ENERGY DEMAND/SUPPLY (1984-2000) IN ATLANTIC CANADA, ENVIRONMENTAL IMPLICATIONS & OPPORTUNITIES FOR ENVIRONMENT CANADA

Environment Canada
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1. INTRODUCTION

In keeping with federal and provincial energy policies, imported oil use will decrease by approximately 50% in Atlantic Canada by the year 2000. During the same period, the regional energy demand will increase by 1.6% per annum. (i.e. energy demand will be increased from 464 petajoules in 1983 to 667 petajoules by 2005). To compensate for the decrease in foreign oil and to provide for security of supply, alternative energy resources will be developed in the region to satisfy future energy requirements. As these energy sources are developed, the potential for environmental impacts will raise the need for environmental information, conservation and protection activities by Environment Canada and others.

To enable the department to effectively deal with regional energy development, an analysis of energy supply, demand and development between 1980-2000 was undertaken in 1982. This analysis was partially based on government and industry attitudes which reflect the current economic and political climate. As such, the energy mix will need to be periodically reviewed and updated to reflect changes which will undoubtedly occur. This document represents the first major revision to the earlier work.

2. ENERGY DEMAND AND SUPPLY

The energy demand/supply forecasts prepared by the National Energy Board were used as a basis for this paper, supplemented by information from the provinces and utilities. These forecasts represent the collective views of government (federal and provincial) and industry. To account for some of the differences between forecasts presented by the various contributors, the average forecast scenario was used.

The following estimates of energy are similar to those projected by the provincial utilities. The estimates of energy (electricity) generated by major fuel type for the Atlantic Provinces over the period 1980-2000 are presented on Tables I through IV. It must be emphasized that the source of oil and gas has not, as yet, been identified and thus the contributions of foreign, Western Canadian and offshore oil in satisfying the future regional demand cannot be differentiated. It is expected OPEC's pricing policy will be a significant determining factor. In addition, tidal power potential and its contribution to the generation of electricity is not recognized which reflects the need to conduct further feasibility studies. Finally, the role of renewables and energy conservation policy in satisfying demand is not presented because it has not been quantified and since it will be developed and used on an incremental basis throughout the region.

The focus of the following energy discussion is directed principally toward electricity demand and supply.

2.1 Hydro

The provinces, particularly Newfoundland, are considering the development of the remaining 7300 MW of available hydro resource potential (Nova Scotia - 100, New Brunswick - 800, Newfoundland - 6400).

2.1.1 Nova Scotia - In 1983, two hydro projects were underway including Gisborne Lake in Victoria County and Fourth Lake on the Sissiboo River system in Digby County (0.2 & 2.5 MW, respectively). In addition, a low-head (i.e. short-water drop) hydro project has now been constructed in Inverness.

TABLE I

FORECASTS OF ELECTRICITY GENERATED IN NOVA SCOTIA BY MAJOR FUEL TYPE

(GWH)

	1980	1985	1990	1995	2000	2005
HYDRO	903	1082	1082	1082	1082	1033
COAL	1508	4762	8259	9644	11365	14602
OIL & GAS	4452	2689	692	712	858	
NUCLEAR	-	-	-	-	-	
TOTAL	6863	8588	10098	11518	13395	
DOMESTIC DEMAND	6809	8838	10098	11517	13394	
NET EXPORT	54	-	-	1	1	
NET IMPORT	-	250	-	-	-	

TABLE II

FORECASTS OF ELECTRICITY GENERATED IN NEW BRUNSWICK BY MAJOR FUEL TYPE

(GWH)

	1980	1985	1990	1995	2000	2005
HYDRO	2666	2692	2692	2692	2822	2647
COAL	457	1482	1256	1839	1305	5392
OIL & GAS	6160	1533	1397	2753	1594	
NUCLEAR	-	4415	4408	4415	8830	17660
OTHER	-	10	10	10	10	
TOTAL	9283	10132	9763	11709	14561	
DOMESTIC DEMAND	8808	10408	12142	14214	16981	
NET EXPORT	475	-	-	-	-	
NET IMPORT	-	276	2379	2505	2420	

Source - Canadian Energy Supply and Demand, 1980-2000, National Energy Board, June 1981.

TABLE III

FORECASTS OF ELECTRICITY GENERATED IN NEWFOUNDLAND BY MAJOR FUEL TYPE

(GWH)

	1980	1985	1990	1995	2000	2005
HYDRO	44860	40724	45454	45454	56754	55860
COAL	-	-	-	418	-	
OIL & GAS	1398	2296	173	797	173	
NUCLEAR	-	-	-	-	-	
TOTAL	46258	43020	45627	46669	56927	
DOMESTIC DEMAND	8429	10790	12984	15716	19318	
NET EXPORT	37829	32230	32643	30953	37609	
NET IMPORT	-	-	-	-	-	

TABLE IV

FORECASTS OF ELECTRICITY GENERATED IN PRINCE EDWARD ISLAND BY MAJOR FUEL TYPE

(GWH)

	1980	1985	1990	1995	2000
HYDRO	-	-	-	-	-
COAL	-	-	-	290	613
OIL & GAS	127	150	150	175	140
NUCLEAR	-	-	-	-	-
TOTAL	127	150	150	465	753
DOMESTIC DEMAND	515	687	794	983	1225
NET EXPORT	-	-	-	-	-
NET IMPORT	388	537	644	518	472

Source - Canadian Energy Supply and Demand, 1980-2000, National Energy Board, June 1981.

The project will demonstrate the feasibility of electrial power generation (28 kW) from a low-head site. EM&R and the province recently completed a micro hydro demonstration project at Mabou, Nova Scotia. The project will demonstrate the use of small-scale hydroelectric power to satisfy the electrical demands of isolated residential dwellings. The provincial government favours the development of hydro resources and to this end is currently investigating low-head hydro potential in all municipal watersheds. It is noteworthy that according to Table I, hydro resource development will not occur, to any significant extent, beyond 1985. This is consistent with the views of the Voluntary Planning Board of Nova Scotia, a group of senior officals from a variety of economic sectors.

2.1.2 New Brunswick - This province has recently increased the power output from Mactaquac by 100 MW and is evaluating additional sites. In 1984, Energy, Mines & Resources and the province allocated funds to install two 1,000 kW low head hydroelectric units on a existing dam located on the Green River below Edmunston. In 1983, the New Brunswick Electric Power Corporation earmarked $1.2 million of that year's $127 million budget to find options for increasing the outputs of several existing hydro electric facilities. In addition,they are considering the development of pumped storage capacity. The province is also considering the development of additional large-scale sites (Morrell and other sites along the Saint John River). According to projections

there will be two periods of expansion in hydro electric generation between 1980-85 and 1995-2000.

2.1.3 Newfoundland & Labrador - This province has, by far, the greatest hydro resource development potential. The provincial utility has developed a number of large-scale developments (e.g. Upper Salmon, Hinds Lake) and recently considered developing 2 small-scale projects (Dry Rocks Brook - 7800 KW and Lake Michael - 12000 kW at Great Northern Penninsula). Before the Gull Island Muskrat Falls development can proceed, the province will have to obtain the right to establish a power corridor either through Quebec or under the Strait of Belle Isle so that excess electricity can be sold, possibly to the New England market. At present, the province is evaluating the latter option.

2.2 Coal - Nova Scotia and, to a lesser extent, New Brunswick, are planning major expansions into coal-fired thermal electric power generation.

2.2.1 Nova Scotia - Coal mining for thermal electric generation will be significantly increased in Cape Breton. The recent fire in Glace Bays' No. 26 Colliery has expedited the need for supporting an expansion of the Cape Breton Coal industry. The following actions have been initiated:

(1) Funds were provided to open the new Lingan-Phalen Colliery and to expand the Victoria Junction coal preparation plant to accomodate coal produced from new mines. It is expected that full production of 1.5 million tonnes could be achieved within 2.5 years.

(2) The federal government provided $24 million to complete the exploratory tunnel for the Donkin Mine. Final approval to proceed with this $500 million mine will not be given until the coal is tested in power plants. Tests will also be conducted to assess the use of coal as feed stock in the new liquification and carbogel process. The Cape Breton Development Corporation says that the mine, if approved, could produce 1.5 million tonnes by 1988-89 and 2.2 million tonnes by 1990-91. The coal will be used exclusively for thermal purposes.

(3) The feasibility of the Glace Bay Colliery to produce metallurgical coal will be assessed. Originally it was envisaged that the No. 26 Colliery would produce metallurgical coal until 1995 and that production from the new mine would begin in 1990-91 with full production of 2.6 million tonnes occuring by 1995. These plans may be accelerated given the fire in No. 26 Colliery. If all three mines are approved, coal production would be increased from 2.3 million tonnes to an estimated 8.5 millions tonnes by 1995-96 at a cost of $2 billion.

The province recently approved a licence for a private contractor to mine coal in the Springhill area. The new mine will reach a total depth of 500 meters and is estimated to produce 20,000 tonnes annually over the next 15 years.

2.2.2. New Brunswick - Coal is receiving increased attention as an important energy source to supplement provincial requirements. According to

NEB forecasts, coal end use will increase by a factor of almost 3 by 1985. However, this will depend on the fate of the Coleson Cove conversion (oil to coal) project which is again being pursued by the province.

New Brunswick power and the federal government have initiated a study (Phase III) to examine the economic feasibility of burning coal, natural gas or a coal slurry in a thermal generating facility at Dalhousie. The study will be completed by March, 1985.

The New Brunswick Power Commission and the federal government provided $36 million to test the use of coal and oil shale to produce electricity. The first million dollars will be used to conduct preliminary tests aimed at assessing the environmental and economic feasibility of the coal/oil shale mixture. The tests, which will not be completed until 1988, will be conducted on two demonstration units at the 30 MW plant in Chatham.

2.3 Nuclear Power Generation

The only province which relies on nuclear power for electricity is New Brunswick. A 630 MW reactor was constructed at Point Lepreau and began commercial operation in 1982. A second reactor, Lepreau II, is in the planning stages. An impact statement has been prepared and public hearings will be held in 1984 to determine the socio-economic and environmental feasibility of the project. This reactor could become operational between 1995-2000 and account for the doubling of electricity being produced by nuclear generation by 2000 (Table II).

2.4 Peat

An additional 10 GWH of other electricity will be produced, likely from peat, in New Brunswick by 1985 (Table II). Peat resources in New

Brunswick approximate 40 million tonnes which is equivalent to 70 million barrels of oil. Sufficient thermal peat reserves exist in the northern part of the province to fuel a 40 MW unit for 30 years. A study by MONENCO found this concept to be technically feasible, environmentally attractive and economically competitive with coal. The province has discussed construction of this facility with a United States engineering firm.

2.5 OFFSHORE OIL & GAS

Exploration has now identified several large gas and oil discoveries, plus numerous presently non-economic accumulations (Table V). The most promising finds of oil and gas are found on the Scotian Shelf (Venture, Thibaud, Cinalta) and the Grand Banks (Hibernia and south Hibernia), respectively.

2.5.1 Offshore Natural Gas - Sable Island - While gas reserves off Sable Island are reported to approximate 2.5 trillion cubic feet, projections for the Scotian Shelf are as high as 34 trillion cubic feet. Providing gas is available in commercial quantities, these reserves could be developed as early as 1987 and go into production for at least a 20 year period. The province of Nova Scotia intends to export a significant amount of this gas to the New England States. Mobil reveals that gas will be produced at a rate of 400 million cubic feet/day during the first 15 years of operation which approximates 41,000 GWH of energy/year. Mobil further reveals that half of this could be used in the region with the remainder being exported to the New England States. This would satisfy 8% of New England's 1995 energy requirements.

2.5.2 Offshore Oil - Successful oil exploration on the continental shelf could lead, over the next 15 years, to the replacement of imported oil. Recent surveys by Mobil reveal that recoverable amounts of oil from Hibernia approximates 1700 million barrels. In 1982, it was suggested that production from Hibernia at a

TABLE V
OIL AND GAS POTENTIAL (RECOVERABLE)

OIL POTENTIAL ($10^6 m^3$)	High Confidence	Average Expectation	Speculative Estimate
Georges Bank	10	168	350
Scotian Shelf**	8	72	139
Grand Banks (South)	2	50	95
East Newfoundland Shelf	300	1128	2190
East Newfoundland Basin	130	270	720
Labrador Shelf	10	134	275
Baffin Bay-Lancaster Sound	5	55	158
TOTAL	*512	1877	*3392

GAS POTENTIAL ($10^9 m^3$)	High Confidence	Average Expectation	Speculative Estimate
Georges Bank	37	150	307
Scotian Shelf**	111	508	991
Grand Banks (South)	20	90	180
East Newfoundland Shelf	170	290	530
East Newfoundland Basin	110	370	900
Labrador Shelf	160	745	1627
Baffin Bay-Lancaster Sound	18	270	803
TOTAL	*725	2423	*4713

* These numbers do not add arithmetically but must be summed using statistical techniques.

** Estimates for this area are under review at time of printing.

rate of 300,000 barrels per day (b/d) could occur by 1990. However, after four years studying development possibilities for Hibernia, Mobil now envisages a two-phase development. The first stage would involve 10 - 20 satellite wells linked to a floating production system capable of producing 50,000 to 70,000 b/d. If the results of the Phase I development are positive, the second phase would proceed either as a fixed or floating production system with an output of 200,000 to 300,000 b/d. In both cases the oil would be transported by tankers, whose destination remains to be determined. The specific details of Mobil's intentions will be revealed in a development plan which will be sent to COGLA for approval in June 1985. It has been suggested that development could begin as early as 1986 and that production "start up" could occur in 1991. It is predicted that exploration drilling will continue at approximately present levels but changes to the National Energy Program could influence the level of activity, by an unknown amount.

2.6 TIDAL POWER POTENTIAL

Tidal power is once again in the news. The start-up of the Annapolis tidal power project has provided the impetus for a larger project.

A number of sites of different potential have been evaluated over the years in the upper reaches of the Bay of Fundy. Two sites have been selected for further consideration but Nova Scotia, the major promoter, has focussed on Minas Basin which would produce some 4,800 MW of power at a cost of approximately $22 billion (1981

dollars). The feasibility of tidal power is currently being assessed based on the performance of the pilot plant situated at Annapolis Royal. EM&R provided $500 K to support this assessment.

In 1977, the Fundy Tidal Review Board published a re-assessment of Fundy Tidal Power for development potential. At that time tidal power was not considered to be economically feasible. An '82 update report illustrated that the benefits are 2.5 to 3.0 times greater than the project costs due to incurred oil prices and improved design. Since that time, oil prices have dropped, which may affect the '82 cost/benefit results by a yet to be determined amount. The main obstacles to developing the project are the lack of financial support, the uncertainity in the New England market and competition from other sources exporting power to the United States, notably Quebec.

2.7 THE SOFT ENERGY PATH: ENERGY CONSERVATION/OTHER RENEWABLES

The utilization of energy conservation measures and renewable energy resources such as wind, solar and biomass are important since they can contribute to energy supply with a minimum of environmental disruption. While large-scale hydro and tidal power are also recognized as renewable sources of energy, they are normally considered in the "hard" energy category. Solar radiation, wind, forest biomass and possibly geothermal, offer opportunities to meet a small portion of the future energy needs of the region, on a local basis.

2.7.1 Conservation - To date, Canadian energy production and consumption patterns have included waste and inefficiency. Production/consumption surveys, conducted in the mid 70's have shown that over 50% of energy produced in Canada was not effectively utilized. As such, there are considerable opportunities for conservation in every sector, particularily in residential and transportation use. To this end, the federal government has promoted conservation measures to reduce total energy demand. Energy conservation is economically attractive since it can shift employment and investment from frontier regions to the point of use (cities, rural communities) and it provides a buffer against escalating energy prices. From an environmental perspective its most obvious role is one of displacement of more significant and environmentally disruptive forms of energy production.

2.7.2 Other Renewables - The use of renewable resources are practical alternatives to oil and other conventional energy sources and they can play a significant role in the oil substitution program. Given a concerted priority through R&D funding, tax and other financial incentives, it would not be unreasonable to see renewable energy resources providing up to 20% of Canada's total annual energy needs by the year 2000. Prince Edward Island, which has an

almost total dependence on out-of-province sources, will likely lead the region in terms of developing available renewable resource potential. The recent signing of the five year $8 million Alternative Energy Development Program between EM&R and PEI will spur the development and expanded use of wood and biomass for energy purposes.

2.7.2.1 Solar - The use of solar heating to supplement hot water and space heating requirements has and will continue to increase in the region, largely because of government subsidy. In July 1984, the Government of Canada announced that $15 million will be committed to the Solar Domestic Hot Water Demonstration program until 1988. The funds are part of a $79 million initiative announced to support the continued development of active solar energy in Canada. These funds are expected to result in the installation of 12,000 new systems across Canada. Last year, a solar heating program to demonstrate the economic feasibility of solar heating aimed at developing the necessary data base, equipment and skills for wide-spread application was implemented. The main program activities have focused on data collection of solar radiation data to design and evaluate solar heating potential.

2.7.2.2 Wind - The Maritime Provinces and particularly Prince Edward Island, are ideally suited for the development of wind energy conversion systems because of high average annual wind speeds. Consideration is being given to establishing a wind farm at Mount Pleasant and the Atlantic Wind Test site has been developed at Cape North. One of the world's largest wind turbines has been installed at this site. The turbine will be tested for one year or more and the electricity produced will be fed into the provincial grid. This site will evaluate wind systems from all over the world for potential use in our conditions. In developing the information necessary to develop wind energy conversion systems, Environment Canada has provided funds to establish wind sensors at the Atlantic Wind Test site.

2.7.2.3 Forest Biomass - The provinces, particularily Prince Edward Island, recognize the importance of using wood fuel to supplement domestic space heating requirements. Prince Edward Island views wood as a preferred energy alternative which will partially displace imported oil and stimulate employment. If the Prince Edward Island forests are used to their full potential, 750 persons-year of direct employment could be generated.

Presently, 265,000 M^3 of wood is used annually for energy generation in Prince Edward Island, which displaces an estimated 314,000 barrels of oil with a retail value of $16 million. Projections of wood use in 1988 approximate 336,000 M^3 which will displace 400,000 barrels of oil with a retail value of $20.4 million. In addition to providing a source of heat to 60% of Island dwellings, wood is used in some hospitals, schools, and other institutional buildings. The province, with support from the federal government, is currently examining the feasibility of increasing the use of wood as an energy source and is also developing an infrastructure of wood fuel supply and distribution systems.

The problem which the province of Prince Edward Island now faces is not one of resource depletion but rather resource availability. Estimated annual growth of wood boimass is 3 m^3/ha/yr or 825,000 m^3 for the province, but due to the large number of small size woodlots, only 57% or 470,000 m^3 is considered available. The annual combined harvest of roundwood fuel, pulpwood, sawlogs and other products approximates 385,000 m^3. While localized shortages of roundwood for the prime fuelwood species may occur in areas adjacent to the larger municipalities, there is generally room for a significant expansion of wood harvest, especially with

increased utilization of low quality hardwood and softwood biomass. This opportunity to increase wood use for energy hastened negotiations between the federal and provincial governments which led to the Canda/P.E.I. Forest Resource Development Agreement signed on July 29, 1983. Overcutting without silviculture and reforestation could lead to serious environmental problems including erosion of soils.

Nova Scotia has also investigated wood as a source of energy and several reports are now available on the subject. Many homeowners have in fact converted to wood heating in whole or in part. The same can be said for New Brunswick and Newfoundland. It has been estimated that the total amount of biomass used in Atlantic Canada, excluding PEI, is as follows:

Province	Residential (green tonnes)	Commercial/industrial green tonnes	Total
New Brunswick	600,000	1,250,000	1,850,000
Nova Scotia	540,000	805,000	1,345,000
Newfoundland	750,000	210,000	960,000

This use of wood is estimated to displace an excess of 1,028,000 barrels of oil whch is equivalent to saving approximately $50,000,000/yr.

* Surveys of Wood Fuel Use on Prince Edward Island 1982-1983. Resource Ventures Inc.

3. ISSUES & POLICIES WHICH AFFECT REGIONAL ENERGY DEVELOPMENT

The concern over energy security in Canada, particularly as it relates to oil availability, has continued to be the focus of policy makers at federal and provincial levels of government in the 1980's. The following is an overview of major decisions and issues that have an impact on energy development, electrical systems planning and resource development.

3.1 Federal Policy Developments

The most significant federal policy development which affects energy development in Canada is the National Energy Program. To accelerate the decline in oil use for electrical production, a program to assist the four Atlantic Provinces in developing their energy options was established:

(i) A utility off-oil fund amounting to $175 million to finance up to 75% of the costs to convert oil fired electricity generating plants to coal was established;

(ii) Provisions to contribute up to $200 million to support the development of the Lower Churchill River in Labrador were made. Some of these funds were directed towards assessing the feasibility of the Strait of Belle Isle underwater cable crossing;

(iii) CBDC has been given funds to develop new coal mines in Cape Breton; and,

(iv) $150 million has been provided to support the development of new coal-utilization technology. The majority of these funds will go to demonstrating the fluidized bed combustion technology in Cape Breton.

Other federal initiatives include the creation of the Energy Research and Development Fund to promote the development of new and more efficient technology. Changes in the National Energy Program are pending but details are not available.

3.2 Provincial Policy Developments & Issues

The Maritime Premiers have established an advisory committee of senior utility officials with federal and provincial observers, to provide technical and operational co-ordination among the utilities. The Committee is responsible for co-ordinating and developing annual load growth forecasting, short and long range utility expansion plans, electrical research and development and conservation programs. It also provides a regional focus for operations involving neighbouring utility systems (Quebec and New England).

Some of the other provincial policy developments and issues which affect energy development include:

3.2.1 Churchill Falls Water Rights Reversion Act - In late 1980, the Newfoundland Government introduced legislation for reversion of water rights for Churchill Falls owned by the Churchill Fall Corporation. In 1984, two Supreme Court decisions ruled in favor of Quebec by concluding that the Water Rights Reversion Act was outside the

territorial jurisdiction of Newfoundland. The agreement between Labrador Hydro and Hydro Quebec will remain in effect for the next 57 years. Negotiations between the two corporations are continuing.

3.2.2 Transmission Corridor for Labrador Power - Running parallel to the above issue is a second one related to access of Labrador power to markets external to Quebec. Newfoundland is seeking to obtain a power corridor through Quebec so that excess electricity from power projects in Labrador (e.g. Muskrat Falls) can be sold in the Maritime and New England markets.

Hydro Quebec recently filed an application with the NEB to export 33 billion kilowatt hours to the New England Power Pool between 1986-1997. In May, 1984 the Board approved six licences to allow exports amount to 24,000 gigawatt hours per year over periods of 11 to 18 years. Newfoundland opposed Hydro Quebec's plans and hoped to gain access to the excess capacity. Premier Peckford has now indicated that the province will examine the feasibility of constructing an underwater cable linking Labrador and Newfoundland under the Strait of Bell Isle to export power to the U.S. SNC consultants have been requested to update earlier studies to examine the question of feasibility. A successful evaluation could provide further impetus for developing Gull Water/Muskrat Falls hydro potential.

3.2.3 Development Considerations For The Fundy Tidal Project - While the most recent cost/benefit analysis was favourable there are a number of administrative

and economic factors which must be resolved before the project proceeds. Since the minimum investment would approximate $23 billion for the preferred alternative (Minas Basin), an inordinate financial burden would be placed on the utility customer in the early years of operation. As such, the financial viability of the project would be dependent on substantial and direct government support to subsidize consumer costs of power from this source.

Another option, described in the '82 update, would be to enter into a joint venture with the New England utilities. If this were to occur, financial arrangements would be required to offset the higher costs of borrowing money from institutions in New England. The New England utilities, which are privately owned, may not have the ability of the Nova Scotia government to raise the necessary funds since their credit ratings would be comparatively lower, and thus, their borrowing costs would be correspondingly higher. These factors would be a consideration in the development of any joint venture.

Before a final decision could be made on the project additional factors would have to be addressed:

(i) The federal and provincial governments constructed a 20 MW tidal power plant at Annapolis Royal which was officially opened in August, 1984. The Nova Scotia Tidal Power Corporation received $500,000 to study the feasibility of tidal power based on the results of the pilot plant. Specifically the study will investigate design, cost estimates, markets,

financial planning and environmental factors to determine if the larger projects are viable . This assessment will be completed by the middle of 1985.

(ii) If the results of the above study are positive, a detailed assessment of the larger project would be required. This assessment, which would focus on the technical, economic and environmental feasibility of the project, could cost $50 million and take up to 5 years to complete. These answers will not be known until 1991 (assuming funding could be secured).

(iii) If the project is deemed feasible, construction would take at least 10 years to complete (i.e. 2001+).

3.3 Federal/Provincial Agreements

Aside from the federal policy developments described above, the Canada/Nova Scotia Agreement on the offshore will result in the expeditious development of offshore gas reserves. Several agreements for offshore exploration have been signed with a number of oil companies totalling over $3 billion. Mobil Oil has prepared an environmental impact statement and a public review was held in 1983 by two Panels. This project could be developed by 1987-88. In addition, Sable Gas Systems Ltd. plans to file an application with the NEB to export Sable Gas to the New England market.

Providing the gas is available in commercial quantities, there are a number of factors which collectively suggest that the project will proceed:

- Government (federal and provincial) has invested a great deal of time and effort advocating the positive economic benefits that Nova Scotia will realize from developing Venture gas. This advocacy has bolstered investor confidence and increased the public's expectations that the project will be developed by 1989. For these reasons, it's believed that government will be committed to developing Venture gas.

- The Eastern Canadian Premiers and the New England Governors adopted, in June of this year, resolutions aimed at urging governments and industry to expeditiously develop Scotian Shelf gas potential and establish the necessary transmission facilities. The political climate for the development of the project and exporting the gas to New England has been favourable.

- The removal of the fixed border price will allow more flexibility for negotiating export agreements. The proximity of the Scotian Shelf (i.e. Venture) gas to the New England market could be a key factor in securing a long term agreement at competitive costs. Considering that it will cost $1 billion to export gas to New England from Nova Scotia and in excess of $6 billion to complete Western Projects (e.g. Polar Gas) Scotian Shelf gas could be less expensive and hence more attractive to the Northeastern States.

- A number of proposals (e.g. Polar Gas and Venture) are seemingly vying for slightly different markets. While Venture focuses on capturing the New England market, the remaining proposals are attempting to secure the larger mid-western U.S. markets.

- The New England Gas Pipeline Co. is contemplating an application to the Federal Energy Regulatory Commission

which will designate the Sable Island area as the source of gas supply for New England. The company also plans to construct a pipline from the Canada/U.S. border to Rhode Island where existing pipelines will allow Sable Gas to reach the broader U.S. eastern seaboard markets, if necessary. Other American companies (e.g. Tenneco) have also expressed interest in building gas pipelines to provide Sable gas to the Northeastern States.

While the Supreme Court ruled in favour of the federal government on the question of offshore resources ownership, Premier Peckford is optimistic that an equitable arrangement between the Canadian governments and Newfoundland is now possible. Additional factors governing the development of Hibernia oil include the establishment of federal-provincial-industry revenue sharing arrangements, the world price of oil and OPEC's pricing policy.

3.4 International Implications

The main international factors which will influence energy development in this region include the world price of crude oil and the future energy plans of the New England States and its market.

3.4.1 World Price of Oil - The decline in the price of oil in response to the 1982 surplus world oil situation created a condition whereby future oil-to-coal conversion projects in Nova Scotia and New Brunswick may not be economically viable. This point is significant when considering that:

- the economic value of Hibernia oil and other oil developments in Canada, was based on an assumed world

price of $45/b (U.S.). Since the world price of oil now stands at $29/b (U.S.), production from Hibernia and other oil projects could be delayed for a number of years. However, security of supply and self suficiency may be key factors in developing our available hydrocarbon resources.

3.4.2 New England's Energy Plans - It is particularly significant that the economic viability of a number of mega-projects notably Sable Gas, Gull Island/Muskrat Falls and Lepreau II is dependent on capturing the New England market. While the federal/provincial governments and industry debate over questions on timing and jurisdiction, New England is facing a critical energy problem and urgently requires solutions. New England is under considerable pressure from Pennsylvania to establish coal fired thermal generating plants to satisfy their long-term needs. The New England States have estimated that their energy requirements by 1995 will approximate 285,000 GWH. At a recent conference, a New England official suggested that their energy demands will be so significant and their options so few, that they could assimilate any and all of the electricity that Atlantic Canada could export. Unless firm decisions are taken soon on developing our energy resources, New England will be forced to develop their own energy generating facilities which will focus on coal-fired thermal plants and possibly nuclear power rather than on Sable Gas, Labrador hydro or Lepreau II power. Imported power from Quebec's James Bay development is another source. If this were to occur, the economic viability of regional projects would be questionable.

3.4.3 Market Potential (Gas) - North Eastern States: The market potential in this area is potentially so large that a number of competing exports approvals could be accommodated:

- Over the long term, New England is committed to increasing the use of natural gas to satisfy their total, primary energy requirements. Currently 9% of New Englands energy requirements are satisfied by using natural gas. (This is 16% lower that the use of gas on a national basis.) New England's interest in using gas at levels more in line with amounts used nationally, could translate into increasing the consumption of gas from 1-2.5 billion cu.feet/day by the mid 1990's.

- Projected declines in oil production from the Gulf of Mexico could create an additional demand of 1 billion cubic feet of gas/day.

4. ENVIRONMENTAL IMPLICATIONS

The development of energy resources can be responsible for various environmental implications. There are environmental costs and benefits associated with each option. The potential regional as well as in some cases the international environmental implications resulting from developing hydro, coal, nuclear, peat and gas resources are discussed in this section. It must be recognized that oil and other fuels which are used for transportation feed stocks or for organic chemicals are not described, as such, as part of the following analysis. Any evaluation of the environmental risks associated with energy options would have to consider the displacement of particular, and the development of new, sources of energy in that context.

4.1 Regional Impacts

4.1.1 Hydro

Aside from the possible development of the large scale Gull Island and Muskrat Falls projects in Labrador and some additional sites in New Brunswick, the provinces favour the establishment of small-scale, low-head hydro developments. The environmental effects resulting from small and large scale hydro developments are described separately, below:

(i) Small scale - The environmental effects of small scale hydro are generally benign, if carefully designed to minimize disruption to the bio-hydrological regime. With low-head developments, for example, there would be less flooding due to impoundments and less reservoir fluctuations as compared to large development. While fish mortality would be comparable to conventional hydro in a relative sense, methods of incorporating fishways are more readily available. On the positive side, the impoundments could create new waterfowl habitat and increase recreational opportunities.

(ii) Large scale - The environmental effects of large scale hydro can be far reaching through the inundation of large tracts of land, which tends to flood wildlife habitat and can eliminate the resource base currently supported by the lands (e.g. agriculture, forestry). Flooding lands tends to result in leaching of metals and nutrients which can create productivity problems

(primary/secondary/tertiary). Downstream environments, used for water supply, recreation and/or fisheries can be impaired.

4.1.2 Coal

Increased mining, transportation, beneficiation and end use of coal reserves in the region could result in widespread environmental effects. The following is a brief description of potential impacts associated with each phase of the coal cycle.

(i) Mining - Mining activities can produce "acid drainage". This phenomenon which has been widely observed throughout the region, has resulted in major fish kills and has reduced recreational use and surface and groundwater supply potential. Strip mining can eliminate wildlife habitat.

(ii) Transportation - Transporting coal can be accompanied by the release of dust particles. While the nature and the magnitude of this problem is not fully known, the loss of the dust can contribute to contamination of the local environment.

(iii) Beneficiation - The major impact associated with coal preparation is the formation of acid mine drainage because of the large volumes of coal which are stockpiled at beneficiation plants. In addition, coal preparation plants which use sophisticated floatation techniques to wash coal and treat the effluent by adjusting the pH to precipitate heavy metals can contaminate receiving aquatic systems.

(iv) End use (thermal generation) - Coal combustion can contribute significantly to the formation of acid precipitation locally and at considerable distances away. The magnitude of the problem in this region is predicted to be significant if local coals containing high levels of sulphur are used. The effects of acid precipitation may include: acidification of aquatic environments and decrease in fish populations; a reduction in soil fertility and forest productivity; and, potential health implications due to leaching toxic elements in drinking water supplies. Also, coals in this region can contain high concentrations of contaminants such as lead, chromium, aluminum, uranium and arsenic which can either be emitted with the flue gas in part, or following combustion be concentrated in the ash, and subsequently, leach into the environment.

4.1.3 Nuclear - Under normal operating conditions, power production from nuclear reactors is responsible for small effects on the environment. Concern over thermal pollution and site preparation plans and the disposal of high-level radioactive wastes were expressed by Environment Canada during the review of Lepreau I.

4.1.4 Peat - The use of peat for fuel can have environmental effects from both harvesting and then burning it for electric power purposes. Harvesting peat can lead to a number of effects on wildlife habitat, the hydrologic regime and local air quality (dust). As metals tend to concentrate in peat lands, combustion can emit toxic substances into the environment. Those not emitted upon combustion would tend to concentrate in the ash and could pose waste disposal problems.

4.1.5 Gas - The main environmental concern associated with drilling and transporting gas to markets are blowouts and pipeline construction, respectively.

(i) Blowout - If a gas blowout occurred in the vicinity of Sable Island, gas, along with condensates, could escape into the atmosphere and could constitute a pollution threat. Concerns have been expressed over the effects of fallout on Island vegetation. The vegetation helps to stabilize the Island. Concerns have also been expressed on potential impacts on groundwater quality which is the sole source of water supply for the Atmospheric Environment Service weather station and on surface water which is used by Sable horses.

(ii) Gas Pipeline - The construction of a gas pipeline could be responsible for a number of impacts to water, wildlife and fisheries resources. The most significant concern is the possible formation of acid drainage when the pipeline crosses sulphide rich deposits (i.e. slate). There are a number of examples which show that excavating in such deposits has been responsible for significant and adverse effects on downstream fisheries, recreational and water supply users. While fisheries and water resources can be affected by "acid drainage", technology to reduce these impacts does exist. In addition, constructing a pipeline over agricultural lands and wildlife habitats will affect these present land use practices.

4.1.6 Offshore Oil

In environmental terms, the most direct marine threat of offshore oil development is obviously that of a major oil

spill, such as may result from an oil well blow-out or major accidental release of oil during storage or transshipment. These are infrequent occurrences, but because of the large volumes of oil potentially involved, they can have disasterous consequences on fish at particular times in their life cycles, wildlife (birds) and additional biological resources. Plants and animals have been shown to differ widely in their resistance and response to oil pollutants and it is, therefore, difficult to predict with precision the ultimate short and long-term effects. Commercially important species of shellfish and fish not killed outright may become tainted with petroleum hydrocarbons following a spill and fishing gear may be extensively damaged. In addition, if not properly regulated, offshore development can result in an accumulation of debris on the seafloor which can plague other users of the marine environment for many years into the future.

Ancillary onshore and nearshore developments established to support offshore development may also impact upon marine environmental quality. Activities such as harbour dredging, infilling and industrial discharges from the expansion or operation of new refining capacity or port and transshipment facilities, would be responsible for these impacts.

4.1.7 Fundy Tidal Power

The magnitude of work required to exploit even a small portion of the energy in Fundy tides will necessarily give rise to social and environmental impacts and will require a broad appraisal. Elsewhere, tidal power is viewed as a beneficial form of energy production since it is renewable,

does not produce noxious wastes and displaces other more environmentally significant forms of energy pollution. Over the past decade, studies have been completed by the Canadian government and research groups (with limited involvement by Americans) largely under the auspices of the Fundy Environmental Studies Committee. The research has increased our understanding of the ecology of the area and changes in tidal regimes that could result from developing the tidal power project. The main research efforts launched thus far include:

(i) With regard to potential impacts on the physical oceanographic regime, our knowledge has been advanced largely because of the numerical tidal modelling efforts by Dr. Greenberg of the Bedford Institute of Oceanography. This model predicts that the project would cause changes throughout the Bay of Fundy and Gulf of Maine, with a tidal amplitude increase of approximately 15 cm predicted in Boston. Other studies have shown that some of the intertidal areas may be submerged which could affect local seabird populations and additional organisms. The effect of this on productivity in the Bay is not, at this time, fully known.

(ii) The establishment of a tidal barrage could be responsible for increasing salt water intrusion into coastal aquifers and impair them as a source of water supply. In addition, drainage of agricultural land located in low lying wetlands situated adjacent to the coast, could be affected and reduce agricultural productivity.

(iii) Socio-economic impacts could result particularly when providing access to large borrow pits, which may require upgrading of existing or the establishment of new transportation links to these sites. Moreover, the construction of the tidal barrier could require the movement of a large labor force into communities which may result in increasing current infrastructure levels. The Nova Scotia Tidal Power Corporation feels that the construction and operation of a tidal power plant would not likely produce effects of a magnitude which would prohibit such a development. However, they recognize a substantial program of environmental studies to provide the basis of an impact assessment would be essential.

(iv) In 1983, it was decided that an ecological modelling effort, initially to describe the existing ecosystems and, if sucessful, to predict the ecological impacts resulting from barrage construction, should be initiated. This effort is now well underway with the assistance of a group of Dutch scientists who have been modelling the Ems-Dollard estuary in the Netherlands. A running model, which provided reasonable outputs, was developed. This developmental work is still continuing and a second modelling-workshop was held in Halifax in July, 1984. The purpose of this workshop was to improve the predictive capability of the model. The model will be the subject of discussion at the fall meeting of the Fundy Environmental Studies Committee which will be held in St. Andrews, New Brunswick.

4.1.8 Soft Energy: Energy Conservation/Other Renewables

The department recognizes the importance of energy conservation measures and the use of wind, solar and additional renewable resources in striking a balance between satisfying energy requirements and minimizing environmental disruption. In this regard, the principal role of soft energy is to displace some of the more environmentally significant forms of energy production and transmission. While the development and use of some renewable energy resources could result in some impacts to the environment, the more significant ones can be readily mitigated through improved technological design and resource management practices. The environmental implications associated with renewable energy options cannot be regarded as constraints on their development.

Some of the more obvious environmental implications include:

(i) The diffuse nature of solar and wind energy may require large land areas for centralized energy conversion. This problem can be ameliorated by multiple land use and decentralized conversion.

(ii) The materials and energy requirements of components used in the manufacture of solar panels could be responsible for significant air emissions and waste generation elsewhere in Canada.

(iii) Increased use of wood for fuel could result in air quality impacts. In addition, constructing access roads and harvesting biomass for fuel could increase the erosion/siltation process and create problems in aquatic environments, particularily in Prince Edward Island.

4.2 International Impacts

Any increase in the use of coal to generate electricity in New England and Nova Scotia could result in international impacts on fish, water supply, recreational potential, and could also reduce agricultural and forestry productivity as well as constitute a health concern.

4.2.1 New England - If the New England States develop coal-fired thermal generating facilities to satisfy their long term energy requirements, the already significant acid precipitation problem in this region could be further aggravated.

4.2.2 Nova Scotia - The increased emissions from coal-fired generating facilities in Nova Scotia could increase the acid rain problem on the Islands of St. Pierre and Miquelon located off the south coast of Newfoundland. The residents of these islands rely on rain water for supply purposes. They have recently re-introduced salmon into local streams and are currently developing the aquaculture potential. In this regard, any increase in the deposition of sulphate or metals could result in effects on drinking water and aquatic resources.

In addition, some researchers have identified the potential for wider tidal ranges along the New England coast which may result in the flooding of low lying coastal lands.

5. STATUS OF ENERGY/ENVIRONMENT ACTIVITIES PROPOSED FOR THE 84-85 FISCAL YEAR

The main thrust of the departments' energy activities follow three lines: (1) ensuring that energy development proceeds in an environmentally responsible manner; (2) providing environmental design criteria to support the development of energy alternatives; and, (3) exploring resource opportunities and identifying research needs. The status of the energy/environment activities recommended for the 1984-85 fiscal year are summarized on the following tables.

6. OPPORTUNITIES AND FUNDING CONSIDERATIONS FOR ENVIRONMENT CANADA IN THE ENERGY SECTOR

The principal objective of Environment Canada in the energy sector is to influence decisions in energy policy, development, production and use by ensuring that energy development proceeds in an environmentally responsible way and by supporting energy development through the provision of environmental design criteria. We have a responsibility to advise others on the environmental effects of their activities and attempt to influence and to express our views on the environmental costs and benefits of energy development proposals.

In this regard, the department cannot support or reject one energy development over another. This specific choice, in the final analysis must consider social, economic, cultural and environmental factors. To this end, we advocate the environmental case and this will change from situation to situation.

Main Area of Interest	Recommendation	Status
1. Ensuring energy developments proceed in an environmentally responsible manner.	1.1 Generic guidelines to screen small-scale hydro projects should be prepared on the basis of the MONENCO study.	1.1 The need to develop the guidelines is not apparent given the lack of projects, of federal interest, planned for the region.
	1.2 The existing coal guidelines will be updated on the basis of the Bridgeport Basin Coal Study.	1.2 The guidelines will be discussed with the Services at the end of this fiscal year when the project will be completed.
	1.3 The Fundy Guidelines will be updated to reflect the new information collected since 1977.	1.3 Held in a abeyance until a firm decision is made to proceed with the project.
	1.4 The potential for reclaiming exhausted peat lands for forest plantations should be assessed.	1.4 CFS/ORDG/EM&R will discuss this in September, 1984.

Main Area of Interest	Recommendation	Status
2. Providing environmental design criteria to support the development of energy alternatives.	2.1 The requests of the provinces on E.C. to provide information to develop renewable forms of energy will be determined to facilitate the departments long-term planning.	2.1 IWD plans to pursue this through existing federal/provincial hydrometric committees. Further consultation will occur through ORDG with the provinces and other federal agencies.
	2.2 Research and development into developing techniques to synthesize flow information to support the development of small-scale hydro potential.	2.2 This project was supported by PERD. ($100 K)
	2.3 If the Sable Gas pipeline is approved the department will explore the initiator's information needs to provide appropriate information at stream crossings.	2.3 No action until the NEB makes a decision.

Main Area of Interest	Recommendation	Status
3. Exploring resource opportunities and identifying research needs.		
3.1 Exploring resource opportunities to support studies.	3.1.1 Energy Research and Development Fund - A long term strategic plan (84-88) to define forest energy R&D needs (sequel to ENFOR) should be prepared. - A proposal was forwarded to PERD/NRC to examine groundwater source heat pump potential and related impacts in the region.	3.1.1 - RDGO coordinated CFS submission. Approximately 80% of the $3 million requested was provided. - NRC has requested IWD to undertake this study and will provide $100 K.
	3.1.2 Toxfund - Modelling to predict the transport of toxic substances from the projected 10-fold increase in coal burning in N.S. should be undertaken and appropriate studies initiated.	3.1.2 - The loss of EPS expertise has delayed implementation. The designation of industrial Cape Breton as a priority area under the Toxfund could result in support.
	3.1.3 Environmental Studies Revolving Fund - ORDG would coordinate regional activities.	3.1.3 - ORDG is no longer involved in ESRF matters .
	3.1.4 Baseline Studies Program - Services should submit accelerated baseline studies on regional energy projects.	3.1.4 - Several worthwhile studies are now underway as cooperative studies with other agencies.
	3.1.5 Information on the fund (stipulated in the NEB approval for the export of Lepreau I power) to support R&D into developing suitable radioactive waste management studies should be obtained.	3.1.5 - Discussions with NBEPC and the Services have failed to provide information on this fund. The NEB will be contacted.

Main Area of Interest	Recommendation	Status
3.2 Identifying research needs.	3.2.1 New England's future plans for establishing coal-fired thermal generating facilities should be determined and modelling studies initiated to assess regional implications.	3.2.1 ORDG staff will pursue this with N.S. representative of the N.E. Energy Committees.
	3.2.2 Dispersion patterns should be modelled to assess air/environment interactions from Lepreau II.	3.2.2 Completed in support of the departmental review of Lepreau II EIS.
	3.2.3 Potential for increased acidity in S.W. Newfoundland in response to projected expansion of the thermal use of coal in N.S. shoud be modelled, the focus should be on assessing aluminium mobility/forest productivity interactions.	3.2.3 Same comments are made on 3.1.2.
	3.2.4 A document describing the design and use of solar and wind energy conversion systems should be prepared.	3.2.4 AES has satisfied this recommendation.
	3.2.5 The use of appropriate small-scale energy sources should be promoted at National Parks to achieve further reduction in the total use of energy.	3.2.5 Discussions planned with EM&R, Centennial Co-ordinator and Parks Canada.
	3.2.6 A review of biomass developments (existing, proposed, and future potential) should be undertaken to identify opportunities for the department.	3.2.6 Funds secured from EC/EM&R; Study is now available.
	3.2.7 An assessment of the opportunities, benefits and impacts associated with existing and potential reuse and recovery projects to provide or conserve	3.2.7 EM&R expressed interest in providing support to this study. Plans have been shelved pending the activities proposed by National Council

To deal with energy development in this region between now and the year 2000, the department must develop specific strategies so we can press our influence where it counts the most and expend our resources effectively. Some of the significant issues, opportunities and interventions for Environment Canada in energy are summarized on the following tables.

A number of sources of funds do exist to support energy-related studies. These however should not inhibit or replace program development for the department's A-Base resources. Those studies which focus on enhancing technological development aspects, may receive support from the Energy R&D program which is managed by Energy Mines and Resources. (For additional information on this fund the reader should refer to the paper on the Energy R&D Fund prepared by the Office of the Regional Director General - Jan. 1983). Projects which deal with offshore oil and gas development and would assist in the decision-making process could be submitted to the Environmental Studies Revolving Fund managed by the Canada Oil and Gas Lands Administration. Projects which focus on data collection for general energy development can be considered under the Baseline Studies Program of Environment Canada.

APPENDIX 1 - CONVERSION FACTORS

1 barrel	0.15891 m^3
1 cubic foot	0.028328 m^3
1 short ton	0.907185 metric tonnes
1 cubic metre	0.000948 BTU
kilo	10^3
mega	10^6
giga	10^9
tera	10^{12}

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