Emissions (t/TWh)**	**Particulate Matter Emissions (t/TWh)**	**Mercury Emissions (kg Hg/TWh)**
Options capable of meeting base load and peak load								
Hydropower with reservoir	48 – 260	2 – 48	2 – 152 projects designed for energy production	5 – 60	3 – 42		5	0,07 methylmercury in reservoirs
Diesel		555 – 883		84 – 1 550	316+ – 12300	1 570	122–213+	
Base load options with limited flexibility								
Hydropower run-of-river	30 - 267	1 – 18	0,1	1 - 25	1- 68		1 – 5	
Bituminous coal: modern plant	7 - 20	790 – 1 182	4	700 - 32 321+	700 - 5 273+	18 – 29	30 – 663+	1 – 360
Lignite: old plant		1 147 – 1 272+		600 - 31 941+	704 - 4 146+		100 – 618	2 – 42
Heavy oil without scrubbing	21	686 – 726+		8 013–9 595+	1 386+	22+		2 – 13
Nuclear	5 - 107	2 – 59	0,5	3 - 50	2 - 100		2	
Natural gas combined cycle turbines	14	389 – 511		4 - 15 000+	13+ - 1 500	72 – 164	1 – 10+	0,3 – 1
Large fuel cell (nat. gas to hydrogen conversion)		290+ – 520+		6	0,3+ - 144	65	2 - 6+	
Biomass: Energy plantation	3 – 5	17 – 118	533 – 2 200	26 – 160	1 110 – 2 540	89+	190 – 212	0,5 - 2
Biomass: Forestry waste combustion	27	15 – 101	0,9+	12 - 140	701 – 1 950		217 – 320	
Intermittent options that need a backup production (such as hydro with reservoir or oil-fired turbines)								
Wind power	5 – 39	7 – 124	24 – 117	21 – 87	14 – 50		5 - 35	
Solar photovoltaic	1 – 14	13 – 731	27 – 45	24 – 490	16 – 340	70	12 – 190	

Source: International Energy Agency, May 2000, *Hydropower and the Environment: Present context and Guidelines for Future Action. Vol. I: Summary and Recommendations, p. 8.*

Consider the reliability and flexibility of options

Each option for generating electricity has unique characteristics which must be considered in planning new supply. These considerations include capacity and energy output, dispatchability, cycling capability, ramp time and automatic generation control. In order to compare energy resources on an equal footing, it is essential to take into account the level of service provided.

A study has been conducted by Hydro-Québec to determine if the commissioning of an intermittent energy source such as windpower, would impose additional backup capacity. Hourly simulations for 7 years (based on actual wind speed measures) were run for scenarios of increased demand, the base case generation being totally hydropower (537 MW of installed hydro capacity providing 2,77 TWh per year). The next table compares scenarios where an 11 % increase in demand is met by more hydropower or wind/hydro combinations.

The simulations show that the introduction of a wind farm, even on an excellent wind site, provides very little service in terms of capacity. If the wind/hydro combination must provide the same level of service as a totally hydro scenario, the wind farms require large additional hydro backup capacity. With 1990 data, a new hydro plant of 56 MW would have met the increase in demand compared to 98 MW of windpower, plus 48 MW of additional hydro capacity.

Can we conclude that these results are applicable to large networks? Yes, the results are valid even in large networks. If a large variety of tools are available to insure reliability, it may reduce the costs of backing up windpower, but these costs would still exist. And if only a relatively small capacity of windpower is implemented, the costs would be proportional to the installed capacity, but again they would not disappear.

Windpower and additional backup capacity

(Scenario where windpower has to meet an increase
in demand relative to a totally hydroelectric generation)

Parameters	**11 % Increase Production Scenarios** Range of results for 1990 to 1996		
	Pure hydro New hydro capacity	**Wind site 1** New windpower capacity + extra hydro capacity to be installed	**Wind site 2** New windpower capacity + extra hydro capacity to be installed
Mean annual wind speed	--	6,8 to 8,0 m/s	4,4 to 5,0 m/s
New required capacity: Hydropower	56 to 62 MW		
Windpower		94 to 120 MW	120 to 146 MW
Additional Hydro backup capacity:		+	+
- Required capacity if same level of service as totally hydro scenario	--	22 to 56 MW	7 to 59 MW
- Required capacity if we tolerate 4 hours of insufficient capacity	--	0 to 48 MW	3 to 52 MW

Source: Hydro-Québec, unpublished data

In practical terms, a rigorous comparison of energy options should include such considerations. And windpower is not the only option requiring backup capacity. Some base load options such as nuclear or cogeneration plants must run always and have no flexibility. They have high use factors, which means that other facilities will be needed to meet seasonal or daily fluctuations. Only a few options such as hydropower with reservoir or diesel plants are flexible enough to cover all demand fluctuations.

Adopt a scientific definition of "renewable energy"

Some definitions of renewable energy in policy documents or restructuring legislation generally reflect a negative perception of large hydroelectric developments and exclude them (partially or completely) from renewable portfolios.

This exclusion of hydroelectricity cannot be justified on scientific grounds. In fact, it is impossible to establish theoretical differences between hydropower and wind power, an energy source always recognized as "renewable". Both wind and hydro are forms of indirect solar energy. Unlike fossil fuels, they do not increase entropy: in other words they convert natural flows of unconcentrated energy in the form of wind or water into the useful form of electricity. Both have very short and efficient energy chains, again unlike fossil fuels which require multiple processing steps. And finally, their operation do not deplete any natural resource.

Moreover, as shown previously, electricity from wind farms is intermittent and the best backup option is hydropower with a reservoir because it is capable of increasing or decreasing production rapidly to compensate for wind fluctuations. This being the case, it is impossible to consider wind power as more renewable than the hydropower upon which its viability depends.

4.3 The misleading preferences among different types of hydropower plants

Some legislation or certification process have made distinctions between different types of hydro plants. These distinctions are generally based on the following two assumptions:
- Small hydro is greener than large hydro.
- Run-of-river plants are greener than plants with reservoirs.

These assumptions are not supported by serious analysis. First, any comparison of options should consider the amount of energy produced. If a small plant has less impact than a large plant, it may not have less impact per unit of energy produced. In fact, it can be argued that the impacts of a single large hydro project are less than the cumulative impacts of several small hydro projects with the same power and generation capacity for the following reasons:

⇒ Geometry tells us that a small object has more surface area in proportion to its volume than a large object; and the difference is quite significant: for instance, when the volume of a cube doubles, its area increases by 60% only. This implies that, to obtain the same reservoir volume, the land mass inundated by 50 projects with 20 MW capacity would be several times larger than the land mass inundated by a single 1000 MW project. This means many more rivers affected and more impacts on land use and habitats to provide the same storage volume as a single large reservoir. This theoretical rule is supported by statistical analysis: the following table, based on existing hydro projects, shows that the average reservoir area of hydro projects may increase up to 8 times for small projects.

Average Size of Hydro Reservoir per Unit of Capacity[6]

Size of plants (MW)	Number of plants in category	Average size of reservoir per unit of power (ha/MW)
3000 to 18200	19	32
2000 to 2999	16	40
1000 to 1999	36	36
500 to 999	25	80
250 to 499	37	69
100 to 249	33	96
2 to 99	33	249

[6] Goodland, Robert. *How to Distinguish Better Hydros from Worse: the Environmental Sustainability Challenge for the Hydro Industry*. The World Bank, 1995.

⇒ Because of this constraint, it is more difficult to design a small hydropower dam with enough stored water volume to meet peak demand and avoid water spilling in time of flood. In a northern environment, water flow fluctuations are significant with low flows in winter, coinciding with peak electricity demand. For instance, the water flow on the Sainte-Marguerite River fluctuates from an average low in winter of 43 m^3/s to an average high in spring of 370 m^3/s. The SM3 253 km^2 reservoir provides a stored water volume of 3 272 hm^3, which enables the 882 MW power house to operate at full capacity when electricity demand is highest. Providing the same stored water volume with small projects would require a much larger total reservoir area.

The second statement assumes that run-of-river plants are greener than plants with reservoirs. This is also not justified. In many cases, run-of-river plants are located on river that are regulated upstream. It is true that they have lower impact, but their existence is dependent on one or numerous upstream reservoirs. It is possible that these plants could not be economically justified without these reservoirs. In such conditions, a fair treatment of hydropower facilities should assume that all plants on a river "share" upstream reservoirs.

In other cases, run-of-river plants are developed on unregulated rivers, without significant upstream reservoir. Two conditions of implementation are possible:
1. The plant is designed to benefit from high flow periods, producing large amounts of electricity in these periods, therefore producing much less electricity during low-flow periods. These plants have no flexibility and requires important backup facilities to meet peak demand.
2. The plant is designed as small as possible to produce relatively constant level of electricity, based on low flow periods. This means that a large portion of the water is sent to spillways during periods of high flow. This approach has fewer local impacts but it can be considered as an inefficient use of good hydropower sites. Backup capacity is required to meet peak demand and other base load facilities are required. In other words, developing **one** site with a reservoir may provide the same electricity service as **two** of these "underdeveloped" sites, therefore having a smaller impact overall.

4.4 Recommendation concerning Renewable Portfolio Standards (RPS)

As it is more and more recognized that hydropower of any size is renewable, other justifications are being used to exclude it from portfolios. The next page table summarizes these potential justifications:

Other justifications to exclude large hydropower from portfolios
(while biomass, windpower and small hydro are recognized)

"Justification" to exclude large hydropower	Facts on large hydropower	Biomass plants	Windpower	Small hydropower
The technology is mature and does not require support	The best sites have been developed and building on new sites will often cost more than gas	Biomass combustion, both in industry and power plants, is well developed (biomass	Windpower technology is well developed, but still more expensive than gas turbines	Technology is the same as large hydro and costs are similar to those of remaining new

	turbines	provides 8% of energy in Quebec)		large hydro
Hydro reservoirs require large areas	Per unit of energy, average area used by large hydro is smaller than biomass plantations (see IEA report)	Biomass is recognized as renewable, even when deforestation's rate is not sustainable.	The land use of windpower is similar to the one of hydropower.	Per unit of energy, small hydro may use more land than large hydro.
Large hydro has serious environmental impacts	Large hydro has virtually no global impact and local impacts can be mitigated.	Coal is often recognized as having the most environmental impacts, but biomass combustion has similar impacts	Windpower requires a backup option (possibly hydro or oil-fired). Its assessment should include the associated impacts	Per unit of energy, impacts of small hydro are similar to those of large hydro.

Source: Hydro-Québec, unpublished data

We can see, from the table, that any justification to exclude large hydro would also exclude small hydro and biomass combustion. For windpower, the analysis is more complex, but if the intermittent character of windpower is considered, it does not have a better performance than hydropower.

In fact, with serious analysis, there is only one concern that remains valid: the fact the current installed hydro capacity is large and could receive an unfair advantage in the design of a renewable portfolio. To address that concern though, excluding hydropower is not the proper approach. It would be much more efficient to adopt different portfolios, one for existing facilities and another for new facilities. In both of these portfolios, large and small hydropower can be included without providing unfair advantage to existing facilities which embedded costs are already partially or completely absorbed.

If the RPS is to encourage the development of more renewable energy, such an RPS should include hydro projects built after 1999. With this approach, existing hydro is not competing with new windpower. The competition would be between new windpower and new hydro (much more expensive than existing hydro). This would widen the opportunities for renewable development, increasing the efficiency of the RPS.

Adopting a separate RPS for existing renewable facilities would also be justified to ensure that existing renewables continue to reduce air pollution in a given region, at a reasonable cost (as in the case of Massachusetts). In this case, hydro can provide large reductions in air emissions, because of its large capacity and low costs.

It is also relevant to note that the current approach to choose and pick renewables has produced a set of States portfolios that are all different. This will create major implementation problems. An approach where all renewables are included fairly would reduce such disparities.

However, the recognition of hydropower facilities of any size as sources of renewable energy should not be perceived as precluding incumbent authorities from buttressing the development of certain type of hydroelectric technology. For instance, a local government may choose to help micro-turbines technology with R&D subsidies or other programs collected through a public charge whereas mature hydro technologies would not necessarily need such a support.

To facilitate their implementation and avoid duplication of efforts, RPS should also be designed to match their requirements with those of other existing information disclosure rules or trading schemes (credits, allowances, etc.) at the regional or international level. The EPA programs for the NO_x and the SO_2 are good examples of such integrated mechanisms. Consistency is critical to the success of the implementation of RPS. It helps to create a more certain and robust market.

4.5 Recommendation concerning Trust Funds

Trust Funds, financed through a SBC collected from electricity bills, generally aim at financing R&D in local emerging technologies, helping them to reasonably compete into the transitional market. Trust funds may also be used to fund energy conservation programs.

There is often a confusion between the purposes of Trust funds and those of RPS. The RPS purpose is to encourage the use of existing or new renewable facilities whereas the trust fund should focus on supporting technological development of emerging technologies. If these respective purposes would be made clear, including the lowest cost renewables in RPS would not be considered an unfair competition relative to more expensive ones such as windpower. The R&D of a specified renewable energy option could then be financed by a Trust Fund. The RPS should not serve as an indirect mechanism to achieve the same purpose.

4.6 Recommendation concerning Emission Performance Standards (EPS)

Some States have adopted standards in order to reduce air polluting emissions within their territory. These standards apply to electricity suppliers who have to disclose the fuel mix and emissions performance of the energy they supply. The average emission rate of their fuel mix portfolio is compared to a local pool or control area benchmark for each specific pollutant, e.g. SO_2, NO_x, CO_2 and mercury.

In order to avoid discrimination and allow for the measurement of the actual level of polluting air emissions in the local pool or control area, EPS should respect the following guidelines :

- Overall, EPS should be consistent with RPS and other disclosure requirements (e.g. labelling);

- The frequent use of the expression "Power pool" to describe the region of origin or destination of the electricity produced may be confusing when such electricity comes from a region where such a pool is not in place. For instance, the Québec province has no power pool but is nonetheless considered as a "control area" where valid information can be collected and used to fulfill disclosure requirement. We propose therefore that definitions such as "imported power" be not restrictive.

- Subject to a credible information disclosure method, electricity imported from an identified power pool should be ascribed the pool (or control area) of origin emission attributes, and not the average of the destination pool or control area. For instance, ascribing the NEPOOL average emission attributes to imported power from HQ, which is 93 % hydro, does not reflect the reality of avoided polluting emissions in New England. [7]

- The electricity imported from an identified power pool (or control area) should include any purchase or exchange of energy made by the power pool of origin aiming to satisfy its total load and exports.

To date New Jersey, Connecticut and Massachussetts are considering to implement EPS. With respect to consistency, we recommend that these States adopt the NESCAUM EPS model Rule (See **Appendix 2**).

4.7 Recommendation concerning information disclosure requirements (*Labelling*)

Labelling the energy sources is largely adopted by restructuring States as a disclosure requirement. A clear and well-understood accounting method is then needed as a baseline. Generators, marketers and consumers are interested in having an accurate description of the fuel mix and air emissions attributes of their power supply [8], and the actual challenge is to agree on a uniform, neutral (i.e. non-discriminatory) and reliable tracking mechanism. This mechanism is, in our view, the essential condition of success of an healthy renewable energy market.

---

[7] See Massachussetts EPS proposal.
[8] See the HQ Label for the 12-month period ending September 30, 1999 in **Appendix 3**

The information to be included in labels should follow the same guidelines as the ones recommended above for EPS.

4.8 Recommendation concerning "Green Certification"

Independent environmental certification is a recognized tool which facilitates the marketing of environmentally preferable electricity. However, there is little consensus around the definition of "green power". A scientific framework capable of assessing the full range of power production options is thus needed to support environmental marketing claims.

A life-cycle assessment of the environmental attributes of the electricity product and of the electricity supplied in the control area could serve as a credible basis. This scientific approach could support the claim of lower impacts for specific environmental indicators when compared to a regional baseline.

4.9 Recommendation concerning Renewable Energy Credits (REC)

Emission allowance trading systems have demonstrated a high level of environmental efficiency. This tool has been successfully implemented for sulfur dioxide and nitrogen oxides.

This approach could also significantly increase the efficiency of RPS. Given the discrepancies of these standards between States, demonstration of compliance could be burdensome and costly. For instance, the issue of double accounting cannot be easily resolved without requiring a lot of coordination between all jurisdictions having RPS. Instead, a Renewable energy credit (REC) system could prove useful in resolving this issue. The design of the system should take into consideration the possibility of extending trading on a national and international basis.

HQ would favor the implementation of a REC system that would recognize one credit for each kW/h of renewable resources and the associated attributes. Such system would have the following advantages :

- Encourage market efficiency;
- Reduce the burden of complying to the RPS;
- Ensure a control over multiple accountings.

4.10 Recommendation concerning Tradable Permit Systems to manage Greenhouse Gas Emissions

Previous sections have focused on tools that have been adopted and discussed in various restructuring efforts. They are well adapted to the new context. One must remember however, that a central underlying goal of all these tools is to reduce atmospheric emissions.

As mentioned, tradable permit systems are very efficient environmental tools and current systems (SO_2 and NO_x) could be expanded. But the most efficient tool, very well adapted to open markets, would be the implementation of Canadian and American permit systems to manage greenhouse gas emissions. If these systems could be harmonized, they would ensure environmental efficiency with a level playing field. The environmental efficiency of such an approach would be high because reducing greenhouse gases also contributes to the reduction of other air emissions. In fact, permit systems managing greenhouse gas emissions could replace many complex initiatives discussed previously, because they would provide strong incentive to develop renewable resources which have low CO_2 emission factors.

5. CONCLUSION

Two basic elements stem from the electricity restructuring in the U.S. : 1) the energy cost reduction in the best consumers interest by opening the market to competition ; 2) the environmental protection and, if possible, its enhancement in order to achieve sustainable development of the energy sector. Legislators and regulators have to reconcile these apparently two opposite goals. Hence, there should be equilibrium between energy development and ecology development, basing both on an efficient utilization of existing technologies and technological innovation.

The impact of the electricity sector restructuring on the environment has been analyzed and debated at the U.S. national and regional levels. It is expected that utilities under competitive pressure to retain their customers will find it difficult to support the various social and environmental goals they have supported in the past. Environmental issues, in particular measures favoring renewable sources of energy, have therefore been addressed in recent legislative proposals in Congress which aim at introducing retail competition nationwide. Many States where retail competition is enforced have as well enacted environmental provisions via their market rules.

What the industry faces now is the danger that certain market rules apparently designed to protect the environment rather protect market participants. By introducing market bias these rules precisely fail to achieve the environmental goal by narrowing the eligibility of renewable sources such as hydropower. In this paper we sought to demonstrate that such an approach is neither scientifically sound nor in the best interest of consumers.

What we also observed, is the potential establishment of barriers to trade by the exclusion of hydroelectricity, totally or partially (large scale hydro) from the RPS, or by the inclusion of reciprocity requirements. For instance, excluding hydroelectricity from a federal RPS would deprive Canadian producers of an important market share in the U.S. (7,5 % on the 2010 horizon, following the DOE bill proposal). Given that more than 70 % of Canadian electricity exports are from hydropower sources, such exclusion would be very harmful. The most adverse impact of not qualifying hydropower in the renewable resources will be an exclusion of the emerging potential renewable markets that are required by consumers.

The exclusion of hydroelectricity from RPS will be costly for consumers and their environment. Just remember that emerging renewable sources still tend to be limited substitutes to hydropower. Wood waste and landfill methane may represent competitive options but with relatively low power output. Wind and solar energy sources are still too costly and provide energy on an intermittent basis only. By contrast, the remaining economic potential of hydropower is significant: 114 TWh/year in Canada [9] and 51 TWh/year in the U.S [10]. The development of 50% of that potential replacing coal and gas generation would enable the avoidance of greenhouse gas emissions equivalent to those of 37 million cars.

Finally, other market rules implemented to support the restructuring such as EPS and labelling, must be consistent with a global and sustainable market, be it at the regional or the continental level. Consistency with eventual trading schemes is highly desirable.

Hydro-Québec would consequently like to make the following recommendations :

1) RPS design should achieve a balance between price to pay and adequacy of supply. To succeed regulators should :
adopt a scientific definition of "renewable energy" ;
include life cycle analysis methodology in comparison of options ;
consider the level of reliability and flexibility of generating options ;
establish a level playing field in environmental protection regimes ;
keep in mind the long term consumer interest ;

2) Environment related market rules (e.g. RPS, EPS, labelling and disclosure requirements) must respect a more global and consistent approach;

---

[9] Energy, Mines and Ressources Canada, *Electric Power in Canada*, 1990.
[10] Water Power and Dam Construction, *The World's Hydro Resources*, August 1992.

3) Reciprocity provisions should be avoided in regulatory language in order to respect each jurisdiction pace of restructuring ;

4) Different restructuring jurisdictions should make an effort toward the implementation of regional or continental trading schemes.

Even in a context of increased competition, the electricity sector can improve its environmental performance, provided proper measures are devised following a rigorous approach, including a fair treatment of all generation options. Incorporating the dimensions presented above would result in changes to measures which are generally proposed or adopted, such as the inclusion of hydropower of all sizes in the definition of renewable energy.

Ensuring equity between energy producers, while aiming at environmental efficiency, calls for the implementation of similar environmental goals and trading instruments in North America. Should a fair consensus emerge from the different stakeholders, there would be no need for a rigid re-regulation of the generation part of the electric industry. The market could develop itself an efficient compliance system that addresses the global threat of climate change while according amply to the free trade spirit of NAFTA.