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United Nations Industrial Development Organization

Guidelines for the development of an effective regulatory framework in view of the divestment of the Guyana Electric Corporation

Final Report

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CHAPTER 1

Terms of reference

Chapter 1 - Terms of Reference

The purpose of our study is to provide the Government of Guyana (specifically of the State Planning Secretariat, the Ministry of Public Utilities and the Public Utilities Commission task force) with pertinent information in view of the ongoing discussions concerning the divestment of the electric utility company.

This information is to be used in the setting up of a regulatory framework, to be implemented and managed by the Public Utility Commission, and also to assist the government in evaluating and negotiating the present draft licence agreement and in evaluating any further draft proposals.

The specific terms of reference is to provide technical assistance in the following areas:

a) the standards and norms with which an electric utility would be required to comply; particularly related to the quality and security of the supply of electricity;

b) the basis and methods for adjusting electric tariffs;

c) the methods for determining an appropriate rate of return for an electric utility and the basis for computing that rate of return.

In this report we provide information, options and recommendations pertinent to the above mentioned areas of concern. We have also provided an assessment of the Leucadia draft licence agreement dated 16/6/90.

This assessment was deemed essential and relevant to our mandate and we were requested by Public Corporation Secretariat (PCS) and State Planning Secretariat (SPS) officials to include the evaluation as part of our report. Because this agreement is presently being negotiated this assessment became our main priority.

In this final report we have also addressed certain issues which were of concern to the Regulatory Commission Task Force, including;

- the regulatory process;
- the evaluation of rate increase requests;
- the use and need for automatic tariff adjustment clauses.

We have also included in this final draft some of the general observations from the Hydro-Quebec expert committee regarding the Leucadia draft licences agreement as well as certain pertinent documents which we have annexed. We have also prepared a summary of our recommendations as a concluding chapter.

CHAPTER 2

Background, definitions and underlying assumptions

Chapter 2 - Background, Definitions and Underlying Assumptions.

There is wide scale agreement that measures must be taken in Guyana to achieve and insure increased electrical system reliability and to satisfy present as well as forecasted levels of demand at the lowest possible price. This is important not only for the well being of the population but it is essential for the short and long term economic development of the country.

Providing an exclusive operating licence to a privately owned electrical company which possessed the proper management and technical expertise and which would be regulated effectively could insure the achievement of the desired objectives.

Regulatory Framework

Considering the monopoly position of an electrical utility company a regulatory framework can be seen as an effective substitute for a competitive environment.

Under this assumption, an effective regulatory environment should:

1) establish and assess demands for tariff increases and insure that proper revenues are provided to the company to cover all productive investment and operating cost requirements,

2) insure that the company would achieve a "fair" rate of return for its efforts and risks,

3) set the rate of return and tariff structure to provide proper incentive so that the company would operate cost effectively to insure the lowest price possible for electricity,

4) insure certain standards and norms regarding customer protection are met.

Operating Standards and Norms

It has been assumed that standards and norms related to "efficiency" could be used as a means to measure and control the utility's productivity and performance.

Efficiency parameters such as technical losses, number of employees per megawatt, per installation, per department or per miles of distribution lines could be proposed to be used in a regulatory framework. However it is our opinion that such values would not be of practical use because these parameters would have to be updated continually with changes in new technology, new equipment (requiring less employees), increased automation, system expansion etc...

We also assume that any company that is given a licence to provide electricity has the required competence, expertise and experience to operate a utility effectively.

The standards and norms that we provide are guidelines related to the "supply" of electricity such as voltages, frequency and reliability.

Tariffication

In a regulatory framework the imposition and adjustment of tariffs serves five fundamental economic purposes:

1) raise revenues to pay the costs of supplying a reliable source of electricity and distribute these costs to the utility's customers,

2) create financial incentives that align production and consumption decisions,

3) insure that rates are as low and as stable as possible,

4) insure that the rate structure is fair and equitable and that there is no discrimination between clients

Rate of Return

The rate of return is used in a regulatory framework as a performance indicator which measures the maximum profit a monopoly is to be rewarded and which acts as a financial incentive for the company to attain.

The calculation of a "fair" rate of return for a regulated company is provided so that only a reasonable benefit compensates the company for the risks it is taking and for the opportunity costs of its capital and expertise. A maximum rate of return is imposed, along with a strict tariff structure, to insure that the company's monopoly power, especially in view of price inelasticity of demand, is not abused and does not burden the consumer.

The rate of return structure can provide proper incentives for the producer of electricity to continually search for new and less costly and more efficient methods of production, transmission and distribution of electricity in the country. It should also provide the incentives to insure that new technologies and alternative sources of supply be investigated for least cost operations to be maintained.

CHAPTER 3

Information to help in the establishment of an effective regulatory environment

Chapter 3- Information that will help in the establishment of a proper regulatory environment.

The following information could be used in the negotiation of a license agreement as well as in the setting up of an effective regulatory framework.

3.1 Standard and norms

These standards are aimed at providing consumers with minimum protection regarding the quality and security of the electricity they are purchasing.

3.1.1 Quality of Supply

3.1.1.1 Frequency

Under normal operating conditions, considering the size of the interconnected and isolated systems, variations in frequency up to 1% is an acceptable limit.

For the interconnected system, an additional parameter to be considered is the maximum total integration deviation that the system should not exceed. Through operation procedures, this deviation is usually corrected once a day to maintain the customers clock on time.

3.1.1.2 Voltage (pressure of energy)

Secondary voltages

We assume that secondary voltages available in Guyana will be standardized at 120/240 volts. These voltages are commonly used by various utilities in North-America and in some other parts of the world. To our knowledge, these utilities have permissible variation of supply that are similar. The values shown in table 1 can be used as the lower and upper limits within which the service should be provided at the customers meter.

If voltages other than 120/240 volts are to be adopted, then the upper and lower limits can be determined by using the percentages in table 1.

The compliance with these limits are one of the parameters used for system design. In practice a voltage depression greater than 10% after fault clearance can be experienced providing the voltage will be quickly restored within the acceptable limits. A one minute restoration delay is reasonable.

Upper limits should never be exceeded. The application of excessive voltage to consumer's appliances and electrical equipment must at all time be avoided even during service restoration using proper system design and operational procedures.

TABLE 1

(in volts)

Emergency condition	low	Normal condition nominal	high	Emergency condition
106/212	110/220	120/240	125/250	127/254
- 12%	- 10%	-	+ 4%	+ 6%

Transmission and primary voltages

The voltage for industrial customers supplied from the transmission and primary lines could be agreed to on a case by case basis.

Continuous fluctuations

The utility should eventually adopt norms related to "flicker" effects. This is usually caused by a customer having a connected load that varies too much with regard to the frequency of variation or by systems apparatus being switch on and off.

"Flicker effects" can be extremely annoying to the customer and will cause insecurity about a perceived unreliability.

3.1.2 Security of Supply

3.1.2.1 Service continuity indices

Continuity of service should be a major concern for a utility. Customers-service interruptions have a number of causes usually divided into two different categories:

- power failures due to equipment breakdown or random events caused by factors external to the system such as fallen trees and branches, wind and lightning;

- scheduled service interruptions allowing the utility to perform maintenance and system modification work.

Each service interruption affects a variable number of customers and varies in duration. For example, distribution system failures are more frequent but affect fewer customers while transmission system breakdowns are much less frequent but affect a large number of customers. It is useful for the utility to classify interruptions by the system from which they originate. This allows a better definition of the corrective measures that have to be taken and a better follow up of the results of these measures.

While quality of service can be evaluated on the basis of the total number of service interruptions during the year, this number only partially reflects the impact of interruptions on customers to establish the reliability of the overall system requires the collection and process of data on outage incidents. From this data recognized international indices can be calculated to determine how well the system is performing and comparison can be made with neighbouring countries with similar systems.

The three main indices used are the following:

- Saifi = $\frac{\text{Total customers-Interruptions}}{\text{Total customer served}}$

- Saidi = $\frac{\text{Total customers-hours of interruptions}}{\text{Total customers served}}$

- Caidi = $\frac{\text{Total customers-hours of interruptions}}{\text{Total customers interruptions}}$

3.1.3. Liability

A responsible utility should assume a certain degree of liability with regards to voltage and frequency standards.

We suggest the following text could be used to incorporate the limits of responsibility in a licence agreement.

"....the utility guarantees neither the maintenance of voltage and frequency at a fixed value nor the continuity of the supply and delivery of electricity. In no cases shall it be held liable for damages and losses caused to individuals or property resulting from:

- the supply or delivery of electricity
- the failure to supply or deliver electricity
- frequency variations and supply voltage variations not exceeding the limits outlined (above) or if these limits are exceeded because of fortuitous events or force majeure."

Under this type of clause, the company will be liability if the stated limits are exceeded during the company's normal operations.

3.1.4 SHORT TERM OPTION (transition period)

3.1.4.1 Voltage standards

Excessive voltage drop are probably common in certain areas (ref: Monenco study) which means that the compliance to specific norms can only be achieved if the necessary corrections to the distribution system are undertaken. The question here is what transient values should the utility comply with until it carried out it's distribution rehabilitation program.

We do not intend to recommend any specific values but instead make a suggestion on how the company could deal with this problem. First we must outline an assumption:

> In the 50 hz system, customer appliances and equipment are normally rated between 220 volts and 240 volts while in the 60 hz system, 230 volts and 240 volts are more likely to be encountered. Low voltage, as defined by the 240 volts standard, may in some cases be adequate for some of the 220 volts and 230 volts equipment. (A 12% drop for 240 volts nominal represents only a 4.0% and 8.2% drop with regards to 220 volts and 230 volts nominal).

We suggest that during the transition period the company deals with voltage complaints on a case by case analysis and takes the necessary actions to make sure the voltage levels are within the limits specified in table 1.

Since the system will not improve overnight the company should not be liable for not respecting these limits until the completion of the rehabilitation program. In the case of a complaint before that time, the company should respond to the customers request and if satisfaction is not received then the company could be held responsible for damages to the customer's equipment. It should be noted here that if, for a specific complaint, the customer receives satisfaction, a following complaint from the same customer within the transition period should be treated as a new complaint and therefore the company should be entitled to take the additional corrective measures as stated before.

3.1.4.2 Service continuity indices

The data required to calculate the continuity indices defined earlier is not presently available at GEC. The new utility should be responsible for the collection and processing of the necessary data. Considering the size of the customer base, this information could be made available within one or two years at the most.

3.1.5 Mechanism for Establishing Commercial Practices

The conditions governing the supply of electricity should be of public domaine. For this reason, we recommend that these conditions be considered by the utility and the regulatory commission for discussion and approval.

As an example, we enclosed Hydro-Quebec's official document which was presented to the government of the Province of Quebec for approval before it became official (Bylaw 411).

We do not recommend that the exact content of this document be implemented in Guyana. This is only an example of the way this issue could be dealt with.

3.1.5.1 Interruption of Supply

This question is covered on page 24 of the Bylaw document. Before a customer is disconnected for not paying his bill, the customer is normally allowed at least 98 days of supply and two warnings, one by telephone and the other by registered mail, to insure that he has been informed.

3.1.5.2 Customer Refund

In certain cases, a customer who has had to pay for work to ensure that he receives electricity may be entitled to a refund if a new customer utilizes the same facilities the first customer has paid for within a five year period (Bylaw 411 page 15).

3.1.6 System Losses

Many questions have arisen concerning system losses. Though we do not feel that a regulatory commission should use a value of system losses for the purpose of controlling the utility's efficiency, we were asked to provide this value.

There are two kind of losses : technical and non-technical. Technical losses for Guyana's system can be economically brought down to a value of around 10% to 12%. The unknown factor is non-technical losses which mainly consists of stolen electricity.

The CIPS report forecasts 16% total losses in 1998. In our judgement, this value should be a minimum target.

3.2 Regulatory Process - Example of a quasi judicial framework

Given the operational objectives of the rate regulation process, the functions performed by the various participants in the process to achieve these objectives can be quite different depending on the structure of the regulated enterprise, the powers and practices of the regulatory commission and the nature of the interventions. There is no such thing as a "typical rate case".

Nevertheless, the general sequence of functions performed in most electric rate cases involves:

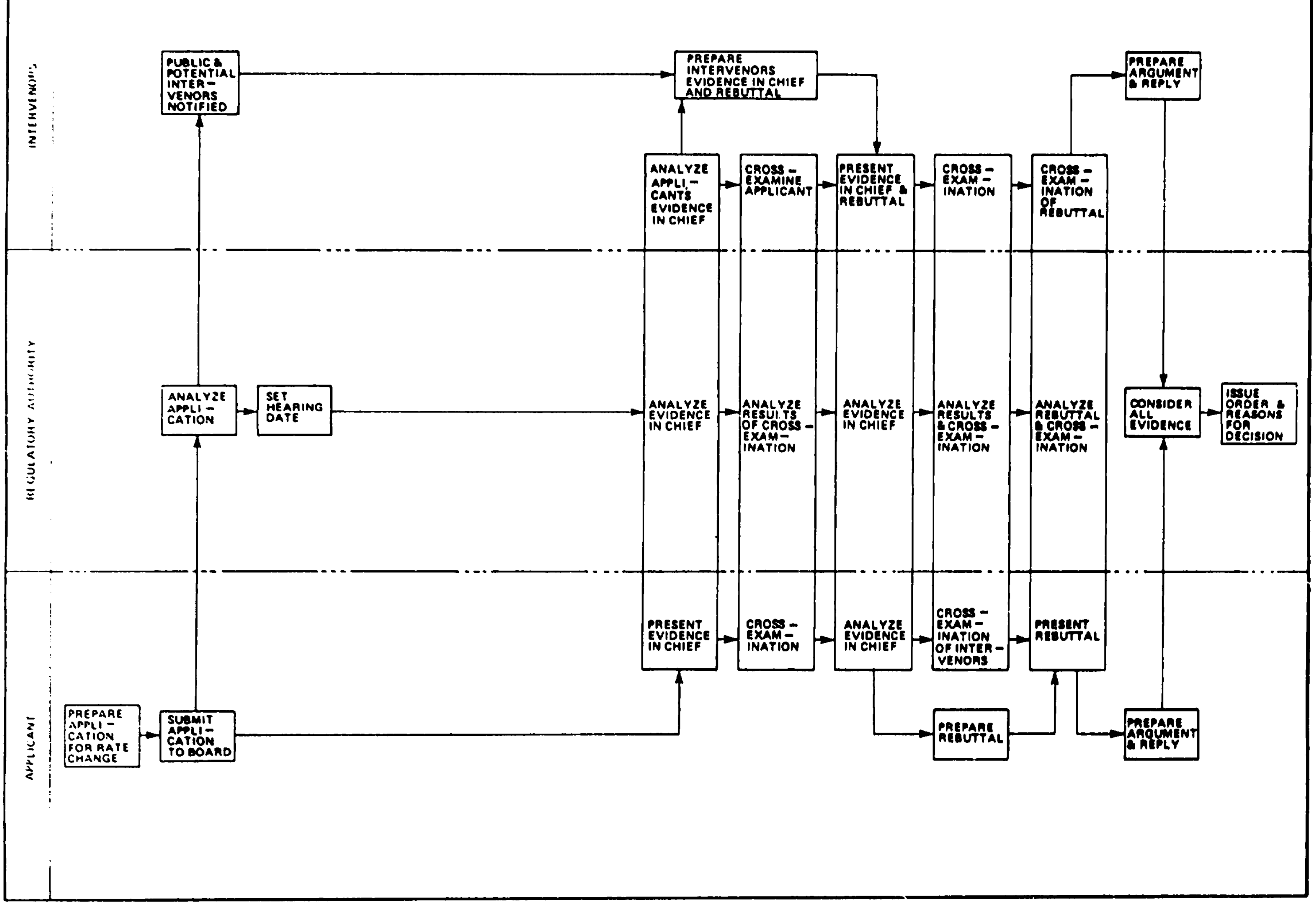
1. Preparation of a rate application
2. Submission of the application to the board
3. Analysis of the application by the board
4. Notification of the public and potential intervenors, and establishment of a hearing date.
5. Presentation of the applicant's evidence in chief
6. Analysis of the applicant's evidence in chief by the board and intervenors.
7. Cross-examination of intervenors and their expert witnesses.
8. Preparation and presentation of intervenors' evidence in chief
9. Analysis of the intervenors' evidence in chief by the board and applicant.
10. Cross-examination of intervenors and their expert witnesses.
11. Preparation and presentation of rebuttals
12. Preparation and presentation of final arguments and rebuttal.
13. Consideration of all evidence by the board.
14. Issuance of a decision, reasons for decision, and an order, by the board.

These functions, in the sequence in which they are performed, are represented by means of a general functional flow diagram presented on the following page.

Under this process, it is assumed that rate adjustments are possible only after a final rate decision by a quasi-judicial body at the conclusion of full public hearings.

It will be possible to expedite the hearing process by insuring participant awareness of the time and cost of the process and providing incentives to improve process efficiency. It is important to facilitate preparation by all parties, including use of "prepared written testimony", prehearings and settlement conferences as well as insuring the process can deal effectively with uncertainty.

GENERALIZED FUNCTIONAL FLOW CHART OF REGULATORY PROCESS



The hearing process could be also shortened if general public or selective interventions by parties not associated with the utility or the board, are not allowed.

The time-frame for a usual process adjustment hearings in the U.S. can be quite lengthy and could vary anywhere between 4 and 18 months.

3.2.1 The Regulatory "Lag"

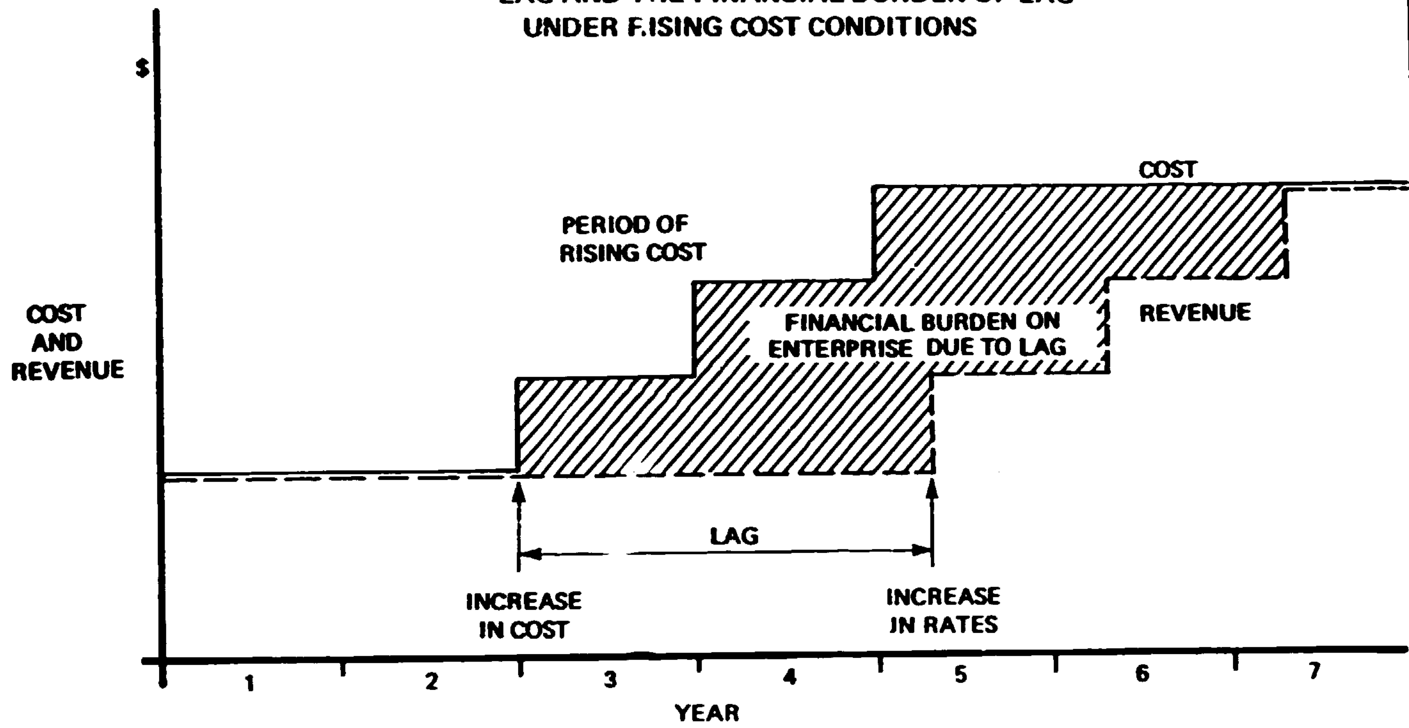
The "regulatory lag" is the characteristic of conventional rate regulation processes which can impose a financial burden on the utility or to consumers due to changing costs.

Generally speaking, lag refers to the time required to make approved changes in rates. More specifically, lag may be defined as the interval of time elapsing between the date when a change (increase or decrease) in the cost of service of a regulated enterprise occurs, and the date when rates are approved which will permit the amount of that cost change to be recovered from or received by customers.

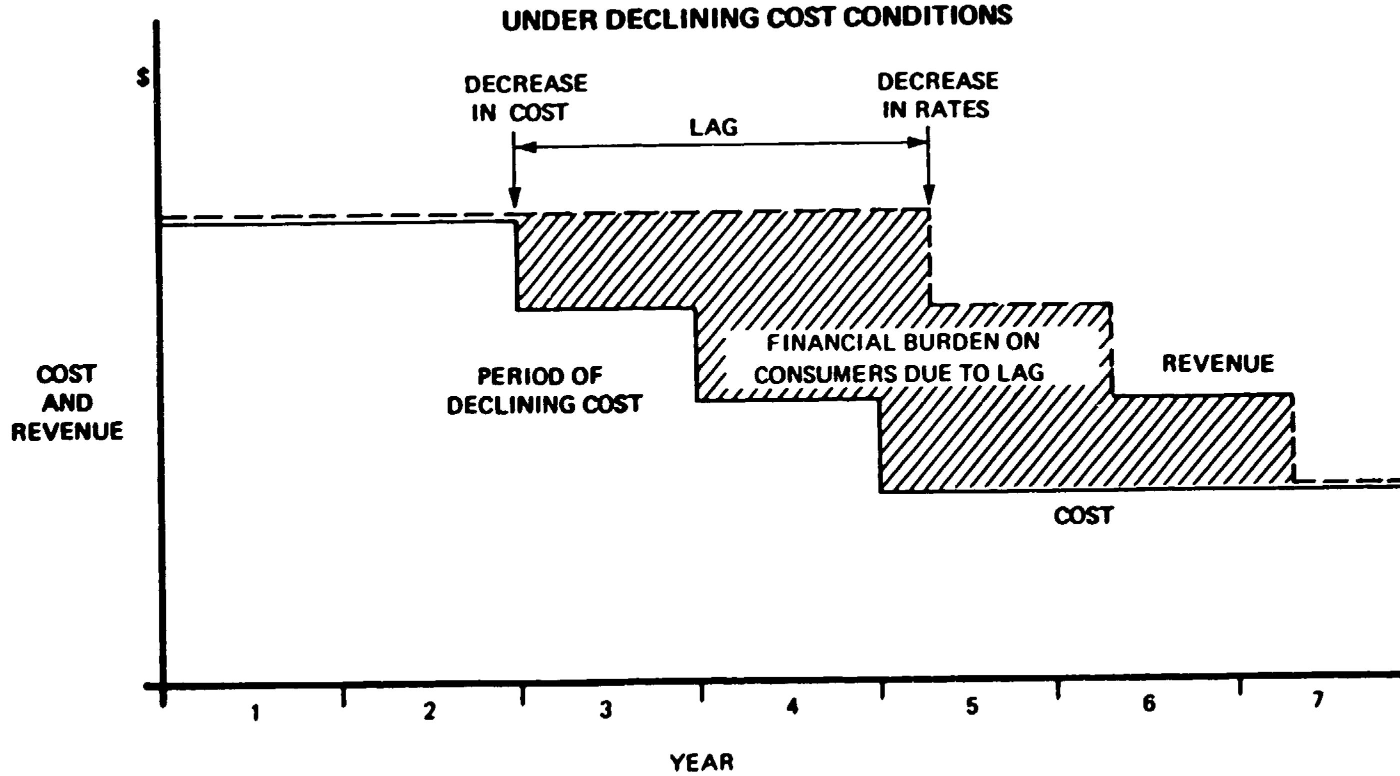
The burden of lag could also be reduced with the use of interim or automatic tariff adjustments as well as relying on forecasted data on cost of service and financial performance instead of using historical data in evaluating requests for tariff increases.

Although measures should be adopted to reduce the financial burden of lag, it can be argued that this burden is the "price" which regulated enterprises should pay for the reduction in business risk and increased stability of earnings which their regulated position in the economy affords them. It could also be argued that "lag", and the financial "burden of lag", have the beneficial effect of providing a spur to increase enterprise efficiency. However in times of rapid cost fluctuations the financial burden of lag could be substantial.

LAG AND THE FINANCIAL BURDEN OF LAG UNDER RISING COST CONDITIONS



LAG AND THE FINANCIAL BURDEN OF LAG UNDER DECLINING COST CONDITIONS



3.3 - Evaluation of tariff increases

Under the best of circumstances the method for determining an appropriate tariff structure and levels should be undertaken using a combination of average costs and long-term marginal cost principles. (such as was used in the Stone and Webster study in November 1988). However, to describe a detailed tariffication methodology in this report, based on average cost and marginal cost principles would not satisfy the immediate needs of the regulatory commission task force.

The need here is to determine how the requested changes in the level of tariffs by the utility should be evaluated by the regulatory authorities. The method for determining if requests for tariff increases are appropriate and reasonable should involve a full cost of service pricing analysis.

3.3.1 Basic information requirements for a full cost of service evaluation

In order for utilities to account to their regulatory body, most utilities follow detailed accounting systems prescribed for them by the regulator, i.e. FERC uniform system of accounts. These uniform accounting practices provide for the classification of transactions into various well-defined categories including: a) operating and maintenance expenses, b) depreciation expense, c) taxes, and d) investment. The cost of service is defined as the sum of a), b) and c) plus a fair and reasonable return on d).

This first principle of rate-making is:

Total Revenue Allowed = Cost of service

where :

$$\text{Cost of service} = E + d + T + (V-D)R$$

E = Operating and maintenance expenses
d = Depreciation expense
T = Taxes
V = Gross valuation of the utility's property
D = Accumulated depreciation
R = Allowable rate of return

(V-D) is the rate base.

The utility needs revenues sufficient to cover proper operating expenses, depreciation expense, and the taxes that would be payable if the authorized rate of return were earned; and to provide a reasonable return on the net valuation of the property used in serving the public.

The regulator must determine what are a utility's allowable and reasonable costs for rate-making purposes. It must be determined if they are costs necessary to provide service. Certain expenditures can be deemed by the board as ineligible for the "cost of service" calculations and are excluded. "Disallowed" costs are frequently those whose nature would otherwise have them classified as ordinary business costs in an unregulated industry. The

Uniform System of Accounts classifies such costs separately in order to facilitate their treatment in the rate-making process. One example of this type of cost is charitable contributions. Disallowances are often made to investments as well as expenses.

The FERC uniform system of accounts is only a starting point for the regulatory process of rate-making. Determining what costs are appropriate for inclusion in the "cost of service" is a matter of prudent and informed judgement. Between regulators and utilities there are usually differences of opinion as to how these records should be used in the "rate-making" process.

3.3.1.2 Use of a "Test Period"

In order to determine the cost of service, the regulatory commission must begin with a review of the utility's operations over a given period of time. This "record of costs" is referred to as the "test period".

A very convenient test period is the latest 12 months for which complete financial data are available. The regulatory commission examines the test period and determines the cost of service by applying the above formula.

However, since the regulatory commission is looking forward into the future when setting rates, a historical test period may not accurately portray the relationships between revenues, expenses and rate base that will prevail in the future. The test period may contain abnormal or non-recurring costs. These costs must be removed.

In order to make the test period representative of the future, regulatory commissions allow the test period to be "normalized", or adjusted to "going levels", in other words, the test period is adjusted for known and measurable changes that will prevail during the immediate and near future ,such as inflation, but which were not fully reflected in the test period results. Adjusted historical costs and forecasted costs would be synonymous here.

The revenue side of the calculation would also be adjusted in the same way, incorporating recent tariff changes as well as expected changes in the overall demand for electricity .

3.3.2 Allowing updating of tariffs using interim cost adjustments.

In order to understand the full impact that changing costs have on the utility's. ability to satisfy its operating requirements, a full cost of service tariff analysis used within a predetermined regulatory process should be undertaken before allowing any tariff increased to be passed onto the consumer. However if the regulator feels that it must insulate the utility from certain operating risks associated with fluctuating costs, then adjustment mechanisms can be defined.

To effectively deal with problems associated with rapidly changing cost structures and the financial impact of lag , interim cost adjustment mechanisms, which would only be instituted once the input price change reached a predetermined level, could be implemented.

Interim costs adjustments would be preferred to basic automatic adjustments since changes in rates could be made simultaneously with a change in input costs without prior authorization of the regulator but would be subject to later examination and final approval by the regulatory authority at the next or soonest possible hearing date.

Tariff adjustment clauses are usually only associated with fuel cost changes and are measured using a international fuel price index. Tariff adjustment mechanisms are seldom used for changes in foreign exchange or for inflation Inflation is usually a considered in the forecasted financial information for which an expected rate was negotiated during the normal regulatory hearing process.

Automatic or even interim fuel-adjustment clauses are quite controversial as they can reduce least cost incentives and can introduce a possible bias towards dependence on thermal production. Also by allowing automatic fuel adjustment clauses a utility could benefit from a rate of return above the maximum allowable level for a certain period of time.

As with most cost inputs the impact these costs have on the entire operating position must be evaluated to judge what portion of the fuel cost increase can be passed onto consumers. If for example it has been found that fuel costs represents only between 50% and 60% of the utility's total operating costs, which was the case for GEC in 1987, then any tariff adjustment should be factored by that percentage.

There are instances, as witnessed in Haiti and a variety of state regulatory commission in the U.S., where fuel cost provisions are separated from other tariff charges on the customers bills in order to demonstrate that ensuing price increase are beyond the control of the electric utility. However these price fluctuations must be of a certain magnitude before being passed automatically onto consumers and the impact of the changes are always evaluated either prior or subsequent to the adjustments.

In situations where the price of fuel decreases or the regulator finds that the company has earned unreasonable revenues since the last evaluation, it is not uncommon for a regulatory body to issue "show cause" orders. Hearings would then be held in which the utility must "show cause" why the rates should not be reduced. In Canada, there are allowances for the regulatory body to roll-back prices or demand a consumer pay-back (as was the recently observed with Bell Canada) if the commission had determined that the rate base calculation forecasts or other information provided to substantiate the tariff increase request was later found non representative or that maximum rate of return parameters were exceeded.

We recommend that at least twice a year the regulator should automatically undertake a full cost of service evaluation if an interim fuel adjustment mechanism is allowed.

3.3.2.1 Fuel adjustment clause

Below is an example of a fuel adjustment clause based on clauses used in the Canadian Atlantic region.

"Application: the following fuel clause will apply to all rate schedules applicable to the sale of energy by xxxx with the exception of that energy provided under signed contracts with individual customers, when such contracts contain separate fuel clauses.

Fuel clause: If because of any variation in the international spot price of Bunker 'C' fuel oil to xxxx utility, above the cost of $2.90 per barrel or below the cost of $3.10 per barrel, the price of energy shall be increased or decreased accordingly by .5 mill per kwh for each whole $0.20 variation in the price per barrel."

3.3.2.2 Maintaining incentives for fuel efficiency.

As mentioned above, one of the risks of allowing for automatic fuel adjustment is that it can create biases towards thermal production or the inefficient use of fuel. One possible method to insure that the utility's incentives for fuel efficiency are maintained once fuel cost adjustment mechanisms are in place is to incorporate a fuel efficiency incentive calculation as part of the adjustment clause.

The efficiency incentive calculation could resemble the one below;

$$R = \text{Fuel efficiency ratio} = \frac{\text{Kwh}}{\text{unit of fuel consumed}}$$

Rt = efficiency in current period

Ro = efficiency in initial period

$$Z = \text{fuel cost factor} = \frac{FC}{TC} = \frac{\text{Cost of Fuel}}{\text{Total (Adjusted) Operating Costs}}$$

$$\text{cost of fuel and efficiency adjustment} = Z * \frac{Rt}{Ro}$$

If fuel efficiency has increase (Rt/Ro > 1) then the adjustment will be greater then the fuel cost factor alone and subsequently if the efficiency has decreased (Rt/Ro < 1) then the tariff adjustment will be smaller then the fuel cost factor. If the efficiency has not changed then the tariff can only be adjusted by Z.

3.3.2.3 Example of how a fuel adjustment could work

Let,

FC = $600,000
TC = $1,100,000 - $100,000
Z = 60%
fo = $30 a barrel
ft = $33.30 a barrel
Rt = 4.5 kwh per gallon
Ro = 5 kwh per gallon of fuel

With,

ft = cost of fuel on international market in current period (ie New York Bunker C)
fo = cost of fuel on international market in initial period .
TC= total (adjusted) operating costs = Total operating costs minus cost disallowances

If ft/fo > 1.10 or ft/fo < .90 (example of a threshold of 10% change) then tariffs could be adjusted by the utility without following the normal regulatory process.

The Fuel Cost Adjustment Factor (FCAF) would then be;

= ((Z * Rt/Ro) * (ft/fo)-1)

= (.60 * .90) * (1.11-1)
= .54 * .11 .
= .0594

Tariffs would be adjusted by 5.94 % in this example. If tariffs would be adjusted by the full fuel cost increase they would be adjusted by 11% ($33.30/$30.00 - 1) which would be quite unreasonable as it would not reflect the impact of fuel costs on total operating costs and would not provide any incentive for the company to improve its efficient use of fuel.

If for example the company's efficiency was to increase to 6 kwh per gallon then the FCAF would increase to 7.92%. This increase should act as an incentive for the utility to increase its efficiency;

= ((Z * Rt/Ro) * (ft/fo - 1)

= (.60 * 1.2) * .11
= .72 * .11 .
= .0792

If on the other hand the company's efficiency was to decrease to 4.0 kwh per gallon then the FCAF would decrease to 5.28%.

= ((Z * Rt/Ro) * ft/fo)
= (.60 * .80) * (1..11 -1)
= .48 * .11 .
= .0528

Also, as an example, if fuel cost were to decrease (i.e. ft = $26.5 a barrel and assuming fuel consumption efficiency was to remain constant) then;

= ((Z * Rt/Ro) * (ft/fo)-1)

= (.60 * 1) * (.883-1)
= ..60 * -.117 .
= - .0702

Tariffs would then have to be decreased by 7.02%.

3.4. - Determining an appropriate rate of return for an electric utility and the basis for computing that rate of return.

As mentioned earlier, the reasoning or basis behind the determination of a "fair" rate of return will be largely a function of the risks associated with the operation of an electric utility in Guyana.

The rate is derived by considering what companies of "similar risk" in unregulated industries normally make. The value associated with risk is not easily derived since all companies operate under distinct circumstances.

A fair rate of return should be an incentive for the company to attempt to achieve and should not be guaranteed. By introducing a guaranteed rate the company's operating risks are reduced as are the company's incentives to operate in a cost effective and efficient manner.

In North America a utility company's "fair" return usually is determined by allowing a reasonable profit measured in terms of its capital assets, however there are certain inefficiencies and biases inherent in using this type of regulatory indicator. Utilities that want to raise the ceiling on allowable profits are sometimes tempted to use more capital than is desirable. The minimization of distortions toward the accumulation of unproductive assets and the favouring of excessive capital expenditure must be considered in the choosing an effective rate of return indicator.

Also , it is important to note that a "fair rate of return" rates are nominal rates and not calculated as real rates net of inflation.

The financial indicators used to determine and limit the company to a "fair" return could include:

- return on assets,
- return on equity,
- economic rents,
- capitalization ratio,
- self financing ratio,
- interest coverage rate,
- profit margins

All of these indicators are described below as available options. They could be used individually or in tandem in order to be more effective considering the type of regulatory framework desired.

Return on Assets

This indicator, which is the one preferred in the draft concession agreement, is measured as a percentage of allowable after tax profits divided by a "Rate Base". "Rate Base" is a regulatory concept defining the computation of an adjusted asset base upon which the utility would be allowed to earn its return.

Under this indicator, however, there will be no disincentive for the company to accumulate excess assets in order to increase its nets profits. If the rate of return was linked to productive capital or new net investments this would give an incentive for the company to invest in new productive capacity and would eliminate the possibility of needless hoarding of non productive assets. It is in this same vein that all attempts at overvaluing the asset base must be minimized as this will only act to increase the net profits over the long-run.

Economic Rents

Economic Rent is a very recent development in the regulation of public utilities and monopolistic government suppliers. Methodology for regulating performance using economic rents (or opportunity cost of capital) has been recently developed in a London Business School paper by Mr. John Kay and Mr. Evan Davis and we feel that a close investigation of this method is warranted.

It is designed as a performance indicator that captures the economic rents a company is making and the loss to the economy if it stops trading. It is designed to capture the economic value of a company in the short and long term. It can be measured as the difference in value between the firm as a going concern and the firm broken up.

Annual rents are equal to operating profits less the revenues the company's assets could have earned if employed elsewhere. Operating profits minus the cost of operation divided by input costs will give the rate of return based on economic rents.

Government regulation can be guided by this measure of corporate performance by setting maximum allowable rent. This could remove some of the distortions felt with regular return on asset indicators.

Return on Equity

Equity on a companies balance sheet is defined as assets minus debt. The rate of return on equity is defined as net income divided by shareholder's equity (averaged over the year). This rate is the one most widely used by North American regulators.

Using this indicator, returns are set at levels that permit utility stocks to trade at prices in relation to the book value similar to those of equities of non regulated companies. Equity return is designed to enable the utility to attract capital on reasonable terms and realize a return on book equity comparable to the returns obtained by competitive enterprises with similar investment risks.

In the U.S. it is felt that since the return on equity is determined from the combination of capital market demands, risk and payout, this value should be a driving variable in the computation of allowable returns.

Capitalization Ratio

Capitalization ratio is measured in terms of shareholder's equity divided by shareholder's equity plus total debt. Total debt being long-term debt, notes payable, long-term debt payable within one year and perpetual debt.

Self Financing Ratio

Self financing ration is measured in terms of total funds provided by operation minus dividends declared divided by investments plus redemption of long-term debt.

Interest coverage

Interest coverage is measured in terms of income before interest and exchange loss plus net investment income divided gross interest charges.

Profit margin

Profit margins, measured as net after tax income in relation sales, or even in relations to revenues or total costs, could be used as effective indicators under a regulatory framework if used in combination with other indicators.

3.4.1 How to calculate an effective value for the Rates

There is no real formula or methodology for determining the appropriate value for the effective rate of return. Their can only be a subjective valuation based on risks accepted by the utility and the basic cost of capital of the utility. If the cost of capital to the utility in the form of either a interest charged on a bank loan or a share issue both associated for the direct purpose of financing the purchase on investments in this project are known, then an effective rate could be derived.

Recommending an appropriate level for the rate in this report will be difficult as it has not yet been determined what the new utility's investment and operating risks or the companies opportunity cost of capital will be under the agreement.

We must stress that since the rate is to be used as an incentive for the utility to operate at a least cost level , the guaranteeing of the rate of return would eliminate that incentive.

We can highlight some information and examples regarding the determination of a value for a rate of return.

- In the U.S., utility companies are to make no more than a "fair" return on equity. The FERC - Federal Energy Regulatory Commission use a DCF (discounted cash flow) methodology to determine the appropriate rates of return value as a function of book equity to indicate what non-regulated, "comparable risk" companies earned on book equity. Sometimes a rate of return on an asset base which is set lower to correspond with the rate of return on equity.

- The British government in setting prices for monopolistic suppliers, such as defense contractors, uses a combination of rates in order to insure that biases towards capital or labour are not felt. These companies are allowed to make an average of 10% return on capital and a 4% return on total costs.

- The Stone and Webster study recommended an 8% rate of return requirement on a Net Fair Value asset base (which includes only productive assets). They state that 8% was a rather standard measure used in earnings test submissions for IDB loan approvals and that an 8% return on productive assets, taken together with depreciation charges, would provide adequate capital recovery for GEC investments.

- Hydro-Quebec, is governed by a Rates Bylaw allowing the company to make no more than a 13% rate of return on equity (which has yet to be attained). The goal of the company is to achieve an overall return on equity greater than its average cost of debt as well as achieve an interest coverage rate of at least 1.0, a capitalization rate of at least 25% and self-financing ratio of at least 30%. However these later indicators are adhered to more for financial security and maneuverability than to conform to set regulatory parameters.

  In order to achieve its objectives Hydro-Quebec's has elaborated a specific strategy including;

1) optimize revenue by establishing a rate structures that reflect the total costs of supply,

2) control cost increases and continue efforts to improve productivity.

3) minimize financing costs, manage financial risks more effectively and limit the payment of dividends.

4) Continue to improve productivity, primarily through increased accountability of functional units.

3.3.4.2 Fair Value Rate Base

As mentioned earlier, when using a rate of return on assets it is important to properly define what elements are included in a fair value rate base. As with defining cost of service elements, what is included in the fair value rate base is subject to prudent judgement.

We recommend that only productive assets be included and that some allowances be given for working capital and fuel stocks. Including such elements as plant under construction in the fair value rate base calculation is controversial and not accepted by a majority of regulatory commissions.

Many regulators question whether today's rate payers should be required to bear the entire cost of financing the construction project. Including work in progress in the rate base could also eliminate incentives for the company to insure that construction is undertaken with the minimum amount of delay.

In order to compensate investors for their foregone earnings if their funds are tied up in construction, some regulatory authorities have permitted the capitalization of Interest During Construction (IDC). This capitalized interest is added to the utilities investment in Plant Under Construction (PUC). Utilities are then compensated for their investment in plant under construction on a deferred basis through the resulting higher depreciation charges after the plant goes into service. In this way the cost is borne by the rate payers over the service life of the plant.

CHAPTER 4

Assessment of the Leucadia draft licence agreement

Chapter 4 - Assessment of the Leucadia Draft Licence Agreement

Our observations are based on the preliminary draft presented by Leucadia to the government of Guyana which is dated June 16, 1990.

General observations

We have concerns whether the present structure of the draft concession agreement will allow for a regulatory environment to operate effectively to achieve the required objectives. We are concerned that in its present state this agreement does not provide the proper incentives for the new company to operate cost effectively and efficiently and subsequently is not in the best interest of the Government and the present and future electric consumers of Guyana.

In its present form the party which will benefit the most from this agreement is Guypower. We find that the agreement does not distribute the risks proportionately between the two parties as Guypower wants too many guarantees. Under this agreement Guypower will operate in an environment that is almost risk free and where there will be few incentives to operate at a least cost level.

The agreement should state clearly that the company will attempt to maintain least cost operations, continually investigate cheaper sources of supply and production, and work to minimize the price of electricity. A 10 year Master Plan stating investment plans as well as 3 year financial forecasts and analysis on which to base tariff rates is also a recommended requirement.

We recommend that an agreement of this nature, which provides an exclusive licence with respect to a strategic economic sector for a 40 year period must not be entered into without proper consideration. We feel that a shorter time frame, such as 15 years, should be considered as their does not seem to be sufficient evidence to warrant a 40 year licence.

Our assessment of this agreement in terms of the three areas of our mandate, with specific reference to the articles of the agreement, are as follows:

1) Standards and Norms (involving minimum standards for security and quality of supply).

- Article 7: point 4: maximum voltage variance is too high over the long term (ie last 35 years of contract). The North American standards are approximately plus 4% during normal operation and plus 6% during emergency operation instead of plus 8% and 10% respectively. High voltages will harm consumer appliances and industrial equipment.

- this agreement does not address the issue of minimizing the voltage fluctuations that can occur with system equipment operation. A standard for "flicker effect" could be proposed by the company to the commission within a five year period.

- Article 9; point 2: in the annual report, an index of reliability could be included which demonstrates the quality of service regarding continuity,

- this agreement does not address the commitment to propose or follow an investment plan for the rehabilitation or upgrade of the system. As an example, article 7, point 2, there is no completion date regarding the conversion of the 50 hz to 60 hz. This could be stated in the agreement in order to reduce technical losses and operational costs as early as possible.

2) Tariffication

- certain articles (13, 14, 16) allow Guypower to amend tariffs at will, this agreement should render any regulatory framework powerless and ineffective.

- the tariff updating structure inherent in this agreement is too immediate (art. 13, 14, 16), and the variation in costs of inputs are passed directly to the consumer without considering the relative impact that these costs have on the company's total operating cost position.

- art. 11 and 12, fuel cost indexing should be done only in proportion to its effects on the company's total cost structure. Indexing for exchange rate fluctuations should apply only to foreign manpower and imported inputs and the impact on total costs must be first examined before allowing rate increases due to currency fluctuations.

- article 13, the structure and responsibilities of the regulatory commission should be finalized before the agreement is signed, if not he government will have much difficulty to introduce any legislation after the signing of the agreement.

- article 8.1, states that the structure and policies of the National Utility Commission should be in compliance with the terms and conditions of this licence. It is normally the other way around.

- article 14, will discriminate against a certain client who should be able to operate without having restrictions placed on the managing of their own foreign exchange requirements.

- if hook up charges are considered for one type of customer they should be considered for all types of customers so their is no discrimination.

3) Rate of Return

- there are no incentives for the company to adjust its operating cost structure or implement internal planning policies to increase its operating efficiency in order to achieve its "fair rate of return", since there are allowances in the agreement such as article 17.3 which states that if the company does not achieve its pre-established rate of return, it will simply adjust tariffs to do so.

- the method of replacement value asset calculation (Reproduction Cost New Value of the assets), article 18, is not a generally accepted procedure and seems unwarranted here. We are very skeptical about this method of assessing asset value and the implications of this method in regulating a "fair" rate of return. The reevaluation of assets means the rate of return is a net real rate (net of escalation). Supposing an inflation rate of 10% for a year, the rate of return thus calculated will be Libor + 3% + 10% which is abnormally high for any standards.

- biases and leakages toward the accumulation of unproductive assets can occur under a simple rate of return on fair value rate base calculation (articles 17 and 18).

- Guypower is not willing to absorb any short-term fluctuations in fuel input costs, exchange rates and even local operating costs by passing everything directly on to the consumer. (Article 16, 22, 23). This will reduce the company's operating risks considerably. If such is the case then the allowable rate of return should be lowered accordingly.

- Guypower wishes to have assurances by the government that all foreign exchange exposure will be covered but without introducing any assurances that foreign exchange requirements will be minimized. It seems that this agreement is structured to insure that foreign exchange requirements will increase in the short and long-run (ie increased need for external auditors, consultants, directors, technical staff, dividend payments, fuel and component imports).

- the rate Guypower is requesting (LIBOR* plus 3%) could be considered high in view of the limited risk that the company seems willing to accept - Article 17.2, 13, 14 & 16. However it is difficult to determine an appropriate rate since it has not yet been established what amount of investment capital the company will inject, what extent this capital will be in the form of loans and who will guarantee those loans. Considering the effect of reevaluation of assets, this rate is properly to high.

* LIBOR - London Interbank Offered Rate is equivalent to the 3 month Euro-U.S. dollar deposit rate in London. On June 6, 1990, this rate was 8.50% and between March 1988 and June 1990 the rate has fluctuated between a high of 10.58% and a low of 7.66%.

CHAPTER 5

Expert committee observations

Chapter 5: Expert committee observations

The expert committee agrees with the overall conclusions and analysis of the inception report. The committee members believe, however that the subject matter is far more complicated and cannot be sufficiently addressed and explained in a report of this size and in such a short time period. The committee does believe that all possible attempts have been made in this report to provide information to protect the Government of Guyana's position under this or any further negotiated agreement.

It is important to point out that bylaw 411 establishing conditions governing the supply of electricity in Quebec (appendix x) required ten years of work including several revisions before being acceptable and enforceable standards. It is hardly conceivable to prepare such a bylaw for Guyana without 2 or 3 of adjustments.

An effective regulatory framework can be established only through a flexible process of adaptive adjustments. There exists no predetermine recipe to insure that a regulatory framework can adapt continuously and dynamically to changing needs, objectives and economic environments.

Concerning tariffication, it is a matter of philosophy. On the one hand, a utility must calculate his true costs for each kilowathour sold and at least two well known methods exist including: cost of service analysis and a marginal cost study. On the other hand, the way those costs are passed on to various categories of consumers is another problem much more political and social, that no methodology can fully cover. In the short term it will be sufficient for the regulatory commission to concentrate on insuring that an alteration of tariff levels are justified using a full cost of service analysis.

The committee has included several appendices such as a copy of Hydro-Quebec's master plan in which are presented a further discussion of some of the issues that are essential for the maintenance of the constant balance between a regulated utility's revenue requirements and the customers best interest.

Format of the agreement

Usually a licence of this nature begins with a special introductory section defining all the terminology. The parties need to refer to terms in the rest of the contract that are properly understood by all parties in order to prevent problem of interpretation during the operating phase.

Also these licence agreements are followed by appendices, that are legally binding, in which equations and adjustment clauses are precisely determine with the description and sources of external or internal data to be used for the calculations.

These two elements are missing from the Leucadia agreement, adding a certain level of confusion. Also, it would be more appropriate to separate the agreement by chapter, each involving a specific subject matter, and divided by section and subsection.

<u>For example</u>

Chapter 1: Definitions

section 1.1 Working capital

1.2 Fair Value Rate Base

1.3 Equity

etc...

Chapter 2: Ownership

2.1 Leucadia

2.2 Government of Guyana

2.3

Subsection 2.3.1

2.3.2

2.3.3

etc...

Appendices: (Must contain clauses that can be revised under the regulatory frame-work. By doing so, parties do not have to reopen the entire agreement each time alterations have to be made.)

Appendix 1. Fuel Cost Adjustment Clause

Appendix 2. Fuel Efficiency Calculation

etc...

CHAPTER 6

Summary of recommendations

Chapter 6: Summary of Recommendations

1- The rate of return should fluctuate between a ceiling and a floor with the ceiling never being guaranteed.

2- LIBOR plus 3% would be an acceptable ceiling for a rate of return on equity but is much too high as a rate of return on a fair value asset base.

3- The use of only one rate of return indicator is insufficient. We propose that a rate of return on equity (the level being derived as a function of the risk accepted by the utility and the cost of its capital to purchase the assets or to undertake short term investments) be used along with an interest coverage rate of approximately 1.5 to 1.6 and a capitalization ratio of 25% .

4- To proceed towards a system conversion of 60 cycles as soon as possible in order to reduce conversion costs and costs associated with losses.

5- Impose a technical loss reduction to a minimum of 12% over the medium term (1998) and have the utility undergo modeling studies to continually estimate how to reduce losses to this level. The 4% minimum for non-technical losses should also be requested although the utility should have sufficient incentives to reduce these commercial losses on their own.

6- Three (3) to four (4) years has been deemed a sufficient grace period until the imposition of the voltage parameters specified in table 1 section 3.1

7- The regulatory framework should be in place prior to the signing of any licence agreement.

APPENDICES

Appendix 1: List of documents referenced and individuals that were consulted between the 8th and the 22nd of August 1990.

1.1 - Documents consulted in Guyana:

1) Distribution Master Plan for Guyana, Monenco Consultants limited, February 1989

2) Guyana Electricity Corporation Rehabilitation Program, Document of the Inter-American Development Bank, May 1985

3) Refurbishment of Major Plants in the Guyana Electricity Corporation System, S.A. Wheeler and B. Newman in association with British Electricity International Ltd., January 1985

4) Master Plan Study on Electric Power Development Project in the Coastal Area, Japan International Cooperation Agency, May 1989

5) Draft Electric Utility Licence Proposal, Leucadia, June 16th, 1990

6) Tariff and Financing Study for Guyana Electricity Corporation, Stone & Webster Management Consultants, Inc., November 1988

7) Hydro-Electric Power Act, 1973

8) Electricity Act, 1975

9) Draft Public Utilities Commission Bill, 1990

10) Federal Energy Regulatory Commission (FERC), Uniform System of Accounts

11) GEC-Leucadia Task Force Report, Attachment 2, Issues of non-agreement re proposed concession contract, July 18th, 1990

12) Ministry of Planning and Development, State Planning Secretariat, Memorandum: Leucadia Comments on Public Utilities Commission Bill 1990, August 15th, 1990

13) Guyana Electric Corporation Integrated Investment Programme, Canadian International Power Services Inc., July 1990

1.2 Consulted individuals: (presented in alphabetical order)

John L. Agard, Department of Industrial Relations, Corporation Secretary, GEC

Mr. H. Bovell, Chief Executive Officer, Public Corporation Secretariat

Mr. Philip Chan, Senior Program Assistant, U.N.D.P.

Mrs. C. Corbin, Head Planning and Business Development Dept., Public Corporation Secretariat

Mr. Robert H.O. Corbin, Deputy Prime Minister, Public Utilities

Mr. B. Crawford, Chairman, Bauxite Industrial Development Company

Mr. Thomas W. Gittens, National Program Officer, U.N.D.P.

Mr. Verlyn D. Klass, Strategic Planning Manager, Guyana Electricity Corp.

Miss Erlinda Layog, Chief Technical Adviser, U.N.D.P.

Mr. W. Leander, General Manager, Guyana Electricity Corporation.

Mr. A. MacDonald, Group Manager, Maintenance and Transport, GEC

Mr. K. Narrain, Permanent Secretary, Ministry of Public Utilities

Dr. C. Rajana, Department of International Economic Cooperation

Mr. Dharamdeo Sawh, M.P., Minister, Public Utilities

Dr. B. Scotland, GNRA, Guyana Natural Resources Agency

Mrs. Simpson, Attorney General Chambers

Mr. Kenneth Thomas, Economist, Guyana Electricity Corporation

Miss Evelyn A. Wayne, Division Head, Macro Monitoring Division, State Planning Commission

Dr. Z. Worku, Officer in charge, U.N.D.P.

Hydro-Québec

BYLAW 411

AS MODIFIED BY BYLAWS 439 AND 475 ESTABLISHING THE CONDITIONS GOVERNING THE SUPPLY OF ELECTRICITY

TABLE OF CONTENTS

CHAPTER I - GENERAL PROVISIONS

Division 1 – Field of Application

1. This Bylaw governs the supply of electricity at low, medium and high voltages, subject to Chapters 3, 4 and 5 applying only to the supply of electricity at low voltage and to the supply of electricity at medium voltage within the limits stipulated in Section 53.

2. Conditions in this Bylaw do not apply to the supply of electricity exceeding 100 kilovoltamperes from an autonomous electrical system located north of the 53rd parallel, or exceeding 1000 kilovoltamperes from an autonomous electrical system located south of the 53rd parallel.

Division 2 – Interpretative Provisions

3. In this Bylaw, the following terms and expressions have the meanings hereinafter described, unless the context indicates otherwise:

Annex:
A civil engineering work attached to or incorporated into a building by means of one or more common walls, erected in such a way that it can be considered a separate building and designed for the installation of a transforming station.

Applicant:
An individual, partnership, corporation or organization requesting the supply of electricity, whether or not the aforesaid individual, partnership, corporation or organization has a contract, when it is necessary to extend or modify the system to supply such electricity.

Autonomous electrical system:
A system for the production and distribution of electricity, independent of the main system, in which the electricity is produced by one or more generating units driven by fossil fuel, gas turbines or wind power.

Available power:
Maximum power, specified in the contract, which the customer may use.

Base:
A structure designed to support electrical apparatus.

Building:
A structure not in contact with other structures or a structure separated from others by a complete fire-resistant wall or a structure whose openings are protected by fire-resistant doors that have been approved by the competent authority.

Canalization:
A series of hollow components, usually with circular cross-sections, designed to contain cables.

Connection point:
Point where the electrical installation of the premises receiving electricity is connected to Hydro-Québec's system.

Consumption period:
Period during which electricity is delivered to the customer and which is included between the two dates used for calculating the bill.

Contract:
Agreement concluded between the customer and Hydro-Québec for the supply and delivery of electricity, or of electricity and services.

Customer:
An individual, partnership, corporation or organization having one or more contracts.

Customer's service entrance:
That part of the customer's electrical installation from and including the service box, up to and including the connection point.

Delivery of electricity:
The supply of electricity to the delivery point through the application of voltage at this point, with or without the use of electricity.

Delivery point:
Point located immediately on the load side of Hydro-Québec's metering equipment and from which electricity is put at the disposal of the customer. In cases where Hydro-Québec does not install metering equipment, or where it is on the line side of the connection point, the delivery point is the connection point.

Domestic rate:
Rate at which the electricity delivered for domestic use is billed under the conditions established by the rates bylaw.

Domestic use:
Domestic use as stipulated in the rates bylaw.

Dual-energy system:
A system that can be used for the heating of water, of space or for any other heating process that uses electricity as the main source of energy and a fuel as an auxiliary source of energy.

Dwelling:
Private suite of rooms for living purposes, in which the inhabitants have free access to all rooms.

Electricity:
The electricity supplied by Hydro-Québec.

Farm:
Land, buildings and equipment used for crop or animal farming, excluding any dwelling.

Flat-rate sale:
The sale of electricity at a fixed rate, regardless of the energy consumed.

Full public lighting service:
The general public lighting service outlined in the rates bylaw and including the supply of electricity and the supply, operation and maintenance of public lighting installations.

General public lighting service:
The general public lighting service outlined in the rates bylaw and including only the supply of electricity.

High voltage:
Nominal voltage between phases greater than 50,000 volts.

Hydro-Québec's service loop:
A circuit extending Hydro-Québec's system from its distribution or transmission line to the connection point.

Low voltage:
Nominal voltage between phases not exceeding 750 volts.

Medium voltage:
Nominal voltage between phases of more than 750 volts, up to and including 50,000 volts.

Metering equipment:
A current transformer, a voltage transformer, a meter, an indicator, an auxiliary recording device, an auxiliary control unit, a terminal testing box, cabling and any other device used exclusively by Hydro-Québec for metering electricity.

Month:
The period between a date in one calendar month and the corresponding date of the following month.

Neutral voltage:
The voltage measured between the neutral conductor in Hydro-Québec's system and a reference electrode located at least 10 metres from any other ground or metal object.

Nominal intensity:
The intensity of the electrical current indicated on the customer's service box.

Operation of indeterminate duration:
Any operation in which the duration of activities cannot be anticipated with certainty; this is, for example, the case of a mine, a quarry, a sawmill, or a campground.

Outbuilding:
All premises appurtenant to a building, whether or not they are contiguous to the building.

Power:
(1) Small power: load of less than 100 kilowatts.

(2) Medium power: load of 100 kilowatts or more, but less than 5,000 kilowatts.

(3) Large power: load of 5,000 kilowatts or more.

Power factor:
The ratio between real power demand, expressed in kilowatts, and apparent power demand, expressed in kilovoltamperes.

Public lighting:
Lighting of streets, lanes, highways, expressways, bridges, wharves, bicycle paths, pedestrian walkways, and other public thoroughfares, as well as signal lights that operate during the same hours as the public lighting. Parking lots, playgrounds and similar places are excluded.

Rate:
The several specifications determining the elements taken into account, as well as the calculation methods, for establishing the amounts the customer owes Hydro-Québec for the delivery of electricity and the supply of services under a contract.

Rates bylaw:
Any Hydro-Québec bylaw governing electricity rates in effect at a given time.

Seasonal service:
Electrical service for the electrical installation of a permanent operation, the use of which is repeated from one year to the next for a period of less than 12 months every year.

Sentinel lighting:
The supply and operation of Hydro-Québec photoelectric-cell luminaires used for exterior lighting and the supply of electricity for such luminaires.

Service box:
A device comprising a metallic box containing fuses and the service switch or a circuit breaker, constructed in such a way that it can be locked or sealed and that the switch or circuit breaker can be operated when the service box is closed.

Special sub-station:
A transforming station located on the customer's property.

Structure:
A civil engineering work, including the necessary material, on or in which electrical equipment is installed or attached.

Supply of electricity:
The supply of electricity to the connection point through the application and maintenance of voltage at this point.

System or Hydro-Québec's system:
Any portion of a Hydro-Québec power line supplying more than one connection point, when these connection points are located on separate plots or portions thereof treated as being separate in deeds registered in registration offices, but not in the case of contiguous plots or portions of plots when the connection points connect the power line to electrical installations operated for the purposes of a single commercial, agricultural or industrial enterprise or a single non-profit institution, non-profit organization or non-profit foundation.

Temporary service:
Electrical service for the electrical installation of an operation whose activities in a given place are of limited duration; such is the case, for example, on a building site, a dredging site, or in a travelling circus.

Transforming station:
The structures and equipment required to transform electricity.

Underground chamber:
An underground civil engineering work located outside a building and designed for the installation of a transforming station.

Winter period:
Period from December 1 of each year to and including March 31 of the next year.

4. For the purposes of the Bylaw, nominal intensity, voltage, power, apparent power and energy are expressed, respectively, in amperes (A), volts (V) or kilovolts (kV), watts (W) or kilowatts (kW), voltamperes (VA) or kilovoltamperes (kVA) and in watthours (Wh) or kilowatthours (kWh).

3/4

CHAPTER 2 – ELECTRICITY SERVICE CONTRACT

5. Any individual, partnership, corporation or organization wishing to obtain electricity service must request it from Hydro-Québec.

6. The request must be made by the prospective customer or his duly authorized representative.

7. The request for electricity service at single-phase voltage, 120/240 V, may be made verbally with respect to:

(1) an electrical installation with a nominal intensity of 400 A or less used for domestic use;

(2) an electrical installation with a nominal intensity of 200 A or less used for other than domestic use.

All other requests must be made in writing.

8. The request must contain the information stipulated in Appendix A.

9. The contract is concluded through agreement between the individual, partnership, corporation or organization requesting service and Hydro-Québec with regard to the conditions under which the electricity will be supplied and delivered, including, if need be, the limit of available power and the technical characteristics of the installations required.

The contract is concluded in writing at the request of either party.

The contract is always concluded subject to this Bylaw and the rates bylaw.

10. Every delivery point is covered by a separate contract, except when:

(1) as of February 1, 1984, the electricity delivered for a dwelling was covered by a single contract although it was metered by more than one set of metering equipment, if this situation still prevails on the date this Bylaw comes into force, and until such time as the customer's electrical installation is modified;

(2) the electricity delivered to a customer can also be delivered to a delivery point located on a backup line;

(3) the electricity is delivered to a customer by more than one line, because of the limited capacity of Hydro-Québec's lines.

Electricity sold at a flat rate or for the purpose of public or Sentinel lighting may be covered by a single contract.

11. The contract is concluded for a term beginning on the date stipulated in the contract for the commencement of the delivery of electricity, or, where delivery begins earlier, on the date of the commencement of delivery.

The term is set according to the category of use as outlined below, subject to the third, fourth, fifth and sixth paragraphs:

(1) the contract for domestic use is concluded for an initial term of at least one week and subsequently continues until either party terminates it by giving the other party at least seven clear days' notice to this effect;

(2) the contract for other than domestic use is concluded for an initial term of at least one year and subsequently continues according to the term agreed upon by the parties or, where no such term has been agreed upon, from one month to another until either party terminates it by giving the other party at least 30 clear days' notice in writing to this effect prior to the end of the initial term or, as the case may be, the term of renewal.

The contract for seasonal service is concluded for an initial term of at least three months and is renewed from year to year, beginning on the date agreed upon by the parties every year, for a term of at least three months, until either party terminates it by giving the other party notice to this effect; however, such notice cannot take effect, as the case may be, before the expiration of the term then under way.

The contract for temporary service continues on a day to day basis until the customer terminates it by giving Hydro-Québec at least one day's notice to this effect.

The contract for general public lighting service is concluded for an initial term of at least four months and subsequently continues until either party terminates it by giving the other party at least 30 clear days' notice in writing to this effect prior to the end of the initial term, or, as the case may be, the term of renewal.

The contract for full public lighting service is concluded for an initial term of at least one year and subsequently continues according to the term agreed upon by the parties or, where no such term has been agreed upon, from year to year until either party terminates it by giving the other party 30 clear days' notice in writing to this effect prior to the end of the initial term or, as the case may be, the term of renewal.

12. The customer remains bound to Hydro-Québec with respect to electricity covered by the contract as long as the contract has not been terminated.

13. The customer must make a new request should he wish to modify his contract. Where Hydro-Québec accepts the new request, a new contract replaces the one in effect.

14. An individual, partnership, corporation or organization which, without having a contract, uses electricity at a given place as an owner, tenant or occupant, is responsible for any sum payable to Hydro-Québec under this Bylaw and the rates bylaw for electricity thus used.

This Section must not be interpreted as authorizing an individual, partnership, corporation or organization using electricity in a given place as owner, tenant or occupant, to use the electricity without concluding a contract.

15. An individual, partnership, corporation or organization which requests the delivery of electricity to a given place or the termination of delivery of electricity delivered under contract must:

(1) give proof that the owner agrees to it, where the individual, partnership, corporation or organization does not own the property; and

(2) repay Hydro-Québec the costs indicated in the second paragraph.

When fewer than 12 months have elapsed between the commencement and the termination of the delivery of electricity, Hydro-Québec is entitled to repayment of costs incurred for establishing and discontinuing service. Under no circumstances may this reimbursement be less than the amount stipulated in Section 1 of Appendix B.

16. When Hydro-Québec is ready to deliver electricity on the date stipulated in the contract but the customer refuses or is unable to take delivery of it, the minimum amounts stipulated for this contract in the rates bylaw are due for each consumption period included between the date of the refusal or hindrance, as the case may be, and the date of expiry of the initial term of the contract.

When the customer refuses or is unable to continue to take delivery of electricity covered by a contract, the minimum amounts stipulated for the customer's contract in the rates bylaw are immediately due for all consumption periods included between the date of refusal or hindrance, as the case may be, and the date of expiry of the term then in effect of the contract.

CHAPTER 3 – MODES OF SUPPLYING ELECTRICITY

17. Electricity is supplied at low or medium voltage at the connection point at a frequency of approximately 60 hertz, or 25 hertz for cases already in existence on the date this Bylaw comes into force.

It is supplied according to procedures outlined in this chapter and in compliance with standard No. CAN3-C235-83 prepared by the Canadian Standards Association and approved by the Canadian Standards Council, the English version of which was published in September 1983 under the title "Preferred Voltage Levels for AC Systems 0 to 50 000 V: Electric Power Transmission and Distribution", and the French version of which was published in July 1984 under the title "Tensions recommandées pour les réseaux à courant alternatif de 0 à 50 000 V."

Division 1 – Supply at Low Voltage

18. Electricity is available at low voltage provided the nominal intensity of the customer's electrical installation is 6000 A or less. It is supplied at the following voltages, under conditions outlined in this Division:

(1) single-phase, 120/240 V;
(2) three-phase, 347/600 V, star, grounded neutral; and
(3) three-phase, 600 V, 3-wire.

Subdivision 1 – Single-phase voltage, 120/240 V

19. Single-phase voltage, 120/240 V, is supplied directly from Hydro-Québec's system where the nominal intensity is 600 A or less.

This voltage is also available directly from the system when nominal intensity exceeds 600 A, provided, on the one hand, that the customer undertakes in writing that current demand will not exceed 500 A and, on the other, subject to the following conditions:

(1) where current demand exceeds 500 A, the customer must install, at his expense and within six months of receipt of written notice from Hydro-Québec, the structures, canalizations and equipment necessary for supply through a special substation; and

(2) where current demand exceeds 500 A in the course of the five years following the date stipulated in the contract for the commencement of delivery of electricity, the customer must repay Hydro-Québec, upon receipt of written notice from the latter, the total cost of installing and removing equipment and material necessary for supplying electricity directly the system, less the salvage value when Hydro-Québec can use such equipment and material elsewhere on its system.

This voltage is also available directly from the system when nominal intensity exceeds 600 A, to supply a dual energy system, but only during the winter period and provided current demand does not exceed 600 A.

20. Single-phase voltage, 120/240 V, is supplied through a special substation, subject to the second and third paragraphs of Section 19, when nominal intensity exceeds 600 A but does not exceed 1200 A.

It is supplied from a transforming station installed, at the customer's discretion, but subject to conditions stipulated in Subdivision 4:

(1) on a base;
(2) on a pole; or
(3) in an underground chamber.

Subdivision 2 – Three-phase voltage, 347/600 V, star, grounded neutral

21. Three-phase voltage, 347/600 V, star, grounded neutral, is supplied directly from the system when nominal intensity is 600 A or less and Hydro-Québec's system is either underground (at voltages of 14.4/24.94 kV or 7.2/12.47 kV) or overhead.

It is also available directly from the system, under the same conditions as those outlined in the second and third paragraphs of Section 19, when nominal intensity exceeds 600 A and Hydro-Québec's system is either underground (at voltages of 14.4/24.94 kV or 7.2/12.47 kV) or overhead.

22. Three-phase voltage, 347/600 V, star, grounded neutral, is supplied through a special substation, subject to the second paragraph of Section 21, when nominal intensity exceeds 600 A.

It is supplied from a transforming station installed, at the customer's discretion, but subject to conditions stipulated in Subdivision 4:

(1) on one or more bases:

(a) when the voltage of the system is 14.4/24.94 kV; or

(b) when the voltage of the system is 7.2/12.47 kV, 7.6/13.2 kV or 8.0/13.8 kV, and nominal intensity is 2000 A or less;

(2) in an annex;

(3) on a pole;

(4) in an underground chamber, when nominal intensity is 1600 A or less; or

(5) on a platform, when nominal intensity is 2000 A or less.

Subdivison 3 – Three-phase voltage, 600 V, 3-wire

23. Three-phase voltage, 600 V, 3-wire, is supplied directly from the system when nominal intensity is 600 A or less; it is available only when the system is underground (at a medium voltage of 7.2/12.47 kV) or overhead, and if distribution is not already provided on the system at another three-phase low voltage at the place electricity is to be supplied.

It is also available directly from the system, under the same conditions as those stipulated in the second and third paragraphs of Section 19, when nominal intensity exceeds 600 A, but only when the system is underground (at a medium voltage of 7.2/12.47 kV) or overhead, and if distribution is not already provided on the system at another three phase low voltage at the place electricity is to be supplied.

In the cases outlined in this section, three phase voltage, 600 V, 3 wire, is supplied provided the customer's electrical installation is designed to eventually receive electricity at three-phase voltage, 374/600 V, star, grounded neutral.

Hydro-Québec may, at any time, change the supply voltage of electricity to the customer's electrical installation in order to adopt three-phase voltage, 347/600 V, star, grounded neutral. In this case, it must inform the customer in writing at least 30 clear days prior to the date of change and termination of service at the existing voltage.

24. Three-phase voltage, 600 V, 3-wire, is supplied through a special substation, subject to the second paragraph of Section 23, when nominal intensity exceeds 600 A.

It is supplied according to the methods and conditions stipulated in the second paragraph of Section 22.

Subdivision 4 – General Conditions of Supply through a Special Substation

25. Hydro-Québec and the customer agree in writing on the characteristics of structures, canalizations and equipment necessary to supply electricity through a special substation and their location.

26. The customer must proceed, at his expense, with the installation, alteration and maintenance of structures, canalizations and equipment other than Hydro-Québec's electrical equipment located on his property and necessary for the installation of Hydro-Québec's electrical equipment to be used to supply the customer with electricity, except where the supply is effected from a transforming station installed on a pole or platform.

Such structures, canalizations and equipment must be designed and built in such a way that they allow Hydro-Québec to install, operate and maintain its electrical equipment in complete safety.

27. The transforming station must always be accessible from the outside by flatbed trailer. The customer must first obtain Hydro-Québec's authorization before making any subsequent alteration to this access.

28. Access is prohibited to the inside of the premises where a special substation is installed, unless Hydro-Québec provides specific authorization to that effect.

29. The supply of electricity from a special substation is undertaken subject to Hydro-Québec's right to supply, from such a substation, electricity service to the electrical installations of other customers, provided the current demand of those customers does not exceed 500 A or, in the case of a dual-energy system, 600 A.

30. The supply of electricity from a special substation installed on a platform is available only when the customer's electrical installation is located, at the time of the installation of the platform, in a place not visible from a public thoroughfare or a neighbouring establishment.

31. The supply of electricity through a special substation installed on a pole is available only when such supply is at three-phase voltage, 347/600 V, star, grounded neutral, or at 600 V, 3-wire, provided the customer undertakes in writing:

(1) that current demand will not exceed 750 A; and

(2) upon receipt of written notice from Hydro-Québec, when current demand exceeds 750 A:

(a) to proceed, at his expense, within a maximum of six months, with the installation of structures, canalizations and equipment other than Hydro-Québec's electrical equipment required for electricity to be supplied from a substation installed according to one of the other modes of supply through a special substation available under the conditions stipulated in this chapter; and

(b) to repay Hydro-Québec, where current demand exceeds 750 A in the course of the five years following the date indicated in the contract for the commencement of delivery of electricity, the total cost of installing and removing equipment and material required to supply electricity from a substation installed on a pole, less the salvage value when Hydro-Québec can use such equipment and material elsewhere on its system.

32. The supply of electricity from a substation installed in an underground chamber is available only when the customer pays Hydro-Québec a sum equal to the difference between the cost of Hydro-Québec's electrical equipment needed to supply electricity from a substation installed in an underground chamber, where this cost is higher, and the cost of Hydro-Québec's electrical equipment needed to supply electricity from a substation installed in an annex.

Division 2 – Supply at Medium Voltage

33. Electricity at medium voltage is available where:

(1) the electrical installation is located on Montréal Island, provided current demand does not exceed 400 A; and

(2) the electrical installation is located outside Montréal Island, provided current demand does not exceed 200 A.

34. It is supplied directly from Hydro-Québec's system and under the conditions stipulated in Sections 35 to 39, at the following voltages:

(1) 2.4/4.16 kV;
(2) 7.2/12.47 kV;
(3) 7.6/13.2 kV;
(4) 8.0/13.8 kV;
(5) 14.4/24.94 kV;
(6) 20.0/34.5 kV;
(7) 44 kV; and
(8) 49.2 kV.

35. Hydro-Québec may at any time change the voltage of supply of electricity to the customer's electrical installation in order to adopt 14.4/24.94 kV voltage.

In this case, it must inform the customer in writing at least 24 months prior to the date of change and termination of service at the existing voltage.

The customer must modify his electrical installation such that the supply of electricity at a voltage of 14.4/24.94 kV is possible when the voltage is converted on Hydro-Québec's system. However, he may opt for one of the low voltages specified in Section 18, subject to conditions outlined in Division I.

(2) at the customer's request, once his electrical installation is supplied at a voltage of 14.4/24.94 kV:

– an amount equal to the cost of material and labour incurred by the customer to connect his installation to the 14.4/24.94 kV voltage.

Subdivision 1 – Supply of electricity to electrical installations connected after this Bylaw comes into force

36. The electrical installation of any customer requesting the supply of electricity at medium voltage from the date this Bylaw comes into force is supplied at a voltage of 14.4/24.94 kV.

However, where the medium voltage of Hydro-Québec's system near the premises to be supplied is not 14.4/24.94 kV, Hydro-Québec may decide to supply electricity to the customer's electrical installation at one of the other voltages mentioned in Section 34.

37. When the voltage of supply of electricity to the installation covered by Section 36 is not 14.4/24.94 kV, this installation must be designed to receive electricity at a voltage of 14.4/24.94 kV and at the other voltage, except when Hydro-Québec notifies the customer in writing to the contrary.

In this case, Hydro-Québec pays the customer the following compensation:

(1) at the customer's request, once his electrical installation has been connected to Hydro-Québec's system:

(a) an amount equal to the difference between the cost of the transformer designed to receive electricity at a voltage of 14.4/24.94 kV and at the other voltage and the cost of a transformer designed to receive electricity solely at a voltage of 14.4/24.94 kV; and

(b) a lump sum equal to the product of the transforming capacity and the unit rate stipulated in Section 2 of Appendix B, when the voltage at which electricity is supplied is lower than 14.4/24.94 kV.

Subdivision 2 – Supply of electricity to electrical installations already connected at the time this Bylaw comes into force

38. A customer whose electrical installation is supplied on the date this Bylaw comes into force at one of the voltages specified in Section 34 continues, subject to provisions in Section 35, to receive electricity at this voltage.

39. When electricity is supplied to the installation covered by Section 38 at a voltage other than 14.4/24.94 kV, any electrical equipment added or replaced in the customer's transforming station following the date this Bylaw comes into force must be designed so that it can eventually receive electricity at a voltage of 14.4/24.94 kV, except where the customer receives written notice to the contrary from Hydro-Québec or in the case of customers whose electrical installation receives electricity at a voltage of 20.0/34.5 kV in Fermont or the Manouane region.

In this case, Hydro-Québec pays the customer the following compensation:

(1) at the customer's request, once the equipment can receive electricity at a voltage of 14.4/24.94 kV and at the other voltage:

(a) an amount equal to the difference between the cost of the transformer designed to receive electricity at a voltage of 14.4/24.94 kV and at the other voltage and the cost of a transformer designed to receive electricity solely at a voltage of 14.4/24.94 kV; and

(b) a lump sum equal to the product of the transforming capacity of the added or replacement transformer, as the case may be, and the unit amount stipulated in Section 2 of Appendix B, when the voltage at which electricity is supplied does not exceed 14.4/24.94 kV;

(2) at the customer's request, when, having received the notice stipulated in Section 35, the customer has effected work necessary to permit his electrical installation to receive electricity at a voltage of 14.4/24.94 kV, or at low voltage:

– an amount calculated according to the method outlined in Appendix C and equal to the depreciated replacement value of the customer's existing electrical installation on the date this Bylaw comes into force and which cannot be used to supply electricity at a voltage of 14.4/24.94 kV, with the exception of electrical equipment added or installed as a replacement since the aforesaid date; and

(3) at the customer's request, once the installation has been connected to the 14.4/24.94 kV voltage under Section 35:

– an amount equal to the cost of material and labour incurred by the customer to connect his installation to the 14.4/24.94 kV voltage.

CHAPTER 4 – CONNECTION TO HYDRO-QUÉBEC'S SYSTEM

Division 1 – Hydro-Québec's Service Loop

40. Hydro-Québec supplies and installs the service loop to the connection point for the customer's electrical installation, subject to conditions stipulated in this Chapter.

The connection point must be located so that it is directly accessible from Hydro-Québec's system.

Hydro-Québec at all times remains owner of the service loop.

41. The customer must make available to Hydro-Québec, at no cost to the latter, the sites and rights required for the installation, connection and maintenance of circuits, poles and all equipment belonging to Hydro-Québec and necessary for the supply of electricity, in locations that are readily accessible, agreed upon with Hydro-Québec and safe. Any subsequent modification or relocation of circuits, poles or equipment made at the customer's request or occasioned by him is made at his expense.

When the customer installs a swimming pool, outbuilding, platform or rostrum above, below or beside Hydro-Québec's service loop, he must ensure that clearances comply with the following standards, prepared by the Canadian Standards Association and approved by the Canadian Standards Council:

(1) Standard No. CAN3-C22.3 No. 1-M85, published in July 1985 under the title "Overhead Systems"; and

(2) Standard No. CAN3-C22.3 No. 7-M86, published in February 1986 under the title "Underground Systems."

The customer must also make accessible, at no charge to Hydro-Québec, a right of way, free of all obstacles, subject to the second paragraph of this section, for the installation and operation of the service loop.

42. The service loop is installed at Hydro-Québec's expense up to a distance of 30 metres measured, to the customer's advantage, according to the following options:

(1) from a line separating the customer's property from the public thoroughfare; or

(2) from Hydro-Québec's system.

The customer must pay Hydro-Québec the cost of the portion of the service loop exceeding 30 metres, such cost being calculated on the basis of the following methods:

(1) where electricity is supplied at single-phase voltage, the cost is calculated according to the unit amounts stipulated in Section 3 of Appendix B; and

(2) where electricity is supplied at three-phase voltage, the cost is calculated according to the terms and conditions stipulated in Section 51.

43. Subject to Section 47, the service loop is overhead where Hydro-Québec's system is overhead at the point at which it is connected, and is underground where the system at that point is underground.

44. Hydro-Québec shall not supply a service loop when the loop would overhang a building or outbuilding belonging to the customer, or where it would be located underneath or inside a building or outbuilding belonging to the customer.

45. When electricity is supplied at medium voltage and Hydro-Québec's system is underground, the customer's electrical installation must be designed and installed in such a way that it can receive electricity through a main line and a backup line, each comprising three single-phase cables with a neutral concentric conductor.

46. When electricity is supplied and delivered at low voltage directly from the system and Hydro-Québec's system is underground, the customer's electrical installation must be designed and installed in such a way that it is compatible with Hydro-Québec's service loop.

47. When electricity is supplied from a special substation, except where it is installed on a platform or a pole, the portion of the service loop at medium voltage located on the customer's property up to the substation is underground, provided the length of this portion, measured as stipulated in Subparagraphs 1 and 2 of the first paragraph of Section 42 is equal to or less than 60 metres.

Where the length of the aforesaid portion exceeds 60 metres, this portion, at the customer's discretion, is either underground, or partly underground and partly overhead, but, in these cases, subject to standards cited in the second paragraph of Section 41.

48. In the cases stipulated in Sections 45 to 47, the customer must undertake, at his expense, civil engineering work needed to ensure the supply of electricity in such a way that Hydro-Québec power lines can be installed, connected, operated and maintained in complete safety.

Division 2 – Extension or Modification of Hydro-Québec's System

49. An applicant who requests the supply of electricity must assume, in the cases and according to the terms and conditions stipulated in this Division, the cost of the work required to extend or, as the case may be, modify Hydro-Québec's system to ensure such supply of electricity.

50. Any extension to, or modification of, Hydro-Québec's system covered in Section 49 must be covered by a written agreement between the applicant and Hydro-Québec prior to the commencement of work, except where the applicant has nothing to pay under Subdivision 2 of this chapter.

Subdivision 1 – Cost of work

51. For the purpose of Section 49, the cost of work is the sum of the following elements, when Hydro-Québec can travel by flatbed trailer to the worksite:

(1) the cost of materials specified by Hydro-Québec needed to carry out the work;

(2) the cost of the necessary poles, including the cost of anchors;

(3) the cost of labour, based on the time Hydro-Québec deems necessary to effect the work, including the time allotted for transportation, excluding the cost of labour for installing poles;

(4) the cost of the equipment required to effect the work, calculated according to the utilization time allotted by Hydro-Québec, including anticipated time for transportation;

(5) the cost of acquisition specified by Hydro-Québec, when the acquisition of right-of-way or other servitudes is necessary to carry out work;

(6) the cost specified by Hydro-Québec for clearing and lopping timber, when these operations are necessary for work to be carried out; and

(7) administration fees at the percentage stipulated in Section 4 of Appendix B applied to the sum of amounts established under Subparagraphs 1, 3, 4, 5 and 6.

The cost of purchasing and installing metering equipment, transformers, and circuit breakers and lightning arresters necessary for the operation of transformers used to supply electricity to the electrical installation are excluded from the cost of work.

When work includes crossing a lake or river, the cost of work related to such a crossing is, instead of the cost calculated according to the first paragraph, that estimated by Hydro-Québec and agreed upon with the applicant; it includes the future cost of operation and maintenance necessary for the supply of the electricity service requested, established in current dollars for a period of 15 years and according to a present value calculated at the annual rate stipulated in Section 5 of Appendix B. This cost is added to the cost of work calculated according to the first paragraph for the portion of work which is not related to the crossing.

The costs covered by Subparagraphs 1, 2, 3 and 4 of the first paragraph are determined according to the unit costs set by Hydro-Québec as at March 31 of every year for the entire territory it serves and are available at Hydro-Québec's customer service offices.

This Section does not apply to work related to an autonomous electrical system.

52. When Hydro-Québec cannot travel by flatbed trailer to the site where work must be carried out or when such work is related to an autonomous electrical system, the cost of work, for the purpose of Section 49, is the cost estimated by Hydro-Québec and agreed upon with the applicant. This cost includes the future cost of operation and maintenance necessary to supply the electricity service requested, established in current dollars for a period of 15 years and according to a present value calculated at the annual rate stipulated in Section 5 of Appendix B.

53. When all or part of the work covered by Section 49 is included in work which Hydro-Québec already intends to undertake in the five years following the date of reception of the request, instead of the cost of work being determined according to Sections 51 and 52, the applicant must assume the following costs:

(1) the financing cost stipulated by Hydro-Québec occasioned by moving such work ahead to immediately serve the electrical installation covered by the request, and

(2) the cost of work, calculated according to Sections 51 and 52, for work which is not included in that which Hydro-Québec intended to carry out.

54. Hydro-Québec at all times remains the owner of the installation and the materials necessary for the extension or modification covered by Section 49, notwithstanding the costs assumed by the applicant under provisions in this chapter.

Subdivision 2 – Applicant's contributions

55. When work covered by Section 49 is effected with a view to supplying electricity for domestic use, the applicant assumes the cost of work established according to Subdivision 1 of this Division, in cases and according to the terms and conditions stipulated in Sections 56 to 58.

56. Where there is a municipal water supply system at the place where electricity is to be supplied, the applicant assumes no cost.

57. Where there is no municipal water supply system at the place where electricity is to be supplied, the applicant must pay Hydro-Québec a contribution corresponding to the excess of the cost of work over the amount established in Section 6 of Appendix B for each dwelling.

This contribution is payable by the following methods, at the applicant's discretion:

(1) When the contribution is $1,000 or less:

(a) in a single payment when the agreement is signed, or

(b) in two payments, the first of which represents half the contribution, when the agreement is signed, and the second, the balance, on the anniversary date of the agreement plus interest calculated on the basis of the rate stipulated in Section 7 of Appendix B.

(2) When the contribution exceeds $1,000:

(a) in a single payment when the agreement is signed, or

(b) in 50 two-monthly payments, including interest calculated on the basis of the rate stipulated in Section 7 of Appendix B, the first payment falling due when the agreement is signed.

The applicant is entitled to the refund of, or a reduction in, his payments, according to the procedures and conditions indicated hereinafter, when, in the course of the five years following the date on which the agreement is signed, other permanent electrical installations are connected to the portion of the system for which the applicant paid a contribution:

(1) as of April 1 of every year within the aforesaid five-year period, Hydro-Québec establishes, for each new installation connected without the payment of a contribution since the date of the agreement in the case of the year following this date, or since the preceding April 1 in the case of the four years subsequent to the first one, an amount determined as follows:

(a) when the new electrical installation is for domestic use or for farm use subject to the domestic rate, the amount is equivalent to the product of the amount specified in Section 8 of Appendix B and the number of two-monthly periods remaining between April 1 of the year in question and the date of the fifth anniversary of the agreement;

(b) when the new electrical installation is for other uses, the amount is equivalent to the product of the unit amount per kilowatt, determined according to Section 9 of Appendix B, and the maximum number of kilowatts of anticipated power demand evaluated for the electrical installation by Hydro-Québec.

(2) Hydro-Québec also establishes an amount equivalent to the product of the contribution determined in the first paragraph and the ratio of the number of two-monthly periods remaining between April 1 of the year in question and the date of the fifth anniversary to 30, and

(3) when, on April 1 of the year in question, the applicant has already paid in full the contribution established in the first paragraph, he is entitled to a refund of the lesser of the amounts established under Subparagraphs 1 and 2 or, when a number of payments have yet to be made, he is entitled to a reduction in the payments proportional to the ratio of the lesser of the amounts established under Subparagraphs 1 and 2 to the amount corresponding to the sum of the payments which have yet to be made.

58. When there is no municipal water supply system at the place where electricity is to be supplied and the applicant is a residential property developer, he must pay Hydro-Québec a contribution covering the full cost of work.

This contribution must be paid in full when the agreement is signed.

Hydro-Québec repays the applicant, at the latter's request, an amount corresponding to that established in Section 6 of Appendix B, for each dwelling connected in the course of the five-year period following the date on which the agreement is signed to the portion of Hydro-Québec's system for which he paid a contribution. The sum of the amounts thus refunded shall in no case exceed the contribution paid by the applicant.

59. When work covered by Section 49 is effected with a view to supplying electricity at single-phase voltage, 120/240 V, for farm use subject to the domestic rate and such work is effected over a distance of more than 0.8 kilometres, the applicant must pay Hydro-Québec a contribution equivalent to 50% of the cost of work related to that part of the distance which exceeds 0.8 kilometres.

This contribution is payable according to the methods stipulated in the second paragraph of Section 57, at the applicant's discretion.

The applicant in no case is entitled to a refund of all or part of his contribution.

60. When work covered by Section 49 is effected with a view to supplying electricity for uses other than those covered in Sections 55 and 59, the applicant must pay Hydro-Québec a contribution as outlined in Sections 61 and 62.

61. Where work is effected with a view to supplying electricity to a permanent electrical installation, the applicant must pay a contribution equal to the excess of the cost of work over the following amount:

the product of the unit amount per kilowatt, established according to Section 9 of Appendix B, and the maximum number of kilowatts of anticipated power demand evaluated for the electrical installation by Hydro-Québec and agreed upon by the applicant.

This contribution is payable when the agreement is signed.

The applicant is entitled to a refund each time, in the course of the five years following the date on which the agreement is signed, that other permanent electrical installations are connected to the portion of the system for which the applicant paid a contribution; he is entitled to this refund only if the electrical installation covered by the request has been used, since it was connected, in accordance with the anticipated use taken into account in the agreement mentioned in Section 50.

This refund corresponds, subject to Paragraph 5:

(1) to the following amount, applicable to each dwelling, where the new electrical installation is for domestic use:

the amount stipulated in Section 6 of Appendix B;

(2) to the amount stipulated in Section 6 of Appendix B for a dwelling, where the new electrical installation is for farm use subject to the domestic rate; or

(3) to the following amount, calculated for each new electrical installation, where such an installation is for other uses:

the product of the unit amount per kilowatt, established according to Section 9 of Appendix B, and the maximum number of kilowatts of the anticipated power demand for the electrical installation evaluated by Hydro-Québec.

In all of the cases specified in Paragraph 4, the amount of the refund is reduced by an amount corresponding to the cost assumed by Hydro-Québec for the modification of its system, when this is necessary to supply electricity to the new electrical installation.

The refund is established in proportion to the number of full years remaining in the aforesaid five-year period.

The refund in no case may exceed the contribution paid by the applicant.

62. Where work is effected with a view to supplying electricity to an electrical installation in an operation of indeterminate duration, the applicant must pay Hydro-Québec a contribution covering the full cost of work when the agreement is signed.

The applicant is entitled to the refund of an amount corresponding to the product of the unit amount per kilowatt, established in Section 9 of Appendix B, and the maximum number of kilowatts of the anticipated power demand for the electrical installation evaluated by Hydro-Québec and agreed upon by the applicant.

This refund is effected through annual payments over a maximum of 10 years; each payment is calculated on the anniversary date of the connection and corresponds to the total of the following amounts:

(1) 25% of the amount billed for electricity for the 12 preceding months; and

(2) interest on the balance yet to be refunded of the amount established in Paragraph 2, calculated on the basis of the rate established in Section 10 of Appendix B; the amount of such interest must not exceed 55% of the amount billed for electricity for the 12 preceding months.

The sum of the payments covered in Paragraph 3 may not exceed the amount established under Paragraph 2.

Where the amount paid by the applicant under Paragraph 1 exceeds the amount established in Paragraph 2, he is also entitled to the refund of amounts according to conditions and methods stipulated in the third, fourth, fifth and sixth paragraphs of Section 61; the sum of the amounts thus refunded may not exceed the sum in excess.

63. When work covered by Section 49 is related to the extension of Hydro-Québec's system into an underground system or the modification of the existing underground system, the applicant must pay Hydro-Québec the following amounts:

(1) the contribution established according to Sections 55 to 62 that he would have to pay if the work was related to the extension of an overhead system or the modification of such a system; and

(2) the difference between the cost of work covered in this Section, established according to Sections 51 to 53, and the cost of work determined according to the aforesaid sections which would be required if the work was related to the extension of an overhead system or the modification of such a system.

Division 3 – Temporary Service

64. When the supply of electricity is requested with regard to temporary service, Hydro-Québec does not supply a service loop; the applicant must supply it at his expense.

The applicant must also pay Hydro-Québec the following amounts, prior to the commencement of work:

(1) connection costs stipulated in Section 11 of Appendix B;

(2) disconnection costs at the connection point stipulated in Section 12 of Appendix B, except when Hydro-Québec anticipates connecting an electrical installation at the same location when the disconnection takes place; and

(3) the cost anticipated by Hydro-Québec for removal of the installations it plans to remove when temporary service ends.

When work to extend or modify Hydro-Québec's system is necessary, the applicant must also pay Hydro-Québec, prior to the commencement of work or, as the case may be, at a time agreed upon with Hydro-Québec, the cost of such work calculated according to Sections 51 and 52 or, as the case may be, the costs stipulated in Section 53, subject to the following conditions:

(1) notwithstanding Subparagraphs 1 and 2 of the first paragraph of Section 51, the cost of material and poles assumed by the applicant is equal to 35% of the cost of material and poles calculated under the aforesaid Subparagraphs 1 and 2; and

(2) notwithstanding the second paragraph of Section 51, the cost of installing metering equipment, transformers and circuit breakers and lightning arresters necessary for the operation of transformers used to supply electricity to the electrical installation covered by the request is taken into account for the purpose of Subparagraphs 3 and 4 of the first paragraph of Section 51.

CHAPTER 5 – INSTALLATIONS, SITES AND RIGHTS ON CUSTOMER'S PROPERTY

65. The customer must make available to Hydro-Québec, at no cost to the latter, the appropriate sites and installations and the rights necessary for the installation, connection, operation, maintenance and maintaining of Hydro-Québec's equipment required to supply, deliver, control and meter electricity.

The sites, including connection and delivery points, must be readily accessible, agreed upon with Hydro-Québec and safe, taking into account requirements stipulated in this chapter, in Subdivision 4 of Chapter 3 and in Division 1 of Chapter 4, bearing in mind that no metering equipment may be installed inside the premises where a transforming station covered by Sections 20, 22 and 24 is located, and that no meter may be installed inside the premises where a transforming station is located belonging to a customer to whom electricity at medium voltage is supplied.

66. The electrical installation located on the customer's side from the connection point belongs to the customer, with the exception of electrical equipment furnished and installed by Hydro-Québec to supply, deliver, control and meter electricity.

For the purpose of this Bylaw, when the electricity is supplied at medium voltage according to provisions in Division 2 of Chapter 3, the customer's electrical installation includes the transforming station.

67. The customer's installations and apparatus must correspond to information supplied by him to Hydro-Québec and must allow connection at the voltage supplied by the latter.

They must also comply with the requirements of the standard respecting fluctuations outlined in Appendix D and with those of any other applicable legislative or regulatory provision and be built, connected, protected, utilized and maintained in such a way that they do not disturb Hydro-Québec's system, jeopardize the quality of the supply of electricity to the installations of other customers or put Hydro-Québec's representatives at risk.

When electricity is supplied at low voltage directly from the system, the customer may not, without Hydro-Québec's written authorization, connect a load likely to cause an abrupt current demand of 100 A or more.

68. When Hydro-Québec's system is overhead and the customer's service entrance is underground, the service entrance may be installed on a pole located on Hydro-Québec's system provided that:

(1) there is sufficient room for this purpose on the pole;

(2) the customer's service entrance can be installed there without jeopardizing technical, safety or operating imperatives;

(3) when the service entrance is at medium voltage, Hydro-Québec installs on the pole, at the customer's expense, the latter's cables, potheads and lightning arresters; all equipment must be compatible with Hydro-Québec's; and

(4) the service entrance and necessary civil engineering work, including, as the case may be, that related to crossing a public thoroughfare, are at the customer's expense; however, when the crossing is required under an applicable legislative or regulatory provision, the crossing is undertaken at Hydro-Québec's expense and the connection point is located, at Hydro-Québec's discretion, on the pole or in the access well located on the customer's property.

However, Hydro-Québec reserves the right to replace, move or remove the pole and the equipment installed on it and the customer must assume the cost of handling his electrical installation and, as the case may be, of connecting it.

69. When electricity is supplied at a three-phase voltage, the customer must limit the difference in current between any two phases to 10% of nominal intensity, subject to the fact that, in the cases stipulated in the second paragraph of Section 21 and in the second paragraph of Section 23, this difference must not exceed 50 A and that, in the case stipulated in Section 31, it must not exceed 75 A.

70. The customer must ensure the protection of property and the safety of persons wherever electricity is supplied or delivered and, if he deems it necessary, must protect himself from the consequences of any interruption in the supply or delivery of electricity and protect his electrical installation and apparatus from voltage variations and losses, frequency variations and accidental groundings.

71. The type, characteristics and adjustment of the customer's protective equipment must allow for coordination of the customer's protection with that of Hydro-Québec.

72. When electricity is supplied at medium voltage by several power lines, the customer must use it through the lines Hydro-Québec indicates to him.

Where one of the designated lines fails or requires an outage, the customer must, with Hydro-Québec's authorization or at its request, use the electricity through another line indicated by Hydro-Québec, solely for the duration of work, unless Hydro-Québec indicates a longer period to him.

73. The customer may not use electrical generating equipment in parallel to Hydro-Québec's system, unless the latter gives him written authorization to do so.

74. When the customer installs an emergency generator set, the latter must be equipped with a manual or automatic switching device authorized by Hydro-Québec.

75. The customer must immediately inform Hydro-Québec of any electrical or mechanical defect in his electrical installation likely to disturb Hydro-Québec's system, jeopardize the supply of electricity to other customers or put property or persons at risk.

76. When electricity is supplied at medium voltage, the customer must designate authorized persons, as set out in the Canadian Electrical Code (14th edition, Part I, CSA C 22.1-1982) adopted by Order in Council 433-82 of February 24, 1982, and subsequently amended by resolutions of the Board of examining electricians of February 25, 1982, June 30, 1982, June 27, 1984 and November 20, 1985, approved, respectively, by Ministerial Orders of March 10, 1982, July 22, 1982, August 1, 1984 and by the Ministerial Order published February 26, 1986 in Part 2 of the *Gazette officielle du Québec*.

Hydro-Québec must, in managing its system, be able to communicate at all times with the aforesaid designated persons.

The customer must immediately inform Hydro-Québec of any changes with respect to the aforesaid designated persons.

77. When the power factor, measured at the delivery point, is usually less than 90% for small and medium power contracts, or less than 95% for large power contracts, the customer must install, at his expense, corrective equipment, when Hydro-Québec asks him to do so in writing.

The corrected power factor must not, however, exceed 100%.

The corrective equipment must be designed and installed in such a way that it does not disturb Hydro-Québec's system and that it can be disconnected, entirely or partly, at Hydro-Québec's request or on the basis of the variation of the power used by the customer.

CHAPTER 6 – CONDITIONS FOR SALE OF ELECTRICITY

Division 1 – Use of Electricity

78. The customer must use electricity according to the available power limit, for the purposes and under the conditions established in the contract, under conditions stipulated in this Bylaw and the rates bylaw and in such a way that he does not disturb Hydro-Québec's system, hinder the supply of electricity to other clients or put Hydro-Québec's representatives at risk.

79. The customer must obtain Hydro-Québec's prior authorization to modify his service entrance or change the use to which electricity is put.

80. The customer must, at all times, provide Hydro-Québec with information respecting the use to which electricity is put and the characteristics of his electrical apparatus when asked to do so in relation to the management or safety of Hydro-Québec's system.

81. The customer does not have the right to resell, rent, lend, exchange or give away electricity supplied or delivered by Hydro-Québec, unless he is a legally authorized electricity distributor.

This section must not be interpreted as prohibiting the rental of any premises or building at a fixed rental, including electricity.

Division 2 – Deposits

82. Hydro-Québec may, subject to the *Act respecting the mode of payment for electric and gas service in certain buildings* (R.S.Q., Chapter M-37), require a cash deposit or a guarantee in the cases and according to the terms and conditions outlined hereinafter.

(1) In the case of a contract covering domestic use, where

(a) in the past, the customer did not pay an electricity bill by the due date for the contract he holds (or held), or

(b) the customer cannot properly establish his identity at Hydro-Québec's request.

(2) In the case of a contract covering use other than domestic use, where

(a) the contract is a new one; or

(b) for a contract in force, the customer in the past did not pay an electricity bill by the due date for the contract he holds.

83. Any deposit or guarantee under Section 82 must not exceed a sum equal to the highest estimated billing for power and energy for two consecutive months within the 12-month period following the date on which the deposit is established.

84. Any cash deposit bears interest, for the 12 months following April 1 in a given year, at the rate determined according to provisions in Section 13 of Appendix B.

Interest is calculated as at March 31 of every year and is payable prior to June 1 of the year; where the deposit is refunded, interest is calculated until the date of the refund and is payable on this date.

85. Hydro-Québec may use all or part of the deposit and accrued interest or the guarantee and apply it to the balance due in the customer's overdue account in the following cases:

(1) it is no longer necessary to deliver electricity for the contract covered by the deposit or the guarantee; or

(2) the delivery of electricity has been interrupted under provisions in Subparagraph 1 of Section 99 for the contract covered by the deposit or the guarantee.

Any balance of the deposit or realized guarantee is then returned to the customer.

86. A customer who has made a cash deposit or supplied a guarantee is entitled to the refund of this deposit or the return of the guarantee:

(1) in the case of a contract covering domestic use, where he has paid his electricity bills by the due date during the 12 months following the payment of the deposit or the supplying of the guarantee; or

(2) in the case of a contract covering use other than domestic use, where he has paid his bills by the due date during the 24 months following the payment of the deposit or the supplying of the guarantee.

The refund of the deposit or the return of the guarantee is effected in the 60 days which follow.

Hydro-Québec refunds the deposit and accrued interest, either by crediting the amount to the customer's account, or by sending him the amount directly, at the customer's discretion.

Division 3 – Metering of Electricity

87. Electricity delivered to a customer is metered using metering equipment supplied and installed by Hydro-Québec, subject to Paragraphs 2 and 3. Such equipment remains the property of Hydro-Québec, which can modify it at any time.

Any equipment or apparatus other than the metering equipment is supplied and installed by the customer at his expense.

When electricity is measured at low voltage, the customer must install Hydro-Québec's current transformers and connect their primary winding when they must be installed in a shielded substation.

When electricity is measured at medium voltage or at high voltage, the customer must install Hydro-Québec's voltage and current transformers and connect their primary winding.

88. Subject to any special condition stipulated in the rates bylaw, electricity delivered is covered by separate metering for each delivery point at the customer's premises, except where:

(1) the electricity is sold at a flat rate;

(2) the electricity is sold for the purpose of public or Sentinel lighting; or

(3) on the date this Bylaw comes into force, the electricity is metered by a single set of metering equipment although it is delivered to several delivery points on the customer's premises, as long as the customer's service entrance is not modified.

89. Even where there are several sets of metering equipment in a building, Hydro-Québec may, at any time, effect an overall metering of electricity delivered throughout, or in a portion of, the building, for the purpose of analysing electricity consumption.

Division 4 – Billing and Payment Procedures

Subdivision 1 – Billing procedures

90. In the case of a contract under which only energy is metered, meters are read at least once every four months.

In the case of a contract under which power and energy are metered, the reading of meters and the resetting of maximum demand meters are effected:

(1) at least every two months, with respect to contracts under which billing demand is usually below 50 kW; and

(2) every month, with respect to contracts under which billing demand is usually equal to or higher than 50 kW.

91. Hydro-Québec sends the customer a bill at least every time it reads a meter.

When Hydro-Québec is unable to read the meters, it may establish bills based on an estimate of energy consumption or, as the case may be, of power demand and energy consumption. Adjustments, if any, are effected on a subsequent bill established according to a meter reading.

Hydro-Québec may also establish the initial bill and the final bill according to an estimate of energy consumption or, as the case may be, of power demand and energy consumption. However, in these cases, the customer may supply his own meter reading and Hydro-Québec establishes the bill accordingly.

92. In cases where electricity measured by Hydro-Québec's metering equipment or billed by Hydro-Québec does not correspond to electricity actually used, or in the absence of metering equipment, Hydro-Québec establishes energy consumption and billing demand on the basis of one or more of the following elements:

(1) data supplied by metering tests;

(2) inventory of connected apparatus and an estimate of its average use;

(3) values recorded during consumption periods immediately preceding or following the breakdown of metering equipment or during the same period of the preceding year;

(4) any other means used to establish or estimate energy consumption and, as the case may be, power demand.

In the case of an autonomous electrical system whose electricity delivered to various customers is not usually metered, Hydro-Québec may also establish the average consumption per contract within a single category of use.

Subdivision 2 – Payment procedures

93. All bills are payable, in the legal tender of Canada, within 21 days of the billing date. Where the 21st day is one on which Hydro-Québec's customer service offices are closed, the due date is deferred until the first business day thereafter. Failure to pay by the due date results in administration charges applied to the unpaid balance as of the billing date at the monthly rate in effect at that date as calculated in accordance with Section 14 of Appendix B. Each month thereafter, Hydro-Québec applies administration charges to unpaid balance at the monthly rate in effect at the previous billing date, as calculated in accordance with Section 14 of Appendix B, and compounded monthly.

In addition, if a cheque issued in settlement of an electricity bill is returned by a financial institution because of insufficient funds (nsf), the customer pays Hydro-Québec the additional charge established in Section 16 of Appendix B.*

**Bylaw number 439*

94. Bills may be paid at Hydro-Québec customer service offices or through any other authorized agent.

95. In no case may the customer deduct from his bill an amount due to him from Hydro-Québec or a direct claim or counter-claim which he has, or claims to have, against Hydro-Québec.

96. The customer whose contract is subject to a domestic rate, or a general small-power or medium-power rate under the rates Bylaw may, upon reaching agreement with Hydro-Québec, benefit from the equalized instalments plan under which Hydro-Québec divides into 12 equal instalments the anticipated cost of electricity, subject to the following paragraphs:

The customer may subscribe to the equalized instalments plan at any time. Any equalized instalments agreement, however, ends on the date of the first meter reading occurring for the first billing after July 31 of each year.

Hydro-Québec may, during the agreement, revise the amount of the instalments in the following cases:

(1) the electricity rate applicable to the contract is modified during the period;

(2) the customer moves during the period; or

(3) while referring, on the one hand, to instalments already paid and, on the other, to electricity actually used by the customer during the months of consumption covered by such instalments, Hydro-Québec realizes there will be a substantial discrepancy at the end of the last month of consumption between total instalments agreed upon and the anticipated cost of electricity.

The last instalment corresponds to the balance of the customer's account at the end of the last month covered by the agreement; the balance of the account is calculated by Hydro-Québec and is equal to the difference between the total cost of electricity actually used by the customer for the months of consumption covered by the agreement and the sum of instalments paid. However, when the balance of the customer's account is greater than the amount of the previous instalment, the customer may ask Hydro-Québec, within the time limit stipulated in Section 93, to break this additional amount down over the next six instalments.

At the end of the final month of consumption, Hydro-Québec reviews the amount of instalments anticipated for the following 12 months of consumption and the initial agreement concluded with the customer is renewed accordingly, subject to the conditions stipulated in Paragraphs 2 and 3, unless the customer advises Hydro-Québec that he wishes to terminate the agreement.

Hydro-Québec sends its customers on the equalized instalments plan either monthly bills for the instalment due or periodical statements of account if the customer pays by automatic debit.

Hydro-Québec may terminate the equalized instalments plan where a customer fails to pay on time.*

* *Bylaw number 475*

Division 5 – Refusal or Interruption of Service

Subdivision 1 – Interruption related to the system

97. Electricity is always supplied and delivered subject to interruptions which may arise from an emergency, an accident, equipment failure or the activating of protective equipment within the system.

98. Hydro-Québec may, at any time, interrupt the supply or delivery of electricity for the purpose of maintenance, repairs, modification or management of the system, or for reasons of public utility or safety.

Subdivision 2 – Refusal to supply or deliver electricity, or interruption of supply or delivery

99. Subject to provisions in the *Act respecting the mode of instalment for electric and gas service in certain buildings* (R.S.Q., Chapter M-37), Hydro-Québec may refuse to supply or deliver electricity or may interrupt the supply or delivery of it in the following cases:

(1) the customer fails to pay his bill on time;

(2) a federal, provincial or municipal agency with jurisdiction in this realm orders it to do so;

(3) public safety requires that it do so;

(4) the customer defrauds, manipulates or tampers with metering equipment or any other Hydro-Québec equipment, impedes the supply or delivery of electricity or contravenes Section 104;

(5) the customer refuses to provide Hydro-Québec with information required under this Bylaw or supplies erroneous information;

(6) the customer refuses to make the deposit or supply any other guarantee required under this Bylaw;

(7) the customer fails to make the modifications or adjustments necessary to ensure that his electrical installation complies with requirements stipulated in this Bylaw or, despite Hydro-Québec's request that he do so, fails to eliminate the causes of disturbances on the system;

(8) the customer does not use electricity in accordance with conditions and requirements stipulated in Division 1 of this Chapter.

(9) contrary to Section 103, the customer refuses Hydro-Québec representatives access to his premises.

(10) contrary to Section 65, the customer refuses to allow the installation on his premises of Hydro-Québec's equipment, including metering and control equipment.

(11) the customer's electrical installation has been connected to Hydro-Québec's system without the latter's approval.

(12) the customer's electrical installation has not been approved or, as the case may be, authorized by an authority having jurisdiction in this realm according to any applicable legislative or regulatory provision; or

(13) an individual, partnership, corporation or organization covered by Section 14 uses electricity without having concluded a contract.

100. Where Hydro-Québec decides to interrupt the supply or delivery of electricity under Section 99, except in cases stipulated in Subparagraphs 2, 3 and 4 of the aforesaid section, it must give the customer at least eight clear days' notice of its intention to proceed with the interruption and indicate the reason for it. This notice must be sent by registered mail or by any other means making it possible to prove the notice was sent.

101. When the supply or delivery of electricity has been interrupted under Section 99, to be entitled to the re-establishment of the supply or delivery of electricity, the customer must have remedied the situation which justified the interruption, pay Hydro-Québec actual costs incurred for the interruption and those stipulated for the re-establishment of the supply or delivery of electricity (in no case may such costs be lower than the amount mentioned in Section 15 of Appendix B) and, if need be, make the deposit or supply the guarantee required under Section 82.

102. When Hydro-Québec has interrupted the supply or delivery of electricity under Section 99 for at least 30 consecutive clear days, it may immediately terminate the contract by sending the customer written notice to this effect.

Costs due, as the case may be, under Section 15 and the rates bylaw, and amounts stipulated in the second paragraph of Section 16, and any other sum due from the customer in relation to the supply or delivery of electricity are immediately due and payable.

Division 6 – Miscellaneous Provisions

Subdivision 1 – Right of access

103. Hydro-Québec has the right of access to the customer's premises in the following cases:

(1) to establish or interrupt the supply or delivery of electricity;

(2) for the purpose of installing, operating, inspecting, maintaining, repairing, modifying or removing its equipment;

(3) to verify whether the customer's use of electricity complies with the requirements stipulated in Division 1 of this chapter; and

(4) to effect meter reading.

The customer must allow access at all times when the continuity of the supply and delivery of electricity or safety so require, and between 8:00 a.m. and 9:00 p.m. every day, except Sundays and holidays, for any other reason.

The customer must first obtain Hydro-Québec's authorization when he intends to proceed with any work on his property which may prevent or hinder access as stipulated under this section, including, among other things, access to metering and control equipment.

Subdivision 2 –Prohibition

104. The customer must not hinder the smooth operation of Hydro-Québec's installations, apparatus and equipment. Moreover, he is prohibited access to such installations, apparatus and equipment and he may not effect any manoeuvre or intervention whatsoever thereto, unless expressly authorized to do so by Hydro-Québec.

CHAPTER 7 – LIABILITY

105. Hydro-Québec guarantees neither the maintenance of voltage and frequency at a stable level nor the continuity of the supply and delivery of electricity. In no case shall it be held liable for damages or losses caused to individuals or property resulting from the supply or delivery of electricity or failure to supply or deliver electricity, or resulting from accidental grounding, mechanical failure on its system, any interruption of service covered by Division 5 (Chapter 6) of this Bylaw, frequency variations, and supply voltage variations not exceeding the following limits:

– If the electricity is supplied at low or medium voltage: according to the limits recommended in the standard mentioned in Section 17 (Chapter 3) of this Bylaw;

– If the electricity is supplied at high voltage: a difference of up to 10% above or below the nominal supply voltage.

Moreover, Hydro-Québec cannot be held responsible for damages and losses resulting from fortuitous events or force majeure, even when such events or force majeure cause supply voltage variations exceeding the limits mentioned in this Section.

106. The customer acts as custodian of Hydro-Québec's equipment installed on his premises, with the exception of poles and overhead conductors.

107. Any contract and any agreement concluded under this Bylaw, any installation effected by Hydro-Québec and any connection between its system and the customer's electrical installation, any authorization given by Hydro-Québec, any inspection or verification effected by it, and the supply and delivery of electricity by it do not constitute and must not be interpreted as constituting an evaluation or a guarantee by Hydro-Québec of the functional value, efficiency or safety of the customer's installations, including his electrical installation and protective devices, nor of their compliance with any applicable legislative or regulatory provision.

When the customer does not use the electricity according to the conditions referred to in Section 78, he is responsible for any damage or inconvenience caused to other customers or to Hydro-Québec.

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CHAPTER 8 – TRANSITIONAL AND FINAL PROVISIONS

108. Hydro-Québec Bylaw No. 405, adopted by Hydro-Québec on March 5, 1986 and approved by Order in Council 461-86 of April 9, 1986 (*Gazette officielle du Québec*, Part 2, No. 17 of April 23, 1986, page 1034), amended by Bylaw No. 410 adopted by Hydro-Québec on June 18, 1986, and approved by Order in Council 1336-86 of August 27, 1986 (*Gazette officielle du Québec*, Part 2, No. 40 of September 17, 1986, page 3892) and the reference to the *Gazette officielle du Québec*, is again amended:

(1) by the replacement, in Section 1, of the definition of the word "contract" with the following:

"Contract":
An agreement concluded between the customer and Hydro-Québec for the supply and delivery of electricity, or of electricity and services.";

(2) by the replacement, in Section 1, of the definition of the word "building" with the following:

"Building":
A structure not in contact with other structures or a structure separated from others by a complete fire-resistant wall or a structure whose openings are protected by fire-resistant doors that have been approved by the competent authority.";

(3) by the abrogation, in Section 1, of the definition of the expression "conditional use of electricity";

(4) by the abrogation, in Section 1, of the definition of the expression "rational use of electricity";

(5) by the replacement, in Section 1, of the definition of the expression "supply of electricity" with the following:

"supply of electricity":
the supply of electricity to the connection point through the application and maintenance of voltage at this point.";

(6) by the replacement, in Section 1, of the definition of the expression "delivery of electricity" with the following:

"delivery of electricity":
the supply of electricity to the delivery point, through the application of voltage at this point, with or without the use of electricity.";

(7) by the replacement, in Section 1, of the definition of the expression "consumption period" with the following:

"consumption period":
during which electricity is delivered to the customer and which is included between the two dates used for calculating the bill.";

(8) by the abrogation, in Section 1, of the definition of the expression "regular meter reading";

(9) by the replacement, in Section 1, in the definition of the word "voltage", of the expression "medium voltage" with the following:

"medium voltage":
nominal voltage between phases of more than 750 volts up to and including 50,000 volts;";

(10) by the replacement, in Section 1, of the definition of the expression "domestic use" with the following:

"domestic use":
use of electricity exclusively for living purposes in a dwelling.";

(11) by the replacement, in Section 1, of the definition of the expression "general use" with the following:

"general use":
use of electricity for all purposes other than those explicitly provided for in the Bylaw.";

(12) by the replacement, in Section 1, of the definition of the expression "mixed use" with the following:

"mixed use":
use of electricity both for living and other purposes under the same contract.";

(13) by the insertion, in Division V, of the following Section 33.1:

"**33.1** Subject to the second paragraph, the customer is entitled to a credit on the amount payable for the billing demand when, during a consumption period, electricity has not been supplied or delivered to his electrical installation for a continuous period of at least one hour for any of the following reasons:

(1) Hydro-Québec has reduced or interrupted the delivery of electricity; or

(2) the customer was unable to use the electricity normally delivered to him, because of a war, a rebellion, a riot, a serious epidemic, a fire or any other case of force majeure, with the exception, however, of strikes or lockouts involving the customer's employees.

To be entitled to the credit, the customer must submit a written request to Hydro-Québec within the 60 days following the conclusion of the event in question.

The credit is applied to a subsequent bill and corresponds to the product of the amount payable for the billing demand for the consumption period during which the event in question occurred and the ratio of the number of hours included in this period during which electricity was not supplied or delivered to the total number of hours in the consumption period.

The customer is not entitled to any credit when the interruption is one covered by Subdivision 4 of Division V of the Bylaw.";

(14) by the replacement of Section 76 with the following:

"**76.** Minimum duration of contract:
In cases where general public lighting service includes only the supply of electricity, the minimum duration of the contract is four consecutive months. In other cases, the minimum duration of the contract is one year.";

(15) by the replacement, in Section 126, of the first paragraph with the following:

"When Hydro-Québec must incur unusual expenditures covered by Sections 75 or 80, it requires payment of a monetary contribution from the customer and may impose any other condition it deems appropriate before the work is undertaken."; and

(16) by the abrogation of Sections 120, 122, 127 to 129, 134 to 136 and 138 to 140.

109. The *Regulation respecting the supply of low voltage electricity for residences and general services* (R.R.Q., Chapter H-5, r.2) is abrogated.

110. This Bylaw applies to any contract concluded as of the date on which it comes into force.

It also applies to any contract concluded with Hydro-Québec or one of its subsidiaries and in effect at the time this Bylaw comes into force, without the customer's having to formulate the request stipulated in Section 5.

Terms and conditions outlined in Section 11 apply to the continuation and renewal of any contract in effect at the time this Bylaw comes into force, according to the category of use for which the contract was concluded, subject to Paragraph 4.

The contract for Sentinel lighting service in effect prior to May 1 continues, if it is still in effect on the date this Bylaw comes into force, until the expiry of the term under way on the date this Bylaw comes into force and subsequently continues according to the term agreed upon by the parties or, in the absence of such agreement, from year to year until either party terminates it by giving the other party written notice of at least 30 clear days to this effect prior to the expiry of the initial term or, as the case may be, the term of renewal.

111. Notwithstanding Division I of Chapter 3, any customer receiving electricity at low voltage on the date this Bylaw comes into force continues to receive it according to the mode of supply in effect on that date, until such time as the customer's service entrance is modified.

However, when the voltage at which electricity is supplied to the customer's electrical installation is three-phase voltage, 600 V, 3-wire, Hydro-Québec may, at any time, at its expense, change this voltage in order to adopt three-phase voltage, 347/600 V, star, grounded neutral. In this case, it must inform the customer in writing, at least 30 clear days in advance, of the date of change and termination of service at the existing voltage.

112. Notwithstanding Chapters 3 and 4, any written agreement concluded prior to the date of publication of this Bylaw in the *Gazette officielle du Québec* concerning a mode of supply or work to extend or modify Hydro-Québec's system remains in effect, subject to Sections 35, 38 and 39 applying to electrical installations which will be connected, once this work is completed, at a medium voltage other than 14.4/24.94 kV and provided such work is completed by the deadline agreed upon in the aforesaid agreement, or at the latest on the one hundred eightieth day following the aforesaid date of publication when the deadline is later than the one hundred eightieth day.

113. This Bylaw comes into force on the fifteenth day following the date of its publication in the *Gazette officielle du Québec*.

APPENDIX A

Information required in the request for a contract

Place to be served

Name of the individual, partnership, corporation or organization
Use of facility
Street address
Billing address

Individual, partnership, corporation or organization responsible for the contract

Name
Address

Use of electricity

Connected loads:

lighting
heating
ventilation
motive power
processes
other

Power requested

Date for which service is requested

APPENDIX B

1. Charges for the termination of delivery of electricity

A minimum of $130.

2. Unit cost for a transformer with a second winding

$2 per kVA of installed transforming capacity.

3. Amounts respecting Hydro-Québec's service loop

- $6 per linear metre;

- $215 per pole required, including anchors, for a low-voltage service loop, and $320 per pole required, including anchors, for a medium-voltage service loop.

4. Administrative charges applicable to the extension or modification of the system

Administrative charges of 30%.

5. Annual rate for calculating the present value of the cost of operating and maintaining installations

An annual rate of 12.5%.

6. Amount applicable per dwelling

An amount of $3,400 is allocated for each dwelling.

7. Interest rate applicable to payments

2% two monthly, i.e. 12.6% annually.

8. Amount of reduction of the payment or amount of refund per dwelling

The two monthly maximum is $100.

9. Amount per kilowatt of maximum power

- $325 for an installation other than an installation covered by seasonal service.

- $80 for an installation covered by seasonal service.

10. Interest rate applicable to refund of amount paid

The discount rate set by the Bank of Canada in effect on the anniversary of the connection, less 2%.

11. Charges for connecting temporary service

An amount of $65.

12. Charges for disconnecting temporary service

An amount of $65.

13. Interest rate applicable to deposits

The average rate applied by Canadian chartered banks to true savings accounts on April 1 of every year, less 1%.

14. Administration charges applied to unpaid balance on electricity bills

As of the date this bylaw comes into force, administration charges will be applied at the rate indicated in the following table, with reference to the range in which the National Bank of Canada prime lending rate falls on that date.

Reference ranges. National Bank of Canada prime lending rate	Administration charges applied to unpaid balance on electricity bills
% per annum	% per month
7.99 or less	1.2 (15.38% year)
8 to 9.99	1.4 (18.16% year)
10 to 11.99	1.6 (20.98% year)
12 to 13.99	1.7 (22.42% year)
14 to 15.99	1.9 (25.34% year)
16 to 17.99	2.1 (28.32% year)
18 or more	2.2 (29.84% year)

This rate is revised whenever, for a period of 60 consecutive days, the National Bank of Canada prime lending rate falls above or below the reference range used to establish the administration charges presently applied. The new rate is applied as of the 61st day.

15. Charges resulting from an interruption in service

A minimum of $24.

16. The charge for a cheque returned by a financial institution because of insufficient funds (nsf):

An amount of $10.

APPENDIX C

Method for establishing the replacement value of the customer's electrical equipment

The value resulting from an annual depreciation of 4% for each component installed in the customer's transforming station and which will no longer be used because of a voltage conversion, calculated according to the following formula:

$$c = \frac{a(100 - 4b)}{100}$$

where

a = the cost of the equivalent new material installed, including material, labour and general administrative costs.

b = the age of the component.

c = the depreciated replacement value.

In the case where a component is subject to a modification rather than replacement, e.g., a rewound transformer, the cost of the modification takes the place of the depreciated replacement value for this component; the cost must not exceed the component's depreciated replacement value.

The depreciated replacement value (c) may not be less than 20% of (a).

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APPENDIX D

Standard respecting fluctuations caused by a customer's equipment

At Hydro-Québec's request, a customer must effect a study of the loads of his electrical installation likely to cause fluctuations on Hydro-Québec's distribution system and affect other customers.

If necessary, Hydro-Québec provides the customer with the short-circuit capacity (s.c. kVA) and the power factor of its system at the connection point of the electrical installation.

Calculating the limit of fluctuations:

The current demand resulting from the application of voltage to any load causes a voltage fluctuation whose amplitude as a percentage (A%) of nominal voltage is calculated as follows:

$$A\% = \frac{100 \times \text{kVA demand}}{\text{s.c. kVA}} \quad (1)$$

where: kVA demand = load demand in kVA with its power factor.

s.c. kVA = the short-circuit power available from Hydro-Québec's system at the point of calculation with its power factor.

The daily fluctuation limit depends on the frequency (F) in hertz and the amplitude (A%) of each source (i) of fluctuation and the number (n) of sources.

For a single source:

$$A \max \% = \frac{0.3}{1 + e^{B} - e^{C}} \quad (2)$$

The maximum fluctuation allowed is 5.8%; it must not appear more than once a day.

Where there are several sources, their cumulative effect must comply with the following equation

$$0.09 \geq \sum_{i=1}^{i=n} \left[A\% \times (1 + e^{B} - e^{C}) \right] \quad (3)$$

Noncompliance with equations (2) and (3) is intolerable on a Hydro-Québec medium-voltage distribution line. This requirement also applies to a customer receiving electricity at low voltage, except where his installation is supplied solely by an M.V. - L.V. transformer reserved for his exclusive use.

List of symbols:

A% = The amplitude of a source of fluctuation as a percentage of nominal voltage

e = the base of the Napierian logarithm.

$$B = \frac{-|8 - Fi|}{2.63 + \sqrt[4.51]{(3400\,Fi)}} \quad (4)$$

$$C = (-0.00308) \times (Fi - 8) \quad (5)$$

Fi = the frequency in hertz of a source of fluctuation.

i = case of a source of fluctuation.

n = the number of sources of fluctuation.

Σ = the mathematical symbol representing the sum.

Following a study of his loads, the customer sends Hydro-Québec two copies of his study. The report must include at least the following information:

the power in kVA and the power demand factor of his largest electrical apparatus or all the electrical equipment which must start up simultaneously;

the power in kVA of each connected apparatus; and

the frequency of starting up of each apparatus and the duration of each one's start up.

The customer must also inform Hydro-Québec of preventive measures he intends to take. He must obtain Hydro-Québec's authorization before purchasing any electrical equipment required by virtue of this standard.

PROPOSED HYDRO-QUÉBEC DEVELOPMENT PLAN 1990-1992 HORIZON 1999

PROPOSED HYDRO-QUÉBEC DEVELOPMENT PLAN 1990-1992 HORIZON 1999

Montréal, March 1, 1990

Madame Lise Bacon
Deputy Prime Minister of Québec and
Minister of Energy and Resources,
Responsible for Regional Development
Québec City

Dear Madam,

Hydro-Québec hereby presents to you its strategies for future development, with special regard to the years 1990, 1991 and 1992.

To fulfill the mandate set out in the Hydro-Québec Act, Hydro-Québec must forecast the province's energy needs and determine ways of meeting these needs in accordance with the energy policies of the Québec government.

In this proposed Development Plan we first review the present energy situation. Then, using various assumptions of demographic, economic and energy development, we establish forecast scenarios for high, average and low growth in the demand for electricity. We propose ways of meeting that demand, while applying the principle of sustainable development that respects the environment. Options include the construction of new generating and transmission facilities and the rehabilitation of existing facilities for increased productivity. We also pay special attention to means of improving electrical efficiency, because we believe that these can help moderate the increase in the demand for electricity.

In addition, we present our objectives and strategies with regard to quality of service and the utility's internal operations. Our financial forecasts have been revised to take into account the forecast changes in cost and revenue factors, and Hydro-Québec's self-financing requirements.

The Québec government has decided to seek general consultation and hold public hearings on the present energy situation and the role of electricity in meeting Québec's future energy needs. We will participate actively and openly in this debate and are prepared to reevaluate our orientations accordingly.

Yours respectfully,

Richard Drouin

Chairman of the Board and Chief Executive Officer

Claude Boivin

President and Chief Operating Officer

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Unless otherwise indicated, the data in this document are those of Hydro-Québec.

All dollar amounts are Canadian dollars unless otherwise indicated.

Symbol for Units of Measurement

J – joule (unit of energy)

kV – kilovolt (unit of voltage)

kWh – kilowatthour (unit of energy)

GWh – gigawatthour, or 1 million kilowatthours

TWh – terawatthour, or 1 billion kilowatthours

MW – megawatt (unit of power)

1

A COMMITMENT TO THE FUTURE

Hydro-Québec's mandate is to supply electricity to Québec at the best possible terms and to make the most of the comparative advantage that hydroelectricity offers. In fulfilling its mandate, the utility has five major concerns:

- to have a level of quality of service that meets customer expectations;
- to promote the efficient use of electricity and ensure optimal and flexible development of the hydroelectric resource that is compatible with sustainable development, i.e. in harmony with the environment;
- to mobilize human resources;
- to remain financially sound; and
- to demonstrate economic and technological leadership that reflects the needs of the utility and its partners.

With the cooperation of its personnel, suppliers and contractors and together with land-use planners and developers, Hydro-Québec will meet the expectations of the people of Québec and the utility's three principal partners: its customers, who are its raison d'être; its shareholder, the Québec government, which determines energy policy and defines the utility's mandate; and its lenders, who supply three-quarters of the capital needed.

Much of 1989 was devoted to the preparation and introduction of a number of major service-quality enhancement programs, as mentioned in last year's Development Plan. These programs are now under way, in spite of work slowdowns related to contract renegotiation. In addition, the utility began rescheduling its ongoing activities, focusing on sectors with the poorest performance and on activities that have an immediate impact on continuity of service, such as tree-trimming. These activities involving the distribution system, combined with more favorable climatic conditions, resulted in a reduction in average service-interruption time, meeting the utility's short-term goals in this area.

Meanwhile, a number of events combined to alter the balance between supply and demand. On the one hand, consumption of electricity in Québec continued to increase rapidly, and demand forecasts for 1992 and beyond, taking into account the new aluminum smelters and a higher household-formation estimate, have been revised upward. On the other hand, another year of runoff well below average levels intensified the decline in energy reserves. To maintain the balance between supply and demand, Hydro-Québec had a number of options. First, the utility decided to move up, to the extent possible, the commissioning of three generating stations under construction at La Grande complex. Then, to reconstitute short-term energy reserves, it temporarily reassigned Tracy thermal generating station to base-load production, bought back dual-energy boiler supply contracts in Québec for a one-year period, and purchased electricity from neighboring systems. Whether to continue, expand or reduce the application of these types of measures will be decided in the fall of 1990, once the year's runoff levels are known. The substantial increase in overall power requirements has put some pressure on short-term reserves, in spite of the projected commissioning of gas turbines in 1992 and 1993.

In the area of labor relations, four agreements were signed, including one with SPIHQ, the engineers' union. However, the goal of renewing collective agreements with some 16,000 permanent and temporary employees affiliated with the Canadian Union of Public Employees (CUPE) was not achieved in 1989.

In spite of the strength of the Québec economy, the utility's net income for 1989 was down by $54 million compared with 1988 because of higher expenditures and revenue losses due to low runoff. This meant that return on equity in 1989 declined to 7%, continuing to fall short of the medium-term objective of meeting the cost of the debt.

1.1 Enhancing Quality of Service

Improving quality of service is of paramount concern for Hydro-Québec, which is responsible for doing its best to serve Québecers' needs. Concern for service quality also applies to deliveries to neighboring systems in Canada and the United States.

Customers vary by category (residential, general or industrial), the amount of their consumption and range of services required. Customers expect, first and foremost, a reliable supply of electricity. They also want rapid connection, an accurate and simple bill, and a choice of payment methods. They appreciate advice on safety and energy conservation. Moreover, they want easy access to business offices, satisfactory settlement in case of error, and service which is courteous, personalized, understanding and flexible. Finally, they want to be warned of any temporary service interruptions planned by the utility in their sector.

All customers deserve continuous, high-quality service. This was reaffirmed by Hydro-Québec in last year's Development Plan in which it placed a new emphasis on its primary mandate: quality of service. This led to three major programs in 1989, for improvement of:

- quality of service of the distribution system (known by its French acronym, PAQS 2);
- maintenance of generating, transmission, sub-transmission and telecommunications facilities (known by its French acronym, PAM);
- quality of customer services (known by its French acronym, PAQS – Clientèle).

Quality of service was also pursued through the redeployment of ongoing operations and maintenance activities, and through enhanced service-quality support activities, including new emphasis on quality assurance in procurement, on R & D and on employee training. Furthermore, the utility has for several years now been revising its practices in various areas. It will therefore be implementing new, more stringent design criteria for the transmission and underground distribution systems, and a new preventive maintenance policy based on monitoring.

Directly or indirectly, quality control is the responsibility of all personnel. Moreover, each employee must be properly trained, the working climate favorable, objectives clear and consistent, results monitored and acknowledged, the organization of work appropriate and conducive to initiative, and human, material and financial resources must be sufficient.

This Development Plan aims to ensure that these requirements are met in order to guarantee the success of programs dedicated to product quality and customer-service quality. The ultimate goal of these programs is to see that Hydro-Québec equals the quality performance of the best Canadian electrical utilities by the mid-1990s. The utility will devote some $4 billion to achieving this goal. While this expenditure will mean higher supply costs and rates, Hydro-Québec's customers will benefit from:

- a transmission system designed according to the most stringent criteria in North America, with minimal probability of a general power failure;
- a distribution system as reliable as other Canadian systems that experience similar climatic conditions, which means a 50% reduction in service interruptions;
- improved customer services, with present causes of dissatisfaction reduced to the extent possible.

Quality of service also depends on how the utility meets its environmental obligations while operating its existing facilities. The orientations adopted by Hydro-Québec are an extension of its activities in this area for a number of years now, exemplified through its management programs for contaminants and hazardous wastes, reservoirs, and noise control, and through actions to better integrate the distribution system into its surroundings.

1.2 Balance between Supply and Demand and Sustainable Development

A sufficient supply of electricity obtained under conditions that respect the environment is Hydro-Québec's constant goal. Since 1982, the utility has successfully met a 52.7% rise in Québec firm-electricity sales. Future electricity needs are determined according to various economic and demographic growth scenarios for Québec, and these forecasts are re-evaluated each year. Hydro-Québec's mandate is to satisfy this demand for electricity. To do so, it must have the necessary flexibility to optimize hyroelectricity's comparative advantage for Québec, in accordance with the principle of sustainable development.

This principle, proposed by the World Commission on Environment and Development, was adopted by the utility in 1988. It suggests that development be optimized in a manner which, while respecting the planet's ecological limits, does not compromise the ability of future generations to meet their needs.

The first part of Hydro-Québec's contribution towards achieving sustainable development is to promote energy conservation, regardless of the demand scenario. Conservation is cost-effective for customers and, when integrated into the utility's strategic planning, it allows the installations plan to be modified to be more in tune with Québec's real future needs. Energy conservation programs must, however, be accompanied by an adequate rates structure, i.e. one based on the costs of supply.

The second part of Hydro-Québec's contribution consists of developing Québec's hydroelectric resources in harmony with the environment and in consultation with all interested parties. This is why Hydro-Québec conducts its study of cumulative environmental effects, and impact-assessment studies for each project.

Electrical Efficiency

The promotion of the efficient use of electricity is essential to carrying out the utility's mandate. This is not a new concern for Hydro-Québec. In the past, the utility has been very active in establishing standards for appliances and home insulation. During the period of major energy surpluses which followed the 1981-1982 recession, it concentrated on peak-load management through dual-energy and interruptible power programs. Now that supply and demand are back in balance, Hydro-Québec is placing a new emphasis on all its activities that affect demand, and at the beginning of the 1990s it is instituting a major permanent program to promote energy conservation.

Programs to promote efficient use of electricity are also a part of customer service. These programs will offer customers additional means to reduce their consumption and lower their electricity bills. This not only makes good business sense by increasing customer satisfaction, but also makes good economic sense compatible with sustainable development; everyone comes out ahead when waste is eliminated through energy conservation methods that cost less than would the generation of additional electricity. Québec's long-term economic development also benefits from the increased margin of manoeuvre resulting from hydroelectric resources made available through conservation.

Energy conservation programs have already made a major contribution to the insulation of buildings and water heaters in Québec. However, a significant potential for energy conservation remains. Of this potential, Hydro-Québec is backing those measures that are cost-effective for customers and the utility; neither customers' quality of life nor long-term rates will be adversely affected. The utility will devote about $1.8 billion by the end of the 1990s to programs involving specific energy-conservation measures.

Hydro-Québec's activities promoting electrical efficiency also affect peak-load management by shaving the demand through dual-energy systems and through interruptible power adopted by large industries. Combined with the impact of energy conservation programs, these measures will reduce growth in priority needs for power by some 5,600 megawatts by 2001, equivalent to the power now required on the Island of Montréal.

Hydroelectric Projects

Energy conservation and peak-load management will, however, meet only part of the growth in demand in Québec.

Based on reasonable assumptions concerning demographic, economic and energy growth, and taking into account measures aimed at electrical efficiency, Hydro-Québec anticipates it will have to meet a 40% rise in electricity demand between now and 2006, in the average scenario.

The utility has an available capacity of 30,000 megawatts The undeveloped potential of the province's large and small rivers is 50,000 megawatts. Studies conducted to date have determined that approximately 18,800 megawatts of this total is economically viable compared with base-load generating options such as coal-fired or nuclear plants.

Were all projects developed in this economically viable potential, the utility's installations would occupy 2% of the province in the next century, compared to 1% today. Initial results of the study of cumulative environmental effects show that these developments will not have major effects on the climate, underground water tables, wildlife habitat and resources, and estuarine environments.This first conclusion takes into account the fact that each project will receive a rigorous impact-assessment study and appropriate mitigative measures. Nevertheless, interactions between resources and their users mean that these projects are liable to have significant cumulative effects in three areas of the human environment: organization and structure of the area, regional economies, and lifestyles of the Native Peoples. Mitigating and managing these effects are possible through an enlarged implementation strategy, focusing on increased collaboration with communities affected, with other land users and with land-use and resource planners and developers.

Sufficient time must therefore be set aside to involve the interested parties in the process of developing this economically viable hydroelectric potential. Accordingly, the utility has revised last year's forecast of the earliest commissioning of the first generating units of the Nottaway-Broadback-Rupert (NBR) complex from 1998 to 2001.

Without Hydro-Québec's intervention, growth in Québec demand could impose an unrealistic schedule on the commissioning of hydroelectric facilities in the 1990s. Promoting energy conservation is therefore another way of achieving sustainable development, by allowing more flexibility for resource-development decisions.

Flexibility in Adaptation

The long lead times required to build major electricity generating and transmission facilities mean that Hydro-Québec must forecast the evolution of demand, and ways of meeting that demand, over a minimum 10-year period. Many unpredictable events can alter this pattern; thus the use of a range of scenarios for long-term demand and runoff cycles.

The utility bases the construction of its new installations on the average-demand scenario. However, given the time required for studies, consultation and construction, it is easier to adjust the construction program downward rather than upward, so the utility plans its studies and applications for government authorization using the strong-demand scenario. Any decision to begin construction is only made after authorizations have been obtained, based on the most recent demand forecasts.

To cover risks associated with cyclical phenomena such as low runoff or strong economic recovery, Hydro-Québec must also have reserves of energy and power. Thus, in addition to efforts to improve quality of service, it has increased its reserve requirement in order to ensure the long-term reliability of electrical supply. To cope with factors like high runoff and economic slowdowns, Hydro-Québec maintains such flexible markets as exports of surplus electricity and industrial boilers.

Despite energy conservation, the ability to adapt to strong demand will be reduced in the 1990s. Over this period, long construction times limit the quantity of energy that can be obtained from the stock of economically viable and environmentally acceptable hydroelectric projects. The process of environmental studies, consultation with the Native communities and other groups, preparation of appropriate mitigative measures and the obtaining of government authorizations prevents the execution of large projects before 1998-1999, except those already under way at the La Grande complex. Authorization for Grande Baleine (3,060 megawatts at the peak) is the keystone in the balance between supply and demand in the medium term. The first commissionings of this complex are planned for 1998 at the earliest. The Nottaway-Broadback-Rupert complex (8,400 megawatts at the peak), whose earliest commissionings are planned for 2001, and which can be executed in several phases depending on demand, will give the utility all the required long-term flexibility. This project represents nearly 45% of the economically viable hydroelectric potential.

Choice of Markets

For many years now, Québecers have opted in large numbers for electric heating. Some 71% of Québec residences, and more than 90% of new homes, are heated by electricity. For all consumption sectors, electric heating represented about 23% of Québec sales in 1989; when water heating is included, this figure rises to 31%.

Electricity's strong saturation of the heating market has greatly contributed to boosting Québec's energy self-sufficiency. In fact, electricity's share among the province's conventional energy sources rose from 19.5% in 1971 to 39.3% in 1989. Substituting electricity for oil has led to major improvements in terms of energy productivity, given the greater efficiency of electric heating systems.

However, current rates do not adequately reflect the cost of supply in the case of the residential all-electric heating market. This is because of the particular nature of the load or demand on the electricity grid, which requires additional generating and other facilities in winter. Consequently, the utility promotes energy conservation options such as dual-energy systems and the implementation of a rates policy which better reflects costs. Customers will then be more sensitized to the importance of using energy wisely.

Beyond meeting Québecers' basic needs, what guides Hydro-Québec's choice of markets is the desire to optimize a collective resource. Hydroelectricity represents one of Québec's major economic assets in the North American context. Accordingly, the use of this comparative advantage to bring industries consuming large amounts of energy to Québec is an important facet of the Québec government's industrial policy. And Hydro-Québec incorporates in its forecast of demand the margins of manoeuvre necessary for Québec to be able to seize interesting opportunities for industrial development. Its risk-and profit-sharing program and incentives to introduce promising electrical processes into industry have proven to be effective levers for development.

Exports constitute another market choice for Québecers. Development of exports to neighboring systems has already brought major benefits to Québec. In the 1980s, more than $5 billion in revenue was reinvested in the utility's activities, thus avoiding major rate shocks in Québec and leading to better utilization of facilities after the 1981-1982 recession. The development of interconnections also enabled Québec to become better integrated with northeast US and Canadian power systems and strengthened its capacity to face variations in supply and demand by temporarily importing power and energy.

There is a significant long-term potential on export markets which allows the utility to select the most profitable markets for thermal-generation replacement from among neighboring systems. Exports are therefore one of the uses of hydroelectricity with the highest economic value for Québec. From a more general environmental point of view, exporting hydroelectricity to neighboring systems contributes in the long term to reducing acid rain and the greenhouse effect, for which their thermal generating stations are partially responsible.

Starting in the year 2000, Québec has the option of moving up for export purposes those hydroelectric projects included in the potential of 18,800 megawatts and not required for internal demand for electricity until much later. This is compatible with realistic commissioning dates that allow a harmonious integration of the economic, social and environmental aspects of these projects. Additional exports of electricity over and above the agreements already signed can then be made for 15 to 20 years without harming Hydro-Québec's ability to achieve its primary goal of satisfying demand in Québec. These contracts are very advantageous for all parties, and at their expiry the utility recovers the electricity generated at these installations for Québec's needs. Furthermore, since these installations will be built earlier than planned, they will cost less than under the original construction schedule.

Accordingly, Hydro-Québec reaffirms its objective of exporting at least 3,500 megawatts of firm power and energy after the year 2000, when these exports will represent some 10% of total sales.

Other Development Choices

There may be other approaches to development that differ from those proposed by Hydro-Québec. However, in the short and medium term the realistic options are limited.

One is to use energy conservation as the primary means to satisfy growing needs. This approach would, however, constitute just as extreme a position as counting solely on new generating facilities.

Given the present state of knowledge, it would be imprudent to depend on much greater energy conservation than that already incorporated in demand forecasts, and which is compatible with incentive measures while being cost-effective and fair. Too great a reliance on energy conservation in the medium term would instead mean dependence on thermal generation and the restriction of certain markets. For example, it would be necessary to limit the quantities of electricity available for the development of large-power industries, or halt the penetration of electric heating, mainly by raising rates – possibly applying a rates policy based on the average cost of new installations, rather than the cost of all generating facilities.

In the longer term, Québec could decide not to sign new export agreements, but this solution would not obviate the need to commission major projects, even if their construction is delayed. In the meantime, Québecers would be collectively poorer, and there would be increasing atmospheric pollution in the northeastern part of the continent.

Another approach Québec could take is to maximize the economic value of hydroelectricity to an even greater degree than is proposed in the present Development Plan. As hydroelectricity is at its most valuable as an export, it could be more profitable to promote a broader range of energy sources for heating in Québec, so as to free up a proportion of electrical output for additional exports abroad.

Hydro-Québec's Proposal

Hydro-Québec believes that the development orientations it proposes are reasonable and that they offer the flexibility to meet the real needs of Québec, respect the environment and optimize the value of the resource by selective market choices.

The approach to development proposed by Hydro-Québec consists of the following choices:

- meet Québec's energy needs, including heating, while actively encouraging electrical efficiency and ensuring that rates reflect the average cost of supply;
- maintain electricity's present role as an important tool for economic development. To this end, stimulate industrial development and promote the use of highly energy-efficient electrotechnologies;
- promote profitable electricity exports by moving up hydroelectric projects that will be required for Québec only when related export contracts expire;
- develop economically viable hydroelectric resources in cooperation with major interested parties. At the same time, ensure that the environment is respected, mainly by carrying out studies necessary to optimize appropriate mitigative measures.

The utility is convinced that Québec would lose a major advantage if it did not seek to reconcile these diverse objectives. Accordingly, it is very receptive to the consultation that will take place with interested parties during hearings of the *Commission parlementaire sur la situation et les perspectives de l'énergie électrique au Québec*. This dialogue will make it possible to determine the social acceptability of developing the 18,800 megawatts of economically viable potential that are judged to be environmentally acceptable.

Hydro-Québec does not seek development at any price. However, delays in the authorization process could compromise the development scenario the utility believes to be most positive, and limit the choices available to Québec society, especially as regards hydroelectricity.

1.3 Mobilization of Human Resources

To meet the challenges of the 1990s, Hydro-Québec needs the full participation of all employees. So it must determine with staff, managers and unions the conditions that facilitate the achievement of the utility's major objectives. There can be no doubt that the difficulties and disputes at Hydro-Québec in recent years have had an impact on the working climate and employee loyalty. Now the utility must rally and mobilize the men and women that are its vital strength.

Three approaches are required at this time. The first is to continue the mobilization activities begun last year with managers and specialists, by means of a strategic development plan that is more comprehensive and longer term, covering all employees. The second is to negotiate in the short term collective agreements that foster a new consensus, based on quality of service, productivity and employee aspirations. Lastly, with moderate growth in staffing levels and the need for succession planning, the utility must, at the beginning of this new decade, improve the quality of its recruiting, both external and internal, and keep the technical, commercial and management skills of all its staff in the forefront of knowledge.

1.4 Maintenance of Financial Health

Another essential condition for achieving the objectives of the Development Plan is the maintenance of a sound financial position.

Hydro-Québec's financial soundness, which has always been recognized, has given it ease of access to the capital markets for financing the investments required to satisfy the growth of Québec's needs. In just two decades, assets have risen from $4 to $34 billion, making Hydro-Québec one of the two largest non-financial corporations in Canada.

The utility's financial policy is clear: generate sufficient net income to cover the principal risks to which revenue and costs are exposed, ensure adequate self-financing of investments, maintain advantageous borrowing conditions and, at the same time, give an accurate price signal to customers.

In previous Development Plans, Hydro-Québec stated that by early in the 1990s it would have reconstituted a minimum financial margin as defined by the four following objectives:

- interest coverage of at least 1.0;
- capitalization of at least 25%;
- return on equity equal to or greater than the average cost of the debt;
- self-financing of at least 30%.

To achieve these interrelated objectives, the utility was counting on three principal strategies:

- productivity gains;
- the application of a rates policy reflecting costs of supply which includes an acceptable return on equity;
- developing profitable export markets.

In recent years, overall productivity has been increased through rationalization and the development of markets. Growth in operating expenditure, adjusted for inflation, was kept to an average of 1.9% per year from 1982 to 1988, as compared to about 10% per year between 1976 and 1982. Hydro-Québec will pursue its efforts by stressing individual productivity. Discussions to this effect are part of current negotiations with the unions. Rate increases have on average been below the rate of inflation for the last five years. The real price of electricity in 1989 was thus slightly less than it was in 1963. Finally, with regard to exports, over the past five years the utility has achieved sales in excess of $2.8 billion.

Thanks to these three strategies, there has been a gradual improvement in the financial health of the utility. Thus, return on equity rose from 4.7% in 1984 to 8.0% in 1988 and 7% in 1989 but this is still below the cost of the debt, which stood at 11.2% last year.

Two factors now slow down the desired improvement in financial health and widen the gap between rates and costs of supply. First, the need to reconstitute water reserves will mean major increases in expenditure, and revenue losses in the short term: $267 million in 1989 and $314 million in 1990, assuming that runoff returns to average in 1990. Second, in the medium term costs are being forced upwards by stronger growth in demand, the downward revision of average output of generating stations, new service-quality enhancement programs and the launching of energy conservation programs whose full benefits will only be felt later. The postponement of certain firm power and energy exports will also have an adverse effect on the improvement of Hydro-Québec's overall financial health.

The problems with runoff illustrate how crucial it is to have sufficient financial margin of manoeuvre to absorb the major variations in supply and demand. Had Hydro-Québec been able to reconstitute the desired margin, it could now consider absorbing a large portion of the negative shocks it is currently experiencing. Unfortunately, this option is not available. Moreover, after the slowdown in investment that followed the 1981-82 recession, Hydro-Québec is now facing renewed spending on large-scale construction and intensive service-quality enhancement programs.

Investment for the average-demand scenario will now be more than $8 billion higher for the 1990-1998 period than was forecast in last year's Development Plan. Some $62 billion is currently projected for the 1990-1999 period, $13 billion of which will be for the next three years. In this context, it is more essential than ever to achieve financial policy objectives.

Steps must be taken to stop the gap between rates and costs of supply from becoming wider. But to avoid excessively large rate increases, Hydro-Québec proposes to spread the rates recovery over two years, with two general rate increases of 7.5% per year. This is a minimum rate of recovery, in 1990 generating only the income required, before interest and exchange loss, to cover gross interest charges. Only in 1992 will the utility begin to approach all of the minimum objectives of its financial policy.

A more accurate reflection of real costs will promote the efficient utilization of electricity and contribute to sustainable development. Electricity will nonetheless remain competitive with other energy sources in Québec, and Québec's electricity prices will remain attractive compared to those in North America as a whole.

1.5 Economic Spinoffs and Technology

Acting as a catalyst for the Québec economy in its activities as employer, purchaser, vendor and researcher, is a fundamental role for Hydro-Québec as a Crown corporation. In 1989, the utility supported jobs evaluated at 62,500 person-years in Québec, and this number will grow substantially by 1992, reaching more than 87,000, an increase of 37%.

For the work force, suppliers and subcontractors, hydroelectricity is undoubtedly the source of energy with the highest Québec content — 76% in 1989 — and the greatest spinoffs. It generates a large volume of economic activity through construction and operation of electrical facilities, which currently represents about 5% of Québec's Gross Domestic Product.

Moreover, Hydro-Québec's procurement policy seeks not only to increase the Québec content of its purchases but also stresses quality assurance and local R & D. This can give suppliers a marked competitive edge in world markets.

The utility also stimulates the inflow of major investment to Québec. For industrial customers, Québec's hydroelectricity is a high-performance energy with many uses: manufacturing, processing, heating, handling and high technology. And customers are offered technical and financial support in introducing energy-efficient electrotechnologies into their industrial processes.

Technology plays a key role at Hydro-Québec: not only was it at the core of the utility's achievements in expanding and operating its huge power system over recent decades, but it will also play a vital part in the future in solving the problems associated with quality of service, the environment, employee health and safety, and cost-effective investments.

With forecast spending on research and development of nearly half a billion dollars over the next three years, putting it among Canadian leaders in this regard, Hydro-Québec remains a driving force of technological development in Québec. And it will continue to broaden its technological activities by forging closer links with industry, government and non-governmental research centres, and universities.

It is currently deploying efforts in four long-term avenues related to the generation, transmission and utilization of electricity: nuclear fusion, superconductivity, hydrogen and polymer-electrolyte (ACEP) batteries. Here, as in all else, the utility reaffirms its commitment to the future.

2

IMPROVING QUALITY OF SERVICE

Quality of service has always been one of Hydro-Québec's paramount concerns. While the utility's efforts brought about an improvement in service continuity between 1982 and 1986, a series of factors resulted in deterioration in this area in recent years. Consequently, the utility placed new emphasis on activities affecting all aspects of quality of service.

Hydro-Québec will raise its performance to a level comparable to that of the best electrical utilities. To achieve this, it has set specific goals for progressive improvements over the coming years both in the quality of product supplied and in the quality of customer relations.

2.1 Product Quality

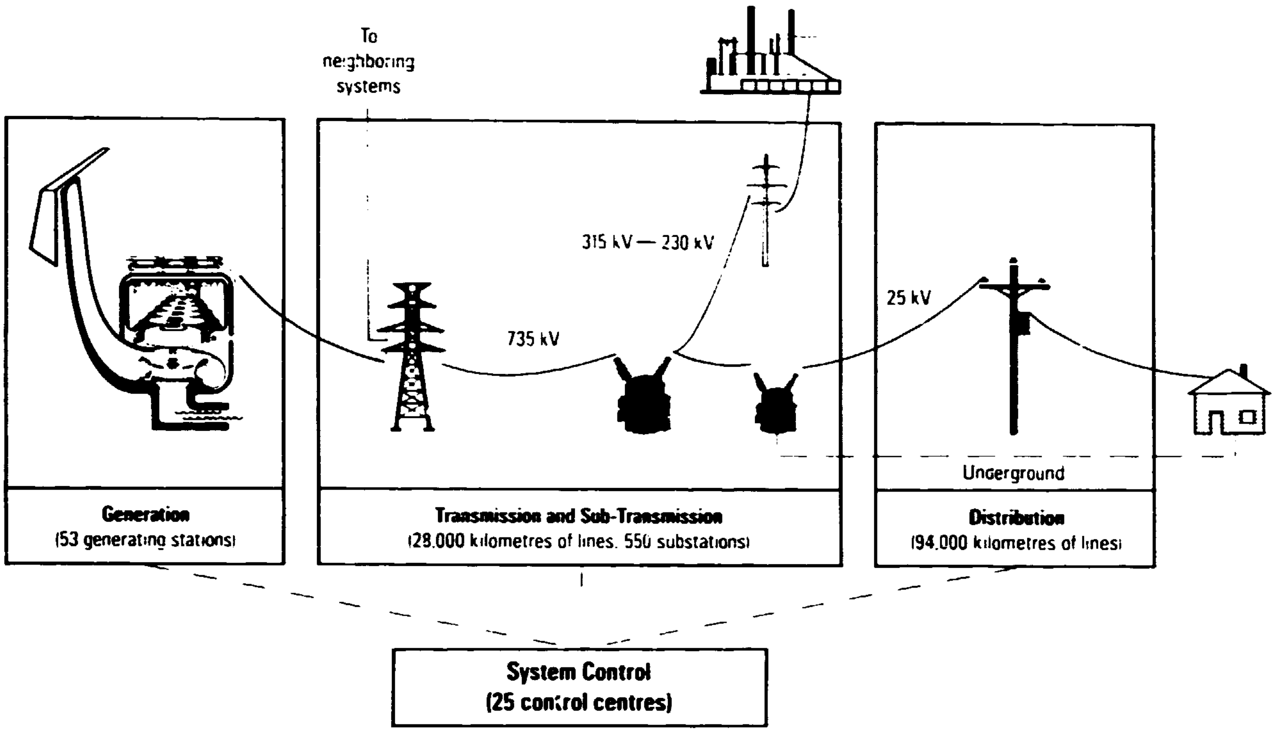
Continuity of service is a major concern for the utility. The Hydro-Québec system contains a large amount of equipment whose behavior affects service continuity.

Energy is generated primarily by 53 hydroelectric generating stations, scattered across the province of Québec. Their output is carried to the distribution system, to the province's major industrial firms and to neighboring systems by the transmission and sub-transmission systems, containing some 550 transformer substations and more than 28,000 kilometres of lines.

The distribution system supplies residential, commercial and institutional customers and small- and medium-sized industrial firms in Québec with medium and low voltage. It delivers electricity to nearly three million customers through 94,000 kilometres of medium voltage lines, 5,800 of which are underground.

Completing this system are the telecommunications facilities, automatic-control devices and operations centres essential to proper operation and vital to its performance.

Diagram 2.1
Principal Installations Supplying Customers



Customer-service interruptions have a number of causes, usually divided into two different categories:

- power failures due to equipment breakdown or due to random events caused by factors external to the system, principally trees and branches, wind and lightning;
- scheduled service interruptions, allowing the utility to perform maintenance and system modification work.

While quality of service can be evaluated on the basis of the total number of service interruptions during the year, this number only partially reflects the impact of interruptions on customers. Each service interruption affects a highly variable number of customers and varies in length. For example, distribution-system failures are more frequent but affect fewer customers, while transmission system breakdowns are much less frequent but affect a much larger number of customers.

These variables have been taken into account in a more general indicator: the average annual service-interruption time per customer.

To analyse the evolution of this indicator, both provincially and regionally, it is useful for the utility to combine interruptions by the system on which they originate. This allows better definition of the measures to take and better follow-up of the results of these programs.

Table 2.1
Breakdown of Average Annual Service-Interruption Time per Customer by System of Origin
(in hours)

	1982	1983	1984	1985	1986	1987	1988	1989
Distribution	5.4	7.3	5.3	5.6	5.2	7.6	8.2	5.2
Transmission and sub-transmission								
• excluding general power failures*	5.9	2.8	3.5	3.4	2.8	1.1	1.8	1.3
• general power failures		–	–	–	–	–	5.3**	8.1***
Generation	–	–	–	–	–	–	–	–
TOTAL	11.3	10.1	8.8	9.0	8.0	8.7	15.3	14.6

* A general power failure corresponds to total loss of power, and is caused by a problem on the transmission system.

** General power failure of April 18, 1988: ice caused a series of short circuits on the three phases of Arnaud substation which caused the loss of Churchill Falls generating station.

*** General power failure of March 13, 1989 caused by a high-intensity magnetic storm.

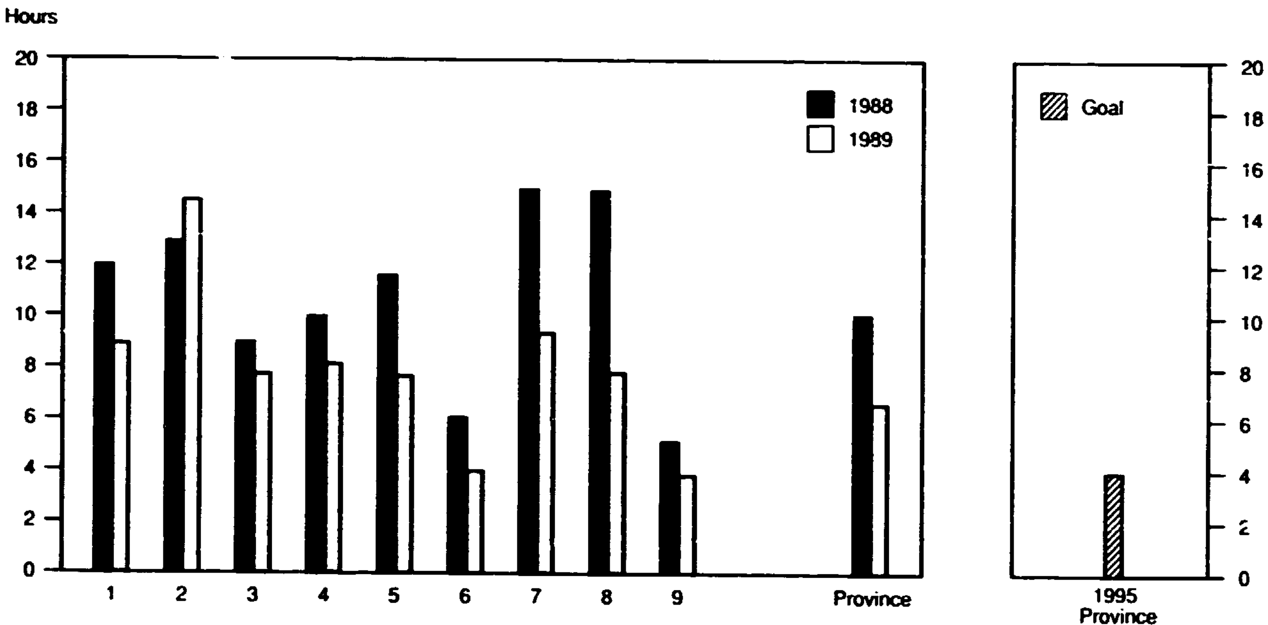
In 1988 and 1989 there was an improvement in average annual service-interruption time per customer on the distribution system, with interruptions dropping from 8.2 to 5.2 hours, exceeding the utility's goal for March 1990 of 6.1 hours. Transmission and sub-transmission system interruptions excluding general power failures dropped from 1.8 to 1.3 hours. However, the general power failure of March 13, 1989 adds 8.1 hours to the figure for each customer.

Changes in annual average service interruption time per customer observed between 1988 and 1989 will be discussed later in this chapter. Hydro-Québec's generating facilities have not been the cause of power failures or scheduled service interruptions that affect service continuity.

The general improvement in continuity of service noted, (excluding general failures), was also observed in virtually all of the utility's administrative regions.

Map 2.1 shows that more than 80% of Hydro-Québec's customers are located in the *Saint-Laurent*, *Laurentides*, *Richelieu* and *Montmorency* regions.

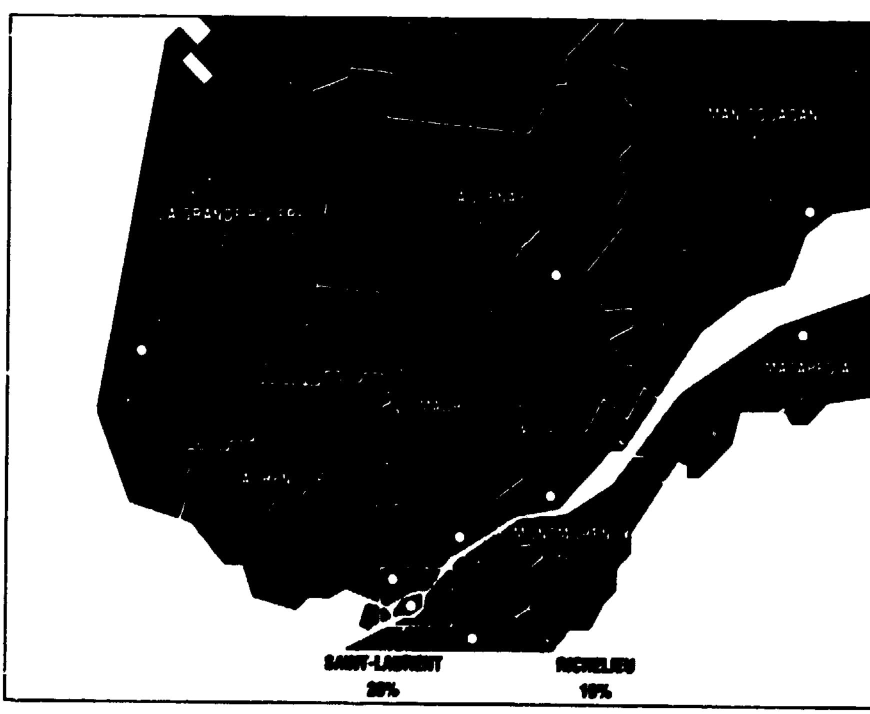
Figure 2.1
Average Annual Service-Interruption Time per Customer by Region*
(Distribution, transmission and sub-transmission, generation)



1- Manicouagan
2- La Grande
3- Saguenay
4- Matapédia
5- Mauricie
6- Montmorency
7- Richelieu
8- Laurentides
9- Saint-Laurent

* Excluding the impact on the distribution system of general transmission-system power failures

Map 2.1
Percentage Breakdown, by Region, of Customer Accounts*



* Approximately 3 million accounts, in total, in 1989

Note:
The cities shown are the locations of Hydro-Québec's regional offices.

By 1995, Hydro-Québec aims to reduce average service-interruption time per customer to 4 hours per year or less, excluding general power failures, a level comparable to the average of other Canadian electrical utilities.

This average annual service-interruption time per customer can be broken down into 3.5 hours on the distribution system and 0.5 hours on the transmission and sub-transmission systems, excluding general power failures. The utility will be introducing new transmission-system design criteria, among the most stringent in North America, which should reduce to a minimum probability general power failures on the transmission system.

Objectives	Principal Strategies	
Average annual customer service-interruption time not to exceed the average of other Canadian electrical utilities by the mid-90s • Distribution: 3.5 hours/year • Transmission and sub-transmission: 0.5 hours/year* • Total: 4.0 hours/year	Distribution	PAQS 2: Service Quality Enhancement Program – Distribution System (1989-1995) Application of new design criteria for the underground system Review of priorities of ongoing activities
	Generation, transmission, sub-transmission and telecommunications	PAM: Maintenance Enhancement Program (1989-1996) Implementation of new design and operations criteria for the transmission system (1989-1994) Maintenance of installations nearing the end of their service life System-operation improvement plan
	Support activities	Implementation of the new maintenance policy Implementation and ongoing review of integrated quality-assurance management for procurement R&D on equipment reliability and operating methods

* Excluding general power failures

2.1.1 Distribution System

Present Situation

PAQS 2: Service Quality Enhancement Program – Distribution System (1989-1995)

This program, announced in last year's Development Plan, includes three types of activity:

- renovation of those sections whose level of service continuity is below average, mainly because of age;
- modification of the system to obviate certain safety constraints (addition of grounding equipment, replacement of surge arresters and modifications to facilitate operations on de-energized lines);
- improving the system's operating flexibility (increasing the number of switching points to reduce the number of customers affected by work) and improving component performance.

As part of this program, activities will occur in projects such as the conversion of Montréal and Québec City's outdated underground systems.

A communication program entitled *Hydro-Québec at Your Service* informs the public of system-reliability and service-quality activities that are either scheduled, underway or completed. In addition to explaining these activities, it will also discuss distribution-system improvement work, and enhancement activities conducted on other system components including transmission and generation.

PAQS 2 began in 1989 with various start-up activities, including the hiring of most of the 99 permanent and 117 temporary employees required for the program. A budget of $31 million was allocated to PAQS 2 for 1989. However, with work slowdowns in the context of renegotiation of collective agreements, only $15 million was spent.

Changing the Priorities for Ongoing Activities

Besides launching special programs like PAQS 2 and activities related to the growth in demand for electricity such as the addition of distribution lines and connecting new customers, Hydro-Québec is carrying out other activities associated with maintenance of the overhead and underground systems, rehabilitation of facilities, and distribution-system upgrading. In 1989, capital and operating expenditure for the distribution system amounted to nearly $250 million.

The utility emphasized greater productivity in its ongoing activities in 1989 by revising work priorities to reflect the impact on quality of service and giving priority to the 10 sectors with the highest annual service-interruption time, mainly in the *Richelieu*, *Mauricie* and *Laurentides* regions. It also carried out regional plans of action to solve local problems, such as tree-trimming.

Special reinforcement activities (new underground cables, replacement of overloaded conductors, etc.) were carried out on certain overloaded sections of the system. In 1989, work of this nature cost nearly $83 million, of which $23 million was spent in the *Richelieu* region, mainly on Montréal's South Shore. Moreover, as part of PAQS 2, more than $4 million of reinforcement work was also done, also mainly on the South Shore.

In addition to these prevention activities, the utility improved the efficiency of repairs on de-energized lines.

Average Annual Service-Interruption Time per Customer Originating on the Distribution System

The average service-interruption time per customer caused by problems originating on the distribution system dropped from 8.2 hours for 1988 to 5.2 hours for 1989. The utility's goal for March 1990 (6.1 hours) has thus already been exceeded.

Figure 2.2
Average Annual Customer Service-Interruption Time Originating on the Medium-Voltage Distribution System*
(moving average over 12 months)

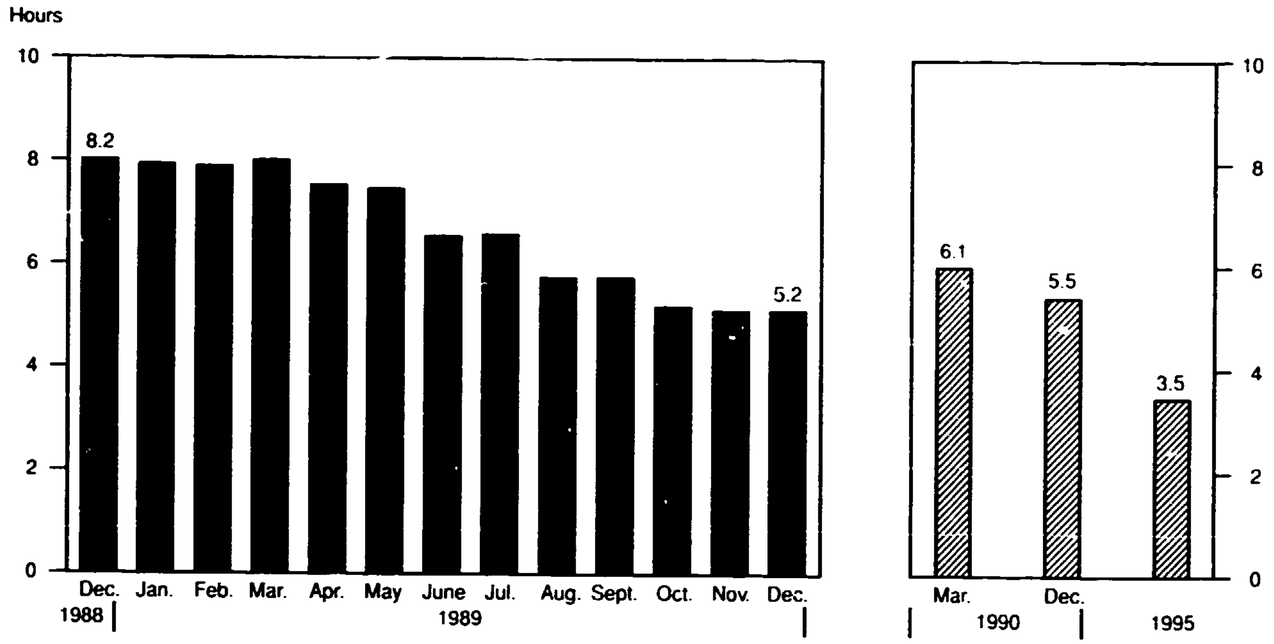
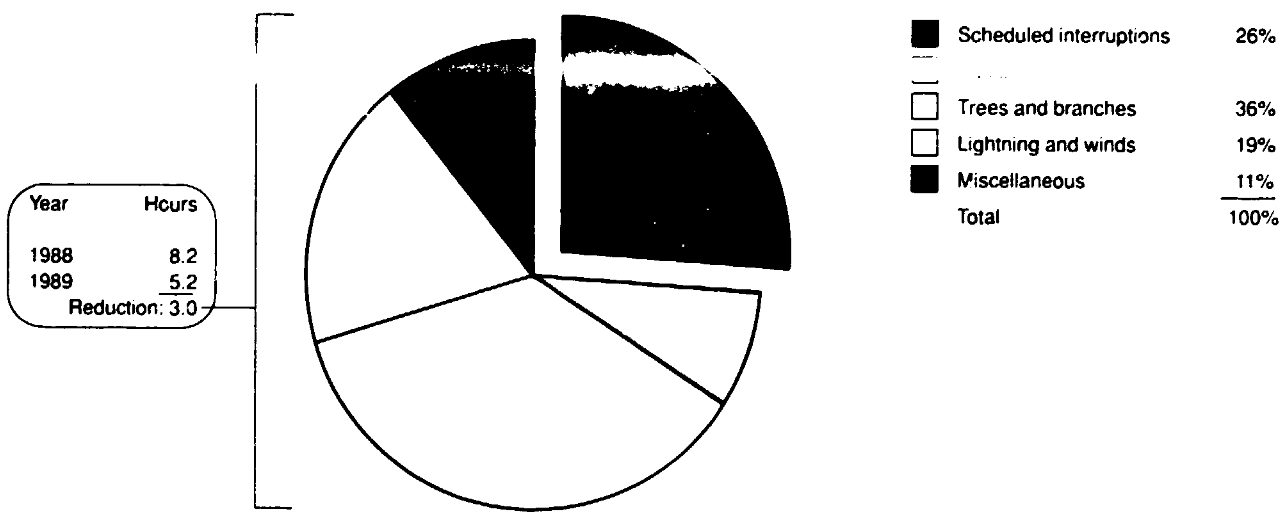


Figure 2.3
Reasons for the Reduction between 1988 and 1989 in Average Annual Customer Service-Interruption Time Originating on the Distribution System



This 3-hour reduction can be broken down as follows:

- 8% attributable to equipment breakdown. The utility has targeted its activities by giving priority to systems used by the highest population densities and in the most overloaded sectors;

- 36% attributable to trees and branches. The tree-trimming budget was increased to $20 million in 1989 and re-allocated according to the needs of the most problematic areas (mainly the *Laurentides* and, to a lesser extent, *Richelieu* and *Saint-Laurent* regions). Moreover, a new formula was used to assign work, involving granting contracts on a fixed cost rather than an hourly basis. This practice has led to improved productivity. Also, the system benefited in 1989 from less unfavorable climatic conditions than in 1987 and 1988;

- 19% attributable to lightning and winds. Besides the more favorable weather conditions of 1989, the replacement under the PAQS 2 program of some existing equipment by more resistant equipment will make the system less vulnerable to extreme climatic conditions;

- 26% attributable to scheduled interruptions. This reduction was due to better planning of repairs on de-energized lines (consolidated maintenance work) and assigning a larger number of crews to a single job. However, some of this reduction is due to the non-completion of work during renewal of the collective agreements;

- 11% attributable to miscellaneous causes, which group together a number of areas such as corrosion and contamination by sea salt.

Future Activities involving the Distribution System

In addition to continuing to assign priorities to ongoing activities, the utility will in coming years carry out the following major programs affecting the distribution system:

Continuation of PAQS 2: Service Quality Enhancement Program – Distribution System (1989-1995)

This program, described above, will cost some $707 million over seven years.

Table 2.2
Financial Commitments of PAQS 2 Program
(capital and operating expenditure)
(in millions of dollars)

Type of activity	1990	1991	1992	1993-1995	Total*
System renovation	41	43	46	154	293
Reliability and safety	9	27	23	18	77
System flexibility	32	30	29	165	261
Training	13	13	12	37	76
Total	95	113	110	374	707

* Including $15 million incurred in 1989.

Application of New Design Criteria for the Underground Distribution System

Built over the last 40 years, the underground system is characterized by a large variety of designs and types of construction, configurations and equipment. This requires the development of various kinds of equipment and poses problems for worker safety. Its design must therefore be revised.

Design orientations were prepared in 1989. They will contribute to improving employee safety and service continuity (average annual service-interruption time per customer and average annual frequency of service interruptions per customer).

Before these new design criteria can be applied, the utility will develop technical guidelines on engineering, standardization and equipment certification. It is expected to take three years to finalize these guidelines. Starting in 1993, they will all be implemented on both the existing and new system. Nevertheless, some guidelines will be available before 1993 and may be used for the modifications required on the existing underground system. Nearly $730 million has been projected as the cost of bringing the existing underground system into conformity with the new criteria from 1993 to 2004. The new criteria will also increase the construction costs of the future system by an average 60%, or by nearly $1 billion from 1993 to 2004.

Remote Control of Lines on the Overhead Distribution System

Remote control of lines on the distribution system will allow procedures to be executed from the distribution control centres. The opening and closing by remote of equipment (circuit breakers) at strategic points on the system will reduce the duration of scheduled maintenance interruptions as less time would be required for repairs; the same procedures will also allow defective line sections to be more rapidly identified during outages, while limiting the number of customers affected. Remote-controlled equipment is planned for installation at 2,200 strategic switching points in urban and semi-urban environments. This project will require investments in the order of $110 million between 1992 and 1994.

2.1.2 Generating, Transmission, Sub-Transmission and Telecommunications Systems

Present Situation

The average annual customer service-interruption time originating from the transmission and sub-transmission system has dropped from 1.8 hours in 1988 to 1.3 hours in 1989 if major power failures are excluded. The major power failure of March 13, 1989, caused by a very intense magnetic storm, lasted on average nearly eight hours. Restoration of power to customers took this long because of equipment breakdowns on the La Grande system, requiring major modifications in the process.

As the result of this power failure, the utility's transmission-system operating practices have been modified to ensure the security of the system during magnetic storms.

Future Activities

PAM: Maintenance Enhancement Program (1989-1996)

This program, which was defined and launched in 1989, contains a series of projects to replace, upgrade, modify and maintain equipment on the generating, transmission, sub-transmission and telecommunications systems. Its goal is to increase the reliability and availability of existing facilities.

For 1990-1992, the utility plans to spend $416 million: $193 million on catching up with maintenance and $223 million to replace and modernize equipment. Nearly $800 million has been projected [illegible]

The final amount will be determined according to the behavior of the system and in light of systematic monitoring of equipment.

Implementation of New Transmission-System Design and Operating Criteria

The increasing use of electricity by the utility's Québec customers makes them more dependent on this source of energy and therefore more demanding in terms of the quality of supply.

To reduce to a minimum the probability of general power failures, in 1984 Hydro-Québec began studies to reevaluate its transmission-system design criteria. This reevaluation however, must be done in conjunction with neighboring systems, given the increasing linkup between them and the Hydro-Québec system.

In the past, when choosing its transmission-system design criteria, Hydro-Québec accepted a higher probability of general power failures than its neighboring systems. The very great distances between the [illegible] is generated and used in Québec make the transmission system more vulnerable to the events that can cause a general power failure. Compensating for this higher probability, however, is the fact that Hydro-Québec's power failures are much shorter in duration than those of neighboring systems. Because Hydro-Québec's generating facilities are almost entirely hydroelectric, the system can be restored to service only a few hours after a general power failure, whereas service restoration on neighboring systems using predominantly thermal-fired facilities may require more than a day.

In view of the expectations of Québec customers and to facilitate the integration of its system with neighboring systems in the Northeast Power Coordinating Council, Hydro-Québec decided to aim to raise the reliability of its transmission system to the same level as neighboring systems by 1994. This implies fundamental modifications to the design and operation of the transmission system. In particular, Hydro-Québec will install series compensators throughout the transmission system and shunt reactors, additional reactive compensation and automatic control devices at various substations.

To achieve this goal, an investment program costing in the order of $1,300 million has been planned. This program covers both Hydro-Québec's projects to harmonize its design and operating practices with those of the Northeast Power Coordinating Council, and the utility's [illegible] upgrade its transmission system. The engineering and procurement activities for all these projects have begun, and the installation of new equipment will continue until 1994. Nearly $140 million was earmarked in 1989 for this program.

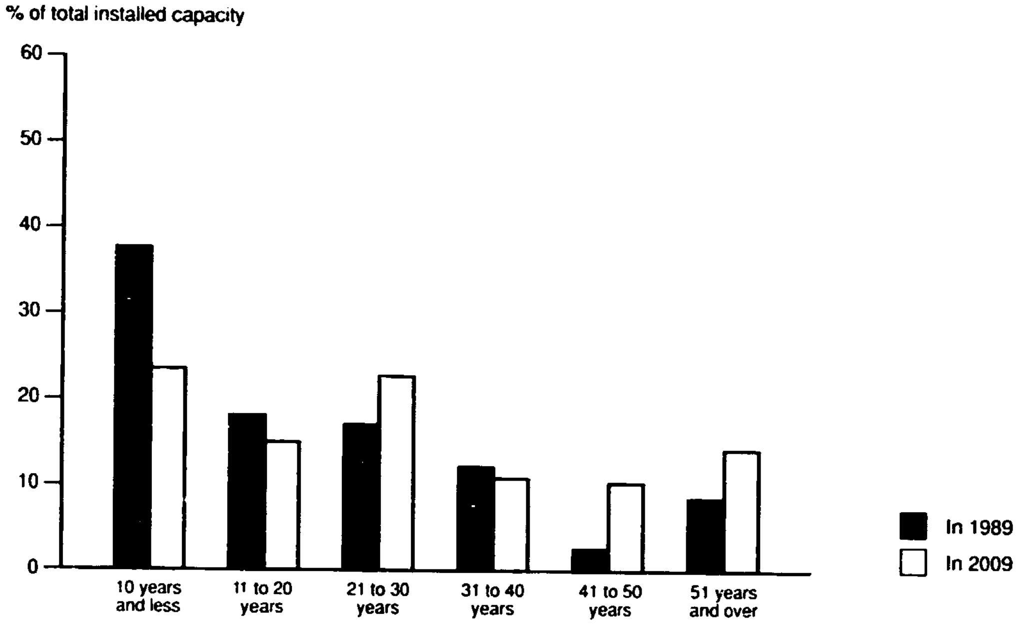
Maintenance of Existing Installations

- Generating Facilities

Spending on the renovation of generating facilities has been relatively low thus far as these facilities are relatively new. In 1989, for example, generating stations more than 50 years old accounted for only 9% of total installed capacity. In the years to come, however, the proportion of generating stations approaching the end of their service life will increase, the proportion more than 50 years old reaching nearly 15% in 2009. Some of these facilities are small and medium sized, with capacity not exceeding 200 megawatts. Maintenance for these installations will require increasing attention from the utility.

In order to keep its installations in good working order, Hydro-Québec is focusing on two major [illegible] habilitation program and major maintenance activities.

Figure 2.4
Age of Hydroelectric Generating Units



In order to ensure the maximum availability of its generating facilities, the utility has developed a master rehabilitation plan. Under this plan, work on upgrading or replacing existing generating facilities will cost in the order of $440 million from 1990 to 1992. A five-year schedule of rehabilitation studies has been prepared to reflect the age of the facility, safety and reliability, environmental impact and the likelihood of the outcome being cost-effective.

In 1989, orientation studies recommended upgrading Beauharnois over a nine-year period, at a cost of $1.2 billion. These studies also recommended upgrading La Gabelle and Drummondville generating stations and decommissioning the small L'Anse Saint-Jean station.

Draft-design studies of rebuilding Les Cèdres generating station continued concurrently with the upgrading study for Beauharnois generating station. Studies of Shawinigan-complex, Grand-Mère, La Tuque and Sept Chutes generataing stations and of a few small power plants (Chute Bell, Métis 1 and 2, Rivière-du-Loup, Pont Arnaud and Chute Garneau) will be completed in 1990. These studies use a comprehensive approach that takes into account various solutions for the rehabilitation, reconstruction and removal from service of generating facilities and equipment.

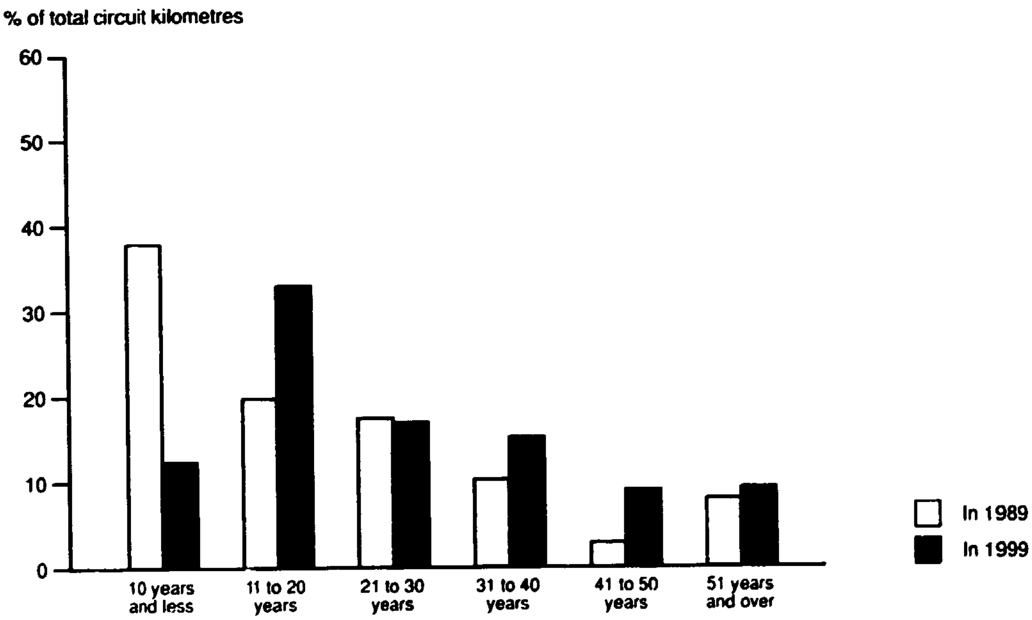
Also, in 1990, new studies of Bryson, Hull 2, Rapide-Blanc and Rivière-des-Prairies generating stations will commence, along with a review of the condition of Tracy thermal generating station to determine its remaining service life.

A total of nearly $475 million will be spent from 1990 to 1992 on major maintenance activities, which mainly involve rebuilding generating units, major work on generators and replacement of turbine runners. The program to replace turbine runners uses new technology to increase efficiency when hydroelectric generating units are upgraded. The program, begun in 1978, aimed to identify units whose rated power could be increased by replacement of their turbine runners. By the end of 1989, an increase of nearly 115 megawatts of power and approximately 200 gigawatthours of energy had been obtained in this way. This replacement program will continue and is expected to result in total gains of 547 megawatts and 400 gigawatthours by 2001, including the upgrading of runners at Manic 5 generating station.

• Transmission System

Although the transmission and sub-transmission system is also relatively new, in the coming years a growing number of components will reach the end of their

Figure 2.5
Age of Circuits - Transmission and Sub-Transmission Lines



service life. In the next seven years, Hydro-Québec will replace certain components of its 735-kilovolt system (insulators, spacers and dampers) on about 2,000 kilometres of circuits of first generation lines (Churchill Falls/Manicouagan/Montréal). This is about 20% of the total length of the 735-kilovolt system. The reliability of automatic-control devices and transmission-system protection systems will also be enhanced by replacing various pieces of equipment. As part of its ongoing maintenance activities, Hydro-Québec expects to spend more than $90 million from 1990 to 1992.

The utility also formed a bank of strategic equipment costing $32 million in 1989 to accelerate replacements in case of equipment breakdown, and will continue to purchase additional equipment (transformers, reactors and circuit breakers) at a cost of nearly $100 million between 1990 and 1992.

System Control and Telecommunications

The principal function of system control centres and equipment is to continuously monitor changes in important system parameters, such as voltage, power and frequency, and to perform the appropriate operations and adjustments depending on fluctuations in demand. This is only possible because of a complex system consisting of the provincial system control centre, regional control centres, distribution control centres, and a telecommunications control centre.

The utility's determination to improve quality of service requires more efficient management of operations that focuses on reducing the risks of power failures, reducing the impact of maintenance on equipment availability, and restoring service more quickly following interruptions.

The plan for upgrading power-system control covers four key sectors:

- real time operation (addition of personnel following the increase in generating capacity at Manic 5 PA and La Grande 2 A, and the addition of monitoring and protection equipment on the transmission system);
- automation of the regional control centres and the system control centre by installing new software;
- technical support for the regions;
- administrative support (adequate staffing, training).

Spending on the principal programs and projects for the development and optimization of the system-control system is estimated at nearly $120 million from 1990 to 1992. Furthermore, in 1989 Hydro-Québec began a study of modernizing the provincial system control centre. This modernization is planned for 1995.

The utility plans to spend about $75 million on the principal telecommunications programs from 1990 to 1992.

2.1.3 Forecasts of Expenditures: Principal Generation, Transmission, Distribution and Telecommunications Programs and Projects

The budgets discussed here are the forecasts for capital and operating expenditures for the principal programs and projects involving the generating, transmission and sub-transmission, distribution and telecommunications systems.

For 1990-1992, financial commitments directly associated with product-quality enhancement are estimated at nearly $1.9 billion.

Between 1989 and 1996, financial commitments directly associated with product-quality enhancement are estimated at nearly $4.2 billion, compared to $2.3 billion between 1989 and 1998 in last year's Development Plan. The difference can be explained mainly by the various major programs that were referred to in last year's Development Plan but not fully costed: first, the Maintenance Enhancement Program, which represents commitments of about $1.2 billion from 1989 to 1996; and then the implementation of the new underground-distribution-system design criteria, to cost some $0.5 billion by 1996.

Table 2.3
Financial Commitments of the Principal Generation, Transmission, Sub-Transmission, Distribution and Telecommunications Programs and Projects
(capital and operating expenditure)
(in millions of dollars)

Programs and projects directly associated with enhanced product quality		1990	1991	1992	1990-1992	1993-1996	Total per project
Distribution	PAQS 2 – Service Quality Enhancement Program	95	113	110	318	374	707 (1989-1995)
	Application of new design criteria to the underground system	3	5	8	16	449	465 (1990-1996)*
	Remote control of lines	3	0	14	17	96	113 (1990-1994)
Generation, transmission and telecommunications	PAM – Maintenance Enhancement Program	93	143	180	416	785	1,208 (1989-1996)
	New design and operations criteria for the transmission system	119	381	423	923	437	1,367 (1989-1994)
	Development and improvement of the telecommunications and system-control systems**	67	78	53	198	143	363 (1989-1996)
Total		380	720	788	1,888	2,284	4,223
Other programs and projects							
Principal maintenance programs for installations nearing the end of their service lives***		262	410	438	1,110		
New maintenance policy (monitoring system)		7	17	19	43		
Health, safety, environment, training		37	26	23	86		

* Program continuing after 1996: the costs shown are for modifications to the existing system and the increase in costs of the future system
** Includes the system-control enhancement plan
*** Includes the master rehabilitation plan, the principal maintenance programs and the bank of strategic equipment

2.1.4 Product-Quality-Enhancement Support Activities

New Maintenance Policy

Hydro-Québec's new approach will make it possible to reduce maintenance activity and thus maintenance costs, and increase equipment availability and thereby improve service continuity.

Experience has shown that it is not always effective to carry out maintenance activities at fixed intervals. From now on, with preventive maintenance based on monitoring, the emphasis will instead be placed on analyzing equipment behavior using sensing devices or sampling. This will enable Hydro-Québec to intervene only when necessary.

Furthermore, the new maintenance policy stresses a system approach, paying as much attention to the status of smaller equipment as to larger facilities where system operation is affected by both.

In order to minimize the impact of equipment unavailable due to maintenance, changes will be made to work organization, including decisions pertaining to scheduling and workshifts, and the introduction of specialized crews.

The utility approved the new maintenance policy in 1989; this calls for the development of automated monitoring systems for generating, transmission and telecommunications equipment, the largest involving monitoring of generating units, circuit breakers and telecommunications equipment. Equipment monitoring projects will cost a total of $125 million by 1996, with $6 million committed in 1989. In 1990, Hydro-Québec will develop the guidelines for implementation of the new policy.

Quality Assurance in Procurement

Quality of service also depends on the quality of the equipment installed on the system. Optimal equipment performance cannot be assured without quality integrated into every phase of the equipment life cycle. In addition to playing a role at the design stage, quality assurance must also be implemented during procurement (certification and standardization, qualification of suppliers, factory testing and acceptance testing). The third stage involves installation, operation and maintenance of equipment as well as systematic evaluation of performance, and feedback to suppliers.

Present Situation

Major progress has already been made in managing quality assurance in the procurement of generating, transmission, sub-transmission and distribution equipment, given their importance in the system and the costs they generate.

There has been an intensification of efforts involving distribution equipment, for which quality assurance measures have been adopted in the last three years. Accordingly, the installation of all major distribution equipment on the system is now governed by a certification process that requires prior laboratory or power-system testing. A revision of quality control procedures upon acceptance has begun in certain regions as well.

Future Activities

For all generating, transmission, sub-transmission and distribution equipment, Hydro-Québec will reinforce reliability by clarifying its expectations of suppliers regarding the quality of purchased products. For manufacturing, Hydro-Québec will stress standardization of its quality control practices among all suppliers of the same kind of equipment and improve its procedures for evaluating both the commercial (on-time delivery, warranty service, after sales service) and technical (compliance with technical and quality-insurance specifications, equipment performance criteria) performance of suppliers. Improving the quality of procured equipment will require improvement of Hydro-Québec's procedures for coordination and consultation between the parties involved, both within the utility and between the utility and outside suppliers.

The utility will implement specific measures affecting generating, transmission, sub-transmission and distribution equipment.

- Generating, transmission and sub-transmission equipment

Quality control practices during manufacture will be standardized for equipment bought for the regions.

- Distribution equipment

Regarding standardization, Hydro-Québec will begin in 1990 to review all specifications for major distribution system equipment. As part of the application of new design criteria for the underground distribution system, equipment will be certified to improve service quality and job safety.

As part of acceptance testing of procured products, the utility will extend the implementation of revised quality control practices to all regions in 1990.

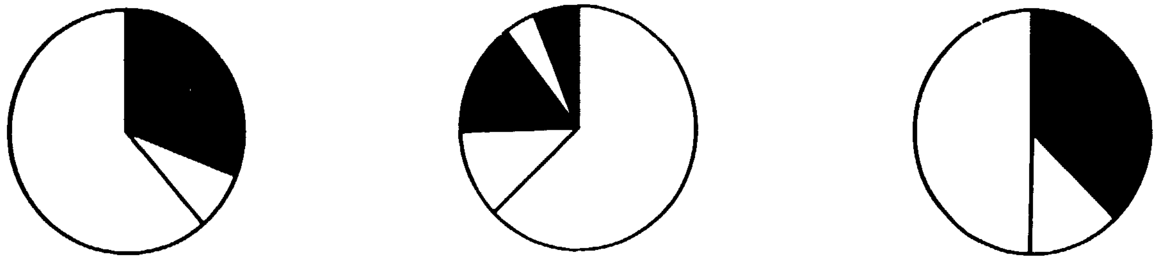
Furthermore, starting in 1990, Hydro-Québec will develop a data collection system to be able to better analyze the performance of major distribution system components.

Technology Supporting Quality of Service

In coming years, R & D will continue to play a crucial role in improving Hydro-Québec's system design, management and operating techniques. A substantial proportion of the R & D activities for generation, transmission and distribution will be focused on improving the productivity and reinforcing the reliability and operating flexibility of equipment. Service quality enhancement alone will account for over three quarters of R & D spending on generation, transmission and distribution from 1990 to 1992, representing $156 million out of a total of $205 million.

Figure 2.6
R & D Goals for Generation, Transmission and Distribution
(in millions of dollars)

Generation | **Transmission** | **Distribution**



Generation

☐ Equipment reliability, durability and productivity	$34.4
■ Design, construction and upgrading of structures	$17.3
☐ Environment	$ 4.3
Total	$56.0

Transmission

☐ Equipment reliability	$ 72.6
☐ System simulation	$ 13.5
■ System monitoring and protection	$ 17.4
☐ Environment	$ 5.2
■ Other	$ 7.1
Total	$115.8

Distribution

☐ Reliability and operating flexibility	$16.8
■ Development of the system	$12.7
☐ Quality of supply	$ 4.2
Total	$33.7

Total expenditure $205 million

Table 2.4
Principal R & D Projects for Generation, Transmission and Distribution (1990-1992)

Area of Activity	Projects
Generation	Continuation of installation of the computerized generating-station control system (SICC) Follow-up of generating-unit behavior: manufacture in 1990 of prototypes of the continuous monitoring system for turbine generators (SUPER)
Transmission	Demonstration of the reliability and performance of high-voltage DC cables (underwater crossing of the Radisson-Nicolet-des Cantons line): tests of cable prototypes and a new 500-kilovolt wall bushing for converter stations Assessment of the prototype line-protection-relay and automatic-control evaluation system (SERA) Simulation of series compensators and appropriate protection systems (new design criteria)
Distribution	Study of the causes of premature deterioration and aging of certain strategic components of the underground system: diagnosis of joints in 1990, review of equipment procurement specifications starting in 1990 Tests of the new explosionproof surge arrester developed by Hydro-Québec

2.2 *Quality of Customer Services*

Hydro-Québec seeks to provide a service that meets the expectations of its customers. To achieve this, specific goals will have to be reached gradually over the next three years. This stage will be followed by other measures intended to make Hydro-Québec one of the best performing electrical utilities.

At this time, surveys indicate that overall customer satisfaction has deteriorated. Levels of 92% in 1985 had declined to 59% in January of 1990.

Surveys and information collected from customers indicate that besides power failures, the major causes of dissatisfaction are the following:

- difficulties experienced by customers in reaching the utility's business offices by telephone;
- customers given insufficient notice of scheduled interruptions;
- a portion of bills are issued on the basis of estimated consumption or are not issued at regular intervals in the absence of readings;
- substantial seasonal variations in size of bills of those customers with electric heating.

In addition, some customers complain that it takes too long for service to be connected.

All activities initiated in 1989, and which will continue for the next few years, focus on these principal causes of customer dissatisfaction and are intended to allow Hydro-Québec to equal the performance of the best electrical utilities.

Objective	Principal Strategies
Enhance customer service quality	Carry out the Service Quality Enhancement Program (PAQS – Clientèle) in order to: • increase the telephone response rate from 73.6% in 1989 to 92% in 1992 • systematically inform customers 24 hours in advance of interruptions scheduled to last more than one hour • increase the rate of billings based on actual readings from 83.5% in 1989 to 96% in 1992 • increase the equalized-payments-plan saturation rate from 9% in 1989 to 35% in 1992 Reduce customer-connection-request response times to meet most of the standard for overhead connections by 1991 and the total standard, including underground connections, by 1992

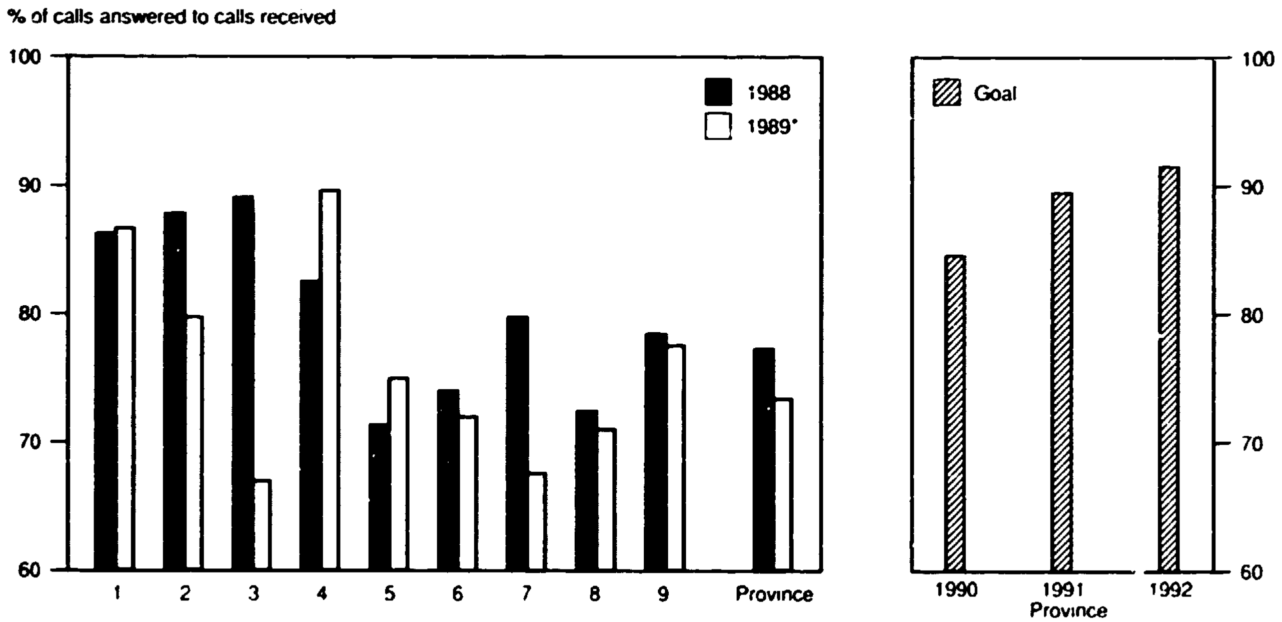
Short- and medium-term activities will focus primarily on the customer service enhancement program, reduced response time for customer connection requests, improved procedures for handling complaints, and modernized collection practices. These activities will require additional resources and better procedures.

PAQS – Clientèle: Service Quality Enhancement Program – Customer Services

Telephone Response Rate

Hydro-Québec measures its performance in this area by determining the proportion of calls answered to calls received.

Figure 2.7
Response Rate to Customer Telephone Calls



1- Manicouagan
2- La Grande
3- Saguenay
4- Matapédia
5- Mauricie
6- Montmorency
7- Richelieu
8- Laurentides
9- Saint-Laurent

*1989 was affected by work slowdowns attributable to the renegotiation of collective agreements

The utility increased the number of employees assigned to these tasks in the *Saint-Laurent*, *Laurentides*, *Montmorency*, *Richelieu* and *Mauricie* regions, which had the lowest response rates in 1988 and 1989 (these five regions account for about 90% of Hydro-Québec's customers).

Throughout the province there has been a decrease in the rate of response, falling from 77.5% in 1988 to 73.6% in 1989. Since additional employees were brought in only in the second half of 1989, the response rate in the first six months of 1989 was relatively unchanged from 1988, being about 77%. The results of the last six months reflect the work slowdowns resulting from the renegotiation of collective agreements. The situation worsened in almost all regions.

> In the short term, Hydro-Québec's goal is to raise the response rate to:
> 85% in 1990
> 90% in 1991
> 92% in 1992

In 1990, Hydro-Québec will complete the installation of a more efficient telephone system in the *Saint-Laurent* region, providing faster access to business offices for customers on the Island of Montréal. Over the medium term, the utility will also revise the work schedules of employees assigned to customer services and introduce new software to acquire and update data on line from customer records.

The other activities under the PAQS – Clientèle program, discussed below, will also help improve the response rate. Increased customer satisfaction should reduce the number of calls received.

Customer Notification of Scheduled Interruptions

Information is one means of reducing the dissatisfaction of customers affected by scheduled interruptions, which are required in order to carry out distribution-system enhancements under safe conditions. Hydro-Québec is currently using various methods (media, written notifications, etc.) to alert the largest possible number of customers to scheduled interruptions.

In 1989, to increase the number of customers reached, the utility ran a successful pilot project in the *Laurentides* region using a voice messaging system, which sends pre-recorded telephone messages to customers informing them of work liable to cause service interruptions.

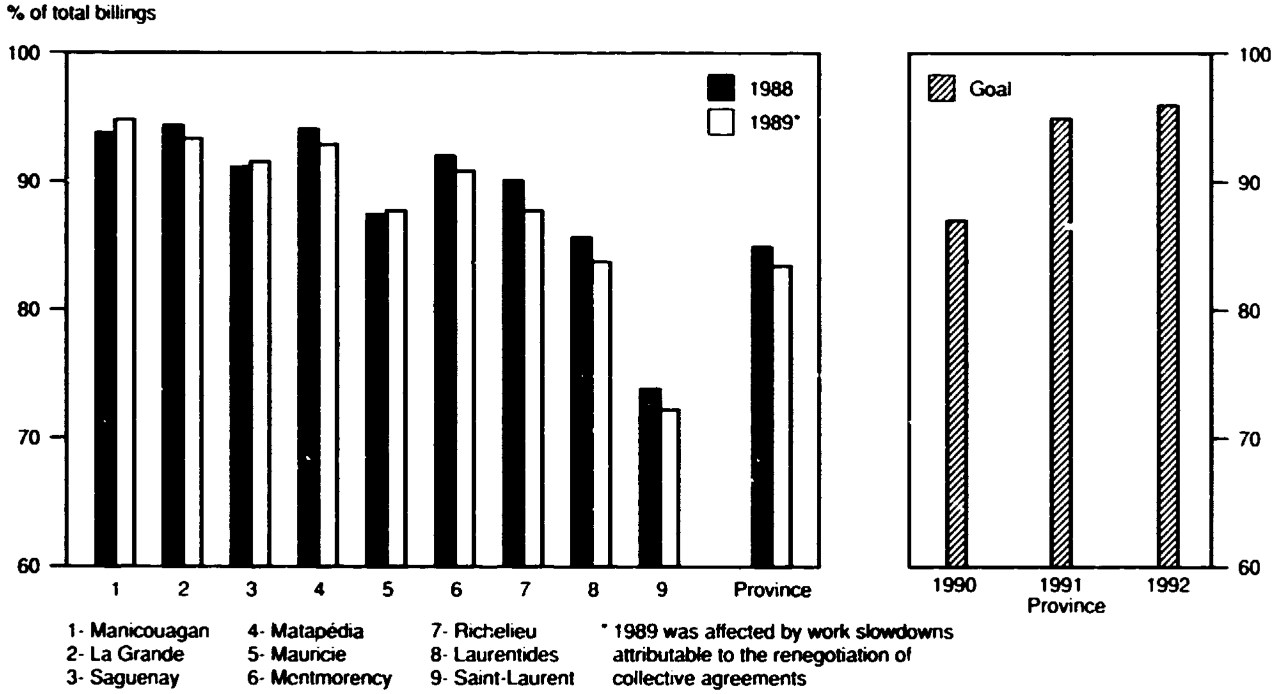
> In 1990, Hydro-Québec intends to systematically inform its customers, 24 hours in advance, of interruptions scheduled to last more than one hour.

The utility will introduce the voice messaging system into all regions in 1990.

Increase in the Number of Bills Based on Actual Meter Readings

Efforts to increase the number of bills based on an actual meter reading encounter two main problems. First, nearly 300,000 meters in Québec are simply hard to get at. This includes about 150,000 meters on the Island of Montréal. More time off for training and intensified measures to improve health and safety have also reduced the real work time of meter readers. In order to reach a new balance between staff levels and the work load, the utility has added appropriate personnel in all regions.

Figure 2.8
Rate of Billings Based on Actual Meter Readings



In the province generally, there has been a reduction in the rate of billings based on actual meter readings from 85% in 1988 to 83.5% in 1989, in spite of an increase during the first six months of 1989. In fact, the rate of billing based on actual meter readings had improved from 85% in 1988 to 87% for the first six months of 1989. However, the results for the last six months of the year reflect work slowdowns due to renegotiation of collective agreements.

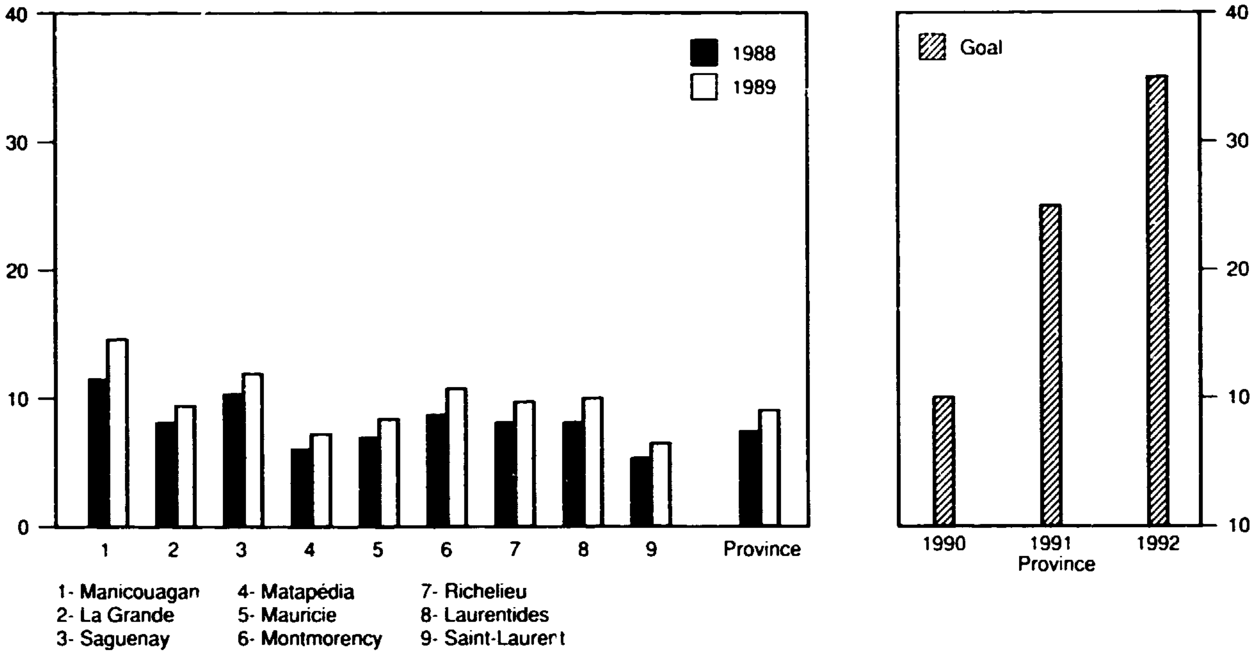
In the short term, Hydro-Québec's goal is to obtain a rate of billings based on actual meter readings of:
87% in 1990
95% in 1991
96% in 1992

Between 1990 and 1992, Hydro-Québec will install 100,000 devices on the Island of Montréal using telephone lines to facilitate readings from meters that are difficult to reach, at a cost of nearly $45 million. The remote-reading devices will also improve productivity.

Variability of Bills

To deal with the seasonal variability of bills, the utility offers an equalized payments plan, revised on a six-month basis. Hydro-Québec is planning to extend this plan to a larger portion of its residential and commercial customers, while improving its operation. At the same time, the utility has tested an accompanying automatic debit option with a target group of customers in the Shawinigan region.

Figure 2.9
Saturation Rate of Equalized Payments Plan



In the short term, Hydro-Québec's goal is to achieve saturation by the equalized payments plan of:
10% in 1990
25% in 1991
35% in 1992

Marketing the equalized payments plan to a target group of customers in the Montréal region will begin in early 1990. The utility will then expand its marketing of equalized payments to all regions by the end of 1990 and begin to market automatic debits in 1991.

The following table shows the financial commitments for PAQS – Clientèle based on the evaluation carried out in 1989.

Table 2.5
Financial Commitments to Enhance the Quality of Customer Service
(capital and operating expenditure)
(in millions of dollars)

	1990	1991	1992	Total 1990-1992*
PAQS – Clientèle	20	41	2	63*
Other activities (connections, stray voltages, collection procedures, etc.)	5	4	1	10
Total	25	45	3	73

* In addition to this amount, $4 million was spent in 1989.

Reduction in Response Time to Customer Connection Requests

A proposal for a standard specifying corporate objectives on customer connection requests was prepared in 1989. This standard sets a time for carrying out each type of request:

- 7 days for an overhead connection of 120/240 volts, 200 amperes or less without any system modification;
- 40 days for a low-voltage overhead connection requiring system extension or modification;
- 10 days for an underground connection of 120/240 volts, 200 amperes or less without any system modification;
- 70 days for a low-voltage underground connection requiring system extension or modification.

Hydro-Québec has also improved its follow-up system which oversees the progress of connection projects and provides a uniform measurement of completion times.

Hydro-Québec will gradually reduce customer connection times to meet most of the standard by 1991, for overhead connections and the entire standard, including underground connections, by 1992.

Additional Measures for Better Customer Relations

Customer Complaints Procedure

In January 1989, Hydro-Québec established a formal procedure for handling complaints from all its customers. This procedure allows customers to be heard at three levels of appeal: the sector manager, regional vice president, and president and chief operating officer. Moreover, in 1989, it also set up a complaints management office, reporting to a vice president at head office, for the corporate management of customer complaints. The utility has also added specialized resources to process complaints in business offices serving large numbers of customers.

5,202 complaints were received by Hydro-Québec in 1989. Most of these complaints concerned problems in contacting certain business offices, and commercial practices and billing procedures. In 1989, average complaints-processing time was 18 working days. However, complaints regarding billing procedures, debt collection and commercial practices currently take much longer than average and this situation will be addressed in 1990.

The *Act concerning the treatment of complaints from the customers of electricity distributors* came into force on September 1, 1989. It allows customers who use electricity for residential purposes to apply to a complaints commissioner, appointed by the Québec government and not answerable to Hydro-Québec, for assistance in settling disputes with Hydro-Québec.

Implementation of the Service Quality Enhancement Program - Customer Services (PAQS - Clientèle) and the efforts deployed to upgrade the power system should also help reduce the number of complaints.

Modernization of Collection Practices

The greater penetration of the equalized payments plan should facilitate the payment of bills, especially in winter.

The financial losses experienced by Hydro-Québec from unpaid accounts are ultimately borne by all customers. In order to keep the amounts in arrears from becoming inordinately large, the utility will start the collection process earlier. And, in certain instances, more flexible payment formulas will be tried. In 1990, a pilot project in the *Saint-Laurent* region will test revised collection procedures, including spreading the payment of some overdue accounts over 12 months. Implementation of this new procedure throughout the province will depend on test results.

Program to Assist Farmers in Reducing Stray Voltages

Hydro-Québec will contribute up to $250 per farm towards an evaluation of electrical installations on farms, to assist in the correction of faulty equipment. This program, initiated by the Québec *ministère de l'Énergie et des Ressources*, will initially be limited to dairy and hog farms, under an agreement with the Québec *ministère de l'Agriculture, des Pêcheries et de l'Alimentation*, but will be extended to other producers once the causes of the problems and their possible solutions have been identified.

Furthermore, Hydro-Québec will participate with the Canadian Electrical Association in preparing a national protocol for measuring the power quality of distribution systems and their effect on the operation of electronic and other equipment owned by customers. Power quality is a concern shared by all Canadian electrical utilities.

2.3 Work Organization, Human Resources and Productivity in Support of Quality of Service

To meet challenges such as better quality of service, Hydro-Québec will need the total support of all its employees and will work with them to determine the conditions under which these key objectives are attained. Improving the organization of work and providing more training and improved tools are essential to achieving these objectives.

The mobilization of human resources, one of the utility's major concerns, is discussed in Chapter 5 of this Development Plan. Here, only the aspects of training, staffing, work organization and technical improvements directly associated with quality of service are discussed.

The amount of work involved in maintaining an expanding generating system – including installations nearing the end of their service lives that must be updated to improve reliability – will require continuing productivity gains if costs are to be controlled in the long term. The same applies to marketing activities, where the number of customers is increasing and catching-up is also required to achieve better quality of service.

Major gains in productivity have already been achieved in recent years by strategic activities affecting supply, demand and resource rationalization. Now the utility must increase its efforts with respect to human-resources management and work organization. A number of measures in this area have already been introduced and others will be introduced shortly.

2.3.1 Generating, Transmission, Sub-Transmission, Distribution and Telecommunications Activities

Training and Staffing

In activities specifically involving generating, transmission, sub-transmission, distribution and telecommunications, the utility will intensify training of supervisory managers. To deal with the loss of operators through retirement, a special technical training plan will train the next generation of system-control operators, while the creation of regional trainer positions for the distribution system will help improve employee skills, given the growing technical requirements in this area.

Work Organization

The utility has adopted the following priorities:

- when negotiating collective agreements, clarify the provisions involving the exercise of the right to refuse to work for health or safety reasons and the sharing of work between in-house resources and subcontractors, issues currently creating major obstacles to improved productivity;

- add evening shifts to complete work on the Montréal underground distribution system, where automobile traffic constraints substantially reduce available work time. Create a second shift to shorten generating equipment maintenance time;

- improve the quality of supervision by redefining the foreman's role in planning, organization, coordination and control of tasks and provide the support and tools needed for these tasks to be carried out effectively;

- increase the productivity of transmission and distribution line workers and splicers by 30% by 1992;

- implent new maintenance policy guidelines;

- contract out tree-trimming at fixed-price rather than hourly-rate contracts, thereby promoting increased productivity.

Technical Improvements

Certain technical improvements contribute to increased short-term efficiency. These include the implementation during 1990 of computerized systems for planning and generating, transmission, sub-transmission and telecommunications work, and systems for scheduling and follow-up of distribution work.

In the longer term, large gains will result from R & D on generation, transmission and distribution, including development of remote control of distribution lines, expert systems, automatic systems for installations monitoring, and robotics.

2.3.2 Customer Services

Training and Staffing

Permanent and temporary positions of trainers have been added in the regions to satisfy the training needs of the Service Quality Enhancement Program – Customer Services. Among other training-related activities are the development of in-service training programs and classroom training to meet the requirements of certain jobs.

The outside hiring process will also be revised to ensure the quality of candidates and better evaluate their capacity for development.

Work Organization

To better respond to customers during peak periods for telephone calls, Hydro-Québec will restructure certain work schedules, and merge certain positions. Furthermore, the utility will seek to relax procedures for filling temporary positions to allow employees already trained in a particular field to receive priority assignment to temporary positions in that field.

Technical Improvements

Various improvements in tools will translate into productivity gains. These include remote reading of hard-to-get-at meters and the installation of a computer system allowing service representatives on-line access to customer files. These short- and medium-term activities will constitute the first stage of enhancement of customer-service quality. To make further gains and to improve productivity, the utility will evaluate new technologies available. One study will evaluate the feasibility and usefulness of electronic communications to be more accessible to customers, making it possible for a larger number of customers to receive information during and after business hours on service interruptions affecting them. Interactive voice-messaging systems would make it possible for customers to report meter readings and inform

Hydro-Québec of any changes in their file. Moreover, the use of general-public videotex systems would allow customers to obtain or provide information and submit requests.

2.4 Conclusion

All these steps should lead to better performance in quality of service. However, a prior condition to the successful realization of the objectives outlined in the Development Plan is the setting-up and implementation of negotiated agreements with unionized personnel, which will form the basis of a new consensus on quality of service, productivity and individual aspirations.

In addition, these steps will require a significant increase in human, material and financial resources. While this will mean an increase in the costs of supply, there will be a very marked improvement in quality of service at all levels by the middle of 1990:

- a transmission system that meets the most stringent criteria in North America, with a minimum probability of major power failure;
- a distribution system whose reliability is on a par with Canadian systems facing similar climatic conditions, resulting in a 50% reduction in interruptions;
- improved customer services to cut to a minimum present causes of dissatisfaction.

Table 2.6
Financial Commitments Directly Associated with Service Quality Enhancement
(capital and operating expenditure)
(in millions of dollars)

	1990	1991	1992	Total 1990-1992
Product Quality	380	720	788	1,888
Customer service quality	25	45	3	73
Technology	52	63	41	156
Total	457	828	832	2,117
including:				
- Capital expenditure	321	645	682	1,648
- Operating expenditure	136	183	150	469

3

SUPPLY AND DEMAND

3.1 Hydro-Québec and Sustainable Development

Various scenarios of economic and demographic growth in Québec, as well as the provincial government's Energy Policy, are used to determine Québec's energy needs. Hydro-Québec's mandate is to meet this demand for electricity. To do this, it must have the flexibility to optimize the comparative advantage that hydroelectricity constitutes for Québec in accordance with the principle of sustainable development.

In 1987, the World Commission on Environment and Development completed work that had started in 1984 and published its final report, ***Our Common Future***, which proposed adoption of the principle of sustainable development. The Commission concluded that reducing energy consumption had to be the first method of achieving sustainable development. This is as true for industrialized nations, which must adopt a way of life that respects the planet's ecological limitations, as it is for developing countries, which have tremendous energy needs. Participants in the 14th Congress of the World Energy Conference, held in Montréal in September 1989, expressed their support for these principles.

Following in the footsteps of the federal and Québec governments, Hydro-Québec adopted the principle of sustainable development in 1988 and announced its decision in last year's Development Plan. Hydro-Québec's first contribution to the realization of sustainable development is to promote energy conservation, whatever the demand scenario. Energy conservation is cost-effective for customers, and its integration into strategic planning enables the utility to adapt its Installations Plan and tailor it to Québec's real needs.

Hydro-Québec aims for substantial and realistic energy savings, which must be supported by a rates structure that reflects the cost of supply in order to encourage the rational use of electricity.

The substantial additional revenue generated from the sale of surplus electricity on the Canadian and U.S. markets will benefit all Québecers.

The electricity generated at new facilities brought forward to meet export needs will later be used, when those contracts expire, to meet needs in Québec. In the overall scheme of environmental concerns, the export of hydroelectric energy to neighboring systems could reduce acid rain and the greenhouse effect, which are partly caused by the thermal generating stations operated by these systems. And interconnections developed in this way could bring into Québec energy from neighboring systems, thus reducing the need to build new plant for peak demand.

Québec's economic development over the coming years will partly depend on the long-term availability of a reliable, stable source of energy. Given current concerns about atmospheric pollution and nuclear-waste management, hydroelectricity is a precious asset for Québec.

The province's small and large rivers offer an undeveloped potential of 50,000 megawatts. Studies to date have determined that 18,800 megawatts of this total is economically viable when compared with other generating options such as oil-fired, coal-fired or nuclear plants. Were all this economically viable potential developed, the utility's installations would occupy 2% of Québec in the next century, versus 1% today.

In this Development Plan, Hydro-Québec presents various hydroelectric project proposals, including the Grande Baleine complex, which will meet additional needs towards the end of the century, and the Nottaway-Broadback-Rupert complex, which will meet the needs after the turn of the century.

Sustainable development can be achieved only if companies such as Hydro-Québec incorporate environmental protection and enhancement into their operations, and if they plan their activities on the basis of the environment's ability to support long-term economic development.

It is with this in mind that Hydro-Québec carries out its preliminary studies, impact-assessment studies and environmental evaluations. Moreover, the study of cumulative environmental effects has enabled the utility to analyze the main issues relating to its Installations Plan.

Initial results of the study of cumulative environmental effects show that these developments will not have major effects on the climate, underground water tables, wildlife habitat and resources, and estuarine environments. This first conclusion takes into account the fact that each project will receive a rigorous impact-assessment study and appropriate mitigative measures. Nevertheless, interactions between resources and their users mean that these projects are likely to have significant cumulative effects in three areas of the human environment: organization and structure of the area, regional economies and local lifestyles. Mitigating and managing these effects are possible through an enlarged implementation strategy, focusing on increased collaboration with communities affected, with other land users, and with land-use and resource planners and developers.

Accordingly, in the context of the *Commission parlementaire sur la situation et les perspectives de l'énergie électrique au Québec*, Hydro-Québec welcomes the opportunity for dialogue with government and other interested parties to determine both the market-development choices and the consensus on the advisability of developing the economically and environmentally viable 18,800 megawatts.

3.2 Demand for Electricity in Québec

3.2.1 The Year 1989

In 1989, sales of firm electricity in Québec grew by 7.8 terawatthours, or 6.5% more than in 1988. However, when sales are adjusted to reflect such factors as the weather and strikes in the industrial sector, the rate of growth is closer to 4.6% (5.5 terawatthours), as forecast in last year's Development Plan. This increase is one in a series of years of strong growth of firm electricity sales in Québec, totalling 44 terawatthours, or 52.7% since 1982. Growth in demand in 1989 remains nevertheless moderate compared to the increase in sales recorded in 1988 (9.4 terawatthours).

The greatest portion of the growth comes from the residential and farm, general and institutional sectors, due mainly to the demand for all electric and dual-energy heating. The all-electric heating market posted growth of more than 2.8 terawatthours, or 36% of firm Québec sales, mainly in the residential sector, with 48,000 housing starts in 1989. Although this reflects slowing new construction, growth in consumption of electric heating is still being carried by the housing starts of 1988 (58,000).

Dual-energy programs continue to be a major source of growth, contributing 1.6 terawatthours or 21% of the increase in demand in 1989. The dual-energy program in the commercial, institutional and industrial sector accounts for almost all of the increase. Although this program ended in June 1988, customer connections carried out in 1989 pushed sales of dual-energy heating to their current level.

The 3.9-terawatthour increase in 1989 in the residential and farm sector must, however, be placed in perspective. If extraordinary events are factored in, the 1989 increase is about 1.5 terawatthours, compared to adjusted growth in 1988 of 3 terawatthours. The particularly cold spell at the end of 1989 alone accounts for 1.8 terawatthours of the increase recorded in this sector.

Consumption of electricity in the industrial sector posted a rather modest increase of 1.7 terawatthours in 1989 or 22% of increased demand, after the strong rise of more than 3.0 terawatthours recorded in 1988. Production levels remained high, especially in industries that are heavy consumers of electricity, while consumption by other industries showed signs of weakening.

Two industrial sectors stand out: pulp and paper, where continued modernization helped increase electricity consumption by 0.3 terawatthours, in spite of a drop in newsprint output, and smelting and refining, where the level of aluminum production stabilized. Moreover, a new sector, magnesium, began to make itself felt.

Although sales of firm electricity increased by 7.8 terawatthours in 1989, the almost total halt in sales of surplus energy by the utility explains why total sales of electricity in Québec fell by 0.6 terawatthours compared to 1988.

Table 3.1
Sales of Electricity by Hydro-Québec in Québec – Average Scenario
(in terawatthours)

	1988	1989	Growth	1990	1991	1992	1996	1999	2006
Residential and farm sector	43.7	47.6**	3.9	46.8	47.0	47.5	49.7	50.6	53.0
General and institutional sector	26.6	28.8	2.2	26.5	29.0	29.4	30.5	31.8	35.0
Industrial sector	44.8	46.5	1.7	48.0	53.4	57.5	69.7	77.0	84.7
Other	4.7	4.7	0.0	4.9	4.9	4.9	5.3	5.7	6.5
Sales of firm electricity in Québec made up of:	119.8	127.6**	7.8	126.2	134.2	139.4	155.1	165.1	179.3
• residential dual energy	0.7	0.8	0.1	1.0	1.2	1.4	1.4	1.4	1.3
• CII dual energy*	3.3	4.9	1.5	1.4	4.1	4.1	3.8	3.7	3.3
• electrotechnologies	0.4	0.9	0.4	1.4	1.6	1.8	3.1	4.2	5.7
Sales of surplus electricity in Québec	8.7	0.3	-8.4	0	0	0	0	0	0
Sales in Québec	128.5	127.8	-0.6	126.2	134.2	139.4	155.1	165.1	179.3

* Commercial, institutional and industrial dual energy.
** Cold weather in late 1989 alone accounts for 1.8 terawatthours of the increase in the residential and farm sector, or 2.2 terawatthours for all firm-electricity sales in Québec.

3.2.2 The Long Term

Average-Demand Scenario

Gross demand for firm electricity in Québec will grow on average by 2.6% between 1989 and 2006, to reach nearly 200 terawatthours. Taking into account the impact of energy conservation, growth in sales of firm electricity in Québec will be 2.0% between 1989 and 2006 in the average-demand scenario. Energy conservation reduces needs for firm electricity by nearly 19 terawatthours, or 10%, giving total sales of 179.3 terawatthours in 2006. On the 1999 horizon, counting on energy conservation of 12.9 terawatthours, or just over 7% of sales, total sales will reach 165.1 terawatthours.

Energy conservation has two components: natural efficiency and efficiency promoted by Hydro-Québec's action programs and rates.

Natural efficiency, the first component of energy conservation, comes about when the various economic agents change their consumption of electricity, independent of any special energy-conservation incentive. It requires only minimal intervention on the part of Hydro-Québec or government but it does however require the continuation of past efforts. Natural efficiency affects heating and consumption by household appliances in the residential and farm sector, as well as captive and competitive uses in the general and institutional sector. The penetration of new heating techniques, such as heat pumps, improved insulation during renovation and the replacement of old appliances all tend to reduce the consumption of electricity. The efficiency gained from this source is estimated to be 3.9 terawatthours in 1999 compared to 1989.

Indeed, an evaluation of natural efficiency in the industrial sector was implicitly included in demand forecasts. Some new production techniques consume less electricity. For example, the new aluminum smelters consume 15% less per tonne than older facilities. On the other hand, some new production techniques consume more electricity. In the pulp and paper industry, for example, new processes which conserve wood fibre can consume twice as much electricity as old ones. Moreover, Québec industry in general is more electrified, partly due to electrotechnologies, partly due to investments in pollution-control equipment, but the scale of this phenomenon remains difficult to quantify.

Energy conservation stimulated by Hydro-Québec's rates structure and programs is the second component of reduced demand. A number of price signals will be sent to customers in coming years: increases in electricity rates that exceed inflation, the federal tax on goods and services charged to residential customers, and reduction of cross-subsidization among various customer categories. Hydro-Québec will also introduce special programs to promote energy conservation in all sectors. These programs and the price signals will mutually reinforce each other over the next few years and should result in more efficient use of and reduced demand for electricity (9.0 terawatthours in 1999). Energy-conservation programs are discussed in detail in section 3.4.

In addition to energy conservation, demand forecasts reflect a number of significant new elements compared to last year. By 1996, new aluminum smelters will require 850 megawatts (5.2 terawatthours) more than forecast in last year's Development Plan. Aluminum smelters supplied by Hydro-Québec will consume nearly 2,300 megawatts (18.3 terawatthours) in this horizon; with Alcan and Canadian Reynolds Metals, the total will exceed 4,000 megawatts. Moreover, an upward revision in the number of new households (an additional 112,000), reflecting a change in the number of households for 1986, and a forecast of higher net immigration, add 2.0 terawatthours to forecasts for 2006.

On the other hand, dual-energy sales in the commercial, institutional and industrial sector have been revised downward. A detailed analysis of competition from other sources of energy has accelerated the projections of long-term erosion of this market. And the temporary halt to this program, as a result of low runoff, will allow the buyback of nearly 4.0 terawatthours of energy in 1990.

Demand forecasts are influenced in the short term by the economic situation. Québec's economy entered a slowdown in 1989, with real growth in the gross domestic product (GDP) of 2.2%, compared to 5.4% in 1988. This slowdown should continue. The average-growth scenario assumes a real increase in the GDP of 1.7% in 1990 and 2.2% in 1991. Lower consumption by individuals and reduced residential investments account for most of this change. However, non-residential investment will support economic growth during these years.

In conclusion, in the average-demand scenario, growth in demand for electricity in Québec will average 2.8% between 1989 and 1996, and 1.5% between 1996 and 2006. This represents a 2.0% growth for the total period 1989 to 2006.

A detailed description of the assumptions involved in the demand forecast is presented in a separate publication entitled *Electricity Demand in Québec*.

Table 3.2
Average Annual Growth of Firm-Electricity Sales in Québec – Average Scenario (in %)

	1989-1996	1996-2006	1989-2006
Residential and farm sector	0.6	0.6	0.6
General and institutional sector	0.8	1.4	1.2
Industrial sector	5.9	2.0	3.6
Other	1.8	2.1	1.9
Firm sales in Québec made up of:	2.8	1.5	2.0
• residential dual energy	8.3	-1.2	2.6
• CII dual energy*	-3.5	-1.6	-2.4
• electrotechnologies	20.2	6.3	11.8

* Commercial, institutional and industrial dual energy.

Uncertainties

The scenarios of strong and weak demand, based mainly on opposing hypotheses of demographic and economic growth, flank the average demand scenario. In the strong-demand scenario, demand in Québec increases at an average annual rate of 2.6% between 1989 and 2006, while the weak-demand scenario is based on average growth of 1.1%.

The strong-demand scenario incorporates more energy conservation than the average-growth scenario because pressure on the costs of supplying electricity to meet strong demand would systematically raise the rates, thus increasing the potential for energy conservation. So special programs and rates could generate 15.5 terawatthours of savings on the 1999 horizon.

In the weak-demand scenario, energy conservation is less present because of lower supply costs and weaker demand, and energy savings would be 7.4 terawatt-hours on the 1999 horizon.

Figure 3.1
Scenarios of Evolution of Firm Electricity Sales by Hydro-Québec in Québec

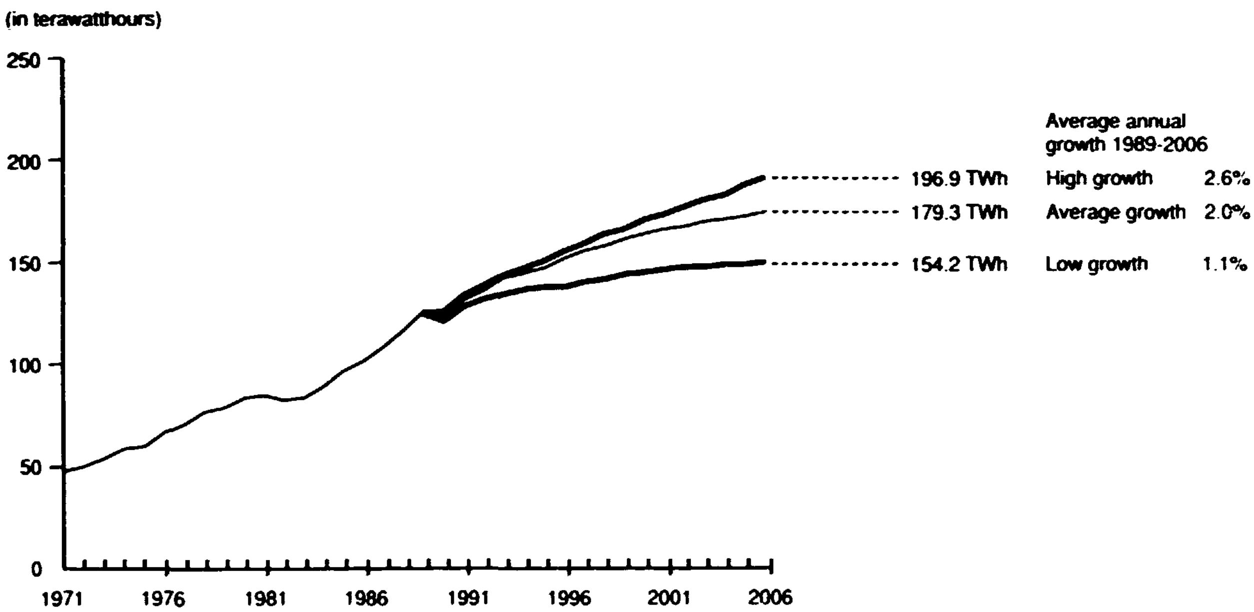


Table 3.3
Average Annual Growth Rate of Demographic and Economic Indicators in Québec
(in %)

	Strong-Demand Scenario		Average Scenario		Weak-Demand Scenario	
	1989-1996	1996-2006	1989-1996	1996-2006	1989-1996	1996-2006
New households	2.1	1.5	1.7	1.1	1.2	0.6
Total GDP*	3.1	2.9	2.6	2.3	1.6	1.6
GDP* of the manufacturing sector	3.3	2.9	2.6	2.2	1.4	1.4
GDP* of the service sector	3.2	2.9	2.7	2.4	1.9	1.8

* Gross domestic product in constant 1981 dollars

Variations in the consumption of electricity can cause reality to diverge from long-term planning scenarios for relatively long periods in all three sectors of consumption.

In the residential and farm sector, demand for electricity could be higher than forecast if the rate of conversion from fuel oil to electricity continues to be fast. Conversely, the use of more efficient household appliances could accelerate. The federal tax on goods and services could cause a major shift away from forecast behavior. And average electricity demand for home heating might also develop differently as residential customers change their consumption patterns.

The general and institutional sector could experience lower consumption of electricity than in the average-demand scenario if penetration by heat pumps is higher. However, potential modifications to ventilation standards for office buildings and commercial premises would increase electricity demand.

Consumption by the industrial sector could be affected by the timing and rate of start-up of large-power industries. The nature and rate of anti-pollution investments and electricity-intensive industrial processes could also increase demand.

Given these uncertainties, Hydro-Québec must have a great deal of flexibility in its methods of adapting to supply and demand fluctuations.

Table 3.4
Firm-Electricity Needs To Be Met
(in terawatthours)

	1988	1989	1990	1991	1992	1996	1999	2006
Strong-Demand Scenario								
Firm-electricity sales in Québec	119.8	127.6	128.3	136.7	141.5	159.3	170.7	196.9
Needs to be met*	163.7	157.0	158.9	169.2	174.5	196.1	211.9	246.2
Average Scenario								
Sales of firm electricity in Québec	119.8	127.6	126.2	134.2	139.4	155.2	165.1	179.3
Sale of surplus electricity in Québec	8.7	0.3	0	0	0	0	0	0
Deliveries as per agreement in Québec**	4.1	5.5	4.7	4.4	4.3	4.2	3.1	3.1
Export sales of firm electricity	9.2	8.8	11.6	12.6	12.8	15.2	19.3	24.5
Export sales of surplus electricity	7.7	0.9	0	0	0	0	0	0
Total deliveries	149.5	143.1	142.4	151.2	156.5	174.5	187.5	206.9
Electrical losses relative to these sales	14.2	14.1	14.3	15.1	15.6	17.1	18.3	20.0
Needs to be met	163.7	157.0	156.7	166.4	172.0	191.6	205.8	226.9
Weak-Demand Scenario								
Sales of firm electricity in Québec	119.8	127.6	124.7	131.7	135.3	142.3	147.6	154.2
Needs to be met*	163.7	157.0	155.1	163.5	167.6	177.5	186.5	199.2

* Deliveries as per agreement and export sales of firm electricity are identical to those in the average scenario.
** Deliveries as per agreement includes the electricity that Hydro-Québec supplies for compensation other than payment.

Power Needs of the Average-Demand Scenario

Priority power requirements correspond to the annual peak demand on Hydro-Québec's system. This projected demand is 35,300 megawatts in 1999 and 38,550 megawatts in 2006, for an average annual growth rate of 2.1% between 1989 and 2006.

This forecast takes into account integrated measures that will reduce demand by about 4,130 megawatts in 1999. They include peak shaving of dual-energy systems and the impact of energy-conservation programs on power demand. Moreover, with respect to industrial markets, in 1996 the utility will have 1,200 megawatts of potential interruptible power to meet peak demand. These management measures will total more than 5,300 megawatts in 1999 and 6,000 megawatts in 2006, or more than 16% of needs to be met.

Table 3.5
Impact of Management Measures and Energy Conservation on Power Needs – Average Scenario
(in megawatts)

	1988**	1989	1990	1991	1992	1996	1999	2006
Peak-demand management measures								
Dual-energy peak shaving	1,700	1,810	1,890	2,060	2,190	2,060	1,990	1,830
Impact of direct measures and rates on energy conservation	0	0	0	460	670	1,590	2,140	3,020
Total	1,700	1,810	1,890	2,520	2,860	3,650	4,130	4,850
Priority needs*	26,466	27,045***	29,070	29,750	31,010	33,440	35,330	38,550
Peak-demand management measures								
Interruptible power	675	783	850	1,000	1,050	1,200	1,200	1,200
Needs to be met	25,791	26,262	28,220	28,750	29,960	32,240	34,130	37,350

* Includes dual-energy peak shaving as well as the impact of energy-conservation programs.
** Winter peaks beginning in December of the year indicated.
*** Peak occurring on December 14, 1989 at 5:00 p.m.

Comparison with the 1989-1991 Development Plan

In the long term, the net variation in firm sales predicted for 1999 between the 1990-1992 and the 1989-1991 Development Plans is 4.9 terawatthours. This is due to increased demand from new aluminum smelters in Québec and an upward reassessment of demographic trends.

In addition to the assumptions related to a reduction of cross-subsidization and natural energy efficiency discussed in the 1989-1991 Plan, the 1990-1992 Plan factors in additional energy conservation, attributable to the combined effects of direct-intervention programs and from rate increases above inflation. All these measures reduce somewhat the increase in demand.

Table 3.6
Comparison of the 1989-1991 and 1990-1992 Plans – Sales of Firm Electricity in Québec – Average Scenario (in terawatthours)

	1989	1990	1991	1992	1996	1999	2006	Growth 1989-2006 (%)
1989-1991 Plan	125.3	130.1	134.4	137.7	151.0	160.2	175.3	2.0
1990-1992 Plan	127.6	126.2	134.2	139.4	155.2	165.1	179.3	2.0
Difference	2.2*	-3.9	-0.2	1.7	4.2	4.9	4.0	

* The forecast in the 1989-1991 Development Plan was based on normal weather conditions and average runoff. Thus the variation of 2.2 terawatthours in relation to the actual 1989 situation is related to colder weather in 1989 and the temporary buyback in 1990 of commercial, institutional and industrial dual-energy contracts.

3.3 Short-Term Supply-and-Demand Review

Objective	Strategies
Medium-term planning of power-system operation to be in a position to cope with extreme variations in water inflows	Re-establish reserve levels in the reservoirs; maintain, manage and develop methods of supply-and-demand management according to runoff cycles

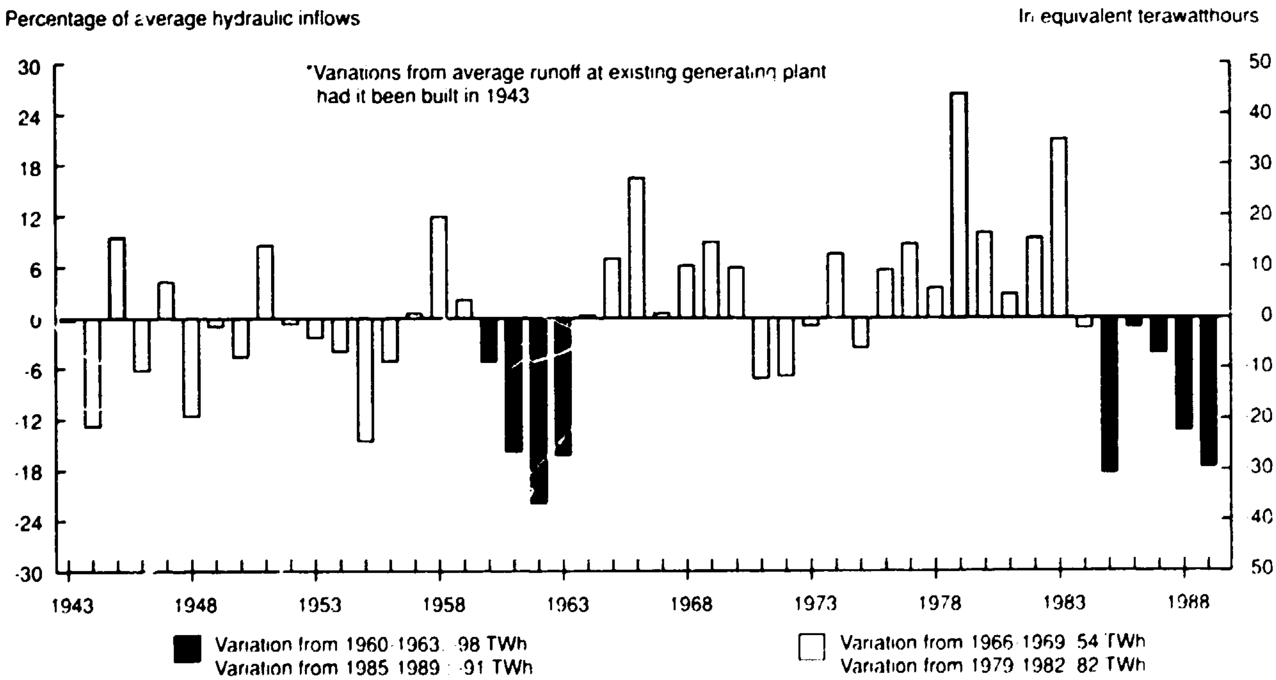
3.3.1 Energy

Inflows

Hydro-Québec's generating facilities are 95% hydroelectric, and they depend on available inflows. If runoff in 1990 is average, energy inflows at the hydroelectric generating stations, including Churchill Falls, should total 165.5 terawatthours.

This figure is 2.9 terawatts below that given in last year's Development Plan and was obtained by the more accurate establishment of inflows from all Québec watersheds and an update of historical data over the 46-year period from 1943 to 1988, rather than 1949 to 1979, for all watersheds including that of Churchill Falls. Recent years of low runoff account for 25% of this downward revision.

Figure 3.2
Historic Variation of Inflows*



Variability of inflow is illustrated in Figure 3.2. Records indicate that inflow levels can vary substantially from year to year. For example, 1962 had 36 terawatthours less than average, and 1979 had 44 terawatthours more than average. From 1960 to 1963 inclusively, the maximum accumulated difference was 98 terawatthours below average, while from 1979 to 1982 it was 82 terawatthours above average.

Since 1985, the accumulated inflow deficit has totalled 91 terawatthours, or more than 70% of total sales in Québec in 1989. This period of low runoff has seen the second largest deficit in the past 25 years.

Inflow Risk Management

In normal circumstances, inflows are adequate to meet demand. However, there can be major variations, upward or downward. Hydro-Québec has large storage reservoirs in which it can either store water reserves or draw from these reserves in times of low runoff. Nevertheless, the size of these reservoirs is limited by economic and environmental factors. So Hydro-Québec must have recourse to measures other than hydroelectric in order to manage its energy reserve. This is always factored into short-term operations planning and long-term facilities planning.

Reserves are composed of a seasonal reserve and a multi-annual reserve. Seasonal reserve offsets low winter inflows when demand is high because of widespread electric heating.

The multi-annual reserve tops up the seasonal reserve. It stores surplus inflows in years of high runoff in readiness for years when runoff is lower than average. Given the limited size of reservoirs, sales of surplus electricity must be made in years of high runoff if spillage is to be avoided.

Conversely, in years of low runoff, the size of reservoirs renders water reserves alone insufficient. So exceptional non-hydroelectric measures must be taken to avoid load-shedding. In addition to halting surplus-electricity sales, these measures are, in increasing order of cost: operation of Tracy thermal generating station, off-peak purchases from neighboring systems, dual-energy buyback, and purchases from neighboring systems during their peak periods.

Exceptional measures must be economic and preventive. They have to be introduced well before an imminent spillage or drying-up of reservoirs. Therefore Hydro-Québec must maintain an adequate reserve, taking into account the cost and availability of these exceptional measures.

Exceptional Measures

As shown in Figure 3.3, the utility was only slightly affected in 1985 and 1986 by low runoff levels, as it continued to have a generating surplus arising from the 1981-1982 recession and the heavy runoff from 1976 to 1983. However, persistent low runoff since 1984 and an exceptionally strong economy caused Hydro-Québec to begin a number of actions that had been described in earlier Development Plans in the event of low runoff.

The first series of actions in 1988 comprised gradually halting surplus-electricity sales. In its second series of actions, Hydro-Québec instituted exceptional measures in 1988 and 1989 to restore its energy reserves in the most cost-effective way. These measures consisted of purchases from neighboring systems during non-peak periods; operation of Tracy thermal generating station as a base-load facility; and the buyback of commercial, institutional and industrial dual-energy contracts.

Using only the least expensive exceptional measures in 1990 and 1991, the utility could cope with two additional years of low runoff equivalent to the two worst years of its history: a deficit of 65 terawatthours compared to average runoff years. Recourse to more expensive additional measures would allow the utility to deal with a period of low runoff in the next four years equivalent to the four worst years of its history. However, there is very little likelihood of its having to do so.

Figure 3.3
Evolution of the Usable Reserve – Average Scenario with Extremes of Inflow

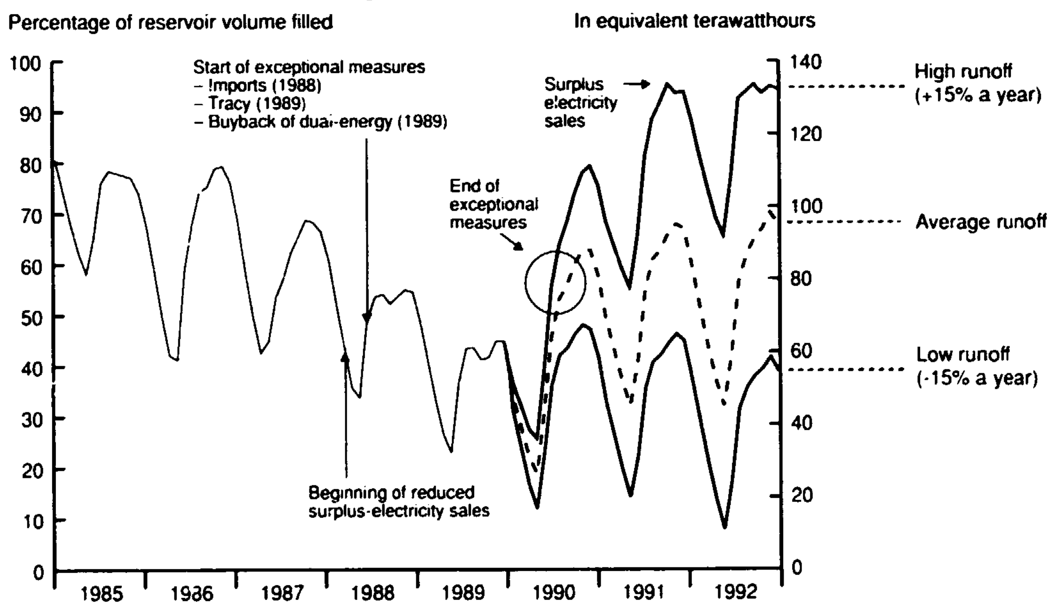


Table 3.7
Exceptional Measures to Ensure Energy Reserves
(in terawatthours)

	Measures Used 1989	Measures Used 1990	Additional Measures Available But Not Implemented 1990	Additional Measures Available But Not Implemented 1991 and after
Buybacks of contracts and CII* dual-energy rates maintained at high levels	0.3	3.8		3.6 to 3.9
Purchases from neighboring systems	3.5**	3.5	4 to 5	7 to 8
Tracy	1.4	2.6	-	3.4

* Commercial, institutional and industrial dual energy.
** Does not include about 0.5 terawatthours of energy obtained from purchases of power in 1989.

Table 3.8
Electrical-Energy Balance Sheet – Average Runoff
(in terawatthours)

	1980	1981	1982
Supply			
Hydroelectric generation			
• inflows*	164.4	165.6	166.0
• Gentilly 2	4.9	3.7	5.0
• isolated systems	0.2	0.2	0.3
Receipts under agreement and contractual purchases	3.9	4.0	4.9
Exceptional measures			
• Tracy	2.6	0.0	0.0
• imports	3.5	0.0	0.0
Total	**179.5**	**173.5**	**176.2**
Demand			
Priority needs – Québec	144.5	153.1	158.5
Export sales of firm electricity and associated losses**	12.1	13.3	13.5
Total	**156.7**	**166.4**	**172.0**
Difference between supply and demand (generation margin used to fill reservoirs)	**22.8**	**7.1**	**4.2**

* Corresponds to average inflows including Churchill Falls. The values reflect variations in the heads of generating stations caused by reservoir filling and improvements to existing installations.

** Includes 0.6 terawatthours of interconnection testing.

3.3.2 Power

To be able to reliably satisfy peak power needs, it is necessary to set aside a power reserve to take into account possible variations in demand due to climatic and economic conditions, and also to provide a reserve to reflect the unavailability of certain equipment.

This power reserve comprises the following options, ranging from the least to most expensive: hydroelectric facilities available at peak periods, thermal generating facilities, purchases of power from neighboring systems, and interruptible power.

Because of the rapid growth in demand, 1990 to 1992 will be characterized by a slight deficit in the required power reserve, even with the addition of gas turbines with a capacity of about 800 megawatts at La Citière and Bécancour.

Before construction of the next peak-load facilities in 1992 and 1993, the utility can use exceptional operating measures for maintaining the system's power reserve. These include additional purchases of power from neighboring systems, special agreements with industrial customers and, as a last recourse, the application of measures to increase the capacity of certain generating stations for short periods. These exceptional measures would result in 300-500 megawatthours of increased output, not including recourse to voltage reductions.

Table 3.9
Power Balance Sheet
(in megawatts)

	1990-1991	1991-1992	1992-1993
Supply			
– Existing plant**	24,820	24,910	24,950
– Various improvements and additions	50	1,050	2,610
– Purchases and sharing of reserve	6,540	6,580	6,690
Total	31,410	32,540	34,250
Demand			
– Priority needs	28,220	28,750	29,960
– Exports	470	600	770
– Isolated systems	-50	-50	-60
Total	28,640	29,300	30,670
Balance			
– Supply and demand	2,770	3,240	3,580
– Required reserve	-3,110	-3,500	-3,890
Surplus, deficit (-) in relation to required reserve	-340*	-260*	-310*

* Temporary operating measures affecting 300 to 500 megawatts are available to manage these power deficits.
** Includes Tracy and Gentilly 2 generating stations. The power available increases gradually until 1992-1993 as reservoir levels return to normal.

3.4 Energy Efficiency

Objectives	Strategies
Develop coherent programs of intervention to promote energy conservation by customers	Starting in 1990, inform customers about energy conservation and begin first measures directly involving them Between 1991 and 1993, implement mass-market energy-conservation programs Reinforce energy-conservation support activities Ensure the technological R & D for energy efficiency
Develop and maintain peak-load management programs and flexible markets that enable the balance between supply and demand to be quickly restored when necessary	Increase interruptible-power contracts from 760 megawatts in 1989 to 1,200 megawatts in 1995 Expand the base stock of residential dual-energy units from 90,000 in 1989 to 150,000 units in 1992 Maintain a base stock of commercial, institutional and industrial dual-energy units Maintain a 1,000-megawatt stock of commercial and industrial electrical boilers
Propose rate increases that reflect supply costs to maintain financial soundness and to support marketing and conservation objectives	By 1992, raise rates to cover supply costs, including a satisfactory rate of return on equity Differentiate rate increases by customer category to better reflect costs of supplying each category Prepare a series of rate options that support specific marketing programs Evaluate the possibility of setting seasonal rates

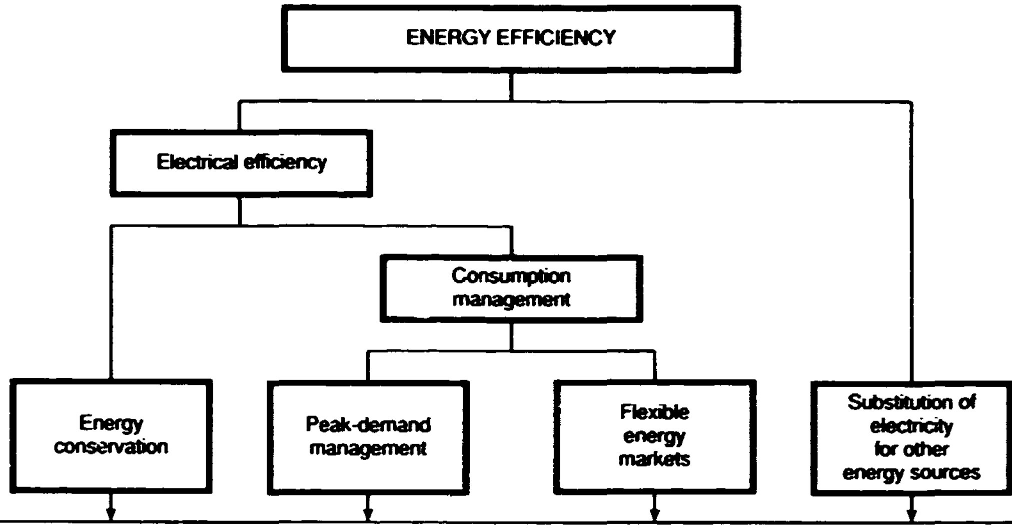
3.4.1 Energy Efficiency

In the past, Hydro-Québec was very active in the field of energy efficiency, modifying its actions as the energy context evolved. Thus, during the oil crises of 1973 and 1979, the utility stressed energy conservation, establishing standards for equipment and the insulation of buildings and water heaters. Later, during the period from 1982 to 1986, characterized by major energy surpluses, peak-load management and flexible energy-market approaches were developed.

In the early 1990s, Hydro-Québec intends to give a new emphasis to energy-conservation activities as part of a long-term orientation that initially focuses on electrical efficiency. This orientation follows the Energy Policy of the Québec government adopted in 1988.

The problem of improving energy efficiency and the utility's long-term orientations and proposed program are discussed at greater length in a separate publication entitled *Hydro-Québec and Energy Efficiency*.

Figure 3.4
Energy-Efficiency Chart – Hydro-Québec Interventions

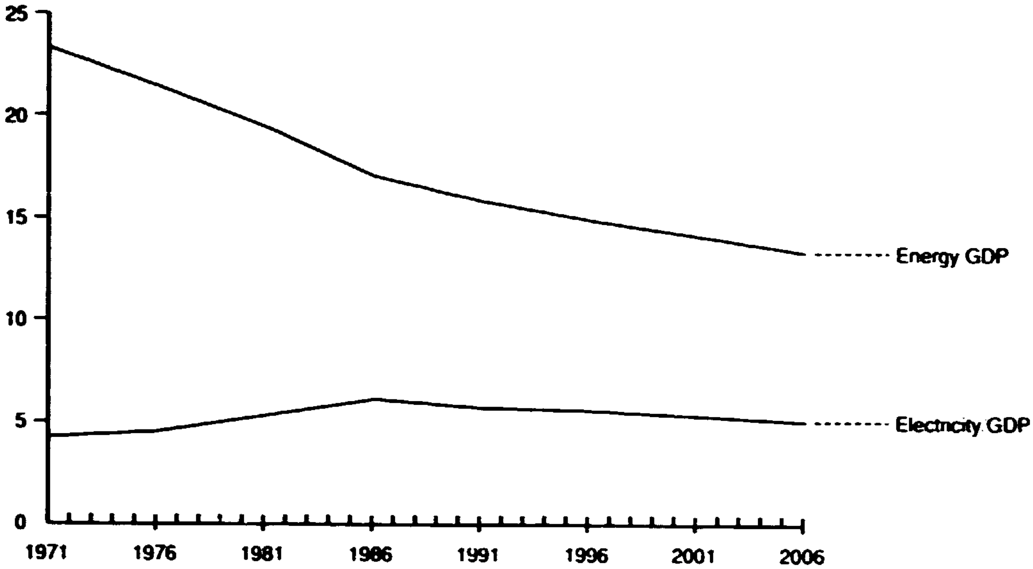


	Energy conservation	Peak-demand management	Flexible energy markets	Substitution of electricity for other energy sources
Measures advocated by Hydro-Québec	Programs starting in 1990 Programs starting between 1991 and 1993 Support measures	Interruptible power Residential dual-energy Maintain commercial, institutional and industrial dual-energy units Seasonal rate	Maintain commercial, institutional and industrial dual-energy units Stock of industrial boilers	Electrotechnologies Maintain commercial, institutional and industrial dual-energy units
Major effects on energy balance	Reduced long-term growth in electricity demand	Lower peak power requirements	Higher or lower electricity demand, as required	Reduced fossil fuel consumption Improved energy self-sufficiency for Québec
Effects on the construction program	Construction program can be optimized, while respecting the environment, as a function of market development	Construction of peaking plant can be avoided	Reservoir management can be optimized	Growth in electricity demand requiring additional plant
Effects on customers	Lower energy bill without a reduction in comfort level			

In Québec, substitution of electricity for fossil fuels has created major gains in energy productivity, given the greater efficiency of hydroelectricity.

Figure 3.5
Evolution of Energy Efficiency in Québec

In terajoules/GDP in millions of 1981 dollars



In the 1990s, electrical efficiency will be especially assured by the promotion of:

- **energy-conservation measures that, in the long term, aim to encourage rational use of electricity and manage growth in firm electricity needs;**

- **peak-load management measures and flexible-energy markets that offer the utility effective means of influencing electricity demand in the short term.**

3.4.2 Energy Conservation

Despite many achievements in electrical efficiency in Québec, there is still a high additional potential for energy conservation. Current estimates put the amount at 23 terawatthours or 18% of firm-electricity sales in Québec in 1989.

To evaluate, from this theoretical hydroelectric potential, the economically viable potential between now and the end of the decade, Hydro-Québec takes into account a number of factors, chief among which are economic considerations, the uncertainties associated with energy conservation and customer acceptance of the concept of energy conservation.

Factors affecting the projected level of energy savings include how popular the programs are, how much is saved, at what cost and how permanently. The popularity of the programs is affected by the relative price of electricity and other considerations specific to each customer. How much is saved, although difficult to measure, will depend on the actual use that customers make of more efficient equipment. How much these savings cost will depend on technological development and prices charged by equipment distributors. The permanency of the savings is related to changing values and lifestyles, equipment obsolescence and technological development.

The utility encourages the efficient allocation of resources by ensuring that the kilowatthours saved are not more costly than the new kilowatthours obtained from hydroelectric projects and other plant. Thus the sum of the amounts paid by the customer and by the utility must be equal to or less than the avoided costs of electricity generation, transmission and possibly distribution.

So the energy-conservation programs Hydro-Québec will launch will not put any greater long-term upward pressure on rates than would the construction of facilities that might otherwise be needed.

Continuing on the basis of sound economic principles, Hydro-Québec could make a significant financial contribution to the promotion of energy conservation. The utility's rates aim to reflect the costs of supply associated with the various customer categories. These rates are based on the average cost of installations, which is obviously lower than the cost of new installations. So Hydro-Québec is prepared, where necessary, to spend up to the difference between the average cost and the marginal cost of the new installations.

This spending could take the form of information programs, visits or direct contributions to customers.

Customers who receive financial contributions would not, in so doing, place an additional burden, in the form of higher rates, on customers as a whole.

Programs Beginning in 1990

There is potential for electrical efficiency in all markets. Uses offering the greatest possibility of energy conservation are:

- residential market: hot water, lighting, heating, household appliances;
- commercial and institutional market: lighting, hot water, HVAC (heating, ventilation and air conditioning);
- industrial market: motors, lighting, improvement in production processes.

However, it should be emphasized that the present perception of Québec customers is not one that lends itself to energy conservation. Electricity prices are relatively low. In other sectors of the economy, although efforts are still being made not to waste energy, and the results have been substantial, there is nevertheless some resistance to additional conservation measures. Greater comfort is often seen as a priority.

Until recently there was a widespread popular perception that electricity was both abundant and cheap. This attitude is due mainly to the energy surpluses caused by the high runoff levels of 1976 to 1983 and by the 1981-1982 recession. In the years of surplus that followed, rate discounts and major sales of surplus electricity played a major role in creating this image of abundance.

Information Program

A major information campaign intended primarily for Hydro-Québec customers in the residential and commercial markets will take place throughout 1990. This program will be rapidly followed by the first direct measures to involve residential and commercial customers.

Residential Program

Accelerated penetration of a vast range of highly energy-efficient devices and equipment will require formulas calling for participation by customers and commitment by private distributors of this equipment. The main devices now being evaluated are shower heads, fluorescent lights, insulation kits, water-flow reducers, programmable thermostats and insulation jackets for water heaters.

In addition, to increase its expertise and maximize its mass-market programs, Hydro-Québec will launch a pilot program of home energy-conservation visits. The idea will be to evaluate the energy-conservation possibilities of building insulation, water heating and some appliances. Following this evaluation, and with customer consent, the utility will, if need be, ensure the installation of high-energy-performance appliances. The trial will target a sample of low-income customers to offer them the benefits of reduced electricity consumption.

Commercial Program

A program involving public lighting is also being prepared. Collaboration with the municipalities involved will increase the program's spinoffs.

Demonstration Projects

In the early 1990s, Hydro-Québec will carry out demonstration projects in its own buildings to give concrete examples to its customers, increase expertise in this area and heighten the conservation awareness of all its personnel.

Furthermore, in 1990 the utility will set up several other pilot projects to optimize the proposed programs.

Programs Beginning between 1991 and 1993

This phase concentrates on mass-market activities that require a longer period of preparation and organization. It will be characterized by the marketing in all sectors of highly efficient appliances, improved building insulation and better industrial processes. The high-efficiency water heater is one example of equipment that will be proposed to customers in the near future.

Plans also call for establishing a program of home visits to make recommendations based on summary energy analyses and to advise customers on which high-efficiency equipment they should install. Furthermore, Hydro-Québec is also planning visits to commercial premises organized by usage and customer category.

Other possibilities are also under study: improved commercial, institutional and industrial lighting, improved motors and the implementation of electrotechnologies in industry.

Support Activities

An essential component of the electrical-efficiency programs is support from regulatory bodies, manufacturers and suppliers, and the general public, specifically in research, development and testing of highly energy-efficient products, such as high-efficiency houses, water heaters, heat pumps with nonelectric backup and integrated dual-energy furnaces, and in efficiency standards and quality labels such as NOVELEC and CASCADE, used in the past. Hydro-Québec will also collaborate with others working in the energy field so that goals in this area can be met.

Objectives

The demand-reduction objectives of the energy-conservation programs have been calculated to incorporate profitability criteria, the commercial context and uncertainties related to the programs themselves.

Hydro-Québec's objective is 12.9 terawatthours of energy savings on the 1999 horizon, out of a theoretical potential of 23 terawatthours. This amount consists of natural savings and savings resulting from specific programs. As discussed in section 3.2.2, natural-efficiency savings, which involve minimal interventions on the part of Hydro-Québec and governments, are estimated at 3.9 terawatthours in 1999. This type of energy saving was taken into account in the demand forecasts of previous Development Plans.

Energy savings arising from specific interventions will result from the interaction of rate increases, reduction of cross-subsidization, and the utility's intervention programs. The impact of these measures is estimated at nine terawatthours on the 1999 horizon and will entail expenditure of $1.8 billion from 1990 to 1999. This amount includes $160 million for support measures, of which a portion will contribute to natural-efficiency savings.

One of the utility's major concerns is obtaining an accurate evaluation of the impact of its energy-conservation measures. To date, the efforts made by other utilities have been inconclusive because of the numerous factors that affect energy consumption. Nevertheless, pilot projects and measurement and follow-up techniques will be used to assess the impact of the measures implemented.

The anticipated reduction in demand from each program will be systematically revised. Clearly, the greater the number of customers who adhere to the programs, the greater the success would be. The growth rate of electricity demand will also affect potential savings.

The energy-conservation programs will require major commitments by the utility in terms of human and financial resources.

Table 3.10
Energy Conservation – 1990-1999

Method	**Impact of programs and rates structure (TWh) 1996**	**1999**	**Beginning of programs**	**Length (years)**	**Cost to Hydro-Québec (in millions of dollars)**
Residential • Devices – promotions • Devices – brochures • Energy analysis • Electric water heaters	3.3	4.7	1990-1992	2 to 10	540
Commercial and institutional • Analyses of Hydro-Québec buildings • Analyses of institutional buildings • Public lighting • Applications to small and medium-sized business	2.2	2.8	1990-1992	3 to 8	800
Industrial • Energy analyses • Energy initiatives • Promotion of high-efficiency motors	1.1	1.5	1990-1992	7 to 10	300
Natural conservation	2.9	3.9	–	–	*
Support measures	–	–	–	–	160*
Total energy conservation	9.5	12.9	–	–	1,800

* A portion of the support measures will contribute to natural conservation.

3.4.3 Methods of Managing Peak Demand and Flexible Energy Markets

Given the considerable variations in runoff and demand, Hydro-Québec must develop and maintain a wide range of methods for influencing Québec's power and energy markets. Their implementation will require ongoing collaboration with other parties in the energy sector.

Interruptible-Power Program

The interruptible-power program is an efficient peak-shaving tool. Customers that join the program agree to reduce their electricity consumption at Hydro-Québec's request, and this reduces the need for high-peaking plant, such as gas turbines. A conclusion drawn from a review of program conditions in 1989 was that interruptions should be longer, when necessary, i.e., from 7:00 a.m. to 7:00 p.m.

In 1989, the utility introduced a new option which was better suited to its needs and which implied 16-hour interruptions. The pulp and paper sector would be particularly interested in this option. However, given many customers' limited ability to reduce their electricity needs over such a long period, the long-term sales objective has been reduced to 1,200 megawatts from 2,000 megawatts last year.

At present, 760 megawatts of interruptible power is under contract. But program revisions that take into account customers' operating methods and the system's peak-load management constraints now offer customers the option of contracting for three megawatts, whereas they were previously limited to five megawatts or more, and the premiums paid reflect the option selected.

Residential Dual-Energy Heating

Dual-energy heating uses electricity about 80% of the time, with another source of energy, such as heating oil, taking over during peak periods. The utility considers this an attractive alternative to all-electric heating. New homes built in Québec are over 90% electrically heated, and this increases peak demand. Dual energy, however, is an advantageous choice, both for the customer, who pays a lower rate, and for Hydro-Québec, which has less need for peak-load thermal generating facilities – a much less efficient use of energy for residential heating.

Residential dual-energy units were first developed in 1983 as an alternative to conversion from heating oil to all-electric heating. The current program dates back to 1987, when customers who opted for dual energy were given special rates. In 1989, the utility extended the program to dual-energy systems using heat pumps and dual-energy systems serving more than one dwelling. The dual-energy (DT) rate combined with a repairs and maintenance program enables customers to significantly reduce their electricity bills.

Hydro-Québec will maintain its current dual-energy stock of 90,000 units, and expects to increase it to 150,000 units by 1992. This increase will take place on the existing all-electric market and on the new market. Advanced technologies such as heat pumps with nonelectric backup and integrated dual-energy heating systems will help the utility achieve this objective.

In addition, Hydro-Québec is studying the possibilities of using residential dual energy as an energy reserve in the interests of customers and the utility.

Commercial, Institutional and Industrial Dual Energy

The commercial, institutional and industrial dual-energy program began in 1984 and ended in 1988. Its main purpose, in a period of electricity surpluses, was to accelerate substitution of electricity for other sources of energy, without requiring additional peak-load facilities.

This heating method can switch temporarily to a backup source during periods of low runoff. Such was the case in 1990, when Hydro-Québec temporarily bought back contracts, to the mutual benefit of the utility and its customers. This is a less costly option than other ways of reconstituting energy reserves, such as peak-period imports from neighboring systems.

Industrial Boilers

An emergency-repairs and maintenance rate is offered to an electric-boiler stock totalling 1,000 megawatts in the industrial sector. In the event of high runoff, surplus electricity could be sold to this market.

3.4.4 Technological Development

Many research projects on electricity uses are now under way in Hydro-Québec's laboratories or in collaboration with partners from universities and the private sector. The emphasis is on industrial electrotechnologies and dual-energy heating systems. The results of these projects will enable the utility to determine options that could become the basis for marketing programs.

In the next few years, research will focus on the following applications: heat pumps with nonelectric backup, improved electric water heaters, integrated dual-energy systems (electricity-oil), storage heating, industrial drying processes, high-temperature heating processes, electrochemistry and high-efficiency heat pumps.

Adoption of electrotechnologies not only increases the ability of Québec industries to compete, but also enhances their energy efficiency. Hydro-Québec will also promote the replacement of existing electrical processes by more efficient ones, with efforts focusing on the most efficient electrotechnologies.

3.4.5 Price Signalling from Rates Policy

Principles of the Rates Policy

Hydro-Québec's rates policy is based on the following principles:

- to maintain standard rates throughout Québec and standard treatment for customers with similar consumption characteristics;
- to ensure that the rates categories, to the extent possible, gradually but accurately reflect the varying cost of supply;
- to facilitate understanding and application of the rates policy;
- to take customers' methods of operation into consideration.

There must be incentives to adopt energy-savings measures, and price signalling through the rates that customers pay is of the utmost importance because energy conservation is more difficult to justify if prices do not properly reflect supply costs. If Hydro-Québec is to ensure that electricity is used efficiently, it is important that customers be fully aware of the costs incurred to meet their needs.

The rates structure must reflect costs of supply and provide a return on equity comparable to those of other utilities. In this way, a number of objectives can be met simultaneously. First, a rates structure based on costs of supply enables Hydro-Québec to re-establish and maintain a financial margin of manoeuvre that hedges it against the inevitable economic, energy and climatic uncertainties, without major rate shock for its customers. Moreover, by ensuring a sound financial position, it helps finance the capital investments necessary to meet demand growth and service-quality objectives. Lastly, by giving customers a better price signal, it promotes more efficient use of electricity.

Supply costs vary a great deal, depending on the season and rates category. A customer supplied with high voltage from the transmission system requires much less of an investment in equipment by Hydro-Québec than a customer supplied with low voltage from the distribution system. In addition, Hydro-Québec must build some facilities specifically to meet the winter peak demand. For this reason, electricity supplied during the winter costs more to generate than electricity supplied during the summer.

So costs of supply are higher for a residential customer with low-voltage supply and using all-electric heating in winter than for a large-power customer whose demand is stable throughout the year. Moreover, in the years to come, major investment in the distribution system and in peak-load facilities will cause the costs of supplying residential customers to rise even faster.

The Québec government has approved Hydro-Québec's objective of reducing cross-subsidization. Recommendations on future rate increases will reflect this objective, although care will be taken to avoid rate shocks and to spread the correction of the current cross-subsidization over several years.

Time-of-Use Rates

Time-of-use rates are one way of promoting energy savings. Hydro-Québec already offers such an option to residential customers with dual-energy heating systems. Similarly, certain components of existing rates, such as progressive residential rates and the general-sector "optimization" (overrun) charge, reflect the seasonal nature of the utility's costs and promote better use of generating facilities. Hydro-Québec will examine the advisability of offering a seasonal rate to customers.

An hourly rates structure cannot be gainfully introduced in Québec because the daily winter peaks in Hydro-Québec's system occur over a long period of time, due to the use of electric heating.

3.5 External Markets

Objectives	Strategies
Develop and maintain agreements that enhance the utility's flexibility by enabling it to balance supply and demand	Purchase available energy or sell surplus energy according to foreseeable reservoir levels Meet a portion of peak-power needs in years to come with purchases from neighboring systems, when it is advantageous to do so
Continue optimum use of interconnections and increase their capacity as required	Negotiate the necessary agreements with neighboring systems regarding the operation of interconnections Plan interconnections so as to maximize exchanges with neighboring systems
Pursue the long-term sales objective of at least 3,500 megawatts of firm electricity	Pursue endeavors to obtain all approvals required to implement agreements already signed Pursue ongoing negotiations for the sale of blocks of firm power and energy, with deliveries after the year 2000 Continue to evaluate the potential of long-term markets to identify the most attractive opportunities

In the short term, imports and exports make it possible to reduce the impact that variations in runoff and demand have on reservoir levels. In recent years, Hydro-Québec has used its interconnections with neighboring systems to sell its surplus energy to neighboring systems. Revenue of more than $5 billion generated in this way from 1980 to 1989 has enabled the utility to keep Québec rates at least 10% lower than they otherwise would have been, and has also helped finance the expansion and upgrading of the power grid. Moreover, the inflow of US dollars has facilitated management of the utility's foreign-exchange risk.

In the long term, firm power and energy exports will be very profitable and will generate substantial economic spinoffs in Québec. Long-term exports involve bringing forward the construction of facilities not immediately required to meet Québec needs. The prices obtained under export contracts are about double Québec's large-power industrial rate, which is a comparable product. Export revenue pays for all expenses related to earlier construction and offers a good return on equity. When the contracts expire, Québec will have facilities that would have been far costlier to build at a later date.

In terms of revenue, income and profitability, and of impact on the Québec economy, electricity exports rank among the projects most advantageous to Québec.

In the overall scheme of environmental problems, moreover, exports of hydroelectric energy to neighboring systems contribute in the long term to reducing acid rain and the greenhouse effect, for which thermal generating stations are partially responsible. Interconnections are also used to import energy, thereby reducing the need to build new plant, especially peaking plant.

Figure 3.6
Purchases from and Sales to Neighboring Systems

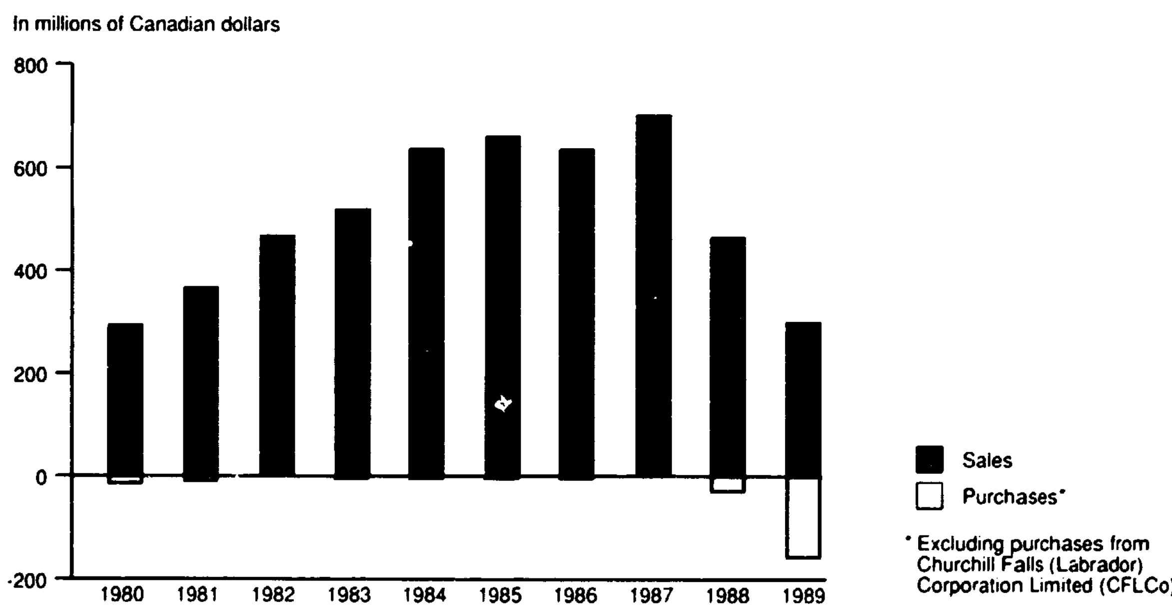


Table 3.11
Summary of Contracts and Agreements with Neighboring Systems

	Start of deliveries	Expiry date	Power (MW)	Maximum annual energy (TWh)	Maximum total energy (TWh)
Firm-power and energy contracts					
CANADA					
New Brunswick Electric Power Commission	1987	1990	50	0.4	1.2
New Brunswick Electric Power Commission	1988	1994	50-350	3.5	20.0
Cedars Rapids Transmission Company	1915	1999	56	0.5	42.0
UNITED STATES					
Citizens Utilities Company	1986	1990	20-56	0.3	1.1
Citizens Utilities Company	1986	1990	32-40	0.1	0.3
New York Power Authority (NYPA)	1978	1998	800	3.0***	
New York Power Authority (NYPA)	1995	2016	1000*	6.6	131.0
New York Power Authority (NYPA)	1999	2018	800	3.0	60.0
Vermont Department of Public Service	1985	1995	150	1.3	13.0
Vermont Joint Owners	1990	2020	450**	3.0	62.0
Vermont Joint Owners	1987	1990	50	0.4	1.2
Vermont Utilities	1989	1991	54	0.5	0.8
Firm-energy sales contract					
UNITED STATES					
New England Utilities	1990	2000	-	7.0	70.0
Surplus-energy sales contracts #					
UNITED STATES					
NEPOOL Participants	1986	1997	-	4.0	33.0
New York Power Authority (NYPA)	1984	1997	-	11.0	111.0
Power-purchase contracts					
CANADA					
Gulf Power	1970	-	3	-	-
UNITED STATES					
New York Power Authority (NYPA) ##	1989	2011	400	-	-
Interconnection and operating agreements	**Effective date**	**Expiry date**			
CANADA					
Alcan (SECAL)	1982	-			
Maclaren (CEMQ)	1984	-			
Compagnie hydroélectrique Manicouagan	1986	-			
Gulf Power	1970	-			
New Brunswick Electric Power Commission	1979	-			
Ontario Hydro	1979	-			
Cornwall Electric	1989	-			
UNITED STATES					
Citizens Utilities Company	1987	-			
New England Power Pool (NEPOOL)	1986	-			
New England Power Pool (NEPOOL) ###	1986	2004			
New York Power Authority (NYPA)	1978	1998			
Niagara Mohawk Power Corporation	1982	-			
Vermont Department of Public Service	1985	-			
Vermont Joint Owners	1987	-			

* 500 megawatts in 1995-1996 and in 2015-2016.
** VJO may exercise options to reduce maximum power by 110 megawatts.
*** The agreement on the associated energy is subject to regular negotiations; the current agreement ends in 1990. Deliveries from April to October.
\# The amounts of energy offered depend on the surpluses available.
\## Peak power deliveries from November to March.
\### Energy-banking agreement.

3.5.1 *The Short Term*

Orientations

Since 1988, low runoff and sustained demand have halted sales of surplus electricity and necessitated purchases of electricity from neighboring systems, which have been possible thanks to flexible agreements negotiated in the past that give Hydro-Québec the ability to adapt to short-term changes.

Actions

Reduction in Export Sales

In 1988 and 1989, the utility stopped delivering electricity under surplus-energy contracts. Deliveries to members of the New England Power Pool (NEPOOL Participants) and to the New York Power Authority (NYPA) under two interruptible-energy contracts were halted. Other sales of surplus energy under interconnection agreements were also suspended. These sales may resume when Hydro-Québec again has surpluses.

Purchases from Neighboring Systems

Hydro-Québec uses the diversity between its system and neighboring systems, both in terms of generating facilities and demand characteristics, to meet a portion of its power needs. In winter, for example, certain systems to the south have surplus power because of their warmer weather. In summer, however, these systems must cope with peak demand because of increased use of air conditioning. Hydro-Québec can therefore sell them power it does not need at this time.

Other systems also have temporary power surpluses that they can make available as required. Hydro-Québec will continue to purchase power from neighboring systems, when it is advantageous to do so to meet a portion of its needs. And these exchanges will reduce both systems' need for peak-load facilities.

When runoff is high, rather than spilling the surplus from its reservoirs, Hydro-Québec can sell this to neighboring systems as surplus energy, to the benefit of all its customers. Although the prices in this instance are lower than those for firm sales, the arrangement is still an attractive source of revenue. Similarly, when runoff is low, the utility can purchase energy from neighboring systems. This enables Hydro-Québec to store water in its reservoirs to maintain its energy reserve. Energy purchases are usually made during off-peak hours, when the amount of energy available is greatest and prices are lowest.

From October 1988 to December 1989, Hydro-Québec purchased 4.7 terawatthours from neighboring systems and it plans to purchase 3.5 terawatthours for 1990, in an average-runoff scenario, to re-establish its energy reserve.

3.5.2 *The Long Term*

Orientations

In recent years, Hydro-Québec has pursued the objective of long-term export sales of 3,500 megawatts of firm electricity, but this could be exceeded, depending on long-term changes in demand in Québec and on neighboring systems. These sales enable the purchasers to avoid construction of new thermal generating facilities and, when the contracts expire, Hydro-Québec will have less costly additional plant, formerly required for export, at its disposal to meet internal demand. So these contracts are profitable for Hydro-Québec and ultimately for all Québecers.

Apart from contracts already signed, i.e. 2,250 megawatts, including 800 megawatts of summer deliveries, Hydro-Québec is now negotiating others for 1,500 to 2,000 megawatts for deliveries beginning after 2000. The realization of these new agreements will depend on the value that neighboring systems place on a reliable and relatively non-polluting source of supply and the competitiveness of the price offered.

Contracts

Table 3.12 lists contracts signed with neighboring systems as part of the long-term sales objective of 3,500 megawatts; others will be added to attain this objective. All contracts already signed are conditional on the issuance of permits by the regulatory bodies in Canada and the United States, with both parties, Hydro-Québec and its partners, providing mutual assistance in order to obtain them.

For example, Hydro-Québec is actively involved in public hearings before the Public Service Board of the State of Vermont to obtain approval of a contract with Vermont Joint Owners (VJO) signed on December 4, 1987. Deliveries would begin in 1990 with 107 megawatts and would gradually climb to a maximum of 450 megawatts in 2000 if VJO exercised all its options. In Canada, this contract requires export licences from the National Energy Board, and Hydro-Québec must demonstrate that the project meets the Board's electricity-export criteria.

In 1989, Hydro-Québec concluded with the New York Power Authority (NYPA) a long-term firm-electricity sales agreement totalling 1,000 megawatts and about 6.6 terawatthours per year for 20 years, beginning in 1995-1996. On January 23, 1990, the utility and NYPA signed another long-term sales agreement for 800 megawatts and three terawatthours of firm electricity to be available in the summer. This 20-year contract will take effect in 1999. Both require approval by US and Canadian regulatory authorities and will be of mutual benefit to Hydro-Québec and the State of New York.

Table 3.12
Contracts as Part of the Export Objective of 3,500 Megawatts

Customers	Start of deliveries	End of deliveries	Maximum power (MW)	Maximum annual energy (TWh)	Maximum total energy (TWh)
Vermont Joint Owners	1990	2020	450*	3.0	62
New York Power Authority (NYPA)	1995	2016	1000	6.6	131
New York Power Authority (NYPA)**	1999	2018	800	3.0	60

* Vermont Joint Owners may exercise options to reduce maximum power by 110 megawatts
** From April to October

A contract for the purchase of 400 megawatts of peak winter power was also signed with NYPA in 1989. Deliveries under this 22-year contract began last November and will continue from November to March each year until 2011.

The sale of 800 megawatts and the purchase of 400 megawatts enables both systems to avoid constructing peak facilities, because Hydro-Québec's peak occurs in winter, whereas NYPA's occurs in summer.

Also in 1989, following the Public Utilities Commission of the State of Maine's refusal to approve a contract between Central Maine Power Company (CMP) and Hydro-Québec, the utility exercised its right to terminate this contract.

Negotiations in Progress

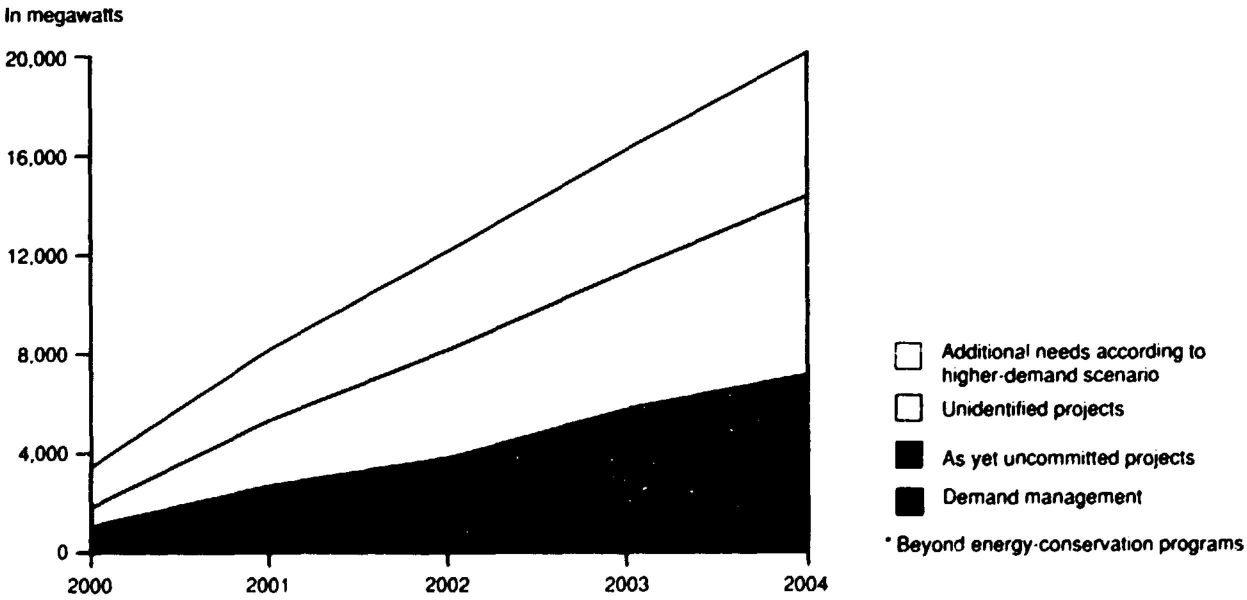
Hydro-Québec is continuing negotiations with neighboring systems regarding the long-term supply of firm power and energy.

The target market, located principally in the northeastern United States, is a replacement market for new base-load generating stations using fuel oil, coal or natural gas. These are required to meet the greater electricity demand in this region and to replace generating stations that will have exceeded their service life.

Long-Term Market Potential

Data from the neighboring systems' development plans indicate that, from 2000 to 2004, new needs to be met will total slightly more than 14,000 megawatts, of which about 2,400 megawatts will be provided by demand-management programs,* 4,700 by projects not yet committed, and 7,000 megawatts by projects not yet identified. Assuming that electricity demand on neighboring systems grows by half a percentage point more than their forecasts, their additional needs from 2000 to 2004 will be almost 6,000 megawatts.

Figure 3.7
Satisfaction of Neighboring Systems' Projected Power Needs*



* Beyond energy-conservation programs

In addition to the demand-management and energy-conservation programs planned, neighboring systems have several options: extending the service life of existing generating stations, building new thermal and combined-cycle stations, and purchasing electricity from independent producers or from neighboring systems. Despite natural gas's increasing attractiveness to the northeastern United States, its limited availability will prevent it from meeting more than a small portion of these needs.

Excluding peak-demand management and energy-conservation programs and taking into account only projects not identified by neighboring systems and a portion of the as-yet uncommitted projects, the market accessible to Hydro-Québec is estimated at 9,000 megawatts, over and above contracts already signed. In the high-growth scenario, the potential accessible market would rise from 9,000 to 14,000 megawatts.

Hydro-Québec will continue evaluating the needs of neighboring systems to identify the most advantageous market opportunities.

Table 3.13
Forecast Exports Compared with Total Hydro-Québec Sales

	Export sales				% of total sales			
	1991	1996	2001	2006*	1991	1996	2001	2006
Energy (in terawatthours)	12.6	15.2	19.3	24.5	10.0	8.7	10.0	11.8
Power (in megawatts)	438	948	2,550	3,550	1.5	2.9	7.3	9.5

* The objective of 3,500 megawatts will be reached in about 2003.

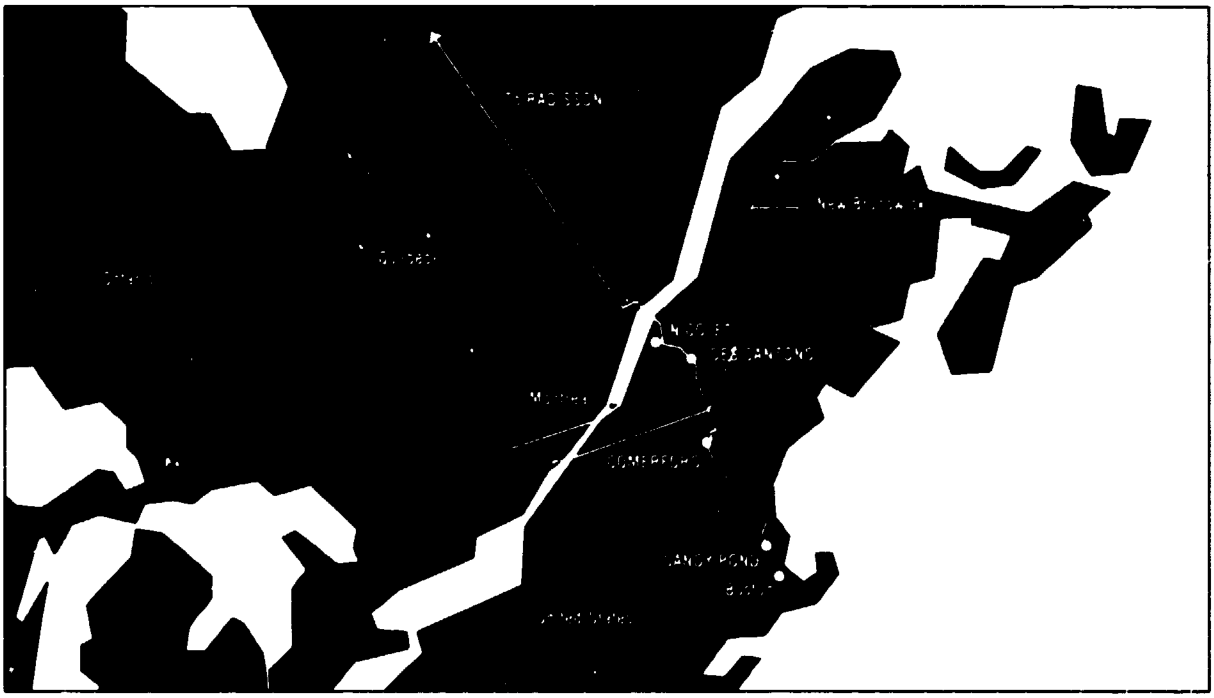
3.5.4 Interconnections

Current Situation

Hydro-Québec's interconnection capacity with its principal neighbors depends on a number of factors, such as the size of loads, the output of the generating stations connected to the line, and the technical limitations of the systems. Accordingly, the import and export capacities indicated on Map 3.2 may differ.

In 1990, the rated capacity of the direct-current interconnection with NEPOOL will increase from 690 to 2,000 megawatts. To make this possible, the Radisson-Nicolet-des Cantons line and Radisson converter station will be commissioned in Québec and, in the United States, the line between Comerford station in New Hampshire and the new Sandy Pond converter station in Massachusetts will be commissioned. Commercial commissioning of this interconnection will take place in 1990, marking the beginning of deliveries under the firm-energy contract with New England Utilities. This contract, which runs until 2000, will enable Hydro-Québec to export 7.0 terawatthours a year to New England Utilities.

Map 3.1
Radisson-Nicolet-des Cantons-Comerford-Sandy Pond Direct-Current Line

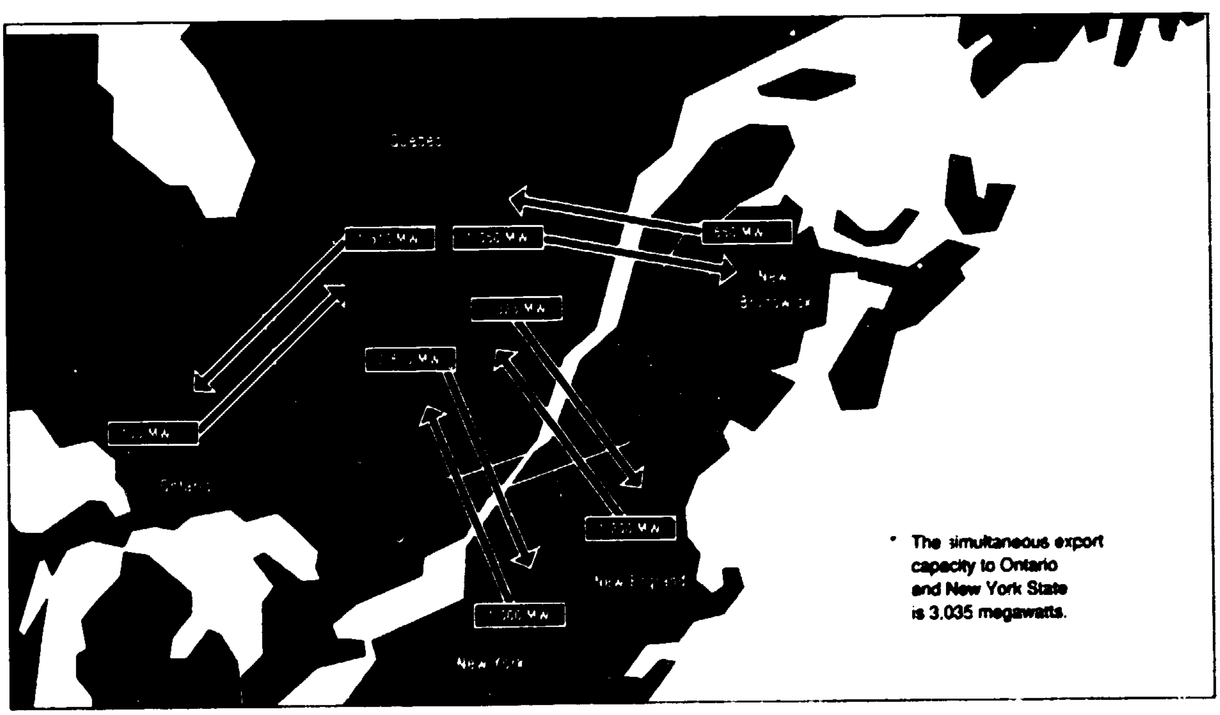


Orientations

In general, interconnections improve power-system reliability and enable utilities to derive maximum benefit from system complementarity. They also permit the pooling of availabilities to meet power and energy demand.

Hydro-Québec is examining the possibility of building new interconnections to increase its exchange capacity with neighboring systems. Additional interconnections would enable the utility to purchase electricity from neighboring systems as required or sell any surpluses.

Map 3.2
Interconnections with Neighboring Systems in the Fall of 1992



3.6 Construction Program

Objectives	Strategies
Ensure, in the medium term, commissioning of generating and transmission facilities required to meet the needs of Québec markets and contractual export commitments	1. Commission the following facilities – additional capacity at La Grande 2 generating station in 1991-1992 and related transmission facilities • Radisson converter station and the 450-kV DC line in 1990 • Nicolet converter station in 1992 • the underwater crossing of the DC line in 1992 – the generating stations in phase II of the La Grande complex • Brisay in 1993 • Laforge 1 in 1994 • La Grande 1 in 1994-1995 and related transmission facilities • the 12th line of the transmission system in 1993 (north section) and 1994 (south section) • the 315-kV lines required to integrate Laforge 1, Laforge 2 and Brisay generating stations into the system • the 735-kV line between Lemoyne and Tilly substations in 1994 – Laforge 2 generating station in 1995 – Eastmain 1 generating station in 1996 – the Grande Baleine complex as of 1998 and related transmission facilities • the 315-kV collector network and the 14th line in 1998 – changes to Manic 5 turbine runners beginning in 1991 – gas turbines at La Citière and Bécancour in 1992-1993 2. Supply power to unconnected systems – Commission the following facilities • Robertson generating station in 1995 • Blanc Sablon diesel generating station in 1992 – Complete activities required for the upgrading of Magdalen Islands diesel generating station between 1990 and 1992 3. Continue studies on the Lévis-des Cantons line to strengthen supply to the south shore of the St. Lawrence beginning in 1995

Objectives	Strategies
Plan Hydro-Québec's generating and transmission facilities to create the margin of manoeuvre needed to adjust rapidly to changes in long-term markets.	1. Optimize all activities necessary for the completion by the year 2000 of the Nottaway-Broadback-Rupert project, the keystone of the utility's long-term construction program 2. Prepare for decisions regarding generating and transmission facilities. To this end, obtain required government authorizations, continue studies and initiate activities needed to retain the earliest commissioning options for the following projects – Sainte-Marguerite generating station by 1999; in 1990, begin process of obtaining sectorial authorization for access infrastructure • reach agreement with the various interested parties on timetable for recovery of merchantable timber that allows commissioning to proceed as scheduled – Ashuapmushuan River developments by 1999 – developments on the Haut-Saint-Maurice by 1998 – additional capacity at Manic 3 by 1995 and Manic 2 by 1996 and related transmission facilities • an AC line to the North Shore to carry additional output from the Manicouagan complex (13th transmission line) 3. Begin a draft-design study in 1990 for a combined-cycle gas-turbine generating station 4. Explore with Newfoundland the possibility of building Gull Island and Muskrat Falls generating stations to develop the Lower Churchill River 5. Purchase electricity from independent producers whose output meets Hydro-Québec's operating standards

3.6.1 Hydroelectric Potential and Other Possibilities

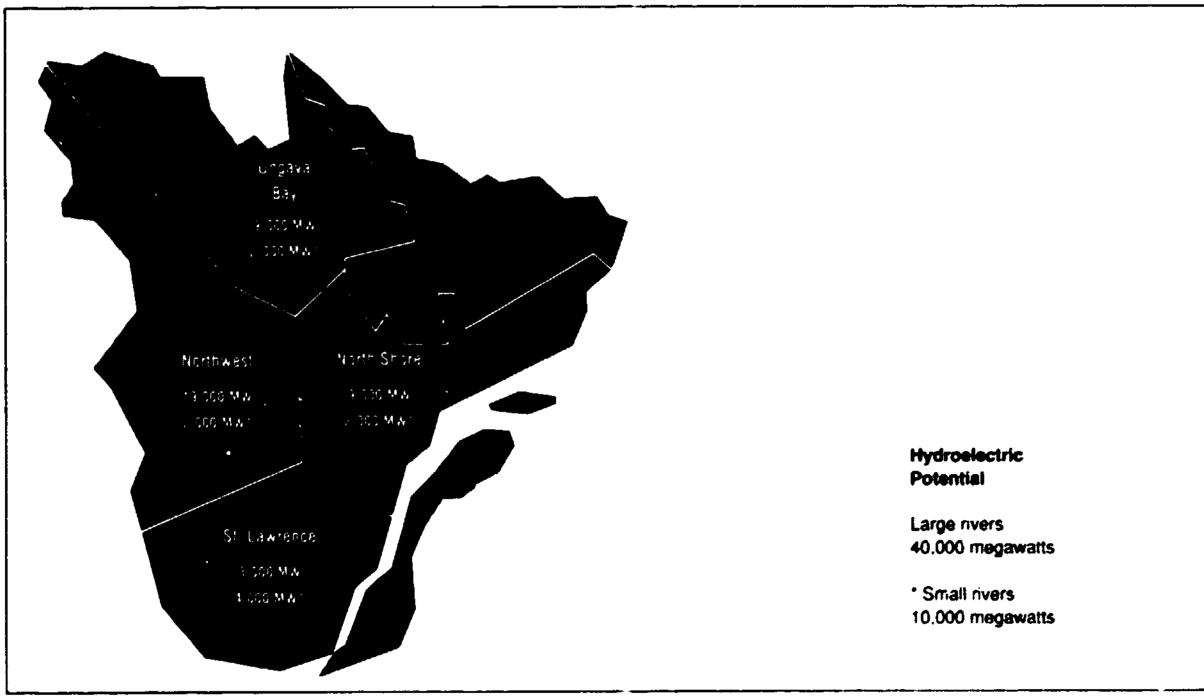
Large Rivers

Large undeveloped rivers represent potential annual energy generation of 200 terawatthours. At a load factor of 60%, this means about 40,000 megawatts of power. Of this potential, about 18,800 megawatts, or 100 terawatthours, is economically viable, and impact-assessment studies will be carried out on it, to optimize the necessary mitigative measures.

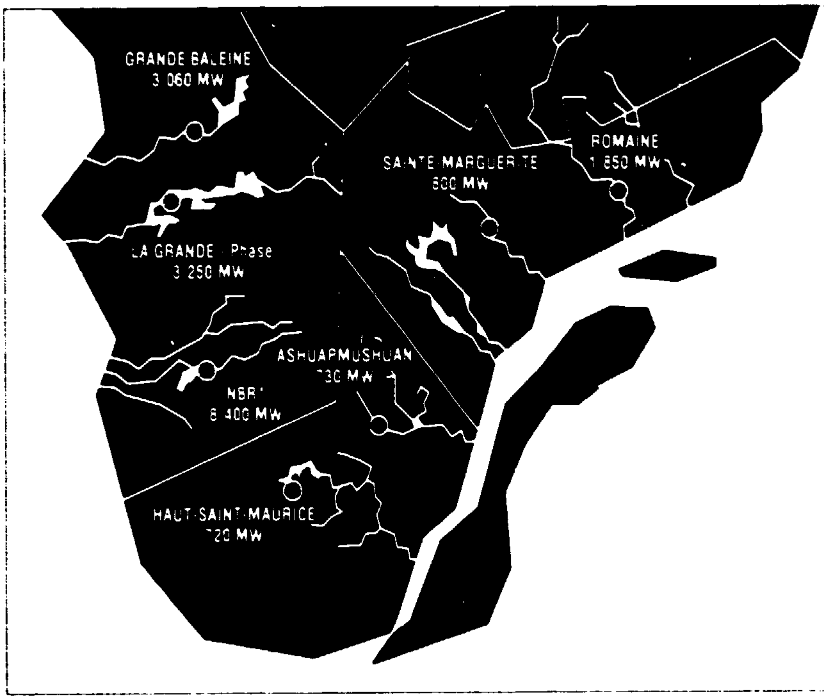
This economically viable potential is about 800 megawatts higher than forecast in last year's Development Plan, mainly due to the addition of the Haut-Saint-Maurice project.

Other than the energy-conservation programs outlined in section 3.4.2, these projects are more economical than any other generating option (nuclear, oil-fired or coal-fired), including the costs of transmitting the electricity to load centres. The Northwest is the region with the best development prospects, as it contains 75% of the potential.

Map 3.3
Québec's Hydroelectric Potential



Map 3.4
Québec's Economically Viable Hydroelectric Potential



18 800 megawatts

28 generating stations
8 additional lines

* Nottaway-Broadback-Rupert

Small Rivers

More than 400 small rivers, scattered throughout Québec, offer combined potential of 10,000 megawatts. This is divided among numerous sites with a potential of less than 100 megawatts, and in most cases as little as one or two megawatts. However, a large portion of this potential could not be developed economically under present conditions.

Table 3.14
Economically Viable Hydroelectric Potential

Hydroelectric generating stations or complexes	Available power at peak (MW)	Average annual generation (TWh)
Projects in progress		
La Grande 1	1,310	7.3
Laforge 1	820	4.5
Brisay	380	2.3
Future projects		
Laforge 2	270	1.7
Sainte-Marguerite	800	4.1
Grande Baleine	3,060	16.2
Ashuapmushuan	730	3.5
Eastmain 1	470	2.7
Haut-Saint-Maurice	720	3.5
Nottaway-Broadback-Rupert	8,400	45.3
Romaine	1,850	8.4
Total	18,800*	100
Other projects under study		
Péribonka	400	2.2
Petit Mécatina	1,450	7.6

* Values have been rounded up to the nearest 100 megawatts.

Peaking Facilities

Additional peaking facilities will be required to meet peak demand in Québec. For medium-peak periods, it is currently more economical to build additional capacity at existing hydroelectric generating stations, such as at Manic 5 PA, commissioned in the winter of 1989-1990, and at La Grande 2A, which will be commissioned in 1991-1992. Similar projects are planned for the generating stations on the Manicouagan River and are under study for those on the Betsiamites, Aux Outardes and Saint-Maurice rivers. For very high peak loads that exceed peak-demand-management programs, Hydro-Québec plans to install additional gas turbines at La Citière, and is evaluating the purchase of peaking power from neighboring systems.

Transmission Facilities

To carry the energy generated in northern Québec to the load centres, alternating-current high-voltage lines (735 or 315 kilovolts) remain the proven technical solution best adapted to the configuration of Québec's power grid.

To integrate the 18,800 megawatts of economically viable potential, eight new high-voltage transmission lines would be needed, six for output from the northwest and two for output from the North Shore.

Purchases of Electricity from Independent Producers

Hydro-Québec has adopted a policy for purchasing electricity from independent Québec producers. According to this policy, the utility purchases electricity from producers whose installations meet the integration and operating standards of its power system.

The output, under this policy, may come from hydroelectric stations with installed capacity of 25 megawatts or less, from incinerators for municipal or forest waste, or from combined steam and electricity generating facilities. In the case of a small generating station whose output is 25 megawatts or less, the independent producer must first obtain the required hydraulic rights from the Québec government.

Hydro-Québec pays a rate that reflects its avoided costs over the lifetime of the contract with the independent producer. In addition to diversifying the utility's sources of output, independent generation helps to develop Québec expertise in this area and create regional economic spinoffs.

Independently produced output that the utility will connect to its power system between now and 1995 is estimated at 390 megawatts, of which 300 megawatts will be from combined generation and 90 megawatts will be from incinerators and small hydroelectric generating stations.

Purchases of Hydroelectric Generation

Hydro-Québec will pursue discussions with Newfoundland on construction of Gull Island generating station (1,700 megawatts) and Muskrat Falls generating station (800 megawatts) as part of the development of the Lower Churchill River.

3.6.2 Construction-Program Design Criteria

Reliability Criteria

Energy Reserve

As discussed in section 3.3, the power system is subject to more or less lengthy periods of high and low runoff. Moreover, long-term energy demand can fluctuate significantly because of changes in the economy. To cope with this situation, Hydro-Québec uses enormous reservoirs with a capacity of 140 terawatthours, including Churchill Falls. Almost 40% of this energy is required for seasonal needs, which means the rest must be left to manage interannual variations in runoff or demand.

In previous Development Plans, on the 1995 horizon an energy reserve of about 110 terawatthours was required to cope with fluctuating runoff over a four- year period. It consisted of an interannual hydraulic reserve and the option of using exceptional methods, such as Tracy thermal generating station and purchases from neighboring systems.

As announced in last year's Development Plan, in 1989 the utility reviewed the energy-reliability criteria used to establish the construction program. In light of past runoff statistics and demand uncertainties, the need for an energy reserve has been re-evaluated on the 1995 horizon at 120 terawatthours for a four-year period or 150 terawatthours for a six-year period.

To ensure its energy reserve, Hydro-Québec has based its long-term planning of facilities on a slight hydraulic surplus in an average runoff scenario in relation to projected demand. With appropriate reservoir management this surplus will be used to counteract situations of low runoff but in high-runoff periods this surplus would be sold on surplus-energy markets.

In exceptional circumstances, the utility would also buy back dual-energy contracts. Other means, such as reserve thermal generating stations, additional reservoirs and extra purchases from neighboring systems have been considered but appear to be more costly. Technical and economic studies will be pursued to optimize energy-reserve criteria.

Power Reserve

Hydro-Québec is intensifying its generating-facilities maintenance programs to keep downtime to a minimum and achieve a high level of service quality.

Despite the broader scope of these programs, downtime due to failures and scheduled maintenance still occurs. A review of projected downtime has increased power-reserve needs by about 500 megawatts.

Hydro-Québec will also give itself an additional margin of manoeuvre of 500 megawatts of power reserve. This is essential to maintain quality of service and will give it more room to face contingencies on the power system. Hydro-Québec plans to attain this additional margin of manoeuvre by 1994. At that time, the required power reserve will be 4,500 megawatts, or a little more than 14% of demand. This amount covers uncertainties related to generating-facility downtime and demand.

Facility-Selection Criteria

To be able to supply electricity in a way that serves Québec's best interests, the utility takes into account the discounted cost of the construction program, environmental criteria, the need for flexibility and a realistic project schedule. It uses nominal and real discount rates of 11.5% and 6%, respectively.

3.6.3 Installations Plan

Projects in Progress

Commissioning of additional capacity at Manic 5 generating station will be completed in the winter of 1989-1990 and at La Grande 2 in 1991 and 1992. The direct-current transmission line from James Bay, the system's 11th line, will be in service in 1990. Because of additional power and energy requirements, Hydro-Québec has brought forward the commissioning of Phase II of the La Grande complex, and Brisay generating station will be available and integrated into the system by 1993. Laforge 1 and La Grande 1 generating stations will be commissioned in 1994. The north section of the 12th transmission line will be in service in 1993, and the south section in 1994. Lastly, the Manic 5 turbine runners will be upgraded from 1991 to 1994 to provide additional peak capacity.

Average Demand-Growth Scenario

Future Projects

In the 1990s, project lead times will limit the amount of energy that the utility can obtain from economically viable and environmentally acceptable projects. For example, the lead time required to make environmental studies, consult various interested parties including native communities, develop appropriate mitigative measures and obtain government authorizations precludes construction of major projects until 1998-1999, with the exception of the La Grande complex projects already in progress.

Commissioning of Laforge 2 and Eastmain 1 generating stations in 1995 and 1996 will complete the development of the La Grande complex. Commissioning of the Grande Baleine complex between 1998 and 2000 will involve construction of the 14th transmission line. Sainte-Marguerite generating station and the second section of the 13th transmission line from the North Shore will also be commissioned in 2000. The first generating stations of the Nottaway-Broadback-Rupert complex will be commissioned beginning in 2001, with subsequent commissionings adapted to needs. The 15th transmission line will be necessary for the commissioning of the first Nottaway-Broadback-Rupert generating stations.

Beyond the year 2000, Hydro-Québec must have enough flexibility to adapt to changing demand. Multiple-phase construction of the Nottaway-Broadback-Rupert complex meets this objective perfectly, because its almost 45 terawatthours of annual capacity can be commissioned in stages, as required. This complex represents almost 45% of the province's economically viable hydroelectric potential, and studies have shown that its construction can be adapted to changing demand.

The addition in 1992 and 1993 of more than 800 megawatts at La Citière and Bécancour gas-turbine stations will meet growth in power needs. On the 1996 and 1997 horizon, additional capacity at Manic 3 and Manic 2 stations will provide output carried on the first section of the 13th transmission line from the North Shore to load centres. Following this horizon, new base-load stations will meet peak-capacity needs.

For the construction schedule, it is essential that government authorizations be obtained within the specified time periods. A great many authorizations are required, as there are many different generating and transmission projects, spread out over a large portion of the province.

Figure 3.8
Energy Needs and Construction Program - Average Scenario

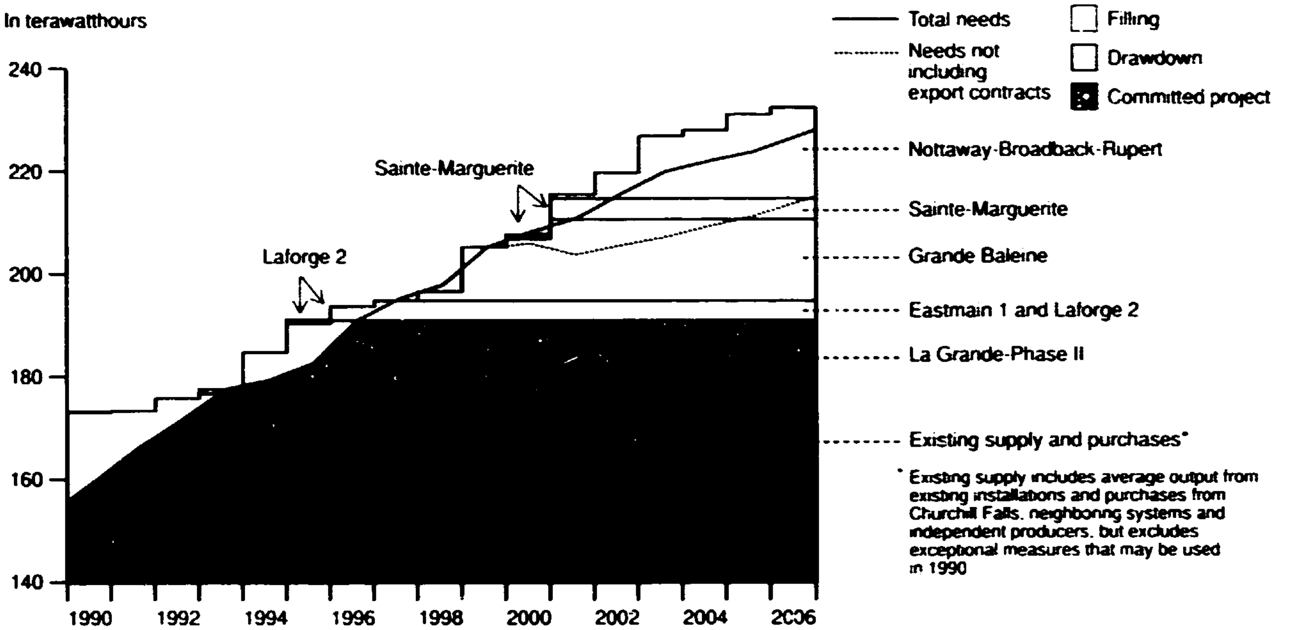


Figure 3.9
Power Needs and Construction Program – Average Scenario

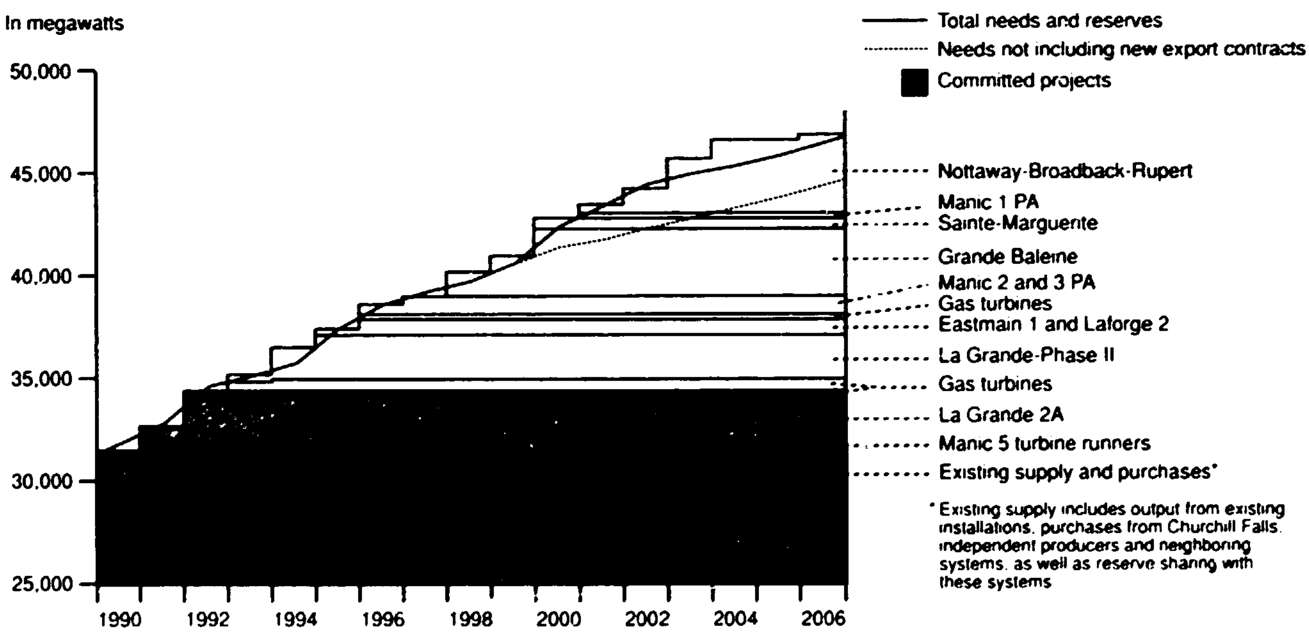


Table 3.15
Commissioning Dates for the Construction Program – Average Scenario

	Available Power at Peak (in megawatts)	Commissioning	
		Plan 1990-1992	Plan 1989-1991
Projects in progress			
• La Grande 2A	1,900	1991-1992	1991-1992
• 11th line: 450 kV DC		1990	1990
• Radisson-Nicolet-des Cantons		1990	1990
• Nicolet converter station		1992	–
• Manic 5 turbine runners	230	1991-1994	1994-1997
LA GRANDE – PHASE II			
• La Grande 1	1,310	1994-1995	1994-1995
• Laforge 1	820	1994	1995
• Brisay	380	1993	1995
• 12th line: 735 kV AC		1993-1994	1994
Additional capacity La Citière	500	1992-1993	
Future projects			
NORTHWEST			
• Laforge 2	270	1995	1996
• Eastmain 1	470	1996	2004
NORTH SHORE			
• Additional capacity at Manic 3, 2 and 1	1,120	1996-97-2001	1997-2003
• Sainte-Marguerite	800	2000	1998
• 13th line: 735 kV AC		1996-2000	1997-1998
GRANDE BALEINE COMPLEX			
• Grande Baleine 1, 2 and 3	3,060	1998-2000	1998-2000
• Integration at 315 kV		1998-2000	-
• 14th line: 735 kV AC		1998	1998
ASHUAPMUSHUAN COMPLEX	730	•	2000-2001
NBR COMPLEX			2004-...
• NBR 1	2,500	2001-2003	
• NBR 2	2,400	2002-2007	
• NBR 3	1,500	2006-...	
• NBR 4	2,000	•	
• 15th line: 735 kV AC		2001	2004
Other installations			
• Peaking plant	550	1992-1993-96	1992-93
• Lévis-des Cantons line: 735 kV AC		1995	1995

• Commissioning after 2006.

Investment

Construction and rehabilitation of generating and transmission facilities in the average-demand scenario will require investment of $45 billion, for the period 1990-1999. Major projects in progress will cost an estimated $6 billion for generation and $2 billion for transmission over the same period.

Supply-Demand Balance

Table 3.16 shows the balance in electricity supply and demand taking the projected commissionings of new generating facilities into account. It indicates the best planning of supply to reliably satisfy Québec's firm-energy needs and Hydro-Québec's contractual commitments. Total supply includes hydroelectric and thermal generation and electricity deliveries, primarily from Churchill Falls.

Table 3.16
Electrical Energy Balance Sheet*
(in terawatthours)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Supply												
Hydroelectric generation												
• runoff**	139.0	133.3	164.4	165.6	166.0	167.0	173.8	180.2	182.7	184.5	186.3	195.0
• variation (drawdown +, accumulation −)	16.2	11.1	−22.8	−7.1	−4.2	−0.1	−5.3	−8.3	−2.3	0.9	1.7	0.4
• spillage	−1.5	−1.9	–	–	–	–	–	–	–	–	–	–
Total	153.7	142.5	141.6	158.5	161.8	166.9	168.5	171.9	180.4	185.4	188.0	195.4
• Nuclear (Gentilly 2)	5.6	5.2	4.9	3.7	5.0	4.8	4.7	4.7	4.7	4.7	4.7	4.7
• Tracy (oil-fired) and gas turbines	0.2	1.5	2.6	–	–	–	–	–	–	–	–	–
• isolated systems	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Total	6.0	6.9	7.7	3.9	5.3	5.1	5.0	5.0	5.0	5.0	5.0	5.0
Electricity received (agreements and purchases)	4.0	7.6	7.4	4.0	4.9	5.8	6.2	6.2	6.2	5.5	5.5	5.5
Total supply = Needs to be met	163.7	157.0	156.7	166.4	172.0	177.8	179.7	183.1	191.6	195.9	198.5	205.9

* The figures in this table have been rounded off. As a result, when added, they may differ from the total shown.
** Real figures for 1988 and 1989 and averages for the other years. They include Churchill Falls.

Flexibility of Adaptation to Various Demand Scenarios

To meet demand, Hydro-Québec must react to a changing environment, adapting to growth that is either higher or lower than forecast. The challenge ahead is to have the flexibility required to adapt to long lead times while ensuring the sustainable development of hydroelectric resources.

The utility bases the construction schedule of its new installations on the average-demand scenario. However, given the time required for studies, consultation and construction, it is easier to adjust the construction program downward rather than upward, so the utility plans its studies and applications for government authorization using the strong-demand scenario. Any decision to begin construction is only made after authorizations have been obtained, based on the most recent demand forecasts.

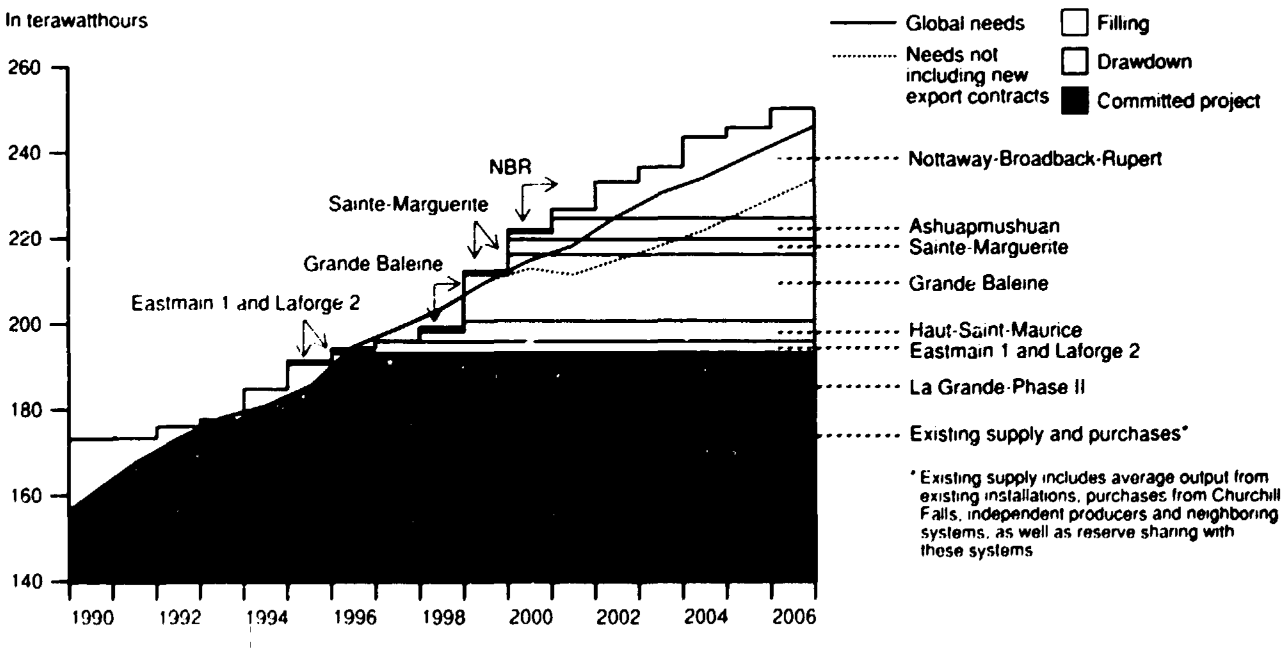
Table 3.17 shows the commissioning dates for the three demand scenarios.

High-Demand Scenario

In a high-demand scenario, all projects would be brought forward to their earliest commissioning dates, additional output would be purchased from independent producers and energy conservation would be stepped up. This scenario calls for construction of all economically viable projects within 25 years. Construction of the Grande Baleine complex would be brought forward to 1998-1999. Sainte-Marguerite generating station would be commissioned in 1999, the generating stations in the Ashuapmushuan complex in 1999, and the station on the Haut-Saint-Maurice in 1998. Commissioning of the Nottaway-Broadback-Rupert complex would begin as planned in 2000, following a compressed nine-year timetable.

In the medium term, in addition to these hydroelectric projects, Hydro-Québec might have to build additional thermal generating plants to ensure reliable supply, should some projects be delayed.

Figure 3.10
Energy Needs and Construction Program – High-Demand Scenario



* Existing supply includes average output from existing installations, purchases from Churchill Falls, independent producers and neighboring systems, as well as reserve sharing with these systems

Low-Demand Scenario

In the low-demand scenario, only the costs of performing these studies and constructing access roads to the sites would be incurred, and the utility could postpone major construction for a number of years.

Table 3.17
Construction Program According to Various Québec Demand Scenarios

	Demand Scenario		
	Average	**High**	**Low**
Projects in progress			
• La Grande 2A	1991-1992	1991-1992	1991-1992
•. 11th line: 450 kV DC	1990	1990	1990
• Radisson-Nicolet-des Cantons	1990	1990	1990
• Nicolet converter station	1992	1992	1992
• Manic 5 turbine runners	1991-1994	1991-1994	1991-1994
LA GRANDE – PHASE II			
• La Grande 1	1994-1995	1994-1995	1994-1995
• Laforge 1	1994	1994	1994
• Brisay	1993	1993	1993
• 12th line: 735 kV AC	1993-1994	1993-1994	1993-1994
Additional capacity at La Citière	1992-1993	1992-1993	1992-1993
Future projects			
NORTHWEST			
• Laforge 2	1995	1995	2000
• Eastmain 1	1996	1996	–
NORTH SHORE			
• Additional capacity at Manic 3, 2 and 1	1996-97-2001	1995-1996	2000-2001
• Sainte-Marguerite	2000	1999	–
• 13th line: 735 kV AC	1996-2000	1995-1999	2000
GRANDE BALEINE COMPLEX			
• Grande Baleine 1, 2 and 3	1998-2000	1998-1999	2005-...
• Integration at 315 kV	1998-2000	1998-1999	2005-...
• 14th line: 735 kV AC	1998	1998	2005-...
HAUT-SAINT-MAURICE	*	1998	–
ASHUAPMUSHUAN COMPLEX	*	2000	–
NBR COMPLEX			
• NBR 1	2001-2003	2000-2002	–
• NBR 2	2001-2007	2002-2004	–
• NBR 3	2006-...	2004-...	–
• NBR 4	*	2004-...	–
• 15th line: 735 kV AC	2001	2000	–
Other installations			
• Peaking plant	1992-93-96	1992-93-96-97	2000-...
• Lévis-des Cantons line: 735 kV AC	1995	1995	1995

* Commissioning after 2006.

3.6.4 Program of Studies

Hydro-Québec will continue studies on Laforge 2, Eastmain 1, Grande Baleine, Sainte-Marguerite, Ashuapmushuan, Haut-Saint-Maurice and Nottaway-Broadback-Rupert to be able to meet a high-demand scenario.

Decisions regarding construction of Laforge 2, Sainte-Marguerite and the Grande Baleine complex should be taken this year. Studies on the Ashuapmushuan and Haut-Saint-Maurice projects will give the utility the flexibility required to meet a strong increase in demand.

Through its 1990 program of studies, Hydro-Québec will maximize its information on projects representing economically viable hydroelectric potential. Still, in the long term other sources may replace hydroelectricity, so the utility will update information on the costs of nuclear energy and study a combined-cycle gas-turbine generating station.

A preliminary study will also be made to evaluate the residual potential of the Péribonka River.

With respect to peaking facilities, early in the 1990s Hydro-Québec will begin installing additional gas turbines at La Citière and Bécancour. Studies of additional capacity at Manic 3 and Manic 2 will also continue in 1990.

Decision Timetable and Applications for Government Authorizations

Hydroelectric Facilities

The schedule for realization of the hydroelectric developments required according to the average-demand scenario is shown in Figure 3.11.

The schedule retained for the Grande Baleine complex offers little margin of manoeuvre because of the lead time required to make a rigorous impact-assessment study and obtain government authorizations.

Discussions are now under way between the federal and Québec governments regarding harmonization of the various study, review and approval procedures applicable to Grande Baleine, particularly the procedure specified in the James Bay and Northern Québec Agreement. Moreover, Hydro-Québec has begun negotiations with Native Peoples to find joint solutions to the environmental, social and economic issues related to the project.

In fact, the draft-design study of the Grande Baleine complex includes two impact-assessment studies. The first concerns access infrastructure and the second, the hydroelectric complex itself.

In the case of access infrastructure, Hydro-Québec expects to obtain a revised directive from the Environment Minister in the spring of 1990 and to submit its draft-design report, including the impact-assessment study, in the summer of 1990. This will enable the utility to obtain government authorizations in the fall of 1990 and finish construction of the LG2-GB1 road section at the end of 1992.

With respect to the hydroelectric complex, the revised directive from the Environment Minister should also be issued in the spring of 1990. The draft-design report and impact-assessment study will be submitted to the government in the fall of 1990 so that authorization can be obtained in early 1992. Commissioning of the complex will take place from 1998 to 2000.

The schedules for Laforge 2 and Eastmain 1 stations are also tight.

Hydro-Québec will apply for, and hopes to obtain, a sectorial authorization for access infrastructure for the Sainte-Marguerite project in 1990. Authorizations for the hydroelectric project itself should be obtained in the fall of 1991.

The Ashuapmushuan and Haut-Saint-Maurice projects are not required in an average scenario but the utility will pursue studies to ensure the flexibility required to meet a larger increase in demand.

Figure 3.11
Decision Timetable for Base-Load Generating Stations – Average Scenario

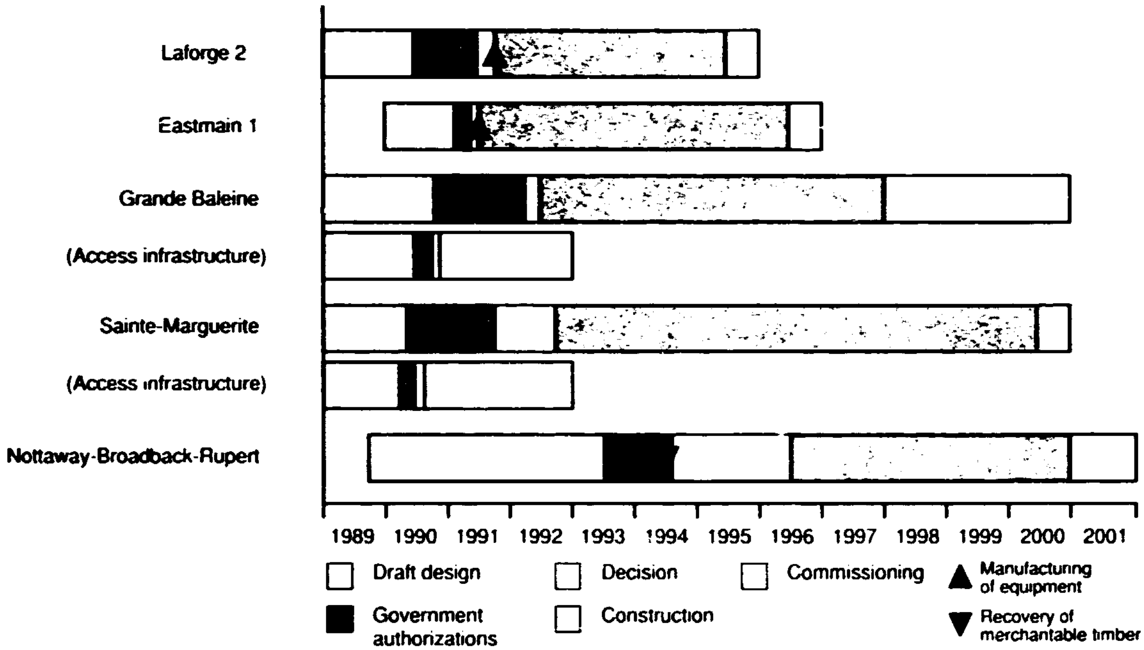
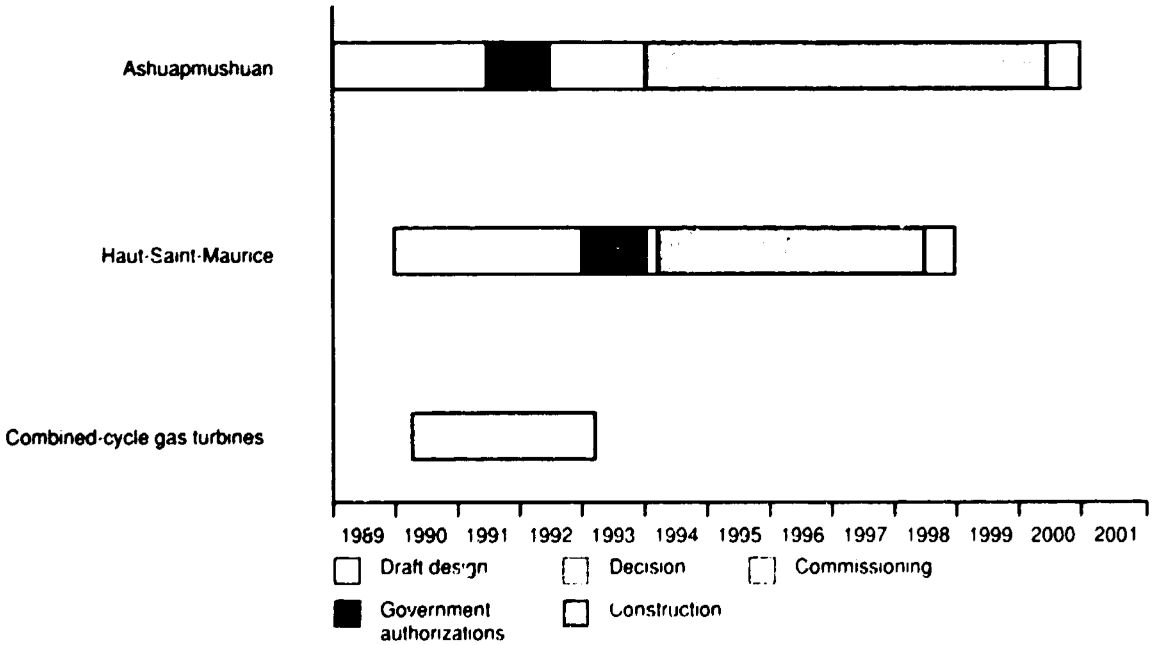


Figure 3.12
Decision Timetable for Generating Stations Under Study – High-Demand Scenario



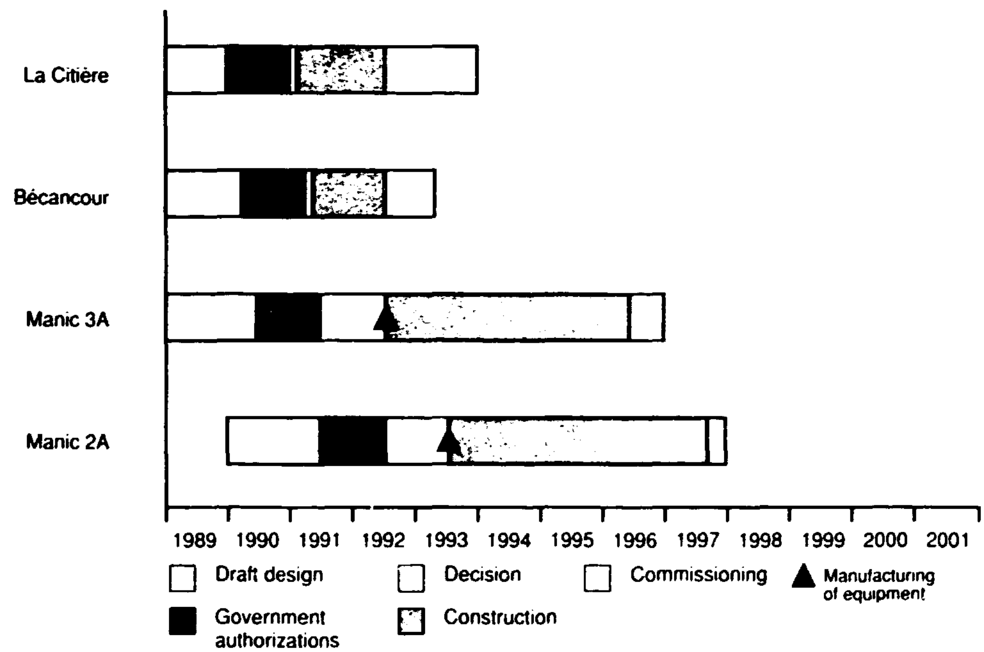
Peak-Load Thermal Facilities

The schedule for peak-load gas-turbine projects is also tight, both at La Citière and Bécancour, so the procurement process for the turbine-generator units will take place at the same time as the utility applies for government authorizations.

The contract for the manufacture of the turbine-generator units will have to be awarded in the summer of 1990, although the government authorizations will not be obtained until early in 1991.

If these deadlines are not respected, the gas-turbine stations will not be available for the 1992-1993 winter peak, and power reliability will be significantly affected.

Figure 3.13
Decision Timetable for Peaking Plant – Average Scenario



Current Québec Procedures

Hydro-Québec's projects must be examined and approved by the Québec government prior to realization. Like other projects, they are governed by the *Environment Quality Act*, the *Act respecting land use planning and development*, and the *Act to preserve agricultural land*. The utility must also obtain prior authorizations under its own *Hydro-Québec Act*.

The *Environment Quality Act* applies to Québec as a whole. It sets out two separate regimes, however, for the evaluation and review of the environmental impacts of projects, depending on whether or not these projects are in the territory covered by the James Bay and Northern Québec Agreement. Tables 3.18 and 3.19 show the authorizations required at the various stages of study and construction, under the two regimes.

Harmonization of Procedures

Hydro-Québec's projects must comply with many laws and regulations, each with its own authorization procedures. These procedures are lengthy and complex, and are carried out simultaneously. They involve a number of government bodies, which are not obliged to coordinate their activities and whose schedules vary according to their workloads. Only the time periods allowed the *Bureau d'audiences publiques sur l'environnement* (Environmental Public Hearings Board – BAPE) for public information and consultation and for public hearings are set out in the *Environment Quality Act*.

Thus far Hydro-Québec has planned its commissioning dates according to schedules agreed with the Québec government. Failure to respect these schedules would delay commissionings and could affect Hydro-Québec's ability to meet long-term electricity demand.

The obtaining of timely government authorizations so as to respect the commissioning dates in the Installations Plan is a very real constraint. It is therefore necessary to harmonize the various procedures for obtaining government authorizations.

The Québec government, as stated in its 1988 energy policy, is now studying ways of improving the review and authorization procedures for Hydro-Québec's projects, both on treaty and non-treaty land. The purpose is to ensure better integration of economic, technical and environmental considerations, on the basis of rigorous impact-assessment studies, and to determine how long each stage of the procedures under the two regimes should last.

On the basis of applicable federal laws and recent environmental decisions by the Federal Court of Canada, the federal government has informed the Québec government and Hydro-Québec that it intends to apply the federal environmental evaluation and review procedure to the Grande Baleine project. The terms of application of this procedure will be contained in an agreement to be reached between the federal government, the provincial government and the Native Peoples concerned.

Table 3.18
Québec Authorization Procedure (Excluding Territory Covered by the JBNQA*)

PROJECT PHASE	AUTHORIZATIONS			
	Ministère de l'Énergie et des Ressources	***Ministère de l'Environnement***	***Commission de la protection du territoire agricole du Québec* (CPTAQ)**	**Regional County Municipalities (RCMs)**
Beginning of draft design	Decree authorizing draft design	Minister's directive regarding impact-assessment study		
End of draft design	Decree authorizing expropriation and construction	Public information and consultation (45 days) • BAPE public hearing (4 months, if required) • Decree authorizing issuance of an authorization certificate • Authorization certificate issued by the Environment Minister	CPTAQ Public hearing (if required) • CPTAQ decision	Compliance notice from RCMs concerned OR Notice from the *Commission municipale du Quebec* OR Procedure to amend the development plans of the RCMs concerned
Realization		Authorization certificates issued by the Environment Minister for certain project components (quarries, camps, etc.)	CPTAQ public hearing (if required) • CPTAQ decision approving siting of structures	

* James Bay and Northern Québec Agreement

Table 3.19
Québec Authorization Procedure (Territory Covered by the JBNQA*)

PROJECT PHASE	**AUTHORIZATIONS**		
	Ministère de l'Énergie et des Ressources	***Ministère de l'Environnement (Administrator of the JBNQA)***	
		South of the 55th parallel	**North of the 55th parallel**
Beginning of draft design		Recommendations by the Review Committee of the Environment Minister on the nature and scope of the impact-assessment study ↓ Minister's directive regarding the impact-assessment study	Recommendations by the KATIVIK Environmental Quality Commission to the Environment Minister on the content and scope of the impact-assessment study ↓ Minister's directive regarding the impact-assessment study
	Decree authorizing draft design		
End of draft design		Analysis of the impact-assessment study by the Review Committee, with oral or written representations by the Cree Regional Authority, bands, village corporations or individuals ↓ Recommendations by the Review Committee to the Environment Minister regarding project authorization and realization ↓ Certificate of authorization issued by the Environment Minister	Analysis of the impact-assessment study by the KATIVIK Environmental Quality Commission, with written representations from interested municipalities, groups or individuals. ↓ Decision by the KATIVIK Environmental Quality Commission regarding project authorization by the Environment Minister and realization ↓ Certificate of authorization issued by the Environment Minister
	Decree authorizing construction and acquisition of immovable property in the public domain and necessary property rights		
Realization		Certificates of authorization issued by the Environment Minister for certain project components (quarries, camps, etc.)	Certificates of authorization issued by the Environment Minister for certain project components (quarries, camps, etc.)

* James Bay and Northern Québec Agreement.

4

ENVIRONMENTAL PROTECTION AND ENHANCEMENT

Over the past 20 years the Environment function has expanded at Hydro-Québec, and environmental concern has been integrated into the utility's various activities. There are now a considerable number of Hydro-Québec manag[illegible]ecialists, engineers, technic[illegible] and trades employees in all fields who have the specific mandate of ensuring environmental protection and enhancement.

Environmental Orientations

Hydro-Québec is concerned about respecting Québec's changing environmental values, while at the same time remaining in the forefront of environmental progress in the province. These are the main factors which have shaped the utility's environmental decisions in the past 20 years and which, in the years to come, will ensure environmental protection and enhancement, as well as integration of the sustainable-development concept into Hydro-Québec's activities and projects.

For 1990-1992, Hydro-Québec has adopted seven main environmental orientations, described in the sections that follow. The complementary document *Hydro-Québec and the Environment* provides further details on the utility's environmental activities.

Hydro-Québec's environmental team in 1990 comprises 143 permanent and temporary employees at the *vice-présidence Environnement* (Environment Branch), 10 employees at *Société d'énergie de la Baie James* (SEBJ) and 57 employees in the various regions. The services of outside specialists and university researchers are also retained, for a total of about 370 person-years.

4.1 Operation of Existing Installations

Objectives	Strategies
Manage contaminants	Plan of Action Concerning PCBs Site-specific maintenance of rights-of-way Plan of action for contaminants Studies of pentachlorophenol and chlorofluorocarbons
Improve existing facilities and properties from the environmental standpoint	Preparation and implementation of a second three-year program (1990-1992) Plan of action for noise created by existing facilities
Ensure environmental integration of the distribution system	Studies of the system's effects on various environments Environmental-evaluation pilot projects in each administrative region Corporate guidelines
Train and sensitize employees	Training sessions Awareness activities

4.1.1 Management of Contaminants and Hazardous Waste

The operation and maintenance of Hydro-Québec's facilities entails the use of various products and thus creates waste, some of which may be hazardous to the environment.

Most of the objectives retained for 1990-1992 are not new. They are a continuation of the measures that Hydro-Québec has taken since late in the 1970s, when governments decided to ban polychlorinated biphenyls (PCBs).

Plan of Action Concerning PCBs

Hydro-Québec adopted its *Plan of Action Concerning PCBs* in 1985. The plan's objective is to remove all PCBs from the generating, transmission and distribution system and eliminate them, by 1995. Table 4.1 summarizes the results obtained at the end of 1989.

Table 4.1
Results of the *Plan of Action Concerning PCBs* since 1985

80% of transformers and 75% of capacitors have been removed from the system.
16% of contaminated oil has been decontaminated (2.4 million litres of a total of 15 million litres). Decontaminated oil measuring from 2 to 50 ppm is destroyed, whereas that containing less than 2 ppm is reused.
325 tonnes of PCBs and of PCB-contaminated products were destroyed in Great Britain prior to August 1989, of the 3,500 tonnes to be destroyed.
40 storage sites comply with new provincial regulations.

An intensive program to decontaminate oil in existing equipment will be carried out in the next few years. Hydro-Québec is also actively involved in research to develop a destruction technology that meets Québec's needs.

While waiting for a means to destroy the PCBs, Hydro-Québec stores them and equipment that contains PCBs at some 40 storage sites at its installations. These sites comply with the new provincial regulations. The utility plans to develop a total of 48 sites that comply with the regulations. This will enable it to close down gradually several of the sites already used for temporary storage.

Right-of-Way Maintenance and Herbicides

Although the utility accounts for less than 2% of the herbicides used in Québec, it is adopting other methods of controlling vegetation (biological control, seeding of herbaceous species, etc.) as it studies their effects on the environment and develops the appropriate protective measures. Hydro-Québec's approach is to use and develop site-specific vegetation-control methods, taking into account their effectiveness and their impacts on the environment and worker health and safety.

Other Contaminants

Hydro-Québec is developing a plan of action for more efficient management of the other contaminants it must use, taking into account the various stages of their life cycles (purchase and selection of products, storage, use, handling, transportation and elimination). This plan of action covers a group of products used on a day-to-day basis, such as solvents, paints, detergents and certain petroleum products.

Hydro-Québec has about 1.5 million poles treated with pentachlorophenol (PCP), which have a service life of 30 to 35 years. In 1989, the utility began a study program to determine the real impacts of this product and find substitutes, if necessary.

Chlorofluorocarbons (CFCs) and halons are used in fire-protection systems. Given their destructive effect on the ozone layer, the utility will carry out studies with a view to adopting practices that eliminate or limit the use of these compounds.

Contaminated Sites

Hydro-Québec's contaminated sites are managed on a case-by-case basis, because the best means of restoring them must be determined individually. For example, decontamination work has begun both on the Magdalen Islands, where groundwater was polluted by fuel used at Cap-aux-Meules generating station, and at the site of the former gas-fired plant on Verdun Street in Québec City, where the soil was contaminated prior to its acquisition by Hydro-Québec in 1963.

4.1.2 Environmental Improvements in Existing Facilities

Three-Year Mitigative and Improvement Program

In 1986, Hydro-Québec implemented a program called the Plan and Review of Environmental Improvements in Facilities and Properties. This three-year mitigative and improvement program is set out in Principle 3 of *Hydro-Québec's Environment Policy*. It ended in 1989, and $127 million (at December 31, 1989) had been spent on improving the environmental performance of existing facilities. The initial evaluation of the program has confirmed its effectiveness, and a new three-year program will be designed and implemented from 1990 to 1992.

Reservoir Management

Hydro-Québec takes action on a case-by-case basis to solve problems relating to reservoir management. An inventory of complaints was recently compiled in order to define the expectations of communities neighboring the reservoirs and to plan an appropriate study program.

Noise

Hydro-Québec is currently developing a long-term plan of action to implement remedial measures at existing facilities in order to lower noise levels in locations where they are considered excessive or to lower or maintain noise levels at rehabilitated facilities.

The utility's objective is to meet provincial and municipal noise standards, even when they do not apply to existing facilities, provided they are economically feasible.

4.1.3 Integration of the Distribution System into Various Environments

In recent years, Hydro-Québec has completed a large number of studies on the distribution system's effects on various environments, such as urban areas, resort areas, heritage areas and scenic routes. These studies have led to implementation of effective measures that integrate the components of the distribution system into the landscape.

While continuing with this study program, Hydro-Québec is incorporating an environmental approach into the building of its distribution systems. In the short term, each of the utility's administrative regions will carry out a pilot environmental-evaluation project on integrating the distribution system into its surroundings. The results will be used to establish corporate guidelines.

4.1.4 Training and Sensitizing Operations Employees

Training employees and sensitizing them to the environmental aspect of their activities will be a management challenge in the next three years. This is one of the utility's preferred methods of ensuring that *Hydro-Québec's Environment Policy* is applied and that all employees take the environment into account at their places of work.

The utility will continue its training sessions and awareness activities, investing nearly $1.3 million in this area from 1990 to 1992.

4.2 Planning and Construction of New Installations

Objectives	**Strategies**
Plan and construct installations while taking the environment into account	Study on the cumulative environmental effects of the Installations Plan Determination of the environmental issues relating to projects Impact-assessment studies and development of mitigative measures Environmental monitoring and follow-up Scientific and technological research on the environment
Broaden construction strategies to enhance the positive spinoffs of projects	Strategies adapted to each project to work in concert with the communities affected to promote their social and economic development

4.2.1 Study and Implementation Process

From the planning to the operation of a new installation, the study and implementation process for Hydro-Québec's projects consists of several stages. Table 4.2 shows the integration of environmental considerations into each stage.

Study of Cumulative Environmental Effects

The study of cumulative environmental effects is integrated into the strategic planning of installations. The initial results were used to prepare Hydro-Québec's Installations Plan.

Impact-Assessment Studies

Ever since Hydro-Québec began carrying out impact-assessment studies more than 15 years ago, they have been included as part of the utility's draft-design studies.

Since 1987, draft-design studies have been carried out in two separate phases, each comprising important information and consultation activities. This approach enables the utility to work more closely with the populations affected, determine the value they place on the resources in their environment, orient studies and decisions accordingly and optimize the mitigative measures required.

Impact-assessment studies cannot be dissociated from the planning, design and implementation of a project, as the technical, economic and environmental aspects of these stages are all interdependent.

To carry out these studies, Hydro-Québec has set up a large team of environmental managers and specialists. It also retains the services of a large number of consultants, such as university researchers and specialists employed by consulting firms noted for their environmental expertise. And for certain projects, Hydro-Québec sets up scientific committees comprised of outside experts.

Table 4.2
Study and Implementation Process

Stages	**Studies and Activities**	**Objectives**
Preparation of Installations Plan Selection of generating and transmission facilities required to supply electricity to Québec and external markets as a function of demand	Study of cumulative environmental effects	Integrate environmental feasibility of the Installations Plan into its technical and economic feasibility Orient the utility's choices regarding installations planning Orient the environmental content of preliminary and draft-design studies
Preliminary studies Initial evaluation of the project's technical, economic and environmental feasibility Establishment of generating-facility development concepts or transmission-system supply scenarios	Identification and analysis of environmental issues relating to projects	Identify environmental advantages and problems that may affect project feasibility Provide environmental input to establish development concepts or supply scenarios
Draft-design studies Phase 1 of draft design (determination of project feasibility): - generating facilities: selection of development option - transmission facilities: corridor selection Phase 2 of draft design: - generating facilities: optimization of option retained - transmission facilities: route selection	Impact-assessment studies Specific information on the environment Studies of development concepts or options Identification and evaluation of impacts Information and consultation with bodies concerned Detailed assessment of impacts Development of mitigative measures Informing and consulting with populations concerned about the solution adopted	Perform impact-assessment study required pursuant to the *Environment Quality Act* and the directive of the Minister of the Environment Consult with communities concerned Develop required mitigative measures Obtain government authorizations
Engineering and Construction	Environmental monitoring Contractor training and sensitization Environmental follow-up Environmental-enhancement program Informing populations concerned	Integrate mitigative measures and other environmental conditions into plans and specifications Ensure respect for the Environment Code and other Hydro-Québec environmental guidelines Measure real impacts of project Evaluate the performance of mitigative measures and optimize them Take advantage of opportunities created by the project to enable the communities affected to participate in restoration of environmental balance disrupted by the project, in order to develop the area's biophysical resources and therefore meet community needs and objectives
Operations	Environmental follow-up	

Environmental Follow-up

The results of environmental follow-up are used not only for project optimization but also to improve impact-assessment methods and mitigative measures for future projects. Thus, in certain instances environmental follow-up takes place over very long periods, such as the La Grande complex environmental follow-up network, which began in 1978.

4.2.2 Environmental Feasibility of the Installations Plan

Hydro-Québec's generating and transmission facilities occupy 1% of Québec (1.5 million square kilometres). Construction of all projects included in the economically feasible potential of 18,800 megawatts could double the area occupied. The utility thus has a clear responsibility to protect and enhance the environment.

The initial results of the study of cumulative environmental effects show that, given current knowledge, construction of the projects in the economically viable potential will not have major effects on the climate, underground water tables, wildlife resources and habitats, or estuarine environments. This first conclusion takes into account the fact that each project will receive a rigorous impact-assessment study and appropriate mitigative measures. Certain general studies of these issues must also be continued in order to provide basic information and specialized methods to be used in each project's impact-assessment studies.

Nevertheless, interactions between resources and their users mean that these projects are likely to have cumulative effects in three areas of the human environment: organization and structure of the area; regional economies; and local lifestyles. These effects will be significant. Mitigating and managing them will require increased collaboration with communities affected, beyond that already included in the impact-assessment and draft-design studies.

Moreover, Hydro-Québec is not the only land user or developer. Environmental protection and enhancement are concerns that must be shared by other users, resource developers and land-use planners and developers.

The utility has therefore decided to broaden its project-implementation strategy to place greater emphasis on social and economic considerations in the environments concerned, in keeping with a multifunctional approach that will enhance the positive spinoffs of its projects.

The Native Peoples

The development of La Grande, which began in 1972, took place within the framework of the James Bay and Northern Québec Agreement. This major hydroelectric project, completed with the continuous help of local representatives, had many positive effects.

The Cree population of the area rose from 7,000 in 1976 to 10,300 in 1988. Moreover, it has been able to form, within its community, an increasingly qualified pool of manpower. In fact, during the construction of Phase I of the La Grande complex, the Cree population supplied 200,000 person-days of work. When construction was at its height, 522 Cree were working on the site.

The James Bay Agreement provides for an income-security program designed to preserve the traditional Cree economy based on hunting, fishing and trapping. Under this program, Québec paid out nearly $12 million in guaranteed income during the 1987-1988 fiscal year alone, or nearly $10,000 per family.

For the development of La Grande, 1,530 kilometres of roads and many dams and dikes were built. These also serve the population of the region, providing easier access to remote trapping areas. Furthermore, construction of the road between Matagami, La Grande 2 and Chisasibi has allowed a wider distribution of goods, which has helped lower their cost. And since the signing of the Agreement in 1975, most villages have been electrified and are supplied by Hydro-Québec.

The development of this region has also led to the formation of Cree businesses. During the 1988-1989 fiscal year, these businesses signed contracts with Hydro-Québec and SEBJ totalling some $30 million.

Moreover, to facilitate the integration of new Cree personnel into its operating activities, the utility has launched a training program which will continue over the next few years. By 1996, Hydro-Québec will have hired some 150 Cree as permanent employees.

However, the utility's projects in the areas where the native peoples live have significant impacts on their way of life and on the economic and social structures of their communities. Initially, these impacts are due to the presence of large numbers of construction workers who change the interactions between the native and white communities. The access roads that Hydro-Québec requires to construct the projects also promote greater accessibility to the region during and after construction.

While the Nottaway-Broadback-Rupert and Grande Baleine projects will have an impact on the Cree and Inuit residents of James Bay and Hudson Bay, the Sainte-Marguerite and Ashuapmushuan projects will also affect the fishing, hunting and trapping activities of the Montagnais. Furthermore, the Haut-Saint-Maurice development will flood 10% of the Atikamek reserve, Weymontachie.

All necessary measures will be taken to ensure that native peoples are involved in the project's development and that they benefit from its direct and indirect economic spinoffs, both during and after construction. Collaboration with native peoples will aim to create economic and social development in their communities according to their needs, so that they can also pursue their traditional activities.

4.2.3 Environmental Issues Related to Major Projects

The study of cumulative environmental effects and preliminary and draft-design studies demonstrate the environmental problems associated with the Installations Plan. The various environmental issues pertaining to projects in the Installations Plan are outlined in Table 4.3.

It should be noted that, in phase I of the development of the *La Grande Rivière*, Hydro-Québec and SEBJ have allocated some $250 million to environmental studies and measures, which is nearly 2% of the total construction cost. Mitigative measures comprise, among others, seeding of river banks, construction of a fish ladder, planting of nine million trees and shrubs, and cutting and clearing of forest debris.

Mercury

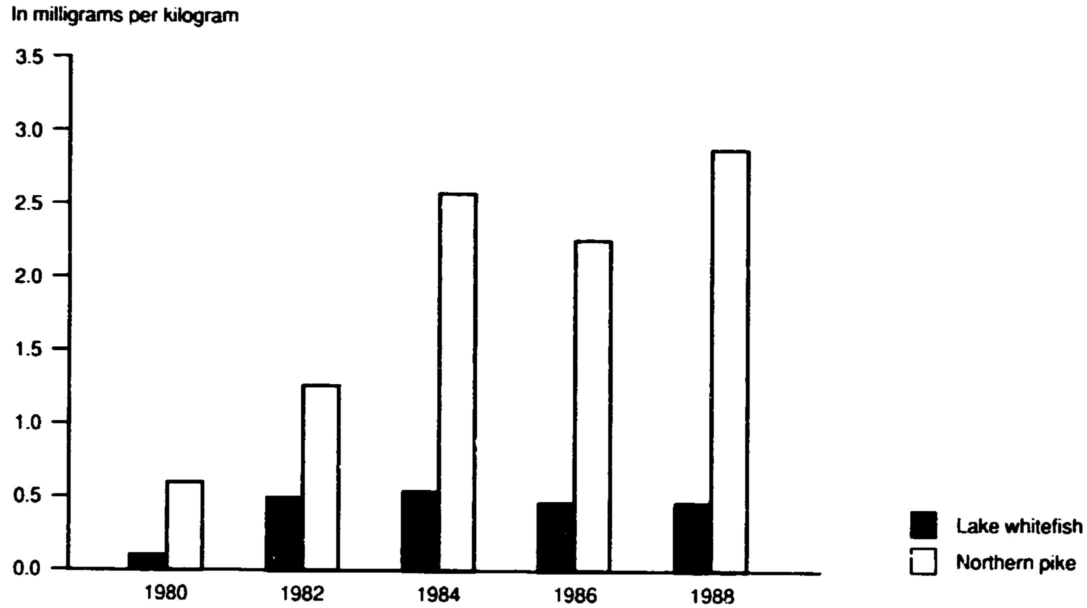
The problem of mercury is one of the most important environmental issues, as it arises in the development of all reservoir-type hydroelectric generating stations. Geological in origin, mercury is released into the environment by complex biogeochemical processes that occur when reservoirs are impounded.

The La Grande complex is an example that has made it possible to better understand this phenomenon. A follow-up of mercury concentrations in the flesh of fish in the La Grande reservoirs began in 1978. The results show that concentrations increase rapidly after impounding, but level off after six or seven years. The phenomenon is therefore temporary, and extrapolations based on follow-up results show that the concentrations return to normal 10 or 15 years after levelling off. It should also be noted that predatory fish, which native peoples are partial to, accumulate greater concentrations of mercury because of their position in the food chain.

The issue of mercury at the La Grande complex was the subject of a trilateral agreement, called the *C.Q. — H.-Q. Mercury Agreement (1986)*, signed by the Québec government, the Cree Regional Authority and Hydro-Québec. The cost of the agreement is $18 million, of which $12.4 million is provided by Hydro-Québec, and its term is 10 years (1986-1995). By 1986, medical follow-up and information campaigns undertaken by the Cree Board of Health and Social Services had brought the level of mercury in the Chisasibi Cree down to levels comparable to those recorded before the reservoirs were created.

Experience acquired at the La Grande complex has made it possible to develop solutions for the Grande Baleine project. A comprehensive approach will be taken in collaboration with native communities, as was done under the above-mentioned Agreement. Thus a food supply based on resources other than predatory fish could be envisaged.

Figure 4.1
La Grande 2 Reservoir
Average Mercury Concentration in the Flesh of Lake Whitefish and Northern Pike



4.2.4 Environmental Research

Environmental research is important in the development of the knowledge required to pursue the study of cumulative environmental effects, preliminary studies and impact-assessment studies. Much of the research also attempts to solve operating problems, and research results are integrated into the planning and design of installations.

Environmental research seeks practical and effective ways to mitigate the negative impacts of projects, enhance Québec's resources and improve the environmental performance of facilities. It consists of three main programs:

- wildlife resources and habitats;
- land-use development and regional development;
- environmental health.

Each program consists of three types of activity:

- acquisition of knowledge;
- development of analytical tools and protection and enhancement technologies;
- environmental follow-up.

4.3 Hydro-Québec's Environmental Performance

Québecers have made environmental protection their foremost concern. In fact, the utility's environmental performance is as important to its customers as is its quality of service. Hydro-Québec will therefore ensure that its environmental performance attains or maintains the level that the public demands. It will, as of 1990, be gradually introducing specific programs to evaluate and audit its performance level.

In addition, Hydro-Québec has concluded that public awareness of its environmental activities and obligations is quite limited. It is thus in the utility's interest to publicize the results of its environmental studies and activities as well as its environmental orientations, as much as possible.

Objective	**Strategies**
Evaluate Hydro-Québec's environmental performance	Evaluate performance using appropriate indicators Evaluate total environmental spending requirements Develop environmental-audit mechanisms

Table 4.3
Environmental Issues Related to the Installations Plan

Project (stage of realization)	**Environmental Issues**	**Solutions Put Forward or Already Implemented***
Grande Baleine (phase 2 of draft design)	Native peoples' way of life	Encourage native communities' social and economic development, according to needs, that would allow them to continue traditional activities
	Mercury	Work together with native peoples: find temporary solutions for an alternative food supply
	Natural environment: – sea mammals (changes in the freshwater supply in the Strait of Manitounouk)	Environmental and impact-assessment studies in progress
	– freshwater seals (changes in the flow of certain rivers feeding Lac aux Loups Marins)	Studies of freshwater seals to determine whether they are in fact an endemic species
	– migratory birds (reduced habitats)	
Sainte-Marguerite (phase 2 of draft design)	Traditional Montagnais activities (fishing, hunting and trapping) Recreational and tourist activities	Multifunctional approach to the project in collaboration with native peoples and other land users
	Salmon in the Moisie River (effect of diverting the Carheil and aux Pékans rivers into the Moisie River)	Stabilization of flow conditions to preserve and even improve salmon habitats, and to encourage sport fishing Ongoing scientific committee, comprised of representatives of Hydro-Québec, the Atlantic Salmon Federation, Fisheries and Oceans Canada, the Québec *ministère du Loisir, de la Chasse et de la Pêche*, environmental consulting firms, and the Atikamek-Montagnais Band Council
	Merchantable timber	Project schedule altered to allow the recovery of merchantable timber and processing by local mills Bring forward construction of the access road, which would eventually have been built by the local forestry industry
	Direct and indirect socio-economic spinoffs	Consultation with population and other users: – maximize spinoffs so as to contribute to regional development – plan the road to provide access to the regions' other forest resources; develop recreational and tourist infrastructures; and carry out measures to protect and enhance wildlife habitats
Ashuapmushuan (phase 1 of draft design)	Landlocked salmon	Original project (4 stations, 1,150 megawatts) reduced to 2 stations with a total of 730 megawatts at peak
	Heritage and recreational value of the river Regional and economic spinoffs Traditional Montagnais activities (hunting and trapping)	Multifunctional approach to harmonize, through dialogue and the introduction of appropriate measures, the various uses of the river and the flooded zones, and to enhance local and regional socio-economic spinoffs Creation, in 1989, of the *Centre écologique du Lac Saint-Jean* with financial assistance from Hydro-Québec

* All projects receive a rigorous impact study and appropriate mitigative measures.

Project (stage of realization)	**Environmental Issues**	**Solutions Put Forward or Already Implemented***
Nottaway-Broadback-Rupert (phase 1 of draft design begins in 1990)	Mercury Wildlife (moose and wildfowl) Estuarine habitats Native peoples' ways of life (possible cumulative effects with the La Grande and Grande Baleine complexes) Opening-up of the territory with the access roads	Construction of the project in several stages, from 2001 through 2026, rather than in a single block of 8,400 megawatts. Staggered construction will permit better management of land clearing, and reduce the project's main impacts on local ways of life. Work together with native peoples (find temporary solutions for an alternative food supply)
Gas-turbine stations: La Citière (addition of 500 megawatts) and Bécancour (300 megawatts) (end of draft-design studies)	Atmospheric pollution by emissions of nitrogen oxides (NO_x) and sulphuric oxide (SO_2) Noise Future use of surrounding land	Studies on La Citière show that air-quality standards will be maintained. Studies on Bécancour are still in progress. Design and implement appropriate mitigative measures to respect provincial and municipal noise regulations
Haut-Saint-Maurice (Rapides des Coeurs, de la Chaudière et Manigance) (phase 1 of draft design)	Flooding of approximately 10% of the Atikamek reserve, Weymontachie Flooding of productive forest areas and recovery of merchantable timber Mercury Rerouting of a section of track owned by Canadian National Railways	Impact-assessment study in progress Consult with other land users in the region
Transmission lines (12th and 13th lines are required in the short term) (phase 1 of draft design)	Land-use organization and structure in the inhabited areas at the foot of the Laurentians and in the St. Lawrence Valley: – recreational areas north of Montréal (Gatineau, Outaouais and Lower Laurentians) – preservation of natural landscapes – crossing of major rivers (St. Lawrence, Saguenay and Ottawa) – visual integration of facilities	Impact-assessment studies in progress Location, design and implementation of appropriate mitigative measures in collaboration with communities affected and with land-use planners and developers of the various areas crossed, especially regional county municipalities (RCMs)

* All projects receive a rigorous impact study and appropriate mitigative measures.

5

EMPLOYEE MOBILIZATION

In its previous Development Plan, Hydro-Québec identified employee mobilization as a strategic concern for the 1990s. Today, this concern has become even more pressing, given the urgent and major challenges that lie ahead: modernization that focuses on power-system reliability and quality of service; balancing the development of installations, changing markets, and concerns relating to the physical and social environment; and maintaining the financial soundness for which Hydro-Québec has always been known.

To meet the new challenges of the 1990s, the utility requires optimal involvement from all its work force. Employees, management and unions must together define those conditions that will enable the utility to achieve its major objectives. There is no doubt that the difficulties, criticism and disputes that have plagued it in recent years have affected the climate of work and employees' commitment. At this stage of its development, it is imperative that Hydro-Québec rally and mobilize the strengths of its employees.

Three areas take priority. The first is to continue the mobilization measures begun last year to involve managers and specialists in a more comprehensive, longer-term strategic development plan pertaining to all human resources. The second concerns relations with unionized employees, with whom the utility must in the shorter term negotiate and implement agreements that will constitute a new consensus focusing on service quality, productivity and employee aspirations. The third relates to training replacement personnel and to moderate growth in the utility's staff levels: at the dawn of this new decade, Hydro-Québec must strengthen its internal and external recruiting efforts, and ensure that the technical, commercial and management expertise of all employees remains at the forefront of progress.

Mobilization, improved labor relations with unionized employees, and staffing and training are the three human resources management objectives that will enable the utility to meet the challenges identified in this Development Plan.

Objectives	Strategies
Promote employee mobilization throughout the utility	Continue the *Action-cadres* program (redefining and enriching the management role) Implement the new *Régime de gestion des spécialistes* (specialists' management plan) Improve occupational health and safety management Implement an employee-mobilization plan for the 1990s
Negotiate and implement new collective agreements with a view to improving the working climate	Renew collective agreements with CUPE and the *Fraternité des constables spéciaux d'Hydro-Québec*, and sign a first collective agreement with the *Syndicat professionnel des scientifiques de l'IREQ* (SPSI) Implement the information, training and follow-up measures associated with the new collective agreements, with a view to improving the working climate
Reinforce staffing and intensify training to support the utility's objective of enhanced service quality and productivity	Reinforce the staffing function Increase women's representation Develop long-term human resources management Intensify training and professional development

5.1 Mobilization of Employees Throughout the Utility

In 1989, measures were introduced to mobilize various groups of employees and enhance productivity and improve the working climate. These short- and medium-term measures primarily affected the managers and specialists, and also focused on occupational health and safety management. In the longer term, an employee-mobilization plan will be developed and implemented as of 1990, serving as a frame of reference for adapting human resources management to the challenges of the 1990s.

Continue the Action-cadres program (redefining and enriching the management role)

Managers were affected significantly by the changes that took place at Hydro-Québec in the 1980s. Thus *Action-cadres*, a three-year program, was launched late in 1988 to redefine and enrich the role of, and provide support for, the utility's 2,200 managers.

A number of the 20 proposed measures were introduced in 1989, as planned. The most noteworthy are: creation of an ongoing consultation structure to increase management involvement in collective bargaining; steps taken to deepen understanding of the financial statements and budget processes; initial reorganization of the work of supervisory management to enable them to spend more time in the field with their crews; and development of a training program for new managers.

In 1990, the focus will be on improving internal communications. A number of measures will also be taken regarding continuing education, professional career tracks and management succession. A collective bonus program will be introduced during the year to recognize team performance, and a review of job-evaluation procedures for managers will begin.

Implement the new *Régime de gestion des spécialistes* (specialists' management plan)

This new plan is based on the same philosophy as the *Action-cadres* program and began at the same time, late in 1988. Specialists have responsibilities directly complementary to those of management. The new program's purpose is to redefine their role in relation to that of management, increase their mobility within Hydro-Québec and harmonize their salary scales, regardless of their field of activity. Phase I of the program, focusing on work organization, staffing and remuneration, began in 1989.

Phase I will continue in 1990, and phase II, regarding mobility and professional development, will get under way. Nevertheless, this program will have to take into account decisions by the Commissioner of Labor regarding applications to unionize certain specialists.

Improve Occupational Health and Safety Management

Hydro-Québec is aware of the impact that occupational accidents and hazards have on employees' quality of life and productivity, and is therefore concerned with improving the utility's health and safety performance. Since 1984, the utility has been progressively implementing the International Safety Rating System (ISRS). Hydro-Québec had to revise its plan of action in 1989, however, when the rating agency raised its evaluation criteria.

Despite stricter requirements, the utility's objectives remain the same: to obtain a 3-star level by the end of 1991 and a 4-star level in 1993, which will now be much more difficult to attain because of the more demanding criteria. Areas of note for 1990 in the revised plan of action are: measures that will be implemented to increase senior management's involvement when serious accidents occur, and improving the functioning of joint (labor-management) committees on health and safety.

With respect to occupational health, more than 4,000 employees received general training in 1989, and training required under the Workplace Hazardous Materials Information System (WHMIS) will be provided in 1990 especially for those employees most exposed to hazardous chemicals.

Health and safety management will also be improved by changes in power-system components and upgraded equipment and working tools. The Distribution function alone spent $24 million on these changes in 1989 and expects to spend an average of $50 million a year from 1990 to 1995.

In the field of ergonomics, a study has examined the work procedures of distribution lineworkers, and the results will determine how improvements in the work environment and working methods can be gradually introduced so as to reduce the incidence of back problems.

Several studies are also in progress on the biological effects of electric and magnetic fields. Hydro-Québec is in fact involved in a wide-ranging epidemiological study of electrical utility employees that examines 150,000 medical files of workers at Hydro-Québec, Électricité de France and Ontario Hydro. This study began in 1988 and should be completed by 1992.

Implement a Strategic Employee-Mobilization Plan for the 1990s

In 1989, although the focus was on immediate human resources priorities, a longer-term reorientation also began, including measures related to training the next generation and redefining and enriching managers' and specialists' roles. In 1990, Hydro-Québec will be developing an integrated plan to mobilize all employees, a major challenge for the utility in the 1990s.

Various studies on the work climate and employees' socio-cultural values have shown discrepancies between the values held by employees and management, problems related to motivation at work, and differences between management and employees in the importance they place on involvement.

The plan will thus establish specific approaches based on the values now held by the utility and on other values to be integrated into its corporate culture, such as developing a new solidarity, renewed leadership and individual accountability. In this context, and more than ever before, employees will be valued as the resource essential to Hydro-Québec's fulfilling its mandate.

To meet this mobilization challenge, a preliminary analysis was done in 1989 of human resources at Hydro-Québec. Senior management must now be consulted to determine the measures to be taken and their order of priority. On the basis of work done by a multidisciplinary task force created for this purpose, a strategic human resources plan will be carried out in 1990 through implementation of two main measures:

- involve managers in choosing major orientations – together identify work to complement the preliminary analysis, and preferred human resources development and management orientations;

- develop and implement a master plan to achieve the desired reorientation; this plan will specify the areas of activity and main programs to be carried out, including a major in-house communications program, as well as priority measures to be retained on the basis of their importance and immediate feasibility in 1990.

Table 5.1
Distribution of Permanent Employees
(at December 31, 1989)

Administrative Unit / Job Group	Managers	Specialists	Engineers	Technicians	Clerical	Trades	Constables	TOTAL
Region								
La Grande Rivière	148	101	32	180	260	471	-	1,192
Laurentides	213	148	30	145	677	822	-	2,035
Maisonneuve	193	147	103	382	266	654	-	1,745
Manicouagan	108	61	26	154	162	434	-	945
Matapédia	67	60	10	67	194	245	-	643
Mauricie	219	138	112	251	426	777	-	1,923
Montmorency	205	140	42	209	585	702	-	1,883
Richelieu	192	123	34	154	580	667	-	1,750
Saguenay	65	41	11	74	127	203	-	521
Saint-Laurent	203	188	38	64	847	649	-	1,989
Total	1,613	1,147	438	1,680	4,124	5,624	-	14,626
Men	1,551	929	420	1,658	1,990	5,588	-	12,136
Women	62	218	18	22	2,134	36	-	2,490
Installations Group	213	344	316	147	360	12	-	1,392
Men	201	271	300	144	131	10	-	1,057
Women	12	73	16	3	229	2	-	335
Head Office	394	1,302	450	258	727	180	108	3,419
Men	356	920	424	253	165	172	101	2,391
Women	38	382	26	5	562	8	7	1,028
Total Hydro-Québec	2,220	2,793	1,204	2,085	5,211	5,816	108	19,437
Men	2,108	2,120	1,144	2,055	2,286	5,770	101	15,584
Women	112	673	60	30	2,925	46	7	3,853

5.2 Negotiation and Implemention of New Collective Agreements with a View to Improving the Working Climate

Given a unionization rate of more than 75% for operating personnel (permanent and temporary), labor relations is an important aspect of the utility's management activities. Thus renewal and implementation of collective agreements affecting more than 17,500 people was one of the main human resources objectives in 1989. As this objective has not yet been reached, the negotiation and implementation of new agreements, with a view to internal coherence, remains a corporate objective for 1990-1992. This will be achieved through improved labor relations and cooperation with unionized employees and their representatives.

It was possible to conclude a number of agreements in 1989 to the satisfaction of both parties. Hydro-Québec renewed its agreements with temporary construction personnel, except those working for Preliminary Studies. A new agreement with the *Syndicat professionnel des ingénieurs d'Hydro-Québec* (SPIHQ) settled disputes regarding accreditation and salary scales. Lastly, the first collective agreement with the *Syndicat professionnel des scientifiques de l'IREQ* (SPSI), accredited in 1989, will have to be ratified by the scientists in 1990. Nonetheless, an agreement covering salary revision for the current year was reached late in 1989.

An improved climate of work is an important concern in the short and medium term. The lengthy and difficult labor dispute that occurred in 1989 was characterized by management's firm determination to institute recovery measures, which encountered some obstacles. The utility must now take steps to effect a rapprochement between managers (especially supervisory managers) and employees, and between unions and management.

The strategy for implementing new agreements and a number of *Action-cadres* activities do aim to improve labor relations. But, first and foremost, measures must be taken to promote communications and direct relations between supervisory management and their employees to re-establish mutual trust. Employees and unions must be kept informed of and involved in the search for solutions, supervisory management must be more present on the work site, regular meetings between employees and their superiors must be held, and so on.

The main issues are contracting-out, notably maintaining and clarifying the balance between work done internally and externally, as well as management of temporary employees, rules governing the right to refuse work for safety reasons and the creation of shifts – three matters relating to productivity. The new agreements should also set out Hydro-Québec's commitments regarding training, mainly for Technicians and Trades employees, and ensure that wages and benefits remain comparable to those at other large Québec companies.

The strategies regarding collective agreements are as follows:

- renew agreements with locals affiliated with the Canadian Union of Public Employees (CUPE) and with the *Fraternité des constables spéciaux d'Hydro-Québec*, and sign a first collective agreement with the *Syndicat professionnel des scientifiques de l'IREQ* (SPSI);

- implement the information, training and follow-up measures associated with the new collective agreements for an improved working climate.

Table 5.2
Employees by Union Accreditation
(at December 31, 1989)

	Permanent	Temporary
Operations		
Syndicat Professionnel des Ingénieurs de l'Hydro-Québec	1,181	36
Syndicat Professionnel des Scientifiques de l'IREQ	172	1
Syndicat des technicien-ne-s d'Hydro-Québec	2,079	265
Syndicat des employé-e-s de bureau d'Hydro-Québec	4,969	1,770
Syndicat des employé-e-s de bureau d'Hydro-Québec (annexe)	34	134
Syndicat des employés de métiers d'Hydro-Québec	5,693	754
Syndicat des employés de métiers d'Hydro-Québec – Répartiteurs	118	–
Fraternité des constables spéciaux d'Hydro-Québec	108	206
Subtotal	14,354	3,166
Construction		
Governed by agreements with Hydro-Québec	–	120
Construction Decree	–	78
Subtotal	–	198
Total	14,354	3,364

5.3 Reinforced Staffing and Intensified Training To Support the Corporate Objective of Enhanced Service Quality and Productivity

Reinforce Staffing

To serve its customers, Hydro-Québec has almost 19,500 permanent employees and more than 5,000 temporary employees working in 10 administrative regions, at head office and in the Installations Group. The number of employees, which is already substantial, will increase between now and 1992 by 3.3% a year for permanent employees so as to meet the requirements of the various client oriented service quality enhancement programs, power-system reliability and normal growth in activities.

This influx of new blood, which in 1989 represented nearly 600 hirings and in 1990-1992 will represent more than 3,300, is a departure from the downsizing and relative stability of the 1980s, as seen in table 5.4. The period of moderate growth now under way will enable young people to obtain employment at Hydro-Québec and will promote more rapid integration of women. For permanent employees, it will create opportunities for promotion, lateral mobility and reorientation. For example, in 1989 more than 500 employees changed from one job group to another. Moreover, if changes from one unit or position to another are included, about 25% of all permanent employees will be reassigned each year within the utility.

As recruiting and internal mobility increase in importance, staffing must be adapted and strengthened. In 1989, management expressed certain misgivings about the length of the recruiting process. This process must become more rapid and rigorous, while taking into account equal-opportunity requirements for target groups. Temporary employees must also be selected with greater care, because they generally take priority over outside applicants when permanent positions are filled.

The following staffing strategy will be implemented:

- develop and adopt a staffing policy that covers turnover (hirings and departures) of permanent and temporary employees and internal mobility (promotions, lateral moves, etc.);

- develop directives applicable to specific groups, in particular for external and internal recruiting of managers, specialists and non-unionized employees;

- revise the hiring process for unionized employees, including the preselection procedure, medical examinations prior to hiring, evaluation of applicants' abilities and personality profile, and training of employees responsible for recruiting unionized personnel.

Table 5.3
Mobility and Turnover of Permanent Employees in 1989*

Job Group	Employees at Dec 31 1988	%	Hirings 1989**	Departures 1989	Arrivals in the group	Departures from the group	Employees at Dec. 31 1989	%
Managers	2,149	11.2	11	75	222	87	2,220	11.4
Specialists	2,697	14.0	106	76	183	117	2,793	14.4
Engineers	1,165	6.0	68	20	28	37	1,204	6.2
Technicians	2,009	10.4	74	25	67	40	2,085	10.7
Clerical	5,270	27.4	127	84	17	119	5,211	26.8
Trades	5,848	30.4	207	126	20	133	5,816	29.9
Constables	114	0.6	1	3	0	4	108	0.6
Total	19,252	100.0	594	409	537	537	19,437	100.0

* Excludes subsidiaries.
** Includes net movements to or from subsidiaries.

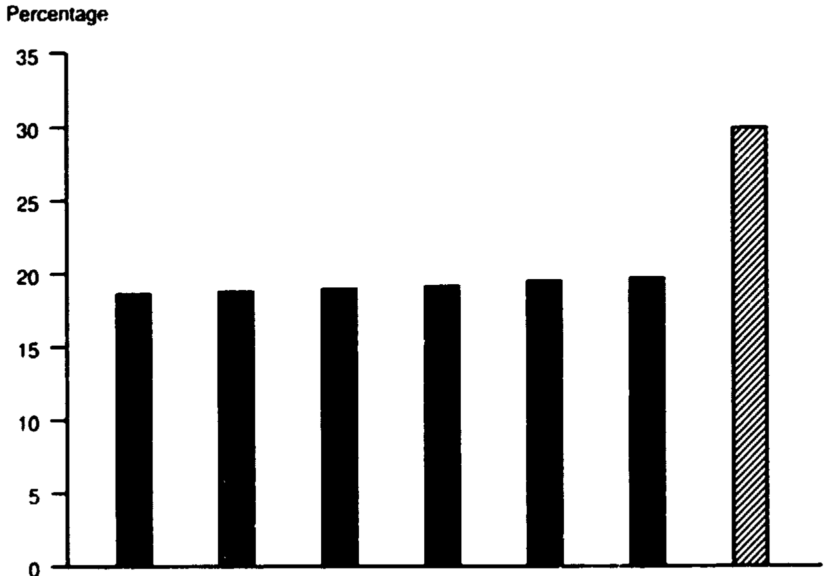
Increase Women's Representation

The strategy to reinforce staffing will be complemented by a specific strategy to increase the proportion of women working for the utility.

Despite the efforts of the past 10 years, women are still under-represented at Hydro-Québec. From 1984 to 1989, the proportion of women increased by only 1.2%, and now stands at about 20% of permanent employees. To accelerate this trend, an Equal Opportunity Program that complies with the regulations of the Québec Human Rights Commission is being developed. Moreover, without neglecting the other target groups, in 1989 the utility adopted the 10-year objective of increasing the proportion of women to 30% of permanent employees by 1999. This corporate commitment was announced officially at a conference of women managers, specialists and engineers in October 1989.

To reach the 30% level, additional efforts must be made. Firm measures regarding the hiring and promotion of women will be initiated in 1990 by the various units in which women are under-represented, and a follow-up procedure will be implemented during the year. At the same time, an analysis of the employment system (staffing, remuneration, training and working conditions) will identify the systemic obstacles that women encounter at Hydro-Québec. This analysis will become the basis for qualitative enhancement objectives.

Figure 5.1
Permanent Women Employees at Hydro-Québec and 1999 Objective



Develop Long-Term Management of Human Resources

Given that staffing activities will assume greater importance in the years to come, it is essential that staff planning be better defined. The first component of this effort is studies and analyses of employment categories (permanent, temporary and contracting-out) as a function of Hydro-Québec's present and future work load. It is also necessary to develop performance and productivity guidelines for long-term management.

During the 1990-1992 period, these studies and tools will be developed to form the basis for further staff planning and enhanced management control. The three aims will be to:

- harmonize the human resources' forecasting process among the utility's units or functions;
- pursue studies on turnover, mobility and temporary employees;
- establish performance guidelines in human resources, primarily as regards staffing, remuneration and benefits, with a view to measuring utility-wide productivity.

Intensify Training and Professional Development

Rapidly filling positions with qualified applicants will contribute significantly to greater productivity, but it is equally important to maintain a high level of on-the-job performance. The stability of Hydro-Québec's staff, the highly technical nature of jobs and rapid technological change have created the need for intensified continuing education and professional development. These measures, tailored to the various job categories, are intended to enhance the quality of individual work, customer service and employee satisfaction.

For example, in 1989 the *groupe Exploitation régionale* (Regional Operations), which covers the employees working in the utility's 10 administrative regions, set aside over $25 million for personnel training throughout the utility. This figure is tangible proof that the development of employees, in their current positions or in their career tracks, is fundamental to the utility's human resources management philosophy.

Several new programs were launched in 1988 and 1989. Unionized clerical employees now receive specific training when they change jobs and may advance to more complex positions by obtaining preparatory training offered at the CEGEP (community college) level. An information system summarizing engineers' existing qualifications was implemented in 1989 and will facilitate the development of programs and approaches for this group. With respect to managers and specialists, the *Action-cadres* program and the new specialists' management plan contain concrete professional-development measures for 1990 and subsequent years. As well, environmental awareness training for operations employees will continue in 1990-1992.

Basically, however, human resources' efforts will focus mainly on technical and marketing training related to the utility's primary mandate. The technical training plans for trades and technical employees, which are central to collective bargaining, are one of the utility's priorities, because they will determine the success of power-system reliability and service-quality efforts. These training plans will cover generation, transmission, sub-transmission, distribution and telecommunications, as well as marketing activities that deal directly with customers.

The utility has, therefore, made a commitment to develop an integrated human resources development policy in 1990, based on professional development relating to current positions and career tracks within the utility. It will continue or will implement diversified programs according to job groups, taking into account the utility's needs and employees' aspirations.

Table 5.4
Employee Statistics

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Permanent Employees* (at December 31)	18,975	18,560	18,208	18,470	18,933	19,252	19,437	20,200	20,900	21,400
Employees at January 1	19,959	18,975	18,560	18,208	18,470	18,933	19,252	19,437	20,200	20,900
Hirings for the year**	146	217	595	487	685	712	594	1,188	1,150	975
Departures for the year										
- retirements	871	501	803	114	132	237	292	300	315	330
- other	259	131	144	111	90	156	117	125	135	145
Temporary Employees***	1,986	2,186	3,163	2,749	2,989	3,521	4,425	5,174	4,805	4,505
Operations	1,610	1,886	2,788	2,326	2,656	3,108	3,885	4,669	4,300	4,000
Construction	262	186	195	242	204	250	328	375	375	375
Construction Decree	114	114	180	181	129	163	212	130	130	130
Management Employees – SEBJ (in person-years)	982	485	200	121	153	200	390	625	675	675

* Excludes subsidiaries.
** Includes not movements to or from subsidiaries.
*** Average based on 26 pay periods.

6

FINANCE AND RATES

Hydro-Québec's financial performance since 1982 illustrates its vulnerability to the various risks and cyclical fluctuations in its environment. Thus, from 1982 to 1987, Hydro-Québec focused on eliminating the imbalance between supply and demand resulting from the recession at the start of the decade, and on introducing recovery measures to maintain control over costs. When combined with vigorous economic growth and the substantial rise in the value of the Canadian dollar, these activities resulted in improvement in the principal financial ratios from 1986 to 1988.

In the last two years, low runoff has been the prime factor affecting financial results, causing a reduction in net income of more than $500 million cumulatively. This is occurring at a time when Hydro-Québec is beginning to resume investment to satisfy growing need for electricity in Québec and to improve the quality of service and reliability of the system, both of

which will put upward pressure on the utility's costs of supply. In this context, rate increases equal to inflation, as proposed in last year's Development Plan, are inadequate to check a significant worsening in the utility's principal financial ratios.

In order to support the substantial borrowing forecast for the next decade, it is fundamental that Hydro-Québec avoid any additional deterioration in its financial situation and restore a margin of manoeuvre that will make it possible to cope with various risk factors. To this end, the utility will continue efforts to improve productivity in order to control costs. It will require rate increases in the next few years that will enable it to achieve by 1992 most of the financial ratios needed for continued development. Such rate increases, which reflect the rates policy that aims to cover costs of supply, will also promote the success of energy conservation programs.

Table 6.1
Evolution of Financial Performance

	1982	1983	1984	1985	1986	1987	1988	1989
Net earnings (in millions of dollars)	800	707	301	209	303	508	619	565
Interest coverage	1.01	1.04	1.10	1.12	1.15	1.25	1.26	1.12
Capitalization (in %)	26.0	26.6	25.3	24.1	24.0	24.9	26.2	25.9
Return on equity (in %)	15.0	11.7	4.7	3.2	4.4	7.0	8.0	7.0
Average cost of debt (in %)	11.8	11.5	11.7	11.4	11.1	10.7	10.5	11.2
Self-financing (in %)	35.1	40.3	34.2	35.7	40.6	41.0	34.0	30.0
Profit margin (in %)	24.1	19.3	7.2	4.7	6.4	10.0	11.7	10.2

6.1 Financial Impact of Runoff

The improvement in the utility's financial health has been slowed by the measures implemented since 1987 to cope with low runoff. In 1988, sales of surplus energy on both export and Québec markets were less than had been forecast in the 1988-90 Development Plan.

In 1989, there was a further reduction against forecasts which had already been substantially lowered in the 1989-1991 Development Plan.

In 1989, the utility had to use exceptional measures to deal with the shortage of water in its reservoirs: operation of Tracy thermal generating station as a base-load facility, purchases from neighboring systems and buyback of dual-energy contracts from commercial, institutional and industrial customers.

Table 6.2
Financial Impact of Low Runoff in 1988 and 1989
(in millions of dollars)

	1988		1989	
	TWh	$	TWh	$
Reduction in surplus sales (Quebec and external markets)				
- Revenue shortfall	9.6	211	2.6	48*
- Buyback of boiler contracts	-	19	-	-
Buyback of dual-energy				
- Revenue shortfall	-	-	0.3	5
- Compensation	-	-	-	76
Purchase of support	0.7	14	3.5	104
Operation of Tracy as a base-load installation	-	-	1.2	34
Total	10.3	244	7.6	267

* These reductions are added to the 13.2 terawatthours and $306 million already projected for 1989 in the 1989-1991 Development Plan

During the low runoff cycle which began in 1984, Hydro-Québec experienced four particularly dry years. This situation forces the utility to extend the use of exceptional measures into 1990, even in the average runoff scenario. Reservoirs must be refilled to ensure a more acceptable level of energy reliability for the future, with additional expenditures and revenue losses of more than $300 million in 1990. However, the utility will have to re-evaluate the situation in 1990, to adjust its strategy to runoff levels actually experienced during the first months of the year.

The corporation's financial situation remains largely dependent on runoff fluctuations, as Table 6.3 illustrates. Thus, if low runoff persists in the next three years, with 15% lower inflows than the annual average, creating an energy shortfall of 75 terawatthours, the utility would have to support additional costs starting in 1990 that could attain as much as $850 million in 1992. On the other hand, in a scenario of heavy runoff, with a 75-terawatthour surplus, the utility would cease to make use of the exceptional measures during 1990. Once the reservoirs are full, surplus-energy sales could be envisaged in 1991, and certainly in 1992. Hydro-Québec's net income could increase by some $550 million in 1992. 1992 net income could thus vary by as much as $1.4 billion, depending on runoff levels.

Table 6.3
Financial Impact of Various Runoff Scenarios *
(in millions of dollars)

	1990		1991		1992	
	TWh	$	TWh	$	TWh	$
Low runoff	13.6	583	15.3	758	15.2	853
Average runoff						
Buyback of dual-energy						
– Revenue shortfall	3.8	102	-	-	-	-
– Compensation	-	9	-	-	-	-
Purchases of support	3.5	122	-	-	-	-
Tracy operated as a base-load installation	2.6	81	-	-	-	-
Total	9.9	314	-	-	-	-
Heavy runoff **	8.9	282	(8.0)	(221)	(19.0)	(553)

* The totals represent all exceptional measures used for each scenario in terawatthours and the corresponding financial impact
** The figures in parentheses are sales of surplus energy and the associated revenue

6.2 *Evolution of Expenditure and Improved Productivity*

Hydro-Québec has taken major steps since 1982 to hold down costs. Growth in operating expenditure adjusted for inflation was reduced to 1.9% on average per year from 1982 to 1988, compared to an average of 10% for the period from 1976 to 1982. Growth was held in check even though the utility experienced growth in total sales of 6% per year, 460,000 new customers were added and the transmission system increased by 3,200 kilometres and the distribution system by 4,300 kilometres.

The result was obtained from improved overall productivity resulting from rationalization of the utility's resources. Despite this, operating expenditure is up considerably for 1989 and 1990, primarily due to measures to counteract low runoff, the start-up of programs to enhance quality of service and energy conservation, and intensified training of employees. The substantial growth in other expenditure in 1989 and 1990 is primarily attributable to purchases of support needed to compensate for low runoff levels.

Table 6.4
Operating Expenditure
(in millions of dollars)

	1988	1989		1990		1991		1992	
	$	$	%	$	%	$	%	$	%
Operating expenditure	1,391	1,597	14.8	1,788	12.0	1,902	6.4	2,062	8.4
Adjustment									
Expenditure due to low runoff*	-19	-110		-90		-		-	
New programs									
- Quality of service	-	-7		-79		-108		-102	
- Energy conservation	-	-		-24		-49		-77	
Training	-20	-24		-44		-46		-49	
Other **	-	-9		-12		-47		-74	
Adjusted operating expenditure	1,352	1,447	7.0	1,539	6.4	1,652	7.3	1,760	6.6
Increase in Canadian CPI (in %)			4.9		4.6		5.7		5.2
Adjusted firm sales*** (in terawatthours)	129.0	136.7	6.0	141.6	3.6	146.8	3.7	152.2	3.7

* Buyback of boiler contracts, operation of Tracy, and compensation for buyback of dual-energy contracts
** Application of Act 116, retirement expenditure, provision for decommissioning of Gentilly 2, and other current activities
*** Readjustments to include impact of buyback of dual-energy contracts

Table 6.5
Other Expenditure
(in millions of dollars)

	1988	1989		1990		1991		1992	
	$	$	%	$	%	$	%	$	%
Purchase of energy and power	136	253	86.0	253	–	182	−28.1	223	22.5
Depreciation of fixed assets	538	585	8.7	635	8.5	687	8.2	744	8.3
Taxes	295	324	9.8	357	10.2	386	8.1	432	11.9
Other expenditure	969	1,162	19.9	1,245	7.1	1,255	0.8	1,399	11.5
Adjustment									
Expenditure due to low runoff*	−14	−104		−122		–		–	
Purchases of power	−15	−51		−27		−49		−55	
Purchases from independent producers	–	–		−1		−27		−78	
Other adjusted expenditure	940	1,007	7.1	1,095	8.7	1,179	7.7	1,266	7.4
* Purchases of support									

Hydro-Québec will hold down operating expenditure by continuing to improve individual productivity. A number of measures along these lines are already under way:

- inclusion in current collective bargaining of a number of productivity improvement issues related to quality of service. The five targeted areas are customer relations, revised work shifts, management of temporary employees, right of refusal (health and safety) and lunch breaks;
- clarification of the contracting-out clause, to restore a climate that will promote greater productivity while retaining the expertise of employees in regular system maintenance and operating activities;
- productivity improvement in carrying out transmission and distribution system work. Our corporate objective will involve quantifiable measures to increase availability at the actual work site by 30% by 1992;
- implementation of the policy of preventive maintenance based on monitoring;
- technological improvements to tools to upgrade utility practices;
- intensification of company-wide training, to ensure the development of employee competence;
- management practices providing for greater accountability in individual administrative regions and corporate functional units with regard to results obtained in their specific mandates.

6.3 Forecast Investment

The next decade will see a marked increase in investments to satisfy growing demand for electricity in Québec, ensure the rehabilitation of installations and improve the energy and power reliability of generating facilities and the performance of the transmission and distribution systems.

In the 1990s, Hydro-Québec will invest $61.8 billion (in current dollars) or $45.8 billion in 1989 dollars including interest, in its construction program. More than half of this amount will go into expanding and maintaining generating facilities and a further 20% into the transmission system.

Total investment for the next three years will reach $13.2 billion, twice the amount invested over the last three years. Of this amount, $4 billion or more than 30% will be devoted to major generating and transmission projects already committed: La Grande 2A, La Grande 1, Brisay, Laforge 1 and the 11th and 12th transmission lines.

About $1 billion will be set aside for the construction of access roads at the Grande Baleine complex and the Sainte-Marguerite 1 project, as well as for the start of work on Eastmain 1. Included is the continuation of draft-design studies on those generating stations and the NBR and Ashuapmushuan complexes.

The target investment program also allocates over $1.6 billion over the next three years to ongoing efforts to improve quality of service.

Table 6.6
Investment for the Construction Program – Average Scenario
(in millions of dollars)

Types of investment*	1987	1988	1989	1990	1991	1992	1993 to 1999	Total 1990-1999	%
Generation	340	499	795	1,545	2,435	2,699	26,263	32,942	53
Transmission	499	766	861	783	817	998	9,851	12,449	20
Distribution	518	494	494	703	764	848	7,758	10,073	17
Support and technology	224	274	262	357	452	439	3,834	5,082	8
Grants, loans, investments and advances	107	74	53	92	124	109	977	1,302	2
Total	1,688	2,107	2,465	3,480	4,592	5,093	48,683	61,848	100

* Investments in sub-distribution are included with transmission and distribution. For the historical data, they are entirely included with transmission

Forecast investment for the 1990-1998 period has been revised upward by $8.1 billion over those contained in last year's Development Plan. This upward revision is primarily due to the bringing-forward of commissioning of the first stations in the NBR complex to the start of the next century and the Eastmain 1 project from 2004 to 1996, the commissioning of peaking plant, the re-evaluation of the station rehabilitation program, increased spending on distribution (primarily the underground system) the maintenance – enhancement program (PAM) and the energy conservation programs.

Table 6.7 shows total investments in the strong and weak demand growth scenarios compared to the average growth scenario.

Table 6.7
Investment According to Various Scenarios
(in millions of dollars)

Scenario	1990	1991	1992	1993-1999	10-Year total
Low	3,480	4,021	4,296	26,213	38,010
Average	3,480	4,592	5,093	48,683	61,848
Heavy	3,480	4,762	5,515	59 329	73,086

6.4 Financial Policy

Objectives	Principal Strategies
By 1992 Improve the financial position of the utility in order to restore the desired margin of manoeuvre and support development while seeking to achieve its principal financial ratios: • interest coverage of at least 1.0 • capitalization of at least 25% • overall return on equity greater than the average cost of debt • self-financing of at least 30%	Control cost increases and continue efforts to improve productivity Minimize financing costs and manage financial risks Limit the payment of dividends Propose rate increases of 7.5% in 1990 and 7.5% in 1991, to better cover the costs of supply and support the energy conservation programs
In the long term Recreate the margin of manoeuvre by improving the financial ratios to better reflect the risks faced by the utility	Continue to improve productivity, primarily through increased accountability of functional units Develop new modes of financing and new instruments for managing financial risks Optimize revenue by: • rates structures that reflect the costs of supply, including an average return on equity of 13% on sales governed by the Rates Bylaw • export market development aimed at a profitability level that is compatible with the specific risk involved

6.4.1 Risk Management

The recent worsening in the utilities financial results demonstrates its vulnerability to external risk factors. Changes in demand, runoff, and exchange and interest rates can affect the desired improvements in the utilities financial situation. Hydro-Québec must manage its risks if it is to protect its customers, lenders and shareholder against an abrupt downturn in its financial situation. It is therefore working on risk management strategies and instruments.

The most serious risk that Hydro-Québec faces is the fluctuation in runoff levels, whose financial impact increases with the size and number of hydroelectric installations. For example, in the 1998 horizon, low runoff for four consecutive years would have a negative impact on net earnings of an average $800 million per year.

There is presently no financial instrument the utility can use to protect itself from low runoff. However, Hydro-Québec is studying the possibility of creating a runoff stabilization fund to reduce the fluctuations in financial results that runoff variation causes.

In coming years, growth of firm sales in Québec will come increasingly from industry. This trend makes the utility more vulnerable to economic fluctuations. Moreover, as part of the development of Québec markets, risk and profit sharing contracts with industrial customers that are major users of electricity can to some extent increase Hydro-Québec's business risk. Although the utility should recover the costs of supply over the life of these contracts, the concept of risk sharing on which this strategy is based may expose it to decreased revenue when the economic situation is unfavorable, so ways to minimize these risks should be found.

Thus, Hydro-Québec adopted a strategic financing plan in 1989 one of whose goals is to limit its vulnerability to interest and exchange rate fluctuations and included specific actions among its financial activities.

6.4.2 Establishing a Financial Margin of Manoeuvre

Existing financial instruments and those it might develop cannot protect Hydro-Québec against all the risks in its economic and energy environment. It must therefore create a financial margin of manoeuvre that exceeds its minimal financial criteria of an interest coverage of 1.0 and capitalization of 25%.

Hydro-Québec had begun to reestablish its financial margin of manoeuvre in recent years. But measures to counteract low runoff have halted this progress and have reduced financial ratios to their minimum thresholds.

Without this margin, as the current situation demonstrates, any serious economic disruption could mean abrupt rate increases, or financial ratios that fall below minimum levels, which would be highly undesirable in a context of major hydroelectric development in Québec.

It is especially important for Hydro-Québec to create such a margin of manoeuvre because hydroelectricity is a capital-intensive product. Fixed costs take up a large share of expenditure and limit the utility's flexibility in financial management. For example, over the next three years, more than half the revenue from sales will be used to cover interest expense, exchange loss and depreciation of fixed assets.

Improvement of the financial situation and reconstitution of a minimum margin of manoeuvre require that Hydro-Québec try to meet the objectives of its financial policy by 1992:

- interest coverage of at least 1.0;
- capitalization of at least 25%;
- return on equity greater than the average cost of debt;
- self-financing ratio of at least 30%.

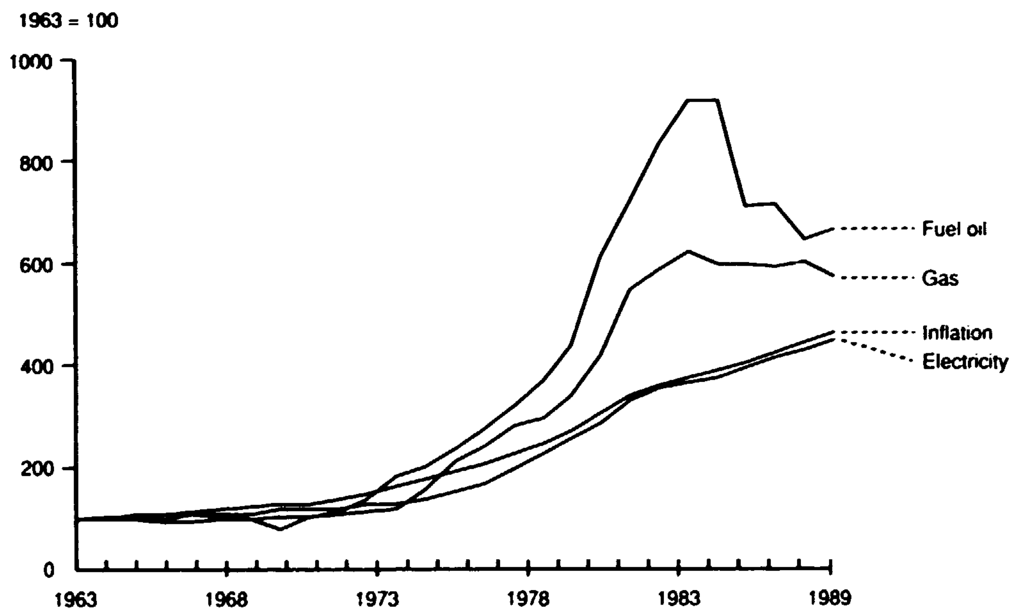
Hydro-Québec has in the past achieved a return on equity that exceeds the average cost of the debt and, if it achieved this again, it could re-establish its financial margin of manoeuvre. Two measures available to achieve this are cost-cutting and a rates policy that reflects the costs of supply including average return on equity of 13% for sales governed by the Rates Bylaw.

6.5 Costs of Supply and Rates

6.5.1 Competitive Position

Hydro-Québec has always been able to maintain competitive prices, in spite of a variable economic and energy context. As Figure 6.1 indicates, electricity prices have remained slightly below inflation. In real terms, consumers have actually been paying slightly less over time.

Figure 6.1
Inflation and Energy Prices



Hydro-Québec has been able to maintain a favorable competitive position in comparison with other forms of energy. In the fourth quarter of 1989, for example, electrical space and water heating for a single-family home cost 9% and 6% less than old fuel-oil and natural-gas systems, respectively. Such old systems make up the majority of fuel-oil and natural-gas heating systems in use in Québec.

Moreover, Québec consumers benefit from some of North America's lowest rates. For example, a residential customer in Vancouver pays 12% more than a Montrealer, and a Toronto resident pays 34% more. New York residents pay 216% more than their Montreal counterparts.

6.5.2 Cost Trends in the Short and Medium Term

One goal of Hydro-Québec's rates structure has always been to reflect the average costs of supply. These consist of all operating expenditure as well as capital expenditure incurred to satisfy Québec demand, and in the case of new facilities, they increase only at the time of commissioning. Capital expenditure includes interest, exchange loss and the return on equity. Hydro-Québec aims for an average return on equity of 13% on sales subject to the Rates Bylaw. Such a return corresponds to the lower limit of average, after-tax return granted to utilities by their regulatory bodies.

This objective of reflecting the costs of supply in rates policy assumes even greater importance when customers are being encouraged to adopt consumption habits that are compatible with a better use of energy resources. The price signal to customers then becomes a major factor because energy conservation and good energy choices are difficult to make when the price signal is distorted and prices do not adequately reflect the costs of supply.

The rise in costs of supply over the three-year period covered by the 1990-1992 Development Plan is substantially greater than forecast in last year's Development Plan, for both contextual and structural reasons.

The contextual reasons include the low runoff which has lasted for six years, forcing the utility to implement a series of costly measures to provide adequate response to Québec demand. The effects of these measures will still be felt in 1990. As Table 6.8 indicates, intensive operation of Tracy generating station, the purchase of support power from neighboring systems and the additional expenditure associated with the buyback of dual-energy contracts will add some $212 million to 1990 expenditure.

Furthermore, structural modifications not factored into last year's Development Plan will result in major expenditure with no impact on sales. The increase has been estimated at $863 million for the 1990-1992 period, as Table 6.8 also indicates. These modifications primarily involve service quality enhancement, the upward revision of the power reliability criterion, the revision of average generating-station output, the acceleration of employee training and energy conservation programs.

Table 6.8
Impacts of Principal Modifications on Expenditure, Interest and Exchange Loss, Compared with the 1989-1991 Development Plan
(in millions of dollars)

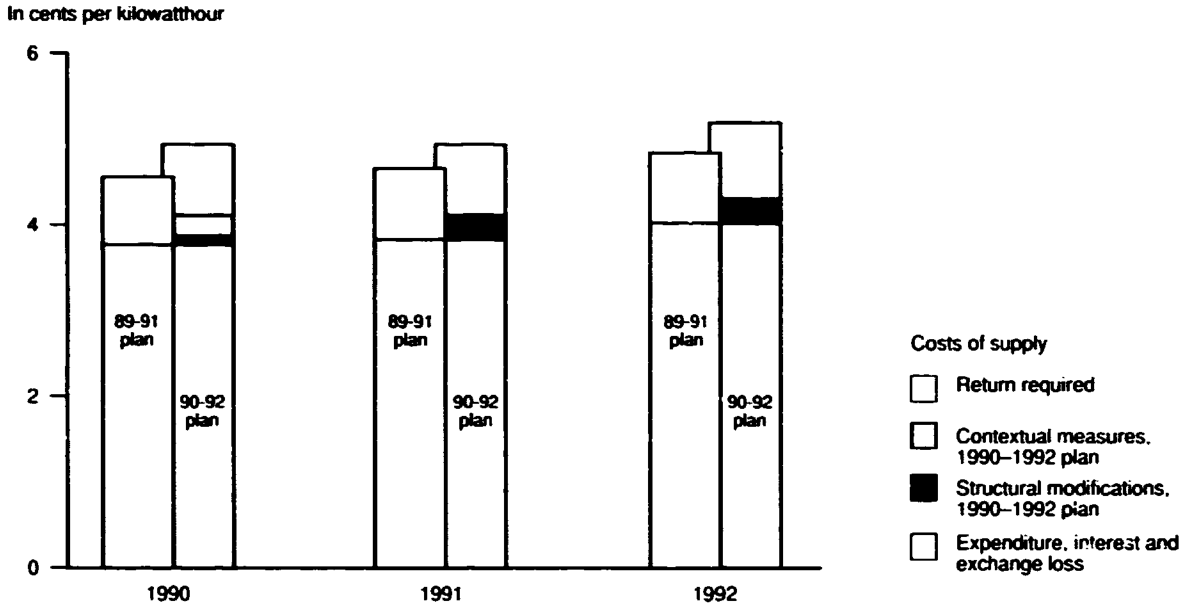
	1990	1991	1992	Total
Contextual impact				
Expenditure caused by low runoff*	212	0	0	212
Structural impact				
Quality of service**	83	118	123	324
Power reliability and revision of the average output of generating stations***	0	58	150	208
Energy conservation	24	54	86	164
Training programs	16	20	20	56
Other modifications****	7	53	51	111
Total structural impact	130	303	430	863
Total	342	303	430	1 075

* Excluding revenue shortfall of $102 million caused by the buy back of dual-energy contracts
** PAM and PAQS-Clientèle programs not evaluated in 1989-1991 Development Plan and reevaluation of PAQS-2 Program for the period
*** Involves additional generating equipment to cope with peak demand, power purchases, and purchases from independent producers
**** Renovation of generating stations, application of Act 116 concerning retirement, provision for decommissioning of Gentilly 2, modifications related to depreciation costs, taxes, economic parameters and other current activities

Thus, for the 1990-1992 period, the additional expenditure totals more than $1 billion. In 1992 the increase represents 7% of total expenditure, interest and exchange loss compared to last year's Development Plan.

Figure 6.2 illustrates the growth in costs of supply for the 1990-1992 period compared to last year's Development Plan, caused by contextual measures and structural modifications described earlier.

FIGURE 6.2



6.5.3 Rates Proposal

Table 6.9
Past Rate Increases

	1984	1985	1986	1987	1988	1989	Average
Electricity rates* (variation in %)	3.4	2.5	5.4	4.6	3.9	4.3	4.0
Canadian Consumer Price Index (variation in %)	4.4	4.0	4.1	4.4	4.1	4.9	4.3

* At May 1 of each year except for 1984 – at February 1

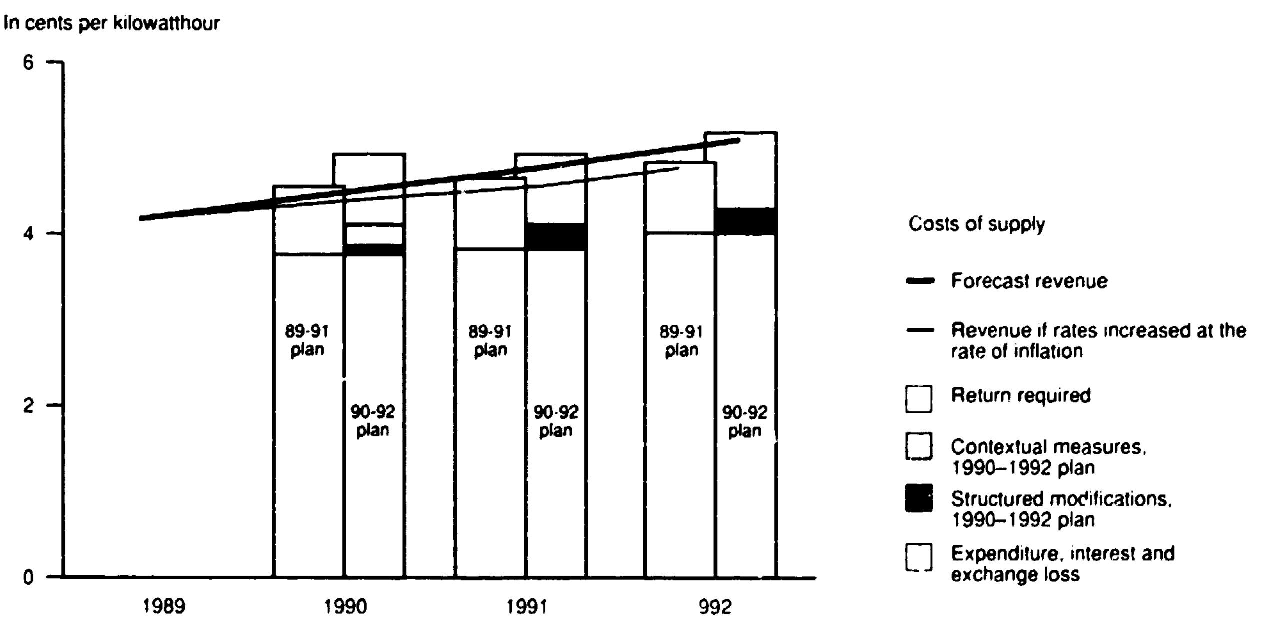
Over the last six years, Hydro-Québec's rates have remained slightly below inflation. In its 1989-1991 Development Plan, the utility envisaged rate increases on a par with inflation but, with the modifications now described, these rate increases would not cover its costs of supply and would diminish its financial soundness at a time of major increases in capital expenditure.

As customers must have a degree of rate stability, it appears quite unrealistic to attempt to achieve the costs of supply objective in 1990. The more than 20% rate increase required would constitute a real shock. Hydro-Québec proposes not to act in 1990 to make the necessary financial adjustment and therefore to allow certain financial ratios to fall to their lower limits. The approach will be gradual, with rate increases spread over time, so that growth of revenue will approach its goal in 1992. It is therefore important to give some guaranteed sign of recovery. That is why Hydro-Québec recommends an increase of 7.5% as of May 1, 1990, to be followed by an identical raise on May 1, 1991. Hydro-Québec retains the hypothesis of a 6% rate increase for 1992.

As Figure 6.3 indicates, with these proposed increases, Hydro-Québec would find itself by 1992 in a position comparable to that forecast last year. It should be noted that the difference in 1992 between revenue generated by increases that equal inflation, as advocated in the 1989-1991 Development Plan, and those generated by the present proposed increase are equivalent to the spending incurred for the modifications proposed and described above.

Further details appear in a separate publication entitled: *"Rates Proposal for 1990-1991"*.

Figure 6.3
Comparison of Revenue and Costs of Supply



6.5.4 Impact of Rate Increases on the Financial Ratios

The results shown in Table 6.10 illustrate the impact of the proposed rate increases on the financial ratios by 1992. Rate increases equal to inflation, as set forth in the 1989-1991 Development Plan, would cause capitalization to fall below the minimum of 25%, and would barely cover interest. Self-financing would fall to 22.7% in 1992, the lowest ever posted by Hydro-Québec. Such a financial situation would affect the borrowing capacity of the utility, leaving it with no margin to cope with external factors. Even the proposed rate increases do not enable the utility to meet all the minimum financial ratios. With this in mind, the suggested increases are minimal.

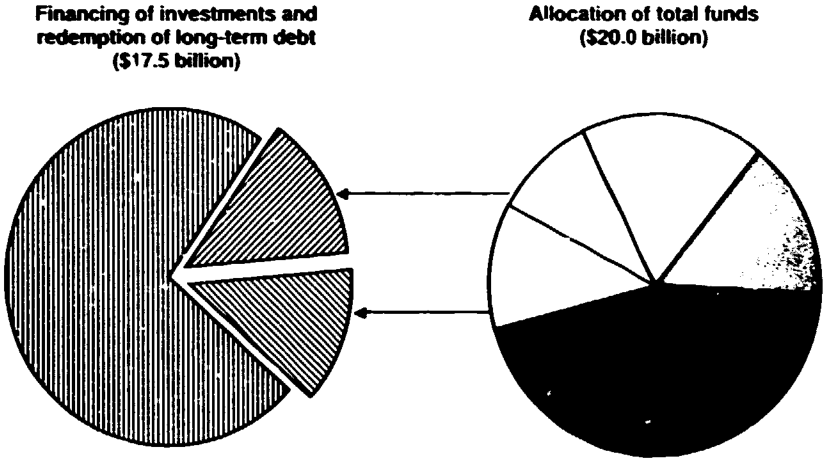
As shown in Figure 6.4, the proposed rate increases would allow the utility to obtain an average self-financing ratio of 28% for the 1990-1992 period.

Table 6.10
Impact of Rate Increases in the 1990-1992 Development Plan Compared with Increases Outlined in the 1989-1991 Development Plan

	1989	1990		1991		1992	
		Plan 1969-1991	Plan 1990-1992	Plan 1989-1991	Plan 1990-1992	Plan 1989-1991	Plan 1990-1992
Proposed rate increases (in %)*		4.5	7.5	4.3	7.5	5.2	6.0
Net earnings (in millions of dollars)	565	305	401	593	879	667	1 099
Interest coverage	1.12	1.02	1.05	1.08	1.17	1.06	1.19
Capitalization (in %)	25.9	24.4	24.7	23.6	24.5	22.6	24.4
Return on equity (in %)	7.0	3.6	4.8	6.7	9.7	7.1	10.9
Self-financing (in %)	30.0	23.7	25.8	22.8	27.5	22.7	29.0
Profit margin (in %)	10.2	5.2	6.8	9.2	13.1	9.5	14.9

* The rate increases proposed in the 1989-1991 Development Plan were applied to the parameters of the financial framework of the 1990-1992 Development Plan

Figure 6.4
Sources of Financing for the 1990-1992 Period, Including Proposed Rate Increases



▥	Issue of long-term debt and other sources	72%
▨	Other funds*	14%
▧	Net income	14%
	Total:	100%

*Principally depreciation of fixed assets

□	Payroll	18%
■	Other expenditure**	14%
■	Taxes	6%
■	Interest and exchange loss	40%
□	Net income	12%
□	Amortization	10%
	Total:	100%

**Including energy purchases

6.6 Financial Framework of the Average Scenario

The financial framework of the average scenario integrates the utility's strategies for fulfilling its mandate and carrying out its development plan. This framework is also a forecast which takes into account the financial orientations adopted, as well as the most probable assumptions with respect to changes in the economic and energy contexts.

6.6.1 Economic Outlook

The North-American economy behaved differently from the European and Japanese economies in 1989. In Japan and Europe, economic growth continued to accelerate throughout the year, forcing central banks in those countries to adopt increasingly restrictive monetary policies to check inflationary trends. In North America, on the other hand, economic activity slowed markedly in 1989, especially during the second half of the year, in response to the restrictive monetary policies introduced in 1988. As a result, inflationary pressures began to diminish in mid-year. The US Federal Reserve Board was more prompt than the Bank of Canada in reducing interest rates, acting during the summer. In Canada, interest rates remained high at year-end, with the consequence of strengthening the Canadian dollar. The US dollar appreciated against European and Japanese currencies in 1989.

In 1990, economic activity in Europe and Japan should remain constant and result in inflationary pressures, high interest rates and an appreciation of their currencies against the US dollar. In North America, however, the weakness in economic activity should persist for most of the year, leading to a slight reduction in inflation and a loosening of monetary policies. The gradual reduction in interest rates in Canada will cause the Canadian dollar to lose value against the US dollar.

It should be noted that the introduction of the 7% federal Goods and Services Tax in Canada planned for January 1, 1991 should provoke earlier spending by consumers and stimulate the economy in the second half of 1990.

As in the United States and the rest of Canada, Québec will experience a second year of slower economic growth in 1990. The increase in Québec's Gross Domestic Product in real terms should be about 1.7%, which is slightly higher than the growth forecast for Canada as a whole. It is principally the strength of non-housing investment that will support the economy.

Table 6.11
Comparison of Economic Forecasts for 1990

Parameters	Principal Forecasts Average	Upper Quartile	Lower Quartile	Forecasts by Hydro-Québec
Rate of growth of Quebec's real gross domestic product (in %)	1.6	2.0	0.7	1.7
Rise in the Canadian Consumer Price Index (in %)	4.8	5.6	4.3	4.6
Interest rates on bonds 10 years and over (in %)				
- Government of Canada	9.3	9.7	8.9	9.5
- Government of the United States	7.7	8.3	7.2	8.0
Rate of exchange of Canadian dollar at December 31				
- US dollar	0.826	0.853	0.810	0.810
- Deutsche mark	1.48	1.73	1.34	1.34
- Swiss franc	1.35	1.52	1.20	1.16
- yen	138.7	147.4	113.6	109.3
Average rate of exchange for the Canadian dollar for the year				
- US dollar	0.839	0.857	0.825	0.818
- Deutsche mark	1.44	1.59	1.34	1.35
- Swiss franc	1.29	1.42	1.17	1.18
- yen	127.3	136.1	112.2	113.5

6.6.2 Results

The marked deterioration in 1990 results is the outcome of the low runoff of recent years. After 1990, the ending of exceptional measures introduced to ensure energy reliability, plus continuing efforts to improve productivity and the proposed rate increases will gradually put the utility in a better financial position.

Self-financing and return on equity will fall markedly in 1990, but will subsequently return to minimum levels. Although interest coverage will fall in 1990, it will remain above the minimum level of 1.0 and subsequently rise. Capitalization will fall below its 25% minimum, thus preventing the declaration of dividends over the 1990-1992 period.

Table 6.12
Principal Parameters of the Financial Framework of the Average Scenario

	1988	1989	1990	1991	1992
Rate of growth of Quebec's real gross domestic product (in %)	5.4	2.2	1.7	2.2	3.0
Volume of sales (in terawatthours)					
• Sales of firm electricity in Québec	119.8	127.6	126.2	134.2	139.4
• Sales of surplus electricity in Québec	8.7	0.3	–	–	–
• Export sales of firm electricity	9.2	8.8	11.6	12.6	12.8
• Export sales of surplus electricity	7.7	0.9	–	–	–
• Total sales	145.4	137.6	137.8	146.8	152.2
Rate of growth of sales volume (in %)					
• Sales of firm electricity in Québec	8.5	6.5	–1.1	6.3	3.9
• Sales of surplus electricity in Québec	–36.5	–96.6	–100.0	–	–
• Export sales of firm electricity	10.2	–4.3	31.8	8.6	1.6
• Export sales of surplus electricity	–62.3	–88.3	–100.0	–	–
• Total sales	–4.9	–5.4	0.1	6.6	3.7
Average rate increase* (in %)	3.9	4.3	7.5	7.5	6.0
Rise in Canadian Consumer Price Index (in %)	4.1	4.9	4.6	5.7**	5.2
World price of a barrel of crude oil (in US dollars)	16.0	19.7	20.0	21.0	22.5
Interest rates on Hydro-Québec bonds 10 years and over (in %)					
• Canadian market	10.8	10.5	10.3	10.6	10.7
• US market	9.9	9.3	9.0	9.6	10.6
Rate of exchange of Canadian dollar at 31 December					
• US dollar	0.839	0.863	0.810	0.800	0.775
• Deutsche mark	1.48	1.46	1.34	1.38	1.28
• Swiss franc	1.26	1.33	1.16	1.21	1.06
• yen	104.7	124.3	109.3	108.0	92.5

* On May 1 of each year and according to the assumption used for 1990, 1991 and 1992
** 1.4% can be attributed to the application of the new Goods and Services Tax (GST)

Table 6.13
Financial Framework of the Average Scenario – Results
(in millions of dollars)

	1988 $	1988 %	1989 $	1989 %	1990 $	1990 %	1991 $	1991 %	1992 $	1992 %
Revenue										
• Firm electricity-Québec	4,650	11.2	5,192	11.7	5,495	5.8	6,217	13.1	6,832	9.9
• Surplus electricity-Québec	102	-29.0	3	-97.1	0	-100.0	0	–	0	–
• Electricity exports	471	-33.9	308	-34.6	384	24.7	435	13.3	502	15.4
• Other operating income	55	96.4	56	1.8	59	5.4	61	3.4	63	3.3
Total	5,278	4.1	5,559	5.3	5,938	6.8	6,713	13.1	7,397	10.2
Expenditure										
• Operations	1,391	14.1	1,597	14.8	1,788	12.0	1,902	6.4	2,062	8.4
• Other	969	7.7	1,162	19.9	1,245	7.1	1,255	0.8	1,399	11.5
Total	2,360	11.4	2,759	16.9	3,033	9.9	3,157	4.1	3,461	9.6
Income before interest and exchange loss	2,918	-1.1	2,800	-4.0	2,905	3.8	3,556	22.4	3,936	10.7
Interest and exchange loss										
• Interest	2,050	-5.5	2,165	5.6	2,392	10.5	2,571	7.5	2,698	4.9
• Exchange loss	249	-8.2	70	-71.9	112	60.0	106	-5.4	139	31.1
Total	2,299	-5.8	2,235	-2.8	2,504	12.0	2,677	6.9	2,837	6.0
Net income	619	21.5	565	-8.7	401	-29.0	879	119.2	1,099	25.0
Maximum dividends likely to be declared	461		238	-48.4	0	-100.0	0	–	0	–
Dividends declared	300		182	-39.3	0	-100.0	0	–	0	–
Expenditure, interest and exchange loss	4,659	2.2	4,994	7.2	5,537	10.9	5,834	5.4	6,298	8.0
Gross interest	2,359	-2.2	2,558	8.4	2,842	11.1	3,100	9.1	3,378	9.0
Investment										
• Gross investment	2,107	24.9	2,465	17.0	3,480	41.2	4,592	32.0	5,093	10.9
• Less: capitalized borrowing expense	257	34.0	323	25.7	378	17.0	458	21.2	606	32.3
Net investment	1,850	23.7	2,142	15.8	3,102	44.8	4,134	33.3	4,487	8.5
Borrowings										
• Net issue of long-term debt	1,860	1.0	2,894	55.6	3,205	10.7	4,414	37.7	4,921	11.5
• Less: redemption of long-term debt	1,249	-18.9	1,223	-2.1	1,026	-16.1	1,544	50.5	1,801	16.6
Net borrowings	611	102.5	1,671	173.5	2,179	30.4	2,870	31.7	3,120	8.7

Table 6.14
Principal Financial Ratios

	1988	1989	1990	1991	1992
Interest coverage	1.26	1.12	1.05	1.17	1.19
Capitalization (in %)	26.2	25.9	24.7	24.5	24.4
Return on equity (in %)	8.0	7.0	4.6	9.7	10.9
Average cost of debt (in %)	10.5	11.2	11.4	11.2	10.9
Self-financing (in %)	34.0	30.0	25.8	27.5	29.0
Profit margin (in %)	11.7	10.2	6.8	13.1	14.9

$$\text{Interest coverage} = \frac{\text{Income before interest and exchange loss} + \text{Net investment income}}{\text{Gross interest charges}^{*}}$$

$$\text{Capitalization} = \frac{\text{Shareholder's equity}}{\text{Shareholder's equity} + \text{Total debt}^{**}}$$

$$\text{Return on equity} = \frac{\text{Net income}}{\text{Shareholder's equity (average of year)}}$$

$$\text{Average cost of debt} = \frac{\text{Gross interest charges}^{*} + \text{net loss on redemption of long-term debt}}{\text{Total debt}^{**}\text{ (average of year)}}$$

$$\text{Self-financing} = \frac{\text{Total funds provided by operation} - \text{Dividends declared}}{\text{Investment} + \text{Redemption of long-term debt}}$$

$$\text{Profit margin} = \frac{\text{Net income}}{\text{Total revenue}}$$

* Interest on debt securities + amortization of debt-security discount and expenses
** Long-term debt + Notes payable + Long-term debt payable within one year + Perpetual debt

6.6.3 Sensitivity Analysis

Financial forecasts are subject to the vagaries of the economic and energy contexts, and variations in climatic conditions. In the short and medium term, runoff levels are the source of the largest potential inaccuracies in the utility's financial forecasts, although exchange and interest-rate fluctuations may also be disruptive.

The financial framework assumes that 1990 will be a year of average runoff. Should low runoff levels persist through 1990, net income could be reduced by some $270 million, while heavy runoff could increase it by some $30 million.

The effect of rate increases introduced on May 1 will not be fully felt until the following years. A difference of 1% in the 1990 rate increases would have an impact of about $50 million on 1991 net income.

Table 6.15
Sensitivity of 1990 Net Income

Parameter	Variation	Variation in net income (in millions of dollars)
Rates	1 % as of May 1	31
Operating expenditure	+1 %	-20
Interest rates	+1 %	-27
Exchange rate of Canadian dollar in US dollars	+0.01 US dollar	2
Exchange rate of Canadian dollar against a basket of currency other than the US dollar	+1 %	4

6.6.4 Comparison with the 1989-1991 Development Plan

Net income for 1989 was $565 million, as against the $652 million forecast in the 1989-1991 Development Plan. The continuing low runoff cycle in 1989 reduced net income by more than $250 million. However this was largely offset by revenue from Québec sales of firm electricity, which was over $100 million above the forecast, mainly as a result of colder temperatures, and by the value of the Canadian dollar, which was stronger than expected.

Forecast net income for 1990 is $401 million, or $311 million less than the $712 million forecast in last year's Development Plan. Total revenue is less than 1% above that forecast last year, despite a rate increase that is 3% higher than forecast. This increase is in fact diluted in large part by the revenue loss resulting from the buyback of dual-energy contracts.

Total expenditure is over $300 million in excess of last year's forecast. The continued use of exceptional measures to counteract low runoff results in additional expenditure of over $200 million, and a future amount of over $100 million against last year's forecast is spent on intensified quality of service measures, energy efficiency and employee training.

Interest charged to operations is up by $92 million in 1990, with the increased volume of borrowings in 1989 and 1990, the short-term rise in interest rates and the decrease in interest capitalized to Construction, all of which are partially offset by the strengthening of the Canadian dollar and the downward revision of long-term interest rates.

The unexpected strength of the Canadian dollar and the impact of swaps used in the exchange-risk management program reduce anticipated exchange loss by $60 million.

Table 6.16
Comparison with the 1989 – 1991 Development Plan
Principal Parameters of the Financial Framework

	1989			1990		
	Plan 1989-1991	**Actual**	**Variation**	**Plan 1989-1991**	**Plan 1990-1992**	**Variation**
Rate of growth of Québec's real gross domestic product (in %)	2.2	2.2	-	2.3	1.7	-0.6
Volume of sales (in terawatthours)						
• Sales of firm electricity in Québec	125.4	127.6	2.2	130.1	126.2	-3.9
• Sales of surplus electricity in Québec	0.6	0.3	-0.3	-	-	-
• Export sales of firm electricity	9.2	8.8	-0.4	11.0	11.6	0.6
• Export sales of surplus electricity	3.2	0.9	-2.3	-	-	-
• Total sales	138.4	137.6	-0.8	141.1	137.8	-3.3
Rate of growth of sales volume (in %)						
• Sales of firm electricity in Québec	4.7	6.5	1.8	3.7	-1.1	-4.8
• Sales of surplus electricity in Québec	-93.0	-96.6	-3.6	-100.0	-100.0	-
• Export sales of firm electricity	0.5	-4.3	-4.8	19.4	31.8	12.4
• Export sales of surplus electricity	-58.4	-88.3	-29.9	-100.0	-100.0	-
• Total sales	-4.8	-5.4	-0.6	1.9	0.1	-1.8
Average rate increase* (in %)	4.7	4.3	-0.4	4.5	7.5	3.0
Rise in Canadian Consumer Price Index (in %)	4.7	4.9	0.2	4.5	4.6	0.1
World price of a barrel of crude oil (in US dollars)	17.0	19.7	2.7	19.0	20.0	1.0
Interest rates on Hydro-Québec bonds 10 years and over (in %)						
• Canadian market	11.4	10.5	-0.9	11.1	10.3	-0.8
• US market	10.5	9.3	-1.2	10.8	9.0	-1.8
Rate of exchange of Canadian dollar at 31 December						
• US dollar	0.800	0.863	0.063	0.781	0.810	0.029
• Deutsche mark	1.27	1.46	0.19	1.27	1.34	0.07
• Swiss franc	1.08	1.33	0.25	1.08	1.16	0.08
• yen	91.2	124.3	33.1	91.2	109.3	18.1

* Applicable on May 1 of each year.

Table 6.17
Comparison with the 1989-1991 Development Plan
Results of the Average Financial Framework
(in millions of dollars)

	1989			1990		
	Plan 1989-1991	Actual	Variation	Plan 1989-1991	Plan 1990-1992	Variation
Revenue*						
• Firm electricity-Québec	5.088	5.192	104	5.483	5.495	12
• Surplus electricity-Québec	7	3	-4	0	0	0
• Electricity exports	373	308	-65	370	384	14
• Other operating income	49	56	7	52	59	7
Total	5.517	5.559	42	5.905	5.938	33
Expenditure						
• Operations	1.446	1.597	151	1.554	1.788	234
• Other	1.065	1.162	97	1.167	1.245	78
Total	2.511	2.759	248	2.721	3.033	312
Net income before interest and exchange loss	3.006	2.800	-206	3.184	2.905	-279
Interest and exchange loss						
• Interest	2.184	2.165	-19	2.300	2.392	92
• Exchange loss	170	70	-100	172	112	-60
Total	2.354	2.235	-119	2.472	2.504	32
Net income	652	565	-87	712	401	-311
Maximum dividends likely to be declared	330	238	-92	150	0	-150
Dividends declared	not determined	182		not determined	0	
Expenditure, interest and exchange loss	4.865	4.994	129	5.193	5.537	344
Gross interest	2.619	2.558	-61	2.765	2.842	77
Investment						
• Gross investment	2.486	2.465	-21	3.103	3.480	377
• Less: capitalized borrowing expense	380	323	-57	426	378	-48
Net investment	2.106	2.142	36	2.677	3.102	425
• Interest coverage	1.17	1.12	-0.05	1.16	1.05	-0.11
• Capitalization (in %)	25.2	25.9	0.7	25.0	24.7	-0.3
• Self-financing (in %)	31.4	30.0	-1.4	33.4	25.8	-7.6
• Return on equity (in %)	8.1	7.0	-1.1	8.4	4.8	-3.6

* The revenue for the 1989-1991 Plan is as estimated with the rate increases proposed last year and not the increases actually approved

6.7 *Dividend Management*

Dividend management is based on the goal of maintaining Hydro-Québec's financial soundness while allowing the shareholder and therefore all taxpayers to receive a reasonable proportion of the utility's net income as a return on their investment and their share in the public resource that hydroelectricity represents.

The mechanism for declaring dividends provided in the Hydro-Québec Act defines the calculation of the maximum dividend that can be paid to the Québec government as being the distributable surplus. This surplus is 75% of the income available, in a given fiscal year, after the total coverage of gross interest charges, i.e.:

Calculation of the surplus available for distribution takes into account gross interest charges. This amount generally increases during growing investment, resulting in the reduction of the surplus available for distribution. Moreover, under the Hydro-Québec Act, there are restrictions on the declaration of dividends to guarantee that the utility's financial criteria are not jeopardized by the payment of dividends. No dividend can be declared whose payment would reduce the capitalization ratio below 25% at the end of a fiscal year.

Following discussions with the shareholder, the wisdom of limiting the dividend was confirmed. In addition to the constraints contained in the law, it was agreed to limit the payment of dividends to about half the utility's net income.

In 1989, the dividend mechanism in the law would have allowed a maximum of $238 million to be declared. The shareholder limited the declared dividend to $182 million to protect a self-financing ratio of 30% in 1989. Over the last two years, combined dividends declared have totalled $482 million, although the maximum dividend entitlement was $699 million. This means that the shareholder has ploughed more than $200 million back into the utility over the last two years. For the next three years, the financial framework of the average scenario does not envisage any dividend because the capitalization ratio is projected to be below 25%.

Distributable surplus	=	75%	Income before interest and exchange loss + Net investment income − Gross interest charges

6.8 Financing Activities

Objective	**Principal Strategies**
Minimize financing costs and manage financial risks so as to reduce their impact on results, rates and dividends	Maximize financing in Canadian dollars Give preference to terms of 10 years or more Renegotiate outstanding debt when economical to do so Reduce volatility of the cost of debt servicing Maintain the floating-rate debt portion at around 12%

The proposed financial policy and rate increases will enable Hydro-Québec to finance about 28% of investment and redemption of long-term debt from internal funds for the 1990-1992 period.

Net borrowings required for the construction program total $8.2 billion for 1990-1992, to which are added long-term debt redemptions of $4.4 billion and renegotiations. These needs will require regular access to financial markets and represent major demands on the capacity of its traditional markets. This means a sound financial situation is essential if the utility is to maintain its capacity to manage its debt servicing. It must preserve its credit rating without mortgaging the credit of its guarantor, since Hydro-Québec's debt constitutes 42% of the debt contracted for or guaranteed by the Québec government.

For the next 10 years, the constant high level of borrowings will be unprecedented. Nevertheless, Hydro-Québec's indebtedness will remain at an acceptable level, in relative terms. During the 1990s, debt will represent on average 4.6 times the revenue from electricity sales, virtually the same as at the end of 1989. In the 1970s, when Phase I of the La Grande complex was under way, this figure stood at 5.7.

Table 6.18
Source and Allocation of Funds (1990-1992)
(in millions of dollars)

	1990		1991		1992		Total	
	$	%	$	%	$	%	$	%
Allocation of funds								
Investment	3.480		4.592		5,093		13.165	
Long-term debt redemptions*	1.026		1.544		1.801		4.371	
Need for funds	4.506		6.136		6.894		17.536	
Source of funds								
Net income	401	9	879	14	1.099	16	2.379	14
Other operating income**	762	17	806	13	899	13	2 467	14
Self-financing	1.163	26	1.685	27	1.998	29	4.846	28
Variation in working capital	138	3	37	1	-25	-	150	1
Issue of long-term debt	3.205	71	4.414	72	4.921	71	12.540	71
Funds available	4.506	100	6.136	100	6.894	100	17.536	100

* Exlcuding renegotiations
** Principally the depreciation of fixed assets

In 1989, Hydro-Québec adopted a strategic financing plan to be able to deal with the major construction of the next decade. The principal objectives of this plan are:

- ensure the completion of the borrowing program, whatever the conditions on the financial markets;
- seek financing at the best cost while trying to limit foreign exchange risk;
- seek an interest-rate structure that minimizes the utility's financial risks and, particularly, achieve an appropriate ratio of fixed-rate to floating-rate debt;
- try to spread maturities in such a way as to facilitate debt refinancing;
- ensure effective management of current debt.

Interest and exchange loss combined represent average annual expenditure in the order of $2.7 billion for the next three years. In this area, Hydro-Québec is pursuing strategies to stabilize the cost of financing and manage its financial risks, as described in the strategic financing plan.

Efforts to maximize financing in Canadian dollars will continue. The Canadian-dollar proportion of debt has risen from 49.9% to 68.5% over the last four years. Moreover, application of the exchange-risk management policy makes it possible to reduce the volatility of the cost of debt servicing by providing maximum hedging of debt in currencies other than the US dollar through currency swaps. Hydro-Québec will also maintain approximately 12% of its long-term debt at a floating rate of interest in order to reduce the average long-term interest rate of its total debt. And it will continue to renegotiate borrowings when this is economical and give preference to maturities of 10 years or more.

Table 6.19
Present Situation – Financing Strategies

	At December 31 1986	1987	1988	1989
Maximize financing in Canadian dollars				
• Portion of debt in Canadian dollars reflecting swaps (in %)	49.9	52.8	62.6	68.5
Give preference to maturities of 10 years and more				
• Average maturity of debt issued in the current year (in years)	18.9	16.2	15.0	23.4
Renegotiate borrowings when it is economical to do so				
• Renegotiations and recalls (in millions of dollars)	1,746	661	591	563
• Interest gain for the year (in millions of dollars)	8.6	8.1	2.1	0.3
• Reduction of exchange loss (in millions of dollars)	77.4	2.4	(22.4)	(21.2)
Reduce volatility of cost of debt service				
• Swaps on debt already issued (in millions of dollars)	811	275	802	372
Maintain approximately 12% of debt at a floating rate of interest to reduce average interest expenditure in the long term				
• Share of debt at variable rate reflecting swaps and perpetual debt (in %)	8.6	9.7	13.1	12.4

7

TECHNOLOGY AND ECONOMIC SPINOFFS

7.1 Technology and Its Role in Hydro-Québec's Development

Technology plays a vital role in Hydro-Québec's development. Indeed, it has been central to the substantial progress made by the utility in recent decades in the expansion and operation of its system. In the years to come, it will remain one of Hydro-Québec's main assets, in light of requirements related to service quality, power-system reliability, the environment, occupational health and safety, and profitability of investment.

With projected spending of almost half a billion dollars, or about 2.4% of projected sales revenue for the next three years, the utility remains one of the principal forces of technological development in Québec. It intends to continue to broaden the structural impact of its technological activities by strengthening as much as possible its cooperative ties with industry, universities, and governmental and private research centres.

It took new steps in this direction in 1989 when it created the *Centre d'innovation technologique en transport d'énergie du Québec* (CITEQ), jointly with Asea Brown Boveri, and endowed a technology-management chair at the *Université du Québec à Montréal.* In addition, early in 1990, Hydro-Québec and its partners will officially launch *Capitecq*, a venture capital fund for the start-up of high-technology companies in the energy sector, with initial funding of $13 million.

7.1.1 Expenditure and Objectives from 1990 to 1992

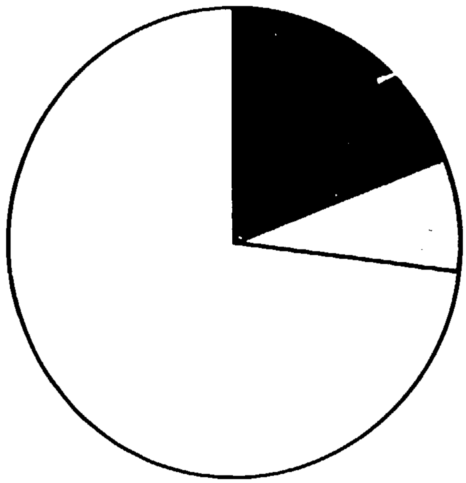
The technological activities planned for 1990-1992 represent expenditure of $467 million (capital and operating expenditure).

These activities will contribute to three objectives:

- gear R & D to Hydro-Québec's needs;
- concentrate long-term research on those avenues most promising to Hydro-Québec;
- market technology and sell expertise to enhance the utility's profitability and to increase Québec exports and the economic spinoffs of Hydro-Québec's activities.

Objectives	**Strategies**
Focus R & D on Hydro-Québec's needs	Generation: - equipment reliability, durability and output - facility design, construction and upgrading - the environment Transmission: - equipment reliability - system simulation - system monitoring and protection - the environment Distribution: - equipment reliability and operating flexibility - future development of the system - quality of the electricity supply Uses of electricity: - industrial competitiveness and environmental protection - energy conservation and load management - development of electric vehicles Product development: - expert systems - systems for power-system management and instant imaging - dual-energy remote control, heat pump with nonelectric backup (PACANE), hydrogen, etc. Open new R & D facilities: - turbo-machine laboratory - certification laboratory for distribution equipment - experimental line
Concentrate long-term research on most promising avenues	Structure a prospecting network Intensify the search for outside partners Ensure in-house technology transfers
Market technology and expertise	Exploit to greater advantage the marketing potential of products and expertise Support the activities of subsidiaries to a greater extent Reinforce current marketing of products and expertise

Figure 7.1
General Breakdown of Technological Expenditure from 1990 to 1992 – Capital and Operating Expenditure
(in millions of dollars)



■	Long-term avenues and prospecting network 13%	$ 61
■	Marketing 6%	$ 27
□	Development of expertise, testing and studies 8%	$ 37
□	R & D 73%	$342
	Total (in millions):	$467

7.1.2 R & D Strategies

R & D activities are divided into six areas: generation, transmission, distribution, uses of electricity, product development and technological-installations development.

Table 7.1
R & D Breakdown from 1990 to 1992
Capital and Operating Expenditure
(in millions of dollars)

	Operating	Capital	Total
Generation	48.7	7.3	56.0
Transmission	102.8	13.0	115.8
Distribution	22.3	11.4	33.7
Uses	36.1	13.2	49.3
Product development	22.8	5.2	28.0
Installations development	–	59 2	59.2
Total	232.7	109.3	342.0

R & D efforts in the field of generation will assume greater importance from 1990 on, because of the utility's accelerated construction program and its need to be flexible enough to adapt to demand. The focus will be on improving design, construction and rehabilitation methods and on increasing the reliability, durability and productivity of facilities.

Most transmission-related R & D will be on equipment reliability and power-system simulation, and will reinforce the corporate objective of enhanced quality of service.

R & D relating to distribution will focus more on future system development and operational reliability and flexibility. The emphasis will be on designing and developing more reliable and efficient equipment and studying the causes of premature deterioration and aging of key components of the distribution system.

R & D on uses of electricity will focus on more cost-effective penetration of the industrial market by increasing the energy efficiency of processes and enhancing the competitiveness of industry. Much of this activity will be devoted to enhanced energy conservation and load management, particularly through the development of new heating equipment that makes more efficient use of the various energy options during peak periods.

With respect to product development, short-term R & D will concentrate on three main areas: expert systems, telerobots or remote manipulators, and power-system control and instant-imaging systems. The selection and management of development projects will be consolidated by all units involved in product development and marketing.

Lastly, Hydro-Québec will continue to put into place the facilities required to meet its technological objectives and to make them available to electrical-equipment manufacturers or other research centres, when it is profitable to do so.

Projected investment from 1990 to 1992 includes three special facilities to be built with outside partners:

- a turbo-machine laboratory;
- an experimental line in Varennes to study line vibrations;
- a laboratory to certify distribution equipment.

There will also be a laboratory for testing residential equipment and commercial equipment for large-power and energy accounts. This project is included in expenditure relating to the uses of electricity.

7.1.3 Strategies for Long-Term Avenues

Hydro-Québec is now involved in four long-term avenues related to the generation, transmission and use of electricity: nuclear fusion, superconductivity, hydrogen and polymer-electrolyte (ACEP) batteries.

Efforts in coming years will be centred on three strategies:

1) Structure a prospecting network to orient long-term technological-exploration activities and influence Hydro-Québec's development strategies as required

Rapid changes in technology require that Hydro-Québec be alert to developments in areas of particular interest to it and be prepared for timely involvement in exploratory research or studies.

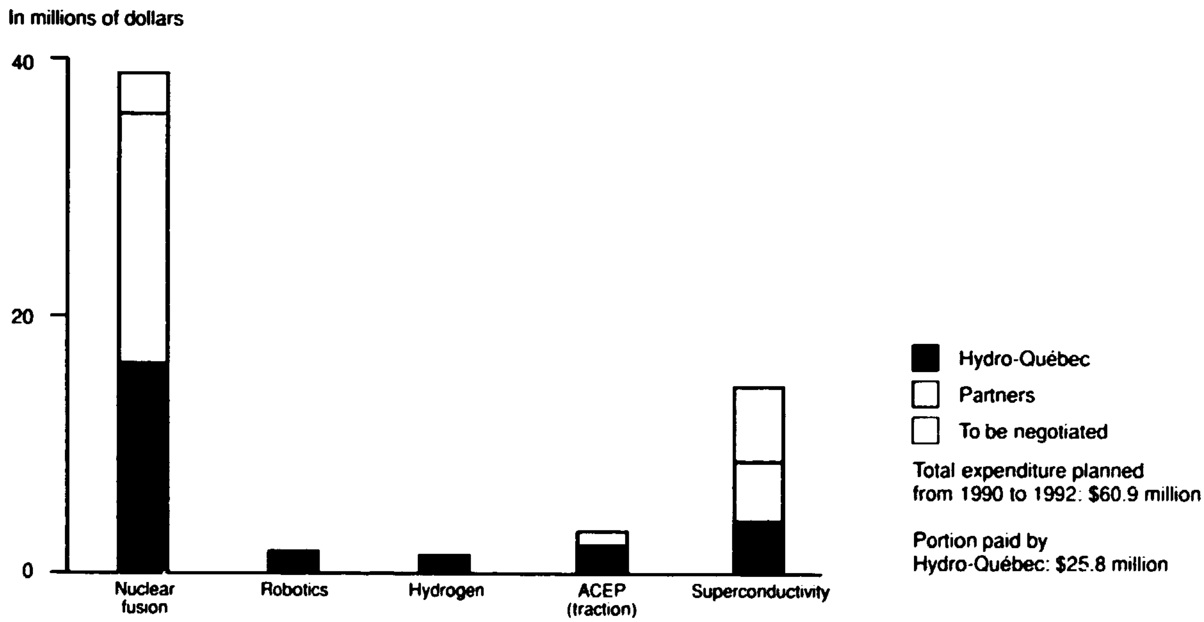
2) Intensify the search for partners

Given the high cost of long-term research, the utility must maximize involvement by partners in financing and carrying out such research. In particular, it must consolidate its joint ventures regarding nuclear fusion and superconductivity and establish similar ventures for hydrogen and ACEP batteries.

3) Ensure technology transfers within the utility

The first objective of these transfers will be to ensure that the intermediate results of long-term research are handled by the units most qualified to apply them to the power system and the utility. Another objective will be to market the by-products of long-term research to obtain optimum profitability from investments.

Figure 7.2
Expenditure for Long-Term Avenues



7.1.4 *Strategies for Marketing Technology and Expertise*

Marketing Hydro-Québec's technological expertise serves two purposes: it contributes to the utility's net income and it spurs the development of Québec's economy by creating new export outlets. Although most marketing activities were formerly divided among Hydro-Québec's *Bureau de commercialisation des produits technologiques*, Hydro-Québec International (HQI) and the subsidiaries of Nouveler Inc., each now has sufficient expertise to undertake a new development phase.

1) Maximize the marketing potential of products and expertise

As of 1990, the units involved in marketing technological products and expertise will consolidate and combine their efforts with a view to better determining the products and expertise to be developed, evaluating their marketing potential and drawing up sales plans. Hydro-Québec will also establish a policy to protect industrial property so as to preserve its technological know-how.

2) Provide more support for activities of subsidiaries

Hydro-Québec's construction and operations expertise is essential for marketing the products and services offered by HQI. For HQI to be able to take advantage of all sales opportunities and to deliver the best possible products and services, it is important that supply thereof be an integral aspect of sales plans. As of 1990, Hydro-Québec plans to add resources to the units that perform a substantial amount of work for HQI.

Hydro-Québec will also provide further support for the marketing of products it develops to meet its own needs, by offering the subsidiaries that market them guaranteed access to its own market, and by promoting these products outside the utility.

3) Strengthen marketing of technology and expertise

HQI will strengthen its expertise in financial packaging, international representations to customers and investors, and its ability to offer a complete range of products and services. Hydro-Québec will also strengthen its existing and future subsidiaries by giving them product ranges that have manufacturing and marketing similarities.

7.2 *Economic Spinoffs*

Hydro-Québec is responsible for developing Québec's hydroelectric resources and contributing to the province's economic growth. To this end, the utility has considerable economic levers at its disposal. The first are related to the substantial human resources and physical plant required for its construction program and the operation of its installations. For example, the utility's operating activities and expenditure alone make a direct and indirect contribution to Québec's economy estimated at nearly 5% of the gross domestic product. Moreover, to maximize the impact of its purchasing power, in January 1989 Hydro-Québec adopted a policy setting out economic-development strategies and orientations to promote the manufacture in Québec of the strategic equipment it requires.

Fulfilling its mandate to supply electricity under the best possible conditions is also a major lever of economic development. More specifically, the utility's attractive rates, combined with marketing programs, enable companies in Québec to improve their ability to compete and thus enhance Québec's industrial dynamism. Lastly, Hydro-Québec is also involved in Québec's economic development by contributing to the government treasury.

7.2.1 *Jobs Sustained*

Over the next three years, the total number of jobs sustained by Hydro-Québec's activities will increase by 24,600 person-years, from 62,500 person-years in 1989 to 87,100 person-years in 1992. This level compares favorably with the 70,000 jobs forecast for 1991 in the 1989-1991 Development Plan.

Construction Program and Operations

In 1989, Hydro-Québec began a new phase of the expansion of its generating facilities. In the years to come, the utility will also be spending substantial amounts to maintain existing installations and strengthen the transmission and distribution systems.

In the next three years, total capital expenditure (excluding grants, investments and loans) will be $12.8 billion, although the figure forecast in last year's Plan was $10.5 billion. The main reasons for this difference are earlier construction of the La Grande 1, Brisay and Laforge 1 projects and accelerated construction of the Grande Baleine project.

This capital expenditure will create substantial economic spinoffs. Direct construction-related jobs for employees of Hydro-Québec and its contractors will increase from 10,400 person-years in 1989 to over 18,100 in 1992. Indirect employment at suppliers will increase from 11,500 to 20,000 person-years.

Furthermore, the utility's operating activities from 1990 to 1992 will require about 19,000 employees and will help sustain an average of 9,000 indirect jobs.

Over the longer term, from 1993 to 1999, gross annual investment will average $6.8 billion according to the average scenario, in comparison with the $5.5 billion forecast for the same period in the 1989-1991 Development Plan. This substantial increase is to a large extent due to earlier construction of Eastmain 1 and of the Nottaway-Broadback-Rupert (NBR) complex. Commissioning of the first NBR generating stations is scheduled for early in the next century.

Québec Content of Goods and Services

Objectives	**Strategies**
Maximize economic spinoffs of Hydro-Québec's purchases of strategic equipment	Enter into manufacturing agreements whereby Hydro-Québec guarantees the supplier a market in return for an undertaking to manufacture the product in Québec and conduct an R & D program Enable companies to test their new products on the Hydro-Québec power system, according to pre-determined conditions Promote, in cooperation with the *Institut de recherche d'Hydro-Québec* (IREQ), the establishment in Québec of companies manufacturing new products Enter into compensation agreements whereby, in exchange for a guaranteed market for one product, manufacturers undertake to produce in Québec another strategic product used by Hydro-Québec

Hydro-Québec can maximize its impact on Québec's economy through measures to raise the Québec content of its purchases, especially those of strategic equipment, which accounted for about 25% of its total purchases in 1989. This type of equipment, which will represent about 30% of construction-related purchases in the next three years, requires special attention. The Québec content of Hydro-Québec's purchases varies widely. In 1989, goods and services purchased by the utility had an overall Québec content of 76%, or 57% for goods and 94% for services and construction work. The Québec content of strategic equipment purchased in 1989 was 66%. If, however, primarily electrical equipment and apparatus are considered, excluding cables and conductors, steel for lines and substations, and metal cables and guy wires, then the figure drops to 51%. Strategic equipment also represents an important target because its reliability and availability have a direct impact on service continuity and quality, and, for many products, the utility is the main purchaser in Québec.

The Canada-US Free Trade Agreement is causing, and further integration of the European Community in 1992 will also cause, widespread rationalization. Rather than winding down, this trend will accelerate in the years to come, and Hydro-Québec intends to take advantage of the possibilities so created to further develop Québec's electrical industry. To do so, in line with the utility's policy of promoting economic development through its purchasing power, it will emphasize two key aspects: product quality and R & D. It will encourage its suppliers to meet ever-higher quality standards and will give priority to suppliers that channel effort and investment into R & D in Québec, so that increasingly competitive products can be developed for export worldwide.

In 1989, Hydro-Québec entered into three manufacturing agreements. The first, contingent on competitive prices, concerns the manufacture in Québec of series compensation equipment for the transmission system at a cost of close to $250 million. The second is for the manufacture, in Québec, of resistive voltage detectors designed by IREQ. The value of this agreement is estimated at $1.5 million. The third agreement, to cost close to $1.2 million, is for the manufacture in Québec of snap-on insulator-holders for the distribution system.

In addition, an R & D program, carried out jointly by Hydro-Québec and a manufacturer under a manufacturing agreement, has led to the development of a cold-temperature SF_6 circuit breaker, the first of its kind in the world. The two parties are now negotiating an understanding that will guarantee Hydro-Québec a competitive cost price and the manufacturer a sufficient initial order to start production.

The objective and strategies outlined last year, under the policy of promoting economic development through purchasing, yielded encouraging results and so will remain the same in the years to come. The utility intends to pursue this policy to increase the Québec content of strategic equipment. And in the prevailing context of market globalization, Hydro-Québec will study the newcomer markets more closely, to obtain its strategic equipment at the best possible conditions.

Marketing and Energy-Efficiency Programs

Objective	Strategies
Maximize the comparative advantages of hydroelectricity as a factor in the location and development of industry	Offer risk-and-profit-sharing formulas to industrial customers for whom electricity is a major production factor Continue the Electrotechnology Implementation Assistance Program, begun in 1988, with emphasis on electrical efficiency Ensure research, development and demonstration of electrotechnologies

In line with its development objective for Québec markets, Hydro-Québec has drawn up a marketing plan that focuses primarily on large-power users. These are primarily the pulp and paper, smelting and refining, and chemical industries. Their ability to compete has enabled them to secure a significant portion of domestic and foreign markets.

With the international scene becoming increasingly competitive, Québec industries must be able to rely on favorable electricity rates to maintain and increase their growth. Another of Hydro-Québec's concerns is ensuring that electricity is used as efficiently as possible. The costs of generation are constantly rising, so it is important to avoid waste. The utility's marketing programs reflect these various concerns.

Electricity-intensive industries that want to locate in Québec can reduce their risks by negotiating with Hydro-Québec contracts based on risk and profit sharing. In 1989, four new contracts were added to the nine signed since 1986 under the risk-and-profit-sharing program. The four contracts represent a total capacity of 1,545 megawatts and are related primarily to aluminum smelter projects.

The US firm Alumax will, by 1992, spend $1 billion to construct an aluminum smelter with an annual capacity of 215,000 tonnes in Deschambault. The Alouette Inc. smelter, also with a capacity of 215,000 tonnes, will start up in Sept-Îles in 1992, at a cost of $1.2 billion. It has the option to double its production capacity in 1995. Reynolds will spend $500 million to add 120,000 tonnes to its existing capacity at Baie-Comeau. All told, these projects represent 1,800 permanent direct jobs.

Hydro-Québec also runs an Electrotechnology Implementation Assistance Program to demonstrate efficient electrical processes and to promote their adoption by Québec industries. Phase I of the program generated 500 projects and $230 million in investment. By 1992, Hydro-Québec expects phase II to add 250 projects entailing investment of $150 million.

Although this very successful program is available to companies of all sizes, it is of special benefit to small and medium-sized businesses. So, while there have been major-spending projects, such as Pétromont's replacement of gas turbines with electric motors, there have also been a large number of cases of the introduction of electrical processes into small and medium-sized businesses, such as the heat pump, electrical resistance and infrared. And new high-performance technologies such as microwaves, high frequencies, osmosis and mechanical steam recompressors, are gradually being introduced into Québec industries.

In the years to come, Hydro-Québec will also promote energy efficiency by the setting-up of various energy-conservation programs. More specifically, it will subsidize the purchase of electrical equipment and accessories that use less electricity. The utility is also likely to institute a program to evaluate the energy-conservation potential of its various customers.

Jobs sustained by electricity-marketing activities will increase from 14,800 person-years in 1989 to 20,400 in 1992.

In conclusion, Hydro-Québec's activities have a permanent impact on Québec's economic development, in addition to temporarily sustaining economic activity during construction periods. Its major generation and transmission projects have given rise to hydraulic and project-management expertise that has contributed to the world-wide success of Québec's consulting engineering firms. Similarly, measures to increase the Québec content of its purchases of strategic equipment have contributed to the development of Québec's electrical-equipment industry, and substantial R & D budgets have spurred technological development in the province. Lastly, optimizing hydroelectricity's comparative advantages has helped sustain permanent jobs, particularly in large-power industries.

Table 7.2
Jobs Sustained by Hydro-Québec
(in person-years)

Activity	**1988***	**1989**	**1990**	**1991**	**1992**
Operations and investment	43,675	47,685	57,670	64,835	66,720
Jobs related to operations	23,475	25,775	28,020	28,055	28,680
– Direct	17,235	18,090	19,040	19,310	19,610
– Indirect	6,240	7,685	8,980	8,745	9,070
Jobs related to investment	20,200	21,910	29,650	36,780	38,040
– Direct	9,530	10,415	14,260	17,665	18,065
– Indirect	10,670	11,495	15,390	19,115	19,975
Marketing	11,455	14,835	22,840	24,255	20,375
Jobs related to operating activities and investment by large-power industries	8,625	13,915	21,390	22,255	18,460
Jobs related to other marketing programs (dual-energy, electrotechnologies, and energy conservation)	2,830	920	1,450	2,000	1,915
Total	55,130	62,520	80,510	89,090	87,095

* Revised figures for 1988.

7.2.2 Contribution to Québec Treasury

Hydro-Québec contributes to Québec's economic growth with tax and revenue income, and the Québec government consolidates Hydro-Québec's net income into its general revenue. This amount was $565 million in 1989 and will average $790 million over the next three years. However, for this period, Hydro-Québec does not expect to pay any dividend to its government shareholder.

The utility also makes contributions in the form of real estate taxes and the tax on capital, as well as 3% of its gross revenue from sales of firm electricity in Québec in lieu of property tax on its generating and transmission facilities. These taxes will average $392 million annually from 1990 to 1992.

Table 7.3
Hydro-Québec Contribution to Québec Treasury
(in millions of dollars)

	1988	1989	1990	1991	1992
Taxes*	294	324	357	387	433
Net income**	619	565	401	879	1,099
of which dividends***	300	182	-	-	-

* Excluding retail sales tax
** Reflecting assumptions of the financial framework
*** Dividends declared for 1988 and 1989

The following publications are available on request:

- ***Proposed Hydro-Québec Development Plan 1990-1992 – Horizon 1999, Summary***
- ***Hydro-Québec and the Environment***
- ***Hydro-Québec and Energy Efficiency***
- ***Rates Proposal for 1990-1991***
- ***Electricity Demand in Québec***

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RATES PROPOSAL FOR 1990-1991

RATES PROPOSAL
FOR 1990-1991

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INTRODUCTION

During coming years Hydro-Québec will work to improve the quality of its service and promote electrical efficiency. Another chief priority will be to maintain a sound financial situation in face of the difficult short-term situation and the resumption of major long-term hydroelectric projects. Thus, rate increases must support a number of the objectives in the Development Plan.

The difficult temporary conditions associated with low runoff, along with Hydro-Québec's efforts to improve service quality and promote energy conservation, will all have a serious impact that the utility intends to manage over time in order to avoid burdening its customers with rate shocks. Towards this objective, Hydro-Québec intends to support electrical efficiency efforts to help its customers offset the rate increases, and contain the growth of demand and associated costs. Demand management programs, such as the dual energy and interruptible power programs, will also help reduce the utility's costs.

After a brief review of electricity prices, this Proposal analyses changes in the costs of supply, sets forth rate and marketing policies, and presents the increases proposed for 1990 and 1991. Finally, it explains rate modifications and increases by rate category, and discusses their impact on customers and the utility's revenue.

Highlights

1. Proposed overall increases of 7.5% on May 1, 1990 and 7.5% on May 1, 1991.
   Average yearly increase by rate category:

Domestic rate		(D) :	8.5%
General rates	- small power	(G) :	6.5%
	- medium power	(M) :	6.5%
	- large power	(L) :	8.0%*

   *Actual impact of 7.2%, taking the rate stabilization program into account.

2. Restructuring of the large power general rate (L).

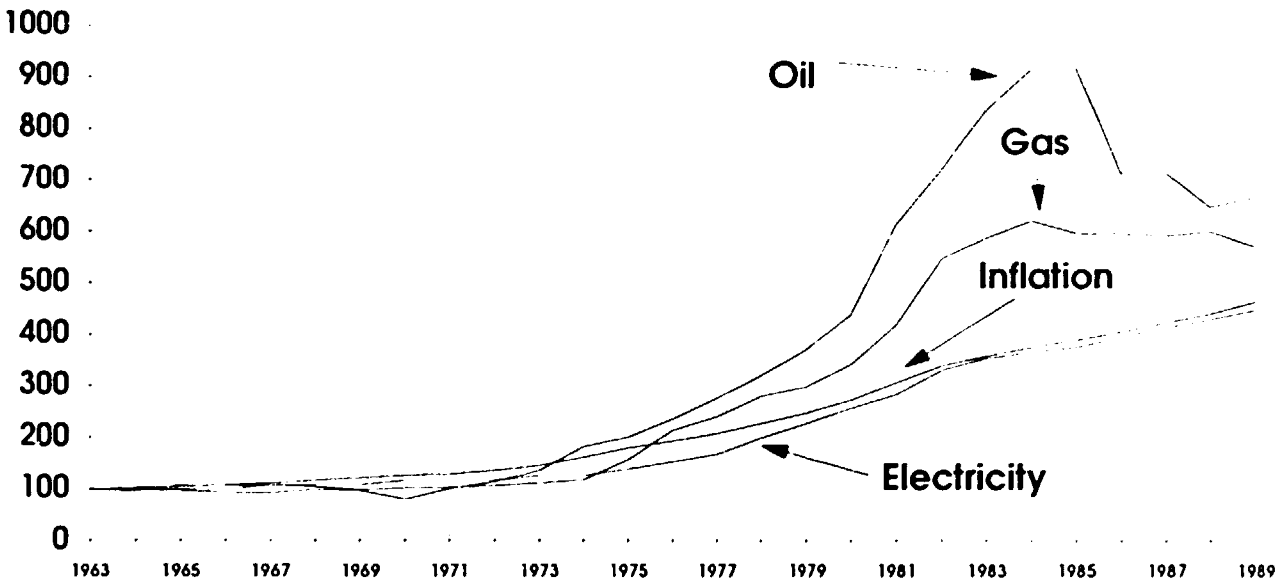
1 REVIEW

1.1 Competitive Position

Since it was nationalized in 1963, Hydro-Québec has succeeded in maintaining stable and competitive prices, in spite of a variable economic and energy context.

As shown in Figure 1, the electricity price index has remained slightly below inflation since nationalization. In real terms, consumers are paying slightly less than in 1963, which has helped increase the buying power of Québec consumers while providing them with the comforts of electricity.

Figure 1
Inflation and Energy Prices
(1963 = 100)



Electricity enjoys a favorable competitive position compared with other forms of energy. As shown in Table 1, electric space and water heating for a single-family home costs 9% and 6% less than with old fuel-oil and natural-gas heating systems, respectively. Such old systems make up the majority of fuel-oil and natural-gas heating systems in Québec. It is interesting to note that approximately 70% of Québec homes are electrically heated, and that the rate of penetration of electric heating in new constructions is 94%. Also, as shown in Table 1, the advantage of electricity increases when it is used as part of a dual energy system whose other energy source is fuel oil.

Table 1
Competitive Positions* — Space and Water Heating in the Residential Sector
Electricity = 100
(Fourth Quarter — 1989)

Type of system	14,800 kWh			18,800 kWh***			30,800 kWh		
(Fuel oil, natural gas and dual energy)	Fuel oil	Natural gas	Dual energy**	Fuel oil	Natural gas	Dual energy**	Fuel oil	Natural gas	Dual energy**
Old	114	114	94	109	106	88	101	94	79
New	105	107	93	99	100	87	90	89	78
High-efficiency	102	89	92	95	83	86	86	73	77

* Including maintenance costs for space and water heating systems
** Dual energy Rate DT, with fuel oil
*** Average consumption of a single-family house for space and water heating

Québec consumers also enjoy some of the lowest rates in Canada and North America. For example, a residential customer in Toronto pays 34% more than a Montrealer. As shown in Table 2, Ontario Hydro's industrial customers also pay 34% more than those of Hydro-Québec.

Table 2
Comparison of Electricity Price Indices — Large Cities — as of May 1, 1989*

	Residential (1,000 kWh)	Small power (40 kW 10,000 kWh)	Medium power (1,000 kW 400,000 kWh)	Large power (100,000 kW) (85% Load factor)
Canadian cities				
Montréal (Québec)	100	100	100	100
Toronto (Ontario)	134	120	121	134**
Winnipeg (Manitoba)	101	75	79	94
Edmonton (Alberta)	110	107	109	---
Vancouver (B.C.)	112	83	83	101
American cities				
New York City	316	243	248	233
Boston (Massachusetts)	232	172	158	204
Detroit (Michigan)	236	181	177	221
Chicago (Illinois)	236	174	175	186

* Excluding sales tax
** Ontario Hydro customers

1.2 Rates and Price Indices

Over the last few years, Hydro-Québec's firm electricity sales in Québec have been growing at a strong pace, increasing at a yearly average rate of 7% since 1984, as indicated in Table 3.

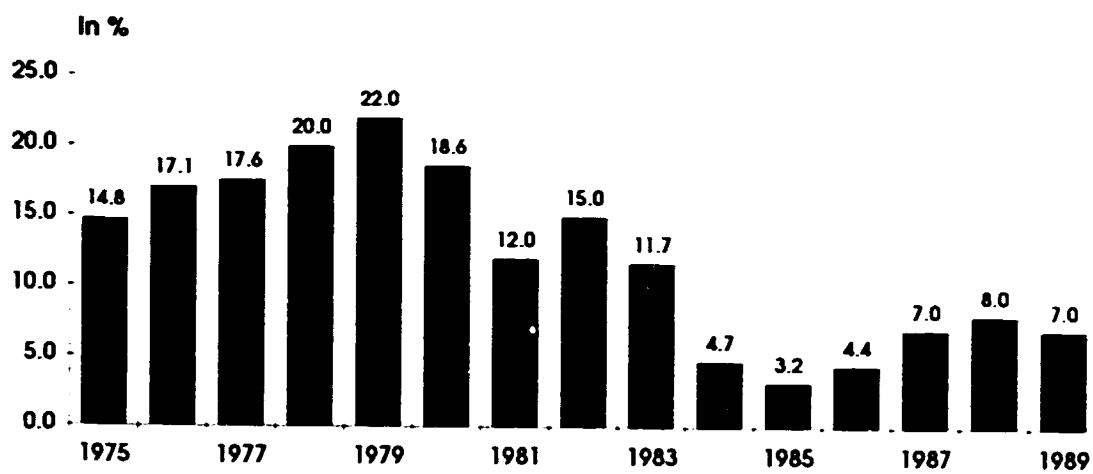
Québec's significant economic growth over this period partly accounts for this increase in electricity requirements. In more specific terms, Québec's domestic product has sustained annual growth of 4.3% since 1984. The relatively moderate increase of electricity rates over the same period has also helped encourage sales growth. In fact, the yearly increase of electricity rates has averaged only 4% -- less than the inflation rate, which increased 4.3% per year on average during the same period. This rapid growth of sales also allowed the utility to slightly improve its financial situation.

Table 3
Changes in Rates and Other Indices

	1984	1985	1986	1987	1988	1989	Average yearly growth
Firm electricity sales in Québec							
TWh	91.0	97.6	103.5	110.4	119.8	127.6	---
% variation	6.9	7.3	6.0	6.6	8.5	6.5	7.0
Québec's GDP							
% variation	6.7	2.7	3.0	5.8	5.4	2.2	4.3
Electricity rates							
% variation	3.4	2.5	5.4	4.6	3.9	4.3	4.0
Consumer price index							
% variation	4.4	4.0	4.1	4.4	4.1	4.9	4.3
Return on equity							
%	4.7	3.2	4.4	7.0	8.0	7.0	---

Nonetheless, the rate increases have not been sufficient to enable Hydro-Québec to regain the financial situation it enjoyed in the early 1980s, as shown in Figure 2. This has left the utility in a vulnerable position as the 1990s begin, at a time when it must again step up its financing program.

Figure 2
Changes in Return on Equity
Hydro-Québec's Overall Activities



2 EVOLUTION OF COSTS OF SUPPLY

The rate increases proposed by Hydro-Québec are based on average costs of supply. In the short term, difficult conditions resulting from the low runoff, the utility's efforts to improve service quality, and the introduction of an ambitious energy conservation program will exercise upward pressure on costs. In the medium and long terms - aside from the ongoing service quality enhancement programs - expenditures incurred to maintain existing facilities and the commissioning of new facilities will make the largest contribution to rises in supply costs. Overall, these factors will have a serious impact which the utility intends to manage over time in order to avoid burdening its customers with excessive rate shocks.

2.1 Characteristics of Costs of Supply

Costs of supply are the expenditures Hydro-Québec must make to generate, transmit and distribute the electricity its Québec customers require. More precisely, these costs include expenditures, interest, exchange loss and the return on equity. Overall, these expenditures include the costs related to Hydro-Québec's facilities, from the oldest to the most recent, required to supply power to its customers. They are therefore average costs.

Return on equity is the shareholder's return on investment, and is an important measure of the utility's financial health. In the coming years, Hydro-Québec is aiming at a 13% return on equity for overall sales subject to the Rates Bylaw. This rate is lower than the returns granted to other public utilities in 1989, such as Gaz Métropolitain (14.25%) and Bell Canada (13.25%).

A sound financial situation should allow Hydro-Québec to continue obtaining financing on attractive terms. This is particularly important in that the period 1990-1999 will be characterized by a large volume of borrowings on financial markets for the planned construction program. It should be underlined that gross annual borrowings will rise from $3.2 billion in 1990 to $4.9 billion in 1992, to attain a total of $50.2 billion for the overall period 1990-1999.

2.2 Costs of Supply in Coming Years

Costs of supply for the three years covered by the Development Plan are appreciably higher than those projected in last year's Development Plan, for contextual as well as structural reasons. Table 4 shows cost increase factors which are independent of demand growth.

From a contextual viewpoint, the low runoff in the last six years has forced Hydro-Québec to implement a series of costly measures to meet demand. In the last two years, the low runoff has been the main factor affecting the financial performance of the utility, causing a cumulative reduction of net income of more than $500 million. The effects of the low runoff situation will still be felt in 1990. As shown in Table 4, the intensive operation of Tracy thermal generating plant and the purchase of makeup power from neighboring systems will reach $212 million.

Table 4
Impacts of Principal Modifications on Expenditure, Interest and Exchange Loss, Compared with the 1989-1991 Development Plan
(in millions of dollars)

	1990	1991	1992	Total
Contextual impact				
Expenditure caused by low runoff*	212	0	0	212
Structural impact				
Quality of service **	83	118	123	324
Power reliability and revision of the average output of generating stations***	0	58	150	208
Energy conservation	24	54	86	164
Training programs	16	20	20	56
Other modifications****	7	53	51	111
Total structural impact	130	303	430	863
Total	**342**	**303**	**430**	**1,075**

* Excluding revenue shortfall of $102 million caused by the buyback of dual-energy contracts
** Introduction of Maintenance Enhancement Program (PAM) and Service Quality Enhancement Program — Customer Services (PAQS — clientèle) and re-evaluation of Service Quality Enhancement Program — Distribution System (PAQS 2) for the period
*** Involves additional generating equipment to cope with peak demand, power purchases, and purchases from independent producers
**** Renovation of generating stations, application of Act 116 concerning pension expense, provision for decommissioning of Gentilly 2, modification for depreciation costs, taxes, economic parameters and other current activities

Furthermore, the launching of new programs will result in major operating and interest expenditures of a more permanent nature. These programs mainly involve energy conservation and the improvement of service quality. The difference between this year's Plan and last year's is $863 million for the 1990-1992 period, as shown in Table 4.

Service quality is one of Hydro-Québec's paramount concerns. This is why it has implemented three major programs: the Maintenance Enhancement Program (PAM) for generation, transmission and telecommunications facilities; the Service Quality Enhancement Program — Customer Services (PAQS - Clientèle); and the Service Quality Enhancement Program — Distribution System (PAQS 2). These programs will require additional expenditures of $324 million over last year's projections.

Also, more stringent reliability criteria and the lower productivity projections for existing generating facilities will result in higher expenditures than those projected in last year's Development Plan. To adequately meet demand, the utility will have to bring forward the construction of gas-turbine generating facilities; purchase power; and buy from independent producers. These steps represent additional expenditure of $208 million in the short term.

As of 1990, Hydro-Québec will implement a major energy conservation program. This commitment will result in expenditures of $1.8 billion between 1990 and 1999 and will reduce energy demand by approximately 12.9 terawatthours in 1999. In the shorter term, promoting energy conservation will entail expenditures of $164 million which were not provided for in the 1989-1991 Development Plan. Although this program will help to hold down customers' electricity bills from 1990, its beneficial effects on the costs of supply will only be fully felt in the longer term as it begins to slow down demand growth and the construction needed to meet the demand.

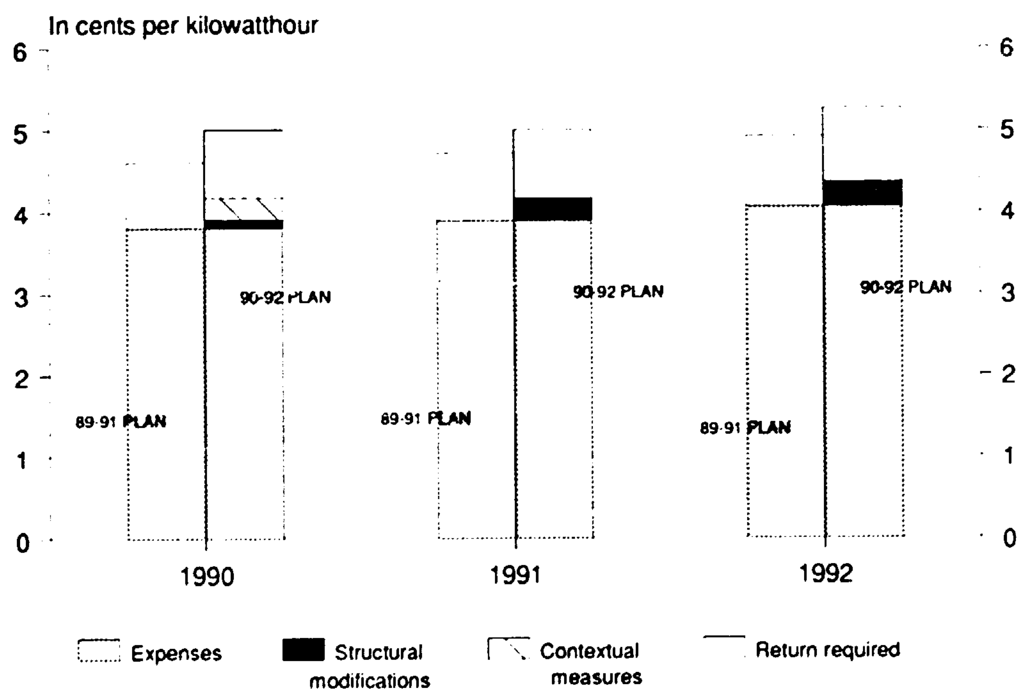
Additional expenditures will also be required to intensify the training of Hydro-Québec's employees, which is warranted by increased service quality activity, the high technical level of work and the quickening pace of technological evolution.

Finally, additional expenditures of $111 million will also be necessary due to increases in depreciation costs and taxes, changes in economic parameters, as well as other modifications such as the application of Act 116 to pension expense and the decommissioning of Gentilly.

Thus, for the 1990-1992 period, additional expenditures will exceed $1 billion, which represents approximately 6% of total expenditure, interest, and exchange loss.

Figure 3 breaks down supply costs in the 1989-1991 Development Plan and the 1990-1992 Development Plan by major expenditure item and required return. The Figure also highlights the importance of structural and contextual factors that were not included in last year's projections.

Figure 3
Breakdown of Costs of Supply 1990-1992
(Sales subject to the Rates Bylaw)



These assessments take into account the measures Hydro-Québec plans to set in motion in the coming years to control the growth of its operating expenditures. The utility did in fact undertake such a control program in 1982. As a result, the inflation-adjusted growth of operating expenditures was reduced to a yearly average of 1.9% for the 1982-1988 period versus 10% for the 1976-1982 period. Hydro-Québec achieved this result while experiencing total annual sales growth of 6%, acquiring 460,000 new customers, and adding 3,200 kilometres of transmission lines and 4,300 kilometres of distribution lines to its system.

In the next few years, Hydro-Québec will continue striving to improve individual productivity. Several measures have already been implemented to increase service quality, clarify the subcontracting issue, improve the productivity of power transmission and distribution projects, and intensify training programs.

Demand management and energy conservation programs will also help control supply costs in the medium and long terms by restraining demand growth. These programs are further described in a complementary document entitled "Hydro-Québec and Energy Efficiency".

Summary

- Supply costs for the 1990-1992 period are higher than those projected in last year's Development Plan. The additional expenditures resulting from the low runoff situation and the implementation of new programs aimed at improving service quality and energy conservation will exceed $1 billion.
- In coming years, Hydro-Québec wants to attain a 13% return on equity for all sales subject to the Rates Bylaw. This objective will ensure the utility's financial soundness and thus support its investment program.
- Hydro-Québec will pursue its efforts in restraining the growth of operating expenditures while continuing to improve individual productivity. Consumption control and energy conservation programs will also help the utility control the growth of supply costs in the medium and long terms by restraining the growth of demand.

3 RATES PROPOSAL

Rates are determined on the basis of a careful balance between the utility's financial requirements on the one hand, and its rate and marketing orientations with regard to customers on the other. This is the basis of the rates policy Hydro-Québec adopted in 1985 which has four guiding principles:

- maintain standardized rates throughout Québec and standard treatment for customers with similar consumption characteristics;
- achieve rate categories that gradually but accurately reflect the costs of supply of the various products delivered;
- take customer methods of operation into consideration;
- facilitate understanding and application of the rates policy.

3.1 Rates and Marketing Policies

Among these guiding principles, an accurate reflection of overall supply costs is of particular importance in a context characterized by growing costs and efforts on the part of the utility to encourage energy conservation through its marketing programs. It is also of prime importance that customers be fully aware of the costs associated with satisfying their power requirements. Thus, electricity rates will have to gradually reflect the supply costs specific to each rate category.

Hydro-Québec will implement a series of programs aimed at ensuring the long-term penetration of energy conservation measures. These measures are advantageous for Hydro-Québec's customers, and their integration into the utility's strategic planning objectives will help Hydro-Québec adjust its construction program and better adapt it to Québec's real needs. In this context, energy conservation is a means of production just like a power plant, and will contribute to satisfying Québec's power requirements while slowing the growth of supply costs and, consequently, the revenue required.

However, the adoption of energy conservation measures as a tool for controlling the growth of supply costs requires certain favourable conditions. Giving consumers the right price signals is crucial to encouraging them to adopt energy-conserving habits and make better use of energy resources in general. Conserving energy and making sound energy choices are more difficult for customers if the price signal is distorted.

Hydro-Québec's goal of accurately reflecting supply costs is one of the main principles it must demonstrate in its rates structure. In fact, this is the very reason why the utility has for several years been proposing rate increases which would bring rates closer to actual costs in each rate category. This objective is particularly desirable in the present context of encouraging consumers and the market to use electricity at its real value.

The reflection of increases in the costs of supply will, however, be adjusted in such a way as to avoid overly sharp rate increases. This approach will make it possible to ensure the stability of rates.

3.2 Proposed Overall Increases

As shown in Table 3, the utility's financial situation has not evolved in such a way as to allow it to achieve the required return on equity. This objective remains out of reach and the rhythm of the 1986-1989 recovery efforts has been broken. The lack of an adequate margin of manoeuvre leaves the utility particularly vulnerable to contextual hazards such as the low runoff problem experienced in recent years. In addition, with increased operating and interest expenditures in 1990, the utility's objective may well become even more distant. Some catching up is therefore in order, especially in view of the forthcoming stepped-up investment program.

3.2.1 Proposed Approach

Since Hydro-Québec intends to ensure its customers a certain degree of rate stability, it would be totally unrealistic to try and attain its return on equity objectives as early as 1990. The 20% rate increase that would be required to do so would be excessive. Nor could such an increase be justified given that the present unfavorable context, which will sharply increase expenditure in 1990, will subsequently disappear. Only structural expenditures will remain, as illustrated in Figure 3.

The utility therefore proposes not to make the necessary financial correction in 1990, and to allow certain financial criteria to fall to their lower limits. It is opting instead for a more gradual approach that will spread rate increases over time, so that the revenue generated will allow it to reach its objective only in 1992.

This gradual approach is also preferable in terms of customers' ability to pay and the utility's marketing objectives. Energy conservation programs are good ways to help customers compensate for rate increases. Because these programs will be implemented gradually, it makes sense to spread rate increases over time. This rate-smoothing approach will still allow Hydro-Québec to send out price signals that promote energy conservation.

Hydro-Québec is pursuing important objectives through certain rate structure modifications proposed in this document. These objectives could not be achieved if a major rate shock were imposed in 1990.

3.2.2 Rate Increases Set for Two Years

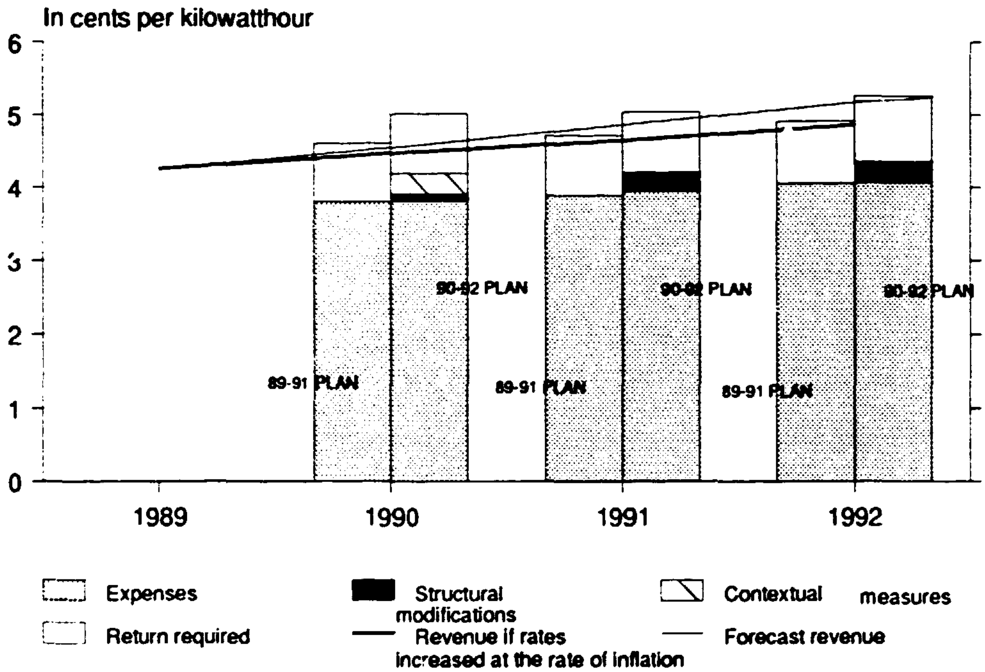
For 1990 an overall increase of 7.5% appears to be the minimum possible. Such an increase barely covers interest costs and would yield a return on equity of only 4.8% from overall sales. This would be difficult to accept if significant recovery were only to take place in the short term.

In order to ensure its financial recovery, Hydro-Québec therefore proposes to set rate increases for two years in the next Rates Bylaw. A 7.5% increase on May 1, 1990 would not allow the utility to maintain satisfactory financial ratios, but is an acceptable solution when combined with an identical increase on May 1, 1991 which would permit recovery.

Setting rate increases for two years will also provide a measure of certainty in financial milieux. It will also give customers a clear picture of the utility's orientations. Since they will know the second year's increase ahead of time, they will be in a better position to plan their financial and energy commitments. They will also receive a clear signal as to the utility's intention to continuously promote energy conservation programs.

This Rates Proposal should allow a rate increase for 1992 that is closer to inflation and consistent with long-term growth in costs. A hypothetical average rate increase of 6% has been retained for 1992, for comparison purposes. Figure 4 shows that, according to this scenario, Hydro-Québec would in 1992 be a situation similar to that projected in its 1989-1991 Development Plan, where increases were strictly limited to keeping up with inflation.

Figure 4
Relative Positions of Inflation-Linked and Proposed Rate Increases (Sales Subject to the Rates Bylaw)



Note that in 1992 the difference between the revenue that would be generated from the inflation-linked rate increases projected in the 1989-1991 Plan and that which would be generated from the increases now proposed is about equivalent to the expenditures to be incurred for the new programs discussed above.

3.2.3 Impact of Rate Increases on Financial Ratios

The impact of the proposed rate increases on Hydro-Québec's financial ratios is illustrated in Table 5. The Table also shows the impact of increases equal to the inflation rate, as projected in the 1989-1991 Development Plan.

Rate increases linked to inflation would be clearly insufficient to maintain the utility's financial ratios. This would not be acceptable since it would affect the utility's borrowing power and would not provide sufficient flexibility to deal with fluctuations in its economic environment.

Table 5
Impact of Proposed Rate Increases Versus Increases Forecast in 1989-1991 Development Plan

	1989	1990		1991		1992	
Rate increases (%)		4.5	7.5	4.3	7.5	5.2	6.0
Net income ($ millions)	565	305	401	593	879	667	1,099
Interest coverage	1.12	1.02	1.05	1.08	1.17	1.06	1.19
Capitalization (%)	25.9	24.4	24.7	23.6	24.5	22.6	24.4
Return on equity (%)	7.0	3.6	4.8	6.7	9.7	7.1	10.9
Self-financing (%)	30.0	23.7	25.8	22.8	27.5	22.7	29.0

The rate increases which Hydro-Québec proposes in this document will enable it to attain, by 1992, a financial situation comparable to that projected in last year's Development Plan. This situation is satisfactory, even though three of the four major ratios that measure the utility's financial health do not rise above their minimum levels. The capitalization rate remains under 25%, the return on equity only reaches the average cost of debt in 1992, and the self-financing rate remains under the 30% objective.

Summary

- The utility's present income levels do not allow it to cover its supply costs including the required 13% return. A financial recovery program is therefore required.
- An attempt to reach the utility's financial objectives as early as 1990 would entail a sharp rate increase of the order of 20%. Hydro-Québec therefore proposes a more gradual approach that will allow it to reach its objective by 1992.
- Hydro-Québec requests immediate approval of a 7.5% rate increase on May 1, 1990, and another 7.5% increase on May 1, 1991.

4 RATE CHANGES AND INCREASES BY RATE CATEGORY

The 1990-1991 rate revision has four aspects: different rate increases for the main rate classes; a modified structure for general-service Rate L for large power; changes in prices and certain conditions of dual-energy rates; and the introduction of a way for industrial customers to experiment with interruptible power.

4.1 Proposed Increases for the Main Rate Categories

As mentioned in the previous section, Hydro-Québec proposes to increase the rates for sales subject to the Rates Bylaw by 7.5% on May 1, 1990, and by 7.5% on May 1, 1991. These increases are averages for all rate categories subject to the Rates Bylaw.

Rate categories D (residential service), G (small power, general service), M (medium power, general service) and L (large power, general service) are Hydro-Québec's main customer categories. They have different characteristics, particularly in regard to consumption, costs incurred to meet demand and contribution to the utility's revenue.

Hydro-Québec's efforts to serve its residential customers are perfectly understandable given their dominant position in relation to other customer categories. Besides its generating and transmission facilities, Hydro-Québec must maintain and develop a large distribution system to meet these customers' growing electricity requirements. It should also be noted that Hydro-Québec's Proposed Development Plan 1990-1992 provides for a $2.3 billion investment over the next three years to develop and modernize the system. This is $283 million higher than forecast in last year's plan.

Also, the high level of consumption resulting from heating and other residential winter requirements, especially during peak periods, is a significant factor in establishing the cost of serving residential customers. On the whole, supply costs for low-voltage, Rate D and G customers are higher than those for medium- and high-voltage, Rate M and L customers.

Table 6
Relative Contribution to Costs and Revenue
by Rate Category
1989

Rate Category	Relative contribution to costs * (%)	Relative contribution to revenue (%)	Revenue/cost ratio**
D (residential)	50.6	45.2	0.89
G (small power)	12.3	15.4	1.25
M (medium power)	15.6	19.4	1.24
L (large power)	21.5	20.0	0.93
Total	100.0	100.0	

* Excluding return
** Ratio of relative contribution to revenue over relative contribution to costs

Table 6 shows an imbalance between the revenue generated from each rate category and the costs required to meet demand within each rate category. For example, residential customers contribute a very low proportion of revenue (45.2%) to costs (50.6%) in this sector.

The ratio calculated in Table 6 illustrates this situation. This ratio expresses the relationship between the contribution to revenue generated and the contribution to the costs of supplying electricity for each rate category. A ratio equal to 1.00 represents a contribution to revenue that is equal to costs incurred. A ratio of less than 1.0 demonstrates an inadequate contribution. In Table 6, Rates G and M show revenue greater than that required for their supply costs. They thus make up for the losses resulting from the cross-subsidization of rate categories.

This imbalance is also illustrated in Table 7 which underlines the residential sector's low contribution to profits from electricity sales in these customer categories. For 1989, the profit margin for sales to Rate D customers is estimated at only 5%. The residential sector has the highest sales volume but generates the lowest proportion of profits. Inversely, Rate G and Rate M customers, with a smaller share of sales, compensate for this through a profit margin greater than 31.0%.

Table 7
Contribution to Profits by Main Rate Category
1989

Rate Category	Share of sales	Profit margin	Contribution to profits
D (residential)	42.3%	4.8%	14.5%
G (small power)	11.1%	31.8%	33.0%
M (medium power)	17.1%	31.3%	40.9%
L (large power)	29.5%	8.6%	11.6%
Total	100.0%	-	100.0%

This dependence of Hydro-Québec's profitability on rate categories G and M, where competition with other energy sources is much more intense and where electricity's competitive position is the weakest of all, constitutes a financially precarious situation in the long term which must be progressively rectified.

As for short-term measures, the option chosen for 1990 and 1991 must take into consideration the economic context. Under present conditions, where proposed overall rate increases are already large, Hydro-Québec believes it must adopt a moderate approach, as indicated in the following table. This approach is in line with the policy retained by the utility to reduce the cross-subsidization between categories D and G by half by the year 2000.

Table 8
Proposed 1990 and 1991 Increases
for the Main Rate Categories

Rate Categories	1990	1991
Rate D (residential)	8.5%	8.5%
Rate G (small power)	6.5%	6.5%
Rate M (medium power)	6.5%	6.5%
Rate L (large power)	8.0%*	8.0%*
Average increase	7.5%	7.5%

* Real effect of 7.2% on revenue, with the rate stabilization program taken into account

The proposed increases will allow a slight correction in the level of cross-subsidization, as demonstrated in Table 9.

Table 9
Revenue-Cost Ratios, Main Rate Categories

Rate Categories	1989	1991
Rate D (residential)	0.89	0.90
Rate G (small power)	1.25	1.21
Rate M (medium power)	1.24	1.22
Rate L (large power)	0.93	0.93

While intended to rectify the potential threat to the utility's financial stability, this proposal would also have a beneficial impact on small businesses and Québec's economy in general. Thus, increases for Rate G and M customers, which include small and medium-sized businesses, would be below the overall average. These businesses, which create jobs in Québec, would be able to improve their competitive position in regard to similar-sized companies in other provinces where, among other factors, natural gas is more widely available and less expensive.

4.2 Proposed Residential Service Rate Increases

The revised rate structure calls for an 8.5% increase for regular residential rates. This increase is higher than the overall average increase in order to allow the utility to gradually reduce the imbalance between rates and supply costs in this category.

This Rates Proposal should also encourage residential customers to adopt simple energy conservation measures which would allow customers who apply them now to reduce their electricity bills and offset a good portion of the proposed rate increase. Hydro-Québec intends to be very active in supporting customers in their energy conservation efforts.

4.2.1 Single-Family Homes (Rate D)

Rate D is composed of a fixed charge which is independent from consumption, two prices for energy consumption and one price for the winter load demand above 50 kilowatts. The energy consumption prices increase with volume: the first block of 30 kilowatthours per day is billed at the lower price, while any extra consumption is billed at the higher price (see Appendix).

In keeping with the utility's policy of encouraging energy conservation, it is more appropriate to increase the price of the second block by a greater percentage than the first. This is because consumption beyond the first energy block mostly occurs during the winter when Hydro-Québec must use costlier peaking plants to meet demand.

The 8.5% annual increase is an average. As shown in Table 10, the increases will actually vary from 7.9% to 9.0%, depending on the consumption level.

Table 10
Residential Service - Rate D
Bill Frequency Distribution by Annual Increase
(2,531,507 customers)

Annual increase	Customer distribution (%)	
	1990	1991
Under 8.0% (minimum 7.9%)	4.9	10.1
From 8.0 to 8.5%	57.2	54.2
Over 8.5% (maximum 9.0%)	37.9	35.6
Total	100.0	100.0

Tables 11 and 12 show the impact of the 1990 and 1991 rate increases on typical electricity bills for single-family homes. The increase for customers whose main heating source is electricity, which averages 8.6%, will be slightly higher than for customers whose main heating source is not electricity, which averages 8.4%. Also, as shown in Table 12, the average monthly summer bill - 650 kilowatthours - will increase by $2.77 in 1990 and $2.95 in 1991. For higher monthly consumption levels - such as 2,500 kilowatthours in winter months for electrically-heated homes - the increase will be $9.94 in 1990 and $10.82 in 1991.

Table 11
Residential Service - Rate D
Impact of the Rate Increase on Average Electricity Bills

Average annual consumption (kWh)	Average monthly bill ($)			Increase			
	Present	Proposed		1990		1991	
		1990	1991	$	%	$	%
16,604 *	66.40	72.07	78.22	5.67	8.5	6.15	8.5
10,333 **	44.09	47.79	51.60	3.70	8.4	4.01	8.4
20,707 ***	81.02	87.98	95.53	6.96	8.6	7.55	8.6

* Average consumption of Québec customers
** Average consumption of customers whose main heating source is not electricity
*** Average consumption of customers whose main heating source is electricity

Table 12
Residential Service - Rate D
Impact of the Rate Increase on Typical Electricity Bills
(Power under 50 kW)

Typical monthly consumption (kWh)		Monthly bill ($)		Increase			
	Present	Proposed		1990		1991	
		1990	1991	$	%	$	%
650 *	33.95	36.72	39.67	2.77	8.2	2.95	8.0
1,400	65.65	71.19	77.17	5.54	8.4	5.98	8.4
2,500 **	114.71	124.65	135.47	9.94	8.7	10.82	8.7
3,000	137.01	148.95	161.97	11.94	8.7	13.02	8.7

* Average summer consumption
** Average winter consumption for customers whose main heating source is electricity

4.2.2 Multi-Family Sector (Rate DM)

As shown in Table 13, residential increases for apartment buildings with bulk metering will vary from 7.9% to 9%, with an 8.4% average.

Table 13
Residential Service - Rate DM
Bill Frequency Distribution by Annual Increase
(16,816 customers)

Annual increase	Customer distribution (%)	
	1990	1991
Under 8.0% (minimum 7.9%)	2.5	7.2
From 8.0 to 8.5%	82.0	80.1
Over 8.5% (maximum 9.0%)	15.5	12.7
Total	100.0	100.0

4.2.3 Farms

Farms billed at the residential rate will have increases ranging from 7.9% to 9.0%, with an average of 8.7%. Detailed figures are given in Table 14.

Table 14
Residential Service - Rate D - Farms
Bill Frequency Distribution by Annual Increase
(46,503 customers)

Annual increase	Customer distributicn (%)	
	1990	1991
Under 8.0% (minimum 7.9%)	1.2	2.3
From 8.0 to 8.5%	41.5	42.4
Over 8.5% (maximum 9.0%)	57.3	55.3
Total	100.0	100.0

A larger proportion of customers will have an increase above 8.5% due the particular load characteristics of this sector. Electricity consumption on farms is generally higher than the average single-family consumption because of electric farm equipment.

Farms billed under Rate D nevertheless remain at a major advantage since they benefit from the domestic rate rather than the general-service rate normally applied to commercial and industrial customers.

4.2.4 Dual-Energy Residential Rate DT

Implemented in 1987, this optional rate is offered to customers who use a dual-energy system for residential purposes. Customers billed at this rate will have an average rate increase of 9.1% in 1990 and 8.9% in 1991.

This increase is higher than the average residential rate increase due to the adjustment required to better reflect the supply cost of each component of the rate. The price for consumption during off-peak periods will increase from 2.75 to 3.00 cents per kilowatthour in 1990, and to 3.27 cents in 1991. The price for peak periods will increase from 10 to 11 cents per kilowatthour in 1990, and to 12 cents in 1991.

Increases will range from 8.9% to 9.3% in 1990 and from 8.7% to 9.0% in 1991. Table 15 shows customer distribution by increase.

Table 15
Residential Service - Rate DT
Bill Frequency Distribution by Annual Increase
(55,527 customers)

Annual increases	Customer distribution (%)	
	1990	1991
Under 9.0% (minimum 8.7%)	17.4	100.0
Over 9.0% (maximum 9.3%)	82.6	
Total	100.0	100.0

The residential dual-energy program provides customers with an attractive rate. Despite the proposed increase, Rate DT will still allow dual energy customers to save approximately $240 in 1990 and $260 in 1991 compared with Rate D customers.

4.3 Proposed Increases for General-Service Rates

In the general-service category, proposed increases to large-power rates are higher than to small- and medium-power rates. The average annual increase of 6.5% proposed for the latter two classes will enable the utility to somewhat lessen the negative effects of the current imbalance between revenue and costs of supply in this customer category. The proposed large-power increase is 8%.

Changes are also made to Rate L and, to a lesser extent, Rate M, in order to simplify the rate structure and to better reflect the costs of supply in each of these rate categories.

4.3.1 General Rate for Large Power (Rate L)

Average Increase

Due to the slight gap between Rate L and the costs of supply for this category, an increase of 8%, which is slightly higher than the average increase, will be applied for this customer category.

Revised Rate Structure

Furthermore, a revision has begun to eliminate this rate's declining-block structure in relation to power demand and to correct the discounts for supply at high voltage. The revised rate structure will thus be simpler since it will be composed only of a demand charge and a single price for all consumption.

These changes are required to simplify an outdated rate structure in the medium term, and to bring the rate into closer line with the costs of supply. This latter objective is particularly important to the promotion of rational use of electricity, as a rate structure which more accurately reflects the cost of supply will encourage customers to adopt consumption habits that lead to savings for themselves and the utility. This revised rate structure will also reduce cross-subsidization between customer groups in this category, as each group will pay according to its real costs of supply. An adequate rate structure will also open the way to the possible future implementation of time-of-use rates.

A comparison of the various elements of the large-power rate with costs of supply has shown that existing high-voltage discounts are too low, and that energy prices decrease unjustifiably quickly.

The proposed restructuring of Rate L therefore provides for a substantial increase in discounts for supply at high voltage, a restructured demand charge and a reduction in the number of energy price levels, from three to one. This restructuring will be spread over several years to avoid abrupt variations in some customers' bills.

Table 16 shows the proposed restructuring of Rate L, with suggested figures only for 1992.

Table 16
Illustration of the Restructured Rate L

	Present	Proposed for 1990	Proposed for 1991	Outlook for 1992
Price per kW of power	$4.47	$6.66	$8.76	$10.67
Price per kWh for the first 120 hours	4.57¢	3.66¢	2.92¢	--
Price per kWh for the next 2,400,000 kWh	2.52¢	2.46¢	2.40¢	--
Price per kWh for the remaining consumption	1.77¢	1.94¢	2.13¢	2.29¢
Discount per kW for supply at medium or high voltage and adjustment for losses				
5 to 15 kV	$0.45	$0.47	$0.49	$0.50
15 to 50 kV	$0.66	$0.70	$0.75	$0.79
50 to 80 kV	$0.80	$1.04	$1.35	$1.72
80 to 170 kV	$0.85	$1.16	$1.57	$2.11
170 kV and over	$1.13	$1.54	$2.10	$2.81

By itself, the rate restructuring will not generate additional revenue; it simply modifies the distribution of the rate increase among customers. Its impact will therefore be beneficial for the majority of customers since it will slightly reduce the level of the rate increase. Some customers will, however, have slightly higher increases.

Customers most affected are those with a relatively high power supply at medium voltage - 40,000 kW and more - who have benefited from particularly attractive rates in the past by taking advantage of the rate's strongly declining block structure without being supplied at high voltage. These customers include a number of municipalities. To avoid burdening such customers with increases which would be too sharp for them to pass on to their customers, a mechanism will be implemented to limit increases.

Other Change

A change will also be made to the conditions applied to the winter overrun (optimization) charge. The current Bylaw provides for a monthly overrun (optimization) charge on demands exceeding 110% of the contract power, regardless of the duration of the overrun.

To encourage customers to manage their load demand more accurately and avoid a repetition of truly exceptional demand requirements, a lower daily charge will be applied to overruns of very short duration.

Impact on Customers and Revenue

It should be noted that in 1984 the majority of large-power industrial customers joined the rate stabilization program, which limits rate increases until 1994 to 5%, 6% or 8%, depending on the chosen option.

Given the rate restructuring and the impact of the rate stabilization program, the proposed 8% increase will increase revenue by 7.2%. The distribution of increases, ranging from 3.1% to 9.8%, is shown in Table 17.

Table 17
General Service - Rate L
Bill Frequency Distribution by Annual Increase
(228 customers)

Annual rate increase	Customer Distribution (%)	
	1990	1991
Under 6.0% (minimum 3.1%)	47.6	47.6
From 6.0 to 9.0%	51.3	50.8
Over 9.0% (maximum 9.8%)	1.1	1.6
Total	100.0	100.0

4.3.2 General Rate for Medium Power (Rate M)

The proposed 6.5% increase in the general-service rate for medium power is lower than the overall average increase in order to reduce the imbalance between revenue and costs of supply, as well as its negative impact.

That is to say, the existing price level may encourage choices that are incompatible with efficient use of energy resources. Thus, too high a price could encourage some customers to switch to other energy sources, when electricity may be the best energy source for certain applications.

Also, the high prices customers are charged under this rate do not allow small and medium-sized Québec companies in this category to benefit from electricity's comparative advantages. These advantages can often help increase the efficiency and competitive position of such companies, which create jobs in Québec.

Rate increases will therefore range from 5.3% to 8.0% in 1990 and 1991 for Rate M customers, as shown in Table 18.

Table 18
General Service - Rate M
Bill Frequency Distribution by Annual Increase
(16,304 customers)

Annual rate increase	Customer Distribution (%)	
	1990	1991
Under 6.5% (minimum 5.3%)	35.8	42.3
From 6.5 to 7.5%	53.1	47.2
Over 7.5% (maximum 8.0%)	11.1	10.5
Total	100.0	100.0

4.3.3 General Rate for Small Power (Rate G)

A situation similar to that with the general rate for medium power also applies to customers billed at the general rate for small power. The average increase is therefore also 6.5%.

More specifically, the Rate G increase will range from 5.8% to 7.9% in 1990 and 1991. Customer distribution by percentage of rate increase is given in Table 19; Table 20 shows the impact of the 1990 increase on monthly bills.

Table 19
General Service - Rate G
Bill Frequency Distribution by Annual Increase
(261,515 customers)

Annual rate increase	Customer Distribution (%)	
	1990	1991
Under 6.5% (minimum 5.8%)	72.8	72.7
From 6.5 to 7.5%	19.2	19.1
Over 7.5% (maximum 7.9%)	8.0	8.2
Total	100.0	100.0

Table 20
General Service - Rate G
Impact of the 1990 Rate Revision on Typical Bills
(Single-phase supply)

Typical monthly consumption (kWh)		Monthly electricity bill ($)			Increase			
		Current	Proposed		1990		1991	
			1990	1991	$	%	$	%
650		48.06	51.08	54.30	3.02	6.3	3.22	6.3
2,500		157.76	167.26	177.32	9.50	6.0	10.06	6.0
10,000	(40 kW)	639.11	679.36	722.27	40.25	6.3	42.91	6.3
30,000	(75 kW)	1,635.34	1,741.88	1,855.37	106.54	6.5	113.49	6.5
40,000	(95 kW)	2,146.74	2,288.28	2,439.17	141.54	6.6	150.89	6.6

4.3.4 Proposed Increases for Public-Lighting Rates

Public-lighting rates include general service and complete service rates. The increase proposed for this category is the same as that for the general rate for small power: 6.5%. However, since the price of general public-lighting service is the same as that of the first portion of the general rate for small power - i.e. for the first 10,440 kilowatthours per month - it will be increased by the same amount: 5.9%. As for other prices for complete public-lighting services, the increase will be approximately 6.5%.

4.4 Proposed Increases for Dual-Energy Rates (Commercial, Industrial and Institutional Sectors)

These rates were completely revised in 1989 in order to allow the buyback of dual-energy contracts, for a one-year period, from customers wishing to participate in the buyback plan. This revision was accompanied by clauses limiting access to Rate BG and offering Rate BE to customers wishing to continue being supplied with electricity for their dual-energy system. The aim was to support the buyback of dual-energy contracts made necessary by persistent low runoff, which forced the utility to implement a series of exceptional measures.

Despite these events resulting from temporary problems which should resolve themselves, in the long term Hydro-Québec wishes to retain its dual-energy customers in the commercial, institutional and industrial sectors. All parties will thus continue to benefit from the dual-energy program during normal and high runoff periods. Thus, Hydro-Québec will be able to optimize the use of its generating facilities, while customers will continue to benefit from attractive savings.

Proposed changes to dual-energy rates BG and BE in 1990 and 1991 reflect this objective. Rate BG will increase from 2.8 to 3.05 cents per kilowatthour on May 1, 1990, and to 3.32 cents per kilowatthour on May 1, 1991, which corresponds to two 8.9% increases. Rate BE will remain unchanged at 3.8 cents per kilowatthour until December 1, 1990, when it will also change to 3.05 cents per kilowatthour, rising to 3.32 cents on May 1, 1991 like Rate BG.

Also, as it was announced last year, a peak-period consumption price will be introduced for these customers, and will begin when appropriate meters are installed.

4.5 Changes to the Interruptible Power Program

Under the interruptible power program, certain industrial customers agree to reduce their peak period consumption at Hydro-Québec's request. This program offers several options developed according to the needs of the customers and of Hydro-Québec's system.

Discounts offered to participating customers are based on costs avoided by Hydro-Québec for construction and operation of peaking facilities and provide a major part of the utility's savings. These discounts were completely revised in 1989, when they were considerably increased.

The rates proposal for 1990 and 1991 calls for annual increases of 4.6% of the discounts granted, approximately the same as the forecast inflation rate.

In addition, a one-year trial program is being introduced for customers who have not yet joined the program but wish to try it out and for customers who have already joined but wish to increase their interruptible load.

5 OVERALL EFFECT OF THE RATE REVISION

Subsequent to the proposed rate increases, revenue from electricity sales in Québec will reach $5,495 million in 1990 and $6,216.7 million in 1991. The rate increase measures and price adjustments under the various contracts between Hydro-Québec and its customers will generate an additional $233.7 million in revenue in 1990, and $253.6 million in 1991. Over a twelve-month period, additional revenue will amount to $389.0 million for the period beginning May 1, 1990, and $423.4 million for the period from May 1, 1991 to April 30, 1992.

Tables 21 to 24 show in detail the impact of the rate increases on Hydro-Québec's revenue. Tables 21 and 23 illustrate the proposed changes over a full year, from May 1, 1990 to April 30, 1991, and from May 1, 1991 to April 30, 1992. The results for the eight-month periods from May 1, 1990 to December 31, 1990, and from May 1, 1991 to December 31, 1991 are given in Tables 22 and 24.

The upper portion of the tables shows the rates charged the majority of Hydro-Québec's customers. Additional revenue resulting from the May 1, 1990 increase of base rates D, G, M and L will reach $222.9 million in 1990, and $370.7 million for the twelve-month period beginning May 1, 1990. Additional revenue resulting from the May 1, 1991 increase of rates D, G, M and L will reach $239.2 million in 1991, and $400.0 million for the twelve-month period beginning May 1, 1991.

The lower portion of the tables shows the contribution to revenue of dual energy and interruptible power programs, and of specific contracts with large customers. In the latter category, revenue is only partially affected by the increase since large customers are subject to their own rate conditions. Additional revenue generated by optional rates and specific contracts will amount to $10.8 million over the last eight months of 1990, and $18.4 million over the twelve-month period starting on May 1, 1990. This additional revenue will amount to $14.3 million over the period extending from May 1 to December 31, 1991, and to $23.5 million for the one-year period beginning on May 1, 1991.

TABLE 21

IMPACT ON REVENUE OF MAY 1, 1990 PRICE REVISION
FOR THE PERIOD MAY 1, 1990 - APRIL 30, 1991
(in millions of dollars)

	REVENUE WITHOUT PRICE REVISION at May 1, 1990			REVENUE WITH PRICE REVISION at May 1, 1990			ADDITIONAL REVENUE FROM PRICE REVISION at May 1, 1990			REVENUE GROWTH (%)
	May-Dec 1990	Jan-Apr 1991	TOTAL 12 months	May-Dec 1990	Jan-Apr 1991	TOTAL 12 months	In 1990	Jan-Apr 1991	May 1990- Apr 1991	
PRINCIPAL RATE CLASSES										
RATE D	1,209.4	927.5	2,136.8	1,312.3	1,006.4	2,318.8	103.0	79.0	182.0	8.5
RATE G (small power)	473.0	287.9	760.8	503.8	306.6	810.4	30.8	18.8	49.6	6.5
RATE M (medium power)	609.7	357.9	967.6	649.4	381.2	1,030.6	39.7	23.3	63.0	6.5
RATE L (large power)	640.3	341.2	981.5	686.7	365.9	1,052.6	46.4	24.7	71.1	7.2
PUBLIC-LIGHTING RATES	46.9	30.8	77.7	50.0	32.8	82.7	3.1	2.0	5.1	6.5
TOTAL	2,979.2	1,945.2	4,924.4	3,202.2	2,092.9	5,295.1	222.9	147.8	370.7	7.5
OPTIONAL RATES AND CONTRACTS										
RATES B,BG,BE,BM AND DT (add. energy)	50.1	107.1	157.2	53.5	111.1	164.6	3.5	3.9	7.4	
INDIVIDUAL CONTRACTS	187.3	116.4	[illegible]	194.9	120.3	[illegible]	7.6	[illegible]	11.6	
[illegible]	(6.9)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

TABLE 22

IMPACT ON REVENUE OF MAY 1, 1990 PRICE REVISION FOR 1990
(in millions of dollars)

	1990 REVENUE WITHOUT PRICE REVISION at May 1, 1990			1990 REVENUE WITH PRICE REVISION at May 1, 1990			ADDITIONAL REVENUE
	Jan-Apr	May-Dec	TOTAL	Jan-Apr	May-Dec	TOTAL	In 1990
PRINCIPAL RATE CLASSES							
RATE D	938.0	1,209.4	2,147.3	938.0	1,312.3	2,250.3	103.0
RATE G (small power)	281.9	473.0	754.9	281.9	503.8	785.7	30.8
RATE M (medium power)	347.9	609.7	957.6	347.9	649.4	997.3	39.7
RATE L (large power)	334.3	640.3	974.6	334.3	686.7	1,021.0	46.4
PUBLIC-LIGHTING RATES	30.7	46.9	77.6	30.7	50.0	80.7	3.1
TOTAL	1,932.8	2,979.2	4,912.0	1,932.8	3,202.2	5,134.9	222.9
OPTIONAL RATES AND CONTRACTS							
RATES B, BG, BE, BM AND DT(dual energy)	41.8	50.1	91.9	41.8	53.5	95.3	3.5
INDIVIDUAL CONTRACTS	83.6	187.3	270.9	83.6	194.9	278.5	7.6
INTERRUPTIBLE POWER CREDITS	(6.6)	(6.9)	(13.5)	(6.6)	(7.3)	(13.8)	(0.3)
TOTAL REVENUE FROM FIRM ELECTRICITY SALES IN QUEBEC	2,051.6	3,209.7	5,261.3	2,051.6	3,443.4	5,495.0	233.7

TABLE 23

IMPACT ON REVENUE OF MAY 1, 1991 PRICE REVISION
FOR THE PERIOD MAY 1, 1991 - APRIL 30, 1992
(in millions of dollars)

	REVENUE WITHOUT PRICE REVISION at May 1, 1991			REVENUE WITH PRICE REVISION at May 1, 1991			ADDITIONAL REVENUE FROM PRICE REVISION at May 1, 1991			REVENUE GROWTH (%)
	May-Dec 1991	Jan-Apr 1992	TOTAL 12 months	May-Dec 1991	Jan-Apr 1992	TOTAL 12 months	In 1991	Jan-Apr 1992	May 1991-Apr 1992	
PRINCIPAL RATE CLASSES										
RATE D	1,292.0	1,014.0	2,306.0	1,401.3	1,099.8	2,501.1	109.3	85.8	195.1	8.5
RATE G (small power)	512.0	312.6	824.6	545.1	332.8	877.9	33.1	20.2	53.3	6.5
RATE M (medium power)	665.1	389.7	1,054.8	708.1	414.8	1,122.9	43.0	25.2	68.1	6.5
RATE L (large power)	707.7	383.7	1,091.4	758.4	411.2	1,169.5	50.7	27.5	78.1	7.2
PUBLIC-LIGHTING RATES	49.9	33.0	82.9	53.2	35.1	88.2	3.2	2.1	5.4	6.5
TOTAL	3,226.8	2,132.9	5,359.7	3,466.1	2,293.7	5,759.7	239.2	160.8	400.0	7.5
OPTIONAL RATES AND CONTRACTS										
RATES B,BG,BE,BM AND DI(dual energy)	128.6	128.3	256.9	133.2	133.5	266.7	4.6	5.2	9.9	
INDIVIDUAL CONTRACTS	298.7	146.2	444.9	308.9	150.3	459.2	10.1	4.2	14.3	
INTERRUPTIBLE POWER CREDITS	(8.2)	(8.2)	(16.3)	(8.5)	(8.5)	(17.0)	(0.4)	(0.4)	(0.7)	
TOTAL REVENUE FROM FIRM ELECTRICITY SALES IN QUEBEC	[illegible]	[illegible]	[illegible]	3,899.6	[illegible]	6,468.6	[illegible]	[illegible]	423.4	

TABLE 24

IMPACT ON REVENUE OF MAY 1, 1991 PRICE REVISION FOR 1991
(in millions of dollars)

	1991 REVENUE WITHOUT PRICE REVISION at May 1, 1991			1991 REVENUE WITH PRICE REVISION at May 1, 1991			ADDITIONAL REVENUE
	Jan-Apr	May-Dec	TOTAL	Jan-Apr	May-Dec	TOTAL	In 1991
PRINCIPAL RATE CLASSES							
RATE D	1,006.4	1,292.0	2,298.5	1,006.4	1,401.3	2,407.8	109.3
RATE G (small power)	306.6	512.0	818.7	306.6	545.1	851.7	33.1
RATE M (medium power)	381.2	665.1	1,046.3	381.2	708.1	1,089.3	43.0
RATE L (large power)	365.9	707.7	1,073.6	365.9	758.4	1,124.3	50.7
PUBLIC-LIGHTING RATES	32.8	49.9	82.7	32.8	53.2	85.9	3.2
TOTAL	2,092.9	3,226.8	5,319.8	2,092.9	3,466.1	5,559.0	239.2
OPTIONAL RATES AND CONTRACTS							
RATES B,BG,BE,BM AND DT(dual energy)	111.1	128.6	239.7	111.1	133.2	244.3	4.6
INDIVIDUAL CONTRACTS	120.3	298.7	419.0	120.3	308.9	429.2	10.1
INTERRUPTIBLE POWER CREDITS	(7.3)	(8.2)	(15.4)	(7.3)	(8.5)	(15.8)	(0.4)
TOTAL REVENUE FROM FIRM ELECTRICITY SALES IN QUEBEC	2,317.1	3,646.0	5,963.1	2,317.1	3,899.6	6,216.7	253.6

Appendix

Principal Rates — Current and Proposed

Residential Service - Rate D

	Current	Proposed		Increase	
		1990	1991	1990	1991
Fixed charge per day*	31.7¢	34.2¢	36.9¢	7.9%	7.9%
Price per kilowatthour for the first 30 kilowatthours per day, or for the first 900 kilowatthours per month	3.76¢	4.07¢	4.40¢	8.2%	8.1%
Price per kilowatthour for the remaining consumption	4.46¢	4.86¢	5.30¢	9.0%	9.0%
Price per kilowatt for demand above 50 kilowatts in the winter period	$1.60	$1.77	$1.95	10.6%	10.2%
*Giving a monthly fixed charge of	$9.51	$10.26	$11.07	7.9%	7.9%

Residential Service - Rate DM

	Current	Proposed		Increase	
		1990	1991	1990	1991
Fixed charge per day, per dwelling*	31.7¢	34.2¢	36.9¢	7.9%	7.9%
Price per kilowatthour for the first 30 kilowatthours per day, or for the first 900 kilowatthours per month, per dwelling	3.76¢	4.07¢	4.40¢	8.2%	8.1%
Price per kilowatthour for the remaining consumption	4.46¢	4.86¢	5.30¢	9.0%	9.0%
*Giving a monthly fixed charge per dwelling of	$9.51	$10.26	$11.07	7.9%	7.9%

Residential Service - Rate DT

	Current	Proposed		Increase	
		1990	1991	1990	1991
Fixed charge per day *	31.7¢	34.2¢	36.9¢	7.9%	7.9%
Price per kilowatthour for energy consumed when the outside temperature is equal to or higher than -12° C or -15° C, as the case may be	2.75¢	3.00¢	3.27¢	9.1%	9.0%
Price per kilowatthour for energy consumed when the outside temperature is lower than -12 °C or -15 °C, as the the case may be	10¢	11¢	12¢	10.0%	9.1%
*Giving a monthly fixed charge of	$9.51	$10.26	$11.07	7.9%	7.9%

General Service - Small Power - Rate G (monthly)

	Current	Proposed		Increase	
		1990	1991	1990	1991
Fixed charge per month *	$9.51	$10.26	$11.07	7.9%	7.9%
Price per kilowatthour for the first 10,440 kilowatthours	5.93¢	6.28¢	6.65¢	5.9%	5.9%
Price per kilowatthour for the remaining consumption	3.65¢	3.82¢	3.99¢	4.7%	4.5%
Price per kilowatt for demand above 35 kW	$7.32	$8.22	$9.24	12.3%	12.4%
Optimization charge: price per kilowatt of power demand exceeding 133 ⅓% of the minimum billing power	$9.09	$9.69	$10.32	6.6%	6.5%
*Giving a daily fixed charge of	31.7¢	34.2¢	36.9¢	7.9%	7.9%

General Service - Small and Medium Power - Rate G-9 (monthly)

	Current	Proposed		Increase	
		1990	1991	1990	1991
Price per kilowatt of billing demand	$2.73	$3.03	$3.36	11.0%	10.9%
Price per kilowatthour for all billing consumption	7.39¢	7.54¢	7.69¢	2.0%	2.0%

General Service - Medium Power - Rate M (monthly)

	Current	Proposed		Increase	
		1990	1991	1990	1991
Price per kilowatt of billing demand	$4.47	$6.66	$8.76	49.0%	31.5%
Price per kilowatthour for the first 120 hours of use of billing demand	5.83¢	4.85¢	4.04¢	- 16.8%	- 16.7%
Price per kilowatthour for the next 78,000 kilowatthours	3.65¢	3.80¢	3.93¢	4.1%	3.4%
Price per kilowatthour for the remaining consumption	2.52¢	2.54¢	2.56¢	0.8%	0.8%
Optimization charge: price per kilowatt of power demand exceeding 133 1/3% of the contract power	$9.09	$9.69	$10.32	6.6%	6.5%

General Service - Large Power - Rate L (monthly)

	Current	Proposed		Increase	
		1990	1991	1990	1991
Price per kilowatt of billing demand	$4.47	$6.66	$8.76	49.0%	31.5%
Price per kilowatthour for the first 120 hours of use of billing demand	4.57¢	3.66¢	2.92¢	- 19.9%	- 20.2%
Price per kilowatthour for the next 2,400,000 kilowatthours	2.52¢	2.46¢	2.40¢	-2.4%	-2.4%
Price per kilowatthour for the remaining consumption	1.77¢	1.94¢	2.13¢	9.6%	9.8%
Optimization charge: price per kilowatt of billing demand exceeding 110% of the contract power	$14.67	$15.84	$17.10	8.0%	8.0%

Monthly Discount for Supply at Medium or High Voltage

	Current	Proposed		Increase	
		1990	1991	1990	1991
Discount applicable per kilowatt of billing power according to the supply voltage:					
5 to 15 kilovolts	$0.450	$0.468	$0.486	4.0%	3.8%
15 to 50 kilovolts	$0.657	$0.702	$0.750	6.8%	6.8%
50 to 80 kilovolts	$0.795	$1.035	$1.347	30.2%	30.1%
80 to 170 kilovolts	$0.849	$1.155	$1.572	36.0%	36.1%
170 kilovolts and over	$1.128	$1.536	$2.094	36.2%	36.3%
Adjustment for transformation losses	$0.1026	$0.111	$0.120	8.2 %	8.1%

Dual-Energy Rate - Rate BG
(Commercial, institutional and industrial)

	Current	Proposed		Increase	
		1990	1991	1990	1991
Price per kilowatthour for consumption when outside temperature is equal to or above the transfer point	2.80¢	3.05¢	3.32¢	8.9%	8.9%
Price per kilowatthour for consumption when outside temperature is below the transfer point	—	30¢	33¢	—	10%
Discount applicable to the price of energy according to the supply voltage:					
5 to 70 kilovolts	0.175¢	0.181¢	0.188¢	3.4%	3.9%
50 to 70 kilovolts	0.203¢	0.218¢	0.234¢	7.4%	7.3%
170 kilovolts and over	0.271¢	0.291¢	0.312¢	7.4%	7.2%

Dual-Energy Rate - Rate BE
(Commercial, institutional and industrial)

	Current	Proposed		Increase	
		1990	1991	1990	1991
Price per kilowatthour for consumption when outside temperature is equal to or above the transfer point	3.80¢	3.80¢*	3.32¢	—	8.9%
Price per kilowatthour for consumption when outside temperature is below the transfer point	—	30¢	33¢	—	10%
Discount applicable to the price of energy according to the supply voltage					
5 to 70 kilovolts	0.175¢	0.181¢	0.188¢	3.4%	3.9%
50 to 170 kilovolts	0.203¢	0.218¢	0.234¢	7.4%	7.3%
170 kilovolts and over	0.271¢	0.291¢	0.312¢	7.4%	7.2%

* The price will become 3.05¢ on December 1, 1990, a drop of 19.7%

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Preface

This is the second edition of CSA Standard C235 (now CAN3-C235) and it supersedes the first edition, which was published in 1969.

Prior to 1969 the need for a recognized set of voltage standards in Canada had been the concern of the electrical industry throughout its history. In preparation for the first edition many studies, questionnaire surveys, and discussions of national scope were conducted. Since its initial publication in 1969 this Standard has served well as a guide to those who are involved in the problems of applying a great variety of electrical devices and equipment to an equally great variety of voltage levels across the country. Improved equipment design ratings and controlled system design levels have both resulted.

This second edition calls for closer control of voltage variation for circuits between the 1000 and 50 000 V levels. Otherwise, it is essentially the same as the first edition.

This Standard was prepared by the Technical Committee on Preferred Voltage Levels for AC Systems under the jurisdiction of the Standards Steering Committee for Electrical Engineering Standards. It has been approved as a National Standard of Canada by the Standards Council of Canada.

September, 1983

Note: *Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the user of the Standard to judge its suitability for his or her particular purpose.*

CSA Standards are subject to periodical review and suggestions for their improvement will be referred to the appropriate committee.

All enquiries regarding this Standard, including requests for interpretation, should be addressed to Canadian Standards Association, Standards Division, 178 Rexdale Boulevard, Rexdale (Toronto), Ontario M9W 1R3.

Requests for interpretation should:

(a) Define the problem, making reference to a specific Clause, and, where appropriate, include an illustrative sketch;

(b) Provide an explanation of circumstances surrounding the actual field condition; and

(c) Be phrased, where possible, to permit a specific "yes" or "no" answer.

Interpretations are published in "CSA Information Update". For subscription details and a free sample copy, write to CSA Information Centre or telephone (416) 747-4058.

Preferred Voltage Levels for AC Systems, 0 to 50 000 V

1. Scope

1.1 This Standard establishes voltage standards for AC Systems in Canada to provide a guide:

(a) To national committees on utilization and control equipment or devices for establishing standard ratings of such equipment or devices on a basis coordinated with standard systems;

(b) To system designers so that new systems will be designed to accommodate standard ratings of equipment and devices;

(c) To system operators and to electrical energy users for determining the need for corrective measures, with respect to existing systems, to accommodate current designs of equipment and devices; and

(d) Towards a uniform system of voltage selections in the country without any suggestion that each utility will supply every voltage listed. The establishment of standards on this basis is aimed at future development towards more uniformity on a national basis.

2. Explanation of Terms

2.1 It is to be noted that this Standard includes nominal voltages and recommended limits to voltage variations under both normal and extreme operating conditions. It should further be pointed out that the voltage listings are not intended as limits of voltage levels which may be experienced during abnormal (or fault) conditions, nor during starting conditions where heavy starting loads are involved.

2.2 Nominal voltage is the voltage by which a system is designated.

2.3 In the interpretation of this Standard it is important to bear in mind the sense of usage for the terms Normal Operating Conditions and Extreme Operating Conditions:

(a) **Normal Operating Conditions.** Where voltages lie within the indicated limits under this heading no improvement or corrective action is required. It is recognized that special situations may call for closer voltage control but such cases are considered to be outside the application scope of this Standard; and

(b) **Extreme Operating Conditions.** Where voltages lie outside the indicated limits for normal operating conditions but within the indicated limits for extreme operating conditions improvement or corrective action should be taken on a planned and programmed basis but not necessarily on an emergency basis. Where voltages lie outside the indicated limits for extreme operating conditions, improvement or corrective action should be taken on an emergency basis. The urgency for such action will depend on many factors such as location and nature of load or circuit involved, extent to which limits are exceeded with respect to voltage levels and duration, etc.

2.4 It is also to be noted that a distinction is made in this Standard between the terms subtransmission circuits and distribution circuits. These terms are used in the following sense:

(a) Subtransmission circuits are generally of the three-phase variety for carrying bulk power:

(i) From a utility main station to a substation of the same utility;

(ii) From a main station of one utility to a substation of a second utility;

(iii) From a utility station to a large user who purchases three-phase power and distributes from his own substation, and

(b) Distribution circuits generally consist of three-phase mains with single-phase branches for distributing power from utility substations (or the equivalent) to a mixture of three-phase and single-phase loads. Generally the distribution circuit terminates at the distribution transformers which step the voltage down to utilization level. These transformers may be single- or three-phase and may be located either at the power user's service entrance or dispersed along the length of the distribution circuit.

3. Nominal System Voltages

3.1 Nominal system voltages are shown in Table 1

4. Recommended Voltage Variation Limits for Circuits up to 1000 V, at Utilization Points

4.1 The recommended voltage variation limits for circuits up to 1000 V, at utilization points are shown in Table 2

4.2 **Caution re: Application of Motors and Other Equipment.** These recommended standards are for circuit or system voltages, and not for ratings of utilization equipment such as motors. Nevertheless, it is considered advisable to add a word of caution in the application of such electrical equipment to utilization circuits, as follows: MOTORS AND OTHER EQUIPMENT DESIGNED FOR APPLICATION TO MORE THAN ONE NOMINAL SYSTEM VOLTAGE LEVEL (SUCH AS 120/208Y AND 240 V SYSTEMS) MUST RECOGNIZE THE MINIMUM RECOMMENDED VOLTAGE LIMITS OF THE ONE AND MAXIMUM RECOMMENDED VOLTAGE LIMITS OF THE OTHER NOMINAL SYSTEM VOLTAGE LEVEL

5. Recommended Voltage Variation Limits for Circuits up to 1000 V, at Service Entrances

5.1 The recommended voltage variation limits for circuits up to 1000 V, at service entrances, are shown in Table 3.

5.2 Table 3 is intended for general application and takes into account secondary voltage drop on the utility system. For three-phase service to large buildings where the utility transformer installation is on the customer's property, and the service entrance is immediately adjacent to the transformer installation so that the utility has very little secondary voltage drop, the service entrance voltages should not fall below nominal voltage by more than:

(a) 5% for normal operating conditions; nor

(b) 8% for extreme operating conditions.

6. Recommended Voltage Variation Limits at Point of Sale and Purchase for Circuits Above 1000 V But Not Over 50 000 V

6.1 Power delivered by a supplier to a purchaser should conform to the nominal voltage levels shown in Clause 3 of this Standard and normally be maintained at any given point of sale and purchase so as not to vary from the nominal voltage by more than ±6%

Table 1

Nominal System Voltages

	Standard for Present and Future	Recognized Existing Standard — Not Preferred for Future	
Single-Phase	120/240 240	480 600	Note. Limited application to special circuits such as street lighting and welder loads
Three-Phase Up to 1000 V (Chiefly for Utilization Circuits)	120/208Y 240/416Y 347/600Y 600	240 480 277/480Y	
Above 1000 V (Chiefly for Distribution and Subtransmission)	2 400/4 160Y 7 200/12 470Y 8 000/13 800Y 14 400/24 940Y 20 000/34 500Y 46 000	2 400 4 800/8 320Y 13 800 22 000 27 600 34 500	

Notes:

(1) On single-phase systems:
Single numbers (eg. 240) indicate 2-conductor circuits;
Double numbers (eg. 120/240) indicate 3-conductor circuits.

(2) On three-phase systems:
Single numbers (eg. 240) indicate 3-conductor circuits;
Double numbers (eg. 120/208Y or 8000/13 800Y) indicate 4-conductor circuits. These 4-conductor circuits are usually multigrounded systems serving both three-phase and single-phase loads, the latter fed by 2-conductor (line-to-neutral) single phase subfeeders or branch circuits.

(3) The 4-conductor system of 20 000/34 500Y, although not an existing standard in current Canadian usage, has been included to encourage a single standard at the next step above current power distribution practice

(4) The level of 46 kV has been included as a nominal system voltage However, actual usage at present includes both 44 kV and 49 kV (nominal) levels

Table 2

Recommended Voltage Variation Limits for Circuits up to 1000 V, at Utilization Points

Nominal System Voltages	Voltage Variation Limits Applicable at Utilization Points			
	Extreme Operating Conditions			
		Normal Operating Conditions		
Single-Phase				
120/240	104/208	108/216	125/250	127/254
240	208	216	250	254
480	416	432	500	508
600	520	540	625	635
Three-Phase 4-Conductor				
120/208Y	105/187	110/190	125/216	127/220
240/416Y	216/374	220/380	250/432	254/440
277/480Y	240/416	250/432	288/500	293/508
347/600Y	300/520	312/540	360/625	367/635
Three-Phase 3-Conductor				
240	208	216	250	254
480	416	432	500	508
600	520	540	625	635

Table 3

Recommended Voltage Variation Limits for Circuits up to 1000 V, at Service Entrances

Nominal System Voltages	Voltage Variation Limits Applicable at Service Entrances			
	Extreme Operating Conditions			
		Normal Operating Conditions		
Single-Phase				
120/240	106/212	110/220	125/250	127/254
240	212	220	250	254
480	424	440	500	508
600	530	550	625	635
Three-Phase 4-Conductor				
120/208Y	110/190	112/194	125/216	127/220
240/416Y	220/380	224/388	250/432	254/440
277/480Y	245/424	254/440	288/500	293/508
347/600Y	306/530	318/550	360/625	367/635
Three-Phase 3-Conductor				
240	212	220	250	254
480	424	440	500	508
600	530	550	625	635