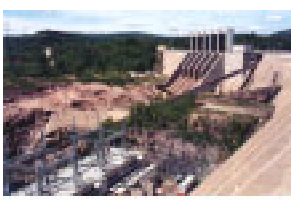
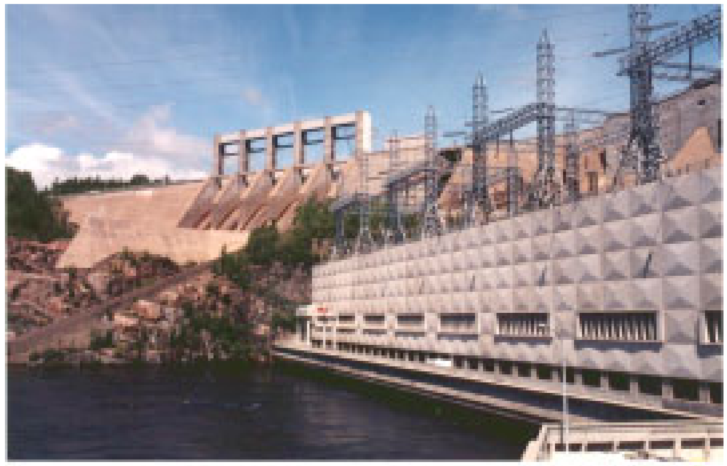
IMPACT ASSESSMENTS AND SUSTAINABLE DEVELOPMENT: TOWARDS A MACROECOLOGICAL PERSPECTIVE





REPORT SUBMITTED TO THE EVALUATION COMMITTEE FOR THE DIRECTIVES FOR THE IMPACT ASSESSMENT OF THE EASTMAIN-1-A AND RUPERT DIVERSION PROJECT

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Group of Applied Research in Macro-Ecology (GRAME)

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The Group of Applied Research in Macro-Ecology (GRAME)

GRAME is an environmental non-profit organization comprised of researchers and independent expert consultants in the development of analysis and management tools. It aims to promote sustainable development by addressing issues affecting both the local and global levels. The multidisciplinary nature of the research team allows for an in-depth and diversified analysis of environmental problems.

Founded in 1989, GRAME has carried out many studies and published several reports[2] on such diverse subjects as cogeneration, urban sprawl, climate change, the use of economic instruments as management tools, the management of tradable emission permits and the development of energy efficiency programs. Also noteworthy is its active role in numerous public discussions on energy related questions, the publishing of a book, *L'autre écologie* (1995), which primarily discusses the reduction of greenhouse gases (GHGs) in relation to urban sprawl and the transport sector, and the completion of several scientific inquiries. The latter have dealt, most notably, with economic incentives to increase the energy efficiency of vehicles, environmental externalities related to different energy sources, and the simulation of a network of wind farms in Quebec. Throughout its 14 years of activity GRAME has also participated in the implementation process of the United Nations Framework Convention on Climate Change and on the implementation of the Kyoto Protocol. GRAME has also partaken in many activities of scientific popularization, including the 2003 Forum on the implementation of the Kyoto Protocol and the community campaign "ClimAction".

As a part of its ongoing work to promote sustainable development, GRAME is proud to partake in the evaluation of the Eastmain 1-A and Rupert diversion project. The following report presents GRAME's reflections, viewpoints and concerns related to the Draft Directives for the preparation of the impact assessment of Eastmain 1-A and the Rupert diversion.

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[2] Including the participation in various public consultations on projects of cogeneration, on the Gentilly-2 nuclear generating station, the Ste-Marguerite 3 generating station as well as many other projects by Hydro-Quebec and Gaz Métropolitain, notably for the Energy Board ("Régie de l'énergie").

1. Introduction

The Evaluating Committee (COMEV), which is comprised of Quebec and Canada government representatives and the Cree regional administration, has the mandate to establish the Directives for the preparation of the impact assessment of the Eastmain 1-A and the Rupert diversion project.

In May 2003, the Evaluating Committee published its "Draft Directives" which we analyse and comment upon in the present report.

In an ideal world, every energy source would entirely internalize its environmental costs. This principle should be applied, by and large, to all energy options, including fossil fuel-based power generating stations. The options with the lowest costs – including, economic, environmental and social costs – would then automatically be privileged.[3] Though this ideal is far from realization, we must nonetheless adopt the tools that at least allow us to favour the best energy options based on the whole of the criteria. The current process falls within this approach.

Such an approach must be objective, pragmatic and reflect the experience acquired throughout the past 30 years in similar projects, particularly in the James Bay area. It must also take into account the new energy context, including the opening of markets and present-day environmental concerns, particularly the recent ratification of the Kyoto Protocol by the Government of Canada and the consequent commitment to reduce greenhouse gas emissions.

It is important that the anticipated environmental, economic and social impacts of the Eastmain1-A and Rupert diversion project be properly identified and that, when the case arises, attenuative and compensative measures be proposed.

[3] This also includes energy efficiency whose full potential could only be achieved if there was a generalized increase in energy prices.

The objective must remain the elaboration of directives that allow for an impact assessment of the project from which we may determine if the environmental, social and economic costs outweigh the benefits.

We do not question the obvious need for a rigorous and comprehensive impact assessment, but seek to define the right measures of precision for relevant information, and fair treatment in order to ensure that hydroelectric projects are not unduly penalized in favour of more environmentally deleterious power stations which, in turn, are currently subject to a much simpler and quicker approval process.

Indeed there exists a flagrant discrepancy in the treatment of this energy option regarding the consideration and internalisation of its social and environmental impacts. Hydroelectric projects therefore remain those projects where costs are most internalized:

> (…) Hydroelectric development is paradoxically a victim of its own ecological virtues: victim of the fact that it does not export its impacts, that it does not dilute them into the atmosphere, it does not externalize them and it does not transfer their weight to future generations. Failing to see the fundamental advantages of hydroelectric power seems to be an aberration resulting from what can be referred to as “not in my generation”.[4]
>
> Guérard et Drapeau, 1993

Nearly three decades of environmental follow-ups, notably at James Bay, should allow us to address the directives of the impact assessment better in order to obtain the required information so that the proper decisions be taken, including suitable mitigation and compensation measures and the evaluation of different possible variants of the project.

[4] Translation from the original : “ (…) le développement hydroélectrique est paradoxalement victime de ses vertus écologiques : victimes du fait qu’il n’exporte pas ses impacts, qu’il ne les dilue pas dans l’atmosphère, qu’il ne les externalise pas et qu’il n’en reporte pas le fardeau sur les épaules des générations futures. Ne pas voir ces avantages fondamentaux de la filière hydroélectrique nous semble être une aberration découlant de ce qu’on pourrait appeler le syndrome « pas dans ma génération. » ”

2. GUIDING PRINCIPLES FOR THE IMPACT ASSESSMENT

2.1 *Sustainable development*

In the wake of the ratification of the Kyoto Protocol, Quebec's socio-environmental context, its international context and its sustainable development options, need to be revised. In this respect, the Evaluating Committee has had the insight to introduce the *problematique* of sustainable development with a definition that respects the World Commission on Environment and Development's report of 1987.

The concept of sustainable development comes within the scope of a development that can be generalized and perpetuated without challenging the very premises upon which it is founded. For instance, a development based on polluting and finite fossil fuels, which destroys its own resource base and the well-being it is meant to provide, is unsustainable. A hydroelectric project that displaces populations, without adequate compensation measures, is equally contradictory in its pretensions for social progress and therefore equally unsustainable.

The event of the United Nations Framework Convention on Climate Change (UNFCCC) and the application of measures incurred by the Kyoto Protocol support the development of renewable energy, which constitutes one of the most concrete efforts toward sustainable development and toward the reduction of greenhouse gas emissions (GHGs). To this effect, the *Climate Change Plan for Canada* recognizes the pursuit of hydroelectric projects as an integral part of the solution by highlighting that:

> An increase in the production and use of renewable energy will be key to meeting our climate change objectives. Renewable energy includes hydroelectricity, which is already widely in use in Canada, as well as emerging sources of renewable energy such as wind, solar and biomass.
>
> *Climate Change Plan for Canada,* (2002) p. 34.

Hydro Quebec, in accordance with its directive to promote sustainable development, must now contemplate future renewable energy projects in order to "meet the needs of the present without compromising the ability of future generations to meet their own needs."(World Commission on Environment and Development, 1987).

> …However, sustainable development is not a state of fixed harmony, but a process of change whereby the exploitation of resources, the direction of investment, the orientation of technological progress and changes to institutions correspond to the needs of both the present and the future. We cannot seek to affirm that this process will be simple or easy. On the contrary, it will be necessary to make difficult choices...[5]
>
> *Ibid*, 1987, p.29.

The selection of the project in question should therefore take into account appropriate economic analysis, but also and more importantly, the capacity of the project to respond to the requirements of sustainable development while respecting the integrity of the affected areas as much as possible.

The promotion of sustainable development should be a fundamental objective of the environmental assessment. The "Draft Directives for the Preparation of the Impact Statement for the Eastmain-1-A and Rupert Diversion Project" state two principles associated with the objective of ensuring sustainable development:

- **The degree to which biodiversity of the region is affected by the project**
- **The capacity of renewable resources, which may be strongly affected by the project, to meet the needs of the present and those of the future.**

It is fundamental that the analysis of these factors be undertaken by clearly outlining the steps leading to the goal of sustainable development and that the integrity of the ecosystem at the micro-ecologic scale is not conserved at the expense of that of the macro-ecologic scale. A new perspective must be developed in order to take into account the global impacts of energy projects in the short and long terms.

[5] This quote is not identical to that found in the French version of the present report.

3.2 Public participation and traditional knowledge

The foundations of sustainable development itself suggest that great importance be attributed to questions of equity among generations, peoples and nations for any decision related to the production and consumption of energy. Members of the First Nations, by their experience of the surrounding environment, have unique knowledge relevant to the Eastmain 1-A and Rupert diversion project. **The directives ascertain that the traditional knowledge that must be relied upon and analysed for the project in question is the knowledge, understanding and values of the Cree.** We add that **particular attention must be given to the points of view and recommendations of *all* aboriginal nations whose territory and way of life are affected by the environmental alterations that would be incurred as a result of the hydroelectric project.** We must also take into account the global environmental impacts, irrespective of borders and generational divisions and for this we must include, as much as possible, all of the communities that would be affected by the project. Bearing in mind the context of Northern Quebec and of James Bay, the integration of economic, environmental and social aspects must be ensured at the local and global levels.

4. Justification for the project

4.1 *The project's "raisons d'être"*

Will there be a need for the energy that would be produced by the Eastmain 1-A and Rupert diversion project? To answer this question, in the present context, we must take into account the new realities of the energy market:

- The energy market goes beyond Quebec borders and it no longer relies on long-term contracts.
- Considering the new environmental policy context (such as the ratification of the Kyoto Protocol), the development of energy sources with minimal GHG emissions should be a priority.

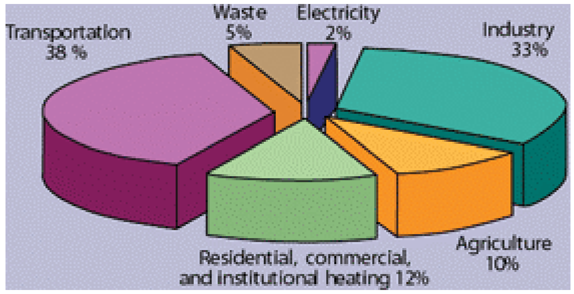
- At issue is not only the demand for electricity, but to foster the ability to meet this demand while substituting more pollutive energy sources with more sustainable options.

According to Hydro-Quebec, energy needs continue to rise (HQ, 2003). Bearing in mind the efficiency of energy saving measures, it is estimated that the consumption of electricity in Quebec will reach nearly 197.8 TWh by 2010, thus 26.1 TWh more than the electricity consumed in 2002. If we consider the annual production capacity, there would then be a shortage of 18.9 TWh.

All forecasts are certainly subject to caution. However, recent experience tends to show that actual energy needs are real and undeniable. We need only to think of the peak demand of January 2003 which surpassed what had been anticipated, or this summer’s heat waves where the air conditioning needs of our Ontarian neighbours where such that the 25 000 MW production capacity was met.

Furthermore, arguments relying solely on the immediate energy needs of Quebec should take into account that, even with substantially increased energy efficiency efforts, demand in energy will continue to rise, notably for substitution purposes, namely in the heating and transport sectors. The transport sector currently consumes only 0.3 TWh. Nonetheless, with the coming of new technologies aimed at replacing oil, such as the electrification of public transport, the potential increases tenfold (HQ 2003). If we divide the greenhouse gas emissions by sector, we notice that the sectors with the highest GHG emissions (transport & industry) could benefit from initiatives premised upon renewable energy sources such as hydroelectricity, so as to meet the required energy supply and thus reduce the use of high GHG emitting sources.

Greenhouse gas emissions in Quebec in 1997



Source : Natural Resources Canada, climate change in Canada; quantified emissions, 2003.

Even if we consider the major energy efficiency gains of the past two decades in Quebec, the replacement of fossil fuels was possible largely as a result of the energy supply provided by hydroelectric projects of James Bay. Relative to 1975 (the year of the implementation of the hydroelectric complex of James Bay), GHG emissions in Quebec declined while in the rest of Canada and in the United States they increased.

Variations in GHG emission since 1975

	1990	1997
Quebec	-27.4%	-25.3%
Canada (without Quebec)	+14.5%	+29.1%
United States	+9,7%	+23.1%

Source : Jean-Pierre Drapeau, 2000.

Compared with what would have been emitted if the energy had been produced with combined cycle gas turbines, it is estimated that the development of hydroelectricity for power generation in Quebec has allowed for up to 15.4 Mt of avoided emissions (HQ, 07/2000). Hydroelectric production has therefore allowed Quebec to substantially reduce its GHG emissions. The development of this source of energy, to the detriment of fossil fuel-based energy sources, has indisputably contributed to improving Quebec's environmental record.

Admittedly, one potential scenario exists in which Quebec's internal energy demand for electricity could be strongly curtailed: if natural gas made a searing breakthrough in energy supply for heating. This option, however, would also imply a substantial increase in Quebec's GHG emissions. In that case, the only acceptable solution, in light of our environmental commitments, would still be the pursuit of our potential in renewable energy, including hydroelectricity, since it would be especially incumbent on Quebec to reduce GHG emissions elsewhere via its energy exports. In addition, once increases in internal needs for energy are noticed, it will be too late to develop a hydroelectric project. The only alternative offering a competitive price and equivalent service would be, in all likelihood, the development of natural gas power stations.

Considering the increasing demand for energy in Quebec we must anticipate an additional supply of energy in order to meet our future energy needs. Nonetheless, this production should not be acquired to the detriment of a concerted effort to reduced greenhouse gas emissions; we must therefore favour "clean" and renewable energy sources.

To plan energy needs based only on the anticipated consumption in Quebec would amount to confining international environmental problems within territorial borders and to disregard global ecologic interactions, which would be self-defeating. The effort to reduce greenhouse gases must be coordinated at an international scale. The pragmatic development of our hydroelectric resources would also allow for energy surpluses that could be used for export; this must reflect an open, growing and integrated energy market. Would we tell Bombardier not to build trains for the New York metro or to limit itself to the Quebec market? Before drilling oil and gas wells in Alberta, do the promoters ask themselves if the province really needs the additional energy supply? In fact, they produce at least ten times more gas than they consume. The result is the squandering of a non-renewable resource. The development of renewable energy sources, including hydroelectricity, should not be confined to closed and conservative public judgement.

If we consider the division of energy production in Canadian provinces and bordering states, we notice that there is an unmistakably open market for renewable energy (including for the substitution of more pollutive energy options).

Proportion of energy production (%) in Canada (1998) and in the United-States (1999), by resource type

Canada	Coal	Natural gas	Oil	Hydro	Nuclear	Other	Total (in GWh)
Quebec	**0**	-	1	**96**	3	-	154,734
Atlantic provinces	**18**	-	12	**64**	5	1	74,717
Ontario	**24**	7	1	**24**	42	1	141,712
Manitoba	**3**	-	-	**97**	-	-	31,739
Saskatchewan	**69**	9	-	**22**	-	1	16,948
Alberta	**78**	16	-	**4**	-	2	55,685
British Columbia	-	5	-	**89**	-	6	67,429
Canada Total	**19**	**6**	**1**	**60**	**13**	**1**	**550 TWh**
United States							
New England	**27**	17	26	**7**	27	9	111,635
Centre North East	**71**	5	1	-	21	1	589,446
Centre North West	**75**	2	1	**5**	16	1	275,383
Atlantic	**35**	17	5	**6**	35	2	397,283
USA Total	**51**	**15**	**-**	**9**	**20**	**2**	**3691 TWh**

Sources: CEC, CCA, CCE (June 2002) *Environmental Challenges and Opportunities of the Evolving North American Electricity Market.*[6]
Canadian total as well as statistics for Quebec and United States totals taken from Hydro-Quebec (dec. 2000). *La production d'électricité et les émissions atmosphériques au Canada et aux Etats-Unis*, 1st edition.

Energy production via thermal energy sources (which use non renewable resources) leads to GHG emissions that are (all gases included) 50 times higher than those of a hydroelectric project of equivalent scale. In addition, the use of thermal energy for

[6] See Annexe 1 for the complete table.

electricity production is far less efficient.[7] The breakthrough of thermal energy during the last (renewable) energy shortage demonstrates that we must anticipate the development of renewable energy sources for the future.

The United States showed an increase in their GHG emissions by 23.1 % between 1975 and 1997.[8] The increase in emissions in the United States is not declining, which is explained, among other things, by a high consumption of energy coupled with a dramatic decrease in the proportion of renewable energy in their energy record.[9] In the year 2000, the reduction related to net sales outside of Quebec reached 18 Mt of CO_2 (HQ, 07/2000). The current energy record in North America, which is in the first world rank in terms of energy consumption and greenhouse gas emissions, is largely dominated by fossil fuels (gas, oil, coal). Consequently, the export of hydroelectricity must also serve to replace these unsustainable sources of energy (see annexe 1).

The energy sector must not be treated differently from other sectors of the economy; it must be able to profit from the opening of the markets and be included in an economic development plan. This requires a paradigm change. We must then consider the export of hydroelectricity as an economically positive contribution at the international environmental level. Furthermore, we must begin now to develop our renewable energies in order to ensure that they will be readily available to meet our own future energy needs.

4.2 *The economic aspects of the project*

Realistically, it is difficult to determine the impact of different variables on the economic viability of a hydroelectric project. **Indeed, it would be peremptory to model**

[7] The general energy efficiency for coal plants is approximately 35 % and around 50 % for combined cycle gas turbines. For example, the projected Suroît natural gas power plant would have been amongst those with the highest energy performance, with about 58 %, for a production of 800 MW (BAPE, report 170, 2003).
[8] See previous table *Variations of GHG emissions since 1975*, p.11
[9] In the United States, the part of the energy market for renewable energy went from 30 % in 1950 to less than 11 % in 2000 (Lafrance, 2002 and HQ, 2000). In Quebec, with the slowing down of hydroelectric developments in the past few years, we risk following this trend, considering that half of the new production resulting from the recent call for tenders is thermal energy.

impacts of certain variables (such as those related to climatology) on the profitability of the project. Certain long-term predictions can be imperfect and vague. For example, during the last few years we have witnessed modifications in precipitation patterns. Obviously, this can (hypothetically) influence the projected profitability of hydroelectric projects. However, this argument is in no way justified since climate modelling simply do not allow for previsions that are either sufficiently precise nor sufficiently valid to make such predictions, at the local or the regional levels. Therefore to judge the long term impacts of these variables would be biased.

We must now begin to anticipate the development of measures for the application of the Kyoto Protocol. Although the framework for its application has not yet been clearly defined, an early start on the reduction of GHG emissions could allow for Quebec to become an influential actor in the market of clean energy. **In the context of sustainable development, the energy sources with low GHG emissions represent, beyond all doubt, an added value that must be integrated in the evaluation for the profitability of the project. These long term considerations must be taken into account starting now in order to ensure a sustainable development of the resource.**

4.3 *Alternative solutions*

The concept of evaluating "alternative solutions" must be revised. By ratifying the Kyoto Protocol in December 2002, Canada has committed itself to respect, on average for the period of 2008-2012, a net greenhouse gas emission quota equivalent to 94 % compared to 1990 levels (Natural Resources Canada, 2003). Taking into account anticipated increases before 2010 in the absence of reduction measures, the Canadian commitment taken in light of the Kyoto Protocol is equivalent to a net reduction in emissions of approximately 25 %, or a reduction of 240 Mt by 2010 compared with the projected emissions if the status quo was maintained (Government of Canada, 2002). To achieve the objectives of the Kyoto Protocol, all profitable energy efficiency measures will have to be implemented. Nonetheless, the production of renewable energy must run parallel to these measures. Even if there were an unexploited potential of energy efficiency equivalent to the anticipated production of the Eastmain 1-A Rupert diversion project, it would be false to expect that this potential would have greater chances of success if the project was not developed. We must combine all possible measures (energy efficiency and the development of renewable resources) in order to optimize our efforts of reducing GHG emissions.

In fact, the energy market in the North-Eastern United States is so significant that Hydro-Quebec's exports are carried out at market prices, and they cannot significantly influence the latter. Thus, the price would not drop due to the additional energy supply that Eastmain 1-A would produce and would therefore not incite an increase in energy consumption.

When analyzing the different possibilities for energy development, we must also compare options offering equivalent services (thus, adjusted in relation to the usage factors). For instance, it would take at least 2000 MW of installed power by one or several wind farms to replace the 900 MW of energy coming from hydroelectricity. To this effect, the International Energy Agency clearly distinguishes the options, allowing for great flexibility between the energy supply of these sources to a reduced or intermittent flexibility (see annexe 2).

In order to compare the different sources of energy, the International Energy Agency has compiled the results of leading international studies (IEA, Vol. I, 2000).[10] On average, compared to hydroelectric production with reservoir, energy derived from coal emits:

- 40 times more CO_2 equivalent
- 2570 times more mercury
- 500 times more SO_2
- 270 times more NOx

Following the same units of measure, natural gas produces:

[10] See table *Summary of environmental parameters between different energy sources* annexed to the present document.

- 25 times more CO_2 equivalent,
- 230 times more SO_2
- 34 times more NOx
- 9 times more mercury

Despite its partial nature, this analysis remains apposite; the use of renewable energy must be prioritised and even anticipated to replace, in the long term, non-renewable energies. The intrinsic advantages of an energy source, such as hydroelectricity, that is renewable, reliable, clean, non intermittent and storable, must be considered.

In fact, in the past we have witnessed many unfavourable biases towards hydroelectric power. Nevertheless, even wind power, which is also a "clean" renewable energy is not free of impacts on a large scale. Some studies have also estimated the ecologic incidences from the combination of wind production combined with a hydroelectric energy source used to regularize wind production. The simulation of combining a hydroelectric power station (statistics forecast for Ste-Marguerite 3) with, respectively, one and seven wind sites allows for an estimate of the impact (see annexe 2).

The coupling of these energy sources leads to the increased variability of both river flows and of hydroelectric reservoir levels in relation to the variations of wind production. The gaps between the maximal variation of turbine flows are far greater when these two energy sources are coupled (respectively, for 10 % of wind power the variation in flow can be more than double while with 25 % of wind production it may be six or seven times greater if it is coupled with seven sites or only with the best site).[11] The level of the reservoirs are equally affected (Bélanger et *al*., 1998).

The goal is not to oppose wind power but rather to suggest moderation in the evaluation of the environmental impacts of the hydroelectric power. Nonetheless, the

[11] See table *Effects of Wind and Hydro Combination on Water Level fluctuations and flows in the Hydraulic Facility*, annexe 3.

development of wind power is an option that must not be neglected in the planning of long-term energy production; this energy source is compatible with the realisation of hydroelectric projects but is not equivalent from the point of view of efficiency of production or in its environmental, social or economic impacts.

While studying the functionally different ways in which to respond to the need for the project, the Directives suggest that environmental, economic, social and technical impacts be considered. **When analysing the environmental perspective, it is important to evaluate the impact of GHG emissions generated by the exploitation of non-renewable energy sources.**

In the present context, it is in fact the alternative options that must be revised. The development of all possibilities for renewable energy must be anticipated taking into account, in their context, the needs, the impacts and the efficiency of each solution. Finally, we must bear in mind that if the project in question were not carried out, the alternative source of replacement would, in all likelihood, be a gas turbine.[12]

5. *Variants for the project*

If several variants to the project can be envisaged, the impact for each of them must be detailed in a clear and concise fashion so that all consultants may understand the importance of each variant. **The variant of the project without the Rupert diversion must also be analysed and the result made available to the consultants.** Again, the micro-ecological impacts must be examined in proportion to the macro-ecological effects of the project. **The degree of importance attributed to the sustainable development of renewable resources must be determined and seriously considered at the time of evaluating variants.**

[12] Thus, the eastern American states anticipate that between 1999 and 2007, nearly 277 128 MW of additional power will be added. The source of energy of choice is natural gas, followed by coal (Commission for Environmental Cooperation of North America 2002).

6. *Assessment of the impacts*

6.1 Ecologic Analysis of the project's impacts

Hydroelectric energy is inexhaustible and the long-term impacts have mitigated, entirely or in part, the short-term impacts of various extant hydroelectric projects. Notwithstanding past fears, the impacts of the projects were manageable. However, we must bear in mind that an objective as demanding and difficult as sustainable development is not necessarily the easiest option in the short-term.

In reference to the Directives, the environmental impact assessment must include an estimate of 20 to 25 years while taking into account the experience acquired in the past 30 years. Beyond a quarter of a century, the validity of the forecasts becomes questionable. It would be unproductive to get bogged down by hypothetical models. However, the main studies related to the different impacts of hydroelectric power stations must be considered, as they are a recorded evaluation of ecological and environmental modifications.

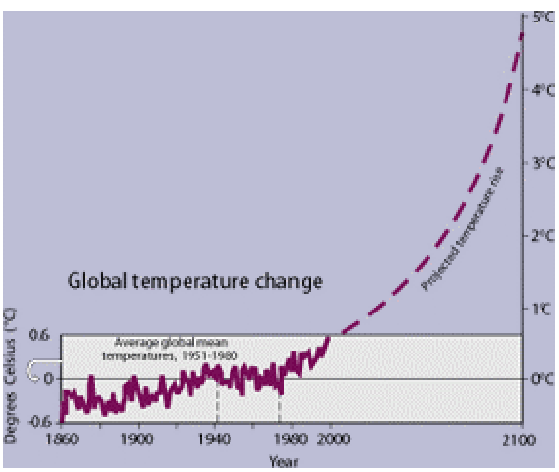
GRAME in no way proposes laxity in the evaluation of environmental impacts related to hydroelectric projects, but favours a relativization of the micro-ecological impacts in relation to the macro-ecological consequences. For example, the *Fisheries Act* (L.R. 1985, ch. F-14) of the Department of Justice of Canada must be applied with discernment:

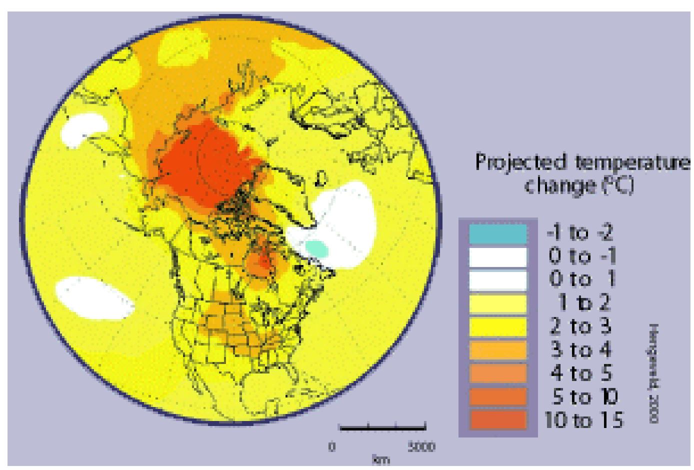
> « No person shall destroy fish by any means other than fishing…»
>
> *R.S., c. F-14, s.30; 1976-77, c. 35, s. 5*

> « No person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat.»
>
> *R.S., c. F-14, s. 31; R.S., c. 17(1st Supp.), s. 2; 1976-77, c. 35 (1), s. 5.*

In the case of the Toulnoustouc project, the in-stream flow requirements reduced energy production by 20 GWh in order to save approximately 160 stream trout each weighing on average 250g. The cost of maintaining a steady population, at 6 cents per kWh, is of 1.2 million dollars ; thus 7500 $ per fish per year.

Another example of the relativisation of long-term impacts would be to consider the effects of climate change caused, to a high degree, by the increase in GHG emissions. In North America, the normal rise in temperature is estimated to be approximately 1 to 2ºC every 100 years (NOAA, 2000). In evaluating the effects of rising GHGs in the atmosphere the Intergovernmental Group of Experts on Climate Change[13] anticipates **an average rise in temperature, on a global scale, of 1,4 to 5,8ºC for the coming century. Furthermore, it is estimated that the impacts of global warming will be 40 % higher in northern regions** (IPCC, 2002, p.10). According to Natural Resources Canada, certain parts of Canada could see a rises in temperature between 5 and 10ºC. The earth's average temperature is rising at a pace unprecedented in the last 10 000 years. Since the 1980s, meteorological services in Quebec have recorded the warmest 10 years of the century (natural resources Canada, 2003).





Environment, Canada 1993 Hengeveld, 2000

Source : Natural Resources Canada, "A Time of Change: Climate Change in Quebec", 2003.

The boreal latitudes and regions further away from the sea will witness a higher increase in temperature than any other part of the planet (*Climate Change Plan for Canada*, 2000). Subarctic

[13] From the Institute for Sustainable Development and International Relations

ecosystems would be greatly affected by such a variation in temperature; which would have a devastating effect on the summering patterns of Canada's largest herds of caribou as well as on the habitat of many animal species. Major impacts could result in the displacement of the areas of occupancy of certain species. These changes would disrupt the traditional lifestyles of aboriginal peoples. **Marine and aquatic species would be gravely affected by a variation in temperature of their habitat. According to the Intergovernmental Group of experts on Climate Change, a reduction of up to 50 % of aquatic habitat must be anticipated in a scenario in which the quantity of CO_2 is doubled (IPCC, 1998).** Finally, according to the World Wildlife Fund, a doubling of the concentration of greenhouse gas emissions could lead to the destruction of 35 % of existing terrestrial habitat (HQ, 07/2000).

It is estimated that the greatest part of greenhouse gases emitted during hydroelectric production is largely a consequence of the degradation of biomass that is submerged due to an increase of water levels. This GHG increase is therefore temporary. According to the International Energy Agency, a decrease in GHG emissions is noted after three years. Furthermore, if a large part of the biomass is removed before the land flooding, there is a reduction of GHG emissions and it also allows to economise on the clearing of other terrestrial spaces. The land infrastructures developed in the framework of the project can also be used by the forest industry, thus leaving other territories unharmed. Therefore, there must be an optimization of forest conservation as well as the preservation of natural carbon sinks to capture CO_2.

One lacuna in multi-criteria evaluation is the risk that the same weight be attributed to a multitude of very diverse impacts, which are often not comparable. By attributing a monetary value to the so-called external impacts, it is then possible to obtain a universal unit that allows us to compare options that have very different impacts. Thus, it becomes possible that a multitude of small impacts impose, overall, an environmental cost of equal or superior value than an impact that is particularly important.

Of course, attributing a monetary value to externalities goes beyond the scope of what may be expected from the impact assessment of the Eastmain 1-A and Rupert diversion project. The conclusions of the most prominent European research project on the attribution of monetary value to externalities for power-producing plants should nonetheless incite caution in the use of multi-criteria analysis for the assessment of impacts:

> In general, the global warming results are of the same order of magnitude as all other quantified damage costs together.
>
> *Mayerhofer et al. 1997*

The reintroduction of mercury in the food chain remains one of the major concerns at the time of assessing the ecological impacts. To this effect, we have taken notice of the concerns expressed by the community of Sanikiluaq, and presented by the Inuit Qikiqtani Association. The latter requested that the impact assessments of mercury variations in the natural environment be extended to the marine bioregion (James Bay, Hudson Bay) touched by the Eastmain-1-A and Rupert diversion project. According to previous studies :

> The creation of reservoirs in the La Grande River basin has had few effects on the levels of mercury in fish on the east coast of James Bay. An increase of this kind has only been noted in the affected area of waters stemming from the La Grande River, thus over a distance of 10 to 15 km from one side to the other of the mouth (of the river). [14]
>
> *Schetagne et Verdon, 1999, in Hayeur, 2001, p. 49*

> We can in no way compare the effects of hydroelectric development of certain tributaries of Hudson Bay to the effects of urban and industrial development centered on the Canadian-American Great Lakes, to the effects of deforestation, to extensive cattle-raising and to the populating of the Amazon forest, or to the effects of canalization, industrialization and urban development that has occurred in the Mississippi Delta region. The fears of seeing the ecosystem of Hudson Bay and of its river basin transform itself under the effects of a multiform development are simply unfounded…The data gathered from the La Grande River show that the levels of mercury in the distal plume waters of the river are similar to those of marine waters. [15]
>
> *Hydro-Québec, 1993, p. 153*

[14] Translated from the original : « La création de réservoirs dans le bassin versant de la Grande Rivière a eu peu d'incidence sur la teneur en mercure des poissons de la côte est de la baie de la baie James. Une augmentation de cette teneur a été observée seulement dans la zone d'influence des eaux issues de la Grande Rivière, soit sur une distance de 10 km à 15 km de part et d'autre de l'embouchure »

[15] Translated from the original : « On ne peut d'aucune façon comparer les effets de l'aménagement hydroélectrique de certains affluents de la baie d'Hudson aux effets du développement urbain et industriel centré sur les Grands Lacs canado-américains, aux effets de la déforestation, de l'élevage extensif et du peuplement de la forêt amazonienne ou aux effets de la canalisation, de l'industrialisation et du développement urbain que connaît la région du delta du Mississipi. Les craintes de voir l'écosystème de la baie d'Hudson et de son bassin versant se transformer sous l'effet d'un développement multiformes ne sont tout simplement pas fondées… Les données recueillies au large de la Grande Rivière indiquent que les teneurs en mercure des eaux du panache distal de cette rivière sont voisines de celles des eaux marines. »

Despite the results of some former studies, certain concerns, presented by representatives of the Inuit Qikiqtani Association at the first public consultation session, should be taken into account:

> (…)even though it may appear at first glance, looking at the maps, that, geographically, the Belcher Islands and Sanikiluaq particularly are on the periphery of the study area, we respectfully submit that there is a direct cause-and-effect relationship between the Belcher Islands Sanikiluaq Inuit in that community and the rivers Rupert and Eastmain 1-A.
>
> M. John MacDOUGALL

> We know our concerns are legitimate both from the traditional knowledge work we have done and from the scientific knowledge about the effects of the river hydrology on nutrient and sediment supply in estuarine and coastal ecosystems, and dispersal, movement, and bioaccumulation of contaminants from rivers and estuaries into the marine current system and the marine food web(…)
>
> M. Moses Novalinga
> *Consultations publiques du 28 mai 2003, Montréal*
> *Projet de la centrale Eastmain-1-A et dérivation Rupert*

We believe that a reasonable effort must be made, using historical knowledge, to assess if there are impacts on the Sanikiluaq community. Traditional ecological knowledge and the concerns of this community must also be taken into account and incorporated in the Directives. **Therefore, the use of compensation and mitigation measures for the communities that are affected, must also be considered.** In fact, the impact assessment must evaluate the impacts of mercury on the Cree community, or any other community susceptible of being affected, and assess all appropriate mitigation measures:

> At the scale of Cree communities of Quebec, the dispersion of hydroelectric projects is such that an increasing number of communities are affected. To this spatial sprawl a temporal sprawl is added. (…) This makes even more important the pursuit of measures applied within the framework of the Mercury Convention to the La Grande Complex, which notably aim to properly inform the affected populations on the real nature of the impacts and to adopt methods for the exploitation of faunic resources which permits us to avoid all impacts on health and to reduce impacts on ways of life. [16]
>
> *Hydro-Quebec, 1993, p. 153*

[16] Translated from the original: « A l'échelle des communautés cries du Québec, la dispersion des projets hydroélectriques fait en sorte que ceux-ci touchent un nombre croissant de communautés. À cet étalement spatial s'ajoute une étalement temporel. (…) Cela rend d'autant plus nécessaire la poursuite des mesures appliquées dans le cadre de la Convention sur le mercure au complexe La Grande, qui visent notamment à bien renseigner les populations touchées sur la nature réelle des impacts du mercure et à adopter des modes d'exploitation des ressources fauniques permettant d'éviter tout impact sur la santé et de réduire les impacts sur le mode de vie. »

6.2 Procédure d'étude du projet

Double Standards…

The assessment for the study of the Great Whale (GW) project was extended over 28 years and cost 256 millions dollars (HQ, 1993). On a smaller scale than the GW project, the impact assessment for the hydroelectric power plant Sainte-Marguerite-3, with a capacity of 882 MW and an annual production of 2.8 TWh/year (BAPE, rapport 60, 1993) was extended over 6 years. In comparison, the assessment for the project for the Suroît (natural gas) power plant, for a capacity of 800 MW and a production of 6.5 TWh/year took place from September 2001 to January 2003, thus over a period of less than one and a half years (BAPE, rapport 170, 2003)! The average timeframe for thermal power plant projects, between the beginning of the project and the time it enters into operation, is approximately two years.

The administrative measures for the assessment of the project must be relativised in relation to the scope of the steps and directives carried out at the time of the assessment of the projects of other power generating sources, such as thermal, nuclear, etc. In the present context, we must avoid exaggerated demands for the impact assessment and optimize the coordination of projects. This does not preclude the fact that justified requests must be thoroughly if and when certain important elements of study may have been omitted from the Directives. Furthermore, special attention may be given to the fact that the Directives, regarding the description of the social environment and the evaluation of impacts, must adhere to a continuity of social measures deployed by Hydro-Quebec and by the governments since the beginning of the exploitation of hydroelectric power plants in the Far North and James Bay.

7. Conclusion

In a context where development of renewable energy potential becomes a priority, GRAME proposes:

- **Maintaining rigorous environmental requirements but an alleviation of the administrative process leading to the authorization of hydroelectric development.**
- **That the experience acquired in the past thirty years facilitates superior study of the issues, resulting in clear and concise directives.**
- **That the new realities - such as the opening of markets and the ratification of the Kyoto Protocol – be included when analysing the necessity for the project.**
- **That different variants for the project, including one without the Rupert diversion, be analysed and presented.**
- **That particular attention be given to the anticipated impacts for the contamination by methyl mercury and to mitigation measures for *all* affected populations.**

Finally, there must be a quest for equity between approaches for the evaluation of hydroelectric projects versus other renewable options as well as thermal power plants.

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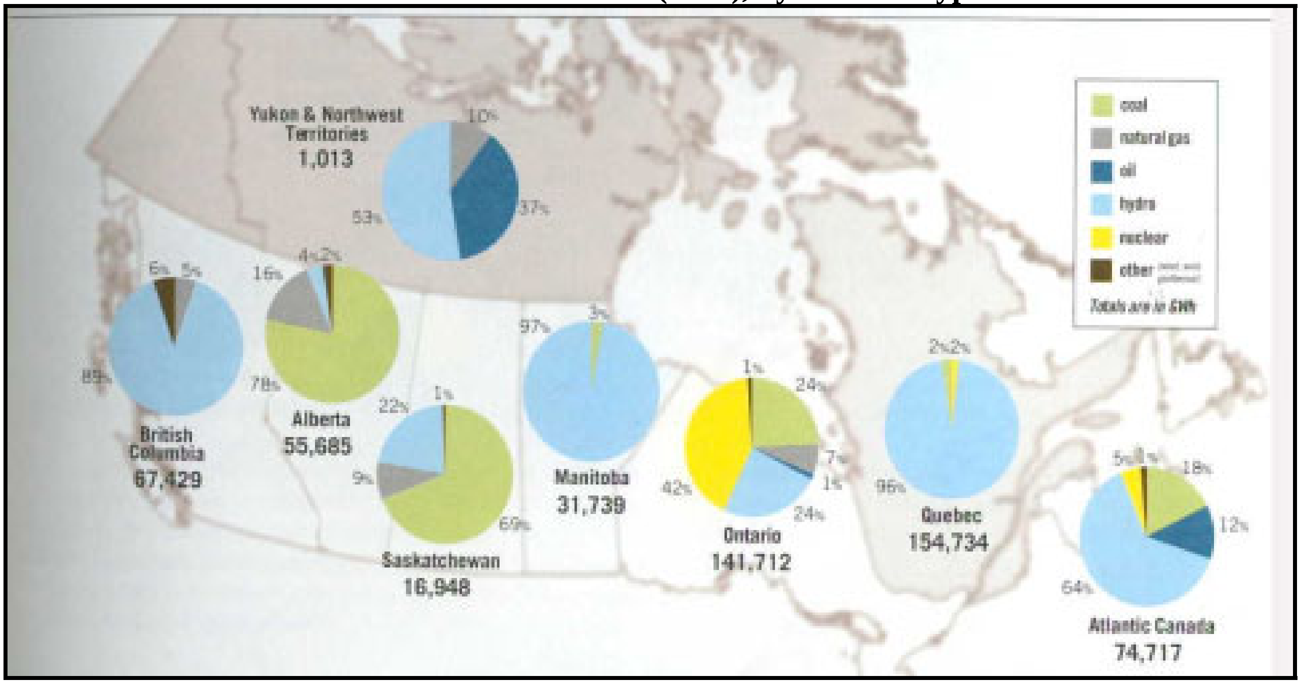
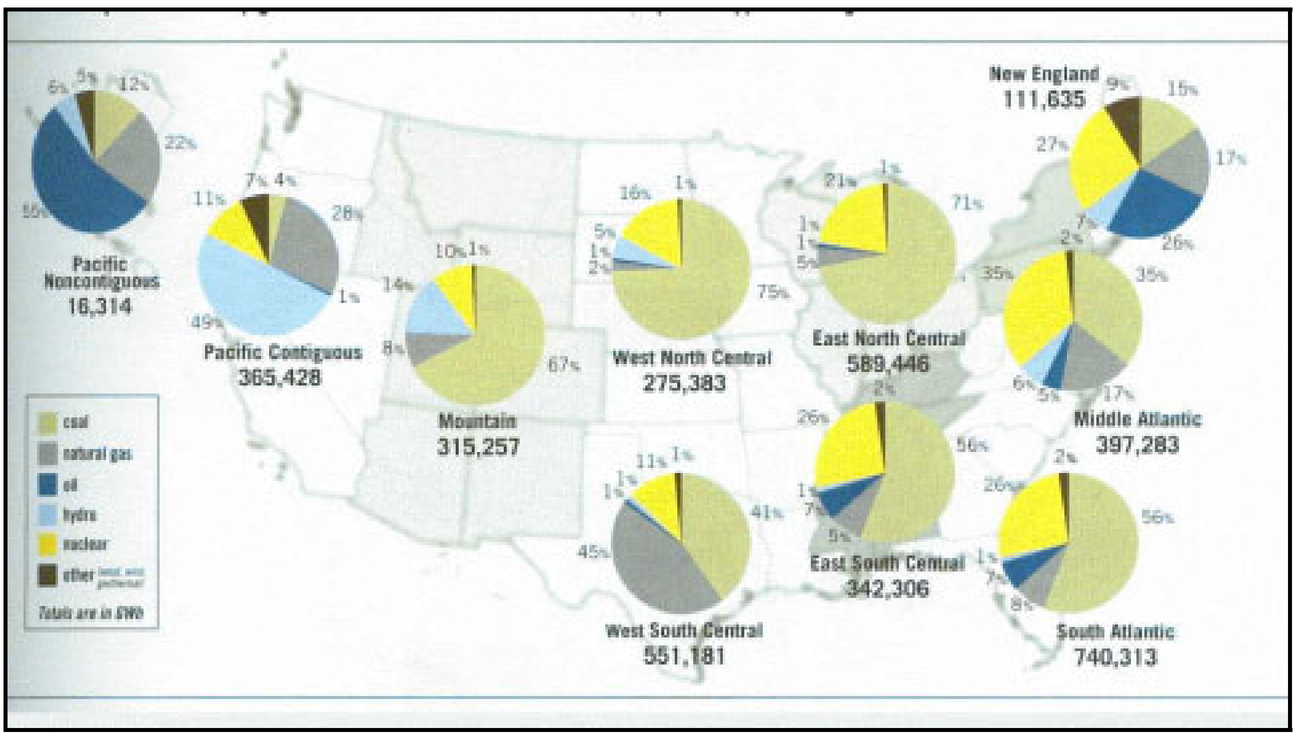
ANNEXE 1

Proportion of energy production (%) in Canada (1998) and in the United-States (1999), by resource type





Source : *Environmental Challenges and Opportunities of the Evolving North American Electricity Market*, CEC, CCA, CCE, June 2002

ANNEXE 2

Synthesis of environmental parameters for electricity options, Statistics compiled from international sources

Electricity generating options	Energy payback ratio*	Greenhouse gas emissions (kt eq CO_2/TWh)	Land requirements (km^2/TWh/y)	SO_2 emissions (tSO_2/TWh)	NOx emissions ($tNOx_2$/TWh)	Particulate matter (t/TWh)	Mercury emissions (kg Hg/TWh)
Options capable of meeting base load and peak load							
Hydro power with reservoir	48-260	**2-48**	2-152	**5-60**	**3-42**	5	0.07 methylmercury in reservoirs
Diesel		555-883	Projects designed for energy production	84-1550	316-12 300	122-213	
Base load options with limited flexibility							
Hydro power Run-of-river	30-267	**1-18**	0.1	**1-25**	**1-68**	1-5	
Bituminous coal : Modern palnt	7-20	**790-1182**	4	**700-32 321**	**700-5273**	30-663	**1-360**
Nuclear	5-107	2-59	0.5	3-50	2-100	2	
Natural gas combined-cycle turbines	14	**389-511**		**4-15 000**	**13-1500**	1-10	0.3-1
Biomass : energy plantation	3-5	17-18	533-2200	26-160	1100-2540	190-212	0.5-2
Wind power	5-39	7-124	24-117	21-87	14-50	5-35	
Solar power	1-14	13-731	27-45	24-490	16-340	12-190	

Source*: Table 1 : Synthesis of Environmental Parameters for Electricity Options* (IEA, vol I, 2000), p.12.
* ratio of energy produced over the energy required to build, maintain and operate a power plant.

ANNEXE 3

Effects of Wind and Hydro Combination on Water Level fluctuations and flows in the Hydraulic Facility

Parameter	Hydraulic energy only	Best wind energy site		Average of 7 wind sites*	
Proportion of wind energy (%)	0	10	25	10	25
Wind power (MW)	--	82	246	102	307
Hydraulic power (MW)	537	595	709	571	659
Total combined energy (TWh)	2.77	3.08	3.69	3.08	3.69
Water level fluctuation (m)	6.0	5.7	5.6	5.7	5.7
Annual maximum turbine flow (m^3/s)	186	206	247	192	229
Annual minimum turbine flow (m^3/s)	61	55	7	60	20
Maximum variation in turbine flow in a 1-hour interval (m^3/s)	16	37	95	18	43

Source : Bélanger, Camille et al. *Wind power and its Dependence on Hydro Reservoirs :Results from Wind Farms Simulations for Quebec*. May 1998

*7 wind sites examined :

Gaspésie region :
- Cap-Chat
- Cap-Madeleine
- Mont-Joli
- Cap d'Espoir

Hudson Bay region:
- Kuujjuarapik

Quebec Region:
- Île d'Orléan

North Shore region :
- Pointe-des-Monts